

Zeitschrift: Boissiera : mémoires de botanique systématique
Herausgeber: Conservatoire et Jardin Botaniques de la Ville de Genève
Band: 29 (1979)

Artikel: A revision of the genus Rotala (Lythraceae)
Autor: Cook, C.D.K.
DOI: <https://doi.org/10.5169/seals-895488>

Nutzungsbedingungen

Die ETH-Bibliothek ist die Anbieterin der digitalisierten Zeitschriften auf E-Periodica. Sie besitzt keine Urheberrechte an den Zeitschriften und ist nicht verantwortlich für deren Inhalte. Die Rechte liegen in der Regel bei den Herausgebern beziehungsweise den externen Rechteinhabern. Das Veröffentlichen von Bildern in Print- und Online-Publikationen sowie auf Social Media-Kanälen oder Webseiten ist nur mit vorheriger Genehmigung der Rechteinhaber erlaubt. [Mehr erfahren](#)

Conditions d'utilisation

L'ETH Library est le fournisseur des revues numérisées. Elle ne détient aucun droit d'auteur sur les revues et n'est pas responsable de leur contenu. En règle générale, les droits sont détenus par les éditeurs ou les détenteurs de droits externes. La reproduction d'images dans des publications imprimées ou en ligne ainsi que sur des canaux de médias sociaux ou des sites web n'est autorisée qu'avec l'accord préalable des détenteurs des droits. [En savoir plus](#)

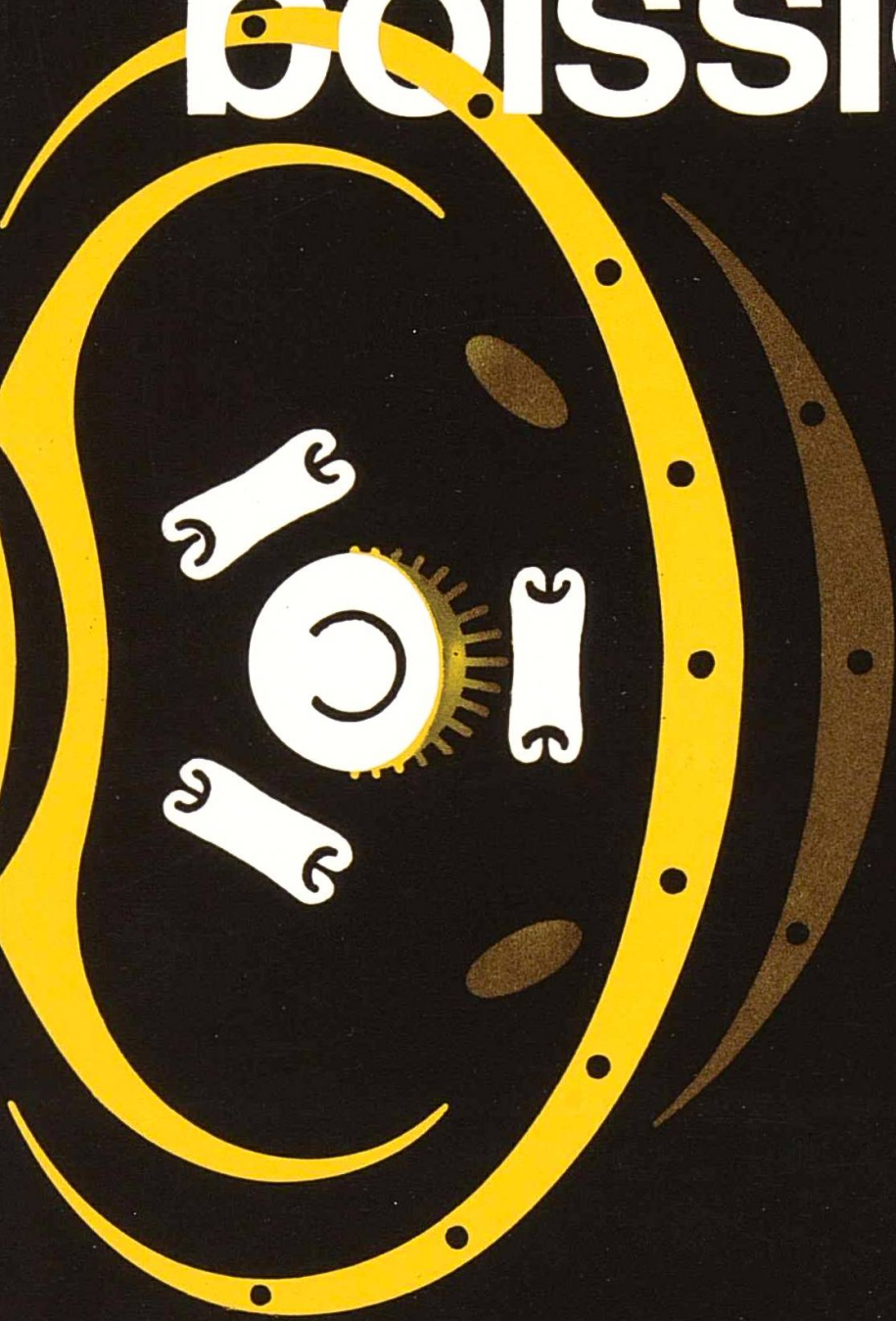
Terms of use

The ETH Library is the provider of the digitised journals. It does not own any copyrights to the journals and is not responsible for their content. The rights usually lie with the publishers or the external rights holders. Publishing images in print and online publications, as well as on social media channels or websites, is only permitted with the prior consent of the rights holders. [Find out more](#)

Download PDF: 31.12.2025

ETH-Bibliothek Zürich, E-Periodica, <https://www.e-periodica.ch>

boissiera

A stylized botanical illustration in white and yellow on a black background. It features a large, irregular yellow border that resembles a cell membrane or a microorganism's outline. Inside this border, there are several white, elongated, and curved structures that look like stylized leaves or petals. A central white circle with a black outline and a small black dot in the middle is surrounded by a yellow, sunburst-like pattern. There are also several small black dots scattered within the yellow border.

Volume **29**

**Mémoires des Conservatoire
et Jardin botaniques
de la Ville de Genève**

Avis aux auteurs

La revue "Boissiera" publie, en langue française, anglaise ou allemande, et éventuellement — avec autorisation spéciale du Directeur — en une autre langue, des travaux scientifiques originaux traitant de systématique, morphologie, chorologie et écologie végétale ainsi que d'autres sujets étroitement liés à la phytotaxonomie.

Les travaux présentés sont appréciés par le comité consultatif de rédaction et, le cas échéant, par un expert spécialement désigné. L'avis de ces instances et la suite à donner seront communiqués à l'auteur.

Les auteurs sont priés de discuter au préalable, avec la rédaction, de tous les problèmes particuliers que pose la publication de leur travail, spécialement en ce qui concerne la présentation des graphiques, tableaux et illustrations de tout genre.

Ne sont acceptés que des manuscrits proprement dactylographiés, en deux exemplaires si possible (dont la frappe originale, sur du papier blanc solide), avec grande marge et double espacement (4 crans). Les auteurs sont instamment priés de ne rien souligner, sauf éventuellement, d'un trait droit, les noms latins des taxons à faire apparaître en caractères italiques dans le texte.

Pour la présentation et la disposition du texte, surtout des citations de tout genre et de la bibliographie, il est vivement recommandé de suivre le modèle des fascicules précédents de cette revue, à partir du volume 14. En particulier, les abréviations des titres des périodiques se conformeront au modèle du "Botanico-Periodicum-Huntianum" (Pittsburgh 1968). Pour la citation des herbiers, on adoptera les sigles de l'"Index herbariorum" (Regnum Veg. 92). Les clefs de détermination en escalier (indented keys) sont à éviter. La publication de tableaux et graphiques dépliant est à exclure.

L'application stricte des dispositions du "Code international de la nomenclature botanique" (Regnum Veg. 97) est de rigueur.

Les dessins au trait et les graphiques seront exécutés à l'encre de chine et numérotés au crayon. Les textes explicatifs doivent être relégués, dans la mesure du possible, dans les légendes. Il est recommandé d'associer à chaque figure un étalon métrique. L'assemblage des figures et leur disposition dans le texte sont du ressort de la rédaction.

La reproduction d'illustrations déjà publiées ailleurs est en règle générale à exclure. Si pour des raisons particulières, une exception à cette règle s'impose, il incombe à l'auteur de se procurer les copyrights requis.

Les légendes des illustrations, aussi concises que possible, seront regroupées sur une feuille séparée. Toute indication chiffrée de l'agrandissement ou de la réduction est à éviter.

Un résumé en français et/ou en anglais, ne dépassant pas 200 mots, doit être proposé. Il est cependant du ressort de la rédaction d'établir les versions françaises et anglaises définitives de ce résumé.

Les contributeurs s'engagent tacitement à céder leur copyright, en exclusivité, aux Conservatoire et Jardin botaniques de Genève. Cette cession devient effective dès la confirmation écrite de l'acceptation du manuscrit pour publication. La propriété intellectuelle des textes reste acquise aux auteurs.

La publication d'un article dans "Boissiera" n'implique nullement que la rédaction de cette revue et le Conservatoire botanique approuvent ou cautionnent les opinions de l'auteur.

Les auteurs reçoivent 50 tirages à part gratuits, sans couvertures. Des exemplaires supplémentaires, à concurrence de 200, pourront être fournis sur demande écrite. Ils seront facturés au prix coûtant, de même que des couvertures si elles sont demandées. Si le nombre de tirages à part requis excède 250, une autorisation spéciale, délivrée par le Directeur, est nécessaire. Ces exemplaires seront facturés au prix de vente pratiqué par le Conservatoire botanique.

Couverture: *Boissiera bromoides* Hochst. & Steud.

Diagramme floral de Hervé M. Burdet
Maquette et réalisation de Saskia Wikström

volume boissiera
29

Mémoires
des Conservatoire et Jardin botaniques
de la Ville de Genève



Editions des
Conservatoire et Jardin botaniques
de la Ville de Genève

Directeur:
Gilbert Bocquet

Rédacteur:
Hervé M. Burdet

Rédacteurs-adjoints:
Manfred Dittrich et Patricia Geissler

Comité de lecture:
Luciano Bernardi, André Charpin, Pierre Hainard, Olivier Monthoux,
Adélaïde Stork, avec la collaboration occasionnelle d'experts extérieurs
spécialement désignés

Réalisation technique:
Robert Meuwly, avec la collaboration de Myriam Delley

Imprimerie du Journal de Genève

Toute correspondance doit être adressée à:
Rédaction "Candollea-Boissiera"
Conservatoire botanique
Case postale 60
CH-1292 Chambésy

volume **boissiera**
29

A revision of the
genus *Rotala* (Lythraceae)

C. D. K. COOK

Genève, le 24 juillet 1979

ISBN 2-8277-0045-X

Contents

Introduction	7
Acknowledgements	8
Evolutionary considerations	9
Generic description	12
Diagnostic features of the species	14
Rotala numbered	15
Key to Rotala	16
Taxonomy	23
The Rotala filiformis group	118
Uncertain species	132
Maps	134
Abstract / Résumé	150
References	151
Index	153

Introduction

Some species of *Rotala* are extremely successful weeds in ricefields and irrigation ditches. In S. India it is quite common to find up to five different species in a single ricefield. The phenomenon of these closely related species growing intermingled and the difficulty of identifying the species were the stimuli for my interest in this genus. The only world-wide revision of *Rotala* was written by A. KOEHNE in a series of works (1880, 1883, 1903, 1907, 1908). By 1908 KOEHNE had recognised 41 species and since then 40 new species have been described (many of them by A. FERNANDES, 1955, 1957, 1959, 1974). Adding some nomenclatural recombinations there are today about 97 “paper” species.

Apart from accounts in Floras the following localized floristic accounts have been published: KOEHNE (1885), GRAHAM (1964) — USA; BLATTER & HALLBERG (1918) — colonial India; LOURTEIG (1954) — Argentina; RAYNAL (1967) — W. and C. Africa; LEEUWEN (1971) — Malesia; MITCHELL (1976) — N. Australia. Very little morphological or anatomical work has been carried out, the most detailed accounts are those of VOS (1974) and PANIGRAHI (1975). One individual in the whole genus has been cytologically examined (*R. ramosior*, $2n = 32$, STRIPLING & ROSS, 1962). I have found no works on the genetics, gametogenesis, population structure, ecology, floral biology or chemistry of *Rotala*.

I have had the opportunity to study and make mass gatherings of 11 different species in the field and have cultivated 10 species in the botanic gardens of the University of Zürich. These studies have given me a limited insight into local population variation, ecology, breeding systems and phenotypic plasticity. On the whole, however, my work has been mostly based on herbarium and literature studies. I have attempted to produce an “alpha” revision of the genus *Rotala* to the level of species on a world-wide basis. I have accepted 44 of the 97 “paper” species. Many species show considerable variation but I feel it is folly to attempt any infraspecific classification on a very widespread group of aquatic and amphibious plants without an experimental approach.

Acknowledgements

I would like to thank the curators of the following herbaria for lending me plant specimens: B, BM, BR, CGE, G, JEPS, K, KYO, L, LE, M, MAK, MEL, MO, NSW, P, TAI, U, UC, Z, ZT. The Council of the “Georges and Antoine Claraz-Schenkung” are thanked for financial assistance. I would like to thank the following for help either with their specialist knowledge or for sending plant material: the late Dr. C. E. B. Bonner (Genève), Dr. W. Greuter (Berlin), Dr. H. Heine (Paris), Dr. H. Kishimoto (Zürich), Prof. K. U. Kramer (Zürich), Dr. B. Nair (Trivandrum), Dr. H. Rössler (München), Dr. J. Schneller (Zürich), Prof. C. G. G. J. van Steenis (Leiden). Miss Martha Seitz kindly prepared the figures 3E, 6A, 7A, 17A, 24A, 24B and 26A. Special thanks go to Dr. Ilse Mendoza-Heuer (Zürich) who found and made detailed notes and drawings of the type of *Rotala rosea* in herbarium of Florence. I would particularly like to thank Dr. Heinrich Farsky for help with plant distributions and Miss Anni Küpfer and Mrs Katy Papadopoulos for typing the manuscript.

Evolutionary considerations

I have had 10 species of *Rotala* in cultivation. The perennial species (*R. myriophylloides*, *R. wallichii*, *R. rotundifolia*, *R. macrandra*) were genetically self-incompatible, had showy flowers, showed a tendency towards having a distinct inflorescence and they flower during a distinct season; they are presumably insect pollinated. The annual species (*R. mexicana*, *R. ramosior*, *R. fimbriata*, *R. densiflora*, *R. rosea*, *R. indica*) were self-compatible, efficiently self-pollinated, occasionally cleistogamous, had non-showy flowers (except *R. fimbriata* and some races of *R. densiflora*), no distinct flowering season, and often showed precocious flowering.

All the heterostylous species, presumably self-incompatible, are large flowered perennials. It is likely that the large, showy-flowered, perennial species are more primitive and it is interesting to note that on the whole they have a larger number of flowering parts than the small-flowered inbreeding annuals.

Within the whole genus, three species only are really widespread, and they are all inbreeding annuals. *Rotala indica* is native in Asia and has relatively recently become established in Africa, Europe and N. America; it is a ricefield weed. *Rotala ramosior* is native in America and has spread to the Philippines and Europe, probably through rice cultivation. *Rotala mexicana* is found throughout the warmer parts of the world but it is not confined to rice growing areas. In spite of it being a small, inbreeding annual it is difficult to predict its area of origin. However, its closest relative *R. occultiflora* is sympatric with it in S. India and N. Australia.

Most species are relatively well-documented; only *R. verdcourtii* is known from a single gathering. *Rotala floribunda*, *R. rubra* and *R. simpliciuscula*, all Asian species, are very local endemics. All other species have relatively well-defined and "reasonable" distributions with, perhaps, the exception of *R. occultiflora* which is confined to S. India and N. Australia. Twentyone species are confined to Africa and Malagsy and twenty species are confined to S. and E. Asia and Australia but of those one species only (*R. diandra*) is confined to Australia. The region of maximum morphological diversity of *Rotala* is S. Asia; Africa has more species but many of them are closely related, inbreeding annuals.

Most annual species of *Rotala* are rather similar in habit and have a somewhat nondescript appearance; they are often confused with species in the following genera: *Ammannia*, *Bergia*, *Bythophyton*, *Crassula*, *Elatine*, *Gonostegia*, *Laurembergia*, *Ludwigia*, *Microcarpaea* and *Nesaea*. This superficial resemblance of unrelated groups indicates a relatively strong evolutionary convergence or, in other words, strong selection pressures for a particular plant form to fit a particular ecological niche. This alone is not unusual but it is unusual in one genus to find up to five related annual species, which need a hand lens for their identification, growing intermingled. The reason for this species richness without ecological differentiation is probably correlated with a high degree of inbreeding.

Species delimitation in inbreeding annuals presents some difficulties. For example, in Africa *R. filiformis* has been split into 16 species, using similar criteria one could also split the American species *R. ramosior* and the Asian species *R. densiflora*, *R. rosea* and *R. indica* into numerous small species. I have tried to make my treatment as even as possible which has led to considerable "lumping" of the African species.

KOEHNE (1880, 1903) based his major infrageneric categories on the arrangement of the leaves, the whorled-leaved species constituting the section *Hippuridium*. Whorled leaves are, I believe, a direct response to the aquatic environment (COOK, 1978). The species of *Rotala* with whorled leaves do not constitute a single phyletic group when their floral characteristics and distributions are considered. Also from cultivation experiments it has been seen that *R. myriophylloides* and *R. mexicana* when grown in water have whorled leaves but when terrestrially grown the same plants often have decussate leaves.

Rotala floribunda and *R. repens* have leaves arranged alternately. These two species have additional interesting common characteristics: somewhat woody at the base in spite of being submerged in water, distinct and remote inflorescences, bracts scale-like and reduced to about the size of the bracteoles, flowers 4-merous with 2-valved capsules and both are local, montane endemics. KOEHNE (1880, 1903) placed both species together in subsections *Nimmonia*. However, each species shows remarkable unique characteristics. *Rotala floribunda* (Fig. 6) is endemic to the Mahabaleshwar Hills in the northern part of the Western Ghats in India, it has a distinctly bi-lobed style and shows an extraordinary combination of aquatic and xeromorphic features with linear, flaccid submerged leaves and ericoid aerial leaves; it is also heterostylous. *Rotala repens* (Fig. 7) is found in flowing water in the Ethiopian Highlands and on Mount Elgon, it has a podostemaceous habit with flattened, creeping rhizomes and long-stalked, almost naked inflorescences; it is homostylous but has long filaments and long styles. Taxonomically these two species take somewhat isolated places in the genus *Rotala*.

Rotala hexandra (Fig. 8) is also taxonomically somewhat isolated; it has 6-merous flowers, a capsule that probably does not open by valves but it does have the characteristic horizontal stripes, it has small, stipule-like outgrowths

on the nodes between the leaves or bracts, and it occasionally has smaller bracteoles in the axils of the bracteoles which may indicate that the solitary flower of *Rotala* is reduced from a cymose inflorescence.

Except for *R. floribunda*, *R. repens* and *R. hexandra* the genus *Rotala* is very uniform. There are many smaller phenetic groups within the genus which I have done my best to combine in the indented key. I have, however, found no satisfactory subgeneric classification that neatly divides the genus into a few, large, more or less natural groups. An arbitrary division based on characters such as number of capsule valves or stamens serves, as far as I can see, no useful purpose. I have, therefore, not proposed any subgeneric classifications.

Generic description

- Rotala**, L., Mantissa 143, 175. Oct. 1771 $\equiv$ *Rotula* Loureiro, Fl. Cochinch. 121: 1790 orth. mut.
- = *Ammannia* L., Sp. Pl. 119. 1753, pro parte. **Type:** *A. latifolia* L.
- = *Peplis* L., Sp. Pl. 332. 1753, pro parte. **Type:** *P. portula* L.
- = *Suffrenia* Bellardi, Mém. Acad. Sci. Lit. Beaux-Arts Turin “pour les années 10: 1802, et 11: 1803” — Sci. Phys. Math. “an. 12: 1804” — p. 445, t. 1, f. 1, on table 1 is written: “Mém. Acad. Sci. Turin 7: 452”. **Type:** *S. filiformis* Bellardi.
- = *Sellowia* Roth ex Roemer & Schultes, Syst. Veg. 5(31): 407. 1819. **Type:** *S. uliginosa* Roth ex Roemer & Schultes.
- = *Winterlia* Sprengel, Syst. 1: 519. 1824, non Moench 1794.
- = *Boykiana* Rafin., Neogenyton 2. 1825, nom. rej. **Type:** *B. humilis* (Michx.) Rafin. $\equiv$ *Ammannia humilis* Michx. $\equiv$ *Boykinia* Rafin., New Fl. 4: 66. 1838. orth. mut., non *Boykinia* Nuttall, 1834, nom. cons.
- = *Ameletia* DC., Mém. Soc. Phys. Genève 2(2): 82. 1826. **Type:** *A. indica* (Willd.) DC. $\equiv$ *Peplis indica* Willd.
- = *Nimmonia* (*Nimmoia* orth. mut.) Wight, Madras J. Lit. Sci. 5: 312. 1837. **Type:** *N. floribunda* Wight.
- = *Nexilis* Rafin., New Fl. 4: 9. 1838. **Type:** *N. indica* (Willd.) Rafin. $\equiv$ *Peplis indica* Willd.
- = *Hypobrichia* M. A. Curtis ex Torrey & Gray, Fl. N. Amer. 1: 479. 1840. **Type:** *H. nuttallii* M. A. Curtis ex Torrey & Gray.
- = *Rhyacophila* Hochst., Flora (Regensburg) 24: 659. 1841. **Type:** *R. repens* Hochst.
- = *Quartinia* Endl., Gen. Suppl. 2: 94. 1842, non A. Richard 1840. **Type:** *Q. turfosa* A. Richard.
- = *Hydrolythrum* Hooker fil. in Hooker, Ic. Pl. Ser. 2, t. 1007. 1843. **Type:** *H. wallichii* Hooker fil.
- = *Tritheca* (Wight & Arnott) Miq., Fl. Ind. Bat. 1(1): 614. 1855. **Type:** *T. pentandra* (Roxb.) Miq. $\equiv$ *Ammania pentandra* Roxb.
- = *Ditheca* (Wight & Arnott) Miq., Fl. Ind. Bat. 1(1): 615. 1855. **Type:** *D. densiflora* (Roth ex Roemer & Schultes) Miq. $\equiv$ *Ammania densiflora* Roth ex Roemer & Schultes.

Type: *R. verticillaris* L.

Aquatic, amphibious or terrestrial, annual or perennial, glabrous herbs. Stems creeping, ascending, erect or floating, simple or branched. *Leaves* decussate, whorled or rarely alternate, simple, entire, sessile or rarely shortly petiolate; stipules absent (in *R. hexandra* stipule-like outgrowths present on the nodes between the leaves). *Bracts* leaf-like or scale-like; bracteoles 2 or absent (additional bracteoles occasionally present in the axils of the bracteoles in *R. hexandra*). *Flowers* bisexual, actinomorphic, monomorphic or dimorphic (heterostylous), occasionally cleistogamous, solitary in the axils of bracts, borne along the main axis or on lateral or terminal racemes. *Calyx* tubular, free from but often enclosing the ovary, hypanthial; calyx lobes 3-6, valvate, persistent; tooth-like calyx appendages or small interjected folds occasionally present between the calyx lobes; nectaries often present at the base of the calyx tube. *Petals* 0-6, minute or large and showy, inserted at the top of the calyx tube, usually crumpled in bud, entire, erose or pinnately divided in *R. fimbriata*. *Stamens* 1-6, episealous never more in number than the calyx lobes, inserted on the inner surface of the calyx tube on the lower half or occasionally basal and appearing free, occasionally replaced by staminodes; anthers dorsifixed, introrse. *Pollen* tricolporate, occasionally heterocolpate, isopolar or occasionally heteropolar, often dimorphic, pseudocolpi absent or if present 3 in number, pore generally in the middle of the principle colpi, amb triangular or circular or angulo-circular, columellae present, sexine granular, reticulate or granulo-reticulate. *Ovary* superior, 2-4 locules; placentation axile becoming free-central at maturity; style simple; stigma capitate or 2-lobed in *R. floribunda*; fruit a septicidally dehiscent capsule opening by 2-4 valves; the valves with microscopic, horizontal striations; one valve is crowned with the persistent style; seeds numerous or few, semi-ovoid to ellipsoidal, with mucilaginous hairs which invaginate before germination; germination epigeal; cotyledons simple.

Diagnostic features for *Rotala* with respect to the rest of the *Lythraceae*: capsule valves with microscopic, horizontal striations; placentation at maturity free-central; style crowning one of the valves; stamens as many or fewer than the calyx lobes; flowers solitary or in racemes (never in cymes).

Diagnostic features of the species

The diagnostic values of morphological characters are discussed after the description of each species. The following list contains diagnostic morphological features common to less than a third of the species.

Leaves regularly whorled: 1, 2, 3, 4, 5, 6, 7.

Leaves alternate: 8, 9.

Leaves with cartilaginous margin: 36, 37, 38.

Stipule-like outgrowths present: 10.

Bracts shorter than flowers: 8, 9, 33.

Bracteoles leaf-like: 7.

Bracteoles exceeding the flower in length: 7, 22, 24.

Bracteoles absent: 32, 33.

Inflorescence distinct: 8, 9, 11, 12, 13, 14, 16, 24, 28, 29, 33.

Flowers distinctly pedicellate: 2, 3, 4, 8, 17, 18, 19, 23, 32, 33, 37.

Flowers dimorphic (heterostylous): 3, 8, 13, 14.

Calyx constricted at throat: 1, 2, 15, 16.

Calyx lobes 6: 10.

Calyx lobes 5: 6, 10, 11, 23, 24, 25.

Calyx lobes 3: 1, 6, 30, 31.

Calyx appendages present: 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 30, 31, 32.

Calyx disintegrating as fruit ripens: 5, 23, 34, 40.

Petals pinnately divided: 23.

Stamens inserted near base of calyx tube: 10, 11, 12, 13, 14, 15, 23, 31, 33, 34, 35, 38.

Stamens 6: **10.**

Stamens 5: **10, 11, 23, 24, 25.**

Stigma 2-lobed: **8.**

Capsule 4-valved: **1, 10, 11, 12, 13, 14, 15, 17, 18, 19, 20, 21, 22.**

Capsule valves induplicate: **15, 16, 17, 18, 19, 21.**

Capsule longer than calyx: **5, 7, 9, 17, 18, 25, 29, 31, 32, 34, 39, 40, 43, 45.**

Rotala numbered

- | | |
|--|---|
| 1. <i>R. verticillaris</i> L. | 25. <i>R. rosea</i> (Poiret) C. D. K. Cook |
| 2. <i>R. gerardii</i> Boutique | 26. <i>R. verdcourtii</i> A. Fernandes |
| 3. <i>R. myriophylloides</i> Welw. ex
Hiern | 27. <i>R. welwitschii</i> Exell |
| 4. <i>R. wallichii</i> (Hooker fil.) Koehne | 28. <i>R. cordata</i> Koehne |
| 5. <i>R. hippuris</i> Makino | 29. <i>R. rubra</i> (Buch.-Ham. ex D. Don)
Hara |
| 6. <i>R. mexicana</i> Cham. & Schlecht. | 30. <i>R. juniperina</i> A. Fernandes |
| 7. <i>R. oculiflora</i> Koehne | 31. <i>R. malampuzhensis</i> R. V. Nair ex
C. D. K. Cook |
| 8. <i>R. floribunda</i> (Wight) Koehne | 32. <i>R. simpliciuscula</i> (Kurz) Koehne |
| 9. <i>R. repens</i> (Hochst.) Koehne | 33. <i>R. serpiculoides</i> Welw. ex
Hiern |
| 10. <i>R. hexandra</i> Wallich ex Koehne | 34. <i>R. stagnina</i> Hiern |
| 11. <i>R. rotundifolia</i> (Roxb.) Koehne | 35. <i>R. gossweileri</i> Koehne |
| 12. <i>R. macrandra</i> Koehne | 36. <i>R. indica</i> (Willd.) Koehne |
| 13. <i>R. nummularia</i> Welw. ex Hiern | 37. <i>R. subrotunda</i> (Wallich ex Kurz)
Koehne |
| 14. <i>R. thymoides</i> Exell | 38. <i>R. diandra</i> (F. v. Müller) Koehne |
| 15. <i>R. elatinoides</i> (DC.) Hiern | 39. <i>R. filiformis</i> (Bellardi) Hiern |
| 16. <i>R. serpyllifolia</i> (Roth) Bremek. | 40. <i>R. capensis</i> (Harvey) A. Fernan-
des & Diniz |
| 17. <i>R. tenella</i> (Guill. & Perr.) Hiern | 41. <i>R. dinteri</i> Koehne |
| 18. <i>R. pterocalyx</i> A. Raynal | 42. <i>R. fontinalis</i> Hiern |
| 19. <i>R. fluitans</i> Pohnert | 43. <i>R. lucalensis</i> A. Fernandes &
Diniz |
| 20. <i>R. ritchiei</i> (Clarke) Koehne | 44. <i>R. smithii</i> A. Fernandes & Diniz |
| 21. <i>R. illecebroides</i> Arn. ex Koehne | |
| 22. <i>R. ramosior</i> (L.) Koehne | |
| 23. <i>R. fimbriata</i> Wight | |
| 24. <i>R. densiflora</i> (Roth ex Roemer
Schultes) Koehne | |

Key to *Rotala*

- 1 Lower leaves alternate (upper leaves occasionally arranged irregularly: alternate, whorled, opposite or in fascicles); upper bracts scale-like, resembling bracteoles
 - 2 Stigmas distinctly 2-lobed; anthers and stigmas borne at different levels (flowers dimorphic, heterostylous); petals showy, 1-1.5 mm long; calyx tube c. 2 mm long (W. India) **8. *R. floribunda***
 - 2 Stigmas obconical; anthers and stigmas borne at the same level (flowers monomorphic); petals insignificant, c. 0.25 mm long; calyx tube c. 1 mm long (Ethiopian Highlands and Mt. Elgon) **9. *R. repens***
- 1 Lower and upper leaves decussate or whorled; bracts not scale-like, not resembling bracteoles or bracteoles absent
 - 3 Leaves in whorls of 3 or more
 - 4 Petals absent
 - 5 Calyx disintegrating as the fruit ripens; capsule opening by 2 valves (Japan) **5. *R. hippuris***
 - 5 Calyx remaining intact as the fruit ripens; capsule opening by 3 valves
 - 6 Bracteoles leaf-like, partly or completely enclosing the flower and at least 2 times as long as the calyx; calyx tube c. 1 mm long (S. India and N. Australia) **7. *R. occultiflora***
 - 6 Bracteoles scarious, linear, not enclosing the flower and rarely exceeding the calyx; calyx tube 0.5-0.7 mm long (Warmer regions of the World) **6. *R. mexicana***
 - 4 Petals present
 - 7 Calyx tube at anthesis cylindrical to sub-urceolate, somewhat constricted at the throat; capsules opening by 3 valves; calyx lobes 3 or 5; petals 3 or 5

- 8 Bracts cordate at base, usually in whorls of 3; calyx lobes 5; petals 5, up to 3 mm long, at least 5 times as long as calyx lobes; flower pedicellate; seeds c. 0.7 mm long (Tropical Africa) **2. *R. gerardii***
- 8 Bracts scarcely widened at base, usually in whorls of 4 or 8; calyx lobes 3; petals 3, c. 0.5 mm long, scarcely exceeding the calyx lobes; flowers sessile; seeds c. 0.4 mm long (S.E. India, Sri Lanka) **1. *R. verticillaris***
- 7 Calyx tube at anthesis campanulate, not constricted at the throat; capsules opening by 2 or 4 valves; calyx lobes usually 4; petals usually 4
- 9 Calyx tube c. 1 mm long; style very short, not more than 0.2 mm long; bracteoles about half as long as the calyx tube; petals not exceeding 0.6 mm long (Japan) **5. *R. hippuris***
- 9 Calyx tube at least 1.5 mm long; style at least 0.5 mm long; bracteoles less than half as long as the calyx tube; petals at least 1 mm long
- 10 Anthers and stigmas borne at different levels (flowers dimorphic, heterostylous); petals not more than 1.5 mm long; calyx tube c. 2 mm long (Tropical Africa, Malagasy) . **3. *R. myriophylloides***
- 10 Anthers and stigmas borne at about the same level (flowers monomorphic); petals c. 2.5 mm long; calyx tube c. 1.5 mm long (Tropical S.E. Asia) **4. *R. wallichii***
- 3 Leaves decussate (or rarely in whorls of 3 at the stem apex)
 - 11 Stipule-like outgrowths present on the nodes between leaves or bracts; calyx lobes, petals and stamens 6-merous (S.E. Asia) **10. *R. hexandra***
 - 11 Stipule-like outgrowths absent; calyx lobes, petals and stamens not 6-merous
 - 12 Petals pinnately divided into linear segments (petals 2-3 mm long) (S. India) **23. *R. fimbriata***
 - 12 Petals entire or lobed, not pinnately divided into linear segments or absent
 - 13 Flowers in axillary clusters (bracteoles absent, leaves petiolate) (Tropical Africa) **33. *R. serpiculoides***
 - 13 Flowers solitary in axils of bracts
 - 14 Calyx appendages present between the calyx lobes
 - 15 Calyx lobes 3
 - 16 Flowers distinctly pedicellate; bracteoles absent; petals absent (E. India, Bangla Desh) **32. *R. simpliciuscula***

- 16 Flowers sessile or subsessile; bracteoles 2, linear, about as long as the calyx tube; petals present
- 17 Capsule about 2 times as long as the calyx tube; stamens inserted near the base of the calyx tube (S.W. India)
31. R. malampuzhensis
- 17 Capsule scarcely exceeding the calyx tube; stamens inserted slightly below the middle of the calyx tube (Tropical Africa)
30. R. juniperina
- 15 Calyx lobes 4 or 5
- 18 Calyx lobes 4
- 19 Capsule opening by 3 valves; stamens usually 2 or occasionally 1 or 3
- 20 Flowers distinctly pedicellate; bracteoles absent; capsule about 2 times as long as the calyx tube (E. India, Bangla Desh) **32. R. simpliciuscula**
- 20 Flowers sessile or subsessile; bracteoles 2, linear, about half as long as the calyx tube; capsule scarcely exceeding the calyx tube (Tropical Africa) **27. R. welwitschii**
- 19 Capsule opening by 4 valves; stamens 4 or very rarely less
- 21 Stamens inserted near the base of the calyx tube; calyx tube globose to subglobose in fruit; leaves and bracts subsessile to somewhat petiolate; bracts cuneate at base (America, Philippines, N. Italy) **22. R. ramosior**
- 21 Stamens inserted about halfway up the calyx tube; calyx tube campanulate to somewhat urceolate in fruit; leaves and bracts sessile; bracts truncate or cordate at base
- 22 Calyx lobes acutely triangular, apiculate at apex; bracteoles equal to or longer than the calyx tube; leaves uniform in shape, ovate-cordate with acute apex (Peninsular India)
21. R. illecebroides
- 22 Calyx lobes very shallowly triangular, obtuse at apex; bracteoles less than half as long as the calyx tube; leaves variable in shape (heterophyllous), with obtuse apex
- 23 Calyx tube not exceeding 2 mm long; capsule c. 2 mm long; capsule valves not induplicate before dehiscence; seed c. 0.3 mm long; submerged leaves linear (W. India)
20. R. ritchiei
- 23 Calyx tube 2.5 mm or more long; capsule c. 3.5 mm long; capsule valves induplicate before dehiscence; seed c.

- 0.5 mm long; submerged leaves elliptic to ovate (Southern Africa) **19. *R. fluitans***
- 18 Calyx lobes 5
- 24 Bracteoles longer than the total calyx (tube, lobes and appendages), with a midrib; style at least 0.5 mm long (C. and S.E. Asia, Australia, Italy) **24. *R. densiflora***
- 24 Bracteoles shorter than the total calyx, without a midrib; style less than 0.5 mm long
- 25 Capsule exceeding the calyx; style very short less than 0.25 mm; bracteoles equal to or slightly shorter than the calyx tube; stamens 5 (S. and E. Asia) **25. *R. rosea***
- 25 Capsule not exceeding the calyx; style c. 0.25 mm long; bracteoles somewhat longer than the calyx tube; stamens 2 (Tropical Africa) **26. *R. verdcourtii***
- 14 Calyx appendages absent between the calyx lobes
- 26 Capsule opening by 4 valves
- 27 Floral bracts distinctly different from the foliage leaves in shape and size
- 28 Anthers and stigmas included within the calyx; bracts longer than wide; bracteoles about equal to the calyx tube in length; inflorescence in fruit more or less remote, lax; stigmas discoid (S. and E. Asia) **11. *R. rotundifolia***
- 28 Anthers and stigmas exerted beyond the calyx; bracts wider than long; bracteoles half or less as long as the calyx tube; inflorescence in fruit more or less sessile, dense, with imbricate bracts; stigma minutely capitate (S. India) **12. *R. macrandra***
- 27 Floral bracts like foliage leaves, at least at the base of the inflorescence
- 29 Anthers and stigmas borne at different levels (flowers dimorphic, heterostylous); petals showy, more than 1 mm long
- 30 Leaves below the inflorescence ovate to broadly ovate; inflorescence indistinct (no marked difference between sterile and fertile parts of the stem); "pin" or long style more than 5 mm long (Angola) **13. *R. nummularia***
- 30 Leaves below the inflorescence linear to lanceolate or obspathulate; inflorescence usually distinctly stalked, more or less globose; "pin" or long style less than 5 mm long (Angola) **14. *R. thymoides***

- 29 Anthers and stigmas borne at the same level (flowers monomorphic); petals absent or not showy and less than 0.5 mm long
- 31 Calyx tube at fruiting stage almost square in transverse section, distinctly 4-winged (C. and W. Africa) **18. R. pterocalyx**
- 31 Calyx tube at fruiting stage more or less terete in transverse section; not winged
- 32 Calyx tube at fruiting stage subcylindrical to urceolate, c. 3 mm long; stamens 2, inserted near the base of the calyx tube (C. and W. Africa) **15. R. elatinoides**
- 32 Calyx tube at fruiting stage semi-globose, c. 1.5 mm long; stamens 4 or rarely less, inserted about halfway up the calyx tube (Africa S. of the Sahara) **17. R. tenella**
- 26 Capsule opening by 2 or 3 valves
- 33 Capsule opening by 3 valves
- 34 Bracteoles leaf-like, partly or completely enclosing the flower at least 2 times as long as the calyx (S. India, N. Australia) **7. R. occultiflora**
- 34 Bracteoles scarious, linear, not enclosing the flower, not more than 2 times as long as the flower
- 35 Calyx lobes 5
- 36 Calyx tube 0.5-0.75 mm long; petals absent (Warmer regions of the World) **6. R. mexicana**
- 36 Calyx tube at least 1 mm long; petals present
- 37 Capsule exceeding the calyx lobes; style less than 0.25 mm long; bracteoles about as long as the calyx tube (S. and E. Asia) **25. R. rosea**
- 37 Capsule not exceeding the calyx lobes: style 0.5-1 mm long; bracteoles longer than the total calyx (C. and S.E. Asia, Australia, Italy) **24. R. densiflora**
- 35 Calyx lobes 4 or 3
- 38 Calyx lobes 4
- 39 Calyx tube 0.5-0.75 mm long (Warmer Regions of the World) **6. R. mexicana**
- 39 Calyx tube more than 0.75 mm long

- 40 Petals as long or longer than the calyx lobes; stamens 4, inserted about halfway up the calyx tube; bracteoles $\frac{1}{4}$ or less as long as the calyx (Asia)
- 41 Capsule exceeding the calyx; style very short, c. 0.1 mm long (Nepal) **29. *R. rubra***
- 41 Capsule included within the calyx tube; style 1-1.5 mm long (S. and S.E. Asia) **28. *R. cordata***
- 40 Petals absent or rudimentary, shorter than the calyx lobes; stamens 2, inserted near the base of the calyx tube; bracteoles about half as long as the calyx tube (Africa)
- 42 Calyx lobes shorter than the calyx tube, monomorphic; capsule longer than the calyx; calyx rupturing as the capsule develops (Tropical Africa) .. **34. *R. stagnina***
- 42 Calyx lobes about as long as the calyx tube, dimorphic; capsule remaining within the calyx tube; calyx not rupturing as the capsule develops (Tropical Africa) **35. *R. gossweileri***
- 38 Calyx lobes 3
- 43 Flowers distinctly pedicellate; bracteoles absent (E. India, Bangla Desh) **32. *R. simpliciuscula***
- 43 Flowers sessile or subsessile; bracteoles 2, linear
- 44 Capsule not exceeding the calyx lobes; petals absent (Warmer Regions of the World) **6. *R. mexicana***
- 44 Capsule exceeding the calyx lobes; petals present (S.W. India) **31. *R. malampuzhensis***
- 33 Capsule opening by 2 valves
- 45 Leaves with a distinct cartilaginous margin
- 46 Flowers distinctly pedicellate; anthers borne above the petals (N.E. India and Burma) **37. *R. subrotunda***
- 46 Flowers sessile or subsessile; anthers included within the calyx
- 47 Style 0.5-1 mm long; anthers and stigmas exceeding or reaching the top of the calyx tube; stamens inserted about half way up the calyx tube, usually 4; bracteoles about as long or longer than the calyx tube (Warmer Regions of the World) **36. *R. indica***
- 47 Style very short, 0.1 mm or less; anthers and stigmas scarcely reaching half the length of the calyx tube; stamens inserted

near the base of the calyx tube, usually 2; bracteoles about half as long as the calyx tube (N. Australia)

38. *R. diandra*

45 Leaves without a cartilaginous margin

48 Calyx tube 2 mm or more long

49 Calyx tube urceolate, constricted at the throat, 2.5-3 mm long; anthers and stigma borne at the same level (flowers monomorphic); inflorescence compact, more or less remote (Pakistan, C. and N.W. India) **16. *R. serpyllifolia***

49 Calyx tube campanulate, not constricted at the throat, c. 2 mm long; anthers and stigma borne at different levels (flowers dimorphic, heterostylous); flowering and sterile parts of the stem alike (Tropical Africa, Malagasy)
3. *R. myriophylloides*

48 Calyx tube less than 2 mm long (*R. filiformis* group)

50 Anthers exerted beyond the calyx lobes; style at least 1.25 mm long (E. Zaire) **44. *R. smithii***

50 Anthers not exerted beyond the calyx lobes; style not more than 1 mm long

51 Stamens 4 (occasionally 1 or 2 sterile and represented by naked filaments); style more than 0.5 mm long

52 Mature capsule longer than the total calyx, ellipsoidal, 2 mm or more long; seeds 0.75-1 mm long, ellipsoidal (C. and S. Tropical Africa) **43. *R. lucalensis***

52 Mature capsule shorter than the calyx tube, subglobose or obovoid, c. 1 mm long; seeds c. 0.4 mm long, semi-ovoid (S. Tropical Africa) **42. *R. fontinalis***

51 Stamens 2 or rarely 1 or 3; style 0.5 mm or less long

53 Calyx tube in fruit not more than 0.75 mm long (usually much less); capsule at least 2 times as long as the calyx tube; style not more than 0.2 mm long

54 Capsule subglobose; calyx tube not splitting as the fruit ripens; bracteoles linear, 0.25-0.5 mm long (S. Tropical Africa) **41. *R. dinteri***

54 Capsule ellipsoidal; calyx tube splitting irregularly as the fruit ripens; bracteoles scale-like, minute, c. 0.1 mm long (Tropical Africa) **40. *R. capensis***

53 Calyx tube in fruit at least 1 mm long; capsule less than 2 times as long as the calyx tube; style 0.25-0.5 mm long (Tropical Africa, N. Italy) **39. *R. filiformis***

1. ***Rotala verticillaris*** L., Mantissa 2: 175. 1771; non Hiern in Oliver, Fl. Trop. Africa 2: 467. 1871 $\equiv$ *Ammannia verticillaris* (L.) Baillon, Hist. Pl. 6: 439, f. 423, 424. 1877.
- *Rotala verticillata* Christm., Pflanzensyst. 5: 195. 1779, orth. mut.
 - *Rotala petaloidea* Wight ex Steudel, Nom. Bot. ed. 2, 2: 474. 1841, nom. nud.
 - *Ammannia rotala* Clarke in Hooker fil., Fl. Brit. India 2: 567. 1879, pro syn., non F. v. Müller, Fragm. Phyt. Austral. 3: 108. 1862.

Type: India orientalis (holotype: LINN, Savage Cat. No. 52-1).

Ic.: Fig. 1A-E; Wight, Ic. Pl. Ind. Or. 1: t. 260. 1840.

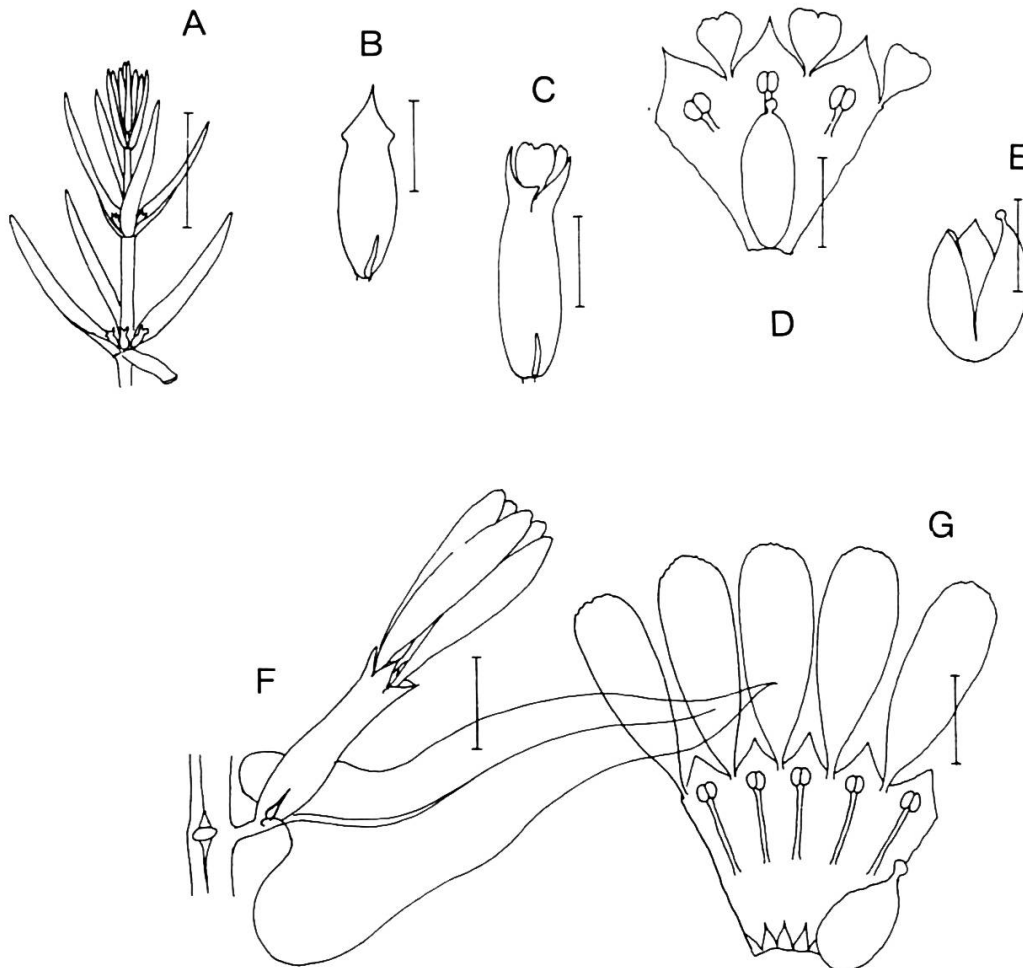


Fig. 1. — *R. verticillaris* (Wallich 6321A); **A**, flowering stem; **B**, flower bud; **C**, flower at anthesis; **D**, flower dissection; **E**, capsule.
R. gerardii (Gérard 1608); **F**, flower and bract at anthesis; **G**, flower dissection (scale: **A**, 5 mm; **B-G**, 1 mm).

Amphibious perennial, or perhaps occasionally annual. *Stems* creeping and rooting below, floating, ascending or erect above, up to 20 cm long but usually less, simple or branched, terete below, angular above, somewhat woody at base. *Leaves* in whorls of 4-8, or occasionally decussate below, 3-10 mm long; submerged leaves capillary, thin, rarely more than 1 mm wide; aerial leaves linear to oblong or oblanceolate, thick, up to 2.5 mm wide; leaf apex truncate or minutely bifid. *Bracts* leaf-like, usually in whorls of 4, rarely 8 or 2; bracteoles 2, capillary, up to 0.5 mm long. *Flowers* monomorphic, sessile, solitary. *Calyx* tube membranous, sub-urceolate, constricted at mouth, up to 2 mm long; calyx lobes 3, rarely 4, deltate, c. 0.5 mm long; small interjected fold present between calyx lobes, persisting in fruit. *Petals* 3, rarely 4, ovate to cordate, pink, usually persisting in fruit, about as long as the calyx lobes. *Stamens* 3, rarely 4, inserted on the upper half of the calyx tube; anthers scarcely reaching the sinuses of the calyx lobes. *Ovary* ellipsoidal; style very short; stigma capitate; capsule globose-ellipsoidal, opening by 3 valves; seeds semi-ovoid, 0.35-0.4 mm long.

DIAGNOSTIC FEATURES

K3(-4), P3(-4), A3(-4), G3; leaves in whorls; calyx tube constricted at the throat. Like *R. gerardii* but differs in having leaves not widened at the base and small seeds, 0.35-0.4 mm long.

DISTRIBUTION

Found in S.E. India and Sri Lanka (Map 1). There are many early collections and it was first reported in Rheede, Hortus Indicus Malabaricus 9: t. 81. 1678-1703. Trimen (Fl. Ceylon 2: 224. 1894) reports that Thwaites considered it common in Sri Lanka but that he himself had never found it; the most recent Sri Lanka collection I have seen is: "*Thwaites 1547*" collected in 1855. The most recent collection from S. India I have seen is 1915. *Rotala verticillaris* grows in regions that have recently been recollected, it is probable that it has become very rare or even extinct. Cooke (Fl. Bombay 1: 507. 1903) reports it from Kanara, I have not seen the cited collection but it is most likely *R. mexicana* which grows in the region; (Cooke, loc. cit., "petals fugacious or 0" which is not normal for *R. verticillaris*). There is no ecological information available, the herbarium material suggests that it grows in temporary pools. The flowering time is from January to March. The flowers are probably autogamous.

SELECTED SPECIMENS

India: s. loc., *Bélangier 91* (LE); s. loc., *Wallich 6321B* (K); s. loc., *Wight 1016* (BR, CGE, G, K, L, MEL); Andhra Pradesh: Nellore, 13 March 1901, *Bourne 2144* (K); Tamil Nadu: Nagapattinam, 1830, *Graham 156* (CGE);

Tranquebar, *Rottler* (K); Chingelput, 7 Feb. 1915, *Herb. S. Ind. Fl.* (K); Pondicherry, *Perrotet 693* (L). **Sri Lanka:** s. loc., 1832, *Wallich 6321A* (CGE, G, K, LE); s. loc. 1855, *Thwaites 1547* (G).

2. *Rotala gerardii* Boutique, Bull. Jard. Bot. Etat Bruxelles 34(4): 503. 1964.

Type: Zaire, Distr. de l'Ubangi-Uele, mare du Pengbele, Nov. 1957, *Gérard 3354* (holotype: BR).

lc.: Fig. 1F-G; Boutique, Bull. Jard. Bot. Etat Bruxelles 34(4): t. 9. 1964.

Amphibious herb. *Stems* creeping, rooting and branching below, erect and usually simple above, 10-50 cm long. *Leaves* in whorls of 3, occasionally some decussate, ovate to ovate-lanceolate, 3-7 mm long, 1.5-3.5 mm wide, at base rotund to cordate, at apex acute, attenuate. *Bracts* leaf-like, at base usually somewhat cordate and shortly petiolate; bracteoles 2, capillary, 0.5-0.7 mm long. *Flowers* monomorphic, solitary, shortly pedicellate; pedicel adnate to petiole of bract, combined structure up to 0.75 mm long. *Calyx* tube membranous, sub-cylindrical to sub-urceolate, 2-2.5 mm long; calyx lobes 5, rarely 4, deltate to triangular, 0.25-0.5 mm long. *Petals* 5, rarely 4, pink, oblong-elliptic, attenuate at base, 2.5-3 mm long. *Stamens* 5, rarely 4, inserted somewhat below the middle of the calyx tube; anthers scarcely reaching the sinuses of the calyx lobes. *Ovary* ellipsoidal; style very short, not exceeding 0.15 mm; stigma capitate; capsule broadly ellipsoidal, opening by 3 valves; seeds semi-pyriform, up to 0.7 mm long and 0.4 mm wide.

DIAGNOSTIC FEATURES

K5(-4), P5(-4), A5(-4), G3; like *R. verticillaris* but in all respects larger; leaves in whorls of 3, widened at the base; petals as long or longer than the calyx tube. Like *R. myriophylloides* but perianth 5-merous; flowers monomorphic; calyx tube tubular; capsule 3-valved.

DISTRIBUTION

Found in the northern part of the Congo basin (Map 2). It grows in temporary ponds, particularly on laterite. The flowering time is from September to December.

SELECTED SPECIMENS

Cameroun: 60 km N.E. Tibati, 24 Sept. 1963, *Letouzey 6001* (P). **Central African Republic:** Reg. Waka, Rewangi, 45 km E. Moroubas, March 1925, *Tisserant 1690* (BR, K, P); Gomoka, 6 Oct. 1963, *Audru & Boudet 3182 bis*

(P). **Zaire:** Distr. de l'Ubangi-Uele, Tukpwo, Dec. 1952, *Gérard* 497 (BR); Tukpwo, *Gérard* 1019 (BR); Pengbele, Nov. 1957, *Gérard* 3354 (BR).

3. ***Rotala myriophylloides*** Welw. ex Hiern in Oliver, Fl. Trop. Africa 2: 469. 1871.
- = *Ammannia cryptantha* Baker, J. Linn. Soc. Bot. (London) 21: 345. Dec. 1884 ≡ *Rotala cryptantha* (Baker) Koehne in Engler, Pflanzenreich 17 (IV. 216): 42. 1903. **Type:** Malagasy, *Baron* 1902 (lectotype: K).
- = *Rotala cordifolia* Baker, J. Linn. Soc. (London) 22: 478. 1887. **Type:** Malagasy, *Baron* 4313 (holo- or lectotype: K n.v.; isotype: P).
- = *Rotala longistyla* L. S. Gibbs, J. Linn. Soc. (London) 37: 445. 1906. **Type:** Rhodesia (Zimbabwe), Victoria Falls, Sept., L. S. Gibbs 170 (holotype: K).
- = *Rotala longicaulis* A. Fernandes & Diniz, Bol. Soc. Brot. Sér. 2, 29: 87. 1955, op. cit. 48: 131. 1974. **Type:** Mozambique, Niassa, Metonia, pr. Vila Cabral, 2 May 1934, *Torre* 96 (holotype: COI n.v.; isotype: LISC).
- = *Rotala pearsoniana* A. Fernandes & Diniz, Bol. Soc. Brot. Sér. 2, 31: 155. 1957. **Type:** Angola, Lubango (Huíla), 10 May 1909, *Pearson* 2657 (holotype: K).
- = *Rotala nashii* A. Fernandes, Bol. Soc. Brot. Sér. 2, 48: 129. 1974. **Type:** Zambia, Mbala (Abercorn) Distr., Lake Chila, April 1954, *Nash* 65 (holotype: BM; paratypes: *ibid.*, *Richards* 4948, K; *Richards* 18084, K).
- = *Rotala hutchinsoniana* A. Fernandes, Bol. Soc. Brot. Sér. 2, 48: 130. 1974. **Type:** Zambia, Mbala (Abercorn), 19 June 1930, *Hutchinson & Gillett* 3872 (holotype: BM; isotype: K).

Type: Angola, Lubango (Huíla), Lopolo, entre Nene e Ohai, 1600 m, May 1860, *Welwitsch* 2348 (holotype: LISU n.v.; isotypes: BM, COI n.v.; K, M).

lc.: Fig. 2A, B; A. Fernandes, Bol. Soc. Brot. Sér. 2, t. 1. 1955; op. cit. 31: t. 5. 1957; op. cit. 48: t. 16, t. 17, t. 18. 1974.

Aquatic, amphibious or terrestrial perennial or perhaps occasionally annual. *Stems* creeping, rooting and branching below; often stoloniferous; floating or erect and usually simple above, up to 50 cm or more long but often much less. *Leaves* in whorls of 3-8 or decussate; submerged leaves in whorls of 3-8, capillary or linear, up to 20 mm long, at apex obtuse or bifid; aerial leaves rarely in whorls of more than 4 or decussate, linear to oblong or ovate, rarely exceeding 5 mm long, at base ovate or somewhat cordate, at apex obtuse. *Bracts* like aerial leaves, at base usually somewhat widened or cordate; bracteoles 2, membranous, linear, up to 0.5 mm long but often less. *Flowers* dimorphic, heterostylous, solitary, subsessile or pedicellate; pedicel adnate to petiole of bract, combined structure up to 1 mm long. *Calyx tube*

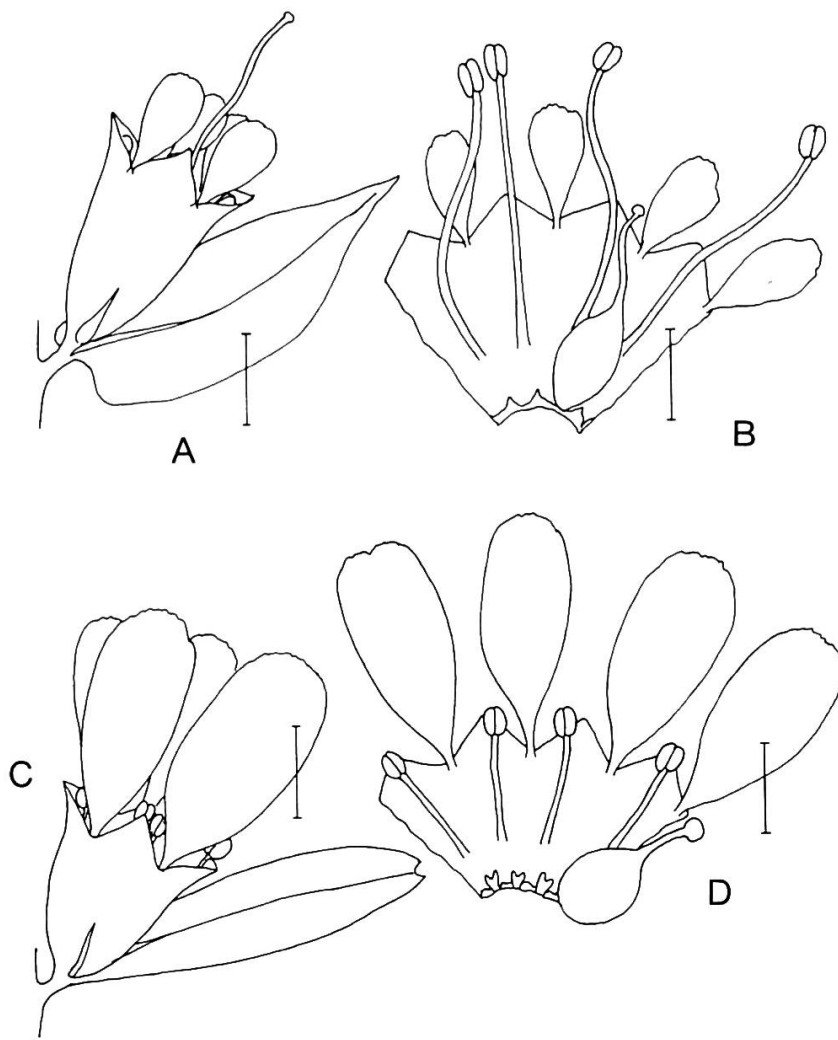


Fig. 2. — *R. myriophylloides* (de Witte 6339); **A**, "pin" flower and bract at anthesis; **B**, "thrum" flower dissection.

R. wallichii (living material, from ? Johore); **C**, flower and bract; **D**, flower dissection (scale: **A-D**, 1 mm).

membranous, campanulate, c. 2 mm long; calyx lobes 4, rarely 3 or 5, shallowly triangular, spreading, c. 0.5 mm long. *Petals* 4, rarely 3 or 5, deep rose, elliptic to obovate, up to 1.5 mm long but often less, persisting in fruit. *Stamens* 4, rarely 5, inserted slightly below the middle of the calyx tube; anthers borne either within the calyx tube or above the petals; filaments either c. 1.5 mm long or c. 3 mm long. *Ovary* ovoid; style either c. 1 mm long or c. 3 mm long; stigma capitate; capsule shorter than the calyx tube, opening by 2 valves; seeds semi-ovoid, c. 1 mm long.

DIAGNOSTIC FEATURES

K(3-)4(-5), P(3-)4(-5), A(3-)4(-5), G2; heterostylous, capsule shorter than calyx tube, seeds c. 1 mm long. Like *R. wallichii* but calyx c. 2 mm long, petals not more than 1.5 mm long, and flowers heterostylous.

DISTRIBUTION

Southern Africa and Malagasy between latitude 8°S. and 20°S. (Map 2). It is found in a wide variety of aquatic and wet habitats. When the whole range is considered it flowers throughout the year.

SELECTED SPECIMENS

Angola: Lubango (Huíla): Lopolo, entre Nene e Ohai, 1600 m, May 1860, *Welwitsch* 2348 (BM, COI n.v., K, M); Serra da Chela, Humpata, 2000 m, 28 Oct. 1941, *Gosseweiler* 13246 (BM, BR); Lubango (Huíla), 1950 m, 10 May 1909, *Pearson* 2657 (K); Ganda: Alto Catumbela, 1450 m, Feb. 1940, *Faulkner* (A)320 (BM, K); Bié: Cuito-Cuanavale, Cuito, entre Cutué e Sobi, 1200 m, *Baum* 770 (BM, BR, G, K, M, Z). **Zaire:** Shaba (Katanga): Buyi-Bala, Kiluba-Mene, 1750 m, 30 March 1948, *Witte* 3590 (BR, K); Mitwaba, Linsinya, 11 May 1949, *Van Meel*, *Witte* 6339 (BR, G, M, Z); Mitwaba, Mukana, 2 Oct. 1948, *Van Meel*, *Witte* 6116 (BR, L); Kipopo, 20 km N.O. Lubumbashi (Elisabethville), 5 May 1958, *Schmitz* 6054 (BR); Lubumbashi, 1220 m, 2 Dec. 1965, *Symoens* 11686 (BR, K, MO); Kundelungu, 7.3 km N. Katshupa, 1690 m, 4 Aug. 1966 *Malaisse* 4508 (BR, K). **Zambia:** Mbala (Abercorn), Lake Chila, 1650 m, 24 Sept. 1949, *Bullock* 1071 (BR); *ibid.*, 23 May 1952, *Richards* 1824 (BR, K); *ibid.*, 15 March 1955, *Richards* 4948 (K); Mbala, Abercorn Lake, 19 July 1930, *Hutchinson & Gillett* 3872 (K); Lake Bangweiler, 27 May 1964, *Fanshaw* 8694 (K); Kalabo, 17 Nov. 1959, *Drummond & Cookson* 6563 (K); 5 km E. Choma, 1319 m, 28 May 1955, *Robinson* 1270 (K); N. lac Shiwa Ngandu (Lake Young), 26 June 1963, *Symoens* 10493 (BR, K, MO); Mutuka, 1260 m, 5 Aug. 1966, *Symoens* 12623 (BR, K). **Malawi:** Nyika Plateau, Lake Kauline, 2150 m, 24 Oct. 1958, *Robson & Angus* 325 (K); *ibid.*, 12 Nov. 1967, *Richards* 22511 (K). **Rhodesia (Zimbabwe):** Victoria Falls, 960 m, May 1904, *Eyles* 124 (BM, K); *ibid.*, May, *Gibbs* 170; *ibid.*, May 1915, *Rogers* 13198 (BM, Z); *ibid.*, *Acocks & Hafström* 1024 (K); *ibid.*, 13 July 1952, *Codd* 7063 (K); Salisbury, 1500 m, March 1919, *Eyles* 1568 (BM); *ibid.*, June 1920, *Eyles* 2284 (K); *ibid.*, 19 Feb. 1927, *Eyles* 4730 (K); *ibid.*, 20 June 1931? 1937, *Brain* 5287 (K); Salisbury, Cleveland Dam, 21 March 1921, *Godman* 177 (BM); *ibid.*, 5 May 1934, *Gilliland* 30 (BM, K) and 33 (BM, K); *ibid.*, 4 May 1946, *Wild* 1077 (K); 37 km E. Salisbury, Goromonzi, 25 April 1967, *Rushworth* 662 (K); Mazoe, Henderson, Res., 7 May 1952, *Wild* 3832 (BR, K, MO); Marandellas, 15 April 1922, *Eyles* 3446 (K); *ibid.*, 14 May 1931, *Brain* 4422 (MO); *ibid.*, 9 Jan. 1942, *Dehn* 586 (M); Marandellas, Digglefold, 18 March 1948, *Corby* 20300 (BM); Gokwe, 13 Sept.

1949, *West 2999* (K). **Botswana:** Maun, Chobe River, 2 June 1930, *van Son 28861* (BM); Maun, Thamalakane River, June 1955, *Mc Connell* (K); Thamalakane River, 23°30'E., 19°55'S., 22 Jan. 1972, *Gibbs, Russel & Biegel 1365* (B, K, MO); *ibid.*, 23°25'E., 20°00'S., 28 Feb. 1972, *Gibbs, Russell & Biegel 1467* (B, K, MO); Okavango Swamp, Khwai River, 23°25'E., 19°10'S., 1 March 1972, *Gibbs, Russell & Biegel 1478* (MO). **Mozambique:** N. Niassa, Metonia, pr. Vila Cabral, 2 May 1934, *Torre 96* (COI n.v.) **Malagasy:** s. loc., *Baron 4313* (P) and *Baron 5248* (P); Vakinankaratra, Antsirabe, Aug. 1908, *d'Alleizette 2487* (L); *ibid.*, April 1924, *Waterlot 770* (P); *ibid.*, 1600 m, *Perrier de la Bâthie 6603* (P); Vakinankaratra, d'Ambatolampy, 29 Nov. 1912, *Viguier & Humbert 1776* (G).

NOTES

I have cultivated cloned material collected in Salisbury, Rhodesia (Zimbabwe), under different conditions at Zürich. The vegetative parts of *R. myriophylloides* are phenotypically very plastic. Generally speaking, plants cultivated in water 10 cm or more deep resemble *Hippuris* with up to 8 linear leaves at each whorl; plants grown terrestrially in direct sunlight are creeping with small, decussate, ovate leaves. The flowers are heterostylous and effectively self-incompatible even after manual pollen transfer. From the herbarium record the "pin" or long-styled race seems to be much commoner than the "thrum" or short-styled race. This has the consequence that many plants are collected without mature capsules and seeds. Vegetative propagation must be relatively effective but no special mechanisms (bulbils, turions, etc.) have been discovered. Capsules with 3 valves have been reported in the literature but I have only seen material with 2 valves.

The spectrum of phenotypic plasticity seen in cultivation of two strains of *R. myriophylloides* at Zürich covers the total variation range of the numerous segregate-species listed in the synonymy.

4. ***Rotala wallichii*** (Hooker fil.) Koehne, Bot. Jahrb. 1: 154. 1880 $\equiv$ *Hydrolythrum wallichii* Hooker fil. in Bentham & Hooker fil., Gen. Pl. 1: 777. Sept. 1867, Hooker fil., Ic. Pl. 11 (or Ser. 3, Vol. 1): 5, t. 1007. Nov. 1867 $\equiv$ *Ammannia wallichii* (Hooker fil.) S. Kurz, J. As. Soc. Bengal 46: 2, 84. 1877.

= *Ammannia myriophylloides* S. T. Dunn, J. Bot. London 47: 199. 1909. **Type:** China, N.E. Kwantung, Hoi Fung, Kwen Ping, 29 April 1904, *Dunn's collector 1838* (holotype: HK n.v.; isotype: K).

Type: Burma, Tavoy, 1827, *Gomez, Wall. Cat. No. 9059* (holotype: K-W; isotypes: K, G, LE).

Ic.: Fig. 2C, D; Hooker fil., Ic. Pl. 11 (or Ser. 3, Vol. 1): t. 1007. 1867; Fl. Taiwan 3: pl. 819. 1977 — named *Elatine triandra*.

Aquatic or amphibious perennial. *Stems* creeping, rooting and branched below, floating or erect and usually simple above, up to 30 cm or more long. *Leaves* in whorls of up to 20 or more; submerged leaves linear or capillary, thin, translucent, tinged with red, up to 20 mm long, at apex bifid; aerial leaves usually in whorls of 3-12 (less than submerged leaves) or rarely decussate, linear to oblong, rarely more than 5 mm long, at base scarcely narrowed, at apex obtuse or bifid. *Bracts* like aerial leaves, oblong to ovate, 1.5-3 mm long, at apex acute or bifid; bracteoles capillary up to 0.5 mm long. *Flowers* monomorphic, solitary, several at each internode, shortly pedicellate; pedicel adnate to bract, combined organ up to 1 mm long. *Calyx* tube campanulate, membranous, translucent, c. 1.5 mm long; calyx lobes 4, deltate, c. 0.5 mm long. *Petals* 4, obovate, showy, pink (or white?), c. 2.5 mm long. *Stamens* 4, inserted below the middle of the calyx tube; anthers borne level with the top of the calyx lobes; nectar scales bilobed. *Ovary* globose; style c. 0.5 mm long; stigma capitate; capsule globose, c. 1 mm diam., opening by 2 valves; seeds semi-ovoid, c. 0.7 mm long (size of capsule and seeds may be underestimated as I have not seen really ripe material).

DIAGNOSTIC FEATURES

K4, P4, A4, G2; leaves never in whorls of less than 4, petals longer than calyx; capsule globose remaining within calyx tube. Like *R. myriophylloides* but not heterostylous, bracts not widened at base and petals longer than calyx. Like *R. hippuris* but flowers larger (calyx tube c. 1.5 mm long, petals c. 2.5 mm long) and not cleistogamous, capsule remaining within the calyx tube.

DISTRIBUTION

Found in tropical S.E. Asia (Map 1), from N.E. India to Malaya and S.E. China.

SELECTED SPECIMENS

India: Bengal, West Duars, Oct. 1895, *Haines 560* (K). **Burma:** Moulmein, 1846, *Lobb 366* (K); Tavoy 1827, *Gomez, Wall. Cat. 9059* (K, K-W, G, LE). **Thailand:** c. 100 km N. Bangkok, 10 m, 24 Nov. 1957, *van Steenis 19580* (K, L); Phatthalung (Patalung), 31 March 1899, *Gwynne-Vaughan 220* (K). **Malaya:** Kedah, Penarak, Lankawi, 16 Nov. 1892, ? *Collector 7075* (K); Johore, Endau River, Sept. 1976, *Tomey* (L, Z). **China:** Prov. Kwangtung, Kwen Ping, Haifeng (Hoi Fung), 29 Aug. 1904, *Dunn's Native Collector 1838* (K). **Taiwan:** Pingtung, *Hsu 3278* (TAI).

NOTES

R. wallichii is cultivated as a decorative aquarium plant. In culture in Zürich the submerged leaves have a reddish tinge. When grown as a

terrestrial plant the leaves are green and in whorls of at least 4. In Zürich it flowers rarely and then only on aerial stems, submerged and cleistogamous flowers have not been observed. The petals are showy but quickly fade from pink to white, which may explain reports of white-flowered plants. In culture *R. wallichii* is effectively self-incompatible even after manual pollen transfer; this may explain the scarcity of mature capsules and seeds.

5. *Rotala hippuris* Makino, Bot. Mag. Tokyo 12: 81. 1898.

Type: Japan, Aichi Pref., Nagoya City, Tashiro, 29 Oct. 1893, *Makino herb. No. 121070* (lectotype: MAK; isotype: MAK). Paratype: Japan, Aichi Pref., Atsumi-gun, Atsumi-cho, Kameyama, 27 Oct. 1893, *Makino herb. No. 121059* (MAK).

lc.: Fig. 3A-D.

Aquatic perennial. *Stems* creeping and rooting below, floating, ascending or erect above, up to 30 cm or more long. *Leaves* in whorls of 5-12 or perhaps more; submerged leaves, capillary 20-30 mm long, at apex microscopically bimucronate; aerial leaves linear, 5-10 mm long, 0.7-1 mm wide, at apex obtusely truncate to obscurely bimucronate, at base scarcely narrowed. *Bracts* leaf-like, either submerged or aerial; bracteoles linear, shorter than calyx tube. *Flowers* monomorphic, sessile, solitary, rarely more than 2 at any internode, fertile internodes somewhat erratic, borne on submerged and aerial shoots; submerged flowers cleistogamous with reduced petals and calyx lobes. *Calyx* tube campanulate, 0.7-1 mm long, splitting and disintegrating as the fruit ripens; calyx lobes 4, deltate, 0.2-0.3 mm long or less in cleistogamous flowers. *Petals* 4, obovate 0.2-0.6 mm long, rudimentary in cleistogamous flowers. *Stamens* 4, inserted on lower half of calyx tube; anthers not exceeding the calyx. *Ovary* globose; style very short; stigma capitate; capsule globose, up to 1.5 mm diam, opening by 2 valves; seeds semi-ellipsoidal, c. 0.6 mm long.

DIAGNOSTIC FEATURES

K4, C4, A4, G2; like *R. wallichii* but calyx disintegrating as the fruit ripens; fertile and sterile internodes intermixed, flowers borne on submerged stems.

DISTRIBUTION

Endemic to Japan between latitude 32°N. and 38°N. (Map 1). Flowering during October.

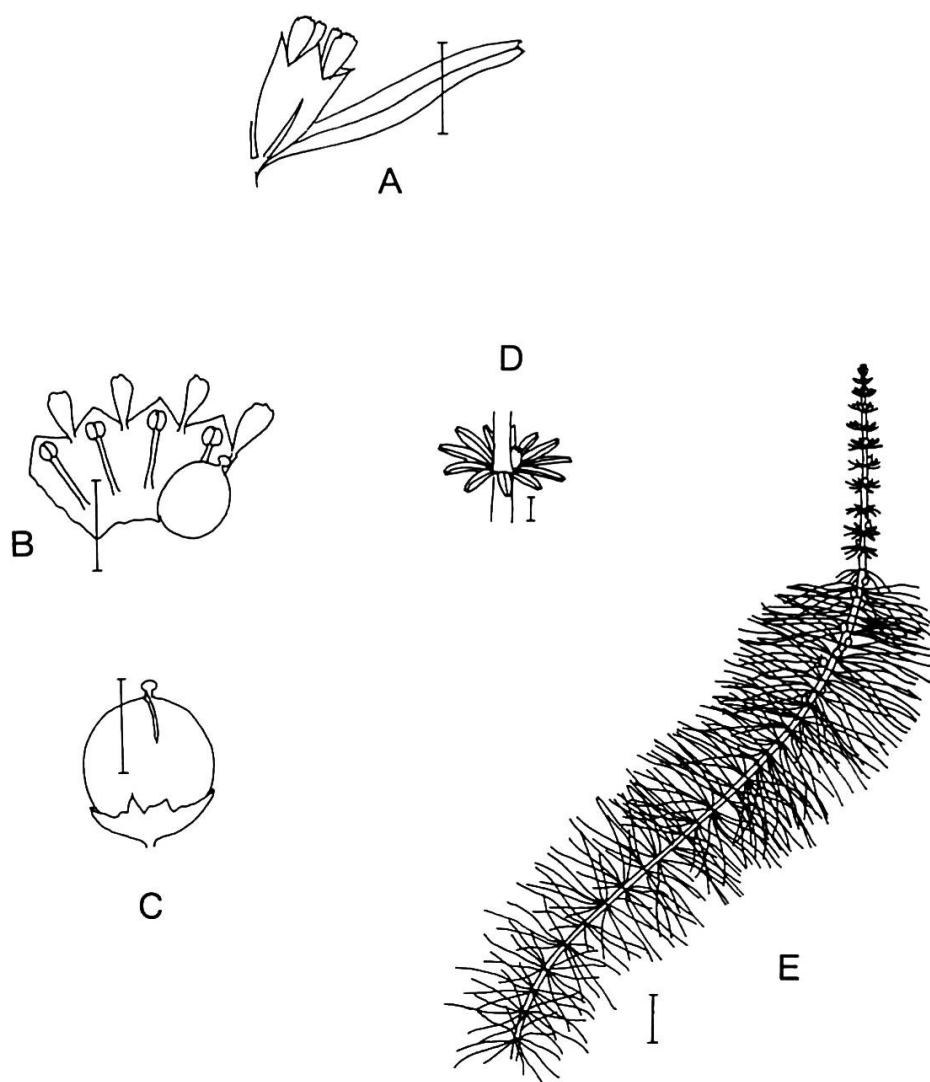


Fig. 3. — *R. hippuris* (Aichi, s. coll. 1906); **A**, flower and bract; **B**, flower dissection; **C**, ripe capsule; **D**, flowering whorl; **E**, habit (scale: **A-D**, 1 mm; **E**, 1 cm).

Japan. Honshu: Pref. Aichi, Nagoya, Tashira, 29 Oct. 1893, *Makino herb. No. 121070* (MAK) and *121068* (MAK); Pref. Aichi, Kameyama, Atsumi-cho, Atsumi-gun, 27 Oct. 1893, *Makino herb. No. 121059* (MAK); Pref. Aichi, Kamashima Yatomi-cho, Amabegun, 1 Nov. 1893, *Makino herb. No. 121067* (MAK); Pref. Aichi, Nagoya, Oct. 1906, s. coll. s.n. (KYO); Pref. Gunma, Tatebayashi, Tadaranuma, s.d. s. coll. herb. No. 121056 (MAK); Kyushu: Pref. Hinga, Miyazaki, Sept. 1911, *Bando* (KYO).

6. ***Rotala mexicana*** Cham. & Schlecht., *Linnaea* 5: 567. Oct. 1830 $\equiv$ *Ammannia mexicana* (Cham. & Schlecht.) Baillon, *Hist. Pl. Madag. Atl.* t. 363. 1895.
- = *Rotala pusilla* Tul., *Ann. Sci. Nat. Sér.* 4, 6: 128. 1856. **Type:** Malagasy, Boivin 2692 (holotype: P).
- = *Rotala apetala* F. v. Müller, *Fragm. Phyt. Austral.* 3: 108, 1862. **Type:** Australia, Western or Northern Territory, Sturt's Creek, F. v. Müller (holotype: MEL; isotypes: K, NSW).
- = *Hypobrichia spruceana* Benth in Benth & Hooker fil., *Gen. Pl.* 1: 777. 1867. **Type:** Brazil, Pará, Santarem, Aug. 1850, Spruce (holotype: K n.v.; isotypes: G, LE) [*H. spruceana* Benth, var. *tenuifolia* Griseb., *Cat. Pl. Cubens.* 106. 1866 based on Wright 2543 is not validly published].
- = *Ammannia pygmaea* S. Kurz, *Seeman's J. Bot.* 5: 376. 1867 $\equiv$ *Rotala pygmaea* (S. Kurz) Rajagopal & Ramayya, *Kew Bull.* 23: 465. 1969. **Type:** India, Hort. Bot. Calcutta, 1867? S. Kurz? (holotype: CAL?).
- = *Rotala diglossandra* Koehne, *Bot. Jahrb.* 23, Beibl. 57: 17. 1897. **Type:** Australia, North Expedition, 15 May 1869, leg. F. Schultz, comm. R. Schomburgk 318 (holotype: K).
- = *Rotala longibracteolata* Domin, *Biblioth. Bot.* 89: 995 (or 441 as book). 1928. **Type:** Australia, Queensland, Townsville, Castle Hill, 1910, Domin 11 (holotype: PR n.v.).
- *Rotala decussata* DC., *Prodr.* 3: 76. 1828, *nom. rejic. prop.* $\equiv$ *Ortegioides decussata* Solander, *nom. in sched.* $\equiv$ *Eutelia ammannioides* R. Brown, *nom. in sched.* **Type:** Australia, Queensland, Endeavour River, R. Brown (holotype: G-DC; isotype: BM).
- *Ammannia rotala* F. v. Müller, *Fragm. Phyt. Austral.* 3: 108. 1862, *nom. invalid.*, pro syn. *Rotala apetala* F. v. Müller.
- *Rotala verticillaris* sensu Hiern in Oliver, *Fl. Trop. Africa* 2: 467. 1871, non L., *Mant.* 2: 175. 1771.
- *Rotala halophila* H. Perrier, *Not. Syst. (Paris)* 14: 307. 1953 (dated 1952), *nom. invalid.* **"Type":** Malagasy, Maevarano, delta de la Betsiboka, Perrier 5205 (P).

Type: Mexico, prope Hacienda de la Laguna, Oct., Schiede & Deppe 566 (holotype: HAL n.v.; isotypes: LE, MO).

lc.: Fig. 4A-O.

Aquatic, amphibious or terrestrial annual. *Stems* branched or simple, creeping, ascending, erect or floating, often tuft- or turf-forming (see notes p. 39). *Leaves* decussate or in whorls of 3-8; submerged leaves linear, up to 15 mm long but usually less, rarely more than 0.5 mm wide; aerial leaves linear to lanceolate or ovate rarely more than 10 mm long but usually less. *Bracts* either leaf-like or ovate to obspathulate and somewhat inflated below; bracteoles linear, usually about as long as the calyx tube but sometimes longer or shorter. *Flowers* monomorphic, sessile, solitary, occasionally

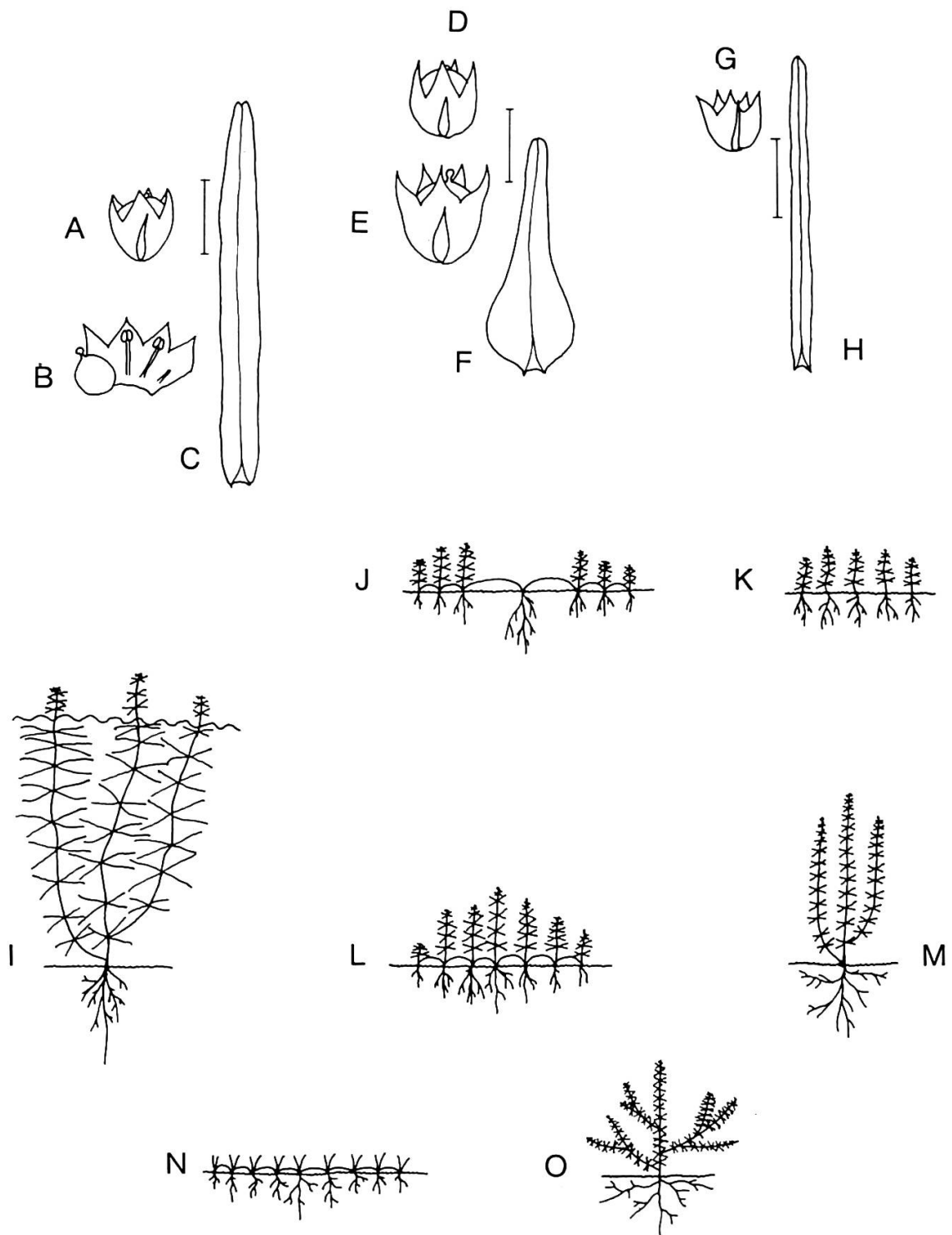


Fig. 4. — *R. mexicana* (A-C, Schiede & Deppe 566; D-F, Spruce 1850; G, H, Boivin 2692); A, flower; B, flower dissection; C, bract (A-C, "*mexicana*" type); D, E, flowers; F, bract ("*spruceana*" type); G, flower; H, bract ("*pusillus*" type); I-O, see text (scale: A-H, 1 mm).

cleistogamous. *Calyx* tube semi-globose, usually 0.5-0.75 mm long, red or pink; calyx lobes 3-5 but usually 4, widely deltate to triangular, 0.25-0.5 mm long; calyx appendages and interjected folds absent. *Petals* absent. *Stamens* 1-4, usually included within calyx tube, but occasionally exerted. *Ovary* globose; style usually very short or rarely up to 0.3 mm long; stigma capitate; capsule globose, 0.5-0.75 mm diam. before dehiscence, red to purple occasionally with white spots, opening by 3 valves; seed semi-ovate, c. 0.3 mm long.

DIAGNOSTIC FEATURES

K(3-)4(-5), P0, A(1-)2(-4), G3; calyx (tube plus lobes) very rarely more than 1 mm long and petals absent. Like *R. capensis* but ovary and capsule globose and opening by 3 valves, not exceeding the calyx and leaves usually whorled.

DISTRIBUTION

R. mexicana is found throughout the warmer parts of the world but is absent from the Congo Basin, N.E. Africa, Arabia and the Pacific Islands (Map 3).

SELECTED SPECIMENS

Mexico: prope Hacienda de la Laguna, Oct., *Schiede & Deppe* 566 (LE, MO); St. Chihuahua, Guerrero, 27 Sept. 1887, *Pringle* 1365 (G, MEL). **Guatemala:** Huehnetenango, Oct. 1876, *Bernoulli & Cario* 2792 (LE). **Panama:** San José Island, c. 89 km S.S.E. Balboa, 22 Dec. 1945, *I. M. Johnson* 830 (MO, U); between Panama and Chepo, Nov. 1934, *Hunter, Steyermark & Allen* 16721 (MO); Prov. Coclé, El Valle de Anton, 500 m, 2 Feb. 1935, *Hunter & Allen* 366 (G). **Cuba:** s. loc. 1860-1864, *Wright* 2543 (G, LE, MO); Prov. Pinar del Rio, Pueblo Nuevo, 8 Oct. 1923, *Ekman* 17556 (G); Prov. Matanzas, Caimito de Hanabana, 8 Aug. 1923, *Ekman* 17015 (G). **Colombia:** Llanos de San Martín, Noca de Monte, Intendencia Meta, 300 m, 16 Aug. 1950, *Galen Smith & Idrobo* 1396 (MO). **Venezuela:** Amazonas, Sanariapo, c. 100 m, 8 Sept. 1944, *Steyermark* 58493 (MO); Estado Bolívar, Cerro Cavilan (Cerro Carichana), 100 m, 21 Dec. 1955, *Wurdack & Monachino* 40910 (G). **Surinam:** Sipaliwini Savanna on Brazilian Border, 260 m, 30 Aug. 1968, *Oldenburger, Norde & Schulz* 38 (U). **Brazil:** Roraima (Rio Branco), R. Surumu, Serra do Mel, Oct. 1909, *Ule* 8254 (G, L, U); Para, Santarem, Aug. 1850 *Spruce* 805 (G, LE, M); Para, Igarapé, Passarao, Aug. 1927, *Luetzelburg* 20762 (M); *ibid.*, Aparecida, Aug. 1927, *Luetzelburg* 20763 (M); Mato Grosso, Nr. Santa Isabel (do Morro), Ilha de Bananal, 25 July 1968, *P. W. Richards* 6313 (U). **Paraguay:** Gran Chaco, Santa Elisa, lat. S. 23°10', April 1903, *Hassler* 2852 (G); Concepción, Rio Apa to Aquidaban, lat. 22-23°, Jan. (pre-1914), *Fiebrig* 5279 (G); Yague, Sept., *Chodat & Vischer* (G). **Argentina:**

Misiones, Pesadas, Bonpland, Almacén Finlandés, 20 Jan. 1908, *Ekman 1926* (ZT); Formosa, Guayculec, July 1917, *Jørgensen 2348* (US), (fide Lourteig, Bol. Soc. Argent. Bot. 5(3): 145, 1954).

Senegal: Richard-Toll, Oct. 1951, *Berhaut 1513* (BR, P); Niokolo-Koba, Hassirik, 21-23 Oct. 1958, *Adam 15722* (P); Niokolo-Koba, Badi, 18 Nov. 1959, *Adam 17067* (P). **Guinea:** Siguri, Sininko, Nov. 1935, *Jaques Félix 521* (P). **Mali:** Saredina, Limons, Sept. 1962, *Demange 1811* (P). **Benin (Dahomy):** Ouécé, Nov. 1910, *Annet 41* (P). **Nigeria:** Nupe, 1858 *Barter 898* (K); Adamawa Div., Vogel Peak, 8°25'-11°50'E., Gurum, 7 Nov. 1957, *Hepper 1252* (K). **Cameroun:** 70 km E.N.E. Maroua, Guirvidig, 10 Oct. 1964, *Letouzey 7248bis* (P); 13 km W.N.W. Yagoua, Gandjam, 1 Jan. 1965, *J. & A. Raynal 12831* (P). **Chad:** (fide Raynal, A., *Adansonia* ser. 2, 7(4): 540, 1967) Doro (?Yoro), 8 Dec. 1964 *Audru 1907* (ALF). **Central African Republic:** Djur, 30 Aug. 1869, *Schweinfurth 2432* (K, MEL, P, Z); Pangula, 26 km S.E. des Moroubas, 20 Oct. 1922, *Tisserant 752* (P). **Angola:** Cuanza Norte, Cacuso, Pungo Adongo, lagoa de Quibinda, March 1857, *Welwitsch 2337* (BM). **Uganda:** ? Serere, Tozo, Dec. 1931, *Chandler 319* (K). **Tanzania:** Kilimanjaro, 27 Aug. 1932, *Geilinger 1097* (Z); Tanga Distr., 6.5 km E.N.E. Korogwe, 300 m, 27 June 1953, *Drummond & Hemsley 3044* (K); Songea Distr., Lumecha Bridge, 4 May 1956, *Milne-Redhead & P. Taylor 9387A* (B, BR); 19 km E. Songea, 22 June 1956, *Milne-Redhead & P. Taylor 10866* (B, BR); 9.5 km S.W. Songea, 24 June 1956, *Milne-Redhead & P. Taylor 10890* (B, BR); Unyanyembe bei Malongwe, 1200 m, 8 Jan. 1926, *Peter 34447* (B); Useguta, Hale, 280 m, 13 Aug. 1918, *Peter 24300* (B). **Mozambique:** (fide Fernandes in Fl. Zambes.) Mutuali, near Malema road, 29 May 1947, *Pedro 3326* (LMA). **Zambia:** Kasama Distr., 105 km E. Kasama, 6 May 1962, *Robinson 5160* (K, M); between Mazabuka and Kaleya, 15 April 1963, *Van Rensburg 1914* (K); Mapanza, 14 March 1954, *Robinson 621* (K); 5 km E. Mapanza, Simansunda, 28 March 1954 *Robinson 651* (K); Masonna dambo, 11 April 1954, *Robinson 863* (K); 9 km W. Pemba, Chepezami Dam, 21 April 1954, *Robinson 706* (K). **Malawi:** Mangochi (Fort Johnson), Ciwalo V., 2 June 1955, *Banda 105* (BM). **Rhodesia (Zimbabwe):** Salisbury, 2 May 1952, *Wild 3812* (K); Matobo, May 1957, *Miller 4355* (K). **South West Africa (Namibia):** Okavangobucht, Niangana, Mid. May 1934, *Dinter 7625* (B). **Republic of South Africa:** Transvaal, Nr. Pretoria, 19 Nov. 1901, *Kirk* (K). **Malagasy Republic:** s.l. *Boivin 2692* (P); delta de la Betsiboka, Maevarano, *Perrier* (P); Tampoketsa, 27 March 1973, *Jaquemin 1300* (P); Tsaraon, Diago, *Bernier* (P). **India.** Rajasthan: Mt. Abu, Oct. 1916, *Blatter & Hallberg 3275, 3276, 3280, 3281* (BLAT), fide Blatter & Hallberg, J. Bombay Nat. Hist. Soc. 25: 704, 1918. Uttar Pradesh: Dehra Dun, Pholhot, c. 600 m, Nov. 1892, *Gamble* (K); Dehra Dun, Lachiwala, 25 Aug. 1927, *Parker* (MEL). Bihar: Chota Nagpur, Parasnath, 17 Nov. 1874, *Clarke 24840* (K); *ibid.*, 18 Nov. 1874, *Clarke 24856A* (K); *ibid.*, *24856B* (LE); *ibid.*, 17 Oct. 1883, *Clarke 33811* (B, G, K, Z); *ibid.*, Chota Nagpur, hazaribagh, c. 700 m, 21 Nov. 1874, *Clarke 24965* (K); Chota Nagpur, Jushpore, Sirgorja 800 m, 5 Nov. 1885, *Clarke 34001* (K). Orissa: Keonjhar, Pipokhri, c. 100 m, 1 Oct. 1946, *Mooney 2760* (K). Andhra

Pradesh: Hyderabad, Osmania University Campus, 400 m, 23 Sept. 1967, *Rajagopal* 352 (K). Karnataka (Mysore): N. Kanara, Kadra, 6 Oct. 1885, *Talbot* 1317 (K). Kerala: Badagara, Madappalli, *Vasudewan* H2830'65 (K); Prov. Kottayam, between Kottayam and Vaikom, 21 Sept. 1973, *Cook, Rix & Schneller* 320 (K, Z); Prov. Quilon, Quilon, ? 1975, *N. Ravi* (Z). Sikkim: Labhath, c. 2500 m, *Ribu & Rhomoo* (fide Blatter & Hallberg l.c.). Assam: Khasi Hills, c. 650 m, *Hooker & Thompson* (K). **Bangla Desh:** between Titilya and Silligoree, Oct. 1868, *S. Kurz* (? CAL, fide Blatter & Hallberg l.c.); perhaps Bangla Desh, N. Bengal, *S. Kurz* (K). **Burma:** Sagaing, Mawlaik (upper Chindwin), Sittaung, Dec. 1907, *Meebold* 7808 (K); Irrawaddi, Pegu, Jan., *S. Kurz* 1967 (? CAL, fide Blatter & Hallberg l.c. p. 703). **Thailand:** Nakhon Sawan, Tak (Wang Djao), 100 m, 14 Oct. 1904, *Hosseus* 122A (M). **China:** Po Hai (Chihli Prov.), T'ien-hing (Tientsin), 1912, *Clemens* 1907 (BR). **Taiwan-Hsinchu:** 21 July 1934, *Shimada* (TAI); Sengari, 25 Sept. 1930, *Isikawa* (TAI). **Korea:** North; Czashigau, Vallis, 28 Aug. 1897, *Komarov*, ? 1128 (K); South, Seoul (Seohl), 11 Sept. 1906, *Faurie* 1178 (KYO); South; Cheju Do (Quelpaert), 22 Sept. 1908, *Taquet* 1461 (KYO). **Japan.** Honshu: Akita, 6 Sept. 1894, *Faurie* 13772 (G, K); Pref. Iwate, Mizusawa-cho, 9 Sept. 1937, *Iwabuchi* 5575 (KYO); Pref. Hyogo, Ichiba-mura, 27 Aug. 1935, *Arakai* 13636 (KYO); Pref. Hyogo, Higami-cho, 16 Aug. 1944, *Hosomi* 9012 (KYO); Pref. Saitama, Kobayashi, Shobu-machi, Minamisaitama-gun, *Makino* 121180 (MAK); Pref. Tokyo, Omiyahachiman, Suginami-ku, *Makino* 121182 (MAK); Pref. Tokyo, Komaba, 12 Oct. 1911, *Onuma* (Z); Yokohama, 1862, *Maximowicz* (K); Pref. Wakayama, Okazaki, Wakayama City, *Makino* 121188 (MAK); Pref. Mino, Gunjogun, 6 Sept. 1925, *Shivta* (KYO); Pref. Tango, Naka-gun, Ikaga-mura, 24 Sept. 1950, *Nakai* 4925 (KYO); Pref. Yamashiro, Kyoto, 5 Sept. 1942, *Nakai* 365 (KYO); Pref. Bungo, *Makino* 121197 (KYO); Kawahara, 6 Oct. 1940, *Hara* N19140 (K); M(N)idumatsuka, 23 Aug. 1890, *Iwakiri & Rikuzen* (K); Chefao, 2 Sept. 1920, *Cowdrey* 924 (K); Suwa-no-Ike, 27 Aug. 1939, *Hara* N73/39 (K); Pref. Tanaba, Yagi-tyo, Funaigun, 7 Sept. 1958, *Murata* 12156 (KYO); Pref. Yamaguchi, Mysonji, 30 Aug. 1939, *Murata* (KYO); Pref. Musashi, 3 Nov. 1893, *Matsuda* (KYO); Pref. Shiznoka, Morokawato, 100 m, 20 Sept. 1959, *Ohmura* 18442 (KYO); Pref. Settsu, Fushia-cho, 6 Aug. 1957, Tamimoto (KYO); Pref. Nagano, 17 Aug. 1913, *Matsuda* (KYO). Kyushu: Pref. Kumamoto, Shinkai, 28 Oct. 1951, *Shimada* 9864 (KYO); Pref. Kagoshima, Airagun, 4 Oct. 1964, *Hatusima & Sako* 28451 (KYO). Shikoku: Pref. Kochi, Kuhokawa-oho, 4 Oct. 1967, *Yamanaka* 51106 (KYO); Pref. Yamato, Katagiri-tyo (Matsuo-yama), 28 Oct. 1956, *Murata* 10472 (KYO). **Philippines-Luzon:** Rizal, Oct. 1914, *Merrill* 9483, (K); Rizal, Montalban, Jan. 1912, *Loher* 12700 (M); Rizal, Caloocan (Calocan), Nov. 1903, *Merrill* 3659 (K); Luzon, *Loher* 2143 (K); Data, Benguet, 2260 m, *Loher* 2142 (K). **Philippines-Mindanao:** March 1904, *Copeland* 430 (K); Davao, 400 m, 26 Aug. 1949, *Edano* 1791 (L). **New Guinea-Irian (Jaya):** Tjendrawasih (Vogelkopp Peninsular), Kebar Valley, 520 m, 16 Oct. 1961, *Van Royen & Sleumer* 6707 (L); Kebar Valley, c. 100 km W. Manokwari, 550 m, 13 Nov. 1954, *Van Royen* 5045 (L). **New Guinea-Papua:**

Morehead River, c. 13 km inland at 141°30'E., 12 Aug. 1967, *Pullen* 7040 (K, L); Daru, 9°05'S.-143°15'E. 8 June 1973, *Henty NGF* 49587 (L); Port Moresby, Boroko, 20 June 1970 *Robbins* 4286 (L); Rubulogo Creek 29 km N. Port Moresby, 11 April 1967, *Pullen* 6668 (L); *ibid.*, *Pullen* 6669 (K, L); Mabaduan, April 1936, *Brass* 6536 (L); Kanosia, 1 March 1935, *Carr* 11557 (L). **Indonesia-Java:** Magelang, Madioen, 350 m, 25 Feb. 1930, *Backer* 36596 (L); Sukamandi, 10 m, 14 Feb. 1974, *Häfliger* (ZT).

Australia. Northern Territory: Port Darwin, March 1870, *Schultz* 318 (K, MEL); Groote Eylandt, Hemple Bay, 1 May 1948, *Specht* 347 (L, MEL, both mixed with *R. occultiflora*); 3 km E. Mt. Todd Battery, 27 Feb. 1965, *Wilson* 361 (K, NSW); Katherine, 16 Feb. 1961, *McKee* 8499 (K, L, NSW); Victoria River, May 1856, *F. v. Müller* (K, MEL); Depot Creek, *F. v. Müller* (K); 10 km N.N.E. Edith River Siding, 10 March 1965, *Lazarides & Adams* 134 (L); Sturts Creek, *F. v. Müller* (K, MEL, NSW); Alice Springs, Morphelt Creek, 9 March 1959, *Chippendale* 5415 (K, NSW); c. 146 km N.N.E. Pine Creek Township, Baroalba Island, 24 March 1965, *Lazarides & Adams* 317 (L); Bickerton Island, 13°45'S.-136°6'E., 7 June 1948, *Specht* 473 (K, L, MEL, NSW). Queensland: New Holland, 1770, *Banks & Solander* (NSW); Cape York Pen., Portland Roads, 10 m, 1 June 1948, *Brass* 18982 (G, K, L, LE); Laura, 22 June 1949, *Roadway* 15135 (NSW); Dimbulah on Petford Road, 500 m, 30 April 1962, *McKee* 9412 (K, L); Atherton, Middle Claudie River, 12°45'S.-143°15'E., 28 June 1972, *Irvine* 291 (L); Cairns, Davies Creek, Lamb Range, 600 m, 4 June 1967, *Brass* 33560 (K, L); Cook Distr., N.W. Cairns, 21 May 1962, *Blake* 21795 (L, NSW); Atherton, Aug. 1901, *Betche* (NSW); Norman-ton, 17°45'S.-140°57'E., 24 April 1974, *Lodd* 1225 (NSW).

NOMENCLATURE

The type specimen of *Rotala decussata* in the De Candolle herbarium at Genève (G-DC) is in accordance with De Candolle's diagnosis in the *Prodromus* 3: 76 (1828). The specimen was collected from the Endeavour River, Queensland, Australia, it is poor but can certainly be assigned to *Rotala mexicana* Cham. & Schlecht., *Linnaea* 5: 567 (1830). Bentham in *Flora Australiensis* 3: 296 (1866) reduced *R. decussata* DC. to a variety of *Ammannia pentandra* Roxb., *Flora Indica* 1: 448 (1820). From Bentham's diagnosis it is apparent that he had not consulted De Candolle's material. On botanical grounds Bentham's move cannot be supported. Hiern in *Oliver, Flora of Tropical Africa* 2: 467 (1871) reinstated *R. decussata* DC. as a species including *A. pentandra* Roxb. as a synonym. This move is, of course, against the nomenclatural rules, concerning priority. Hiern's description is not in accordance with *R. decussata* DC. nor with *A. pentandra* Roxb. but refers to a distinct African species. KOEHNE (1880 and 1903) accepted Hiern's description and cited the species as "*R. decussata* Hiern". This citation was accepted in numerous African floristic works until Exell (*Bol. Soc. Brot. Sér.* 2, 30: 70. 1956) pointed out this nomenclatural nonsense and correctly named

Hiern's species *R. welwitschii*. Exell, however, passed no judgement on the identity of *R. decussata* DC.

Rotala decussata DC. quoad typum is conspecific with *R. mexicana* Cham. & Schlecht., but predates it. In terms of priority *R. decussata* DC. should be accepted in favour of *R. mexicana* Cham. & Schlecht. In Australia since Bentham's Flora (1866) *R. decussata* DC. has been assigned to the *R. pentandra* group and is usually misidentified *R. densiflora* (Roemer & Schultes) Koehne. In Africa, until 1956, the name *R. decussata* has been widely used for *R. welwitschii*. If one accepted *R. decussata* as the correct name for *R. mexicana* this would have the consequence that the epithet "*decussata*" which has been used for two different species, one in Australia and one in Africa would have to replace *R. mexicana* a well known species which, of course, occurs in both continents. Since Bentham (1866), the name *R. decussata* DC. has never been correctly applied. In accordance with Article 69 of the code of nomenclature (1978), the name *Rotala decussata* should be rejected as it has been widely and persistently used for taxa not including its type. I intend to place the name *Rotala decussata* on the list of nomina rejicienda. Should *R. decussata* DC. quoad typum be considered specifically distinct from *R. mexicana* then the name *R. diglossandra* Koehne could be accepted.

VARIATION

R. mexicana is a widespread and very variable species. Not only does it show considerable phenotypic plasticity but there is ample evidence of genecological differentiation. I have cultivated material collected in India (Kerala, Cook, Rix & Schneller 320) at Zürich. From experience with cultured plants, *R. mexicana* is an obligate annual and genetically self-compatible. It is usually autogamous and the high degree of inbreeding may help in understanding the often apparently irrational distribution of minor variants. The variation is described under different headings but without more experimental evidence no attempt is made to recognise the variation in terms of taxonomic categories.

Growth form. — Plants growing in water 10 cm or more deep usually have stems branched below and simple above (Fig. 4I); the submerged leaves are linear, thin, translucent and usually in whorls of 4 but in Australia whorls of up to 8 are found. When submerged plants are stranded on land, the submerged leaves die and numerous erect shoots develop from the tips of the stems. This secondarily terrestrial state is usually turf-forming or caespitose (Fig. 4J). When seeds germinate in shallow water or on wet soil, the form of the plant is usually controlled by the density of the seedlings or competition with other plants. When many *R. mexicana* seeds germinate together without excessive interspecific competition the plants are usually erect and unbranched and are turf-forming (Fig. 4K). When the plants are less dense, the main stem is creeping; in some races it remains creeping (Fig. 4N) and in other

racess the prostrate stem develops numerous simple erect lateral branches (Fig. 4L). Creeping stems usually develop leaves in pairs. In competition with other plants, the main stem is erect with lateral branches; when the main competitors are grass-like plants, the lateral branches are simple and erect (Fig. 4M) and in competition with low growing forbs the lateral branches are spreading and secondarily branched (Fig. 4O).

Some races of *R. mexicana* have stems which remain prostrate and creeping. I have had a creeping race collected in S. India in cultivation at Zürich; irregardless of planting density, underwater or on land it remains prostrate. However, other collections which develop erect stems underwater are indistinguishable from the creeping race when cultivated on wet mud. In S. India I have seen both races growing together. In India this race is frequently called *R. pygmaea*, however, indistinguishable plants have also been seen in S.E. Asia, Africa, and S. America.

Leaves. — The number of leaves at each node varies from 2 to 8. The commonest number is 3. In some plants the number of leaves in each whorl remains constant while in other plants it is variable, for example, plants from North-Australia have been seen (*McKee 9412*) with 8 leaves at the base of the stem grading to paired, decussate leaves above.

Bracts. — The bracts are usually leaf-like but somewhat shorter than normal foliage leaves. Occasionally they are ovate to obspathulate with somewhat inflated bases (Fig. 4F). This kind of bract develops late in ontogeny; the lower (older) bracts are usually leaf-like. Plants with obspathulate bracts are found in South America where they are often given the varietal name "*spruceana*" and Australia where they are often named "*R. diglossandra*".

Bracteoles. — The bracteoles are usually from 0.5 to 0.75 mm long and are equal to or shorter than the calyx tube. In northern Australia, plants are found with bracteoles up to 2 mm long and exceeding the calyx lobes; this race has been named *R. longibracteolata*.

Sepal lobes. — The number of sepal lobes varies from 3 to 5. The commonest number is 4. Some individual plants (for example, the type of *Hypobrichia spruceana*) has 3-, 4- and 5-lobed calyces on the same stem. Some plants from Brazil have exclusively 5 lobes but no plant with exclusively 3 lobes has been seen.

Stamens. — The commonest number of stamens is 2 but flowers with 1 or 3 stamens are often found. This variation may be inter- or intra-plant. One specimen (*Ekman 17015*, from Cuba) has been seen with 4 stamens, however, most of the flowers on this specimen have 3 stamens.

Capsule. — The capsule before dehiscence varies in colour from bright red to dull straw. In America and Australia the capsule often has distinct rows of regularly spaced, white spots. Normally, *R. mexicana* has 3 capsule valves, occasionally one valve does not split thus giving the appearance of 2, unequal

valves. Literature reports of 2-valved plants are probably due to misinterpretation when one valve fails to split or, more often, due to confusion with *R. capensis* which is regularly 2-valved but superficially somewhat similar to *R. mexicana*.

7. ***Rotala occultiflora*** Koehne, Bot. Jahrb. 1: 152. 1880.

— *Rotala braceata* Blatter & Hallberg, nom. in sched.

Type: India, Malabar, Concan, *Laws, Hooker fil. & Thomson* (holotype: K; isotype: L).

lc.: Fig. 5A-I.

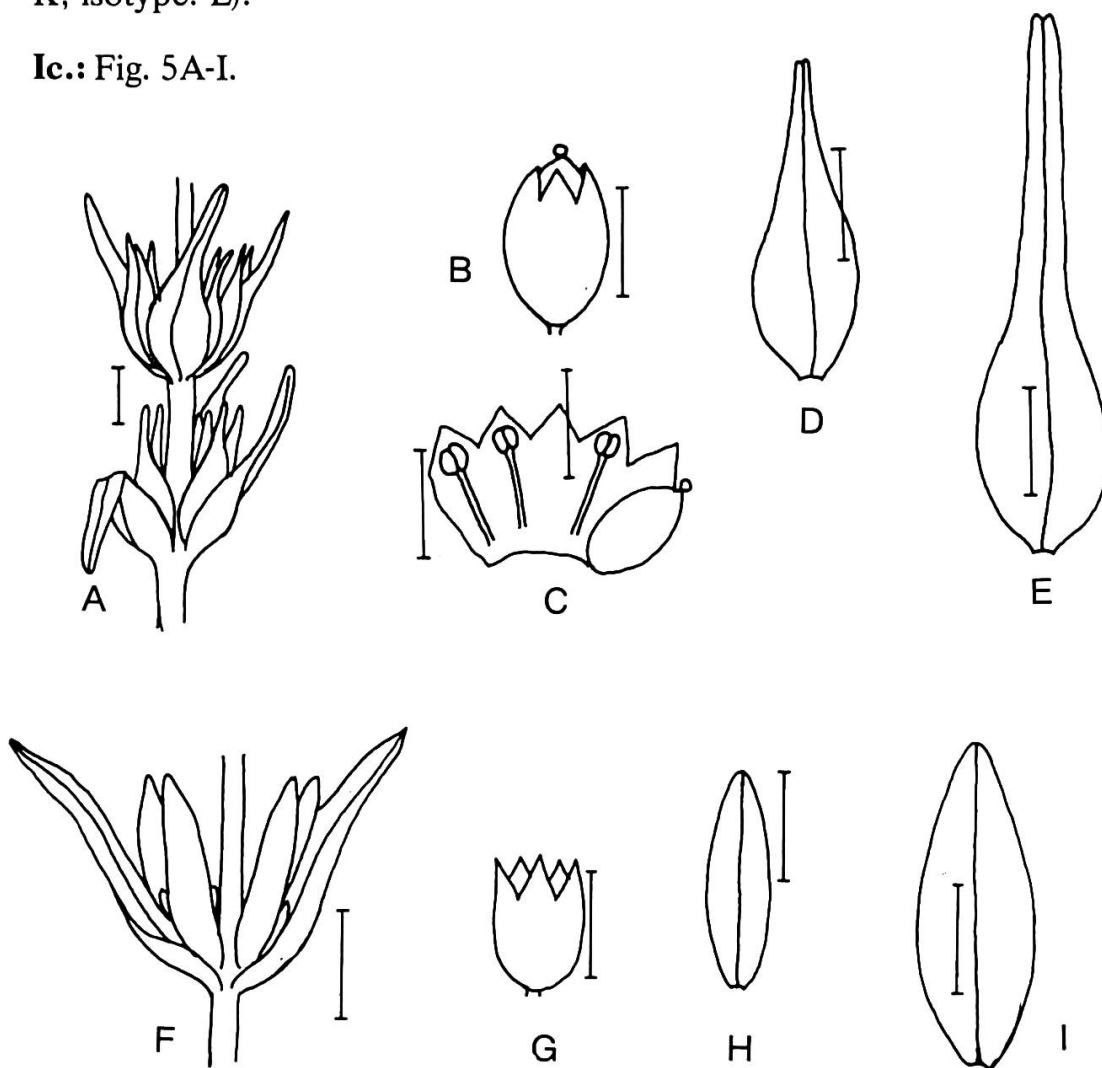


Fig. 5. — *R. occultiflora* (A-E, Sedgwick & Bell 7433, India; F-I, Schodde AE 75, Australia); A, F, flowering whorls; B, G, flowers at anthesis; C, flower dissection; D, H, bracteoles; E, I, bracts (scale: A-I, 1 mm).

Amphibious annual. *Stems* creeping and branching below, erect above, up to 10 cm long. *Leaves* in whorls of 3 or rarely 4 or decussate; submerged leaves linear, up to 12 mm long, usually whorled; aerial leaves linear to ovate, usually less than 10 mm long. *Bracts* leaf-like or obspathulate and at base often boat-shaped and partly enclosing the bracteoles and flower, up to 10 mm long, at apex obtuse to bifid; bracteoles 2, bract-like, ovate to obspathulate and at base often boat-shaped and partly enclosing the flower, at apex truncate to bifid. *Flowers* monomorphic, sessile, solitary, occasionally cleistogamous. *Calyx* tube membranous translucent, sub-urceolate, c. 1 mm long; calyx lobes 5, triangular to deltate, not spreading, up to 0.4 mm long; calyx appendages and interjected folds absent. *Petals* absent. *Stamens* 3, perhaps occasionally more or less, inserted near base of calyx tube; anthers included in calyx tube. *Ovary* ellipsoidal; stigma subsessile, capitate; capsule ellipsoidal, c. 1.5 mm long, somewhat longer than the calyx, opening by 3 valves; seeds semi-ellipsoidal, 0.4-0.5 mm long, usually black.

DIAGNOSTIC FEATURES

K5, P0, A3, G3; bracteoles large, leaf-like, partly enclosing the flower. Like *Rotala mexicana* but capsule ellipsoidal and somewhat longer than the calyx, calyx tube sub-urceolate, transparent and calyx lobes consistently 5 and not spreading at anthesis.

DISTRIBUTION

R. occultiflora is found in the western part of Peninsular India from about 14°N. to 20°N. and in western and northern Australia (Map 9).

SELECTED SPECIMENS

India: Malabar, Concan, *Laws, Hooker fil. & Thomson* (K, L); Nr. Lonav(u)du, Malavli, 650 m, Sept. 1920, *Sedgwick & Bell* 7433 (K); Karnataka (Mysore): N. Kanara, Shirjan, 160 m, Nov. 1929, *Ambo* 6877 (K); N. Kanara, Yellapur (Yellapore), 21 Oct. 1884, *Talbot* 273 (K); *ibid.*, *Talbot* 1332 (K); Shimoga, 760 m, Oct. 1908, *Meebold* 10281 (fide Blatter & Hallberg, J. Bombay Nat. Hist. Soc. 25: 705. 1918); Maharashtra (fide Blatter & Hallberg): Bombay Island, at Sion, *Blatter & Hallberg* 3277 (BLAT); Salsette, between Andheri and Marol, *Blatter & Hallberg* 3303 (BLAT); Igatpuri *Blatter & Hallberg* 3304, 3279 (BLAT); Khandalla, *Blatter & Hallberg* 3278 (BLAT).

Australia. Western Territory: between King Island on Exmouth Gulf, 1916, *Basedow* (NSW). Northern Territory: Port Essington, 1840, *Armstrong* 522 (K); Groote Eylandt, Hemple Bay, 1 May 1948, *Specht* 347 (K, L, MEL, NSW — L and MEL material mixed with *R. mexicana*); Arnhemland, Adelaide River, 27 July 1971, *Balgooy & Byrnes* 1410 (L); Shoalwater Bay, *R. Brown* 4471 (K); Arnhemland, Waterfall Creek, U.D.P. Falls, 150 m, 26 July

1971, *Balgooy & Byrnes* 1389 (L); 30 km N. Katherine, Edith Falls, 14 April 1967, *Adams* 1762 (L, NSW); Herbert River to Carpenteria, *Dittrich* (MEL, NSW — mixed with *R. mexicana*); Nicholson River, 17°15'S.-137°29'E., 11 June 1974, *Henshall* 389 (NSW); Nourlangie Billabong, 8 June 1972, *Schodde* AE75 (K, L).

NOTES

Variation. — Although I have seen less material of *R. occultaflora* than *R. mexicana* the variation spectrum of its vegetative parts closely parallels that of *R. mexicana*. Both species are patristically related and this variation may be considered to be homologous. In India some plants have been seen with obspathulate bracts and bracteoles (*Sedgwick & Bell* 7433, Fig. 5A, D, E) which are not found in Australia. Koehne (Bot. Jahrb. 4: 387. 1883) described a variety (var. *leichhardtii*) for Australian material which cannot be upheld on the basis of the material I have studied.

8. ***Rotala floribunda*** (Wight) Koehne, Verh. Bot. Vereins Prov. Brandenburg 19 (Sitz. 41): 49. 1877 $\equiv$ *Nimmonia* (*Nimmoia* orth. mut.) *floribunda* Wight, Madras J. Lit. Sci. 5: 312, t. 20. 1837 $\equiv$ *Ameletia floribunda* (Wight) Wight in Hooker, Ic. Pl. Ser. 2, 5: t. 826. 1840 $\equiv$ *Ammannia floribunda* (Wight) Clarke in Hooker fil., Fl. Brit. India 2: 567. 1879.

Type: India, Maharashtra, Mahabaleshwar, *Nimmon* (holotype: CAL-MH?; Wight's illustration, loc. cit. is good and may be used as a standard pending examination of the holotype).

Ic.: Fig. 6; Wight, Madras J. Lit. Sci. 5: t. 20. 1837; Hooker, Ic. Pl. Ser. 2, t. 826. 1840.

Amphibious or terrestrial herb. *Stems* often shortly creeping at base, erect above, up to 40 cm tall, reddish, at base angular, terete above and very slender, branched towards apex. *Leaves* sessile, alternate, opposite or in fascicles (on the same plant); submerged leaves linear, up to 50 mm long, up to 2 mm wide, flaccid; aerial leaves linear to lanceolate, rarely more than 5 mm long and 0.5 mm wide, rigid, and somewhat ericoid in appearance, green or tinged, with red, at base cuneate to auriculate and clasping, at apex acute. *Bracts* at base of inflorescence leaf-like, about as long as the flower, at apex of inflorescence bracteole-like, c. 2 mm long; bracteoles 2, linear to lanceolate, relatively thick and green or tinged with red, up to 2 mm long. *Flowers* dimorphic, heterostylous, subsessile or with an up to 1.5 mm long pedicel, in dense, terminal, more or less remote, globose racemes. *Calyx* tube elongate-campanulate, c. 2 mm long, membranous, pale green tinged with pink above, weakly 4-nerved; calyx lobes 4, deltate, c. 0.5 mm long, pink or

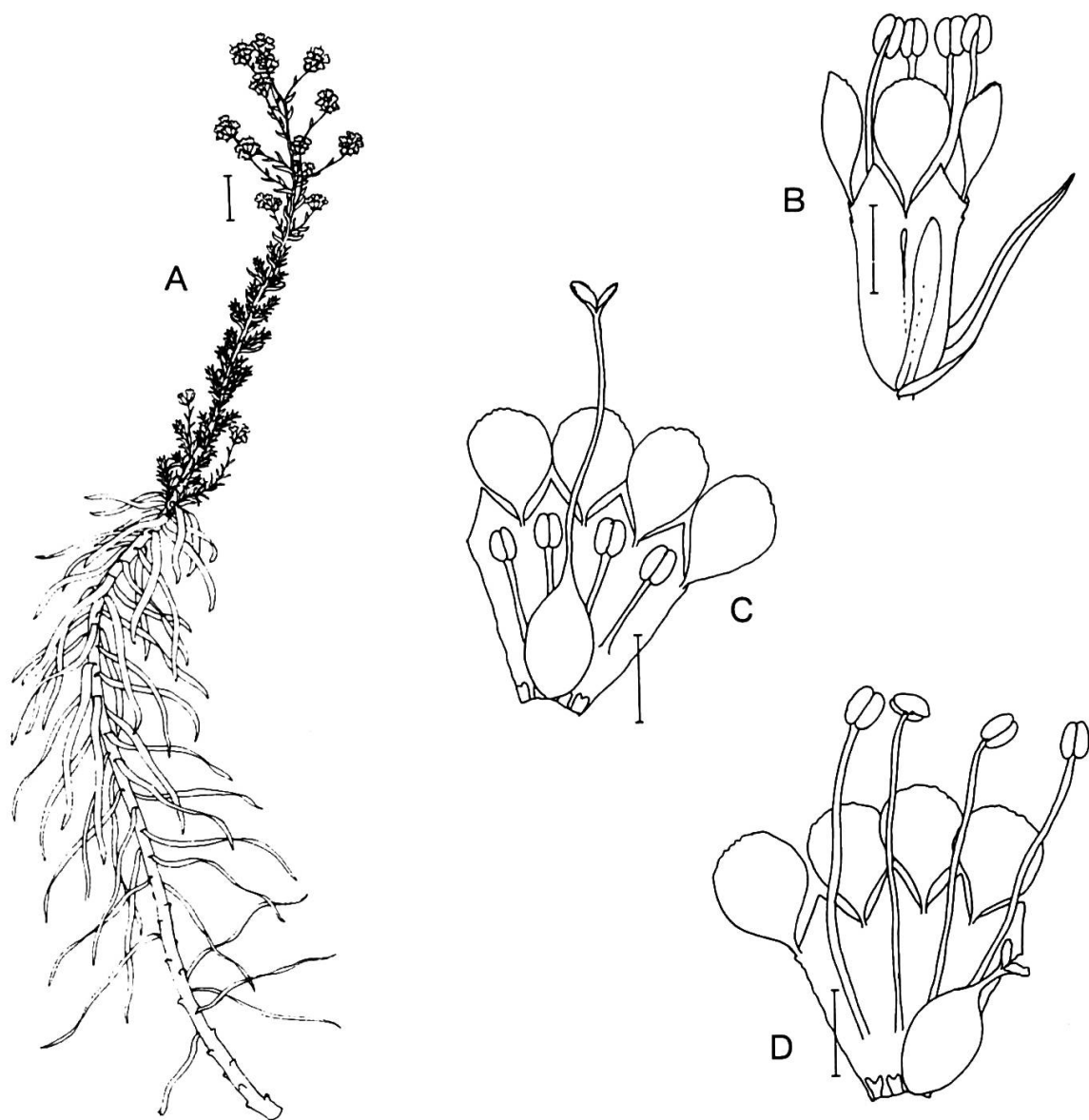


Fig. 6. — *R. floribunda* (Stocks & Law); A, habit; B, "thrum" flower at anthesis; C, "pin" flower dissection; D, "thrum" flower dissection (scale: A, 1 cm; B-D, 1 mm).

rose; calyx appendages and interjected folds absent. *Petals* 4, showy, bright rose, obovate, 1-1.5 mm long. *Stamens* 4, inserted on the lower third of the calyx tube; filaments either c. 1 mm or c. 4 mm long, anthers either included in calyx tube or borne above the petals. *Ovary* ellipsoidal; styles either c. 0.5 mm or c. 3.5 mm long; stigmas deeply 2-lobed, borne either above or below the anthers; capsule ovoid to ellipsoidal, opening by 2 valves; seeds semi-ellipsoidal, c. 0.4 mm long.

DIAGNOSTIC FEATURES

K4, P4, A4, G2; leaves arranged irregularly; aerial leaves ericoid; stigmas deeply 2-lobed; upper bracts remembling bracteoles; distylous.

DISTRIBUTION

India, Maharashtra, local endemic confined to Mahabalaeshwar Hills (Map 4) at an altitude of about 1500 m. It flowers in December and January. It grows in dense patches on rocks and in small rock pools.

SELECTED SPECIMENS

India: Maharashtra, Mahabaleshwar Hills, s.d., *Stocks & Law* (BR, CGE, G, K, L, LE, M); *ibid.*, *Ralf 166* (CGE, K); *ibid.*, 1848, *Hooker* (K); *ibid.*, Dec. 1918, *Sedgwick & Bell 4600* (K); *ibid.*, Dec. 1920, *Sedgwick & Bell 7757* (K); *ibid.*, Jan. 1892, *Cooke* (K); *ibid.*, s.d., *Ritchie* (K); without locality, 1902, *Gibbs* (K); *ibid.*, *Dalzell* (K).

NOTES

An attractive plant locally called Mahableswar heather. It is remarkable for its combination of aquatic and xerophytic characters. It shows relationships on one hand to the widespread Asian species *R. rotundifolia*, and on the other to the Ethiopian species *R. repens*.

9. ***Rotala repens*** (Hochst.) Koehne, Verh. Bot. Vereins Prov. Brandenburg 22 (Sitz. 73): 24. 1880 $\equiv$ *Rhyacophila repens* Hochst., Flora (Regensburg) 24: 659. 1841 $\equiv$ *Quartinia repens* (Hochst.) Endl. ex Walp., Rep. Bot. Syst. 5(4): 673. 1846.

= *Quartina turfosa* A. Richard, Tent. Fl. Abyss. 1: 227. 1847. **Type:** Ethiopia, 1839-1843, *Quartin, Dillon & Petit* (holotype: P; isotype: P).

Type: Ethiopia, distr. Sanna, Docheli, 1 Nov. 1839, *W. Schimper 729* (holotype: ?; isotypes: B, BM, BR, G, L, LE, M, MEL, P, Z, ZT).

lc.: Fig. 7A-C.

Aquatic perennial. (It grows in flowing water and looks as if it may have a rhizome resembling a podostemaceous thallus but I have not seen well collected material of the stem base). *Stems* floating, variously branched, flexible, terete, up to 50 cm long, often denuded of leaves below, reddish. *Leaves* submerged, tinged red, capillary up to 35 mm long, 0.1-0.5 mm wide, irregularly arranged (alternate, opposite or whorled on the same stem),

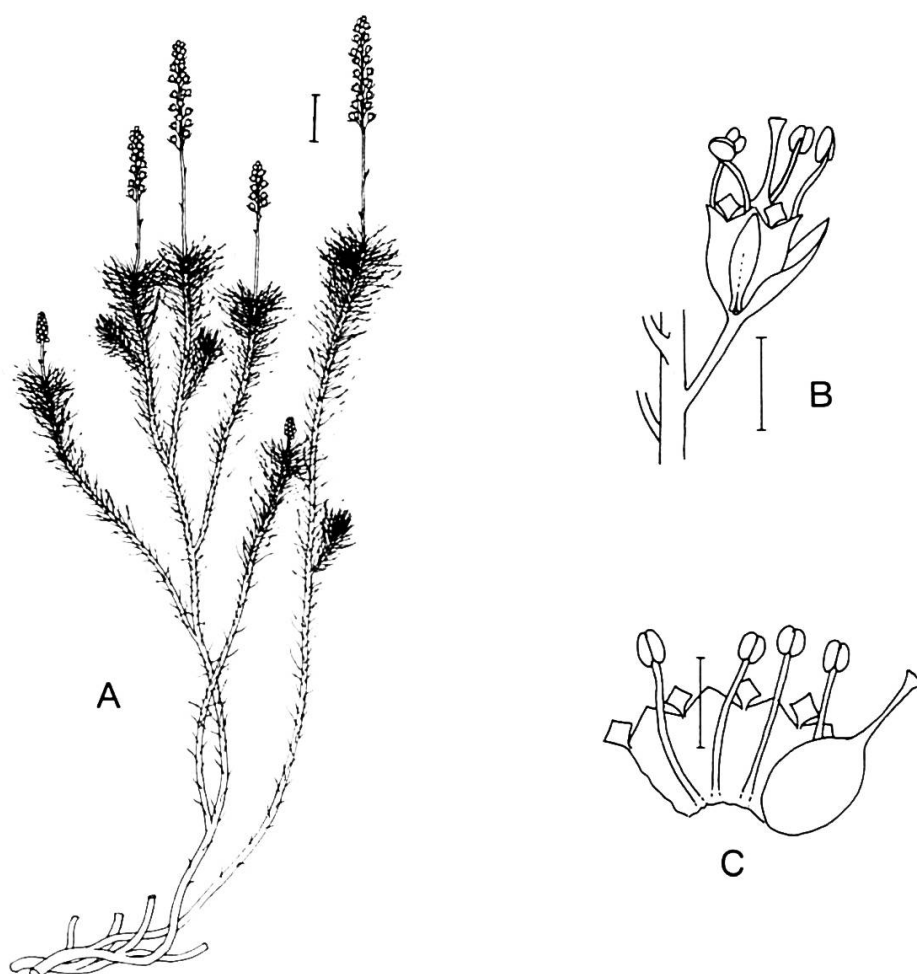


Fig. 7. — *R. repens* (A, Taylor 3412; B, C, Steudner 1165); A, habit; B, flower; C, flower dissection (scale: A, 1 cm; B, C, 1 mm).

numerous, covering the stem above, at apex acute. *Bracts* oblinear to lanceolate, up to 1.75 mm long, borne below the flower on the distal end of the pedicel: bracteoles 2, bract-like, lanceolate, up to 1.5 mm long, on any single flower slightly shorter and narrower than the bract. *Flowers* monomorphic, borne on simple but irregularly branched, emergent, terminal racemes, each flower borne on a c. 2 mm long pedicel. *Calyx* tube membranous, campanulate or cup-shaped, c. 1 mm long; calyx lobes 4, shallowly triangular, c. 0.25 mm long; calyx appendages and interjected folds absent. *Petals* 4, pink or white, rhomboidal, scarcely exceeding the calyx lobes. *Stamens* 4, inserted near base of calyx tube; filaments c. 1.5 mm long; anthers borne above the petals. *Ovary* ellipsoidal to ovoid; style up to 1 mm long; stigma obconical, borne level with the anthers; capsule ovoid, c. 1.5 mm long, opening by 2 valves; seeds semi-ellipsoidal, c. 0.5 mm long.

DIAGNOSTIC FEATURES

K4, P4, A4, G2; leaves irregularly arranged, developing only submerged in water, petals rhomboidial; bracts like bracteoles, borne on the distal end of the pedicel. Like *R. floribunda* but lacks ericoid, aerial leaves, flowers monomorphic with long style and stamens.

DISTRIBUTION

R. repens is found in flowing water in the Ethiopian highlands and on Mount Elgon (Map 2). From the somewhat limited information it is found at an altitude of 1300 m to 2200 m.

SELECTED SPECIMENS

Ethiopia: s. loc., *Schimper* 33 (BR, G, LE, P, ZT); Schire (Chire), *Quartin, Dillon & Petit* (P); Gondar, 23 Jan. 1862, *Steudner* 1165 (LE, Z); Ifag, c. 2000 m, 18 Oct. 1863, *Schimper* 1380 (BM, Z); Docheli, Sanna, 1 Nov. 1839, *Schimper* 729 (B, BM, BR, G, L, LE, M, MEL, P, Z, ZT); Lac Tana, Zeghie, 19 Feb. 1937, *Pichi-Sermolli* 262 (BR); Tana, Isola Dek, 22 Feb. 1937, *Pichi-Sermolli* 263 (MO); Lac Tana, May 1909, *Rousseau* (L, MO); Abai, 17 March 1881, *Stecker* (L, MO); Kurudelungu, July 1939, *coll. illeg.* (BR). **Uganda:** Prov. Bugisu, Mt. Elgon, Sipi, 2160 m, Sept. 1934, *Synge* 51161 (BM); Mt. Elgon, Greek River, 1300 m, Jan. 1936, *Eggeling* 2496 (BR). **Kenya:** Trans Nzoia Distr., River Swan, Karamoja drift, 1660 m, 18 Feb. 1935, *G. Taylor* 3412 (BM, MO).

10. *Rotala hexandra* Wallich ex Koehne, Bot. Jahrb. 1: 167. 1880 $\equiv$ *Amman-nia hexandra* Wallich, Cat. No. 2103, nom nud.

= *Rotala kainantensis* Masamune, Trans. Nat. Hist. Soc. Taiwan 33: 251. 1943. **Type:** China, Kwangtung, Hainan Tao (Kainanto), Ryosui, 1940, *Masamune & Fukuyama* 503 (holotype: TAI n.v.).

— *Rotala stipulata* Blatter & Hallberg, J. Bombay Nat. Hist. Soc. 25: 710. 1918, nom. invalid., based on the type of *R. hexandra*.

Type: Burma, Seguen in Ava, *Wallich* 2103 (holotype: K-W; isotypes G, K, LE).

lc.: Fig. 8A-D.

Amphibious annual or perhaps perennial. *Stems* creeping and rooting below, erect above, up to 40 cm tall, sharply 4-angled to 4-winged. *Leaves* decussate, sessile, lanceolate to oblong, 1-3 cm long, at apex obtuse;

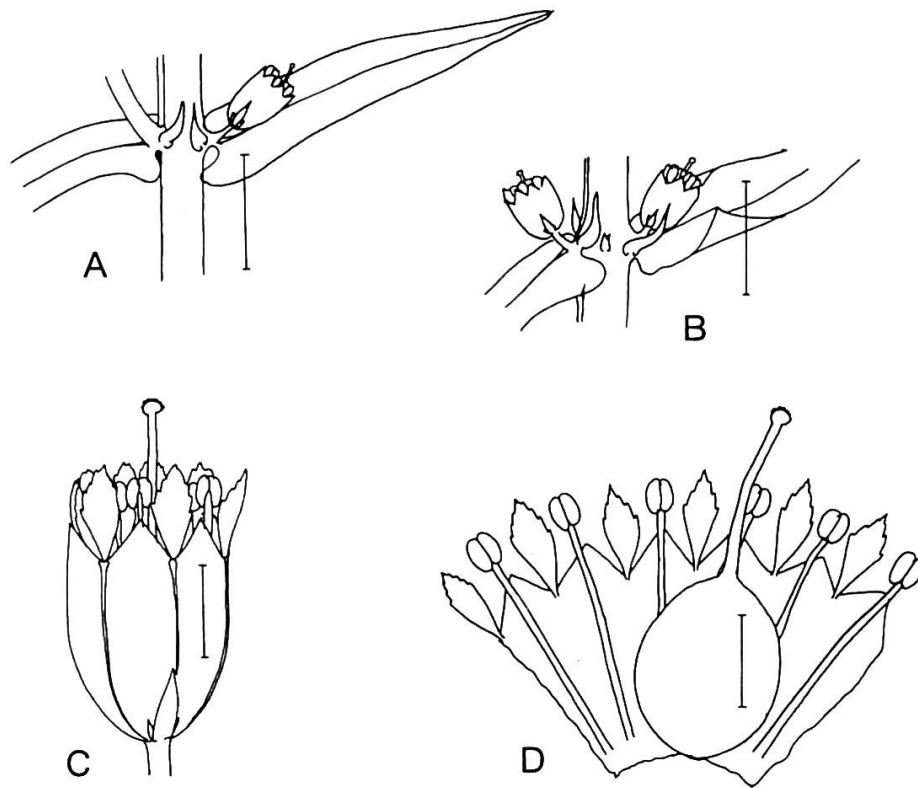


Fig. 8. — *R. hexandra* (Wallich 2103); **A, B**, flowering nodes; **C**, flower; **D**, flower dissection (scale: **A, B**, 5 mm; **C, D**, 1 mm).

submerged or lower leaves cuneate to cordate at base; aerial or upper leaves cordate to auriculate at base; stipule-like outgrowths situated on the nodes near the leaf bases present, subulate, up to 2 mm long, caducous, not to be confused with bracteoles; similar but smaller structures occasionally found on the nodes between the leaf pairs. *Bracts* leaf-like, usually enclosing young flowers, at base usually auriculate, associated stipule-like outgrowths present; bracteoles scarious, linear, not more than 1 mm long; a second pair of microscopically small bracteoles often present in axils of normal bracteoles. *Flowers* monomorphic (?), solitary, shortly pedicellate, often cleistogamous and borne underwater. *Calyx* tube campanulate, c. 2 mm long, with distinct nerves between the calyx lobes; calyx lobes 6, shallowly triangular, c. 0.5 mm long; calyx appendages absent. *Petals* 6, obovate to oblanceolate, c. 1 mm long, usually somewhat erose at margin. *Stamens* 6; filaments attached near base of calyx tube, appearing almost free; anthers exerted. *Ovary* globose, 4-locular; style exerted, c. 2 mm long, persistent; stigma capitate; capsule subglobose, c. 2.5 mm long, apparently breaking up at maturity (characteristic *Rotala* stripes present); seeds semipyriform, 0.6-1.0 mm long.

DIAGNOSTIC FEATURES

K6, P6, A6, G4; stipule-like outgrowths; minute bracteole pairs in axils of normal bracteoles; flowers 6-merous; capsule breaks into pieces at maturity.

DISTRIBUTION

Burma, China-Hainan Tao, Philippines and Java; flowering time from July to December (Map 4).

SELECTED SPECIMENS

Burma: Sagaing (Segaen), Ava, 4 Nov. 1826, *Wallich 2103* (G, K, K-W, LE); Moulmein, 1859, *Parish 216* (K). **China:** Kawangtung, Hainan Tao (Kainanto), Ryosui, 1940, *Masamune & Fukuyama 503* (TAI n.v.). **Philippines:** Luzon Centr., San Fransisco del Monta, 8 Dec. 1893, *Loher 2154* (K, M). **Indonesia, Java:** Bogor (Buitenzorg), Tegal Sapi, 30 July 1922, *Bakhuizen van den Brink 1519* (U); cultivated in Bogor Botanic Garden, 22 April 1927, *Schröter* (ZT).

NOTES

I have not yet seen a really complete, well preserved specimen of this species. It is not certain if it is perennial or annual. The capsule has no obvious valves and appears to break up at maturity, I have sectioned a young capsule and seen 4 locules; the characteristic transverse stripes of *Rotala* are visible on the capsule wall. A pair of small bracteoles are present in the axils of some bracteoles which may be an indication that the solitary flower of *Rotala* is derived from a cymose inflorescence like that found in most other genera of the *Lythraceae*. The small stipule-like outgrowths around the nodes are characteristic for this species but unique in *Rotala* and all other *Lythraceae* that I have examined.

- 11. *Rotala rotundifolia*** (Buch.-Ham. ex Roxb.) Koehne, Bot. Jahrb. 1: 175. 1880 $\equiv$ *Ammannia rotundifolia* Buch.-Ham. ex Roxb., Fl. Ind. ed. 1, 1: 446. 1820 $\equiv$ *Ameletia rotundifolia* (Buch.-Ham. ex Roxb.) Dalz. & Gibson, Bombay Fl. 96. 1861, non Wight, Ic. Pl. Ind. Or. 1: t. 258. 1840.
 $\equiv$ *Ammannia subspicata* Benth in Hooker, London J. Bot. 1: 484. 1842 $\equiv$ *Ameletia subspicata* (Benth) Benth in Hooker, Bot. Kew Gard. Miscell. 4: 81. 1852. **Type:** Hong Kong, 1841, *Hinds* (holotype: K, isotype: LE).
 — *Ammannia orbiculata* Heyne, nom. in sched.

Type: India, "plants sent from Lukshmeepora and Malda where they are indigenous, flowered in (Calcutta) botanic garden during the cold season

1797"; holotype: ? CAL; Roxburgh, Fl. Ind. Plate No. 1344 in K is an accurate illustration and may be used as a standard pending discovery of the holotype.

Ic.: Fig. 9A-D.

Special literature: Vos, O. C. de, The anatomy of the shoot apex of *Rotala rotundifolia* (Roxb.) Koehne (Lythraceae). Acta Bot. Neerl. 23(1): 7-18. 1974 — the material used in this study could be *R. macrandra*.

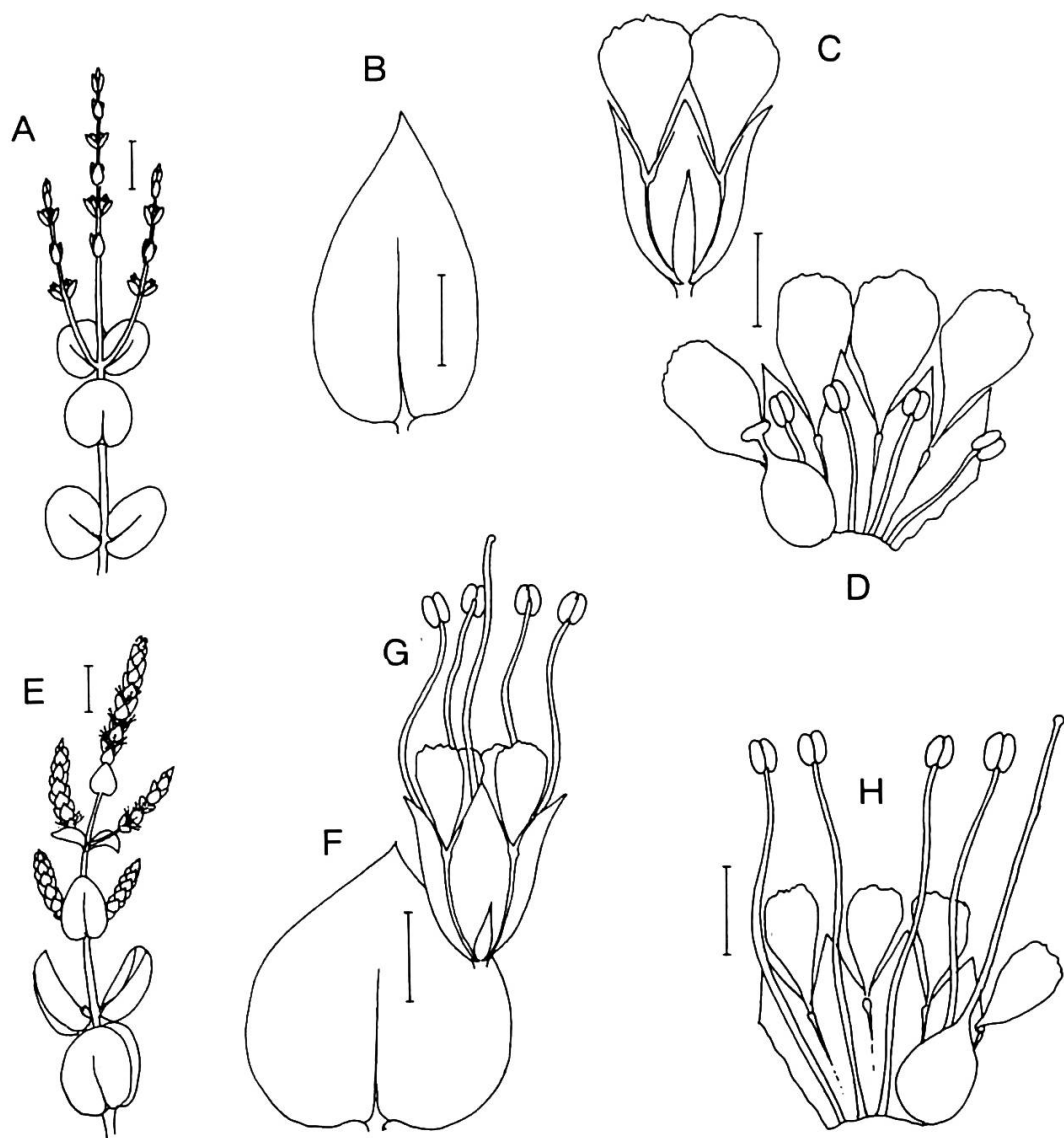


Fig. 9. — *R. rotundifolia* (Onuma 19082); A, habit; B, bract; C, flower; D, floral dissection. *R. macrandra* (Meebold 10284); E, habit; F, bract; G, flower; H, flower dissection (scale: A, E, 1 cm; B-D, F-H, 1 mm).

Amphibious perennial or perhaps occasionally annual. *Stems* branched and often somewhat woody below, creeping or floating, up to 40 cm or more long, usually simple and 4- or occasionally 6-angled above. *Leaves* decussate or occasionally in whorls of 3, sessile or shortly petiolate, variable in form and colour; submerged leaves linear to orbicular, up to 2 cm long, green, grey or red or grey-green on adaxial surface and red or purple on abaxial surface; aerial leaves obovate to orbicular, up to 2 cm long and 2.5 cm wide, green or occasionally red on abaxial surface; leaf nerves distinct, pinnate, green, white or red. *Bracts* ovate, 1-4 mm long, usually longer than wide; bracteoles c. 1 mm long, about equal to calyx tube in length, linear to lanceolate, scarious. *Flowers* monomorphic, subsessile, solitary in axils of bracts; inflorescence distinct, a many-flowered, usually pedunculate raceme, dense at early anthesis, elongate, lax (stem visible between nodes) in fruit. *Calyx* tube campanulate c. 1 mm long, membranous, green tinged with pink, with 4 rib-like nerves; calyx lobes triangular, up to 1 mm long, green or pink; calyx appendages and interjected folds absent. *Petals* 4, obovate, 2 to 3 times as long as calyx lobes, bright rose. *Stamens* 4, filaments inserted near base of calyx tube, c. 1.5 mm long; anthers level with middle of calyx lobes. *Ovary* globose; style up to 0.5 mm long; stigma peltate, discoid, relatively massive, about 0.3 mm diam., level with anthers; capsule globose, c. 1.5 mm diam., opening by 4 valves; seeds semi-ellipsoidal, c. 0.5 mm long.

DIAGNOSTIC FEATURES

K4, P4, A4, G4; like *R. macrandra* but bracteoles about as long as calyx tube, filaments c. 1.5 mm long, anthers borne level with the calyx lobes, style not more than 0.5 mm long, stigma relatively massive and about 0.3 mm diam., inflorescence somewhat lax in fruit.

DISTRIBUTION

South and Southeast Asia from India to Japan (Map 5), mostly in mountainous regions, growing up to 2650 m in China. Flowering specimens have been collected throughout the year but the majority have been collected from January to April. For further ecological information see *Rotala macrandra* p. 56.

SELECTED SPECIMENS

Pakistan or India — exact locality uncertain: Punjab, *Thompson* (CGE, G, K, L, M); N.W. India, *Royle* (K); N.W. India, 1844, *Edgeworth* (K). **India:** Karnataka (Mysore): Belgaum, Ghale, Feb., *Richie 1069* (K); Belgaum, Dharwar, March 1919, *Sedgwick & Bell 5512* (K); Hassan Distr., 15 Jan. 1969, *Saldanha 12215* (MO); *ibid.*, 24 March 1969, *Saldanha 13112* (MO); *ibid.*, 6 Feb. 1970, *Saldanha 16271* (MO); *ibid.*, 13 March 1970, *Saldanha 16601* (MO); Hassan Distr., Habalu, 1000-1200 m, 23 Feb. 1973, *Bogner 510* (M); S.

Kanara, Mercara, Feb., *Hohenacker* 560 (G, K, LE, M, U, Z). Kerala: Wynad, 1816, *Rottler* (K); S. Wynad, Naddikarna, 14 Jan. 1903, *Barber* 5623 (K). Tamil Nadu: Nilgiri Hills, 1837-1838, *Perrottet* 359 (K); *ibid.*, *Perrottet* 360 (K); *ibid.*, *Perrottet* (G); *ibid.*, *Wight* 75 (CGE, G); *ibid.*, *Wight* (M); *ibid.*, 1851, *Hohenacker* 1144 (K, L, LE, M, U, ZT); *ibid.*, *Hohenacker* 1145 (G, LE, M); *ibid.*, 1823, *Leschenault* 52 (G); *ibid.*, *Thompson* (CGE, K, M); *ibid.*, *Schmidt* (K); *ibid.*, *Foulkes* (K); *ibid.*, *Gardner* (K); *ibid.*, *Adam* (K); *ibid.*, *Preston* (K); *ibid.*, Coonoor, 1600 m, May 1883, *Gamble* 11640 (K); *ibid.*, 2000 m, Oct. 1883, *Gamble* 13099 (K); *ibid.*, 11 July 1896, *Bourne* (K); Nilgiri Hills, Arawly, 2400 m, Nov. 1884, *Gamble* 15697 (K); Nilgiri Hills, Pykara, 22 May 1900, *Bourne* (K); Nilgiri Hills, Octocamund, Rees Swamp, 11 July 1904, *Bourne* 4607 (K); Octocamund, The Downs, 27 July 1904, *Bourne* 4650 (K); *ibid.*, 18 Sept. 1908, *Bourne* 5210 (K); Baudy Shola, 2200 m, 8 April 1916, *Fischer* (K); Moyar River, 10 Feb. 1963, *Subramanian* 88 (L); Madurai Distr., Kodaikanal, 2300 m, Dec., *Anglade* 742 (G); *ibid.*, 26 June 1913, *Sauliere* 34 (K); *ibid.*, 31 May 1926 or 5 May 1928, *Bembower* 159 (MO); Pulney Hills, c. 2300 m, 18 Aug. 1911, *Fischer* 2863 (K); Pondicherry, *Perrottet* (K). Andhra Pradesh: Vishakhapatnam (Vizagapatnam), Madgoe Hills, Endrika, c. 1700 m, 27 May 1914, *Lushington* (K). Orissa: Bonaigarh (Bonai State), Koira, 1700 m, 26 Feb. 1946, *Mooney* 2631 (K). Bihar: Singhbhum, Tirilpori, April 1903, *Haines* 669 (K); Ranchi, Ghotama Fall, 16 April 1960, Kangi, *Murata & Tuyama* (KYO). Punjab: Gurdaspur, 3 March 1917, *Stewart* 1358 (K). Uttar Pradesh: Baijnath, Kangra, 1000 m, 19 May 1933, *Koelz* 4587 (MO); Kumaun, Champawat, 1650 m, 7 May 1961, *Bhallacharyya* 14906 (L); Kumaun, Almora, 1700 m, *Strachey & Winterbottom* 1 (K); Kumaun, Bhim, 1500 m, 11 June 1885, *Duthie* 4021 (BR, LE); Kumaun (Kumoon), 1832, *Wallich* 2095/5 (G); Mussoorie, Tons, Valley, 1000 m, *Duthie* 5/91 (K, LE); Dehra Dun, *Gamble* 26513 (K); Dehra Dun, Suarua Thab, 1000 m, *Schäfer* (M); Tehri Garhwal, Parolha, *Gamble* 24402 (K); Tehri Distr., Jhadyar, 1000 m, May 1891, *Gamble* 23029 (K); Bahraich, 7 March 1900, *Juayat* 23649 (G); Bahraich (Oudh), 1825, *Wallich* 2095C (LE, M). Assam: s. loc., *Jenkins* (CGE); *ibid.*, *Masters* (M, Z); *ibid.*, *Simons* (L, LE, M); 1845, *Griffith, Lemann* (K); Khasi and Jainta Hills, *Griffith* (CGE); *ibid.*, 1000 m, 1878, *Gallatly* 72 (M); Nongpoh, 3 April 1886, *Clarke* 4329B (LE); *ibid.*, 750 m, 26 Feb. 1943, *Bor* 16999 (L); Umrang, 1300 m, 10 April 1949, *Koelz* 22486 (L); Sonapahar, 1200 m, 4 March 1952, *Thakur Rup Chand* 5277 (L); *ibid.*, 11 March 1952, *Thakur Rup Chand* 5296 (L); Mawphang, 2000 m, 18 March 1954, *Thakur Rup Chand* 7397 (L); Shillong, 1400 m, 21 Jan. 1943, *Bor* 16988 (L); Dalgaen, April 1902, *Chatterjee* (BR, G, L, LE, M, NSW, U); Sibsagar, Dumar Dullong, April 1895, *Coll. ?* 10495 (M); Assam Valley, Akha Hills, March 1890, *Badul Khan* 152 (Z); Lakhimpur Distr., Talap, 24 March 1894, *Gammie* 159 (Z); Jaboea, Nage Hill, Feb. 1899, *Prain* 735 (U); Shilley, 22 March 1892, *Prain* 70 (NSW). Sikkim: Sikkim, 1 Feb. 1867, *Anderson* (L). Manipur: Manipur, c. 1000 m, 4 Feb., *Watt* 5835 (G); Khong Valley, Nong Shong, 1300 m, 6 April 1882, *Watt* 6297 (Z); Ranglatongbi, 1200 m, 28 Feb. 1946, *Bullock* 963 (L). **India**, without exact locality or locality not found:

Wight 977 (L, LE, M, sheets in L and LE mixed with *R. macrandra*); ? 1836, Wight 1028 (BR, CGE, G, K, LE); *Stocks & Law* (G); *Wallich 2095/G* (CGE); Bengal, *Hooker & Thompson* (CGE, G, K, L, LE, M, U); Risekoond, 1820, *Wallich 2095/L* (G, LE); Devarage, 600 m, March 1919, *Sedgwick & Bell 5466* (K); Changbhakar, Bhumka, 30 March 1938, *Mooney 751* (K); Kawardha, Chilpi, 800 m, 29 Feb. 1940, *Mooney 1269* (K); Hawalbaugh, 11 June 1846, *Fischer* (LE). **Bangla Desh:** Sylhet (Sillet), *Wallich 2095/4* or *2095/D* (CGE, G, K-W, L, LE, M); ? Bangla Desh, East Bengal, *Griffith 2312* (CGE, G, L, LE). **Nepal:** Jiri, 12 June 1963, *Numata 1311* (KYO); Namudu, 18 June 1963, *Numata 1623* (KYO); Katmandu, Tapley, 1400 m, April 1953, *Nakao* (KYO); Katmandu, Sundarijar, 1500 m, 13 Feb. 1969, *Kanai 45* (KYO); Sangu-Koprang, 340 m, 11 Jan. 1970, *Kanai 670617* (KYO); Pachkhal, 19 April ? 1963, *Numata 159, 166 et 176* (KYO); Dumrie, 21 April 1963, *Numata 243* (KYO); Ralmaling, Banepa, 1400 m, 19 April 1963, *Yoda* (KYO); S.W. Mt. Everest, 2000 m, March 1965, *Noordyk* (L). **Burma:** S. Shan State, Taungyi, 1894, *Abdul Khali* (G); Bhamo Distr. Kaihtaik, 1450 m, 8 Jan. 1958, *McKee 6019* (NSW); Hsenwi (Hseniui), 18 April 1905, *Wehrli* (G, Z); Bhamo, 24 Jan. 1905, *Wehrli* (G, Z); Myitkyna, Indaw, 20 March 1905, *Wehrli* (G, Z); Kentung, Loi Mwe, 1700 m, March 1938, *Dickason 9116* (L). **Thailand:** Chiang Mai, Doi Sutep, 750 m, 29 Dec. 1904, *Hosseus 273* (G, K, L, M); *ibid.*, 1050 m, 14 March 1905, *Hosseus 491* (K, M), *491A* (M), *491B* (M); *ibid.*, 14 April 1958, *Sørensen, Larsen & Hansen 2726* (K, L); Bo Luang-Om Koi, 1000 m, 19 Jan. 1964, *Hansen, Seidenfaden & Smitinand 10972* (L); East of Fang, 28 Feb. 1958, *Sørensen, Larsen & Hansen 1791* (K); N. Chiang Mai, Pha Maun, 1200 m, 18 April 1960, *Smitinand & Alsterlund 6713* (K); Chiang Mai, Boluang, 18°45'N.-98°25'E., 1100 m, 13 June 1973, *Geesink, Phanichapol & Santisuk 5916* (L); *ibid.*, 1000 m, 13 June 1968, *Beusekom & Phengkhlai 1209* (L); Doi Inthanon, 19°30'N.-98°30'E., 1200 m, 20 Jan. 1969, *Nooteboom 788* (L); Doi Angka, 1260 m, 1 Jan. 1936, *Garrett 1033* (K, L); Ban Kwang Hê, between Mê Rim and Sămông, 1100 m, 2 Feb. 1913, *Kerr 2909* (K). **Laos:** Borikhane, Wiengchan, 200 m, 28 March 1932, *Kerr 20775* (K, L); Sémon, *Marmand 1129* (K). **Vietnam:** Tonkin Region: En Phap, 31 March 1887, *Balansa 3121* (G, K, L, LE); Dong Dang, 27 Jan. 1886, *Balansa 1401* (K); Prov. Thai-Nguyen, Don Du, *Eberhardt 3943* (K); Quong Jon, Dec. 1908, *Alleizette* (L); Hanoi, June 1908, *Alleizette* (L). **China:** Yunnan: s. loc., *Forrest 7172* (K); *ibid.*, *Delavey* (K); Lang-ngu-tsin, 1904, *Ducloux 2677* (G, Z); Yungbei, Dawan, 2650 m, 2 July 1914, *Handel-Mazzetti 3390* (M); Houang-ts'ao-pa, 1918, *Cavalerie 8069* (K); Mengbi, c. 1600 m, *Henry 9355* (K); Tengyueh, 2000 m, May 1912, *Forrest 7716* (K); *ibid.*, March 1923, *Rock 8046* (K). Szechuan: Pei-pah, 24 April 1946, *Law 496* (K). Kweichow: Twyun, Yun-fou-shan, 730 m, 19 July 1930, *Tsiang 5933* (G); Kweichow, Tungtzu, 400 m, 20 May 1930, *Tsiang 4978* (K, M). Hunan: Yi Chang Distr., P'ing T'ou Shan, T'ang Wan, 17-30 April 1934, *Tsang 23673* (G, NSW). Kwangsi: Loh Hoh Tsuen, Ling Yün Hsien, 1150 m, 12 March 1933, *Steward & Cheo 176* (G). Kwangtung: Kuang Chou (Canton), 1870, *Hillebrand* (G); *ibid.*, 1 March 1884, *Sampson* (K); *ibid.*, 10 Feb. 1917, *Levine 385* (MO); Tsin Leong San,

850 m, June 1936, *Gressitt 1254* (G, MO); *ibid.*, 840 m, June 1936, *Gressitt 1245* (G, MO, Z); Naam Kwan Shah, 3 April 1932, *Tsang 20074* (K, KYO); Peihai, April 1884, *Playfair 47* (K); Liang-Yong, 29 Jan. 1935, *Whiting & Stewart 189* (K); Honam Island, 21 May 1917, *Levine 789* (MO); Wai-yeung Distr., Pak-wan Cheung, March 1932, *Tsui 101* (K, KYO, MO). Kwangtung-Hainan Tao: Toam Chan-Lam Ko Distr., Lin Fa Shan, 24 April 1928, *Tsang Wai-Tak 16768* (G, K, MO); Hainan, 8 Jan. 1934, *Wang 36196* (G, M); T'a Hon, 21 April 1922, *Mc Clure 9223* (K, MO); Ching Mai Distr., Pak Shik Ling, 18 March 1933, *Lei 453* (K, KYO); Lam Ko Distr., Lin Fa Shan, July-August 1927, *Tsang Wai-Tak 243* (K). Kiangsi: Lu-Ling-Hsien, 400 m, *s. coll.* (K); Pinghsiang, 600 m, 1920, *Wang Te Hui 175* (Z). Fukien: Baek-liang, 500 m, 26 April 1926, *Metcalf 3460* (G, M, MO, Z); Changchow, 27 March 1923, *Chung 1176* (K); *ibid.*, *Faber 794* (K); Hsia-men (Amoy), 22 April 1923, *Chung 1456* (K); Fu-chow, 3 May 1928, *Tang Sin Ging 7625* (NSW); *ibid.*, 1897, *Charles 582* (K); Shan-tou (Swatow), *Perry* (K). Chekiang: Chekiang, *Hickin* (K). Shantung: Chefoo Mts., *Faber 305* (K). **Manchuria:** Fukushima, *Makino 121214* (MAK), locality not found. **Hong-Kong:** *s. loc.*, *Champion 99* (K); *ibid.*, *Hinds* (K, LE); *ibid.*, 1861 *Urquhart 157* (K); *ibid.*, 1853-56, *Wright 164* (K, L); *ibid.*, May 1862, *Tate* (K); *ibid.*, 1845, *Fortune* (M); Lantau Island, Silver Mine Bay, 20 Feb. 1969, *Shiu Ying Hu 6692A* (K). **Taiwan:** *s. loc.*, *Henry 1788* (MO); *ibid.*, 1862, *Swinhoe* (K); *ibid.*, pre-1912, *Price* (K). Taipai Prov.: Taipai, 20 March 1968, *Hsu 4330* (KYO); *ibid.*, 23 Feb. 1929, *Yamamoto & Suzuki* (TAI); *ibid.*, 16 April 1961, *Liu or Lin* (MEL, MO); *ibid.*, 2 April 1969, *Hsu 5246* (KYO); Nesuangchich, 11 Feb. 1973, *Kuo 2939* (TAI); Hsientien, 23 March 1974, *Kuo 4675* (TAI); Taikoku, 20 Jan. 1932, *Kitamura* (KYO); *ibid.*, 12 April 1916, *Ito* (KYO); *ibid.*, 21 March 1933, *Ohmi 88* (KYO). Nantou Prov.: Sun Moon Lake, 2 Aug. 1971, *Kao 5656* (TAI). Shinten Prov.: Taihoku-shu, 27 April 1932, *Tanaka & Shimada 10980* (BR, G, L, M, MEL, MO, TAI, Z). **Japan.** Kyushu: Higo, 10 May 1912, *Tashiro* (KYO); Kumamoto, June 1899, *Faurie 3736* (G); *ibid.*, *Makino 121201* (MAK); *ibid.*, *Makino 121209* (MAK). Hondo City, *Makino 121202* (MAK); *ibid.*, *Makino 121205* (MAK); Kiyama, 15 June 1962, *Kuranari* (K); Nagasaki, 1863, *Maximowicz* (BR, K, L). Honshu: Tokyo Pref., Yoyagi, 7 July 1908, *Kohei Onuma 19082* (Z).

12. *Rotala macrandra* Koehne, Bot. Jahrb. 1: 176. 1880.

— *Ameletia rotundifolia* Wight, Ic. Pl. Ind. Or. 1: t. 258. 1840, non Buch.-Ham. ex Roxb. 1820.

Type: "Mons. Ind. or., locis non indicatis (verisim. Nepal)", in 1903 Koehne (Pflanzenreich) wrote "wahrscheinlich Nepal, *Wallich n. 2095H*". *R. macrandra* does not occur in Nepal and *Wallich 2095H* was probably collected in India, Kerala, near Ernakulam where it still grows today. It is not clear which of Wallich's numerous duplicates of *2095H* was used by Koehne, I designate the K-W specimen lectotype and the K, CGE, LE specimens isolectotypes.

lc.: Fig. 9E-H.

Special literature: Benl, G. *Rotala macrandra* Koehne (Lythraceae). Die Aquarien- und Terrarien-Zeitschrift (Stuttgart) 25(6): 198-201. 1972.

Amphibious perennial or perhaps occasionally annual. *Stems* branched below, creeping or floating, up to 40 cm or more long, usually simple and 4-angled above. *Leaves* decussate or occasionally in whorls of 3, sessile or subsessile, variable in form and colour; submerged leaves linear to orbicular but usually ovate, up to 5 cm long, pink to purple with pale nerves, abaxial surface darker than adaxial; aerial leaves obovate to orbicular, up to 2 cm long, green or somewhat reddish; leaf nerves distinct, usually pale pink or whitish. *Bracts* broadly ovate, up to 3 mm long, as wide or wider than long; bracteoles c. 0.5 mm long, about half the calyx tube in length, linear to lanceolate, scarious. *Flowers* monomorphic, subsessile, solitary in axils of bracts; inflorescence distinct, a many-flowered usually sessile raceme, remaining dense in fruit (stem not visible between nodes); solitary flowers occasionally found in axils of normal foliage leaves. *Calyx* tube campanulate, c. 1 mm long, membranous, white or tinged with pink above, with 4 rib-like nerves; calyx lobes 4, triangular, up to 1 mm long, pink; calyx appendages and interjected folds absent. *Petals* 4, obovate, about 2 times as long as calyx lobes, bright rose. *Stamens* 4; filaments inserted near base of calyx tube, c. 4 mm long; anthers exceeding petals and bracts. *Ovary* globose; style c. 3.5 mm long; stigma minutely capitate, about level with anthers; capsule globose, c. 1.5 mm diam., 4-valved; seeds semi-ellipsoidal, c. 0.5 mm long.

DIAGNOSTIC FEATURES

K4, P4, A4, G4; like *R. rotundifolia* but bracteoles c. 0.5 mm long, about half as long as calyx tube; filaments c. 4 mm long; anthers exceeding petals and calyx lobes; style c. 3.5 mm long; stigma minutely capitate and scarcely wider than the style; inflorescence remaining compact in fruit.

DISTRIBUTION

Confined to southern India in the States of Karnataka (Mysore) and Kerala (Map 5), no specimens have been seen from Tamil Nadu but it is likely to be found there. It is essentially a lowland species and flowers from about October to November.

SELECTED SPECIMENS

India: s. loc., *Bentham* (M); *ibid.*, *Stocky*, mixta cum *R. rotundifolia* (K); *ibid.*, *Wight* 977, mixta cum *R. rotundifolia* (LE); Karnataka (Mysore): Ananthapur, Oct. 1908, *Meebold* 10284 (Z); Kerala: Calicut Distr., Badagara, 28 Oct. 1900, *Bourne* (K); Trichur Distr., Trichur, 20 Nov. 1814, *Rottler* (LE);

Ernakulam Distr., near Ernakulam, *Wallich 2095H* (CGE, K, K-W, LE); Ernakulam Distr. at edge of Muvattupuzha River, 30 Sept. 1973, *Cook & Schneller*, Cult. Botanic Garden University of Zürich, pressed 28 Nov. 1974, *Cook (Z)*.

NOTES

I have seen *R. macrandra* in the State of Kerala. It usually grows in more or less permanent water and is often found in swiftly flowing water. It is frequently found growing together with *Vallisneria* and *Blyxa*. I have cultivated both *R. macrandra* and *R. rotundifolia* and agree with BENL (1972). In general *R. macrandra* is more aquatic and develops very attractive pink to purple submerged leaves; it also requires higher temperatures and grows best with a water temperature of 25-28°C, *Rotala rotundifolia* grows better at or slightly below 20°C.

- 13. *Rotala nummularia* Welw. ex Hiern** in Oliver, Fl. Trop. Africa 2: 468. 1871, pro parte, emend. Exell, J. Bot. (London) 67: Suppl. Gossweiler, Polypet. 187. 1929.

Type: Angola, Lubango (Huila), pr. Lopollo et Catumba, 1600-1760 m, Jan. 1860. *Welwitsch 2345* (holotype: LISU n.v.; isotypes: BM, M).

Ic.: Fig. 10A-C.

Amphibious perennial. *Stems* creeping below, floating, ascending or erect above, up to 40 cm long, often crowded, variously branched. *Leaves* decussate or occasionally in whorls of 3, sessile or subsessile; submerged and juvenile leaves elliptic to ovate, up to 2 cm long; aerial leaves ovate to suborbicular, the broader ones cordate at base, up to 1 cm long; nerves pinnate not distinct. *Bracts* leaf-like at base of inflorescence, somewhat smaller and narrower above; bracteoles linear, membranous about as long as calyx tube. *Flowers* dimorphic, heterostylous, shortly pedicellate, solitary in the axils of leaf-like bracts (inflorescence not stalked). *Calyx* tube conical to cup-shaped, membranous, tinged with pink, c. 1.5 mm long; calyx lobes 4, triangular, pink, c. 1 mm long; calyx appendages and interjected folds absent. *Petals* 4, obovate, bright pink, c. 2 mm long. *Stamens* 4; filaments inserted near base of calyx tube, either c. 1.5 mm or c. 6 mm long; anthers either included or excluded. *Ovary* broadly ellipsoidal to globose; styles either c. 1 mm or at least 5 mm long; stigma capitate, borne either above or below the anthers; capsule globose, 4-valved; seeds semi-ellipsoidal, c. 0.4 mm long.

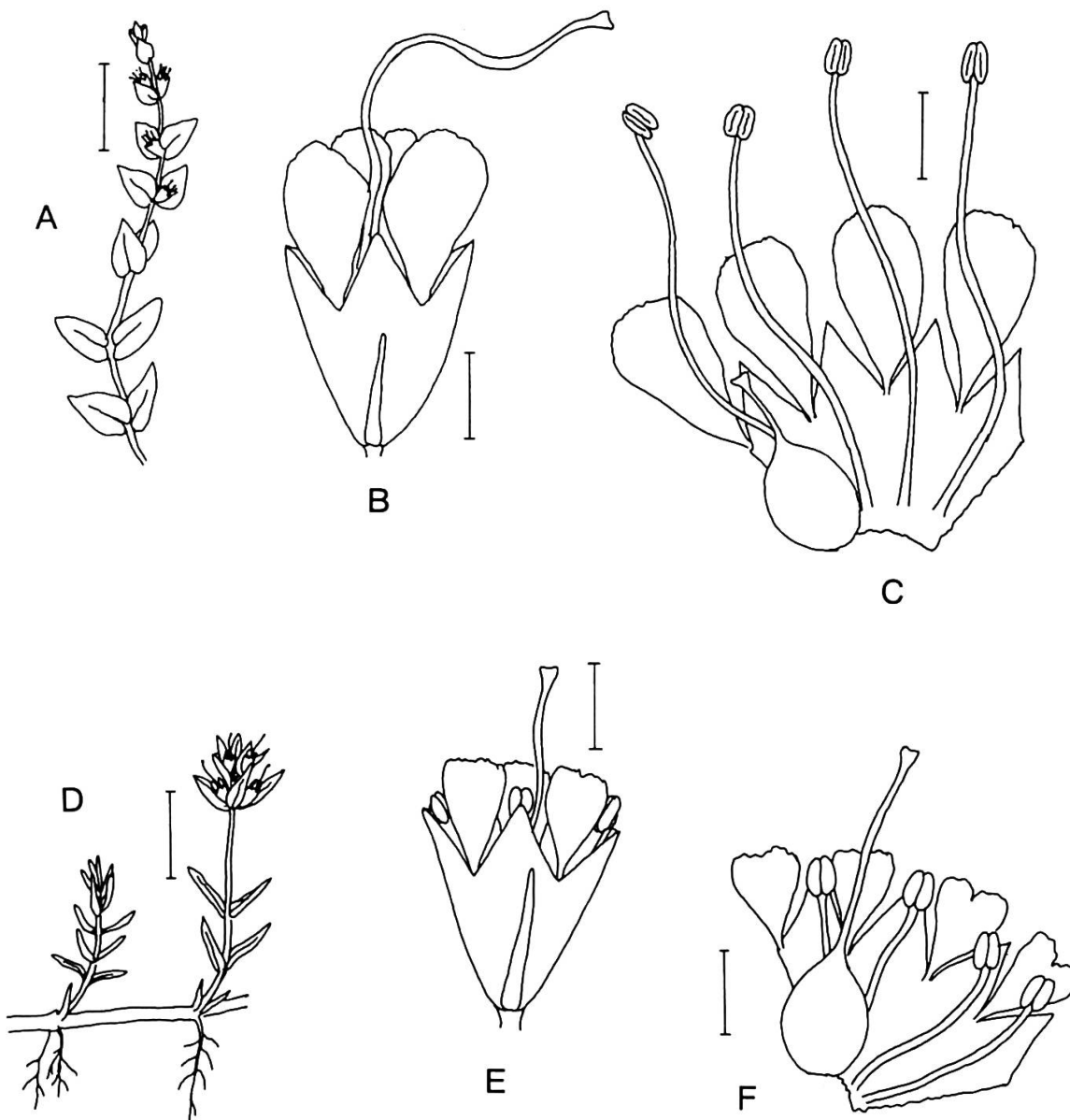


Fig. 10. — *R. nummularia* (Welwitsch 2345); A, habit; B, "pin" flower; C, "thrum" flower dissection.

R. thymoides (Welwitsch 2344); D, habit; E, "pin" flower; F, flower dissection (scale: A, D, 1 cm; B, C, E, F, 1 mm).

DIAGNOSTIC FEATURES

K4, P4, A4, G4; like *R. rotundifolia* and *R. macrandra* but heterostylous, inflorescence not stalked and aerial leaves usually longer than wide. Like *R. thymoides* but leaves below the inflorescence not linear to lanceolate nor obspathulate and the "pin" style 5 mm or more long.

DISTRIBUTION

Endemic to S.W. Angola in the provinces of Bié and Lubango (Huíla) (Map 6). It grows in mountainous regions at an altitude between 1400 m and 1800 m. It flowers from September to January or perhaps a little later.

SELECTED SPECIMENS

Angola: Bié: Ganguelas, Vila Artur de Paiva (Vila da Ponte), a E. do Forte Princesa Amélia, rio Cubango, 20 Sept. 1905, *Gossweiler 1997* (BM); *ibid.*, Oct. 1905, *Gossweiler 4192* (BM); Ganguelas, andados 12 km de Vila Artur de Paiva para Cassinga, 1430 m, 7 Jan. 1960, *Mendes 2009* (BM, BR, P); Lubango (Huíla): Huíla, pr. fonte K'Ehombo, 1770 m, *Dekindt 1150* (P); Huíla, 1770 m, *Dekindt 3012* (P); Huíla, pr. Missão Católica, margens do rio Mucha, 25 Jan. 1956, *Santos 177* (BM); Lubango, pr. Lopollo et Catumba, 1600-1760 m, Jan. 1860, *Welwitsch 2345* (BM, M).

14. *Rotala thymoides* Exell, J. Bot. (London) 67: Suppl. Gossweiler, Polypet. 187. 1929.

= *Rotala nummularia* Welw. ex Hiern in Oliver, Fl. Trop. Africa 2: 468. 1871, pro parte, emend. Exell, J. Bot. (London) 67: Suppl. Gossweiler, Polypet. 187. 1929.

Type: Angola, Lubango (Huíla), entre Mumpula e Nene, rio Quipumpunhime, Oct. 1859, *Welwitsch 2344* (holotype: BM; isotypes: LISU n.v., M).

lc.: Fig. 10D-F; Fernandes & Diniz, Bol. Soc. Brot. Sér. 2, 29: t. 5. 1955, reprinted Consp. Fl. Angolensis 4: t. 19. 1970.

Amphibious perennial. *Stems* creeping below, floating ascending or erect; erect stems 4-sided, often crowded, up to 5 cm or more tall, simple or branched. *Leaves* decussate or in whorls of 3 or 4, linear to oblong-elliptic, up to 8 mm long and 3 mm wide. *Bracts* leaf-like, obspathulate to ovate; bracteoles linear, membranous, about as long as calyx tube. *Flowers* dimorphic, heterostylous, subsessile, solitary in axils of leaf-like bracts; inflorescence globose, up to c. 1 cm diam., sometimes stalked or continuous with foliage leaves. *Calyx* tube conical to cup-shaped, membranous, c. 1.5 mm long; calyx lobes 4, triangular, c. 1 mm long; calyx appendages and interjected folds absent. *Petals* 4, obovate, pink to violet-purple, 1-1.5 mm long. *Stamens* 4; filaments inserted near base of calyx tube, either c. 2 mm or c. 5 mm long; anthers either included or excluded. *Ovary* broadly ellipsoidal to globose; styles either c. 1 mm or c. 5 mm long; stigma obconical, borne either above or below the anthers; capsule globose, 4-valved, up to c. 1.2 mm diam.; seeds semi-ellipsoidal, c. 0.4 mm long.

DIAGNOSTIC FEATURES

K4, P4, A4, G4; like *R. nummularia* but leaves linear to lanceolate or obspathulate, style of the "pin" flower not exceeding 5 mm and petals not exceeding 1.5 mm long.

DISTRIBUTION

Endemic to S.W. Angola in the mountainous regions in the provinces of Bié and Lubango (Huila) (Map 6). It is sympatric with *R. nummularia*.

SELECTED SPECIMENS

Angola: Bié: Cuito-Cuanavale, margens do ribeiro Chancamba, *Gossweiler 2645* (BM); Cuito-Cuanavale, Cuito, margens do ribeiro Domba, *Gossweiler 2823* (BM); Lubango (Huila): entre Mumpula e Nene, margens do rio Quipumpunhime, Oct. 1859, *Welwitsch 2344* (BM, M); Lubango, entre Jau e Humpata, Lagoa Nuntechite, 1840 m, 15 April 1960, *Mendes 3602* (BM).

NOTES

Fernandes and Diniz (Bol. Soc. Brot. Sér. 2, 29: 90, t. 5. 1955) described a variety *angustifolia* based on details of leaf shape and the size of calyx and petals. I can find no clear cut distinction between this variety and the type.

R. thymoides superficially looks unlike *R. nummularia* but florally they are very similar and no doubt patristically related. I suspect when some more plants have been collected or cultivation experiments are undertaken that *R. thymoides* will not deserve specific status.

15. *Rotala elatinoides* (DC.) Hiern in Oliver, Fl. Trop. Africa 2: 466. 1871
≡ *Ammannia elatinoides* DC., Mém. Soc. Phys. Hist. Nat. Genève 3(2): 92, tab. 3, fig. B. 1826, non A. Rich. 1847 ≡ *Ameletia elatinoides* (DC.) Blume, Mus. Bot. Lugd. Bat. 2: 136. 1856.

Type: Senegal, s. loc., 25 Jan. 1825, "*Lythrum uniflorum*" Perrottet 92 (holotype: P; probable isotypes: BR, G, G-DEL K, LE).

lc.: Fig. 11A-E; De Candolle, Mém. Soc. Phys. Hist. Nat. Genève 3(2): tab. 3, fig. B. 1826.

Terrestrial or amphibious annual or perennial. *Stems* simple or creeping and branched below, erect above; erect stems usually simple or occasionally irregularly branched, 5-15 cm long, often denuded of leaves below. *Leaves* decussate, sessile or subsessile; lower or submerged leaves linear to oblong,

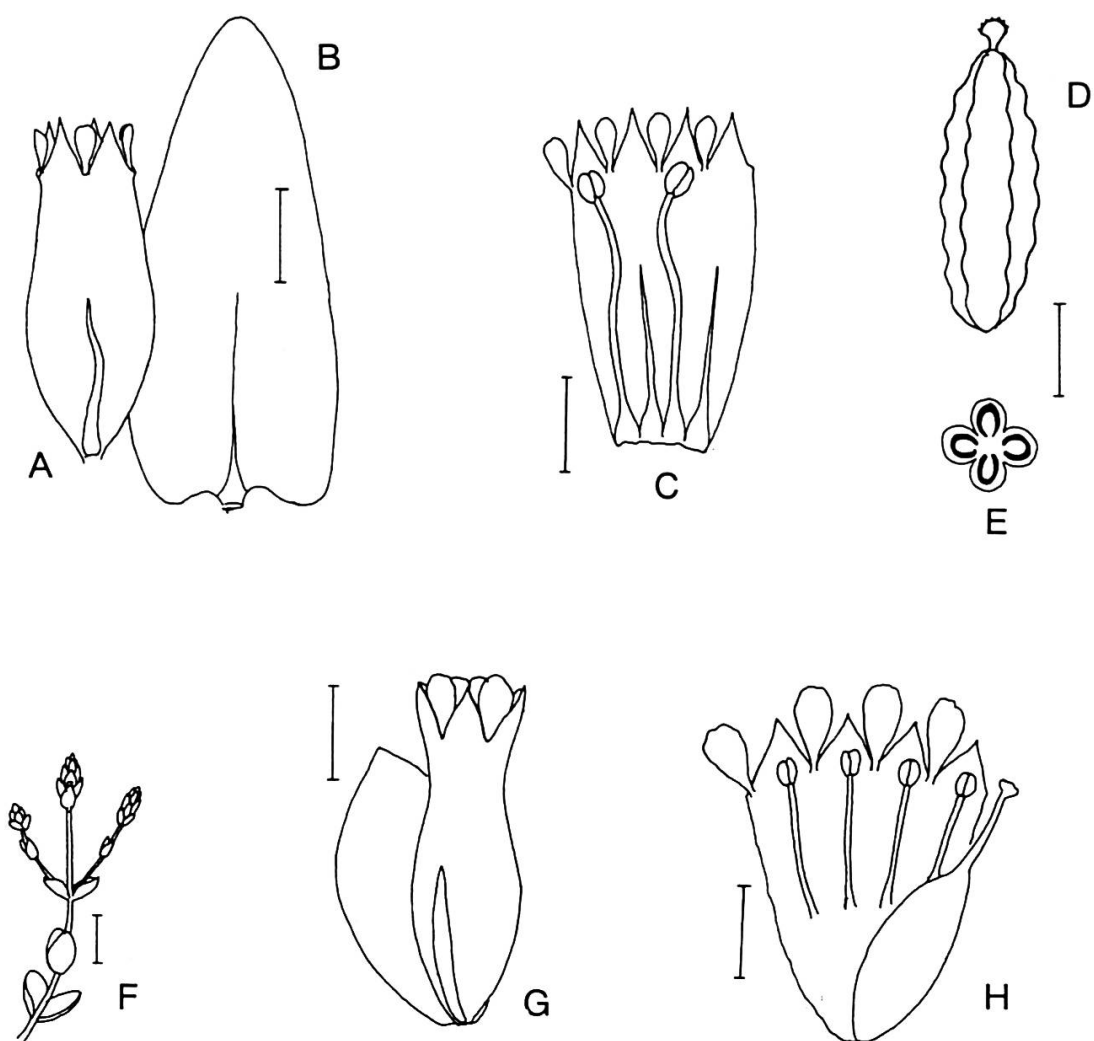


Fig. 11. — *R. elatinoides* (Richard 1407); A, flower; B, bract; C, flower dissection; D, capsule; E, transverse section of capsule (scale: A-E, 1 mm).

R. serpyllifolia (Cook & Gut 63); F, habit; G, flower; H, flower dissection (scale: F, 1 cm; G, H, 1 mm).

up to 20 mm long, thin and flaccid; upper or aerial leaves oblong to ovate, rarely more than 8 mm long, subcordate to cordate at base, obtuse at apex. *Bracts* leaf-like, ovate, up to c. 6 mm long, subcordate to cordate at base, obtuse at apex; bracteoles capillary, c. 1.5 mm long, about half as long as calyx tube. *Flowers* monomorphic, subsessile, solitary in axils of leaf-like bracts. *Calyx* tube subcylindrical to somewhat urceolate, not accrescent, c. 3 mm long, 8-nerved (4 distinct, 4 less so); calyx lobes 4, widely deltate, c. 0.5 mm long, somewhat mucronate at apex; calyx appendages absent; small interjected folds present. *Petals* 4, obovate, not exceeding the calyx lobes. *Stamens* 2, opposite; filaments c. 3 mm long, inserted at base of calyx

tube but slightly adnate to it for about half their length, at base running into 2 of 4 triangular, glandular regions; anthers level with top of calyx tube. *Ovary* ellipsoidal, 4-locular with each loculus induplicate; style very short; stigma capitate, subsessile; capsule ellipsoidal, 4-valved, c. 3 mm long; seeds semi-ellipsoidal, c. 0.6 mm long.

DIAGNOSTIC FEATURES

K4, P4, A2, G4; calyx tube cylindrical to urceolate, stamens 2 and inserted at base of calyx tube, ovary loculae induplicate and seeds c. 0.6 mm long.

DISTRIBUTION

In the dryer regions of West and Central Africa from Mauritania and Senegal to Chad and Central African Republic (Map 6). It is usually collected from the banks of relatively large rivers. It flowers from December to June.

SELECTED SPECIMENS

Mauritania: Kaedi, 3 Dec. 1898, *Chevalier 2823bis* (P). **Senegal:** s. loc., 26 Jan. 1825, *Perrottet 92* (P); *ibid.*, s. dat., *Perrottet* (BR, G, G-DEL, K, LE, Z); *ibid.*, *Perrottet 332* (BM, LE, M); *ibid.*, 1831, *Perrottet* (L); Walo, 1827, *Perrottet* (K); Walo, 1834, *Perrottet* (P); Dagana, 1825, *Leprieur* (G, K, LE, P); Matam, 6 April 1965, *Adam 28021* (MO); Richard-Toll, Feb. 1951, *Berhaut 1407* (BR, P, Z); Tiguet, 27 Jan. 1966, *Audru 3146* (P). **Mali:** Gao, Bagoundie, 20 Feb. 1936, *De Wailly 4966* (P); Gao, Goura, R. Niger, 16 April 1937, *De Wailly 4692* (P); Gao, R. Niger, 3 March 1936, *De Wailly 4983* (P); *ibid.*, 17 Nov. 1935 — Sterile, *De Wailly 4891* (P). **Cameroun:** Makari, Serbewel, 26 Dec. 1964, *J. & A. Raynal 1281* (P). **Chad:** Bahr el Azreg, près Ft. Archambault, 10 June 1903, *Chevalier 8683* (K, P). **Central African Republic:** Dar Goulla, entre Ndellé et le Mamoun, March 1903, *Chevalier 7870* (P — fide Raynal, *Adansonia* 7: 542. 1967).

16. *Rotala serpyllifolia* (Roth) Brem., *Acta Bot. Neerl.* 3(1): 149. 1954 $\equiv$ *Micranthus serpyllifolius* Roth, *Nov. Pl. Sp.* Halberstadt: 282. 1821. = *Ameletia tenuis* Wight, *Ic. Pl. Ind. Or.* 1: n. 13, tab. 257B. 1840 $\equiv$ *Amman-nia tenuis* (Wight) Clarke in Hooker fil., *Fl. Brit. India* 2: 567. 1879 $\equiv$ *Rotala tenuis* (Wight) Koehne, *Bot. Jahrb.* 1: 177. 1880. **Type:** it is not certain which of Wight's plants was used as the basis of his illustration, Wight's plate loc. cit. can be accepted as standard.

Type: Herb. Ind. Or., *Heyne* (isotype: L).

Ic.: Fig. 11F-H; Wight, *Ic. Pl. Ind. Or.* 1: tab. 257B. 1840.

Terrestrial or amphibious, often cushion-forming, annual or perhaps occasionally perennial. *Stems* creeping and rooting below, ascending above or with erect axillary branches; erect flowering stems up to 25 cm long, slender, terete, red and shining. *Leaves* decussate, sessile or subsessile, linear to broadly ovate (lower ones sometimes orbicular), 2-15 mm long, cuneate at base, acute or obtuse at apex. *Bracts* green or tinged with red, lanceolate to oblong, at base occasionally subcordate, smaller than foliage leaves, rarely exceeding 4 mm long; bracteoles caducous, linear-lanceolate, c. 1.5 mm long. *Flowers* monomorphic, sessile or subsessile, solitary in the axils of bracts, in dense, terminal, pedunculate, spike-like racemes; racemes up to 35 mm long. *Calyx* tube urceolate, constricted at the top, 2.5-3 mm long, often exceeding the bract, white with red nerves; calyx lobes 4, widely deltate, c. 0.5 mm long; appendages and interjected folds absent. *Petals* 4, obovate, somewhat longer than the calyx lobes, pink. *Stamens* 4; filaments inserted about halfway up the calyx tube; anthers included within the calyx. *Ovary* ellipsoidal; style c. 1 mm long; stigma capitate, level with the anthers; capsule ellipsoidal, somewhat shorter than the calyx, 2-valved; seeds semi-ellipsoidal, c. 0.7 mm long.

DIAGNOSTIC FEATURES

K4, P4, A4, G2; inflorescences spike-like, pedunculate; calyx tube constricted below the calyx lobes; capsule ellipsoidal but shorter than calyx.

DISTRIBUTION

Widespread in C. and N.W. India and Pakistan (Map 4). It grows in seasonally inundated areas and flowers as the water recedes. Flowering may take place throughout the year, but the main flowering time is from October to February. The erect stems are often densely packed and cushion-forming. I have seen it in India at the Abheba Tank, Kota, Rajasthan. The commonest associated species were: *Eriocaulon cinereum* R. Br., *Scirpus maritimus* L., *Rotala indica* (Willd.) Koehne, *R. rosea* (Poiret) Cook, *Ammannia baccifera* L., *Glossostigma diandra* (L.) O. Kuntze, *Bacopa floribunda* (R. Br.) Wettst., *Microcarpaea minima* (Koenig) Merr., *Dopatrium junceum* (Roxb.) Buch-Ham.

SELECTED SPECIMENS

Pakistan: Dera Ismael Khan, 15-22 Feb. 1857, *Schlaginweit* (G, L, LE, M, Z). **India:** s. loc., *Heyne* (L); *Stocks & Law* (BR, CGE, G, K, L, M, U); s. loc., *Stocky* (K); s. loc., *Jaquemont* (G, K); "Behar", *Hooker* (CGE, G, K, L, M); "Behar", *S. Kurz* (K); Deccan, *Ralf* (G); Bengal, *Griffith* (CGE, K, LE); Concan, *Law* (K, LE); Maharashtra: Bombay, *Law* (K); Bombay, *Dalzell* (K); Bombay, 3 July 1901, *Woodrow 19* (K); Bombay, Oct. 1934, *Lester-Garland* (K); Rewa, *S. Kurz* (K); Sendwal, 17 Dec. 1888, *Duthie 8295* (K, LE); Bundelkhand, *Edgeworth* (K); Bundelkhand, 9 Dec. 1886, *Duthie 6382* (K);

Nala, 8 Nov. 1910, *Haines* 3282 (K); Nagpur, Nov. 1912, *Haines* 3283 (K); Rajasthan, Kota, 29 Oct. 1970, *Cook & Gut* 63 and 75B (K, Z); Sambalpur, 31 Dec. 1942, *Mooney* 2142 (K); Satpuras, Dec. 1918, *Bell & Sedgwick* 4996 (K); Jabalpur, Jan. 1874, *Kurz* (K); Jabalpur, 4-19 Jan. 1856, *Schlaginweit* (LE); Kolapur, Jan. 1853, *Richie* (K); Karnataka (Mysore), Belgaum, Jan.? 1853, *Richie* (K); Banda, 1852, *Edgeworth* 3005 (K); Lalitpur, 7 Jan. 1888, *Duthie* 6954 (LE); Singharh Fort, 19 Nov. 1950, *Santapau* 12012 (MO); Unai, 2 Nov. 1953, *Santapau* 17191 and 17192 (MO); Khandala, 26 Oct. 1950, *Santapau* 11724 (MO); Saurashtra, 5 Oct. 1953, *Raizada* 21384 (L); Mirzapur, 9 Feb. 1961, *Bhattacharyya* 13607 (L). **Bangla Desh:** ?E. Bengal, *Griffith* 2310 (K).

17. ***Rotala tenella*** (Guill. & Perr.) Hiern in Oliver, Fl. Trop. Africa 2: 467. 1871 $\equiv$ *Ammannia tenella* Guill. & Perr. in Guillemain, Perrottet & Richard, Fl. Senegambiae: 297. 1833 (or? 1832) $\equiv$ *Ameletia tenella* (Guill. & Perr.) Blume, Mus. Bot. Lugd. Bat. 2: 136. 1852.
 = *Rotala brevistyla* Baker fil., J. Linn. Soc. Bot. (London) 37: 153, 154, 30 Sept. 1905. **Type:** Uganda, Mulema, 29 May 1903-1904. *Bagshaw* 316 (holotype: BM).
 = *Rotala oblonga* Peter, Abh. Ges. Wiss. Göttingen N.F., 13: 22, in obs., 87, fig. 18. 1928. **Type:** Tanzania, Uyansi, Tschaya-See, 1240 m, Jan., *Peter* 34143A (holotype: B; isotype: B).
 = *Rotala submersa* Dinter ex Pohnert, Mitt. Bot. Staatssammlung München 1(9-10): 449. 1954 $\equiv$ *Ammannia submersa* nom. in sched. 1934, *Dinter* 7351. **Type:** South-West Africa (Namibia), Amboland, Kanovley, *Dinter* 7281 (holotype: M; isotype: B); paratype: Pad Tsumeb-Grootfontein, 22 April 1934, *Dinter* 7351 (B, M n.v., Z).
 = *Rotala pedicellata* A. Fernandes & Diniz, Bol. Soc. Brot. Sér. 2, 31: 152. 1957, op. cit. 48: 128. 1974. **Type:** Zambia, Mapanza, 14 March 1954, *Robinson* 622 (holotype: SRGH n.v.; isotype: K).
 — *Rotala peregrina* Perrier, Not. Syst. (Paris) 14: 308. 1953 (dated 1952), nom. invalid., no type indicated, among the material cited are two species of *Ammannia* as well as *Rotala tenella* — the description is “stretched” to incorporate all the material.

Type: Senegal, s. loc., *Perrottet* 333 (holotype: P; isotypes: BM, G, LE).

lc.: Fig. 12A-K; Fernandes & Diniz, Bol. Soc. Brot. Sér. 2, 31: t. 2. 1957.

Aquatic or amphibious annual or perhaps perennial. *Stems* inflated when submerged, floating or creeping and branching below, usually erect and scarcely branching above, up to 40 cm long but usually less. *Leaves* decussate, sessile; submerged leaves membranous, elliptic to oblong or obovate, up to 20 mm long but usually less, cordate at base, obtuse at apex;

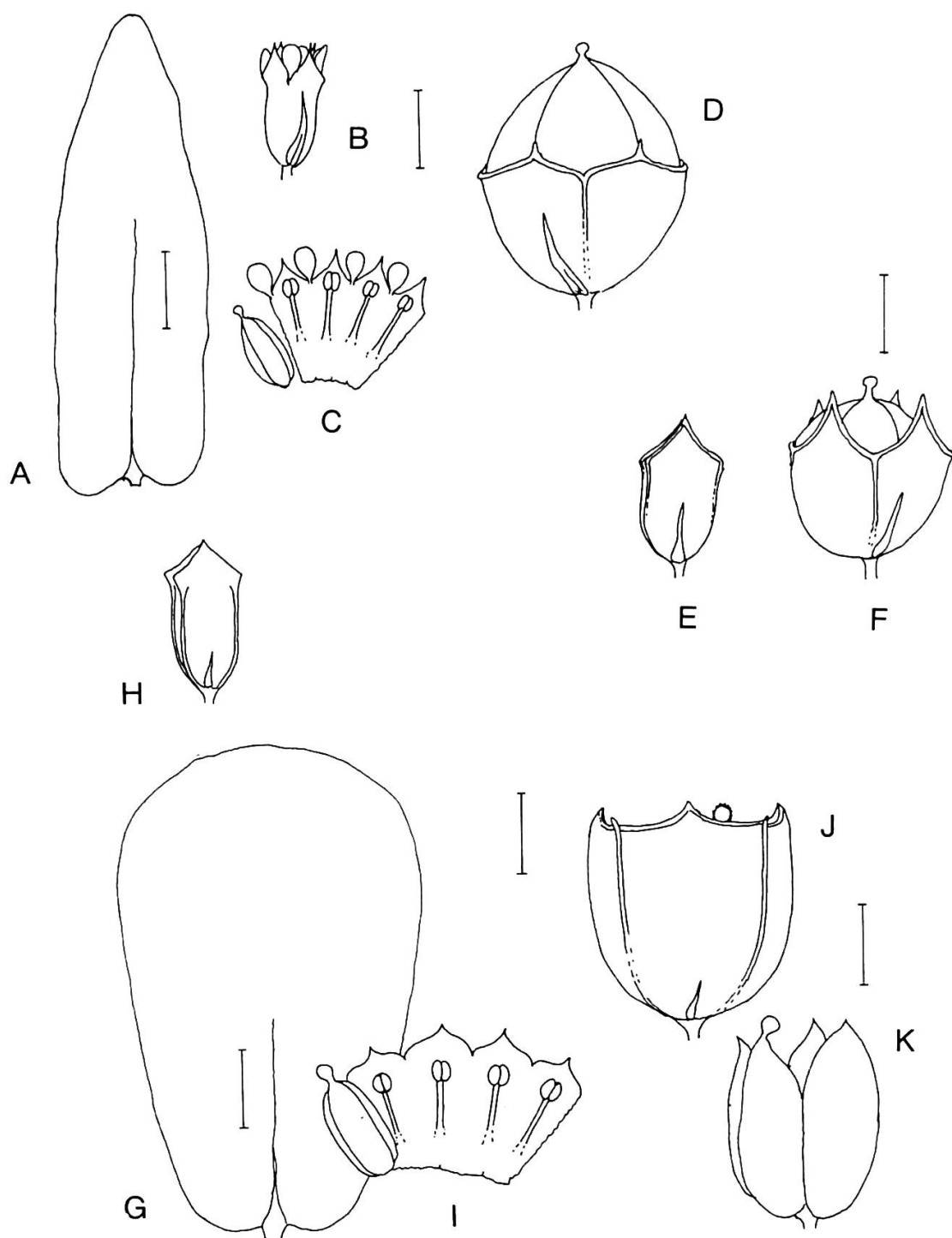


Fig. 12. — *R. tenella* (A-D, Schlieben 9413; E, F, Perrottet 333, "*tenella*" type; G-K, Dinter 7351, "*brevistyla*" type); A, bract; B, flower; C, flower dissection; D, ripe capsule; E, flower bud; F, ripe capsule; G, bract; H, flower bud; I, flower dissection; J, ripe capsule surrounded by calyx; K, dehiscing capsule (scale: A-K, 1 mm).

aerial leaves oblong to obovate, rarely exceeding 12 mm in length, cordate at base, obtuse at apex. *Bracts* like foliage leaves; bracteoles 2, capillary to linear-lanceolate, membranous, 0.25-1.0 mm long. *Flowers* monomorphic, solitary in axils of leaf-like bracts, distinctly pedicellate; pedicel in fruit up to 2 mm long. *Calyx* tube at anthesis subcylindrical to urceolate, accrescent, at fruiting stage semi-globose, often splitting as the capsule dehisces; calyx lobes 4, at anthesis widely deltate, c. 0.5 mm long, often mucronate, in fruit becoming shallowly triangular; interjected folds distinct at anthesis but stretched in fruit. *Petals* very variable, caducous, absent or up to 4, rudimentary, linear to obovate, at anthesis not exceeding the calyx lobes, pink. *Stamens* 4 or occasionally less, inserted about halfway up the calyx tube or somewhat lower; anthers level with the top of the calyx tube. *Ovary* at anthesis ellipsoidal, 4-locular with each loculus induplicate; style very short; stigma capitate, subsessile; capsule ellipsoidal to globose, 2-3 mm long, equal to or exceeding the calyx, 4-valved; valves induplicate before dehiscence, usually rupturing the calyx tube as they open; seeds semi-ovoid, 0.35-0.6 mm long.

DIAGNOSTIC FEATURES

K4, P0-4, A4, G4; calyx distinctly accrescent after anthesis. Like *R. pterocalyx* but calyx tube without wings; like *R. fluitans* but without calyx appendages.

DISTRIBUTION

Widespread in the dryer regions of Tropical Africa, south of the Sahara and in southern Africa (Map 7).

SELECTED SPECIMENS

Senegal: s. loc., *Perrottet* 333 (BM, G, P); s. loc., 1833, *Perrottet* (G, LE); s. loc., *Heudelot* 632 (P); Niokolo-Koba, April 1951, *Berhaut* 1512 (P). **Guinea-Bissau:** Dandun, Boé, 27 Jan. 1947, *Santo* 2370A (P); *ibid.*, *Santo* 2379 (K); Madina, Boé, 10 Jan. 1951, *Santo* 2869 (BR, M). **Guinea:** Toumanéa, Oct. 1907, *Pobéguin* 1897 (K, P). **Sierra Leone:** N. Province, Kambia, Magbema, 24 Nov. 1949, *Jordan* 377 (K); *ibid.*, 14 July 1951, *Jordan* 472 (K — sterile material); *ibid.*, 20 Dec. 1954, *Jordan* 970 (K); *ibid.*, *Jordan* 971 (K); Kambia, 3 Nov. 1963, *Morton & Gledhill* SL 570 (K); Kasewe Hills, 15 Nov. 1964, *Morton* SL 1548 (K); Talla Hills, Mt. Gonkwi, 16 Feb. 1892, *Scott Elliot* 4852 (BM, K); Toma, Bonthe Island, 11 Nov. 1931, *Deighton* 2285 (K). **Mali:** Bura, 24 Sept. 1927, *Hagerup* 406 (K); Bura, Ansongo, Vand, 24 Aug. 1927, *Hutchinson* 406 (BR). **Ivory Coast:** Ferkassidongou, 13 Oct. 1967, *Ouliop* (P). **Ghana:** Lawra, Burufo, 4 Sept. 1965, *Hall* 752 (K). **Togo:** s. loc., Sept. 1931, *Mahoux* 96 (P). **Nigeria:** Ado Rock, 7°49'N., 3°26'E., July 1960, cult., Ibadan, 21 Nov. 1960, *Hamblen* 1028 (BM). **Central African Republic:** Yaoyam, 20 km

W. Bozoum, 11 Nov. 1937, *Tisserant* 3582 (P); 6 km S.W. Ippy, Reg. Bambari, Oubangui, 4 Dec. 1928, *Tisserant* 2734 (K); Ylinga, 21 July 1921, *Le Testu* 2993 (P); Bongo, Gir, 27 July 1869, *Schweinfurth* 2146 (K — mixta cum *R. stagnina*); *ibid.*, 12 Oct. 1869, *Schweinfurth* 2489 (K, MEL); Djur, 2 Oct. 1870, *Schweinfurth* 4265 (K). **Sudan Republic:** Jebel Marra, Mortagello, 6 May, *Wickens* 1590 (K). **Cameroun:** s. loc., 1938-39, *Jaques-Félix* (K); Dega près Guirvidig, 70 km E.N.E. of Maroua, 10 Oct. 1964, *Letouzey* 7262 (K, MO, P); Maltam, 28 Dec. 1964, *J. & A. Raynal* 12733 (P). **Gabon:** Tchibanga (Mokoualou), 1908, *Le Testu* 1355 (BM, BR, P). **Republic of Congo:** Loango, Joffre-Madingou, May 1959, *Koechlin* 5855 (P); Madimba, Kimayala, 27 April 1960, *Compère* 2040 (BR). **Zaire:** Kinshasa (Leopoldville), 1915, *Achten* 54A and 54B (BR); Bokala, March? 1909, *Laurent* 604 (BR); Garamba, 8 June 1950, *Noirfalise* 446 (BR); Garamba, 7 Dec. 1951, *De Saeger* 1559 (BR); Garamba, 17 July 1952, *Troupin* 1560 (BR); Garamba, 19 July 1952, *Troupin* 1587 (BR); Tupkwo, 7 July 1955, *Boutique* 113 (BR); entre Amadi et Poko, June 1931, *Lebrun* 3112 (BR). **Rwanda:** Kigali, Nyamata, 1450 m, 13 April 1959, *Deuse* 1377 (BR); *ibid.*, 1530 m, 2 May, *Troupin* 15051 (BR); *ibid.*, 4 May, *Troupin* 15092 (BR); Kibungu, Matinzā, 1500 m, 31 March 1973, *Troupin* 14906 (BR). **Uganda:** E. Mengo Distr., Bulemezi, Co. Kakinzi, 0°57'N., 32°28'E., 1100 m, 4 Oct. 1969, *Lye* 4390 (K); Karamoja Distr., Dodoth Co., Karenga, Hapore Hills, Nov. 1972, *Wilson* 2168 (K); Kampala, June 1917, *Dümmer* 3204 (BM, K, MO); Kampala, Ngulu Hill, Aug. 1937, *Hancock & Chandler* 1843 (B, BM, BR, K); Serere Teso, Dec. 1931, *Chandler* 320 (K); Kalula, May 1919, *Dümmer* 4109 (BM, P, Z); Mulema, May 1903-04, *Bagshaw* 316 (BM); Bunyoro, Sonso Riv., Nov. 1935, *Eggeling* E2312 (BM, MO). **Kenya:** Thika Plateau, c. 1700 m, 25 June 1947, *Bogdan* 793, *comm. Bally* 5197 (K); Thika, 16 Sept. 1967, *Faden* 67632 (K); Nairobi, Royal National Park, Nr. Impala Point, 21 Jan. 1962, *Verdcourt* 3237 (BR, K); Mwea-Tebere Scheme, Nguka Village, c. 1300 m, 14 Nov. 1966, *Wood* 751 (K). **Tanzania:** Iringa Distr., Tanganyika River, 900 m, 6 May 1970, *Greenway & Kanuri* 14466 (M); Iringa Distr., Makindi, 7°43'S., 34°55'E., 850 m, 10 Aug. 1970, *Thulin & Mhoro* 677 (K); Lake Prov., Mwanza-Burru, 1250 m, 30 March 1952, *Tanner* 619 (B, BR, K); Mbeya Distr., Kazikazi, 1300 m, 10 June 1932, *Burt* 3705 (K); Moshi Distr., Mpolo, 1150 m, Aug. 1928, *Haarer* 1528 and 1529 (K); Ujansi, Tschaia See, 1240 m, 4 Jan. 1926, *Peter* 34143A (B). **Zambia:** Mbala (Abercorn), *Michelmores* 434A (K); Mazabuka, Mapanza, Choma, c. 1155 m, 13 April 1958, *Robinson* 2837 (K, M); Mapanza, 14 March 1954, *Robinson* 622 (K). **Rhodesia (Zimbabwe):** Kariba, Sengwa, 18 Nov. 1964, *Jarman* 80 (K); Wankie, April 1932, *Levy* 24 (K); Gatooma, Salope Farm, 12 April 1971, *Conway* 34/71 (K). **Botswana:** 196.5 km N. of Maun, 19.5 km N. of Jovenega Pan, 7 Aug. 1937, *Erens* 345 (PRE, fide Fernandes, Fl. Zamb.). **South West Africa (Namibia):** Ovambo-land (Amboland) Kanovley, *Dinter* 7281 (B, M); Grootfontein, Tsumeb, 22 April 1934, *Dinter* 7351 (B, Z); Waterberg, 28 April 1963, *Giess, Volk & Bleissner* 6619 (M). **Republic of South Africa (Transvaal):** Kruger Nat. Park, Nelspruit, Skukuza Koppies, 6 Feb. 1962, *Schlieben* 9413 (B, BR, M, Z);

Ramakapa, 1330 m, 16 Feb. or Nov. 1894, *Schlechter* 4506 (BM, G, LE, MEL, NSW, Z); Trigardsfontein, Hogge Veld, 1875-80, *Rehmann* 6703 (BM); Kwenene, c. 650 m, 2 Feb. 1953, *Schyff* 2101 (K). **Malagasy Republic:** Andramasina, 7 June 1972, *Jacquemin* HJ1051 (P); Autsirabe, *Perrier* 6596 (P); Autsirabe (Centr.), 1500 m, *Perrier* 18476 (P); Autringiha, 1600 m, *Perrier* 13647 (P); Tampoketsa, 24 March 1973, *Jacquemin* 963 (P); Tampoketsa, 27 March 1973, *Jacquemin* 1299 (P); Andramasina, 7 June 1972, *Jacquemin* HJ1051 (P).

NOTES

R. tenella is a very variable species. The type specimen, collected in West Africa, represents a more or less intermediate state: capsule equal to or slightly exceeding the calyx, bracteole c. 0.5 mm long (Fig. 12F). In western and southern Africa there is a tendency for the capsule to exceed the calyx and the bracteole is up to 1 mm long (Fig. 12D illustrates an extreme state); this state has never been taxonomically recognised. In eastern and southern Africa there is a tendency for the calyx to be highly accrescent and longer than the ripe capsule, the bracteole is also smaller and may be no more than 0.25 mm long (Fig. 12J); this state has been recognised as a distinct species. The earliest name is *R. brevistyla*, later names are: *R. oblonga*, *R. submersa* and *R. pedicellata*. From herbarium studies all degrees of intermediacy between the extremes are found throughout the range of the species. However, *R. brevistyla* plants are commoner in East Africa. Morphologically certain correlations can be seen, generally speaking the longer the mature calyx the shorter the bracteole. Without firsthand field experience or cultivation experiments, I feel it is safer to follow a "lumping" policy.

18. *Rotala pterocalyx* A. Raynal, *Adansonia* N.S. 7: 337. 1967.

— *Rotala rotunda* A. Chevalier, *Etudes Fl. Afr. Centr. Franç.* 1: 130. 1913, nom. nud. "**Type**": Central African Republic, Dar Banda, 4 Dec. 1902, A. Chevalier 6651 (BR, P).

Type: Senegal, Tiél, 106 km N.E. of Kaffrine, 12 Oct. 1961, *J. Raynal* 7704 (holotype: P).

lc.: Fig. 13A-E; Raynal, A., *Adansonia* N.S. 7: 338, fig. 8. 1967.

Amphibious annual. *Stems* ascending or erect, rarely branched, when submerged somewhat inflated. *Leaves* decussate, obovate up to 7 mm long but usually less, cuneate at base, obtuse at apex. *Bracts* leaf-like; bracteoles 2, subulate, not exceeding 0.5 mm long. *Flowers* monomorphic, probably cleistogamous, solitary in the axils of leaf-like bracts, distinctly pedicellate; pedicel in fruit up to 2 mm long. *Calyx* tube at anthesis 4-sided and 4-angled

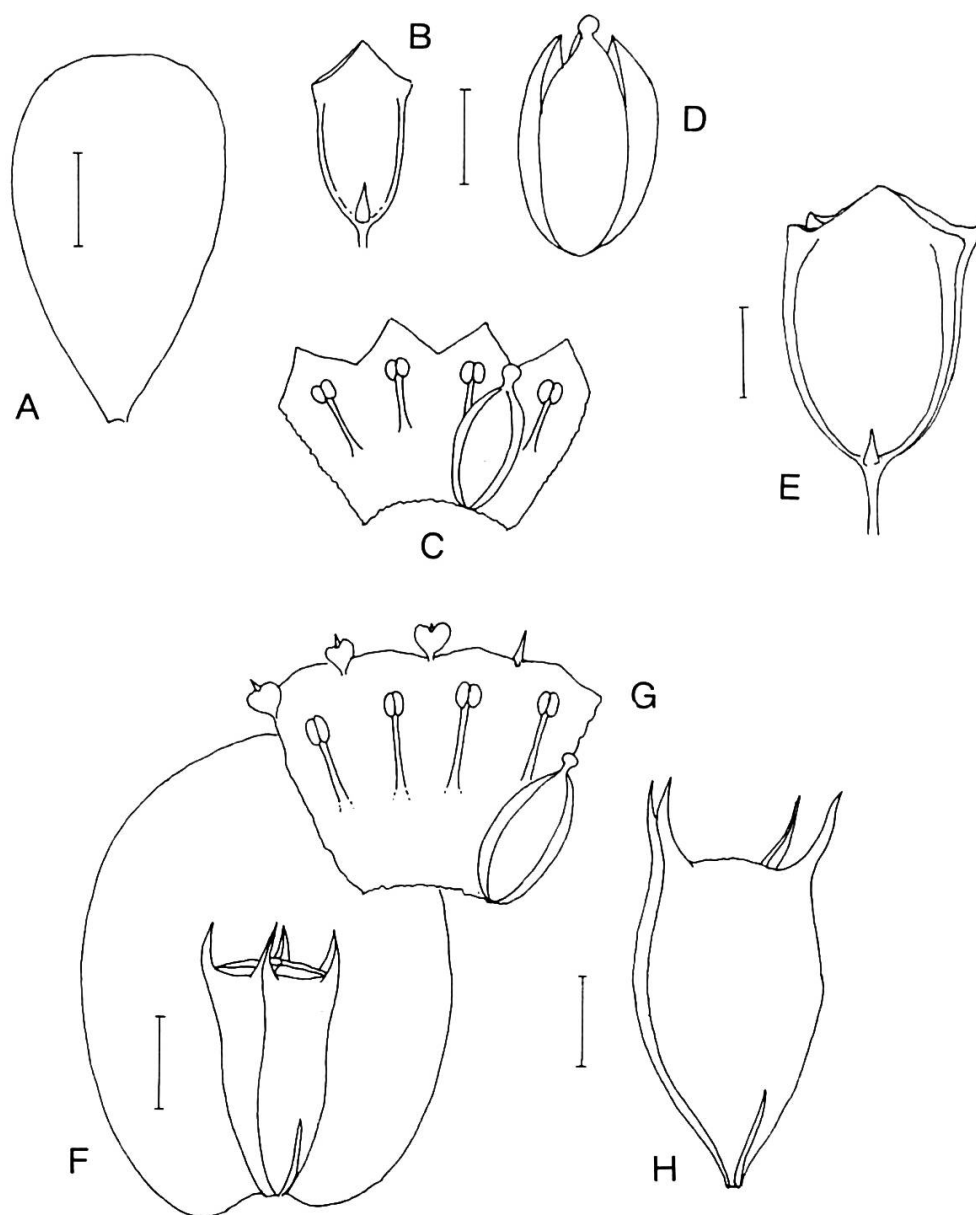


Fig. 13. — *R. pterocalyx* (J. Raynal 7704); A, bract; B, flower bud; C, flower dissection; D, dehiscing capsule; E, mature calyx.

R. fluitans (Exell & Mendonça 2834); F, bract and flower bud; G, flower dissection; H, mature calyx (scale: A-H, 1 mm).

(almost square in transverse section) with distinct wings on the angles, accrescent, up to 2.5 mm long in fruit; calyx lobes 4, broadly triangular, c. 0.5 mm long, remaining more or less closed; interjected folds distinct, persisting in fruit but obviously folds and not calyx appendages. *Petals* absent or up to 4, smaller than calyx lobes or rudimentary. *Stamens* 4, inserted about halfway up the calyx tube or somewhat lower; anthers below the top of the

calyx tube. *Ovary* ellipsoidal, 4-valved, with each valve induplicate; style very short; stigma capitate, subsessile; capsule ellipsoidal, not exceeding the calyx tube, opening by 4 valves; seeds semi-ovoid, c. 0.6 mm long.

DIAGNOSTIC FEATURES

K4, P0-4, A4, G4; calyx almost square in transverse section with distinct wings on the angles; capsule valves distinctly induplicate before dehiscence; stigma subsessile; flowers pedicellate. *R. pterocalyx* is somewhat similar to the "*brevistyla*" state of *R. tenella* (p. 67) but can be distinguished by the 4-sided and 4-winged calyx; it is also like *R. fluitans* but can be distinguished by the presence of broadly triangular calyx lobes (even in fruit) and the lack of calyx appendages.

DISTRIBUTION

Northern Senegal, Niger and Central African Republic (Map 7). Flowering time is from October to December.

SELECTED SPECIMENS

Senegal: Tiél, 106 km N.E. Kaffrine, 12 Oct. 1961, *J. Raynal* 7704 (P); Matam, 22 Oct. 1969, *Fotius* 1801 (G). **Niger:** Takiéta, 15 Oct. 1966, *Peyre de Fabrègues* 2234 (P). **Central African Republic:** Dar Banda, Fluv. Kourouon an Kaga Mbrarupes, 4 Dec. 1902, *A. Chevalier* 6651 (BR, G, L).

NOTES

R. pterocalyx is known from only four collections all of which show a very similar habit (small, erect, annual plants with obovate leaves). It is, however, likely that this species is capable of developing longer, branched stems and specialized submerged leaves.

19. *Rotala fluitans* Pohnert, Mitt. Bot. Staatssamml. München 1(9-10): 448. 1954.

= *Rotala tetragonocalyx* A. Fernandes & Diniz, Bol. Soc. Brot. Sér. 2, 29: 88. 1955. **Type:** Angola, Lubango (Huila), Humbe, rio Cunene, 11 April 1937, *Exell & Mendonça* 2834 (holotype: COI n.v.; isotypes: BM, EA n.v., LISC n.v., LISJC n.v., M, SRGH n.v.).

Type: South West Africa (Namibia), Ovamboland (Okavangobucht), Niangana, Mitte April? 1934, *Dinter* 7621 (holotype: M. There are two collections with the number *Dinter* 7621, one collected in April, the other in May; the following herbaria probably have isotypes: B, BM, G, K, M, Z).

lc.: Fig. 13F-H; A. Fernandes & Diniz, Bol. Soc. Brot. Sér. 2, 29: tab. 2. 1955; named *R. tetragonocalyx*.

Aquatic or amphibious annual or perennial. *Stems* creeping and rooting below, floating or erect above, up to 40 cm or more long. *Leaves* decussate, sessile; submerged leaves membranaceous, often tinged red, widely elliptic to ovate, often cordate at base, up to 2 cm long and 1 cm wide; terrestrial leaves herbaceous to cartilaginous, elliptic to ovate, usually cordate at base, usually less than 1 cm long. *Bracts* leaf-like; bracteoles subulate, c. 1 mm long. *Flowers* monomorphic, sessile or very shortly pedicellate, solitary in the axils of bracts. *Calyx* tube distinctly 4-angled, at anthesis tubular-campanulate and c. 2.5 mm long, accrescent, in fruit somewhat urceolate and c. 3.5 mm long; calyx lobes 4, very shallowly triangular to almost flat; calyx appendages 4, erect, subulate, up to 1 mm long. *Petals* 4, suborbiculate, 0.25-1.0 mm long. *Stamens* 4, inserted slightly below the middle of the calyx tube; anthers included within the calyx tube. *Ovary* ellipsoidal; style very short; stigma capitate; capsule ellipsoidal, c. 3.5 mm long, opening by 4 somewhat induplicate valves; seeds semi-ellipsoidal, c. 0.5 mm long.

DIAGNOSTIC FEATURES

K4 + 4, P4, A4, G4; *R. fluitans* is phenetically similar to the Asian species *R. ritchiei* but it develops no linear submerged leaves; flowers sessile or subsessile; calyx 4-angled, becoming urceolate in fruit and reaching 3.5 mm long; petals distinct; seeds up to 0.5 mm long. Like *R. pterocalyx* but calyx appendages present; calyx tube not winged; flowers sessile or subsessile.

DISTRIBUTION

Central and western Africa between 10°S. and 23°S. (Map. 7).

SELECTED SPECIMENS

Zaire. Shaba (Katanga): Dilolo, River Mangoa, 23 July 1932, *Young 243* (BM). **Angola.** Lubango (Huila): Cuamato, Humbe, rio Cunene, 11 April 1937, *Exell & Mendonça 2834* (BM, M); Curoca, rio Cunene, 29 Aug. 1954, *Pritchard 388a* (BM). **South West Africa (Namibia):** Ovamboland, Niangana, April or May 1934, *Dinter 7621* (B, BM, G, K, M, Z); Grootfontein N., Runtu, 8 May 1939, *Volk 1910* (M). **Zambia:** Senanga, 16°S.-23°3'E., 2 Sept. 1952, *Codd 7345* (BM, K); Chroma, Mapanza, 13 April 1958, *Robinson 2837* (M); Kalabo, 2 Aug. 1962, *Robinson 5443* (B). **Rhodesia (Zimbabwe):** Victoria Falls, Südseite Insel, Nov. 1933, *Meebold 11768* (M). **Botswana:** Chobe River, Kazane, 13 July 1937, *Erens 416* (K).

20. ***Rotala ritchiei*** (Clarke) Koehne, Bot. Jahrb. 4: 386. 1883 $\equiv$ *Ammannia ritchiei* Clarke in Hooker fil., Fl. Brit. India 2: 566. 1879.

Type: India, Maharashtra, Belgaum, Oct., *Ritchie 1184* (holotype: K).

Ic.: Fig. 14A-E.

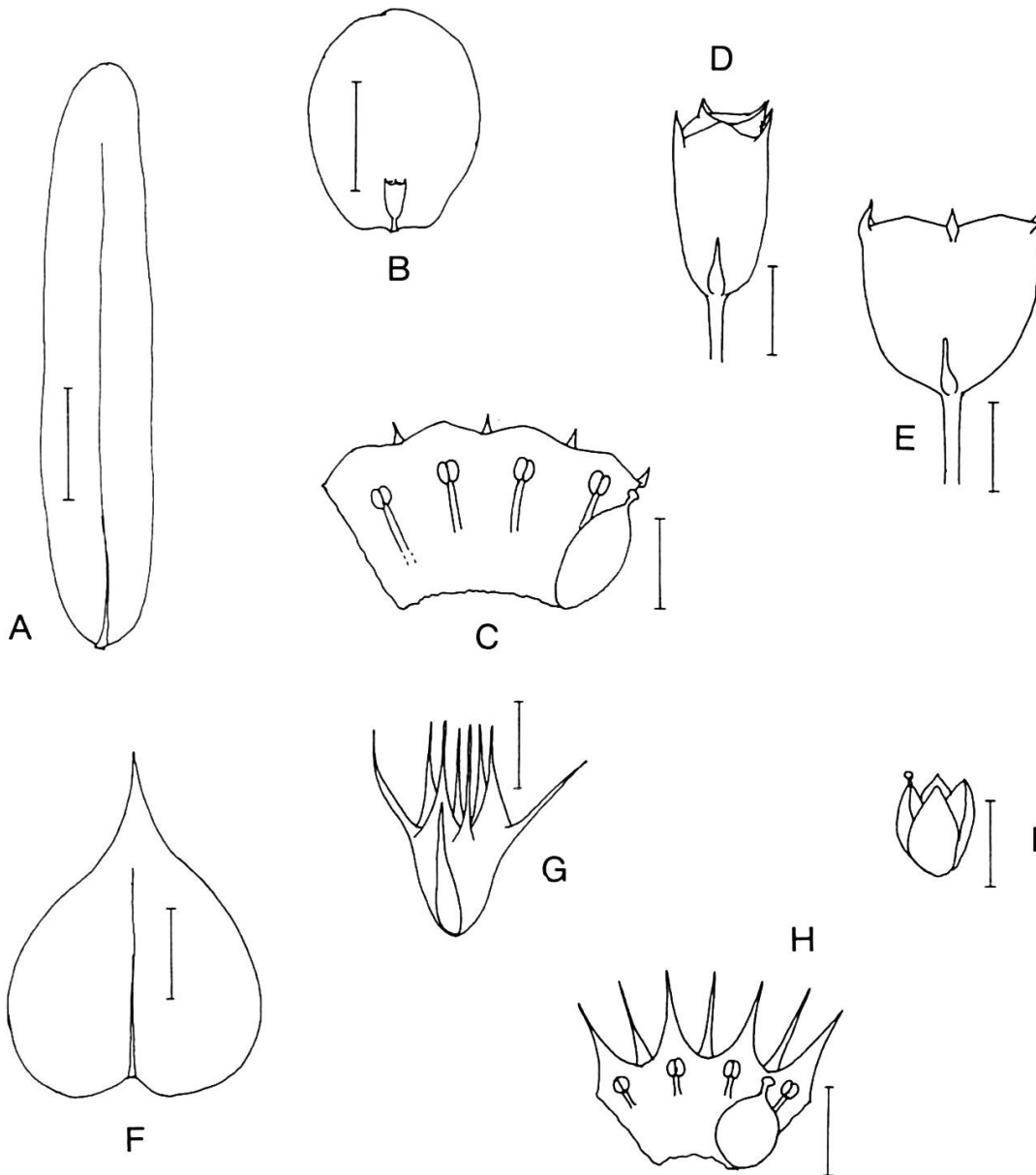


Fig. 14. — *R. ritchiei* (Ritchie 1184); A, submerged leaf; B, bract and flower; C, flower dissection; D, flower bud; E, mature calyx (scale: A, B, 5 mm; C-E, 1 mm).

R. illecebroides (Rangachari 13962); F, bract; G, flower; H, flower dissection; I, dehiscing capsule (scale: F-I, 1 mm).

Aquatic or amphibious perennial or annual. *Stems* branched below, creeping or floating and usually simple above, up to 40 cm or more long. *Leaves* decussate, sessile, very variable in form; submerged leaves linear to orbicular, up to 3 cm long, almost translucent, green to red; terrestrial leaves obovate to orbicular, up to 1 cm long, with indistinct nerves. *Bracts* leaf-like; bracteoles subulate, 0.2-0.4 mm long. *Flowers* monomorphic, solitary in the axils of bracts, distinctly pedicellate; pedicels in fruit 1.0-1.5 mm long. *Calyx* tube sub-cylindrical, c. 2 mm long, pink when young; calyx lobes 4, very shallowly triangular, almost flat in fruit; calyx appendages or interjected folds 4, acute, somewhat exceeding the calyx teeth. *Petals* 4, minute and caducous or absent. *Stamens* 4, inserted below the middle of the calyx tube; anthers included within the calyx tube. *Ovary* ellipsoidal; style very short; stigma capitate; capsule ellipsoidal, up to 2 mm long, opening by 4 valves; seeds semi-ellipsoidal, c. 0.3 mm long, straw-coloured.

DIAGNOSTIC FEATURES

K4 + 4, P0-4, A4, G4; like the African species *R. fluitans* but submerged leaves often linear; flowers distinctly pedicellate; petals minute or absent; somewhat smaller in the dimensions of floral parts.

DISTRIBUTION

India, northern part of the western Ghats (Map 8). Flowering starts in August.

SELECTED SPECIMENS

India: Maharastra, Poona Distr., Kochala cha talao, on Chakam-Alandi road, 16 Aug. 1966, *Janardhanan* 68579 (K, L); *ibid.*, 8 Oct. 1966, *Janardhanan* 92784 (K, L); Karnataka (Mysore), Belgaum, Oct., *Ritchie* 1184 (K).

- 21. *Rotala illecebroides*** (Arn. ex Clarke) Koehne, Bot. Jahrb. 1: 161. 1880
 ≡ *Ammannia pentandra* Roxb. var. *illecebroides* (Arn. ex) Clarke in Hooker fil., Fl. Brit. Ind. 2: 569. 1879.
 = *Rotala fysonii* Blatter & Hallberg, J. Bombay Nat. Hist. Soc. 25: 709. 1918. **Type:** India, Tamil Nadu, Anaimalai (Anamally), Dec. 1916, *P. F. Fyson* 3292 (holotype: MH n.v.).
 — *Rotala fischeri* Gamble, nom. in sched., India, Tamil Nadu, Anaimalai Hills (Anaimallais), Attakatti, 1200 m, 27 Dec. 1911, *C. E. C. Fischer* 3218 (K) nom. invalid.

Type: India "Peninsula Ind. Orientalis", *Herb. Wight propr. No. 2317* (holotype: K; isotypes: K, G).

lc.: Fig. 14F-I; Fyson, Fl. S. Ind. Hill Stat. 2: 611. 1932; Rajagopal, T. & Ramayya, N., Curr. Sci. 37: 387. 1968.

Special literature: Rajagopal, T. & Ramayya, N., *Rotala illecebroides* (Lythraceae) — a little known flowering plant from India. Curr. Sci. 37: 386-388. 1968.

Terrestrial or amphibious annual. *Stems* erect or creeping and rooting below, simple or branched above; erect flowering stems up to 10 cm long, slender, 4-angled to 4-winged. *Leaves* decussate, sessile, regularly spaced along the stem, often red above, broadly ovate-cordate, c. 4 mm long, c. 3 mm wide, semi-amplexicaul at base, acute at apex. *Bracts* leaf-like; bracteoles 2, persistent, whitish, linear, equal to or somewhat exceeding the calyx tube in length. *Flowers* monomorphic, sessile, solitary in axils of leaf-like bracts. *Calyx* tube in fruit, scarious, whitish, campanulate, c. 1 mm long; calyx lobes 4, acutely triangular, c. 1 mm long, apiculate at apex; calyx appendages 4, linear, about as long as calyx lobes, spreading in bud. *Petals* minute or absent. *Stamens* 4, or occasionally less; filaments inserted on upper half of calyx tube; anthers level with top of calyx tube. *Ovary* globose; style very short; stigma capitate; capsule globose, red, c. 1 mm long, opening by 4 (or rarely 3) valves, seeds semi-ellipsoidal, c. 0.3 mm long.

DIAGNOSTIC FEATURES

K4 + 4, P0-4, A4, G4; *R. illecebroides* is a very distinct species with regularly spaced ovate-cordate leaves which remain very constant in shape and size, and the calyx tube is equal in length to the calyx lobes and the calyx appendages.

DISTRIBUTION

Central Peninsula India between 18°N. and 12°N. (Map 8).

SELECTED SPECIMENS

India: s. loc., *Wight 2317* (G, K); *ibid.*, *Heyne* (LE). Andhra Pradesh: Hyderabad, *Campbell* (G); Hyderabad, Thummla Kunta, 400 m, *Rajagopal 578* (HY n.v.). Karnataka (Mysore): Anekal, 38 km S. of Bangalore, 11 Nov. 1970, *Cook & Gut 169* (K, Z); Salem Distr., Hosur, 29 Dec. 1916, *Rangachari 13962* (K). Tamil Nadu: Anaimalais, Attakatti, 1200 m, 27 Dec. 1911, *Fischer 3218* (K).

NOTES

I have seen *R. illecebroides* at Anekal about 38 km South of Bangalore. It was growing on a wet flush on a granite hill, the associated species were:

Drosera burmannii Vahl., *Striga euphrasioides* (Vahl.) Benth., *Eriocaulon quinquangulare* L., *Panicum myosuroides* R. Br., *Fimbristylis dichotoma* Vahl., *F. monostachya* Hassk., *F. woodrowii* Clarke and *Cyperus hyalinus* Vahl. Rajagopal & Ramayya (l.c., 1968) reported it to be growing on sandy soil on dripping rocks with *Drosera burmannii*, *D. indica* and various grasses and sedges. It flowers from November to January.

- 22. *Rotala ramosior* (L.) Koehne** in Martius, Fl. Brasiliensis 13(2): 194. 1877
 ≡ *Ammannia ramosior* L., Sp. Pl.: 120. 1763.
 = *Ammannia humilis* Micheaux, Fl. Bor.-Amer. 1: 99. 1803 ≡ *Boykiana humilis* (Micheaux) Rafin., Neogenyton: 2. 1825 — *Boykinia humilis* (Micheaux) Rafin., New Fl. 4: 66. 1838, orth. mut. (*Boykiana* Rafin. and *Boykinia* Rafin. have been rejected in favour of *Boykinia* Nutt. — Saxifragaceae). **Type:** North America, *Micheaux* (holotype: P n.v.).
 = *Ammannia catholica* Cham. & Schlecht., Linnaea 2: 378. 1827, pro var. *philippinensis*, excl. var. *brasiliensis* ≡ *Rotala catholica* (Cham. & Schlecht.) B. van Leeuwen, Blumea 19(1): 54. 1871. **Type:** Philippines, Luzon, *Chamisso* (lectotype: LE, see B. van Leeuwen, op. cit.; isolectotype: G).
 = *Ammannia monoflora* Blanco, Fl. Filip. (ed. 1): 64. 1837. **Type:** Philippines (topotype: Luzon, Manila, Oct.-Nov., *Merrill* 426 and 752: K, L, MO).
 = *Ammannia dentifera* A. Gray, Smithsonian Contrib. Knowl. (Washington) 5: 55. 1853 ≡ *Rotala dentifera* (A. Gray) Koehne, Bot. Jahrb. 1: 161. 1880 ≡ *Rotala ramosior* (L.) Koehne var. *dentifera* (A. Gray) Lundell, Bull. Torrey Bot. Club 69: 395. 1942. **Type:** Mexico, Sonora, Santa Cruz, *Wright* 1063 (holotype: ? US n.v.; isotype: G).
 — *Ammannia ramosa* Hill., Veg. Syst. 11: 14. 1767, nom. illeg.
 — *Peplis occidentalis* Sprengel, Syst. 2: 135. 1825, nom. nud. ≡ *Ammannia occidentalis* (Sprengel) DC., Prodr. 3: 78. 1828.

Type: North America, Virginia, *Clayton (Gronovius)* No. 774 (holotype: BM, see Fernald & Griscom, Rhodora 37: 169. 1935).

lc.: Fig. 15A-G; Martius, Fl. Brasiliensis 13(2): pl. 39, fig. 1. 1877; Mason, Fl. Marshes California, fig. 275 and 276 a-g. 1957.

Chromosome number: $2n = 32$, USA, Texas, Angelina Co., voucher: *Lewis & Oliver* 5273 (SMU) — Lewis, W. H., Stripling, H. L. & Ross, R. G., Rhodora 64: 152, fig. 27. 1962.

Vernacular name in the USA: Toothcap.

Terrestrial or amphibious annual, low and sprawling to erect and spreading. *Stems* creeping and rooting below, ascending above or erect,

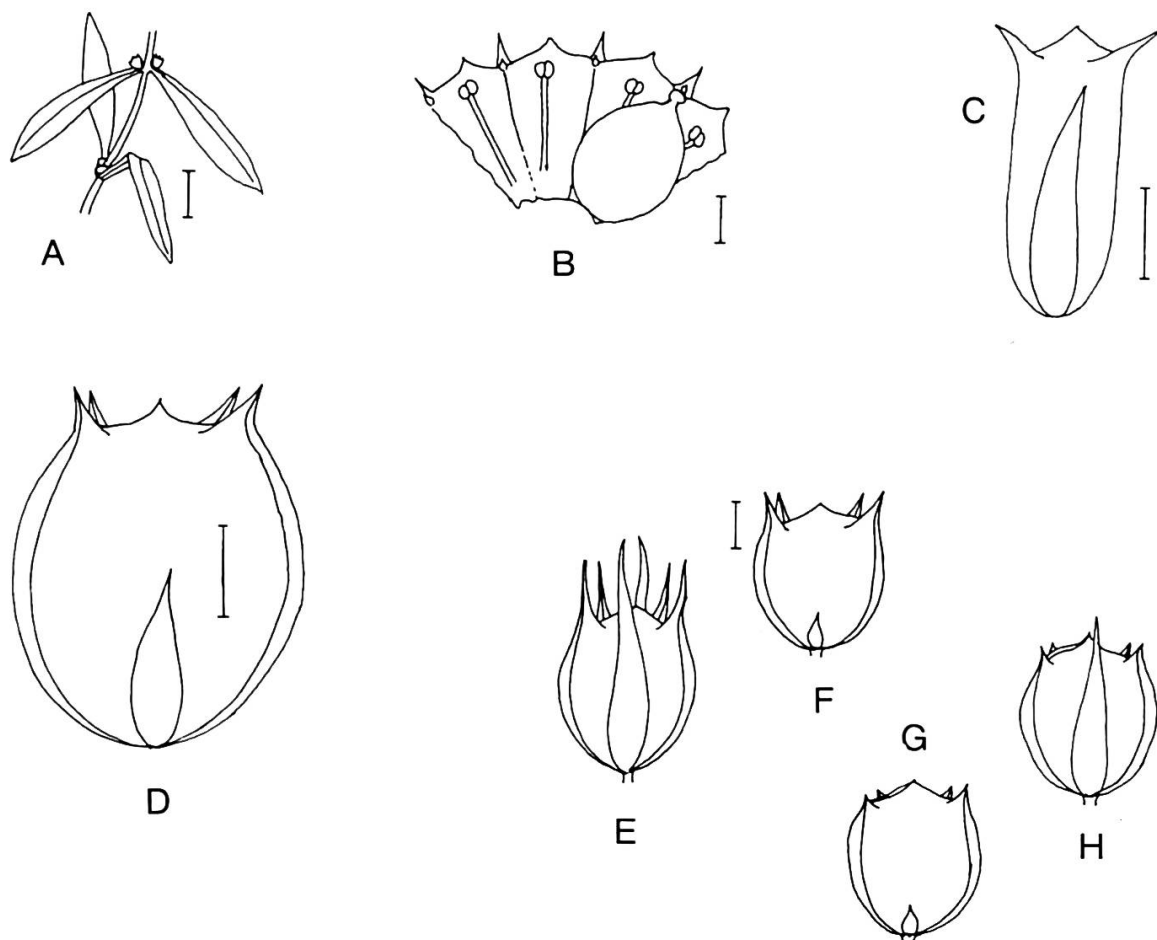


Fig. 15. — *R. ramosior* (A-D, Cook & Rix 103; E, Pringle 4337; F, Curtiss 5901; G, Kiener 17130; H, Langlois 1885); A, bracts and flowers; B, flower dissection; C, flower bud; D-H, mature flowers (scale: A, 1 cm; B-H, 1 mm).

simple or branched; erect flowering stems 1.5-55 cm long (usually 10-25 cm long), weakly 4-angled. *Leaves* decussate, sessile to somewhat petiolate, linear-oblong to elliptic or oblanceolate, up to 45 mm long, 3-7 mm wide, obtuse at apex. *Bracts* leaf-like, cuneate at base; bracteoles persistent, 1-6 mm long, 0.25-1 mm wide, the larger bracteoles somewhat leaf-like. *Flowers* monomorphic, sessile, solitary in axils of bracts. *Calyx* tube in fruit globose, 2-4.5 mm long, greenish-white or tinged with red; calyx lobes 4, shallowly triangular, c. 0.5 mm long, acute or apiculate; calyx appendages 4, triangular or apiculate, spreading in bud, 0.5-2 mm long (usually 0.5-1 mm long). *Petals* 4, minute or up to 0.5 mm long, white or pink, or usually absent. *Stamens* 4; filaments inserted near base of calyx tube; anthers white, included within calyx. *Ovary* globose; style less than 0.5 mm long; stigma capitate; capsule globose, 2-4.5 mm long, enclosed within the calyx, opening by 4 or rarely 3 valves; seeds numerous, semi-pyriform, c. 5 mm long, dark red to brown.

DIAGNOSTIC FEATURES

K4 + 4, P0-4, A4, G4; *R. ramosior* is distinct and not readily confused with other *Rotala* species: characteristic are the relatively long bracts with cuneate bases; calyx appendages spreading in bud; fruits relatively large (up to 4.5 mm diam.), globose and enclosed within the calyx tube. Superficially *R. ramosior* resembles several species of *Ammannia* but on floral characteristics it clearly belongs to the genus *Rotala*.

DISTRIBUTION

R. ramosior is widespread in America between about 50°N. and 30°S., and in the Caribbean Islands (Map 9). It is not known if the absence of *R. ramosior* from most of the Amazon Basin and the Guianas is real or due to insufficient collecting. *R. ramosior* is naturalized in the Philippines on the island of Luzon. It was first collected in the 1820's and probably got there from Mexico through the Spanish Acapulco-Manila galleon route between 1570 and 1812. This is supported by Merrill, E. D., 1954 (The Botany of Cook's Voyages, *Chronica Botanica*, Waltam, Mass. 14(5-6): 193, 273) and by morphological evidence. This Mexican race of *R. ramosior* has also become naturalized in the ricefields of the USA and northern Italy around Vercelli, Cook, C. D. K., 1973 (New and noteworthy plants from the northern Italian ricefields, *Ber. Schweiz. Bot. Ges.* 83(1): 61). It is not certain whether the Italian plants came directly from the Philippines or indirectly from the USA. In the Italian ricefields it grows with weeds from Asia and America. The flowering time is somewhat variable; in the USA and Italy it flowers from June to September, in Central America and the Caribbean from February to December, in South America from March to August and in the Philippines from October to March.

SELECTED SPECIMENS (the distribution in America is far from complete)

United States of America. Washington: Spokane Co., 28 June 1884, *Suksdorf* (M, LE, Z); Falcon Valley, 17 July 1886, *Suksdorf* (G); *ibid.*, 7 Aug. 1909, *Suksdorf* (G, L). Oregon: Dalles City, 18 July 1909, *Suksdorf* (Z). Idaho: Canyon Co., Falk's Store, c. 700 m, 7 June 1910, *Mac Bride* 199 (G). California: Plumas Co., Lake Almanor, 18 Aug. 1949, *Nobs & Galen Smith* 1355 (UC); Butte Co., Butte Sink, 15 Aug. 1946, *Mason & Grant* 13048 (UC); Butte Co., 833 Canal, 4 Sept. 1946, *Mason & Grant* 13110 (UC); Butte Co., 4.5 km W. of Biggs, 27 Sept. 1946, *Mason & Grant* 13134 (UC); Sierra Nevada, Sierra Co., Calpine, c. 1600 m, 19 July 1952, *Mason* 14454 (UC); Lake Co., Thurston Lake, 8 Sept. 1949, *Nobs & Galen Smith* 1853 (UC); Colusa Co., 4 km W. of Williams, 18 July 1949, *Nobs & Galen Smith* 1008 (UC); Sutter Co. Sutter bypass S. of Marysville, ricefield, 29 July 1949, *Nobs & Galen Smith* 1094 (UC); San Joaquin Co., Stockton, 1890-91, *Stanford* (JEPS); Tuolumne Co., Malther, c. 1400 m, 15 July 1936, *Mason* 11256 (G,

LE, UC); Merced Co., Los Banos, Aug. 1921, *Jussel* (JEPS); *ibid.*, 22 July 1948, *Nobs & Galen Smith* 204 (UC); Merced Co., 24 km E. of Gustine, 24 Aug. 1948, *Nobs & Galen Smith* 425 (UC); Fresno Co., 3.5 km W. of Tranquility Junction, Highway 180, 29 July 1941, *Bacigalupi, Wiggins & Ferris* 2683 (UC); Fresno Co., Sandbar, Mendota Pool, 24 Aug. 1948, *Nobs & Galen Smith* 445 (UC); Fresno Co., 8 km S. of White's Bridge, Highway 180, 15 July 1949, *Nobs & Galen Smith* 998 (UC); Fresno Co., 8 km S. of White's Bridge, Highway 180, 15 July 1949, *Nobs & Galen Smith* 998 (UC); Fresno Co., 5 km W. of Orange Core, 4 June 1936, *Hoover* 1270 (UC). Arizona: Apache Pass, 1881, *Lemmon & Wife* 493 (UC). Nebraska: York, c. 600 m, 15 Aug. 1944, *Kiener* 17130 (G). Kansas: Neodesha, 11 July 1937, *Horr* E157 (L). Texas: s. loc., 1848-49, *Wright* (G); Wood Co., Hawkins, *Shinners* 24272 (U); Dallas, July 1879, *Reverchon* (LE); Dallas Co., Bachman's Dam, 24 Aug. 1942, *Lundell* 11630 (UC); Austin, 28 June 1911, *Fischer* (G); Austin, Colorado River, 2 Nov. 1938, *Tharp* (UC); Bastrop, 14 Aug. 1936, *Tharp* 43-432 (UC); Madison Co., Normangee, 11 Sept. 1968, *Correll* 36414 (UC); Hempstead, 1872, *Hall* (LE). Missouri: St. Louis, *Engelmann* (K, L, LE, M, ZT); St. Louis, Mississippi Fl., 22 Aug. 1875, *Eggert* (Z); Columbia, 23 Aug. 1933, *Drouet* 1004 (Z); Centerville, July 1938, *Meebold* 25384 (M); Greer, July 1938, *Meebold* 25266 (M); Butler Co., Bluespring, 19 Aug. 1892, *Eggert* (U); Mc Donald Co., Noel, Butler Creek, 1 Sept. 1913, *Palmer* 4046 (LE). Arkansas: s. loc., *Rafinesque* (G). Louisiana: Maguernine, 12 Aug. 1885, *Langlois* (M); Alexandria, Carey (K); De Soto Parish, Logansport, 12 July 1955, *Shinners* 20501 (U). Michigan: s. loc., Carey (K); Illinois: Peroia, Sept. 1858, *Mendel* (Z); St. Clair Co., E. St. Louis, 4 Aug. 1892, *Eggert* (U). Mississippi: Lowndes Co., Columbus, 9 Aug. 1964, *Demaree* 51271 (G). Massachusetts: Sharon, Massapoag Lake, 7 Sept. 1901, *Williams & Fernald* 25 (G, L, LE, Z); Boston, *Hooker* (LE). There are literature records for Rhode Island and Connecticut. New York: Wading River, 16 Aug. 1872, *Miller* (LE). Pennsylvania: Bucks Co., Morrisville, 13 Sept. 1925, *Diersbach* 4127 (LE). Ohio: s. loc., 1837, *Frank* (G, L, LE); Columbus, *Sullivant* (K); Fernbank, *Steetz* (M); Fernbank, North Bend, *Short* (K); Loveland, 9 Sept. 1877, *James* 947 (K). Indiana: Goldie, *Fischer* (LE); Alleghany Mt., *Gray & Sullivant* (LE). New Jersey: Sussex Co., Panther Pond, 18 Sept. 1904, *Mc Kenzie* 1070 (CGE); Camden, *Martindale* (L). Washington D.C.: Washington, Aug. 1877, *Holm* (G); Washington, 1 Aug.-4 Sept. 1899, *Steele* (G). Virginia: Bedford Co., Sept., *Curtiss* (LE, Z, ZT); Sussex Co., Stony Creek, 24 Aug. 1938, *Fernald & Long* 853 (G, L, LE, U); Stafford C., Falmouth, 12 Sept. 1943, *Illtis* 2299 (LE). Kentucky & Tennessee: s. loc., *Rafinesque* 149 (G); Kentucky: Harlan Co., Harlan Court, Aug. 1893, *Kearney* (G); Bullitt Co., Lake Nevin, 22 Aug. 1954, *Gunn* 1222 (U). North Carolina: Rutherfordton, Sept. 1841, *Rugel* (G, LE); N. Carolina: Tyrrell Co., Columbia, 6 Aug. 1958, *Radford* 39179 (U). Tennessee: Olympia Springs, Aug. 1835, *Peter* (L). Georgia: Chattooga Co., E. of Menlo, 19 Aug. 1951, *Venard & Duncan* 13093 (LE). Florida: Collier Co., 16 km W. of Monroe, 18 Oct. 1936, *Fennell & Jones* 868 (LE); Collier Co., 5 Oct. 1965, *Lakela* 29192 (U); *ibid.*, 14 Sept.

1966, *Lakela* 30232 (U); Key West, *Chapman* (K); *ibid.*, *Blogett & Gray* (K); Jamony, June 1843, *Rugel* (G); De Funiak Springs, 22 June 1897, *Curtiss* 5901 (CGE, G, LE, Z); Apalachicola, Aug. 1897, *Chapman* 2015 (Z); Indian River, July, *Curtiss* 947 (LE, M); Dade Co., Everglades, Perrine, 18 Nov. 1916, *Small* 7879 (G). **Mexico:** Sinaloa, Culiacan, 23 Nov. 1939, *Gentry* 5011 (MO); Sinaloa, N.E. Imala, 450 m, 22 Oct. 1973, *Breedlove* 35591 (MO); Chihuahua, Rio Mayo, Guasaremos, 27 Sept. 1935, *Gentry* 1876 (MO); St. Jalisco, Guadalajara, Nov. 1892, *Pringle* 4337 (G, LE, M, MO, Z); *ibid.*, *Pringle* 4337A (G, M); *ibid.*, 14 Oct. 1895, *Pringle* 7365 (G); *ibid.*, 5 Aug.-5 Dec. 1902, *Pringle* 11279 (L, MO, NSW, Z); Morelia, Aug. 1909, *Arsène* (G); Tampico, Tamaulipas, sea level, Feb. 1910, *Palmer* 299 (MO); Guerrero, 28 km W. of Chilpancingo, 2000 m, 24 Oct. 1944, *Sharp* 441489 (MO); Vera Cruz, Corral de Piedras, Oct. 1918, *Purpus* 8242 (MO); Chiapas, Tonalá, Puerto Arista, 3 m, 18 Oct. 1971, *Breedlove & Thorne* 20888 (MO); Temascaltepec, Tenayac, 18 Aug. 1933, *Hinton* 4444 (G). **Guatemala:** s. loc., 1841, *Friedrichsthal* (LE); Izabal, Quiriguá, May 1922, *Standley* 24172 (MO); Retalhuleu, Nov. 1875, *Bernoulli & Cario* 2780 (LE). **Belize:** Toledo Distr., Forest Home, 50 m, 18 Dec. 1933, *Schipp* 5492 (MO). **El Salvador:** Dept. Morazán, Divisadero, (13°36'N., 88°02'W.), 210 m, 14 Dec. 1941, *Tucker* 543 (G, MO). **Costa Rica:** Guanacaste, Comeko, 5 km N.W. Bagaces, 26 Nov. 1973, *Opler* 1921 (MO); Guanacaste, 10 km S. Las Canas, 10 March 1965, *Godfrey* 66970 (MO). **Cuba:** Santa Clara, Mordazo, 9 Aug. 1923, *Ekman* 17040 (G). **Dominican Republic:** Santa Domingo, *Bertero* comm. *Balbio* (M); *ibid.*, Dec. 1930, *Ekman* 16532 (G). **Puerto Rico:** Coamo, 16 Dec. 1885, *Sintenis* 3099 (LE, M); Bayamon, Oct. 1886, *Stahl* 588 (L, Z); Fajardo to Ceiba, March 1913, *Britton & Shafer* 1513 (MO). **Guadeloupe, Martinique, Barbados, Trinidad** — literature records. **Colombia:** Santa Marta, 30 m, March 1898-1901, *H. H. Smith* 1966 (LE, MO, U); Cundinamarca, c. 150 m, 5 Dec. 1917, *Pennell* 2933 (MO); Huila, Villavieja, 450 m, in ricefields, 13 July 1950, *Galen Smith* 1212 (MO). **Venezuela:** Cabo Blanco, 20 Feb. 1922, *Pittier* 10202 (G). **Brazil:** s. loc., 1837, *Sellow* (L, E); Salvador (Bahia), 1838 or earlier, *Salzmann* 243 (G, LE, M). **Ecuador:** Prov. Manabi, Manta, 6 April 1955, *Asplund* 15979 (G, Z); Guayaquil, 1845, *Jameson* 382 (G); Chanduy, "litore Maris Pacifici", 1865, *Spruce* 6385 (G, LE). **Peru:** Dept. Loreto, Caballo Cocha, on Amazon River, Aug. 1929, *Llewelyn Williams* 2299 (MO). **Bolivia:** Dept. Santa Cruz, Sara, 400 m, July 1924, *Steinbach* 6086 (G). **Paraguay:** Gran Chaco, 10 June 1903, *Pride* (K); Cordillera de Altos, May 1913, *Hassler* 12615 (K). **Argentina:** Prov. Formosa, Laishi, March 1924, *Herb. Mis. Furanciscanas* (BAF); Prov. Corrientes, Riochuelo, ricefield, 1973, *Cristobal & Schiekini* (?*Schinini*) 1011 (MO, ZT). **Philippines.** Luzon: s. loc., *Chamisso* (G, LE); Ilocos, Bangui, Mar. 1909, *Ramos* 7688 (NSW); *ibid.*, Feb.-Mar. 1917, *Ramos* 27639 (MO); Manila, *Eschscholtz* (LE); *ibid.*, Nov. 1903, *Merrill* 3667 (K); *ibid.*, Nov. 1909, *Merrill* 17 (G, M, Z); *ibid.*, 21 Nov. 1910, *Merrill* 8015 (G, MO); *ibid.*, Oct.-Nov. 1914, *Merrill* 426 (K); *ibid.*, *Merrill* 752 (K, L); *ibid.*, Oct. 1914, *Merrill* 9782 (K, mixed with *R. rosea*); *ibid.*, 27 Dec. 1903, *Hallier* 4214 a (L); *ibid.*, *Loher* 2153 (K); *ibid.*, Nov. 1905, *Loher* 6104 (K). **Italy:** Prov. Vercelli,

Prarolo, 23 Aug. 1972, *Cook & Rix 102 and 103* (Z); *ibid.*, 2 km N. Prarolo, 20 Aug. 1974, *Krattinger & Schneller* (Z); *ibid.*, 1 km N. Prarolo, 21 Aug. 1974, *Krattinger & Schneller* (Z).

NOTES

Ecology. — *R. ramosior* is usually found in annually inundated areas. The seeds germinate when submerged; flowering and fruiting takes place as the habitat dries out. It is also a relatively widespread weed in ricefields. Sometimes it is found in shallow permanent water in ponds and streams and occasionally on wet grounds in marshes. It is frequently associated with various species in the following genera: *Cyperus*, *Eleocharis*, *Bergia*, *Elatine*, *Lindernia* and *Bacopa*.

Variation. — I have cultivated *R. ramosior* collected from North Italy under various conditions in the University of Zürich botanic gardens. *Rotala ramosior* is an obligate annual. It is self-compatible and is normally self-pollinated; the flowers frequently never open but set copious seed.

The degree of branching, length and number of internodes and length and width of the leaves are readily modified by environmental factors. Solitary plants in a wet, rich potting mixture have large leaves with branched stems up to 50 cm tall. Solitary plants in moist sand or crowded plants in rich soil have simple, short stems and small leaves. Plants grown in poor conditions flower very early, occasionally the first foliage leaves bear flowers.

The length of the calyx tube and the size of the fruit can be modified by environmental factors; on well grown plants the first flowers and fruits are smaller than the later ones and on poorly grown plants the flowers and fruits remain small. The bracteoles are more complicated in their variation. Some races have small bracteoles (c. 1 mm long) that are non-acrescent and remain small as the fruit develops (Fig. 15F, G); other races have longer bracteoles that are sometimes acrescent and either continue growth as the fruit matures (Fig. 15E, H) or they are non-acrescent (Fig. 15D). Occasionally, acrescent and non-acrescent bracteoles are found on the same plant (Fig. 15C, D).

The calyx lobes are shallowly triangular and about 0.5 mm long; within and between plants they remain more or less constant in shape and size. The calyx appendages are more or less constant in size on any particular plant but very variable between plants (the minimum length is 0.5 mm, the maximum is 2.0 mm). Acrescent bracteoles are usually but not invariably associated with long calyx appendages; the two extreme states are rather unlike (compare Fig. 15E and Fig. 15G). However, all degrees of intermediacy between these extreme states are found (Fig. 15F, H). The type of *R. ramosior* has short bracteoles and short calyx appendages. The type of *R. catholica* (= *R. dentifera*) has long but not extremely long bracteoles and long but not extremely long calyx appendages. Because there is continuous variation in these characters I am not willing to recognise two species. However, the

morphological variability is correlated with geographical distribution. It is hoped to publish a detailed description of the geographical variation of *R. ramosior* elsewhere but, generally speaking, the plants with extremely long bracteoles and calyx appendages are found in Central Mexico and there are clines of decreasing length going South and North. The race that became established in the ricefields of the Philipinnes (variable bracteoles and middle-long calyx appendages) has also become established in ricefields in Italy and America. This has the consequence that the cline becomes interrupted in rice growing areas. This is particularly well marked in the USA in Central California where very different looking plants may be found growing relatively close together. The very high degree of inbreeding may prevent hybridization.

- 23. *Rotala fimbriata*** Wight, Ic. Pl. Ind. Or. 1: t. 217. 1840 $\equiv$ *Ammannia pentandra* Roxb. var. *fimbriata* (Wight) Clarke in Hooker fil., Fl. Brit. India 2: 569. 1879 (excl. syn. *Ammannia hexandra* Wallich).
— *Ammannia heyneana* Wallich, Cat. No. 2104. 1828, nom. nud.

Type: it is not certain which of Wight's collections was used as the basis of his illustration, Wight's plate (t. 217) loc. cit. can be accepted as lectotype.

Ic.: Fig. 16A-D; Wight, Ic. Pl. Ind. Or. 1: t. 217. 1840.

Amphibious annual. *Stems* creeping and rooting below, erect above, up to c. 50 cm tall, simple or branched, weakly 4-angled. *Leaves* decussate, sessile, lanceolate to oblong, 1-3 cm long, obtuse at apex; lower leaves cuneate to cordate at base; upper leaves cordate or auriculate at base. *Bracts* like upper leaves, usually somewhat auriculate at base; bracteoles acute-triangular to subulate, usually somewhat less than 1 mm long. *Flowers* monomorphic, sessile, solitary in axils of leaf-like bracts. *Calyx* tube campanulate, 2-2.5 mm long, disintegrating in fruit; calyx lobes 5 or rarely 6, deltate, c. 0.5 mm long; calyx appendages absent; interjected folds rudimentary. *Petals* 5 or rarely 6, pinnately divided into linear segments, 2-3 mm long, bright pink, showy. *Stamens* 5 or rarely 6; filaments 3-3.5 mm long, attached to base of calyx tube thus appearing free; anthers exerted, borne level with the stigma, deep brown before dehiscence. *Ovary* ellipsoidal; style c. 2 mm long, exerted; stigma capitate; capsule elongate-ellipsoid, c. 3 mm long, opening by 3 valves; seeds semi-ellipsoidal, c. 1.5 mm long.

DIAGNOSTIC FEATURES

K5(-6), P5(-6), A5(-6), G3; petals fimbriate, pinnately divided into linear segments; seeds exceptionally large, c. 1.5 mm long.

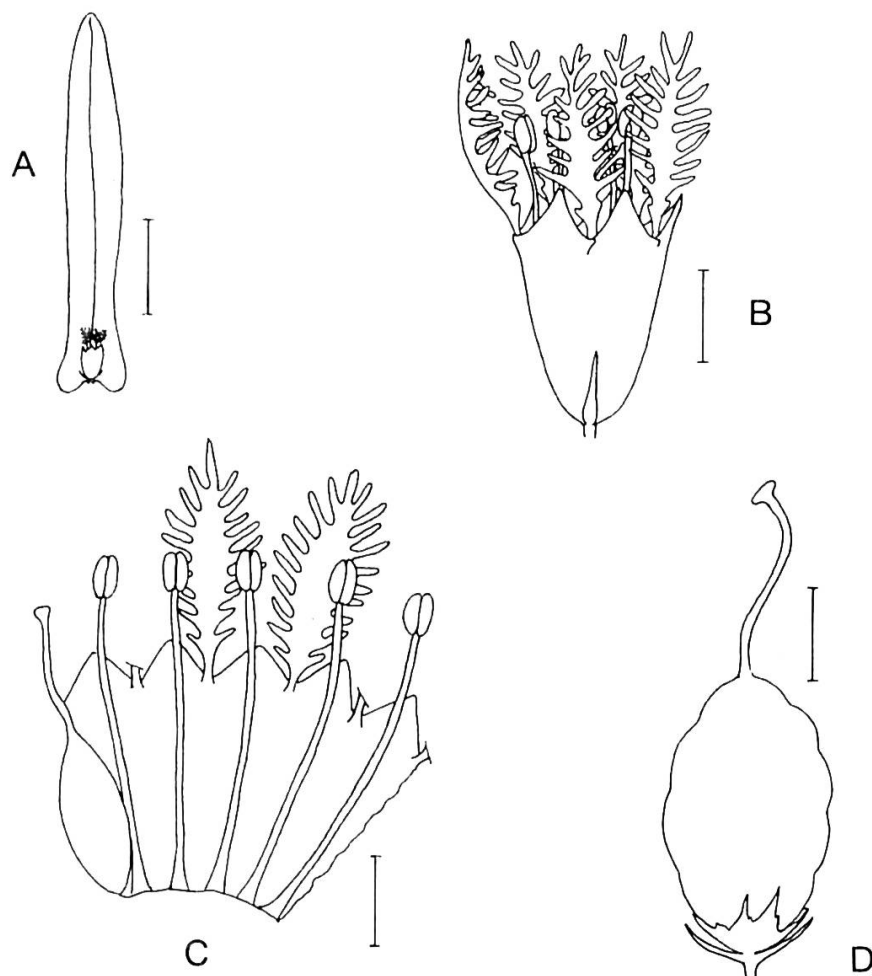


Fig. 16. — *R. fimbriata* (Cook & Gut 107); A, bract and flower; B, flower; C, flower dissection; D, mature capsule (scale: A, 5 mm; B-D, 1 mm).

DISTRIBUTION

Endemic in peninsular India between latitude 12°N. and 16°N., up to an altitude of about 1300 m (Map 8). The flowering time is from August to December, seeds germinate at the beginning of the Monsoon.

SELECTED SPECIMENS

India: s. loc., ex Herb. Heyne, 1832, *Wallich 2104* (CGE, G — one sheet mixed with *R. rosea*, K-W, LE); s. loc., probably Karnataka (Mysore), *Wight 975* (K, L, LE, M, MEL). Goa, Daman et Din: Sanvardem, Oct. 1908, *Meebold 10282* (fide Blatter & Hallberg). Karnataka (Mysore): Badami, Sept. 1911, *Bhide* (fide Blatter & Hallberg); Bangalore, Campus of the Agricultural University, 4 Nov. 1970, *Cook & Gut 107* (K, Z); *ibid.*, Paddy testing fields,

5 Nov. 1970, *Cook & Gut 113* (K, Z). Tamil Nadu: Horsley Konda, Aug. 1889, *Gamble 21171* (K); *ibid.*, 3 Sept. 1918, *Fischer* (K).

NOTES

I have studied this species around Bangalore. It grew in ricefields, the commonest associated species were: *Rotala densiflora* (Roth ex Roemer & Schultes) Koehne, *Dopatrium junceum* (Roxb.) Buch.-Ham., *Lindernia hyssopioides* (L.) Haines, *Lindernia antipoda* (L.) Alston, *Myriophyllum oliganthum* (Wight & Arn.) F. v. Müller, *Leptochloa chinensis* (L.) Nees, *Cyperus difformis* L. and *Fimbristylis littoralis* Gaudich. It was also found in small rock pools that dry out after the Monsoon; it usually grew in dense, single species stands or occasionally mixed with *Rotala densiflora*. When growing in dense stands the flowers are conspicuous and attractively scented.

I have cultivated *R. fimbriata* at Zürich from seeds collected at Bangalore. The seeds germinate submerged in water or in wet soil. Flowering is precocious; the first flowers develop in the axils of the 3rd or 4th leaf pairs. The cultivated plants were self-compatible and efficiently self-pollinated. Except for occasional 6-merous flowers, the form and size of the flowers remains very constant; 4-merous flowers have been reported but I have not seen any in the examined material.

- 24. *Rotala densiflora*** (Roth ex Roemer & Schultes) Koehne, Bot. Jahrb. 1: 164. 1880 $\equiv$ *Ammannia densiflora* Roth ex Roemer & Schultes, Syst. Veg. 3: 304. 1818 $\equiv$ *Dithea densiflora* (Roth ex Roemer & Schultes) Miq., Fl. Ind. Bat. 1(1): 1855.
 $\equiv$ *Sellowia uliginosa* Roth ex Roemer & Schultes, Syst. Veg. 5: 407. 1819 $\equiv$ *Winterlia uliginosa* (Roth ex Roemer & Schultes) Sprengel, Syst. 1: 788. 1824. **Type:** India orientali, *B. Heyne* (isotype: L — not the same specimen as the type of *R. densiflora*).
 — *Rotala roxburghiana* Wight, Ic. Pl. Ind. Or. 1: t. 260B, 1840, nom. illeg. based on *Ammannia pentandra* Roxb.
 — *Ammannia pterocaulon* Edgeworth 3029, nom. in sched. (K).

Type: India orientali, *B. Heyne* (isotype: L).

Ic.: Fig. 17A-H.

Amphibious or terrestrial annual. *Stems* erect, rooting at base, tetragonal and usually winged but wings not running directly into the leaves or bracts, up to 40 cm or more tall, simple or branched; lower branches erect like the primary stem; upper branches slender, usually opposite and spreading, usually fertile with leaf-like bracts considerably shorter than foliage leaves. *Leaves* decussate (on upper portion of the stem alternate

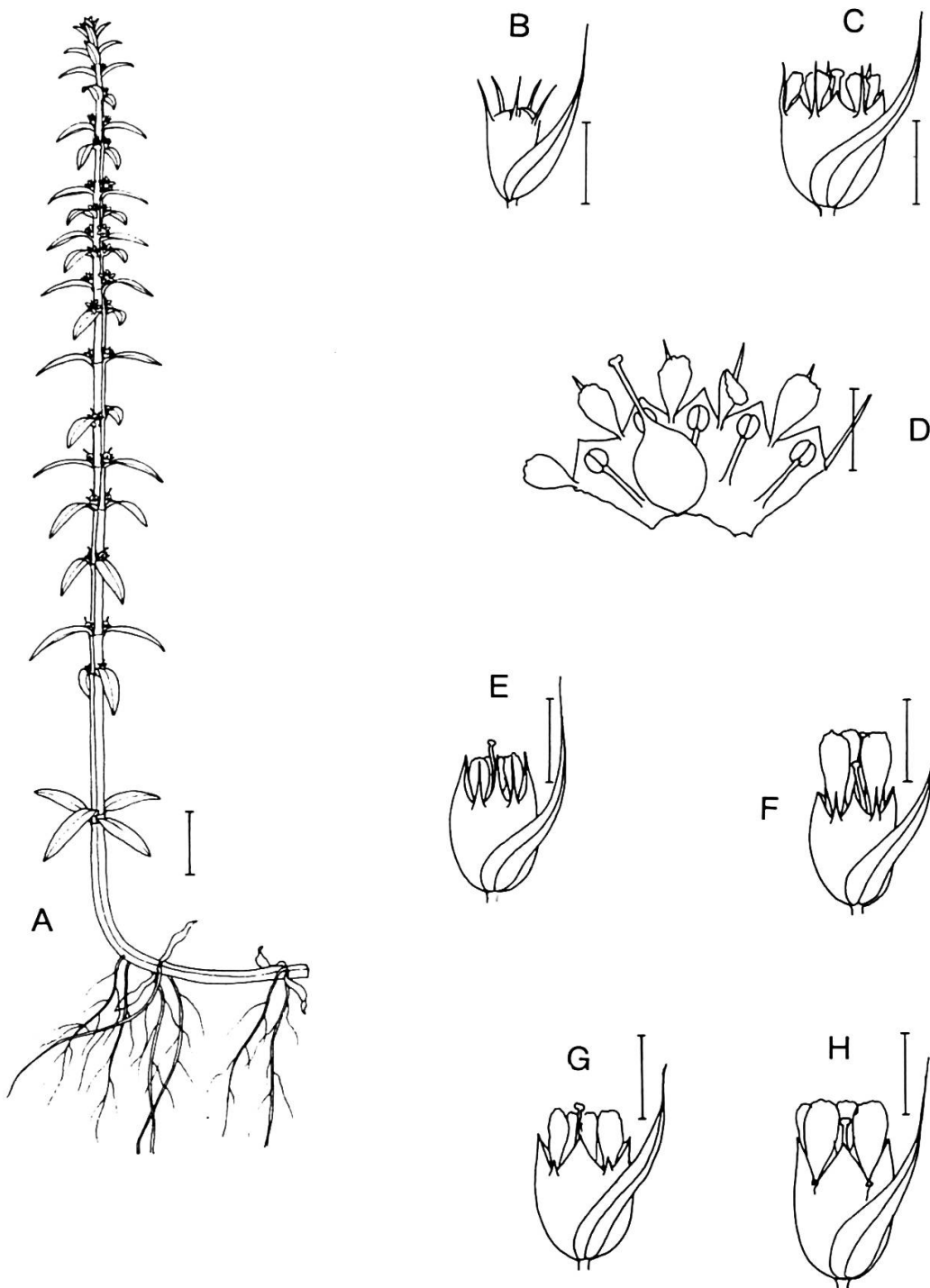


Fig. 17. — *R. densiflora* (A-D, Cook & Rix 101; E, Sedgwick & Bell 7563; F, Gamble 8765; G, Sedgwick & Bell 4874; H, Cook & Gut 114); A, habit; B, flower bud; C, flower; D, flower dissection; E-H, flowers (scale: A, 1 cm; B-H, 1 mm).

internodes are often shortened thus leaves may appear to be in whorls of 4), very variable in shape and size (even on a single plant), linear-lanceolate to ovate or oblong, 2-35 mm long, at base cordate to obtuse, at apex obtuse to acute or acuminate. *Bracts* almost dimorphic; on the main stem or on lower branches bracts like foliage leaves; on the upper lateral branches bracts usually ovate to broadly ovate, much shorter than foliage leaves and sometimes scarcely exceeding the flowers; bracteoles pinkish, lanceolate to oblong-ovate, usually with a distinct midrib, attenuate at apex, at maturity as long as or exceeding the calyx. *Flowers* monomorphic, solitary and sessile or subsessile in the axils of bracts. *Calyx* tube campanulate at anthesis becoming subglobose in fruit, 1-1.5 mm long; calyx lobes 5 or rarely 4, triangular to shallowly triangular, acute to acuminate, c. 0.5 mm long; calyx appendages alternating with calyx lobes, usually linear or capillary, as long as or up to 2 times as long as calyx lobes or rarely rudimentary or absent, usually erect in bud, becoming brittle in fruit and often breaking off. *Petals* 5 or rarely 4, obovate, obtuse, occasionally erose or 2-lobed at apex, bright pink or rarely white, persistent but losing colour in fruit, 0.5-1 mm long, at least as long as the calyx lobes. *Stamens* 5 or rarely 3 or 4; filaments inserted just below the middle of the calyx tube; anthers borne about level with the calyx lobes. *Ovary* globose; style 0.5-1 mm long; stigma capitate, exerted; capsule globose, occasionally flattened above, about as long as calyx tube, opening by 3 valves; seeds semi-ovoid, c. 0.5 mm long.

DIAGNOSTIC FEATURES

K(4-)5 + (4-)5 (or calyx appendages rarely rudimentary or absent), P(4-)5, A(3, 4-)5, G3; capsule not exceeding the calyx; style exerted, 0.5-1 mm long; bracteoles as long as or exceeding the calyx; bracts almost dimorphic, long on main axis or lower branches, short on upper lateral branches; petals longer than calyx lobes.

DISTRIBUTION

Western Himalaya (Tadzhik, Pamir, N. Pakistan and N. India), absent from the N. Indian Plain, reappearing in the hills of N.E. India (Assam and Manipur), widespread in peninsular India, Sri Lanka, Australia (E. Queensland) and isolated collections in Sabah (N. Borneo) and N. Italy (Prov. Vercelli) (Map 10). *Rotala densiflora* is certainly a relatively recent introduction to N. Italy (COOK, 1973). In Australia it is almost certainly native as it was collected by Banks & Solander in 1770 on Cook's first voyage.

SELECTED SPECIMENS

USSR. Central Asia: Sry Darya, Mzlikstan, 27 Sept. 1932, *Variter & Alektorolea* (LE); Pamir-Alai, W. part of Pamir-Alai, Kasha Darya Valley, 1938, *Goucarov* (LE). **Pakistan:** Kurram, Shálizán, 10 Aug. 1880, *Aitchison 417* (K,

LE). **Pakistan** or **India** (exact location not found): Kashmir, Pir Pātšāski or Kishtār Pass to Islamabad, 5-10 Aug. 1856, *Schlaginweit* (G); W. Himalaya, *Griffith* (CGE, G, L, M, Z); N.W. Frontier, Ba(o)tel, Hazaru(n), Sept. 1907, *Deane* (K); N.W. Himalaya, between Dharmasala and Dadh, 1350 m, 22 Aug. or Sept. 1896, *Gammie 18678* (K); *ibid.*, 22 Aug. 1896, *Duthie 18678* (LE); N.W. India, *Royle* (LE). **India**. Kashmir: Sringagar, 10 Aug.-30 Sept. 1856, *Schlaginweit 4273* (L, LE); Dal Lake, Shalimar, 1850 m, 4 Aug. 1917, *Stewart 3226* (K); *ibid.*, *Stewart 23062* (K); *ibid.*, ricefields, 17 Aug. 1917, *Stewart 3319* (K); Nowb?g, 13 Sept. 1876, *Clarke 31239* (K); Erin Nallah, 3 Aug. 1960, *Malhotra 12222* (L). Himachal Pradesh: Manali, Kuln Valley, 1850 m, 2 Aug. 1964, *Maas 14088* (L); Simla, Aug., *Edgeworth 3029* (K); Chanda Distr., 18 Dec. 1889, *Duthie 9479* (K). Maharashtra: Bombay, *Dalzell* (K); Lonavala, Malavi, c. 700 m, Sept. 1920, *Sedgwick & Bell 7435* (K); *ibid.*, 7437 (K); *ibid.*, 7440 (K); Mahabaleshwar, 1500 m, Oct. 1920, *Sedgwick & Bell 7443* (K); *ibid.*, Nov. 1918, *Sedgwick & Bell 579* (K); Pauchgani, 135 m, Oct. 1920, *Sedgwick & Bell 7563* (K); Kahandala, *Meebold 8909* (Z). Karnataka (Mysore): N. Kanara, Karwar, Dec. 1918, *Sedgwick & Bell 5035* (K); N. Kanara, Kumat (Coompta), 17 Dec. 1884, *Talbot 271* (K); N. Kanara, Honavar (Honore), sea coast, 19 Nov. 1884, *Talbot 46* (K); Kalinadi, 600 m, Nov. 1918, *Sedgwick & Bell 4874* (K); S. Kanara, Mangalore, *Hohenacker 1611* (G, K, L, LE, M, Z); Belgaum, Belgaum, Sept., *Ritchie 1749* (K); *ibid.*, Oct. 1852, *Ritchie 1185* (K); Hassan Distr., 10 km before Arsikere, 25 Jan. 1971, *Ramamoorthy HFP1258* (MO); Hassan Distr., Magadi, 15 Jan. 1969, *Saldanke 12262* (MO); Bangalore, University of Agriculture Campus, 5 Nov. 1970, *Cook & Gut 114* (K, Z); probably Karnataka (Mysore), *Wight 974* (M, MEL); *ibid.*, *Wight 1026* (G); *ibid.*, *Wight 1027* (G, K, L, LE, NSW — this number represents several different collections). Kerala: Wynad, *Beddome 3113* (Z); Ernakulam, nr. Piravam, c. 50 m, 18 Sept. 1973, *Cook, Rix & Schneller 289* (Z); 12 km E. of Ernakulam, sea level, 18 Sept. 1973, *Cook, Rix & Schneller 295* (Z); half way between Trivandrum and Quilon, 27 Sept. 1973, *Cook, Rix & Schneller 353* (Z). Tamil Nadu: Distr. Salem, Hofanakkal, 260 m, 10 Feb., or 2 Oct. 1927, *Jacob 17984* (K). Andhra Pradesh: Hyderabad, *Campbell* (G). Madhya Pradesh: Chota Nagpur, Jashpurnagar, c. 800 m, 25 Nov. 1890, *Wood 126* (K). Bihar: Chota Nagpur, Hazaribagh, Mandu, 25 Nov. 1874, *Clarke 25034C* (LE); Singbhum, 7 Dec. 1903, *Haines 713A* (K); W. Ranchie, Lahardaga, 650 m, Nov. 1880, *Gamble 8765* (K). Orissa: Kalahandi, Jamchua, 650 m, 22 Jan. 1943, *Mooney 2179* (K); Gangpur, Dalakudar, 23 Feb. 1946, *Mooney 2617* (K mixed with *Ammannia*). Assam: Khasi Hills, Jumbulpore, *Griffith* (L, M); Jaintia Hills, River Mungut, 1000 m, 21 Oct. 1867, *Clarke 5920* (LE). Manipur: Imphal, c. 800 m, 12 Dec. 1954, *Bullock 859* (K, L). **India** or **Bangladesh**. Bengal, s. loc., *S. Kurz* (M). **Sri Lanka**: s. loc., *Thwaites 1548* (BR, G, LE); s. loc., 1829, *McRue-Lindley* (K). **Australia**: s. loc., "New Holland", 1770, *Banks & Solander* (NSW). Queensland: Brisbane River, Aug. 1855, *F. v. Müller* (K); Brisbane Rifle Range, March 1917, *Langman* (K); Brisbane, Geebung, 2 April 1934, *Blake 5305* (K); Atherton, May 1910, *Betche 81901* (MEL, NSW); Moreton Bay, *F. v. Müller*

(MEL); Port Mackay, *Dietrich 2544* (MEL). **Sabah (N. Borneo):** Usukan to Khota Balud, Kinabalu trip, 27 Oct. 1915, *Clemens 9766* (K). **Italy:** Prov. Vercelli, Prarolo, c. 6 km S.E. Vercelli, 24 Aug. 1972, *Cook & Rix 101* (K, Z).

NOTES

I have seen *Rotala densiflora* in N. Italy and in India at Bangalore and three localities in Kerala. Except for some rockpools near Bangalore where it was growing with *R. fimbriata*, it was always in ricefields with other ubiquitous ricefield weeds and almost invariably growing together with *R. indica*. In Kerala, in addition to *R. indica* it was usually growing intermingled with *R. malampuzhensis* and *R. rosea*.

I have cultivated material at Zürich collected from Italy (*Cook & Rix 101*) and India, Bangalore (*Cook & Gut 114*) and Ernakulam (*Cook, Rix & Schneller 289*). In cultivation all three populations were alike. The cultivated plants were annual and self-compatible with efficient self-pollination. The first flowers develop on the main axis in the axils of leaf-like bracts; these flowers usually have much shorter calyx appendages and in some cases the appendages are rudimentary or absent (Fig. 17G, H); these early flowers are occasionally 4-merous. On poorly grown or crowded plants, side branches rarely develop and all flowers may have reduced calyx appendages. On well-grown plants the majority of flowers are borne on lateral branches with small bracts; these flowers usually have long calyx appendages and 5-merous flowers. The length of the style and the bracteoles remains under all conditions relatively constant. The length and shape of the petals is variable but does not appear or follow any discernable pattern.

From the rather limited amount of Australian material examined, the plants appear to have 3 stamens. There is no doubt that *R. densiflora* is native in Australia as it was first collected by Banks & Solander in 1770. These plants may be worthy of taxonomic recognition below the rank of species.

On mature stems alternate internodes are often shortened and thus the leaves appear in whorls of 4. It is possible that other species have evolved to the whorled leaved state by irregular growth of internodes. This phenomenon is described by COOK (1978).

25. *Rotala rosea* (Poiret) C. D. K. Cook, *comb. nova* $\equiv$ *Ammannia rosea* Poiret in Lamarck, *Encycl. Méth. Bot. Suppl.* 1: 329. 1810.

= *Ammannia pentandra* Roxb., *Fl. Ind.* (ed. 1) 1: 448. 1820 $\equiv$ *Tritheca pentandra* (Roxb.) Miq., *Fl. Ind. Bat.* 1(1): 614. 1855 $\equiv$ *Rotala pentandra* (Roxb.) Blatter & Hallberg, *J. Bombay Nat. Hist. Soc.* 25: 707. 1918, pro parte, pro basionym et syn. *R. leptopetala*. **Type:** Roxburgh, *Flora Indica*, unpublished plate No. 548 (holotype: K).

= *Ammannia littorea* Miq., *Prol. Fl. Jap.*: 149. 1866 $\equiv$ *Rotala littorea* (Miq.) Nakai, *Chôsen-Shokubatsu*: 359. 1914. **Type:** Japan, pr. Simonose Ky, *Miquel* (holotype: L).

- = *Rotala densiflora* (Roth ex Roemer & Schultes) Koehne var. *formosana* Hayata in Matsumura & Hayata, Enum. Pl. Formos.: 149. 1905. **Type:** not located.
- *Ammannia leptopetala* Blume, Mus. Bot. Lugd. Bat. 2: 134. 1856 ≡ *Rotala leptopetala* (Blume) Koehne, Bot. Jahrb. 1: 162. 1880, pro parte, emend. Koehne, Bot. Jahrb. 3: 388. 1883; nom. illeg. based on *Ammannia pentandra* Roxb.
- *Ammannia repens* Heyne, nom. in sched.

Type: Indes orientales, herb. *Desfontaines* (holotype: FT).

lc.: Fig. 18A-H.

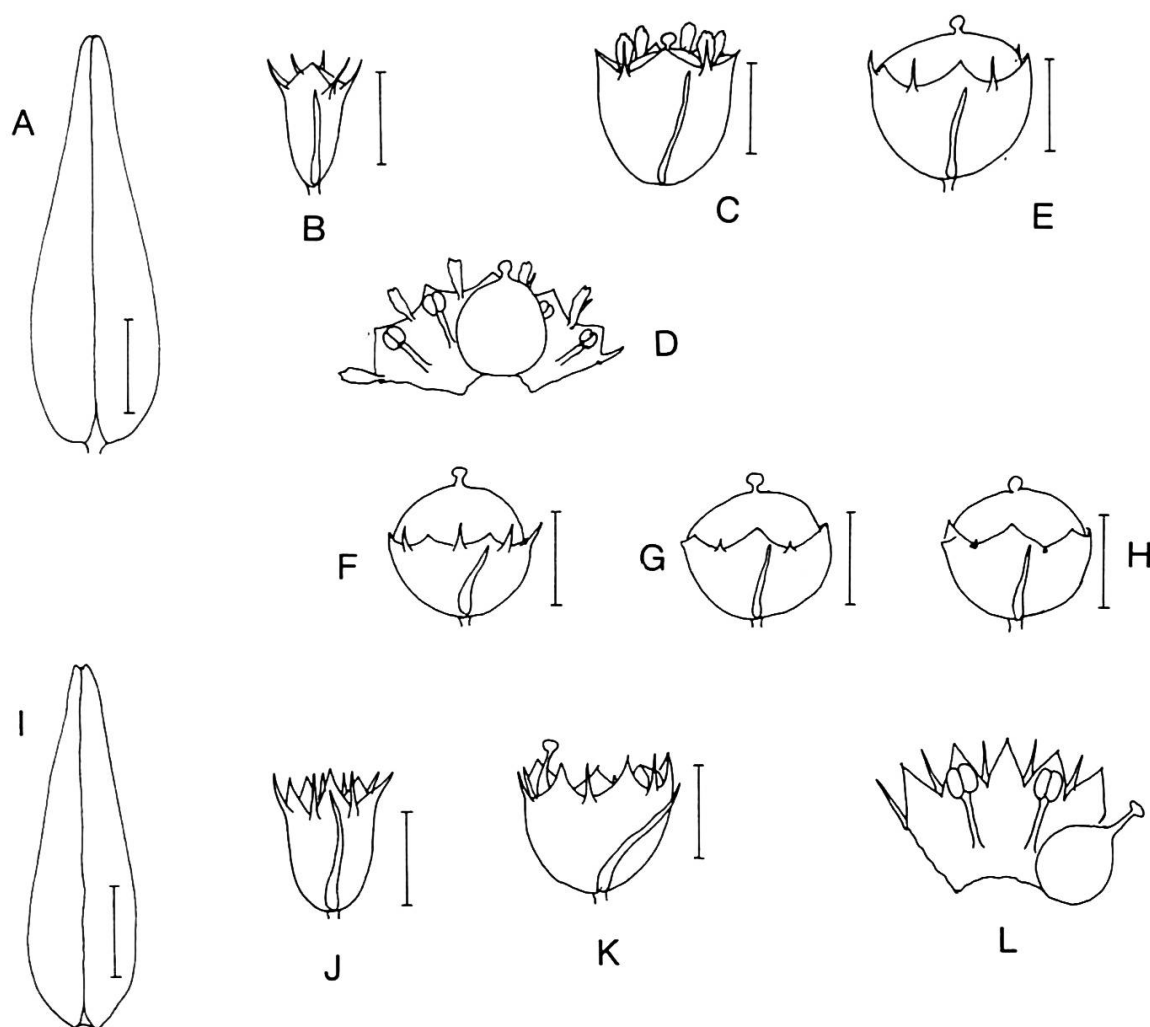


Fig. 18. — *R. rosea* (A-E, Merrill 9432; F, Cook & Gut 32; G, Taquet 1462; H, Sedgwick & Bell 4330); A, bract; B, flower bud; C, flower; D, flower dissection; E-H, mature capsules.

R. verdcourtii (Verdcourt 2854); I, bract; J, flower at anthesis; K, flower with dehiscent capsule; L, flower dissection (scale: 1 mm).

Amphibious or terrestrial annual. *Stems* erect, rooting at base, simple or branched from below, rarely branched above, rarely more than 30 cm tall. *Leaves* decussate, linear-lanceolate to ovate, at base obtuse or cuneate, at apex obtuse or acute. *Bracts* like foliage leaves, usually obtuse at base; on the rarely developed upper lateral branches bracts smaller than foliage leaves but always longer than the flowers; bracteoles linear or capillary, 0.5-1 mm long, not exceeding the calyx tube. *Flowers* monomorphic, solitary and sessile in the axils of bracts. *Calyx* tube campanulate at anthesis becoming semi-globose as the fruit ripens; calyx lobes 5 or rarely 4, shallowly triangular, c. 0.25 mm long; calyx appendages alternating with calyx lobes, subulate, spreading in bud, usually about as long as the calyx lobes, c. 0.25 mm, rarely longer or rarely rudimentary or absent. *Petals* 5 or rarely 4 or rarely rudimentary, not persisting in fruit, up to 0.25 mm long. *Stamens* 5 or rarely less; filaments inserted just below the middle of the calyx tube; anthers included, borne level with the top of the calyx tube. *Ovary* globose; style very short, absent to 0.25 mm long; stigma capitate; capsule globose, about 2 times as long as calyx tube, up to 2 mm diam., usually red above, opening by 3 valves; seeds semi-ovoid, c. 0.3 mm long, straw coloured.

DIAGNOSTIC FEATURES

K(4-)5 + (-4)5 (or calyx appendages rarely absent or rudimentary), P(4-)5, A(3, 4-)5, G3; capsule about 2 times as long as calyx tube, bright red above; style very short, less than 0.25 mm long; petals c. 0.25 mm long, not persisting in fruit.

DISTRIBUTION

India, S.E. Asia to New Guinea, Philippines, S. China, Korea and Japan up to latitude 40°N. (Map 11). In tropical regions it may be found flowering at any time of the year but in temperate regions it flowers from August to October.

SELECTED SPECIMENS

India: s. loc., *Wallich 2105* (CGE, G, LE); *ibid.*, *Ritchie* (K); N.W. India, s. loc., *Royle* (LE); Concan, s. loc., *Law* (K). Punjab: nr., Indri, 1888-1889, *Drummond* (K). Rajasthan: Kota, 28 Oct. 1970, *Cook & Gut 32* (K, Z). Karnataka (Mysore): N. Kanara, Sidashyagud, 2 Aug. 1883, *Talbot 586* (K); N. Kanara, Castle Rock, 600 m, Sept. 1918, *Sedgwick & Bell 4330* (K); N. Kanara, Karwar, by sea, Oct. 191?, *Sedgwick & Bell 6680* (K); s. loc., probably Mysore, *Wight 1026* (G, K); *ibid.*, *Thomson* (G, L). Kerala: Prov. Ernakulam, 6 km N. Alwaye, sea level, 17 Sept. 1973, *Cook, Rix & Schneller 269* (K, Z); *ibid.*, outskirts of Alwaye, sea level, 17 Sept. 1973, *Cook, Rix & Schneller 265* (Z); *ibid.*, S. Perumpavur, 17 Sept. 1973, *Cook, Rix & Schneller 276A* (Z); *ibid.*, between Ernakulam and Vaikom, sea level, 19 Sept. 1973,

Cook, Rix & Schneller 307 (K, Z); *ibid.*, c. 10 km N.W. Moolamattom, c. 600 m, 19 Nov. 1970, *Cook & Gut 222* (K, Z); *ibid.*, Vaikom (Vaikam), 30 Nov. 1970, *Cook & Gut 286* (K, Z); Prov. Kottayam, between Kottayam and Vaikom, sea level, 21 Sept. 1973, *Cook, Rix & Schneller 318* (Z); Prov. Quilon, 20 km E. Quilon, c. 50 m, 26 Sept. 1973, *Cook, Rix & Schneller 345A* (Z); Prov. Trivandrum, between Trivandrum and Quilon, sea level, 27 Sept. 1973, *Cook, Rix & Schneller 351* (K, Z); *ibid.*, *Cook, Rix & Schneller 352* (Z); *ibid.*, Kovalum, sea level, 28 Sept. 1973, *Cook, Rix & Schneller 358* (K, Z); Adur (Adyar), 22 Jan. 1899, *Barber 99* (K). Tamil Nadu: Salem Distr., Hosur, 29 Dec. 1916, *Madras Herb. No. 13960* (K); Madura Distr., Pulney Hills, Tamdikuoli, 100 m, Jan. 1925, *Anglade 743* (G); *ibid.*, 28 May 1899, *Bourne 2624* (K); *ibid.*, Poombarai Valley, 1899, *Bourne 933* (K); Madras, Spur Tank, 19 Sept. 1899, *Bourne* (K). Pondicherry, 1835, *Perrottet* (BR, K, M, L, LE); *ibid.*, s.d., *Perrottet 247* (L). Orissa: Ganjam Distr., Naupada, Jan. 1890, *Gamble 21603* (K). Bihar: Singbhum, 18 Aug. 1903, *Haines 5191* (K); Chota Nagpur, Ranchi, 650 m, 25 Oct. 1873, *Clarke 20608* (LE). Bengal: S. Calcutta, Komurah Kali, 27 March 1960, *Hara, Kanai & Tuyama 2903* (KYO). Assam: Upper Assam, *Jenkins* (K); ? Cachar, 1 Dec. 1872, *Clarke 18553C* (LE). **Bangla Desh:** Sylhet (Sillet), ?1832, *Wallich 2101B* or /2 (BR, CGE, G, K, LE); Nasirabad (Mymensingh), 4 Nov. 1868, *Clarke 7975* (K); Chittagong, 3 Jan. 1851, *Hooker & Thomson* (K); ?E. Bengal, *Griffith 2311* (LE). **Burma:** Ava, ?1826, *Wallich 2102A* or /1 (G, K, LE); Ramree Island, Kyaukpyu, Aug. 1945, *Wallace 9143* (K). **Sri Lanka:** Kalutara (Caltura), *Macrae 172* (CGE, BR); s. loc., *Macrae* (BR). **Malaysia:** Malacca, Alor Gajah Distr., Kampong Gadek, 20 April 1957, *Sinclair 8928* (L). **Thailand:** Chiang Mai, 300 m, 18 Jan. 1911, *Kerr 1648* (K, L). **Vietnam:** Tongking, Sha Nam, Yen The, 13 Dec. 1902, *Bois 222* (K); South Vietnam, Nha Trang, Annam, March 1911, *Robinson 1205* (L). **Indonesia:** Java, s. loc., *Horsfield* (CGE, K); *ibid.*, *van Hall 127* (L); *ibid.*, *Zollinger 714* (L, LE); *ibid.*, 1880, *Zollinger* (G, LE, ZT); *ibid.*, *Hostm.* (U); Java, Bogor (Buitenzorg), 240 m, 1 Feb. 1950, *van Oostrom 21654* (L); Dramaga, 30 Jan. 1921, *Bakhuisen van den Brink 741* (U). W. Sumatra, Mt. Sago, nr. Pajakumbuh, 800-900 m, 4 May or 5 April 1957, *Meijer 5760* (L). Irian Barat (New Guinea, Jaya), Maranke, between Mopa and Taram, 5 m, 4 Aug. 1954, *van Royen 4579* (K, L). **Philippines:** s. loc., *Cuming 735* (CGE); *ibid.*, 1841, *Cumming* (LE); Luzon, Manila, Sept. 1892, *Loher 2160* (M); Luzon, Rizal, Oct. 1914, *Merrill 9782* (K mixed with *R. ramosior*, L); Mindanao, Surigao, Hinatun, 16 May 1911, *Piper 508* (K); Mindanao, Davoe Prov., 425 m, Aug. 1949, *Edaño 11302* (L). **China:** Yunnan: s. loc., *Ducloux 263* (K). Kwangtung, Hainan Tao: Ting Ch'ang (Zaom-chau), Chi To Shan, 16 Sept. 1927, *Tsang Wai-Tak 882* (L, U); *ibid.*, *Tsang Wai-Tak 16381* (G, K). Kiangsi: Lungnan, Lam Uk, 1-15 Oct. 1934, *Lan 4806* (G). ?Lungchow, *Morse 251* (K). **Taiwan:** Lake Suisya, 12 Sept. 1929, *Sasaki 79644* (TAI); probably Taiwan, locality not found, Pachuna, 29 Nov. 1896, *Makino* (KYO). **Korea:** Cheju Do (Quelpaert), Honguo, Sept. 1908, *Taquet 1462* (G, K, KYO); Pusan, 30 Oct. 1901, *Faurie 472* (G); not found, Mantoku-zan, Zenrahokudo, 15 Sept. 1940, *Cho 1226* (KYO). **Japan:**

Okinawa. Kunigami: Kunigami, 7 Aug. 1951, *Walker, Tawanda & Amano* 6463 (K, L); Nagocho, 1 Sept. 1938, *Kaneshira* 903 (KYO); Higashi-mur(s)a, 18 Sept. 1938, *Kaneshira* 1416 (KYO); Beemata, 30 Sept. 1934, *Kaneshira* 1815 (KYO). Kyushu: Hizen Pref., Noma, 15 Sept. 1934, *Nakazima* 471 (KYO); Kagoshima Pref., Tarumi, *Makino* 121170 (MAK); Naga-saki, 1863, *Maximovicz* (K). Shikoku: Kochi Pref., Mihara-mura, Hatagun, 28 Sept. 1967, *Yamanaka* 51002 (KYO); Kochi Pref., Kochi, Misato, *Makino* 121164 (MAK). Honshu: Kii Pref., Owase-tyo, 31 Oct. 1954, *Higuchi* (KYO); Tomida Pref., Ise, Sept. 1905, *Makino* 121154 (MAK); Mie Pref., Yokkaichi, *Makino* 121154 (MAK) a duplicated herbarium number; Gifu Pref., Nakatsugawa, *Makino* 121149 (MAK); Tango Pref., Naka-gun, 24 Sept. 1950, *Nakai* 4933 (KYO); Hanto Pref., Takatamatsuhara, 10 Aug. 1932, *Toba* 223 (KYO); Yokohama, 1862, *Maximovicz* (BR, K, M); Yama-gata Pref., Murayama, *Makino* 121142 (MAK); Aichi Pref., Hoi-gun, Ichinomiya-machi, *Makino* 121152 (MAK); Akita, 6-7 Sept. 1894, *Faurie* 13762 (G, K). The following localities have not been found: Loochoo, 1923, *Koidzumi* (KYO); Utchina, Nagagami, 27-31 May 1923, *Koidzumi* (KYO); Hata, Tosa, 12 Oct. 1891, *s. coll.* (K); Japan, *s. loc.*, *Bürger* (M); *ibid.*, 1880, *Makino* (ZT).

NOTES

I have seen *Rotala rosea* in India, Rajasthan, near Kota where it was growing in shallow water and on land at the edge of a water reservoir; the associated species were: *Ceratopteris thalictroides* (L.) Brongn., *Limnophila aquatica* (Roxb.) Alston and *Rotala indica* (L.) Willd. In India, Kerala it is very common in seasonally inundated places and ricefields and frequently grows with other species of *Rotala*: *R. densiflora*, *R. indica*, *R. malampuzhensis* and *R. mexicana*.

I have cultivated material collected in Kerala. The cultivated plants were obligately annual, self-incompatible and efficiently self-pollinated. The calyx appendages are small or rudimentary on poorly grown or crowded plants. The relative proportions of the bracteoles, calyx and capsule remain more or less constant. The petals are very variable in size and shape and are occasionally absent; there does not appear to be any discernable pattern in the variation.

26. *Rotala verdcourtii* A. Fernandes, Bol. Soc. Brot. Sér. 2, 49: 10. 1975.

Type: Tanzania, Buha Distr., 115 km from Kibondo on Kasulu Road, 1340 m, 15 July 1960, *Verdcourt* 2854 (holotype: COI n.v.; isotype: K).

Ic.: Fig. 18I-L; Fernandes, Bol. Soc. Brot. Sér. 2, 49: t. 3. 1975.

Amphibious annual or perhaps perennial. *Stems* erect, rooted and denuded of leaves below, irregularly branched above, up to c. 30 cm long.

Leaves decussate, sessile; submerged leaves linear but gradually tapering towards the apex, up to c. 15 mm long; aerial leaves linear-lanceolate to lanceolate, rarely exceeding 6 mm long, truncate or bifurcate at apex, cuneate at base. *Bracts* leaf-like, lanceolate, up to c. 6 mm long; bracteoles 2, linear, c. 1.25 mm long. *Flowers* monomorphic, sessile, solitary in the axils of leaf-like bracts. *Calyx* tube cup-shaped at anthesis becoming hemispherical in fruit, c. 1 mm long, whitish below, pinkish above; calyx lobes 5, triangular at anthesis becoming shallowly triangular in fruit, up to 0.5 mm long, pink; calyx appendages 5, capillary to subulate, c. 0.5 mm long. *Petals* absent. *Stamens* 2, inserted on the lower half of the calyx tube; anthers borne at top of calyx tube. *Ovary* ovoid to globose; style c. 0.25 mm long; stigma capitate; capsule globose c. 1 mm diam., opening by 3 valves; seeds hemispherical, c. 0.3 mm diam.

DIAGNOSTIC FEATURES

K5 + 5, P0, A2, G3; it is like *R. welwitschii* but differs in having 5 calyx lobes, bracteoles c. 1.25 mm long and style c. 0.25 mm long.

DISTRIBUTION

Tanzania (Map 10), known only from the type gathering.

SELECTED SPECIMENS

Tanzania: Buha Distr., 115 km from Kibondo on Kasulu Road, 1340 m, 15 July 1960, *Verdcourt* 2854 (COI n.v., K).

27. *Rotala welwitschii* Exell, Bol. Soc. Brot. Sér. 2, 30: 69. 1956.

— *Rotala decussata* auct., sensu Hiern in Oliver, Fl. Trop. Afr. 2: 467. 1871, excl. syn., et distrib. austral. et asiat., non *Rotala decussata* DC.

Type: Angola, Cuanza Norte, Pungo Andongo, Lagoa de Quibinda, Mar. 1857, *Welwitsch* 2340 (holotype: BM; isotype: LISU n.v.)

lc.: Fig. 19A-D.

Amphibious or terrestrial annual or perennial. *Stems* branching and rooting below, erect above; erect stems 10 cm or more long, 4-angled to 4-winged. *Leaves* decussate, sessile; submerged leaves linear but gradually tapering towards the apex, up to 40 mm long, red to pink, sometimes almost translucent; aerial leaves elliptic to oblong or obovate, up to c. 6 mm long and c. 4 mm wide, at base cuneate on lower part of stem becoming cordate on upper part of stem, at apex obtuse. *Bracts* leaf-like, linear to oblong or

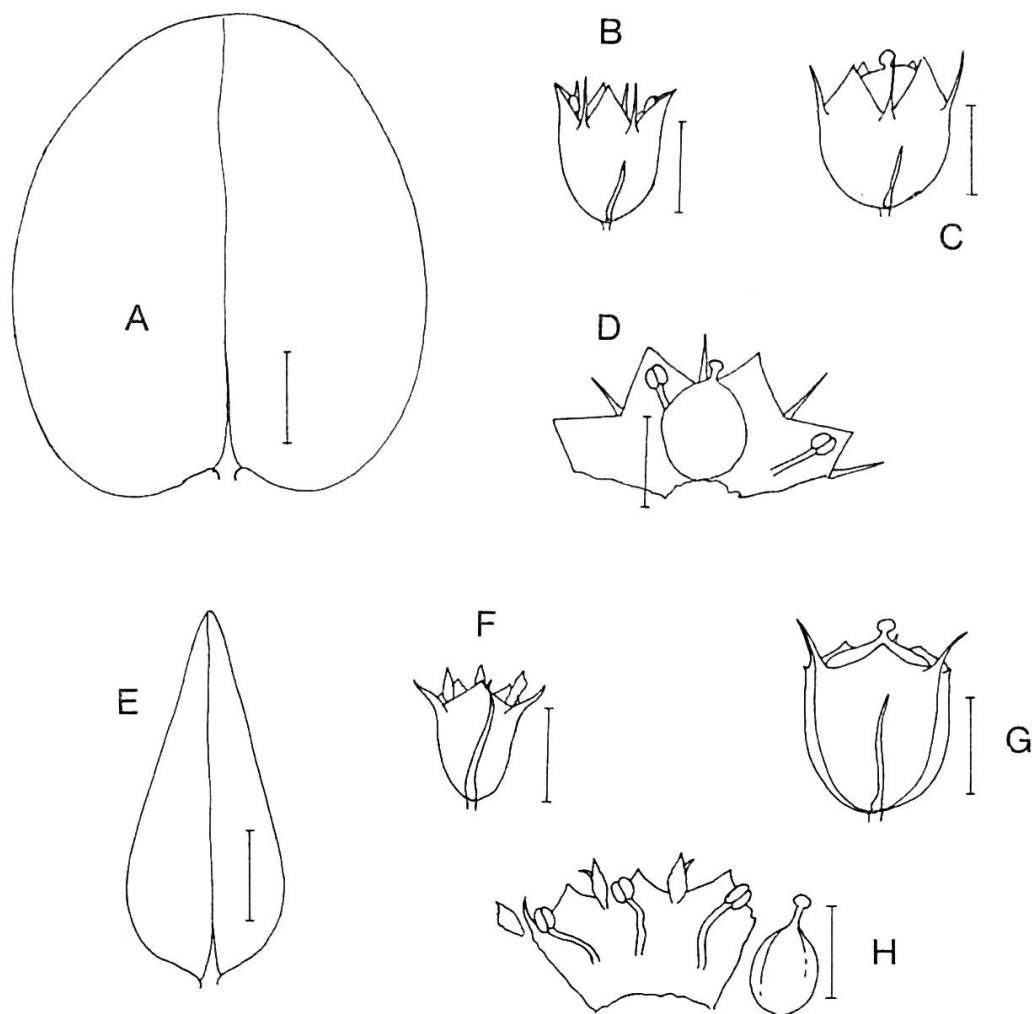


Fig. 19. — *R. welwitschii* (Warnecke 229); **A**, bract; **B**, flower at anthesis; **C**, flower with mature capsule; **D**, flower dissection.

R. juniperina (Robinson 5353); **E**, bract; **F**, flower at anthesis; **G**, flower with mature capsule; **H**, flower dissection (scale: **A-H**, 1 mm).

obovate, usually cordate at base; bracteoles 2, linear, c. 0.5 mm long. *Flowers* monomorphic, sessile, solitary in axils of leaf-like bracts. *Calyx* tube cup-shaped at anthesis becoming hemispherical in fruit, c. 1 mm long; calyx lobes 4, deltate, up to 0.5 mm long; calyx appendages 4, linear or capillary, c. 0.5 mm long. *Petals* absent or up to 4, microscopically small. *Stamens* 2 or occasionally 3 or 1, inserted about halfway up the calyx tube; anthers visible between the calyx lobes. *Ovary* ovoid to globose; style very short, less than 0.2 mm long; stigma capitate; capsule globose, 1-1.25 mm diam., opening by 3 valves; seeds numerous, hemispherical to rounded-deltoid, c. 0.25 mm diam.

DIAGNOSTIC FEATURES

K4 + 4, P0-4, A2, G3; it is like *R. verdcourtii* but differs in having 4 calyx lobes, bracteoles c. 0.5 mm long and a very short style (less than 0.2 mm long).

DISTRIBUTION

Tropical West Africa from Sierra Leone (Senegal) to northern Angola, and Tropical Central Africa to Sudan (Map 10). Flowering time from October to March.

SELECTED SPECIMENS

Sierra Leone: northern Prov., Kambia, 2 Nov. 1963, *Morton & Gledhill* SL25 (MO). **Upper Volta:** Broussèra, 30 Dec. 1964, *Aké Assi* 7549 (BR). **Ghana:** Tamale to Bolga, mile 48, 27 Aug. 1965, *Hall* 430 (K); Busunu, Damongo to Yapei, 10 Sept. 1965, *Hall* 889 (K). **Togo:** Lome, *Warnecke* 229 (BM, BR, G, K, L, P, Z). **Nigeria:** 3 km S.W. Iseyin, 7°58'N.-3°34'E., 350 m, 1962, *Gillett* 15397 (K); Lokoja, 7 Nov. 1909, *Dalziel* 210 (K). **Cameroun:** 80 km N.E. Mora, Ndiguina, 5 Oct. 1964, *Letouzey* 7354 (K, P); 70 km N.E.E. Maroua, Guirvidig, Dega, 10 Oct. 1964, *Letouzey* 7270 (P). **Gabon:** Ogooué, plaine de Sopi, Feb. 1887, *Thollon* 772 (K, P). **Angola:** Cuanza Norte, Pungo Adongo, Lagoa de Quibinda, March 1957, *Welwitsch* 2340 (BM); *ibid.*, Pungo Adongo, pr. Motola, March 1857, *Welwitsch* 2343 (BM). **Sudan:** Bahr el Ghazal, Ghabbt el Arab, 29 March 1930, *Simpson* 7699 (K). Raynal, Adansonia 7: 544. 1967, cites specimens from: Senegal, Mali, Ivory Coast and the Republic of Central Africa.

28. *Rotala cordata* Koehne, Bot. Jahrb. 1: 172. 1880.

= *Rotala diversifolia* Koehne, Bot. Jahrb. 41: 77. 1907. **Type:** Thailand, Chiang-Mai (Chieng-mai), E. Dai Sutep, c. 750 m, 29 Dec. 1904, *Hosseus* 275 (holotype: G; isotypes: K, L, M).

Type: Koehne op. cit. wrote "Bengal, Herb. Ind. Or., Hook. fil. & Thomson, als *R. roxburghiana* ausgegeben, mixta cum *R. pentandra*." One sheet at G (De Candolle legat, presented 1921) bears two species, one is *R. densiflora* (= *R. pentandra* sensu Koehne), the other is *R. cordata*. The plant of *R. cordata* has four labels in Koehne's handwriting, including a provisional description and the intention to name it *R. cordata*. This specimen can be accepted as the holotype (holotype: G).

lc.: Fig. 20A-E.

Amphibious or terrestrial annual or perhaps perennial. *Stems* erect, rooting at base, usually branched but occasionally simple, up to 50 cm or

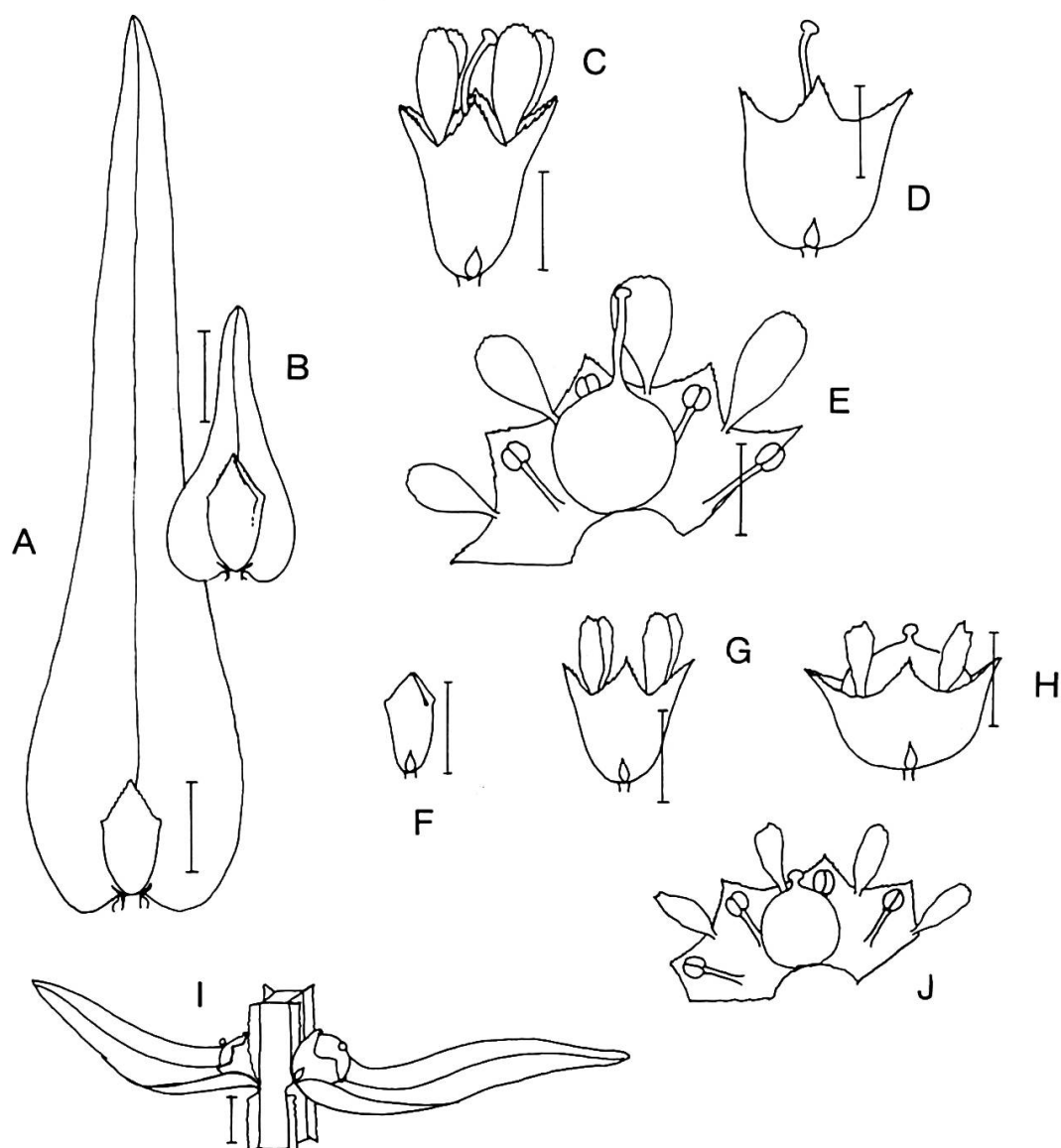


Fig. 20. — *R. cordata* (Hooker fil. & Thomson); **A**, bract and flower from main stem; **B**, bract and flower from lateral branch; **C**, flower at anthesis; **D**, flower with mature capsule; **E**, flower dissection.

R. rubra (Wallich 2107A); **F**, flower bud; **G**, flower at anthesis; **H**, flower with mature capsule; **I**, flowering node; **J**, flower dissection (scale: **A-J**, 1 mm).

more long, brown or yellow below, usually red above with 4, distinct, white wings which run into the leaf or bract margins at each internode. *Leaves* decussate, sessile, lanceolate to ovate or oblong, up to 25 mm long, cordate at base, obtuse at apex. *Bracts* on main stem like foliage leaves; bracts on lateral inflorescence branches lanceolate to oblong, usually tinged with red, spreading or recurved, cordate at base, 2-3 times as long as subtended flower;

bracteoles 2, minute, c. 0.2 mm long. *Flowers* monomorphic, subsessile or shortly pedicellate, solitary in axils of bracts, usually borne on contracted lateral branches or occasionally on the main stem. *Calyx* tube campanulate at anthesis becoming subglobose in fruit, 1-1.5 mm long; calyx lobes 4, triangular, acuminate, usually microscopically toothed at margin, 0.5 mm long, usually pinkish; calyx appendages absent. *Petals* 4, obovate, equalling or up to 2 times as long as calyx lobes, pink to purple, persistent in fruit. *Stamens* 4 or rarely less, inserted about halfway up the calyx tube; anthers level or slightly exceeding the tips of the calyx teeth. *Ovary* globose; style elongate, 1-1.5 mm long, persistent; stigma capitate, exerted; capsule globose, usually somewhat flattened above, 1-1.5 mm diam., included within the calyx tube, opening by 3 valves; seeds semi-ovoid, c. 0.5 mm long.

DIAGNOSTIC FEATURES

K4, P4, A(2-)4, G3; *R. cordata* has white wings on the stem which run directly into the margins of the leaves or bracts at each internode, the calyx has 4 lobes without calyx appendages, the style is 1-1.5 mm long and the stigma is exerted. It bears a superficial resemblance to *R. densiflora* but is easily distinguished by the characters mentioned above and by the very short bracteoles.

DISTRIBUTION

From N.E. India (Orissa and Bihar) and E. Nepal through Tropical S.E. Asia to Irian Barat (W. New Guinea) (Map 12). *R. cordata* is mostly found in mountainous regions where it grows in bogs and besides streams and waterfalls. It appears to be one of the few *Rotala* species not recorded from ricefields. The flowering time is from August to March.

SELECTED SPECIMENS

India. Orissa: Keonjhar, Garjantoli, 1000 m, 3 Oct. 1946, *Mooney* 2812 (K); Ganjam Distr., Bondogorha, 500 m, March 1884, *Gamble* 14071 (K). Bihar?: Purnea Distr. (Purnesh), Adikari, Dec. 1918, *Haines* 5164 (K). Bengal: Siliguri (Silliguri), Dec. 1874, *Gamble* 527 (K). **India or Bangla Desh:** Bengal, *Hooker fil. & Thomson* (G). **Nepal:** eastern Nepal, Khebang-Bharomdin, 24 Nov. 1963, *Hara, Kanai & al.* 6306503 (K — mixed with *R. indica*, KYO). **Burma:** Pegu, 1854, *McLelland* (K). **Thailand.** Chiang Mai: Dai Sutep, 750 m, 29 Dec. 1904, *Hosseus* 275 (G, K, L, M); *ibid.*, c. 600 m, 3 Dec. 1911, *Kerr* 2260 (K, L); 5 km W. Bo Luang, 1100, 29 Jan. 1964, *Hansen, Sidenfaden & Smitihand* 10983 (L). Kanchanaburi Distr., Huay Bankau, 14°55'N-98°45'E., 750 m, 10 Nov. 1971, *van Beusekom, Phegkhlai, Geesink & Wongwan* 3629 (KYO, L). **Vietnam:** South, Bien Hoa, Jan. 1873, *Pierre* (K — mixed with *R. indica*); *ibid.*, March 1873, *Pierre* (K). **Indonesia.** Sulawesi (Celebes): Masamba, between Wono and Lodang, 1100 m, 24 July 1937, *Eyma* 1253 (K,

U); Poso, swamps nr. Malino, 20-21 Aug. 1938, *Eyma* 3458 (K, L, U). Irian Barat (W. New Guinea): Tjendrawasih (Vogelkop Peninsular), Kebar Valley, 520 m, 16 Aug. 1961, *van Royen & Sleumer* 6704 (L). Djawa (Java), Djawa Barat, Sukamani, 10 m, 14 Feb. 1974, *Häfliger* (ZT).

29. *Rotala rubra* (Buch.-Ham. ex D. Don) Hara, J. Jap. Bot. 52(7): 197. 1977 $\equiv$ *Ammannia rubra* Buch.-Ham. ex D. Don, Prodr. Fl. Nepal.: 220. 1825.

= *Rotala alata* Koehne, Bot. Jahrb. 1: 171. 1880. **Type:** Koehne, op. cit. wrote "Nepal, *Wallich* 2107A, intermixt. cum *R. indica*". None of the *Wallich* 2107A specimens that I have seen has *R. alata* and *R. indica* mixed. One specimen in G (De Candolle legat, presented in 1921) bears two labels in Koehne's handwriting mentioning his intention to name the plant *R. alata*. I select this specimen as lectotype (lectotype: G; isolectotypes: BR, CGE, G, K, K-W, LE).

— *Ammannia pentandra* Roxb. var. "*alpha*" Wight & Arn., Prodr. Fl. Pen. Ind. Or. 1: 305. 1834, pro parte, quoad specim. *Wallich* 2107.

Type: Nepaliâ (Nepal), *Hamilton* (holotype: BM).

Ic.: Fig. 20F-J.

Amphibious or terrestrial annual or perhaps perennial. *Stems* erect rooting at base, simple or branched, up to 20 cm or perhaps more long, brown or red above with 4, distinct, white wings which run into the leaf or bract margins at each internode. *Leaves* decussate, linear-lanceolate to ovate, up to 20 mm long, usually cuneate or occasionally obtuse at base, obtuse to acute at apex. *Bracts* on main stem like foliage leaves; bracts on lateral inflorescence branches lanceolate to broadly ovate, about 2 times as long as subtended flower; bracteoles 2, minute, c. 0.2 mm long. *Flowers* monomorphic, sessile or subsessile, solitary in axils of bracts, usually borne on contracted lateral branches or occasionally on the main stem. *Calyx* tube campanulate at anthesis becoming hemispherical in fruit, c. 1 mm long; calyx lobes 4 or rarely 3, triangular, c. 0.5 mm long, margin occasionally microscopically toothed, acuminate at apex; calyx appendages absent. *Petals* 4 or rarely 3, obovate, equalling or somewhat exceeding the calyx lobes, up to c. 1 mm long, often with erose margin, persistent, pink but losing colour in fruit. *Stamens* 4 or rarely 3, inserted half-way up the calyx tube; anthers borne below the tips of the calyx lobes. *Ovary* globose; style very short, c. 0.1 mm long; stigma capitate; capsule globose, c. 1.5 mm diam., exceeding the calyx, opening by 3 valves; seeds semi-ovoid, up to 0.4 mm long.

DIAGNOSTIC FEATURES

K(3-4), P(3-4), A4, G3; *R. rubra* is like *R. cordata* but has a very short style (c. 0.1 mm long) and a capsule that exceeds the calyx tube, the leaves are

cuneate to obtuse at the base, the petals are smaller (not exceeding 1 mm long) and the flowers are usually sessile.

DISTRIBUTION

Known only from Nepal (Map. 11).

SELECTED SPECIMENS

Nepal: s. loc., *Wallich 2107A* (BR, CGE, G, K, K-W, LE); the following specimen is cited by Hara, J. Jap. Bot. 52(7): 197. 1977: E. Nepal, Tumingtar, Arun R., c. 600 m, 25 Dec. 1961, *Norkett 8120* (no herbarium cited).

30. *Rotala juniperina* A. Fernandes, Bol. Soc. Brot. Sér. 2, 48: 126. 1974.
= *Rotala decumbens* A. Fernandes, Bol. Soc. Brot. Sér. 2, 48: 127. 1974.
Type: Zambia, Kabulamwanda Dam, 108 km N. of Choma, c. 1150 m, 24 April 1954, *Robinson 723* (holotype: K).

Type: Malawi, Mlanje Distr., 16 km N.W. of Likabula Forest Depot, 700 m, 15 June 1962, *Robinson 5353* (holotype: SRGH n.v.; isotypes: BR, K, M).

lc.: Fig. 19E-H; Fernandes, Bol. Soc. Brot. Sér. 2, 48: t. 12 and t. 13. 1974.

Amphibious annual or perhaps perennial. *Stems* creeping, ascending or erect, branched, up to 30 cm or more long, when submerged somewhat inflated, when aerial 4-angled occasionally with wings on the angles. *Leaves* decussate or occasionally in whorls of 3, lanceolate to ovate, up to 20 mm long on main axis but less on lateral branches, cuneate to cordate at base, acute at apex. *Bracts* like foliage leaves on main axis, smaller on lateral inflorescence branches; bracteoles 2, linear, 1-1.5 mm long. *Flowers* monomorphic, solitary in axils of bracts, borne mostly on lateral branches. *Calyx* tube campanulate, c. 1 mm long at anthesis, c. 1.5 mm long in fruit; calyx 3, very shallowly triangular, c. 1 mm wide at base; calyx appendages 3, spreading at anthesis, subulate in fruit, up to 0.5 mm long, exceeding the calyx lobes. *Petals* 3, elliptic, up to 0.5 mm long, more or less persistent. *Stamens* 3, inserted slightly below the middle of the calyx tube; anthers borne at the top of the calyx tube. *Ovary* subglobose; style c. 0.25 mm long; stigma capitate; capsule subglobose, 1.5-2 mm long, equal to or scarcely exceeding the calyx, opening by 3 valves; seeds semi-ovoid, c. 0.4 mm long.

DIAGNOSTIC FEATURES

K3 + 3, P3, A3, G3; in habit *R. juniperina* resembles the Asian species *R. densiflora*, *R. cordata* and *R. rubra* but is easily distinguished on the basis of

the 3-merous flowers. Florally it is like *R. malampuzhensis* but the calyx appendages are subulate in fruit, the capsule scarcely exceeds the calyx and the stamens are inserted about half-way up the calyx tube.

DISTRIBUTION

Known from three gatherings from E. Zaire, S. Zambia and S. Malawi (Map 9). Flowering time from April to July.

SELECTED SPECIMENS

Zaire: Shaba (Katanga), Mitwaba Terr., Simama, riv. Dikuluwe, 12 July 1956, *Bryneart 505* (BR). **Zambia:** Kabulamwanda Dam, 108 km N. of Choma, 1150 m, 24 April 1954, *Robinson 723* (K). **Malawi:** S. Malanje Distr., 16 km N.W. of Likabula Forest Depot, 15 June 1962, *Robinson 5353* (BR, K, M).

- 31. *Rotala malampuzhensis*** R. V. Nair ex C. D. K. Cook $\equiv$ *Rotala malampuzhensis* R. V. Nair, J. Bombay Nat. Hist. Soc. 72(1): 57. 1975, nom. inval. published without nomenclatural type.

Type: I choose the following specimen: India, Kerala, Palghat Distr., Malampuzha River, July 1971, *R. Vasudevan Nair, herb. No. 89602* (holotype: MH).

lc.: Fig. 21A-E; Nair, J. Bombay Nat. Hist. Soc. 72(1): 58-59, fig. 1-18. 1975.

Amphibious or terrestrial, usually tuft-forming annual. *Stems* creeping, much branched, often denuded of leaves and rooting below with numerous, erect branches or stems; erect branches and stems simple or scarcely branched, up to 30 cm tall but usually less. *Leaves* decussate, sessile; submerged or lower leaves scale-like to orbicular, c. 2 mm long becoming lanceolate to linear further up the stem; aerial or upper leaves linear to narrowly oblong or lanceolate, up to 15 mm long and 4 mm wide but usually less. *Bracts* like upper leaves, linear to lanceolate; bracteoles capillary, c. 1 mm long, about as long as the calyx tube. *Flowers* monomorphic, sessile, solitary. *Calyx* tube campanulate, up to 1 mm long, bright red; calyx lobes 3, shallowly triangular at anthesis, becoming laterally stretched as the fruit matures, up to 0.5 mm long but usually less, bright red; calyx appendages 3, shorter than the calyx lobes at anthesis sometimes rudimentary or absent. *Stamens* 3, inserted near the base of the calyx tube; anthers included. *Ovary* globose; style very short or absent; stigma capitate, sessile or subsessile; capsule globose, exceeding the calyx, up to 1.5 mm diam., opening by 3 valves, bright red; seeds semi-ovoid, c. 0.6 mm long, bright red or yellow.

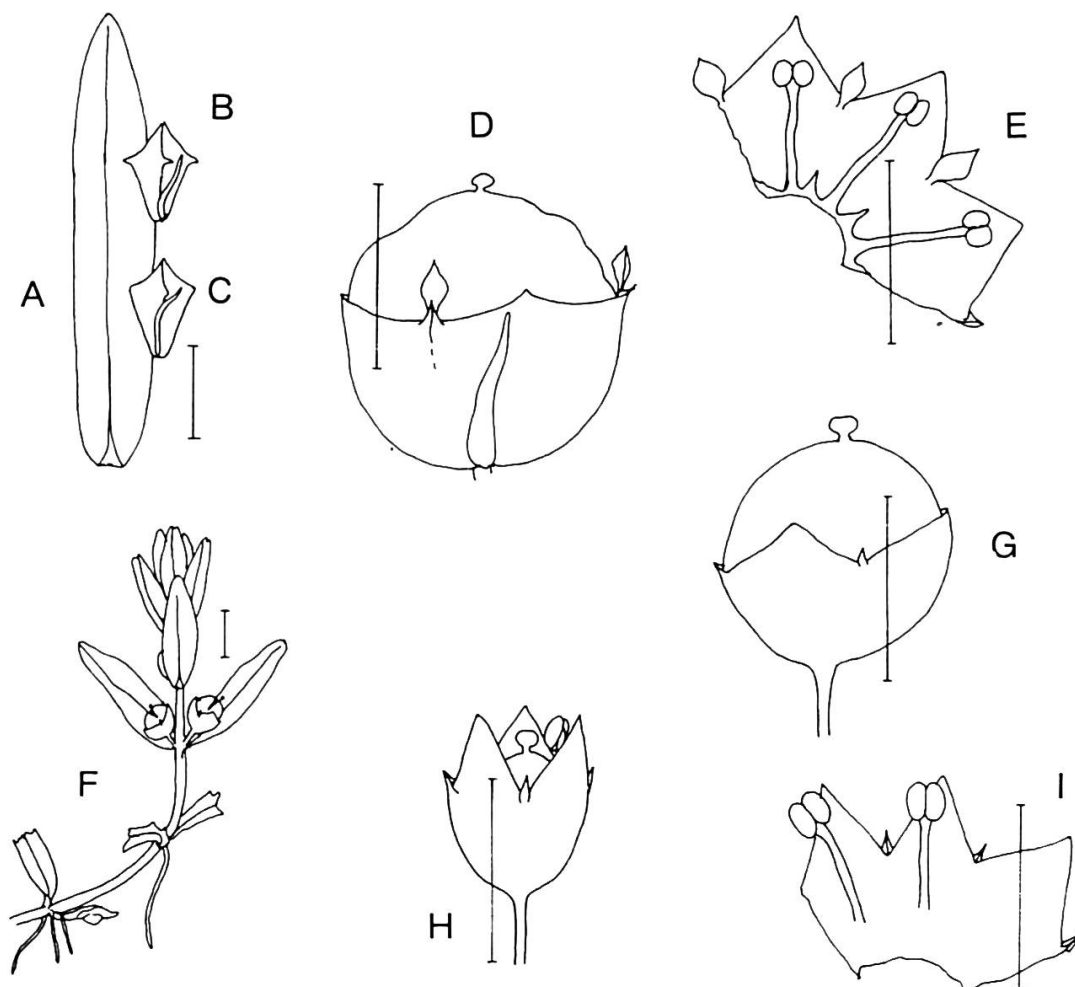


Fig. 21. — *R. malampuzhensis* (Cook, Rix & Schneller 276B); A, bract; B, C, flower buds; D, flower with mature capsule; E, flower dissection.

R. simpliciuscula (Hooker fil. & Thomson); F, habit; G, flower with mature capsule; H, flower at anthesis; I, flower dissection (scale: A-I, 1 mm).

DIAGNOSTIC FEATURES

K3 + 3 (appendages sometimes rudimentary or absent), P3, A3, G3; like *R. rosea* but flowers 3-merous, seeds c. 0.6 mm long. It often grows intermingled with *R. rosea* but in the field is simply identified by its tufted habit, smaller and narrower leaves and the intense red of the calyx and fruit.

DISTRIBUTION

The coastal plain of Kerala, S. India, between the latitudes 9°N. and 12°N. (Map 12). It flowers and fruits from about July to September.

SELECTED SPECIMENS

India. Kerala State: Calicut Distr., Badagara, Sept. 1967, *R. V. Nair* (MH); Palghat Distr., Malampuzha River, July 1971, *R. V. Nair* (MH); Ernakulam Distr., Perumpavur, sea level, 17 Sept. 1973, *Cook, Rix & Schneller 276B* (Z); Ernakulam Distr., Piravam (Privam), c. 50 m, 18 Sept. 1973, *Cook, Rix & Schneller 290* (K, Z); Distr. Kottayam, between Kottayam and Vaikom, sea level, 21 Sept. 1973, *Cook, Rix & Schneller 319* (Z); Quilon Distr., Kottarakara, 26 km E. Quilon, c. 50 m, 26 Sept. 1953, *Cook, Rix & Schneller 343* (Z); Quilon Distr., 20 km E. Quilon, c. 50 m, 26 Sept. 1973, *Cook, Rix & Schneller 345B* (Z).

NOTES

Rotala malampuzhensis is a small, inbreeding, shortlived annual common in ricefields and other inundated places along the coastal plain of S. Kerala. It flowers and fruits during the western Monsoon season. I found it in great quantities in September usually with other *Rotala* species (*R. densiflora*, *R. indica*, *R. mexicana* and *R. rosea*). On a second visit in December I failed to find it. Other annuals in Kerala seem to have a similar rhythm, i.e. *Nymphoides macrospermum* Vasudevan, *N. parvifolium* (Griseb.) Knuth, *Microcarpaea minima* (Koehne) Merr., *Mitrasacme polymorpha* R. Br., and several species of *Lindernia*.

- 32. *Rotala simpliciuscula*** (S. Kurz) Koehne, Bot. Jahrb. 1: 159. 1880 ≡ *Ammannia simpliciuscula* S. Kurz, J. Asiatic Soc. Bengal 40(2): 54. 1871 — reprinted with comments by C. Hasskarl, Flora (Regensb.) 54(19): 291. 1871.

Type: Bangla Desh, Chittagong, *S. Kurz* (holotype?: CAL n.v.).

Ic.: Fig. 21F-I.

Dwarf, mat-forming, amphibious annual. *Stems* creeping and branching below, ascending and usually simple above, 1-4 cm long, 4-angled. *Leaves* decussate, somewhat petiolate; lower leaves narrowly oblong to oblong, 2.5-5 mm long, 0.5-2 mm wide; upper leaves somewhat smaller, oblong to obovate oblong, obtuse or retuse at apex. *Bracts* leaf-like, oblong to oblanceolate, usually shortly petiolate; bracteoles absent. *Flowers* monomorphic, solitary in axils of bracts, distinctly pedicellate; pedicel 0.5-1 mm long. *Calyx* tube campanulate at anthesis becoming hemispherical in fruit, 0.25-0.35 mm long, red; calyx lobes 3 or rarely 4, deltate at anthesis becoming shallowly triangular in fruit, 0.25-0.35 mm long; calyx appendages 3 or rarely 4, minute, erect in bud. *Petals* absent. *Stamens* 1 or occasionally 2, inserted

on the lower half of the calyx tube. *Ovary* globose; style very short; stigma subsessile, capitate; capsule globose, up to 1.4 mm diam., about 2 times as long as the calyx, opening by 3 valves; seeds semipyriform to hemispherical, c. 0.5 mm long.

DIAGNOSTIC FEATURES

K3(-4) + 3(-4), P0, A1-2, G3; *R. simpliciuscula* is a distinct species with the habit of *Elatine* (dwarf, mat-forming plants with creeping stems and opposite leaves). The calyx is 3-merous with small calyx appendages and the flowers are distinctly pedicellate and lacking bracteoles

DISTRIBUTION

Known only from Chittagong, Bangla Desh (Map 11).

SELECTED SPECIMEN

Bangla Desh: Chittagong, *Hooker fil. & Thomson* (G, K, L, M).

NOTES

S. Kurz in his original description said that it grows on muddy ground around ponds and in inundated ricefields at Chittagong. He also mentioned that it was rare and flowers in October. In the key he wrote that the calyx is 4-toothed; from my experience this is rarely the case, most flowers have 3 calyx lobes. In the description he wrote "stamina 4", this must be a mistake as I have examined many flowers and found 1 or occasionally 2 stamens. However, I have not examined the holotype.

33. *Rotala serpiculoides* Welw. ex Hiern in Oliver, Fl. Trop. Africa 2: 469. 1871.

Type: Angola; Lubango (Huila), pr. Monhino, c. 1850 m, April 1860, *Welwitsch* 2355 (holotype: LISU n.v.; isotype: BM).

lc.: Fig. 22A-E.

Terrestrial or amphibious annual. *Stems* erect, simple or sparsely branched, up to 25 cm or more tall, green or tinged with red. *Leaves* decussate, elliptic, attenuate at base into a short petiole, erecto-patent, up to c. 25 mm long, with a prominent midrib (the leaves are very constant in shape). *Bracts* of two kinds; bracts subtending axillary racemes like normal foliage leaves; bracts subtending individual flowers on lateral inflorescences

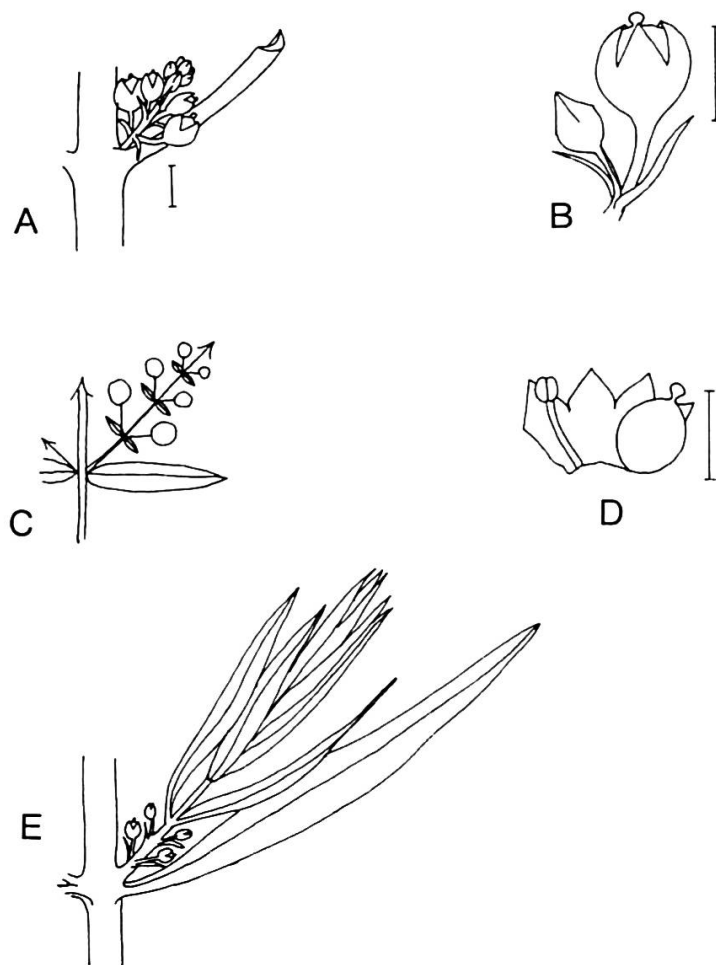


Fig. 22. — *R. serpiculoides* (Milne-Redhead & Taylor 9860); **A**, inflorescence; **B**, flower and flower bud; **C**, diagramme of inflorescence; **D**, flower dissection; **E**, vegetative growth beyond the flowers (scale: 1 mm).

linear, membranous, c. 1 mm long, about as long as the pedicel, borne at base of pedicel; bracteoles absent. *Flowers* monomorphic, (1-)3-12 in contracted axillary racemes, pedicellate; pedicel up to 2 mm long. *Calyx* tube cup-shaped, membranous, often tinged with red, c. 0.6 mm long; calyx lobes 4, triangular, tinged with red or pink, c. 0.4 mm long, scarcely spreading. *Petals* absent. *Stamens* 1 (?2 or 3), inserted at base of calyx tube; anther borne level with calyx lobes. *Ovary* subglobose; style very short; stigma capitate, subsessile; capsule globose, up to 1 mm diam., opening by 3 valves; seeds semi-ellipsoidal, c. 0.5 mm long.

DIAGNOSTIC FEATURES

K4, P0, A1, G3; the flowers are pedicellate, lack bracteoles and are borne in contracted, lateral racemes.

DISTRIBUTION

Central Tropical Africa from Sudan to S. Zambia and S. Angola (Map 13).

SELECTED SPECIMENS

Sudan: Kartoum, 30 Jan. 1963, *Pettet 111* (K). **Central African Republic:** 50 km N. of Bambari, Gerelenji, 26 Nov. 1928, *Tisserant 2736* (P); Djur, Ghattus, 30 Oct. 1869, *Schweinfurth 2575* (K, MEL); Djur, Molmul, Oct. 1870, *Schweinfurth 4270* (K). **Uganda:** Masaka Distr., Lake Nabugabo, c. 1260 m, Aug. 1935, *Chandler 1366* (K). **Kenya:** Thika, 16 Aug. 1967, *Faden 67629* (K); Nairobi, c. 1500 m, 22 Sept. 1916, *Dowson 409* (K); *ibid.*, July 1951, *Verdcourt 536* (K); *ibid.*, 21 Jan. 1962, *Verdcourt & Brown 3249* (K). **Tanzania:** Tanga Prov., Pangani, Serawani, 18 Sept. 1955, *Tanner 2047* (K); Manyoni Distr., Itigi Station, 1350 m, 11 April 1964, *Greenway & Polhill 11514* (BR, K); Ruaha Riv., 2 km S. of junction with Yovi Riv., 450 m, 15 July 1970, *Thulin & Mhoro 418* (K); Iringa Distr., Ruaha Nat. Park, Magangwe, 1330 m, 9 May 1972, *Bjørnstad AB1654* (K); Songea Distr., Songea, 990 m, 30 April 1956, *Milne-Redhead & Taylor 9860* (B, BR, G, P); 19 km E. of Songea, 1050 m, 22 June 1956, *Milne-Redhead & Taylor 10873* (B, BR). **Rwanda:** Kigali, 26 Oct. 1953, *Liben 842* (BR); Terr. Kigali, Uruanda, Bugesera, 3 March 1954, *Liben 1398* (BR). **Burundi:** Terr. Bujumbura, Ruzizi, 800 m, 19 March 1973, *Reekmans 2532* (BR). **Zaire:** S. of Lake Edward (lac Edouard), 1100 m, April-May 1929, *Humbert 8708* (BR, P); locality not found: Zambi, bank of Congo River, 23 June 1915, *Bequaert 7872* (BR). **Malawi:** Zomba Distr., W. of Lake Chilwa, 21 June 1962, *Robinson 5398* (K); not located: Ciwalo, Kalembo *Jackson 1671* (BR). **Zambia:** Mkushi Distr., Fiwila, c. 1300 m, 1932, *Hewitt 6* (BM); Choma Distr., Mapanza, 24 March 1957, *Robinson 2185* (BR); *ibid.*, 20 March 1958, *Robinson 2871* (K, M); Choma (Tchoma), July 1939, *Bredo 3184* (BR); Kafue Basin, Namvala, 18 April 1963, *van Rensburg* (K). **Rhodesia (Zimbabwe):** Salisbury, Gatooma road, 12 Jan. 1946, *Wild 1062* (SRGH n.v.). **Angola:** Lubango (Huila), pr. Monhino, c. 1850 m, April 1860, *Welwitsch 2355* (BM).

NOTES

Superficially *R. serpiculoides* differs from other species of *Rotala* by having several flowers in the leaf axils. These partial inflorescences are usually described in the literature as being cymose (scorpioid, dichasial, trichasial or pleiochasial) and thus similar to the lateral inflorescences of other related genera of the *Lythraceae* (*Ammannia*, *Hionanthera* and *Nesaea*). However, closer examination reveals that they are no more than contracted simple racemes (Fig. 22C) and thus not comparable with the other genera. Occasionally vegetative growth continues after flowering (Fig. 22E). Similar but less contracted lateral inflorescences are seen in: *R. floribunda*, *R. repens*, *R. densiflora*, *R. cordata*, *R. rubra*, *R. rotundifolia* and *R. indica*.

The bracts subtending the racemes are leaf-like but the bracts subtending the individual flowers are small, membranous and bracteole-like. In contradiction to literature accounts the bracteoles in *R. serpiculoides* are lacking. This misinterpretation in the literature is probably because the floral bracts have about the same dimensions as bracteoles in most other species. Small bracts resembling bracteoles are found in: *R. floribunda* and *R. repens*. In floral characteristics *R. serpiculoides* is very like *R. simpliciuscula*, a species which also lacks bracteoles. In the literature *R. serpiculoides* is reported to have 1-3 stamens, I have examined many flowers and found only solitary stamens.

34. *Rotala stagnina* Hiern in Oliver, Fl. Trop. Africa 2: 467. 1871.

Type: Ethiopia, Gafta, 14 Sept. 1838, *Schimper 1187* (holotype: BM; isotypes: B, CGE, G, K, L, LE, M, Z, ZT).

Ic.: Fig. 23A-E.

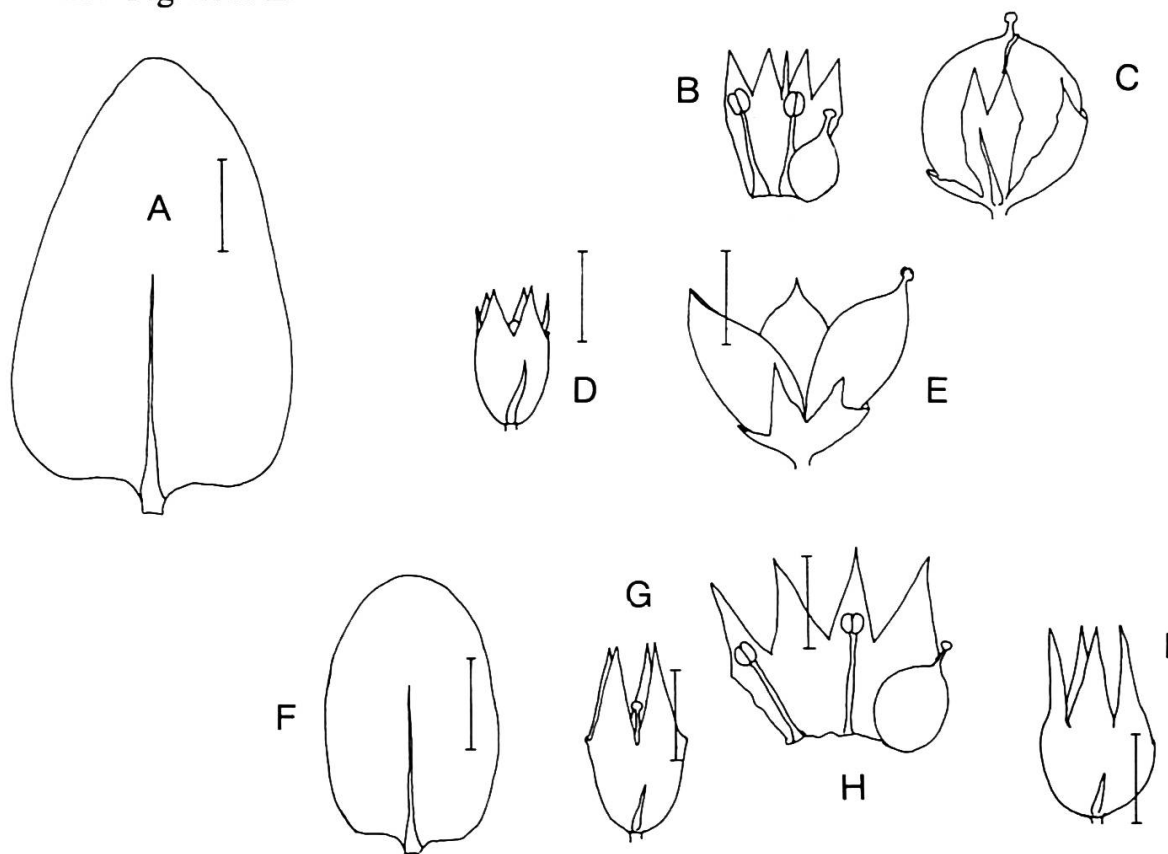


Fig. 23. — *R. stagnina* (Schimper 1187); A, bract; B, flower dissection; C, flower with mature capsule; D, flower at anthesis; E, dehiscent capsule.

R. gossweileri (Gossweiler 1145); F, bract; G, flower at anthesis; H, flower dissection; I, flower with mature capsule (scale: A-I, 1 mm).

Amphibious or terrestrial annual. *Stems* erect, simple or irregularly branched, up to c. 20 cm long. *Leaves* decussate, sessile or subsessile, lanceolate to ovate or oblong, up to 9 mm long, truncate to cordate at base, obtuse at apex. *Bracts* leaf-like but somewhat smaller, rarely more than 6 mm long, usually somewhat cordate at base; bracteoles capillary, c. 0.5 mm long. *Flowers* monomorphic, sessile or subsessile, solitary in the axils of leaf-like bracts. *Calyx* tube scarious, cup-shaped at anthesis, not accrescent, splitting irregularly as the fruit ripens, c. 1 mm long; calyx lobes 4, triangular to widely deltate, c. 0.5 mm long, pink, not spreading; calyx appendages absent; small interjected folds visible in bud but becoming stretched and not visible at anthesis. *Petals* usually absent but occasionally 1 or 2 linear, caducous petals present at anthesis. *Stamens* 2, opposite, inserted at base of calyx tube; filaments 2, c. 1 mm long, somewhat thickened below; anthers included in calyx tube. *Ovary* subglobose; style c. 0.25 mm long; stigma capitate; capsule globose, exceeding the calyx lobes, c. 2 mm diam., opening by 3 valves; capsule valves spreading and rupturing the calyx; seeds semi-globose, c. 0.4 mm long.

DIAGNOSTIC FEATURES

K4, P0(-2), A2, G3; like *R. gossweileri* but the developing fruit ruptures the calyx, the calyx lobes are equal in shape and shorter than the calyx tube and the capsule is up to 2 mm diam.

DISTRIBUTION

West and Central Africa from Senegal to Ethiopia more or less in a band between 5°N. and 15°N. (Map 13).

SELECTED SPECIMENS

Senegal: s. loc., *Perrottet* 332 or 333 (P); Niokolo-koba, April 1951, *Berhaut* 1513 (P). **Guinea:** Mali, Aug.-Sept. 1937, *Scaetta* 3383 (P); de Sombalato à Boulivel, 28-29 Aug. 1907, *Chevalier* 18657bis (P). **Sierra Leone:** Kurubonla, 15 Nov. 1965, *Morton* SL2524 (K); Kambia, 22 Nov. 1963, *Morton & Gledhill* SL25 (K); Wonkifu (Tonko-Limba), 2 Oct. 1953, *Jordan* 933 (K). **Ivory Coast:** entre Ségiuéla et Bonabé, 6 Nov. 1965, *Bonardi* (P). **Ghana:** Lawra, Burufo, 4 Sept. 1965, *Hall* 747 (K); *ibid.*, Oct. 1947, *Hinds* 5013 (K). **Nigeria:** Zaria, 30 Sept. 1948, *Olorunfemi* 24400 (BR, K); Zaria, Anara, Kan Gimi, 20 Oct. 1947, *Keay* 20130A (K); Fuka, c. 56 km E. of Minna, 9 Oct. 1957, *Hepper* 968 (K); Guduma, c. 60 km E. of Minna, 9 Oct. 1957, *Hepper* 973 (K); Adamawa Prov., S. Muri Distr., Gidan-Anju, Kurmi Nya, 22 Nov. 1954, *Latilo & Daramola* 28727 (K, MO). **Cameroun:** Ouda Ngaoui, 70 km E.N.E. of Meiganga, 17 Oct. 1963, *Letouzey* 6209 (P). **Central African Republic:** Yalinga, 9 Oct. 1921, *Le Testu* 3336 (BR, P); Yakélé, pr. Ft. Crampel, Sept. 1957, *Trochain* 10460 (P); Sanba, 21 Sept. 1963, *Audru &*

Boudet 1976 (P); Djur, Seriba Ghattas, 1869, *Schweinfurth* 2442 (MEL). **Zaire:** Sources de la Bili, Ango, 700 m, Dec. 1945, *Germain* 4396 (BR, M); Distr. de l'Ubangi-Uele, Tukpwo, 22 Oct. 1959, *Gérard* 4259 (BR); Mont. Genze, 30 Sept. 1953, *Gérard* 839 (BR). **Ethiopia:** Gafta (?Gamo Gofa), 14 Sept. 1838, *Schimper* 1187 (B, BM, CGE, G, K, L, LE, M, Z, ZT); Chire (?Sire), ?1844, *Quartin, Dillon & Petit* 169 (P). Raynal, *Adansonia* 7: 542. 1967, cites specimens from: Mali and Upper Volta.

NOTES

In the original description Hiern wrote "leaves 1 in. long" this is a missprint and should be " $1\frac{1}{2}$ in."

- 35. *Rotala gossweileri*** Koehne, Bot. Jahrb. 42: Beibl. 97: 48. 1908.
 = *Rotala urundiensis* A. Fernandes & Diniz, Bol. Soc. Brot. Sér. 2, 29: 89. 1955. **Type:** Burundi, Ruyigi, Sept. 1951, *Michel & Reed* 228 (holotype: COI n.v.; isotypes: BR, MO, YANG n.v.).
 = *Rotala minuta* A. Fernandes & Diniz, Bol. Soc. Brot. Sér. 2, 31: 151. 1957, quoad typum. **Type:** Zambia, Mufulira, 11 May 1934, *Eyles* 8343 (holotype: SRGH n.v.; isotype: K).

Type: Angola, Malange, Quizanga, 1903, *Gossweiler* 1145 (it is not certain which specimen is the holotype, perhaps it was destroyed in B; isotypes: BM, K, P).

lc.: Fig. 23F-I; Fernandes & Diniz, Bol. Soc. Brot. Sér. 2, 29: t. 4. 1955 — as *R. urundiensis*; op. cit., 31: t. 1957 — as *R. minuta*.

Amphibious or terrestrial perennial or annual. *Stems* erect or creeping below, simple or irregularly branched, up to c. 15 cm long often much less. *Leaves* decussate, sessile or subsessile, narrowly elliptic to ovate-orbicular, up to c. 6 mm long, attenuate to cordate at base, obtuse at apex. *Bracts* leaf-like, up to c. 6 mm long, usually obtuse or cordate at base; bracteoles capillary, c. 0.5 mm long. *Flowers* monomorphic, sessile or subsessile, solitary in the axils of bracts. *Calyx* tube scarious, cup-shaped, not markedly accrescent but not splitting as the fruit ripens, c. 1 mm long; calyx lobes 4 or rarely 5, triangular, c. 1 mm long, red, dimorphic, 2 opposite lobes somewhat wider at base than the other pair; calyx appendages absent; interjected folds distinct at anthesis, sometimes persisting in fruit. *Petals* absent. *Stamens* 2, opposite, inserted at base of calyx tube; filaments 2, c. 1 mm long, not thickened at base; anthers included in calyx tube. *Ovary* subglobose; style c. 0.25 mm long; stigma capitate; capsule globose, remaining within the calyx tube, c. 1 mm diam., opening by 3 valves; capsule valves not widely spreading and not rupturing the calyx tube; seeds semi-globose, c. 0.3 mm long.

DIAGNOSTIC FEATURES

K4(-5), P0, A2, G3; like *R. stagnina* but the calyx lobes are dimorphic (1 opposite pair wider at base than the other opposite pair) and the lobes are at least as long as the calyx tube, the capsule remains within the calyx tube and does not rupture it as the capsule matures.

DISTRIBUTION

Tropical Africa from Senegal to Ethiopia between 20°N. and 20°S. but absent from the southern part of West Africa and most of the Congo Basin (Map 15).

SELECTED SPECIMENS

Guinea Bissau: Bafata, Bricama, 28 Dec. 1961, *Alves Pereira* 2486 (K). **Senegal:** Niokolo-Koba, Badi, Dec. 1951, *Berhaut* 113 (P). **Mali:** Bamako, 16 Dec. 1955, *Adam* 11359 (P). **Nigeria:** between Kontagora and Auna, 17 Jan. 1950, *Meikle* 1040 (BR, K). **Cameroun:** 25 km N.E. of Bafia, Niasskounou, 26 Nov. 1969, *Letouzey* 9632 (K); Bamenda, Wum, April 1931, *Maitland* 1594 (K); Iri, 5°N.-12°E., 20 Dec. 1969, *Letouzey* 9738 (P); 17 km S.S.W. Koso, 60 km S.S.W. Batouri, 28 July 1963, *Letouzey* 5525 (BR, K, P); 47 km E. Nagaoundere, Tello Riv., 1200 m, 27 Nov. 1964, *de Wilde* 4272 (BR); Roumsiki, 35 km S.W. Mokolo, 10 Jan. 1965, *J. & A. Raynal* 12928 (P); Ngoro, 30 March 1963, *J. & A. Raynal* 10603 (P). **Chad:** Reg. Moundo, Logone, 25 March 1963, *Descoings* 10560 (P). **Central African Republic:** 20 km N. Bambari, Kogo, Ndokpwa, 1925, *Tisserant* 2818 (P); 40 km N. Bambari, Balimbwa, 13 Oct. 1925, *Tisserant* 2044 (P); next two localities not found but the place names occur in Zaire: Télé, 2-12 May 1903, *Chevalier* 8255bis (P); Dinga, 24 Nov. 1921, *Le Testu* 3478 (P). **Zaire:** Garamba, Nawozoko, 26 Feb. 1952, *Troupin* 211 (BR); Garamba, Mabanga, 7 March 1952 *Troupin* 359 (BR); Garamba, Bagbele, Mogbwamu, 7 March 1950, *Noirfalise* 2 (BR). **Angola:** Malange, Quizanga, 1903, *Gossweiler* 1145 (BM, K, P); Malange, 22 Sept. 1932, *Young* 856 (BM); Lunda, Dala, Biúla, rio Cassai, c. 1190 m, 28 April 1937, *Exell & Mendonça* 1346 (BM, M); Benguela, Caconda, rio Polente, 22 May 1937, *Carrisso & Sousa* 163 (BM). **Ethiopia:** Kefa Prov., Kochi, 7°38'N., 36°50'E., 1690 m, 1 Jan. 1973, *Friis, Getachew, Aweke, Rasmussen & Voliesen* 2066 (BR, K). **Kenya:** Kitale, 18 Sept. 1956, *Bogdan* 4296 (K); *ibid.*, 15 May 1961, *Bogdan* (BM); *ibid.*, 200 m, March 1967, *Tweedie* 3426 (K). **Uganda:** Koboko, *Eggeling* 1854 (K); Maracha, April 1940, *Eggeling* 3880 (K); Bukasa, Kigezi, 1952, *Norman* 150 (K); Entebbe, Victoria Nyanza, 17 Sept. 1905, *Bagshaw* 769 (BM); Bukoto Co., Masaka Distr., E. Side Lake Kanyanja, 1150 m, 14 March 1971, *Lye* 5917 (K); Masaka Distr., Lake Nabugabo, 1140 m, 6 Oct. 1953, *Drummond & Hemsley* 4639 (BR, K); Kampala, King's Lake, 1300 m, Sept. 1935, *Chandler & Handcock* 30 (BR, K). **Rwanda:** Kibungu, lac Ihema, 27 Oct. 1969, *Bouxin & Michel* 527

(BR — sterile). **Burundi:** Ruyigi, Sept. 1951, *Michel & Reed* 228 (BR, MO); Kiharo, 3°6'S., 30°6'E., 8 april 1952, *Michel & Reed* 1663 (BR — sterile). **Tanzania:** Songea Distr., Chipoli, 890 m, 2 June 1956, *Milne-Redhead & Taylor* 10537 (B, BR, K); Songea Distr., Luhira, ricefield, 1050 m, 23 June 1956, *Milne-Redhead & Taylor* 10889 (B, BR, G). **Malawi:** N. Prov., Mzimba Distr., c. 4.8 km W. of Mzuzu, Katoto, 11°30'S., 34°00'E., 1500 m, 3 Aug. 1973, *Pawek* 7284 (MO); Nyassa Highlands, Kyimbila, c. 1000 m, 10 June 1912, *Stolz* 1347 (B, BM, G, L, MO, U, Z). **Zambia:** Mbala (Abercorn), May 1943, *Bre-?on* 5389 (BR); Mbala (Abercorn), Mwambe R., Chitembwa, nr. Kambole, 1500 m, 14 June 1961, *Richards* 15268 (K); Mbala, Mbulu, 18 May 1968, *Sanane* 132 (K); Serenje, Bolelo R., 1370 m, 24 June 1963, *Symoens* 10429 (K); Mufulira, 1350 m, 11 May 1934, *Eyles* 8343 (K); Mwinilunga, Kalenda Plain, Matonchi, 16 April 1960, *Robinson* 3578 (K, M). **Rhodesia (Zimbabwe):** Sebungwe, Chicomba Vlei, 12 Aug. or Sept. 1951, *Whellan* 525 (BM); *ibid.*, *Whellan* 526 (BM).

NOTES

R. urundiensis was separated from *R. gossweileri* because it was larger, more robust, more branched and had rounder leaves. In the material I have examined I have found all degrees of intermediacy between *R. urundiensis* and *R. gossweileri*. Also *R. urundiensis*-like plants are widespread and not limited to a particular area. I have no doubts that the two species should be united. The type of *R. minuta* has been dried without being pressed; on some flowers, the interjected folds look a little like calyx appendages. This led Fernandes to separate *R. minuta* from *R. welwitschii*. Some specimens determined *R. minuta* by Fernandes are *R. welwitschii* but the type specimen is *R. gossweileri*.

- 36. *Rotala indica* (Willd.) Koehne, Bot. Jahrb. 1: 172. 1880** $\equiv$ *Peplis indica* Willd., Sp. Pl. 2(1): 244. 1799 $\equiv$ *Ameletia indica* (Willd.) DC., Mém. Soc. Phys. Nat. Hist. Genève 3(2): 82, t. 3, f. A. 1826 $\equiv$ *Nexilis indica* (Willd.) Rafin., New Fl. 4: 9. 1838.
 = *Ammannia nana* Roxb., Fl. Ind. (ed. 1) 1: 448. 1820, non Wallich. **Type:** Roxburgh plate No. 549 — kept at K.
 = *Ammannia repens* Rottler ex Martius, Acad. Münch. Philos. 6: 190. 1820. **Type:** India, Bengala, *Rottler* 789 (holotype: M).
 = *Ameletia polystachya* Wallich ex Wight & Arnott, Prodr. Fl. Ind. Or. 1: 304. 1834 $\equiv$ *Ammannia polystachya* Wallich, Cat. No. 2094, nom. nud. $\equiv$ *Rotala subrotunda* (Wallich ex S. Kurz) Koehne var. *polystachya* (Wallich ex Wight & Arnott) Koehne, Bot. Jahrb. 1: 174. 1880. **Type:** Wight & Arnott cited two Wallich collections (2904A and 2904B). I choose to select the "A" collection as lectotype. Bangla Desh, Sylhet (Silhit, Sillet), *Wallich* 2094A (lectotype: K-W; isolectotypes: CGE, K, G, LE, M).

Syntypes: Nepal, s. loc., *Hamilton?*, *Wallich 2094B* (K, K-W, G, LE, M, U). (The Wallich collection from "Promé" is incorrectly numbered 2094 in G and LE, it should be 2093).

- = *Ameletia elongata* Blume, Mus. Bot. Lugd.-Bat. 2: 135. 1852, fide Koehne.
- = *Ameletia acutidens* Miq., Fl. Ind. Bat. 1: 617. 1855, fide Koehne.
- = *Ameletia uliginosa* Miq., Ann. Mus. Lugd.-Bat. 2: 261. 1865-1866, fide Koehne $\equiv$ *Rotala indica* (Willd.) Koehne var. *uliginosa* (Miq.) Koehne, Bot. Jahrb. 1: 173. 1880 $\equiv$ *Rotala uliginosa* (Miq.) Nakai, Bull. Sci. Mus. Tokyo 31: 80. 1952.
- = *Rotala elatinomorpha* Makino, Bot. Mag. Tokyo 24: 100. 1910. **Type:** Japan, Tosa Pref., Iwamedzi, 22 Oct. 1892, *Makino*, or Japan, Shimoosa Pref., Usui, 10 Sept. 1895, *Makino* (no type material in MAK, perhaps in TI) — material determined by Makino seen in MAK.
- = *Rotala koreana* (Nakai) Mori, Enum. Pl. Cor. 261. 1922, n.v. $\equiv$ *Rotala indica* (Willd.) Koehne var. *koreana* Nakai, Fl. Korea 1: 236, t. 12, f. 3. 1909.
- *Ammannia peploides* Sprengel, Syst. Veg. (L., Syst. Nat., ed. 16) 1: 444. 1824; nom. illeg.
- *Ammannia obovata* Buch.-Ham. nom. in sched.

Type: India, 1795, *Klein 546* (holotype: B-Herb. Willdenow 814/7001).

lc.: Fig. 24A-F.

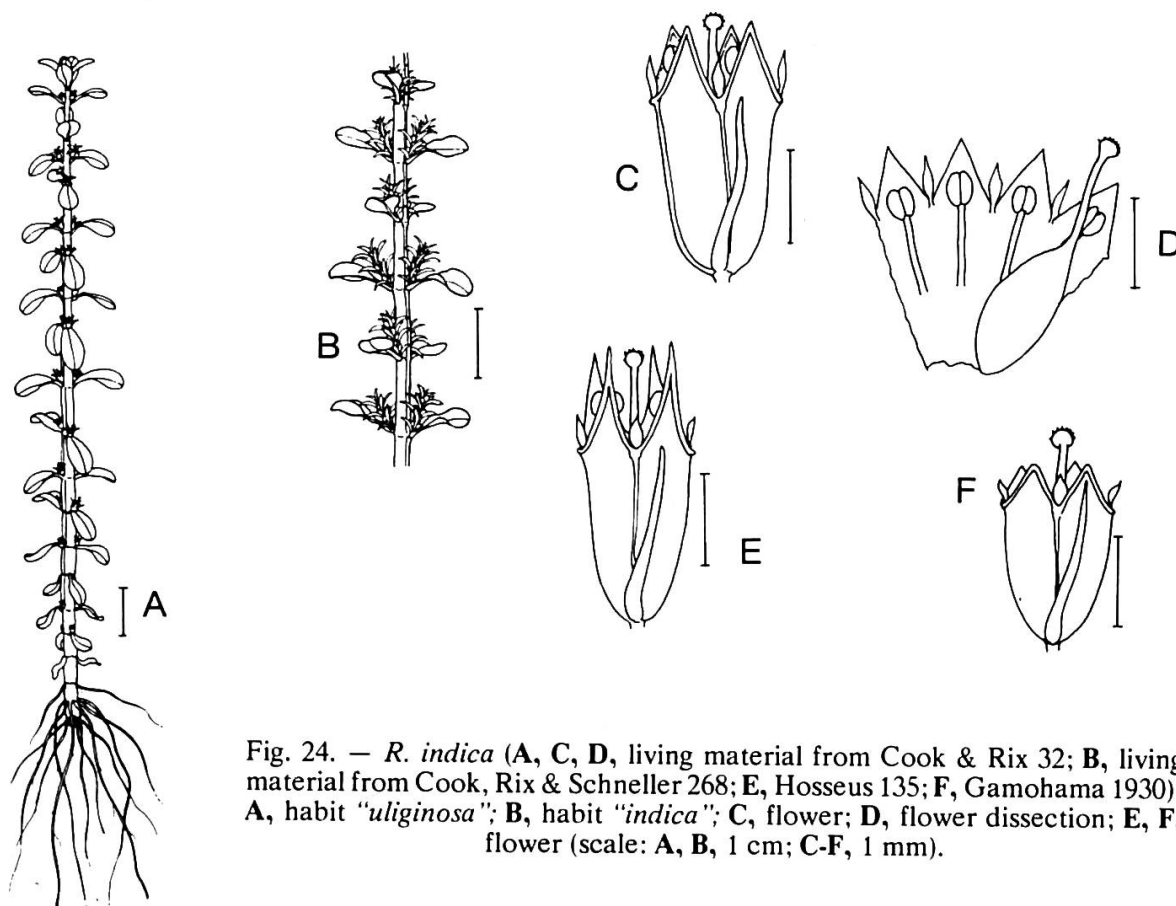


Fig. 24. — *R. indica* (A, C, D, living material from Cook & Rix 32; B, living material from Cook, Rix & Schneller 268; E, Hosseus 135; F, Gamohama 1930); A, habit "*uliginosa*"; B, habit "*indica*"; C, flower; D, flower dissection; E, F, flower (scale: A, B, 1 cm; C-F, 1 mm).

Amphibious or terrestrial annual. *Stems* erect or decumbent and rooting at the nodes, usually 1, 2 or more times branched, occasionally simple; erect flowering stems usually 4-40 cm long (exceptionally up to 86 cm long), weakly 4-angled or terete, when old somewhat woody. *Leaves* decussate, sessile or subsessile, obovate to subspathulate-oblong or suborbicular or narrowly oblong, 4-20 mm long, cuneate to obtuse or somewhat cordate at base, acute or obtuse with or without mucro or emarginate at apex; leaf margin cartilaginous (distinct on dried leaves). *Bracts* polymorphic, leaf-like or on short spike-like, lateral inflorescence branches smaller than foliage leaves, occasionally hardly exceeding the flowers, when very small usually lanceolate; bracteoles 2, linear to lanceolate, 1.25-2.25 mm long, usually about as long as the calyx tube. *Flowers* monomorphic, sessile or subsessile, solitary in axils of bracts, borne either on main axis or on short, spike-like, lateral inflorescences. *Calyx* tube narrowly to broadly campanulate, angled on the nerves, pink or red at anthesis, light brown and scarious in fruit, 1.5-2.25 mm long; calyx lobes 4, deltate to acutely triangular, 0.5-1.5 mm long, with cartilaginous margin, often mucronate at apex; calyx appendages absent. *Petals* 4, persistent, pinkish, linear to narrowly ovate, less than half as long as the calyx lobes or occasionally minute. *Stamens* 4 or occasionally less; filaments inserted about half-way up the calyx tube; anthers appearing just above the calyx lobe sinuses. *Ovary* ellipsoidal; style 0.5-1 mm long, persistent in fruit; stigma capitate, borne level with or above the calyx lobes; capsule ellipsoidal, c. 2 mm long, opening by 2 valves; seeds almost hemispherical, 0.3-0.4 mm long.

DIAGNOSTIC FEATURES

K4, P4, A4, G2; the leaves have a distinct cartilaginous margin which is clearly visible on dried material. Like *R. subrotunda* but flowers are not pedicellate, petals are shorter than the calyx lobes, the stamens are not longer than the calyx and the style is not more than 1 mm long. Like *R. diandra* but petals present, stamens 4, filaments inserted about half-way up the calyx tube and the calyx tube not more than 2.25 mm long.

DISTRIBUTION

S.E. Asia from Tadzhik to N. Korea and N. Honshu southwards to Java and Sri Lanka. Perhaps also native in a small area on the W. side of the Caspian Sea from E. Azerbaydzhan to N. Iran. Introduced and more or less naturalized in N. Italy, C. Portugal, Congo near Brazzaville and the USA in California and Louisiana (Map 14). It is a very successful weed in ricefields.

SELECTED SPECIMENS

Iran: Lahijan, Guilan, 1937, *Lindsay* 980 (K). **U.S.S.R.** Azerbaydzhan: Prov. Talysch, pr. Astara, Oct. 1821-41, *Hohenacher* (K, M); *ibid.*, *Hohen-*

acher (LE); Prov. Baku, Lenkoran, 6 Sept. 1914, *Pastuchow* (LE); *ibid.*, 30 July 1930, *Bobrov & Cvelev* 1090 (LE); Bakinskaya, Gerherniga, Lenkasran, 15 Sept. 1914, *Pastuchow* (LE). Tadzhikistan: 12 km from Dushaube (Stalinbad), 13 Sept. 1932, *coll. illeg.* (LE). **Afghanistan:** Kabul, *Griffith* 2313 (K). **Pakistan:** no specimens seen but likely to be present. **India.** Kashmir: Srinagar, 10-30 Sept. 1856, *Schlagintweit* 4273 (LE); Lower Scinde Valley, 2000 m, 8 Sept. 1922, *Stewart* (K). Haryana: Karnal, 1886, *Drummond* 24401 (G, K); Sadhaura, 1844, *Edgeworth* 36 (K). Uttar Pradesh: Moradabad, Sept. 1844, *Thomson* 810 (K); Mirzapur, Sirsi, 9 Dec. 1961, *Bhattacharyya* 18313 (L). Rajasthan: Kota, 29 Oct. 1970, *Cook & Gut* 62 (K, Z); *ibid.*, 28 Oct. 1970, *Cook & Gut* 33 (Z). Maharashtra: Uran, 27 Dec. 1961, *Divakar* 5310 (MO); *ibid.*, 18 Feb. 1962, *Divakar* 3829 (MO); ?Bhandup, Dec. 1919, *Sedgwick & Bell* 7314 (K). Karnataka (Mysore): Karwar, Dec. 1918, *Sedgwick & Bell* 5118 (K). Kerala: Nilambur, Jan. 1881, *Beddome* 3116 (Z); *ibid.*, s.d., *Beddome* 7181 (K); Badagara, 27 Oct. 1900, *Bourne* (K); 6 km N. of Alwaye, 17 Sept. 1973, *Cook, Rix & Schneller* 268 (Z); between Kottayam and Vaikom, 21 Sept. 1973, *Cook, Rix & Schneller* 317 (Z); Thekkadi (Tekkadi), Anaipadi, 600 m, 3 Dec. 1912, *Fischer* 3520 (K). Tamil Nadu: Nilgiris, *Thomson* (CGE, G, K, L, M, U); Tranquebar (Trankenbar), *Schwaegrichen dedit. Hiendlmayr* (M — very old specimen). Orissa: Ganjam Distr., Bondogorka, 500 m, March 1884, *Gamble* 14072 (K); *ibid.*, Chatrapur, Dec. 1887, *Gamble* 21547 (K). Bihar or Orissa: Chota (Chutia) Nagpur, Sirguja, 500-600 m, 21 Dec. 1890, *Wood* (K). Bihar: Singbhum, Dec. 1903, *Haines* 714 (K); Ranchi, 500-600 m, 30 Sept. 1871, *Wood* (K); Hazaribagh, Manda, 26 Dec. 1874, *Clarke* 25128 (LE). Bengal: Calcutta, 1836-38, *Helper* 169 (G, L); Serampore, 1845, *Griffith* (CGE, K). Assam: Cachar, *Keenan* (K); Assam, 1865, *Masters* (G, L, M); Assam, *Jenkins* (CGE); Assam, *Simons* (K); Khasi Hills, Jumbhelpore, *Griffith* (CGE). Nagaland: Naga Hills, Sibong, 1000 m, Dec. 1907, *Meebold* 7475 (K). **Andaman Islands:** South Andaman, Port Mouat, 18 March 1893, *King's collector* (CGE, L, LE); Car Nicobar, Johnson's Village, 20 June 1895, *King's collector* (G). **Sri Lanka:** Kalutara (Caltara), *Macrae* 208 (BR, K); s. loc., *Thwaites* 1546 (BR, CGE, G, LE — different collections); s. loc., *Walker* (G); s. loc., 1839, *Mackenzie* (K). **Nepal:** between Khebang and Bharomdin, 24 Nov. 1963, *Hara, Kanai & al.* 6306593 (K); Mahara, Bahara-Gauriganja, 13 Dec. 1963, *Kanai, Murata & Togashi* 6306590 (K, KYO); Illam-Jog, Mai-Ranga Pan, 8 Dec. 1963, *Hara, Kani & al.* 6306578 (KYO); Ghorwa-Sanichare, 10 Dec. 1963, *Hara, Kanai & al.* 6306588 (KYO); Tapeljung Distr., Dumhan, 700 m, 31 Oct. 1963, *Murata, Togashi & Tuyama* 6306585 (KYO); *ibid.*, 1 Nov. 1963, *Murata, Togashi & Tuyama* 6306586 (KYO); Biratnagar, 14 Oct. 1963, *Hara, Kanai & al.* 6306584 (KYO); Katmandu Airport, 13 Oct. 1963, *Hara, Kanai & al.* 630692 (KYO); s. loc., 1821, *Wallich* 2094A (G, LE, M, U, additional specimens in G and LE from Prome, 1826 are incorrectly numbered 2094). **Bhutan:** (Bhotan), s. loc., 1863, *Griffith* (G, K, LE). **Bangla Desh:** Nasirbad (Mymensingh), Dewanganj, 14 Nov. 1868, *Clarke* 8036 (LE); Sylhet (Silhit), 1832, *Wallich* 2094B or 2094/2 (B, CGE, G, K, K-W, LE, M); E. Bengal, Noogury, *Griffith* (CGE, K, M, L);

perhaps Bangla Desh: Bengal, Kurz (M, Z); Bengala, Rottler 798 (M). **Burma:** Meiktila, Dec. 1887, Collett 37 (K); Prome, 1826, Wallich 2093 (CGE, K, LE, additional sheets in G and LE incorrectly numbered 2094); Pegu, 20 m, 15 Dec. 1957, Mc Kee 5834 (K, NSW); Mergiu, Griffith (K). **Thailand:** Fang, 21 Feb. 1958, Sørensen, Larsen & Hansen 1444 (K); Chiang Mai, 300 m, 18 Jan. 1911, Kerr 1647 (K, L); *ibid.*, 27 Dec. 1912, Kerr 2816 (K); Bau Mae Kon, N. of Chiang Mai, 5 Jan. 1962, Matsuoka 105 (KYO); Nakawn Sawan, Wang Chao (Wang Djar), 100 m, 31 Oct. 1904, Hosseus 135 (M); Distr. Kanchanaburi, 14°55'S., 98°45'E., 750 m, 7 Nov. 1971, Bensekom, Phengkhlai, Geesink & Wongwan 3489 (L); Ayuthia, Sara Buri, 50 m, 8 Dec. 1923, Kerr 7953 (K); Nakawn Sritamarat, Padang Besar, 50 m, 25 Dec. 1927, Kerr 13633 (K); Phuket, Ranawng, Lam Lieng, c. 10 m, 18 Dec. 1918, Kerr 16406 (K, L); Krabi, Ban Heng, c. 25 m, 10 Nov. 1930, Marcan 2591 (K); Hugop, 14 Dec. 1918, Haniff & Nur SFN4033 (K); nr. Sriracha, c. 10 m, 30 Nov. 1927, Collins 2008 (K). **West Malaysia:** Kedah, Langkawi, Jan. 1897, Ridley 8293 (K); Perak, Perlis, ?Gwlney Kalok, March 1910, Ridley 15034 (K); Malacca, Alor Gajah, Kampong Gadek, 20 April 1957, Sinclair 8927 (L). **Laos:** N. of Ban Hang (?Ban Hai), 2 Jan. 1958, Toyama L57449 (KYO); Ban Kinsing (?Khing), Feb. 1914, Faurie 738 (KYO). **Cambodia:** no specimens seen but recorded in Fl. Indochine. **Vietnam:** Tonkin Prov., Ninh-Binh, Bon 99 (BR); *ibid.*, Bon 117 (Z); Tonkin, Khang Khuong, 22 Dec. 1881, Bon 1175 (K); Qung Yen, E. Hanoi, 26 Dec. 1885, Balansa 1403 (G, K); Ouanlei, Nov. 1885, Balansa 1402 (G, K); En Phap, Jan. 1880, Balansa 3124 (G, K); Puc Yen Prov., Phu Lo, Jan. 1936, Pételot 5550 (MO); Quang Lon, Dec. 1908, Alleizette (L); Bien Hoa, Jan. 1873, Pierre 1272 (K); *ibid.*, April 1873, Pierre 1272 (G, K — mixed with *R. cordata*); *ibid.*, 1862-66, Thorel (G, Z); *ibid.*, Thorel 193 (BR); Nha Trang, Annam, March 1911, Robinson 1530 (K). **Indonesia.** Sumatra: Medan, 15-20 m, 20 March 1928, Lörzing 13013 (L, Z); N. of Pajakumbuh, Suliki, 500 m, 8 May 1957, Meijer 5778 (L); nr. Pajakumbuh, Sikabu-Kabu, 700 m, 27 July 1957, Meijer 7139 (L). Djawa (Java): Bogor (Buitenzorg), 29 Dec. 1888, Borlage (L); Tjibodas, Tjisaraea, 20 July 1896, Raap 885 (L); Bantardjati, 29 July 1896, Raap 513 (L); Tjiamis, Kamp Gawa, 10 Oct. 1888, Boerlage (L); Tegal, Sapi, 26 June 1922, Bakhuisen van den Brink Jr. 1510 (U); Solo, 18 Aug. 1932, Kooper 1907 (U); Preanger, Malang-Tjadas, 20 July 1917, Bakhuisen van den Brink Jr. 2547 (L, U); Tengger, Bodo Gendro, 1000 m, Aug. 1911, Moussefs (G); s. loc., 1845, Zollinger 540 (G); *ibid.*, Zollinger 714 (G — sterile); *ibid.*, 4 Sept., Horsfield (CGE, K). Sumbawa, Lombok: Pangantaps, sea level, 2 July 1909, Elbert 2366 (L). Sulawest (Celebes): Palopo, 22 July 1929, Kyellberg 1952 (L); Makasar, July 1913, Robinson 2456 (K, L); Lombasang, c. 950 m, 4 May 1921, Bünnermeyer 11347 (K, L). **Philippines.** Luzon: Rizal, San Pedro Macati, Dec. 1909, Merrill 62 (G, M, U, Z); Rizal, May 1907, Ramos 2692 (BR, L, LE); *ibid.*, Dec. 1912, Reillo 19157 (MO); Iba, Zambales, 27 Dec. 1954, Santos (L); Cavite, 9 Feb. 1913, Robinson 18268 (MO, NSW); Manila, Santa Rosa, 8 Dec. 1892, Loher 2158 (K, M); Manila, San Francisco del Monte, 8 Dec. 1892, Loher 2157 (K, M); Nueva Vizcaya, Dupax, March-April 1912, McGregor 11454 (K). Panay,

?1841, *Cumming* 1655 (CGE, G, K, L, LE). **China.** Yunnan: Bhamo, 23 Jan. 1868, *Anderson* (K); Pin-fa, 24 Feb. 1902, *Cavalerie* 4279 (K); Gan-chouen, 1914, *Cavalerie* 4279 (K); Tao-wang, 2400 m, 2 July 1914, *Schneider* 1707 (K). Szechuan: Hui-li Chuo, 24 March 1914, *Schneider* 562 (K); O-mei Shan (Mt. Omi), June 1904, *Wilson* 3653 (K). Kweichow: Fan Ching Shan, Ta Ho Yen, 19 Aug. 1931, *Steward, Chiao & Cheo* 631 (K, L). Kwangtung: Canton (Kuang Chou), Nov. 1869, *Hillebrand* 1889 (G); *ibid.*, 9 Oct. 1884, *Sampson* (K); *ibid.*, Oct. 1866-Nov. 1869, *Hance* 10322 (K). Kwangtung-Hainan Tao: Pao-t'ing (Po-ting), c. 360 m, Aug. 1935, *How* 73473 (G — mixed label "Tree by stream, flowers white"); T'un-ch'ang, Chi-to Shan, 16 Sept. 1927, *Tsang & Qai Tak* 882 (K); Hai-k'ou (Jaichow), Jan. 1933, *How & Chun* 70012 (K). Kiangsi: Lungnan Distr., Oo Chi Shan, Lam Uk Village, Oct. 1934, *Lau* 4805 (G). Chekiang: Hang Chow, 11 Oct. 1928, *Chiao* 18680 (G); Chekiang, *Hickin* (K). Hupeh: I-chang, Feb. 1887, *Henry* 2369 (K); Hupeh, *Cheo* 18453 (Z). **Taiwan:** Teipeh, 1896, *Makino* (KYO); *ibid.*, 12 Oct. 1960, *Chou, Li, Lin, T'sai & Wang* 7422 (TAI); Kao-hsiung (?Boakinsing), *Henry* 814 (K); Skniten, Nov. 1914, *Faurie* 1255 (KYO); Taoyuan, Chungli, 24 Oct. 1975, *Kuo* 6381 (TAI); Nantou, Ta-kan-hu, 5 Aug. 1971, *Huang* 5670 (TAI); Nantou, Lake Shuishe (Suisya), 12 Sept. 1929, *Sasaki* (TAI); Jaihoku, 3 Nov. 1932, *Suzuki-Tokio* 7776 (TAI); Insl. Yonaguni, Liukiu, 11-13 Aug. 1923, *Koidzumi* (K). **Japan.** Okinawa: Nago-cho, 27 Oct. 1938, *Kanashiro* 1198 (KYO); Okinawa, 23 Sept. 1937, *Nakanone* (KYO). Kyushu: Kagoshima Pref., Kagoshima, *Makino* 121133 (MAK); Kumamoto Pref., Shinkai, 28 Oct. 1951, *Shimada* 12672B (KYO); Kumamoto, 16 Oct. 1954, *Shimada* 9859 (KYO); Satsuma Pref., Koshikijima, Mt. Otake, 20 Oct. 1928, *Ohya* 8928 (KYO); Unzen, *Fotlara* 104/37 (K); Nagasaki, Simabara, 1863, *Maximowicz* (K, ZT); Nagasaki, 7 Sept. 1935, *Fo Hara* 126/35 (K). Shikoku: Awa Pref., Shishikui, Kaihu-gun, 1 Nov. 1951, *Kitamura & Nakai* 139 (KYO); Ehime Pref., Kitayoshii, Shigenobu-cho, Onsen-gun, *Makino* 121123 (MAK). Honshu: Kii Pref., between Koguchi and Zizochaya, Higashimuro-gun, *Makino* 13102 (MAK); *ibid.*, Okumotori-yama, 16 Oct. 1960, *Murata* 13719 (MAK, U); *ibid.*, Koguchi, 16 Oct. 1960, *Murata* 13719 (KYO); *ibid.*, 16 Oct. 1960, *Kitamura* (KYO — last 3 one gathering?). Kyoto Pref., Uji River, Oct. 1920, *Fushimi* (KYO); *ibid.*, Funai-gun, Sonobe-cha, Rurikei, 29 Sept. 1963, *Aya Nitta* 11799 (KYO); *ibid.*, Iwakura, 1 Nov. 1938, *Okamoto* (KYO); *ibid.*, Sugo, 10 Sept. 1936, *Okamoto* (KYO); *ibid.*, Kamigamo, 16 Oct. 1920, *Kinashi* (KYO). Hyogo Pref., Shizimi-cho, Miki-schi, 22 Sept. 1968, *Murata & Nishimura* (KYO). Hiroshima Pref., Onomichi, 10-11 Nov. 1893, *Faurie* (G, K). Settsu Pref., Toyonaka, 5 Oct. 1958, *Murata* 12263 (KYO), U). Yamato Pref., Katagiri-tyo, 28 Oct. 1956, *Murata* 10473 (KYO). Yokohama, 1862, *Maximowicz* (BR, G, K, L, M). Koshigaya in Musashi, Sept. 1885, *s. coll.* (G). Komba nr. Tokyo, 20 Sept. 1911, *Onuma* (Z). Mikawa, Mima-mura, 21 Sept. 1953, *Murata* 6677 (KYO). Tanaba Pref., Yagi-tyô, Hunai-gun, 28 Sept. 1954, *Murata* 8344 (KYO). Nagano Pref., Suwa, 27 Aug. 1939, *Fo Hara* (K). Kawachi Pref., Shinodamura, Izukita-gun, 23 Sept. 1956, *Murata* 10221 (KYO). Shiga Pref., Bomura, Shiga-gun, 10 Oct. 1966, *Nagai* (KYO). Mikawa

Pref., Kamogaya, Thukude-mura, 55 m, 24 Sept. 1959, *Murata 13180* (KYO). Yamashiro Pref., Tanbetyo, 22 Sept. 1950, *Nakai 4980* (KYO). Tōbōri Pref., Yoshinara, 10 Oct. 1971, *Tanaka 14170* (KYO). Gunma (Gumma) Pref., Numata City, Yakatahara, *Makino 121092* (MAK). Kumamoto Pref., Tōmonji, Kawachiyoshinomura, Houtaku-gun, *Makino 121128* (MAK). Miyagi Pref., Kateyama, 30 Oct. 1931, *s. coll.* (Z); ?*ibid.*, Sendai, 20 Oct. 1918, *Isiba* (G); *ibid.*, Nagamati, 17 Oct. 1927, *Iisiba* (G). Akita Pref., Akita, 6-7 Sept. 1894, *Faurie 13763* (G, K). Aomori Pref., Hirosaki, Nov. 1888, *Faurie 3389* (K). **Korea:** Cheju do (Quelpaert, Hongno), Oct. 1907, *Taquet 281* (KYO); *ibid.*, 28 Sept. 1908, *Taquet 1463* (G, K, KYO); *ibid.*, Oct. 1906, *Faurie 925* (KYO). Pusan, 4 Oct. 1901, *Faurie 473* (KYO). Chinese-Korean boarder: Ya-lü Chiang (Amnok-Gan River), Pen-nian Prov., 31 Aug. 1897, *Komarôv 1124* (K). Korea localities not found: Mt. Tii, 27 Sept. 1934, *Okamoto 17916* (KYO); Zenrahokudo, Tokutsu, 13 Sept. 1940, *Cho 1263* (KYO).

Italy. Piemonte: Vercelli, 16 Sept. 1909, *Ferrari & Gola* (L, NSW); *ibid.*, 17 Sept. 1909, *Mattirolo 1517* (LE, Z); *ibid.*, 7 Sept. 1951, *Koch & Hess 680A*, *685A* and *687* (ZT); *ibid.*, 8 Aug. 1951, *Koch & Hess 577* (ZT); *ibid.*, 29 Aug. 1955, *Landolt 120* (ZT); *ibid.*, 1 Aug. 1957, *Merxmüller & Wiedmann 15/57* (M); *ibid.*, 23 Aug. 1972, *Cook & Rix 32*, *33*, *57* and *95* (Z); Novara, 31 Aug. 1950, *Berger* (ZT); *ibid.*, 7 Aug. 1951, *Koch & Hess 555* (ZT); *ibid.*, 6 Sept. 1951, *Koch & Hess 639*, *641A* and *653A* (ZT); 22 Aug. 1972, *Cook & Rix 1*, *6* and *25* (Z). **Portugal:** no specimens seen, reliable records from C. Portugal.

Congo: Brazzaville, Pongo, Sept. 1900, *Coomans* (BR).

USA: no specimens seen, reliable records from: California, Butte Co. (*Mason*) and Louisiana, Rice Experiment Station, 4 km N.E. of Crowley, Acadia Parish, 16 Sept. 1971, *Thieret 36102* (LAF).

NOTES

Variation. — I have cultivated material of *R. indica* collected in Kerala, India (*Cook, Rix & Schneller 268*) and N. Italy (*Cook & Rix 6*) through two generations. The plants in cultivation were obligate annuals, self-compatible and effectively self-pollinated. When grown singly in pots without competition, the Indian material developed branched stems with lateral, contracted, spike-like inflorescences (Fig. 24B). The Italian plants remained virtually unbranched and developed flowers on the main stem in the axils of leaf-like bracts (Fig. 24A). These unbranched plants have been recognised as taxonomically distinct and given the rank of variety or species with "*uliginosa*" as the epithet.

The "*uliginosa*" race certainly has a genecotypic basis but it is often morphologically masked by the plasticity of "normal" *R. indica*. When "normal", *R. indica* is cultivated under unsuitable conditions or at high density it remains unbranched and develops flowers on the main stem; it is not distinguishable from the genetically fixed *uliginosa* genecotype. This has the consequence that *uliginosa*-like plants are found throughout the geo-

graphical range but the branched state is more or less confined to the tropical zone. This is a fine example of phenotypic plasticity masking genecological differentiation and thus hindering taxonomic recognition based on morphological characteristics.

The flower of *R. indica* is variable in shape, two extremes are shown on Fig. 24E and 24F. However, there are all degrees of intermediacy between these extremes.

Ecology. — *R. indica* is a very successful weed in ricefields. In Italy and India I have hardly found a ricefield without *R. indica* but in both countries I have never found *R. indica* not associated with rice cultivation.

37. *Rotala subrotunda* (Wallich ex S. Kurz) Koehne, Bot. Jahrb. 1: 174. 1880, excl. var. *polystachya* (Wallich ex Wight & Arnott) Koehne $\equiv$ *Ammannia subrotunda* Wallich ex S. Kurz, J. Asiatic Soc. Bengal 40(1): 55. 1871, reprinted in Flora (Regensb.) 54(19): 191. 1871, typified in J. Asiatic Soc. Bengal 46(2): 85. 1877 $\equiv$ *Rotala indica* (Willd.) Koehne forma *subrotunda* (Wallich ex S. Kurz) Blatter & Hallberg, J. Bombay Nat. Hist. Soc. 25: 713. 1918.

— *Ammannia latifolia* Wallich in Wallich Cat. No. 2096, nom. nud., non L., nec Walp.

Type: Burma, Sagaing (Segain, Seguen) 1826, *Wallich 2096* (holotype: ?CAL n.v.; isotypes: G, K-W, LE).

lc.: Fig. 25A-C.

Terrestrial or amphibious annual or perhaps perennial. *Stems* erect or decumbent and rooting at the base, usually branched with numerous, upright, distinctly 4-angled shoots, 8-40 cm long. *Leaves* decussate, sessile, broadly ovate to suborbicular, rarely more than 10 mm long, obtuse to cordate at base, obtuse at apex; leaf margin distinctly cartilaginous (visible on dried leaves). *Bracts* lanceolate to oblanceolate, scarcely exceeding the flowers, obtuse or acute at apex; bracteoles 2, capillary, rarely exceeding 1 mm long. *Flowers* monomorphic, distinctly pedicellate, solitary in the axils of bracts, borne on contracted, spike-like lateral branches; pedicels 0.5-2 mm long. *Calyx* tube campanulate, membranous, pink, c. 1.5 mm long; calyx lobes 4, deltate, c. 0.5 mm long, with cartilaginous margins, occasionally mucronate at apex; calyx appendages absent. *Petals* 4, narrowly obovate to suborbicular, c. 1 mm long, up to 2 times as long as calyx lobes, deep pink to purple. *Stamens* 4; filaments inserted about half-way up the calyx tube, c. 2.5 mm long; anthers exerted, borne above the petals. *Ovary* ellipsoidal; style 2 mm or more long; stigma capitate, exerted, borne level with the anthers; capsule ellipsoidal, c. 1.5 mm long, opening by 2 valves; seeds elongate-ellipsoidal, c. 0.4 mm long.

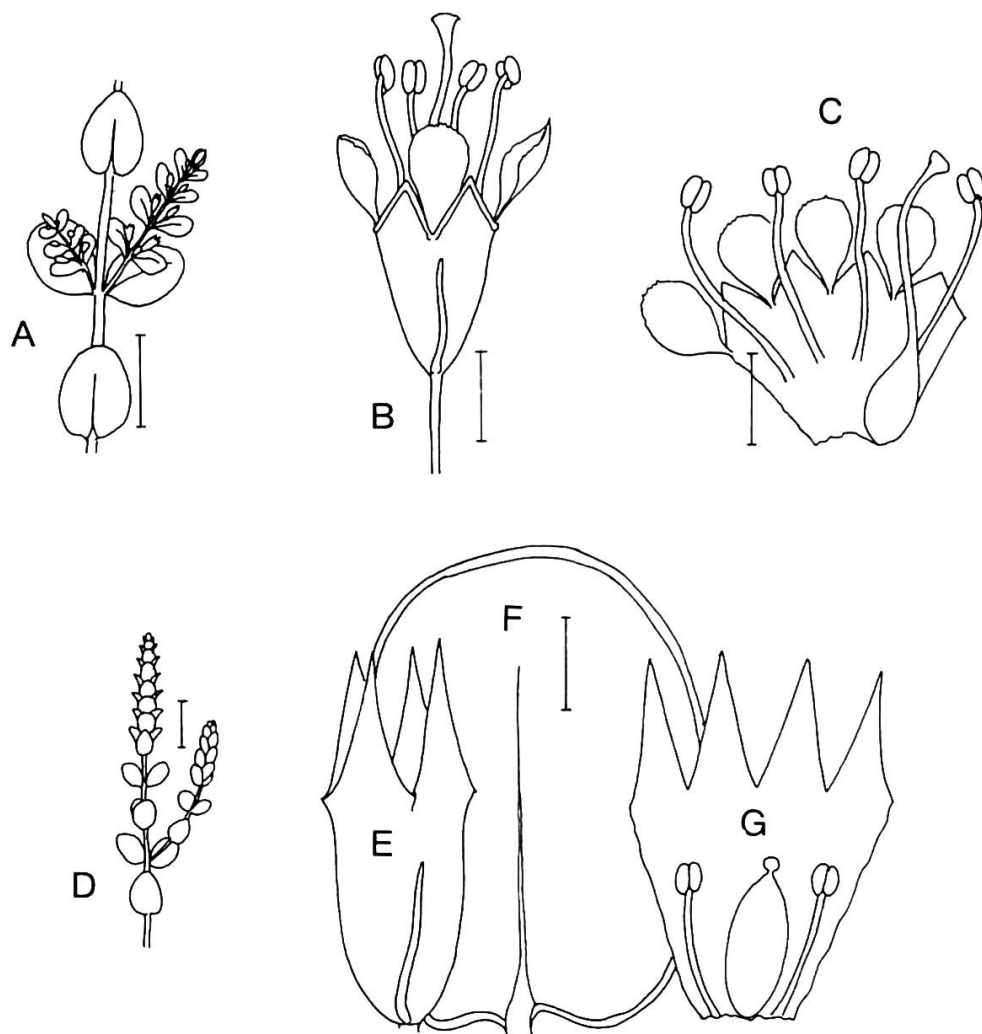


Fig. 25. — *R. subrotunda* (Lace 4490); A, inflorescence; B, flower; C, flower dissection. *R. diandra* (Victoria R., Müller); D, inflorescence; E, flower; F, bract; G, flower dissection (scale: A, D, 1 cm; B, C, E-G, 1 mm).

DIAGNOSTIC FEATURES

K4, P4, A4, G2; like *R. indica* but plants usually taller and more branched; flowers distinctly pedicellate, not borne on main axis; petals relatively large and showy, up to 1 mm long; anthers and stigmas exerted and borne above the petals.

DISTRIBUTION

N.E. India and Upper Burma (Map 12). Flowering time December to April.

SELECTED SPECIMENS

India. Manipur: Laireen, c. 1000 m, April 1882, *Watt 7312* (K). **Burma:** Sagaing (Segain, Segaien), 1826, *Wallich 2096* (G, K-W, LE); Mandalay, 11 Jan. 1868, *Anderson* (LE); *ibid.*, 14 Jan. 1964, *Kanai 2542* (KYO); Myinmoo (Minjoo), 10 March 1893, *King's Coll. 304* (Z); Monywa, Dec. 1907, *Meebold 7928* (K); Chindwin, Tawnob, Dec. 1907, *Meebold 7602* (K); Bhamo Distr., Palin, c. 160 m, 14 Dec. 1908, *Lace 4490* (K); Katha Distr., 19 Jan. 1868, *Anderson* (L); Zhemun, Muilen, Jan. 1903, *Shalk Mokin 1123* (G, NSW); Yun Tee, c. 100 m, 10 Jan. 1970, *s. coll.* (K); *ibid.*, 20 Jan. 1970, *s. coll.* (K).

- 38. *Rotala diandra*** (F. v. Müller) Koehne, Bot. Jahrb. 1: 169. 1880 $\equiv$ *Ameletia diandra* F. v. Müller, Fragm. Phyt. Austral. 3: 108. 1862 $\equiv$ *Ammannia diandra* (F. v. Müller) Benth, Fl. Austral. 3: 296. 1866.

Type: Australia, Northern Territory, Victoria River, *F. v. Müller* (holotype: MEL; isotypes: K, MEL).

lc.: Fig. 25D-G.

Amphibious annual. *Stems* erect or creeping and rooting below, variously branched, erect above, up to c. 20 cm tall. *Leaves* decussate, sessile, broadly ovate to suborbicular, usually less than 10 mm long, obtuse to cordate at base, obtuse at apex; leaf-margin cartilaginous (distinct on dried leaves). *Bracts* leaf-like, broadly ovate to suborbicular, somewhat imbricate and covering the flowers; bracteoles 2, capillary, membranous, up to 1.5 mm long. *Flowers* monomorphic, sessile, solitary in the axils of leaf-like bracts. *Calyx* tube campanulate, membranous, ?straw-coloured, up to 2.5 mm long; calyx lobes 4, triangular, up to 1.5 mm long, without a cartilaginous margin; calyx appendages absent; interjected folds rudimentary. *Petals* absent. *Stamens* 2; filaments inserted near base of calyx tube, c. 1.5 mm long; anthers included, reaching about half-way up the calyx tube. *Ovary* ellipsoidal; style very short, almost absent; stigma capitate, borne about level with the anthers; capsule ellipsoidal, c. 1.5 mm long, scarcely exceeding half the length of the calyx tube, opening by 2 valves; seeds narrowly ellipsoidal, c. 0.4 mm long.

DIAGNOSTIC FEATURES

K4, P0, A2, G2; like *R. indica* but bracts imbricate more or less covering the flowers; calyx large up to 4 mm long (tube and lobes); anthers and stigmas about half-way up the calyx tube — no sexual parts visible from outside; petals absent; stigma sessile to subsessile.

DISTRIBUTION

Northern Australia from W. Queensland to King's Sound (Map 14). Flowering time from April to August?

SELECTED SPECIMENS

Australia. Queensland: Nicholson River, 17°56', 138°43', 5 May 1974, *Jacobs 1459* (NSW). Northern Territory: Victoria River, *F. v. Müller* (K, MEL); Upper Victoria River, *F. v. Müller* (K); Herbert River to Carpentaria, 1886, *Dittrich* (MEL); Lake Nash, Milne River, 1886, *Dittrich* (MEL); Newcastle Waters, 1887, *Giles* (MEL); 51 km S.W. of Hooker's Creek, 12 Aug. 1956, *Chippendale 2251* (MEL); Ampax Camp, 2 June 1971, *Taylor 63* (MEL); Katherine, 14°20', 132°, 107 m, 24 April 1947, *Blake 17438* (L, MEL). Western Australia: King's Sound, 1888, *Froggat* (NSW); Kimberly Distr., 1887, *Nyulasy* (MEL, NSW); Kunumurra, Sept. 1967, *Johnson NSW137475* (NSW); Fitzroy River, 1883, *Forrest* (MEL); W. of Cambridge Gulf, 1887, *Keiller* (MEL); between Norman and Gilbert Rivers, 1874, *Gulliver 89* (MEL).

The *Rotala filiformis* group

The *Rotala filiformis* group can be characterized by the following diagnostic features: annual or perhaps occasionally perennial; leaves decussate; calyx 4-lobed; petals small, rudimentary or absent; stamens 4 or less, inserted about half-way up the calyx tube; capsule opening by 2 valves.

The *R. filiformis* group is widely distributed in Africa. From the floral structure the plants are highly inbreeding. As it is frequently the case in inbreeding annuals, numerous races with more or less distinct morphological, geographical and ecological characteristics have evolved. Some of the races have been given formal taxonomic recognition, others not. The following species in this group have been described: *R. capensis*, perhaps *R. cataractae*, *R. congolensis*, *R. cordipetala*, *R. debilissima*, *R. dinteri*, *R. filiformis*, *R. fontinalis*, *R. heteropetala*, *R. heterophylla*, *R. lucalensis*, *R. milne-redheadii*, *R. robynsiana*, *R. smithii*, *R. sphagnoides*, *R. stuhlmannii* and *R. wildii*. Authentic herbarium material of *R. cataractae* and *R. stuhlmannii*, both described by Koehne, has not been found (probably destroyed in Berlin) so their exact identity is not known, *R. cataractae* is probably synonymous with *R. myriophylloides*.

Morphological distinctions between species are sometimes obscured by phenotypic variability. Unfortunately, I have not had the opportunity to cultivate plants from this group, but when an analysis is made of repeated gatherings from one locality (i.e. the spray zone below the Victoria Falls) or comparisons made between individual plants from large gatherings (i.e. collections of: Milne-Redhead & Taylor, Richards, Robinson, Schlieben or Verboom) it is possible to predict which morphological features are unreliable as diagnostic characters.

With some reservations, the following previously accepted morphological characters are unreliable and can hardly be used as diagnostic features:

1. The length and degree of branching of the stem, although *R. capensis* and *R. dinteri* are usually much smaller than the other species.
2. The dimensions and shapes of the foliage leaves; the bracts, on the other hand, are relatively constant.
3. The relative proportions of the bracteoles, calyx tube and calyx lobes, although absolute measurements are often of use.
4. The number, size and shape of the petals is very variable between individuals and often between flowers on a single stem. *R. capensis* appears to be the only species in this group that is consistently without petals, although some races of the other species may be apetalous.
5. The number of stamens varies from 1 to 4. Some races have consistently 2 stamens and no staminodes while other races have consistently 4 stamens but occasionally 1 or 2 are sterile. Other races have from 1 to 3 fertile stamens. Stamen number is a useful character when used in conjunction with other characters.
6. The shape of the ovary at anthesis is globose in all species, in some it remains globose, in others it becomes ellipsoidal.

The following characters have been found to be of diagnostic value in the *R. filiformis* group: bract shape and length, bracteole length, calyx tube length, calyx lobe length, stamen number, filament length, style length, capsule shape and length, seed shape and length. The distribution of these diagnostic features are summarized on Table 1.

Table 1. — Diagnostic features in the *Rotala filiformis* group (all length measurements in mm)

	<i>R. filiformis</i>	<i>R. capensis</i>	<i>R. dinteri</i>	<i>R. fontinalis</i>	<i>R. lucalensis</i>	<i>R. smithii</i>
Bract shape	lanceolate to ovate	linear to lanceolate- ovate	linear to ovate	lanceolate to widely ovate	lanceolate	ovate to widely ovate
Bract length	-8	-5	-8	-8	-8	c. 4
Bracteole length	0.5-1	0.1-0.25	0.25-0.5	-1	-1	c. 0.5
Calyx tube length	1-1.5	0.3-0.5	0.4-0.5	1-1.5	c. 1	c. 1.25
Calyx lobe length	c. 0.5	0.2-0.4	0.3-0.45	0.5	0.5	0.5-0.75
Stamen number	(1-2(-3)	2	(1-2(-3)	4	4	4
Filament length	0.5	0.1	0.4	0.5	0.5	1.0-2.5
Style length	0.25-0.5	0.1-0.2	0.2	1	0.75-1	1.25-2.5
Capsule shape	ellipsoid to obovoid	ellipsoid	subglobose	subglobose	ellipsoid	ellipsoid
Capsule length	-2	1-1.25	1-1.25	1	2	1.5
Seed length	0.4	0.4	0.4	0.4	0.75-1	0.4

39. *Rotala filiformis* (Bellardi) Hiern in Oliver, Fl. Trop. Africa 2: 468. 1871, excl. syn. $\equiv$ *Suffrenia filiformis* Bellardi, Mém. Acad. Sci. Lit. Beaux-Arts Turin — Sci. Phys. Math. pt. 1, “pour les années X (1802) et XI (1803)”: 445, t. 1, f. 1.? 1804. (The publication date is uncertain, Koehne cites “1794” which is incorrect, the work was perhaps published in 1803 but had certainly appeared by 1804).

= *Rotala heteropetala* Koehne, Bot. Jahrb. 22: 149. 1895. **Type:** Ethiopia, Sire (Schire), ?1840, *Dillon & Petit 761* (holotype: ?destroyed in B; isotype: P).

= *Rotala debilissima* Chiov., Ann. Bot. (Roma) 9: 61. 1911. **Type:** Ethiopia, Erithrea, Scimezana Guna Guna, 2000 m, 21 Aug. 1902, *Pappi 769* (holotype: ?FI).

= *Rotala congolensis* A. Fernandes & Diniz, Bol. Soc. Brot. Sér. 2, 29: 89. 1955. **Type:** Zaire, Shaba (Katanga), Lubumbashi (Elisabethville), May 1948, *Schmitz 1684* (holotype: COI n.v.; isotype: BR).

= *Rotala heterophylla* Welw. ex A. Fernandes & Diniz, Bull. Jard. Bot. Etat. Bruxelles 27: 106. 1957. **Type:** Angola, Cuanza Norte, Pungo Andongo, Lagoa de Quibinda, March 1857, *Welwitsch 2342* (holotype: LISU n.v.; isotypes: BM, M).

Type: Italy, Piemonte, Vercelli, *Suffrens* (holotype: TO n.v.; probable isotypes: G, K, LE, M).

lc.: Fig. 26A-E; Fernandes & Diniz, Bol. Soc. Brot. Sér. 2, 29: t. 3. 1955 (*R. congolensis*); Fernandes & Diniz, Bull. Jard. Bot. Etat. Bruxelles 27: pl. 3. 1957 (*R. heterophylla*).

Amphibious or aquatic annual or perhaps occasionally perennial. *Stems* erect, occasionally creeping below, simple or irregularly branched, often packed together and denuded of leaves below, 5-40 cm long. *Leaves* decussate, sessile or subsessile; submerged leaves usually linear to lanceolate, up to 10 mm long; aerial leaves lanceolate to ovate, rarely more than 8 mm long, truncate to cordate at base, obtuse at apex. *Bracts* sessile or subsessile, lanceolate to ovate, rarely more than 8 mm long; subcordate to cordate at base, obtuse at apex, imbricate at anthesis, spreading in fruit; bracteoles 2, capillary, c. 0.5-1 mm long. *Flowers* monomorphic, sessile or subsessile, solitary in axils of leaf-like bracts. *Calyx* tube cup-shaped, membranous, somewhat accrescent, 1-1.5 mm long; calyx lobes 4, deltate, c. 0.5 mm long; calyx appendages absent, small interjected folds present at anthesis. *Petals* absent or up to 4, not exceeding the calyx lobes, linear to obovate or orbicular (often variable in shape within one flower, petalous and apetalous flowers often found on the same plant). *Stamens* 2 and opposite or occasionally 3 or 1, inserted about half-way up the calyx tube; filaments c. 0.5 mm long; anthers included, borne below the stigma. *Ovary* at anthesis subglobose; style 0.25-0.5 mm long; stigma capitate; capsule ellipsoid or obovoid, up to c. 2 mm long, as long as or somewhat exceeding the calyx lobes, opening by 2 valves; seeds semi-ellipsoidal, c. 0.4 mm long.

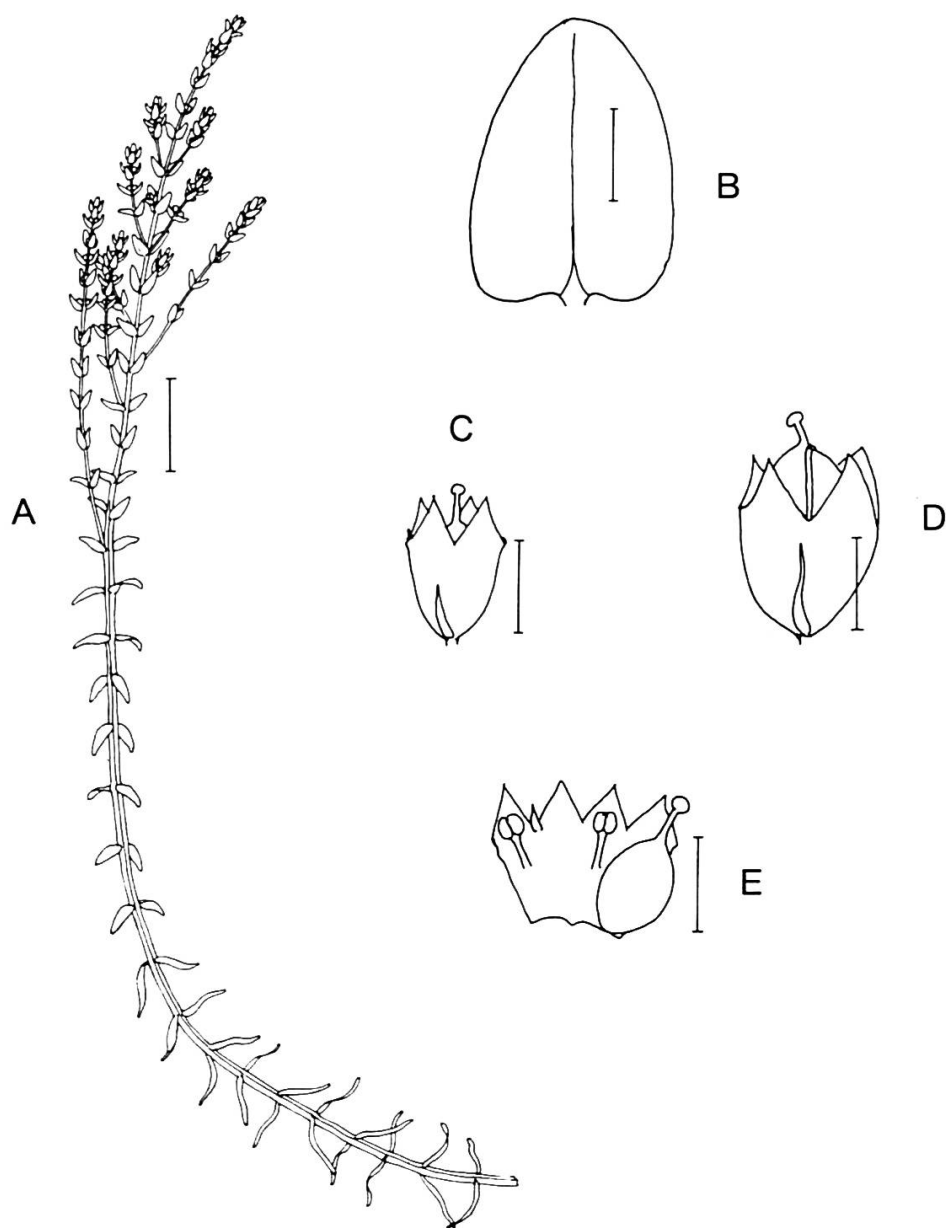


Fig. 26. — *R. filiformis* (Malinverni Sept. 1875); **A**, habit; **B**, bract; **C**, flower at anthesis; **D**, flower with mature capsule; **E**, flower dissection (scale: **A**, 2 cm; **B-E**, 1 mm).

DIAGNOSTIC FEATURES

K4, P0-4, A(1-)2(-3), G2; capsule before dehiscence ellipsoid or obovoid, as long as or somewhat exceeding the calyx; style 0.25-0.5 mm long; calyx tube at least 1 mm long.

DISTRIBUTION

Widespread in Africa from Mali to Ethiopia southwards to the northern part of South West Africa and the Transvaal, it is also in Malagasy. It was found in Piemonte, North Italy from the 18th century until about 1912; repeated searches in the last few years have failed to find it. Its relatively short time in Italy and the fact that it was known only from ricefields support the argument that it was never truly native in Italy (Map 16).

SELECTED SPECIMENS

Italy: in BR, G, K, LE, M and MO are some very old specimens without locality, date and collector. Piemonte: s. loc., *Balbis* (G, LE); *ibid.*, 1807, *Bellardi* (LE); *ibid.*, 1868, *van Herch* (BR); *ibid.*, *Müller-Arg.* (ZT); *ibid.*, 22 Sept. 1827, *Welden* (M); Vercelli, *Suffrens* (G, K, LE, M); *ibid.*, *Caesati* (LE, ZT); *ibid.*, 1876, *Gibelli* (G, LE, Z, ZT); *ibid.*, 1864, *Rostan* (G); *ibid.*, 1887, *Rostan* (G); Prov. di Vercelli, Quinto, Sept. 1871, *Gibelli* (BR, K, Z, ZT); *ibid.*, 30 Sept. 1875, *Malinverni* (K, M, Z, ZT); *ibid.*, 1878, *Gibelli* 252B (Z); *ibid.*, Sept. 1880, *Mori* (M); Oldenico, *Caesati* (BR, LE, MO, U, Z, ZT); *ibid.*, 8 Aug. 1879, *Malinverni* (LE, Z); *Novara*, 1809, *De Candolle* (Z); *ibid.*, 10 Aug. 1875, s. col. (Z); Pavia, s.d. *Franzoni* (M); *ibid.*, Oct. 1823, *Franzoni* (ZT); *ibid.*, Sept. 1840, *Franzoni* (ZT); *ibid.*, 1823, *Mayer* (M); Legnano, *Bubani* (LE); Villerbois, Aug. 1812, *Perret* (LE).

Mali: Gao, vers la Dune Rose, 5 April 1936, *De Wailly* 5016 (P). **Nigeria:** Zaria Prov., Anara, Kan Gimi, 20 Oct. 1947, *Keay* 20130 (K). **Cameroun:** 13 km W.N.W. of Yagoua, Gandjam, 1 Jan. 1965, *J. & A. Raynal* 12832 (P). **Central African Republic:** Gungere, pr. Ippy, 4 Nov. 1928, *Tisserant* 2735 (P). **Ethiopia:** Sire (Schire), ?1840, *Dillon & Petit* 761 (P); Kaffa Prov., Kochi, c. 5 km E. of Jimma, 1740 m, 2 Nov. 1970, *Friis* 55 (BR, K). **Zaire:** Terr. Kasangulu, Zongo, 2 July 1971, *Hallé* 1927 (BR); L'Upemba, Ngose, 27°15'E., 8°50'S., 11 May 1942, *de Witte* 6329 (BR); 80 km N.E. of Lubumbashi (Elisabethville), 3 March 1961, *Schmitz* 7195 (BR); Keyberg, pr. Lubumbashi, Sept. 1945, *Quarré* 6936 (BR); *ibid.*, May 1948, *Schmitz* 1684 (BR); Lubumbashi, 25 June 1928, *Quarré* 1240 (BR, G, K); Katentania, 26°02'5, 1700 m, 26 May 1952, *Schmitz* 3993 (BR). **Angola.** Cuanza Norte: Pungo Andongo, Lagoa de Quibinda, March 1857, *Welwitsch* 2342 (BM, M); Lubango (Huila): Alto Cunene, Mulondo, 23 Sept. 1963, *Menezes* 803 (K); Calueca, Donguena, Rio Runene, 1000 m, 10 May 1937, *Gossweiler* 10892 (K); between Ruancana and Humbe, 1000-1150 m, 10 June 1937, *Exell & Mendonça* 2904 (BM, M); Kamba sur le Cunene, 6 July 1933, *Thiébaud* (ZT). **Tanzania:** Iramba Distr., Kiomboi, 1800 m, 30 April 1962, *Polhill & Paulo* 2262 (B, BR, K); Lupembe, Ruhudje Riv., March 1931, *Schlieben* 450 (B, BM, BR, G, K, M, P, Z); Songea Distr., Kwamponjore Valley, 19 June 1956, *Milne-Redhead & Taylor* 10835 (B, BR); *ibid.*, 20 June 1956, *Milne-Redhead & Taylor* 10848 (BR); Songea Distr., Riv. Luhira, nr. Mshangano, N. of Songea, 1030 m, 15 June 1956, *Milne-Redhead & Taylor* 10815 (B, BR).

Malawi: Central Prov., Kasungu Distr., Kasungu National Park, 1000 m, 7 Sept. 1972, *Pawek 5699* (MO). **Zambia:** Mbala (Abercorn); Ningi Pans, 1500 m, 1 June 1961, *Richards 15193* (K); Mbala (Abercorn), *Michelmores 433* (K); *ibid.*, Lake Lyapa, 7 Sept. 1966, *Richards 31415* (K, numbered 21415 in MO); Kasama Distr., Chiskimba Falls, 20 May 1962, *Robinson 5202* (B, BR, K); 25 km W. of Kasama, 7 May 1961, *Robinson 4637* (K, M); Bangweulu, Ncheta Island, 3 Sept. 1969, *Verboom 2638* (B, BR, K); Chilongowelo, Plain of Death, 1600 m, 5 May 1955, *Richards 5536* (BR, K); Mwinilunga Distr., 7 km N. of Kalene Hill, 15 April 1965, *Robinson 6565* (B, K); Barotse, Masese, 16 June 1960, *Fanshaw 5740* (BR, K); Barotse, Mongu, Nov. 1959, *Drummond & Cookson 6349* (K); c. 20 km S. of Mongu, Namushakende, 1150 m, 25 June 1955, *King Aie 33* (K); Mazabuka, 19 March 1958, *Robinson 2798* (K, M); Namwala, Mulela Flood Plain, 19 April 1963, *van Rensburg 2065* (K); *ibid.*, 17 April, *van Rensburg 2031* (K). **Rhodesia (Zimbabwe):** Victoria Falls, 1860, *Kirk* (K); *ibid.*, *Keilhack* (B); *ibid.*, May 1915, *Rogers 5986* (BM); *ibid.*, 6 Aug. 1929, *Rendle 418* (BM); *ibid.*, 18 July 1930, *Young-Moss 18542* (BM); *ibid.*, 30 Aug. 1947, *Greenway & Brenan 8031* (K); Salisbury, Parktown, 11 April 1944, *Greatrex 18410* (BM); *ibid.*, *Greatrex 18412* (BM); Arcturus, 18 April 1944, *Greatrex 18411* (BM). **South West Africa (Namibia):** Okavango, Niangana, May 1934, *Dinter 7261* (B, BM, K, M); *ibid.*, *Dinter 7622* (K, M, Z); Grootfontein N. Runtu, 8 May 1939, *Volk 1934* (M); Ovamboland, Eunda, 15 June 1963, *Giess & Leippert 7609* (M). **Republic of South Africa:** Transvaal, Ermelo Distr., Chrissiesmeer (Lake Chrissie), 27 Feb. 1928, *Weintroub & Blenkinson 16291* (BM). **Malagasy Republic:** Tananarive, May 1962, *Bosser 15587* (P); *ibid.*, Nanilana, Feb. 1906, *D'Alleizette 2487* (L); *ibid.*, entre Tanjobato et Ankadievo, Ambohimanantrika, 7 Sept. 1972, *Jacquemin 1103* (P); Andramasina, 7 June 1972, *Jacquemin 1052* (P); *ibid.*, 1053 (P); *ibid.*, 1054 (P).

NOTES

The form of the vegetative part of this species is very variable; at one extreme is *R. filiformis* quoad typum (= *R. heterophylla*) a slender, heterophyllous plant and the other extreme is *R. congolensis* a robust, homophyllous plant with large ovate leaves. *R. filiformis* from N. Italy is heterophyllous but most sheets bear only apical portions of mature stems. I cannot agree with A. Fernandes & M. A. Diniz, Bull. Jard. Bot. Etat Bruxelles 27: 104-111. 1957 and A. Raynal, Adansonia 7: 544-545. 1967 that the European and African material belong to different species. I am not suggesting that the variation spectrum is no more than phenotypic plasticity. It is an autogamous species and almost certainly has numerous genecotypically distinct races but the morphological variation presented on herbarium specimens covers a whole range of intermediates. This has forced me to lump some widely recognised species together. Two collections are particularly interesting. The mass gathering by *Milne-Redhead & Taylor 10815* from Tanzania shows almost the whole range of variation in one

collection and the collection *J. Pawek 5699* from Malawi shows a "*congo-lensis*" plant at the stem apex with linear submerged leaves below.

- 40. *Rotala capensis*** (Harvey) A. Fernandes & Diniz, Bull. Jard. Bot. Etat. Bruxelles 27: 105. 1957 $\equiv$ *Suffrenia capensis* Harvey, Thes. Cap. 2: 56, t. 189. 1863.
 = *Rotala robynsiana* A. Fernandes & Diniz, Bull. Jard. Bot. Etat. Bruxelles 27: 110. 1957. **Type:** Zaire, Shaba (Katanga), Dilolo, 1940, *F. Freyne 48* (holotype: COI n.v.; isotypes: BR, YANG n.v.).
 — *Rotala sphagnoides* Perrier, Not. Syst. (Paris) 14: 308. 1953 (dated Dec. 1952), nom. invalid., no type designated, material cited: Malagasy, Antsirabe, *Perrier 6598* (n.v.); *ibid.*, *6620* (P); *ibid.*, *6621* (n.v.); Andringitra, *Perrier 13592* (P); *ibid.*, *13592* (P); *ibid.*, *13651* (P); Firingalava, *Perrier 752* (P).

Type: Republic of South Africa, Draakensberg, 1862, *T. Cooper 1044* (holotype: TCD n.v.; isotypes: K, MEL, Z).

lc.: Fig. 27A-D; Harvey, Thes. Cap. 2: t. 189. 1863; Fernandes & Diniz, Bull. Jard. Bot. Etat. Bruxelles 27: t. 3. 1957.

Amphibious, tufted or turf-forming annual. *Stems* branched and creeping below, erect and mostly simple above, often packed together and denuded of leaves below, up to 10 cm long but usually less. *Leaves* decussate or rarely in whorls of 3; submerged leaves linear, tapering to a slender, emarginate apex, up to 8 mm long; aerial leaves linear to lanceolate or ovate, obtuse or emarginate at apex, rarely exceeding 5 mm long. *Bracts* leaf-like, linear to lanceolate or lanceolate-ovate, rarely exceeding 5 mm long; bracteoles 2, scarious, minute, 0.1-0.25 mm long. *Flowers* monomorphic, subsessile, minute, solitary in axils of bracts. *Calyx* tube cupshaped, membranous, 0.3-0.5 mm long, not accrescent, splitting irregularly as the fruit ripens; calyx lobes 4, deltate, 0.2-0.4 mm long; calyx appendages and interjected folds absent. *Petals* absent. *Stamens* 2, inserted about half-way up the calyx tube; filaments very short, c. 0.1 mm long; anthers included within the calyx tube. *Ovary* at anthesis globose becoming ellipsoidal later; style 0.1-0.2 mm long; stigma subcapitate; capsule ellipsoidal, 1.0-1.25 mm long, about twice as long as the calyx, bright red, opening by 2 valves; seeds semi-ellipsoidal, c. 0.4 mm long.

DIAGNOSTIC FEATURES

K4, P0, A2, G2; calyx (tube plus lobes) less than 1 mm long; capsule twice as long as the calyx; calyx tube splitting irregularly as the capsule develops. Like *R. mexicana* in habit but it has a 2-valved capsule that exceeds the calyx. See notes following *R. dinteri* p. 128.

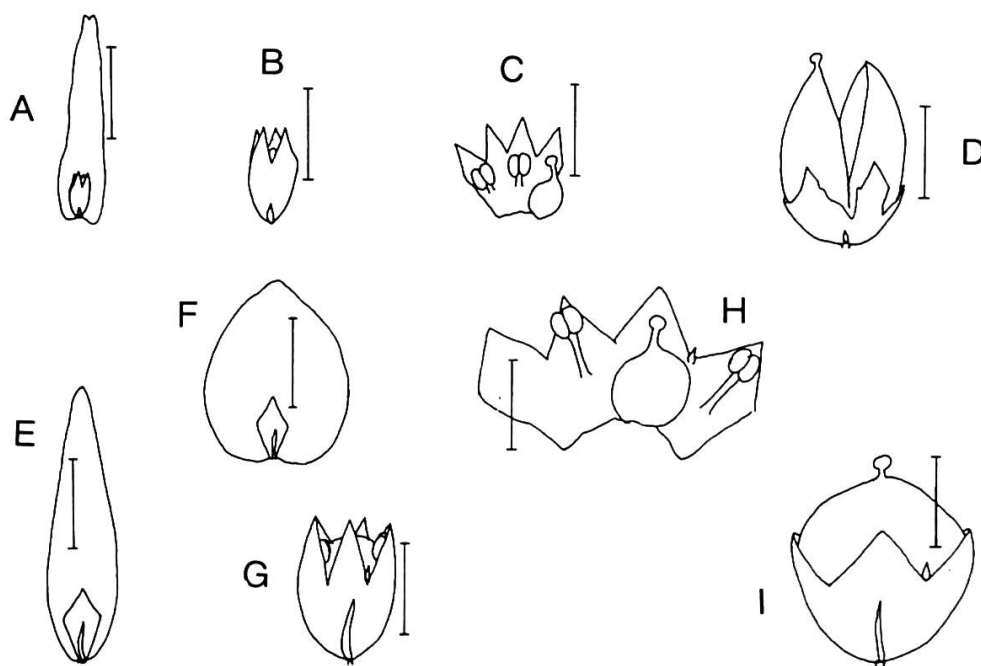


Fig. 27. — *R. capensis* (Cooper 1044); **A**, bract with flower; **B**, flower at anthesis; **C**, flower dissection; **D**, flower with dehiscing capsule.

R. dinteri (Dinter 7262); **E**, **F**, bracts with flowers; **G**, flower at anthesis; **H**, flower dissection; **I**, flower with mature capsule (scale: **A**, **E**, **F**, 1 mm; **B-D**, **G**, **I**, 0.5 mm).

DISTRIBUTION

Widely scattered from northern Cameroun and Tanzania southwards to the eastern part of South Africa and Malagasy (Map 15).

SELECTED SPECIMENS

Cameroun: 70 km E.N.E. of Maroua, Guirvidig, Oct. 1963, *Letouzey 7248bis* (BR); 60 km N.E. of Tibati, Sabal Haléo, 26 Sept. 1963, *Letouzey 6021* (P). **Zaire:** Shaba (Katanga), 15 km E. of Lubumbashi (Elisabethville), 23 March 1955, *Schmitz 4814* (BR); *ibid.*, 25 km N.E.E. of Lubumbashi, 23 March 1955, *Schmitz 6446* (BR); *ibid.*, 26 km N.E. of Lubumbashi, 12 Feb. 1961, *Schmitz 7119* (BR); *ibid.*, 25 km N.E. of Lubumbashi, 10 April 1963, *Schmitz 8296* (BR); *ibid.*, Namopala, 1300 m, 12 April 1962, *Symoens 9376* (BR, K); Dilolo, 1940, *F. Freyne 48* (BR). **Angola:** Lubango (Huila), Humpata, rio Maombo, 2020 m, 18 April 1960, *Mendes 3654* (BR). **Tanzania:** Itigi, E. of Bangayega, 1300, 30 Dec. 1925, *Peter 33758* (B); Ujansi, Schaya Lake, Pori, 1250 m, 3 Jan. 1926, *Peter 34009B* (B); *ibid.*, 34012 (B); *ibid.*, 1240 m, 4 Jan. 1926, *Peter 34143B* (B). **Rhodesia (Zimbabwe):** Salisbury, 19 May 1953, *Wild 4114* (K, MO); Hartley, 7 April 1954, *Wild 4553* (K, MO); Bikita, Turgwe-

Dafana confluence, 1050 m, 5 May 1969, *Biegel 3029* (K); Matobo, 1500 m, April 1958, *Miller 5890* (M). **Republic of South Africa:** Transvaal, Benoni, 19 April 1925, *Moss 11006* (BM); Orange Free State, Harrismith, Laskop, 2100 m, 13 March 1970, *Stam 411* (L); Swinburne, 23 March 1970, *Stam 426* (L); Natal, Naanwhoek, 2250 m, 28 Feb. 1963, *Devenish 1604* (K). RSA, or perhaps Lesotho: Drakensberg, 1862, *T. Cooper 1044* (K, MEL, Z). **Malagasy Republic:** Antsirabe, *Perrier 6620* (P); Massif d'Andringitra, *Perrier 13592* (P); *ibid.*, *13651* (P); Firingalava, *Perrier 752* (P).

41. *Rotala dinteri* Koehne in Schinz, Mém. Herb. Boissier 20: 24. 1900.

= *Rotala milne-redheadii* A. Fernandes & Diniz, Bol. Soc. Brot. Sér. 2, 33: 21. 1959. **Type:** Zambia, Mwinilunga Distr., Kalenda Plain, 30 Jan. 1938, *Milne-Redhead 4414* (holotype: K; isotype: COI, the type material is immature and may be referable to *R. filiformis*).

Type: South West Africa (Namibia), Hereroland, Waterberg, 9 April 1899, *Dinter 564* (Z).

lc.: Fig. 27E-I; Fernandes & Diniz, Bol. Soc. Brot. Sér. 2, 33: 5, 2. 1959.

Amphibious, tuft-forming annual. *Stems* simple or branched below and usually simple above, up to 12 cm long but usually less. *Leaves* decussate, sessile; submerged leaves lanceolate to linear tapering to a slender and emarginate apex, c. 8 mm or perhaps more long; aerial leaves linear to lanceolate or lanceolate-ovate, up to c. 8 mm long. *Bracts* leaf-like, linear to lanceolate or ovate, when ovate then imbricate, up to 8 mm long; bracteoles 2, linear, 0.25-0.5 mm long. *Flowers* monomorphic, sessile, solitary in axils of bracts. *Calyx* tube cup-shaped, membranous, 0.4-0.5 mm long; calyx lobes 4, deltate, 0.3-0.45 mm long, usually not splitting as the fruit ripens; calyx appendages and interjected folds absent. *Petals* absent or 1-2 rudimentary. *Stamens* 2 or rarely 1 or 3, inserted about half-way up the calyx tube; filaments c. 0.4 mm long; anthers included in the calyx. *Ovary* at anthesis and when ripe subglobose; style c. 0.2 mm long; stigma capitate; capsule subglobose, bright red, exceeding the calyx, 1.0-1.25 mm diam., opening by 2 valves; seeds semi-ellipsoidal, c. 0.4 mm long.

DIAGNOSTIC FEATURES

K4, P0-2, A(1)-2(-3), G2; capsule subglobose and exceeding the calyx lobes; calyx (tube plus lobes) not more than 1 mm long.

DISTRIBUTION

Northwestern Zambia, Northeastern Namibia (South West Africa) and Northeastern South Africa (Map 15).

SELECTED SPECIMENS

Zambia: Mwinilunga Distr., Kalenda Plain, 30 Jan. 1938, *Milne-Redhead* 4414 (K); Mbala (Abercorn) Distr., Chilongolwelo, 1440 m, 9 May 1957, *Richards* 9620 (K). **South West Africa (Namibia):** s. loc., *Volk* (M); Hereroland, Waterberg, March 1898, *Bernsmann* (Z); loc. cit., 9 April 1899, *Dinter* 564 (Z); Flugplatzufer am Okavango in Niangana, Mid-May 1934, *Dinter* 7262 (B, M, Z); Grosshuis, Early May 1934, *Dinter* 7292 (B, BM, K, M, Z); Tsumeb, Nosibpad, km 11, Mid-April 1934, *Dinter* 7445 (BM, M, Z). **Republic of South Africa.** Transvaal: pr. Mororiot-Drift, 1400 m, 14 April 1894, *Schlechter* 4774 (Z). Natal: Estcourt, Griffinshill, 1875-1800, *Rehmann* 7298 (K, Z).

NOTES

Rotala dinteri is not a very satisfactory species because it grades into *R. filiformis* at one end of its variation spectrum and into *R. capensis* at the other. Some collections, particularly from Zambia (*Robinson* 5202, 6565 and *Richards* 5536, 31415) are intermediate between *R. dinteri* and *R. filiformis* but as they are relatively large plants with calyces exceeding 1 mm long and a fruit scarcely exceeding the calyx, I have assigned them to *R. filiformis*. The type specimen of *R. robynsiana* (*Freyne* 48) and the collection of *Symoens* 9376A from Zaire are intermediate between *R. dinteri* and *R. capensis* but as they have ellipsoidal capsules, no petals and consistently 2 stamens I have assigned them to *R. capensis*.

42. *Rotala fontinalis* Hiern in Oliver, Fl. Trop. Africa 2: 468. 1871; excl. specim. *Christen Smith* 13, 14, and 16.

= *Rotala cordipetala* R. E. Fries, Feddes Repert. 12: 541. 1913. **Type:** Zambia, Lake Bangweulu, 19 Sept. 1911, *R. E. Fries* 656 (holotype: UPS n.v.; isotype: Z — calyx and petal length shorter on the isotype Z than reported in the type description).

Type: Angola, Pungo Andongo, pr. Lombe et Quisonde, March 1857, *Welwitsch* 2346 (holotype: BM; isotype: LISU n.v.).

Ic.: Fig. 28A-D.

Amphibious or terrestrial annual or perhaps perennial. *Stems* simple or branched, creeping and often denuded of leaves below, erect above, up to 20 cm or more long. *Leaves* decussate, sessile, lanceolate to widely ovate, up to 8 mm or perhaps more long, cuneate to cordate at base, rounded at apex. *Bracts* leaf-like, lanceolate to widely ovate, usually cordate at base, imbricate at anthesis, spreading in fruit, up to 8 mm long; bracteoles linear, up to 1 mm

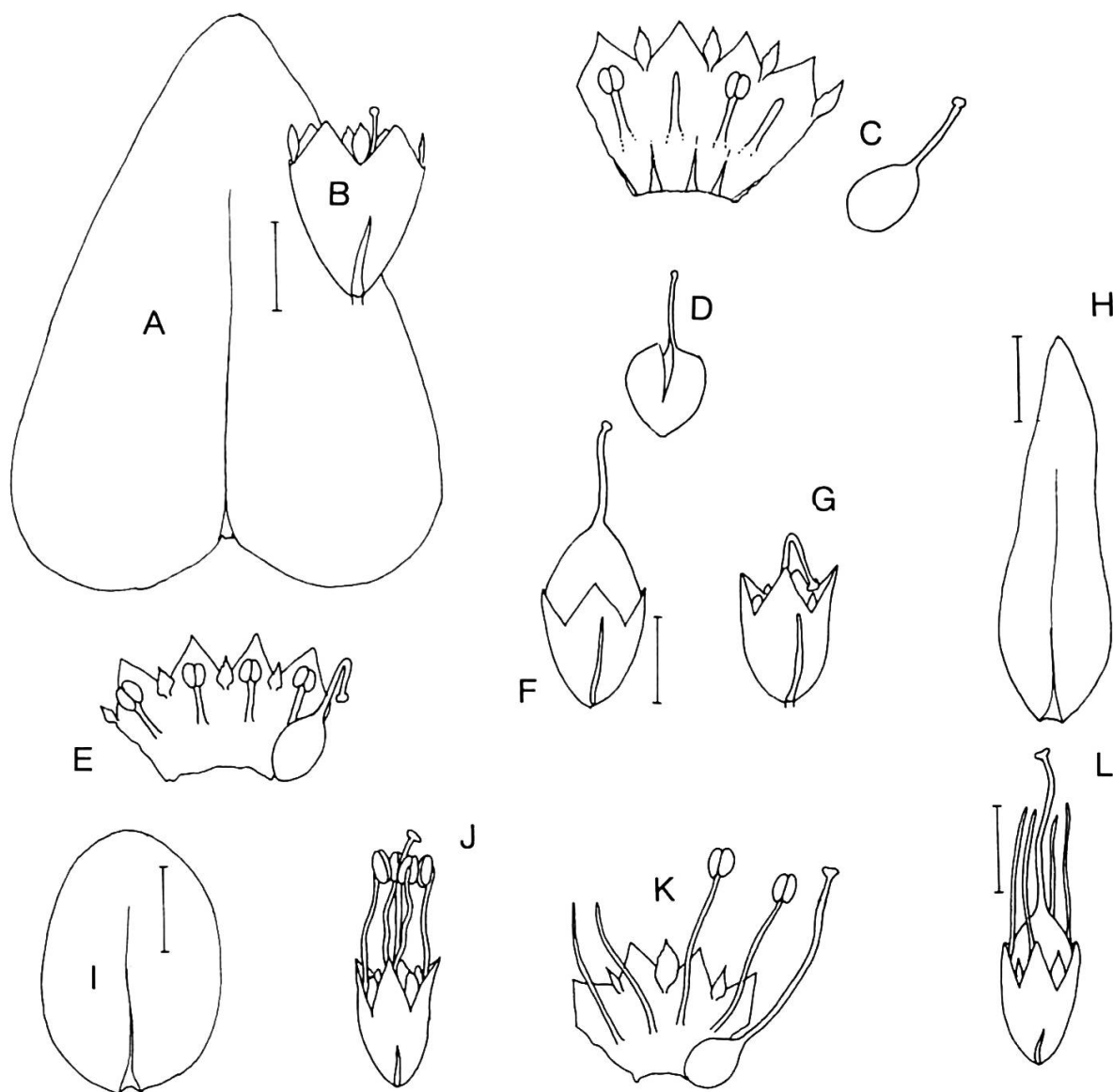


Fig. 28. — *R. fontinalis* (Welwitsch 2347); A, bract; B, flower; C, flower dissection; D, capsule. *R. lucalensis* (Bamps & Martins 4296); E, flower dissection; F, flower with mature capsule; G, flower at anthesis; H, bract. *R. smithii* (Bequaert 7897); I, bract; J, flower at anthesis; K, flower dissection; L, flower with mature capsule (scale: A-L, 1 mm).

long, usually about half as long as the calyx tube. *Flowers* monomorphic, sessile solitary. *Calyx* tube cup-shaped, membranous, not accrescent, 1-1.5 mm long; calyx lobes 4, deltate, c. 0.5 mm long; calyx appendages and interjected folds absent. *Petals* usually 4, ovate, about as long as the calyx lobes, or 1 or more reduced and rudimentary. *Stamens* 4, occasionally 1 or 2 sterile and represented by naked filaments, inserted somewhat below the middle of the calyx tube; filaments c. 0.5 mm long, somewhat glandular at base; anthers borne at top of calyx tube or slightly exerted. *Ovary*

subglobose; style up to c. 1 mm long, persisting in fruit; stigma capitate borne above the calyx lobes; capsule obovoid to subglobose, usually somewhat flattened above, c. 1 mm long, opening by 2 valves, remaining within the calyx tube; seeds semi-ovoid, c. 0.4 mm long.

DIAGNOSTIC FEATURES

K4, P4, A4, G2; stamens 4, occasionally 1 or 2 sterile and represented by naked filaments; mature capsule subglobose, remaining within the calyx tube.

DISTRIBUTION

Northern Angola, Eastern Zaire and Northern Zambia (Map 13).

SELECTED SPECIMENS

Angola: Cuanza Norte, Pungo Andongo: pr. Lombe e Quisonde, March 1857, *Welwitsch* 2346 (BM); ibid., pr. Candumba e Mutollo, March 1857, *Welwitsch* 2347 (M). **Zaire:** Shaba (Katanga), Kaniama, Haut Lomami, 900 m, 20 April 1947, *Mullenders* 266 (BR). **Zambia:** Lake Bangweulu, 19 Sept. 1911, *R. E. Fries* 656 (Z).

43. *Rotala lucalensis* A. Fernandes & Diniz, Bol. Soc. Brot. Sér. 2, 31: 154. 1967.

= *Rotala wildii* A. Fernandes, Bol. Soc. Brot. Sér. 2, 40: 128. 1974. **Type:** Rhodesia (Zimbabwe), Mtoko, Makate Ruins, 15 Feb. 1962, *H. Wild* 5662 (holotype: SRGH n.v.; isotypes: COI n.v., K, MO).

Type: Angola, Malange, Rianzondo, Duque de Bragança, ad margines fluminis Lucala, 1000 m, March 1937, *Gossweiler* 11818 (holotype: COI n.v.).

lc.: Fig. 28E-H; Fernandes & Diniz, Bol. Soc. Brot. Sér. 2, 31: t. 3. 1957, reprinted in: Consp. Fl. Angolensis 4: t. 17. 1970; Fernandes, Bol. Soc. Brot. Sér. 2, 40: t. 15. 1974, reprinted in Fl. Zambes. Lythraceae, t. 79. 1978 — the scale of Fig. 9 and 10 is not in accordance with the type description and specimen.

Amphibious annual or perennial. *Stems* creeping and irregularly branched below, usually erect above, up to c. 25 cm long. *Leaves* decussate, sessile; submerged leaves linear to lanceolate; aerial leaves narrowly lanceolate to lanceolate, up to 8 mm long. *Bracts* leaf-like, lanceolate, up to 8 mm long; bracteoles 2, capillary, up to 1 mm long. *Flowers* monomorphic,

sessile, solitary. *Calyx* tube cup-shaped, membranous, not accrescent but remaining intact in fruit, whitish or pink, c. 1 mm long; calyx lobes 4, deltate, pink, c. 0.5 mm long; calyx appendages and interjected folds absent. *Petals* 4 or occasionally less, lanceolate to ovate, from rudimentary to c. 0.25 mm long. *Stamens* 4 or occasionally less, inserted about half-way up the calyx tube; filaments c. 0.5 mm long; anthers included within the calyx. *Ovary* ellipsoidal; style 0.75-1.0 mm long, folded in bud and at early anthesis becoming erect later; stigma capitate, borne level with the stamens at anthesis becoming erect later; capsule ellipsoidal to obovoid, at least 2 mm long about twice as long as the calyx tube, opening by 2 valves; seeds ellipsoidal, black or dark brown, 0.75-1.0 mm long.

DIAGNOSTIC FEATURES

K4, P4-0, A4(or less?), G2; seeds 0.75-1.0 mm long and ellipsoidal; mature capsule at least 2 mm long; style 0.75-1.0 mm long, folded in bud and at early anthesis becoming erect later; anthers included within the calyx.

DISTRIBUTION

Angola, Western Kenya, Northern Uganda and Rhodesia (Zimbabwe) (Map 16).

SELECTED SPECIMENS

Angola: Malange, Duque de Bragança, Rianzondo, pr. catarates do rio Lucala, 1000 m, March 1937, *Gossweiler 11818* (COI); Cuanza Sul, Santa Comba-Amboiva, bac du Queve, 1300 m, March 1973, *Bamps & Martins 4296* (BR, MO); Bié, Cuando-Cabango, Menongue, c. 10 km de Cuchi para a Missao, 1430 m, 30 March 1960, *Mendes 3357* (BM, BR, P). **Kenya:** Western Prov., Kipkarren, *Brodhurst Hill 565* (K). **Rhodesia (Zimbabwe):** Mtoko, Makate Ruins, 15 Feb. 1962, *Wild 5662* (K, M, MO). **Uganda:** Maracha, Dec. 1937, *Hazel 397* (K).

- 44. *Rotala smithii*** A. Fernandes & Diniz, Bol. Soc. Brot. Sér. 2, 31: 154. 1958.
— *Rotala fontinalis* Hiern in Oliver, Fl. Trop. Africa 2: 468. 1871; pro parte, quoad specim. *Christen Smith 13, 14* and *16*.

Type: Zaire, s. loc., *Christen Smith 16* (holotype: BM; paratypes: *Christen Smith 13* BM; *ibid.*, *14* BM).

lc.: Fig. 28I-L; Fernandes & Diniz, Bol. Soc. Brot. Sér. 2, 31: t. 4. 1959; reprinted in Consp. Fl. Angol. 4: 6. 17. 1970; Boutique, Fl. Cong. Rwand. Bur., Lythraceae: t. 16. 1967.

Amphibious annual or perhaps perennial. *Stems* erect, occasionally creeping below, simple or irregularly branched, often packed together and denuded of leaves below, up to c. 25 cm long. *Leaves* decussate, sessile, elliptic to widely ovate, up to 4 mm long but usually less. *Bracts* leaf-like, ovate to widely ovate, c. 4 mm long; bracteoles 2, capillary, c. 0.5 mm long, shorter than the calyx tube. *Flowers* monomorphic, sessile, solitary. *Calyx* tube cup-shaped, membranous, not accrescent and remaining intact in fruit, c. 1.25 mm long; calyx lobes 4, deltate, 0.5-0.75 mm long; calyx appendages and interjected folds absent. *Petals* 4-0, variable in size and number between and within individuals, ovate to subulate or rudimentary, up to 0.5 mm long but usually less. *Stamens* 4, inserted half-way up the calyx tube; filaments 1.0-2.5 mm long; anthers exerted beyond the calyx lobes, borne just below or around the stigma. *Ovary* ellipsoidal; style 1.25-1.5 mm long, erect at anthesis; stigma capitate borne above or level with the anthers; capsule ellipsoidal, c. 1.5 mm long, when ripe exceeding the calyx, opening by 2 valves; seeds semi-ovoid, c. 0.4 mm long.

DIAGNOSTIC FEATURES

K4, P4-0, A4, G2; anthers exerted beyond the calyx lobes. Like *R. lucalensis* but anthers exerted; bracts ovate to widely ovate; seeds c. 0.4 mm long, semi-ovoid.

DISTRIBUTION

Eastern Zaire (Map 16).

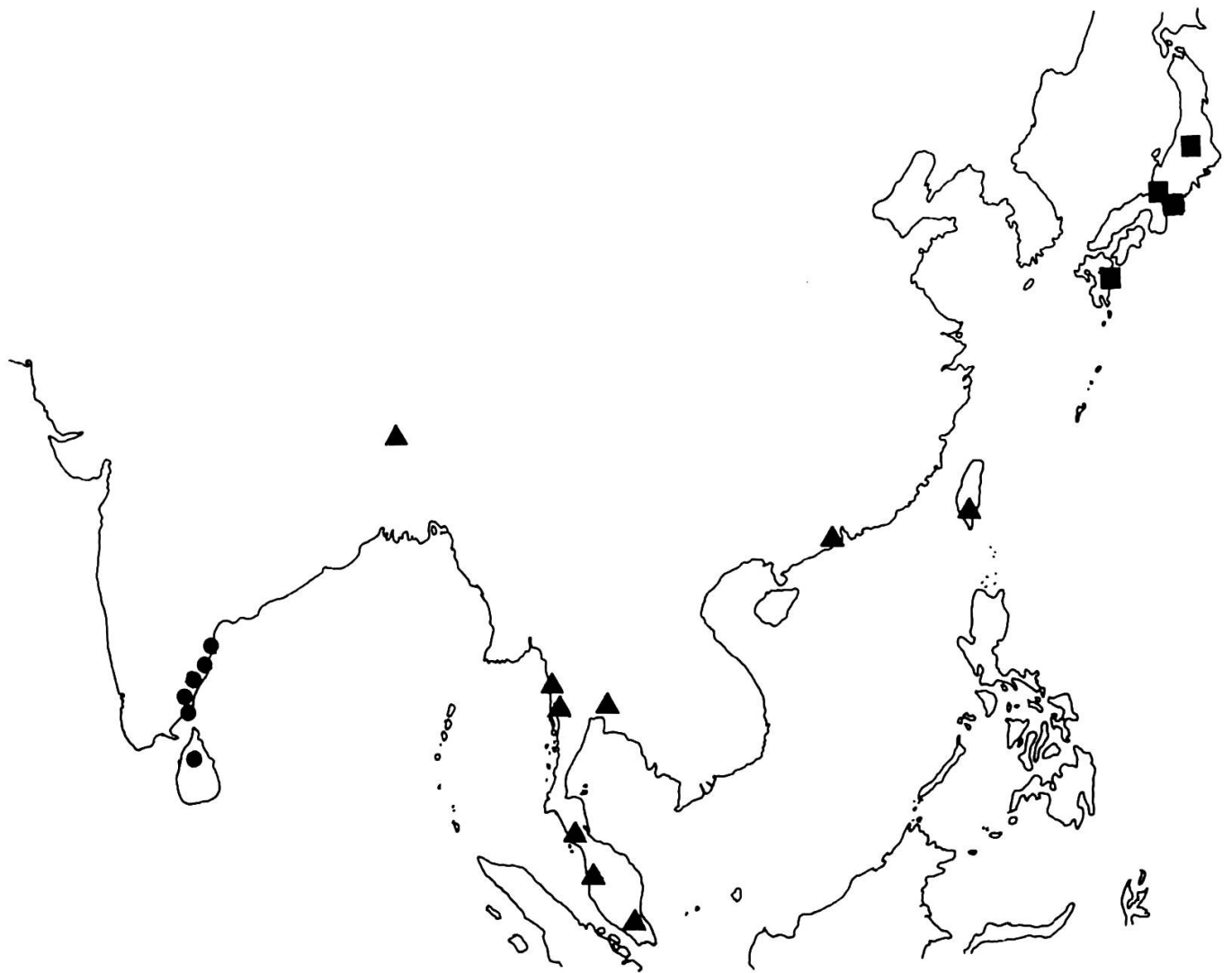
SELECTED SPECIMENS

Zaire: s. loc., *Chr. Smith* 13 (BM); *ibid.*, 14 (BM); *ibid.*, 16 (BM); Malela (Nualela), 31 Dec. 1918, *Vermoesen* 1246 (BR — I am not sure that the dot on the distribution map is correctly located, there are several Malelas); Katale (Zambi), 28 June 1915, *Bequaert* 7897 (BR).

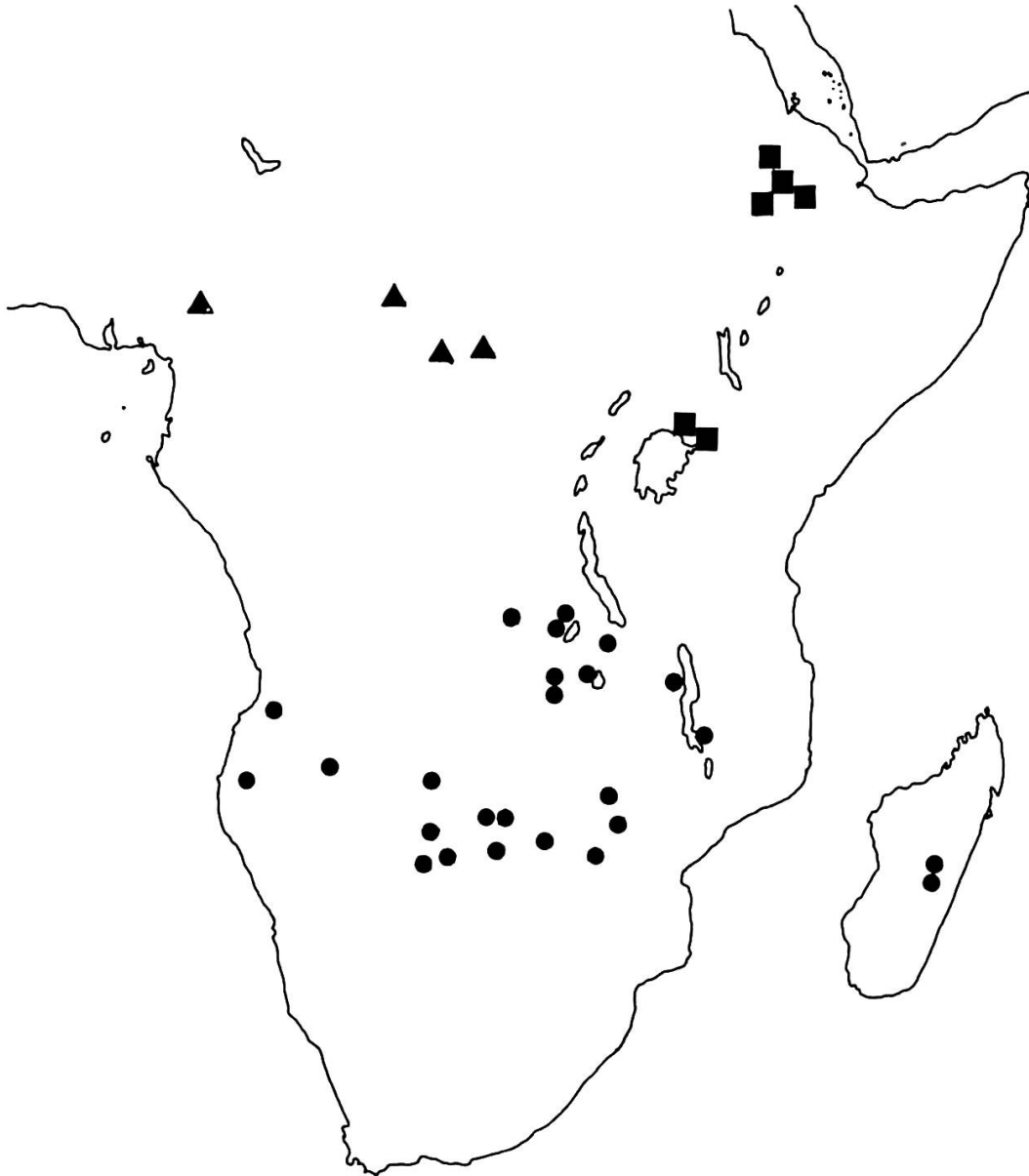
Uncertain species

Rotala cataractae Koehne, Bot. Jahrb. 39: 663 (1907). **Type:** Rhodesia (Zimbabwe), Victoria Falls, "grasiger Rand des Regenwaldes, bespritzte Felsen", 930 m, 12 and 13 Sept. 1905, *Engler* 2990 (type material destroyed in B). It is most likely a "pin" race of *R. myriophylloides* and not a near relative of *R. fontinalis* as Koehne suggests.

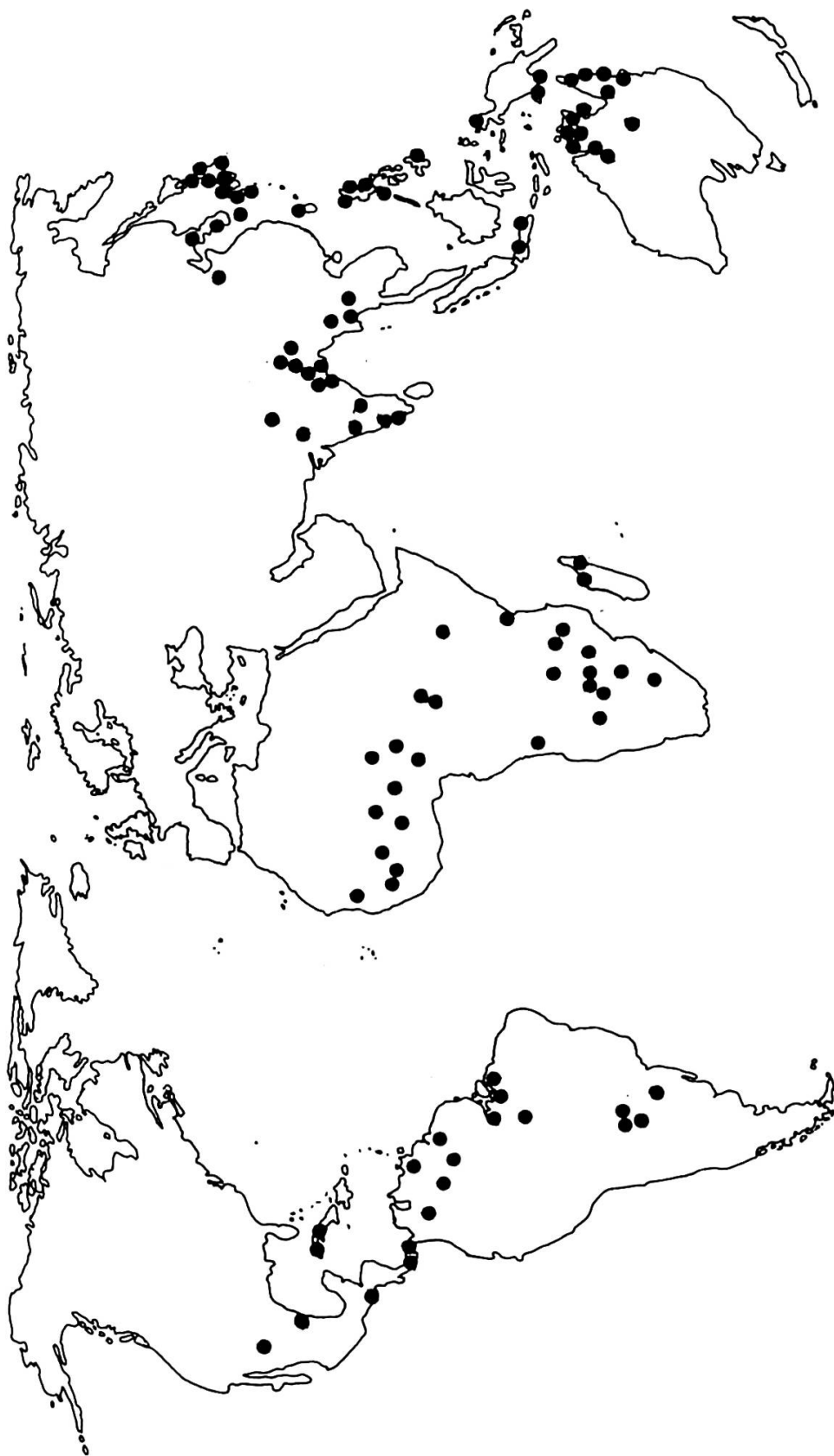
Rotala stuhlmannii Koehne ex Gilg in Engler, Pflanzenwelt Ost Afrikas, Teil C: 285. 1985. **Type:** "Pori, Ost-Usindscha, *Stuhlmann 3551*" (type material destroyed in B). It is most likely in the *R. filiformis* group and not near *R. tenella* and *R. rubra* (*R. alata*) as suggested by Gilg.



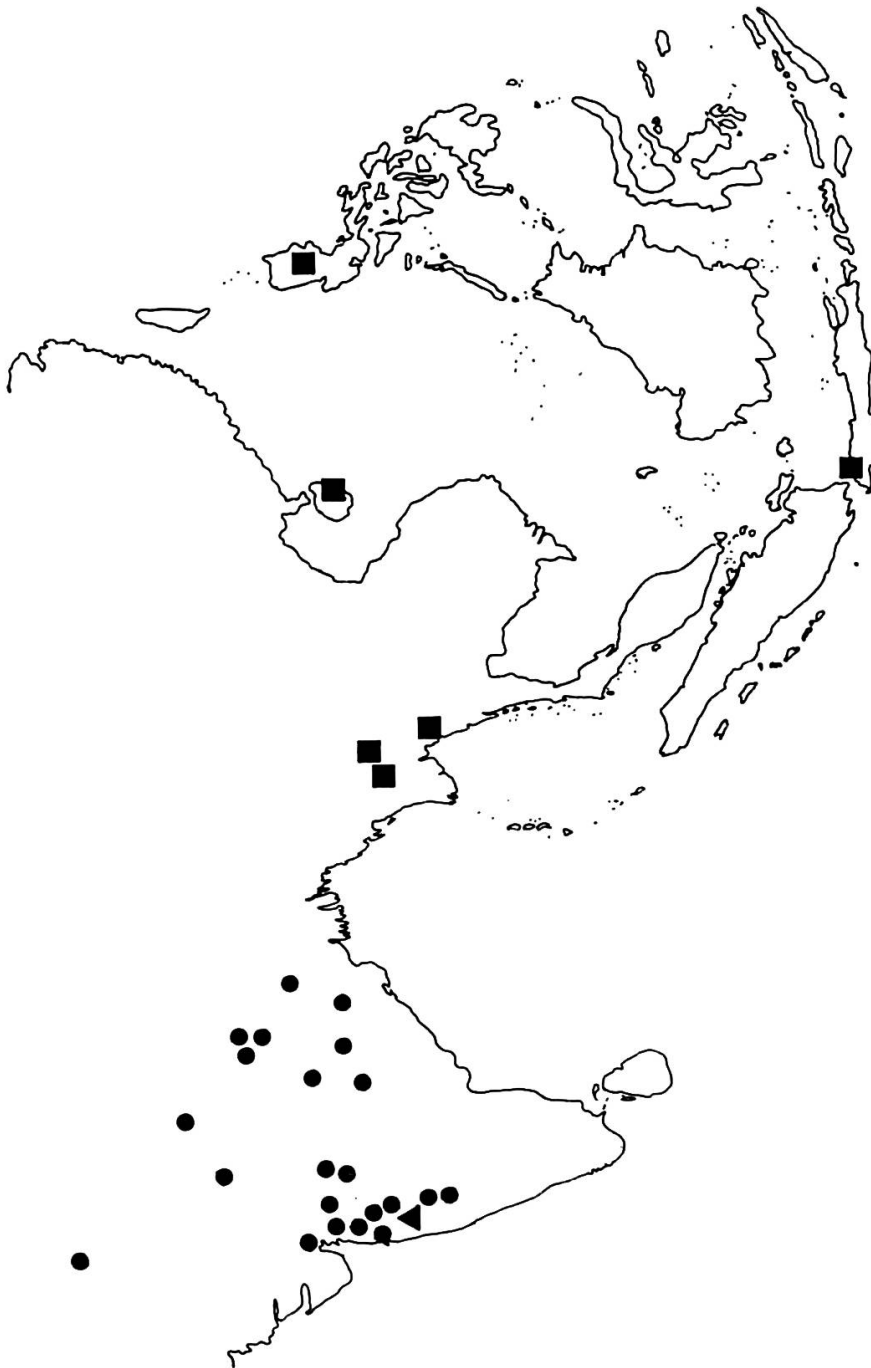
Map 1. ● *R. verticillaris*.
▲ *R. wallichii*.
■ *R. hippuris*.



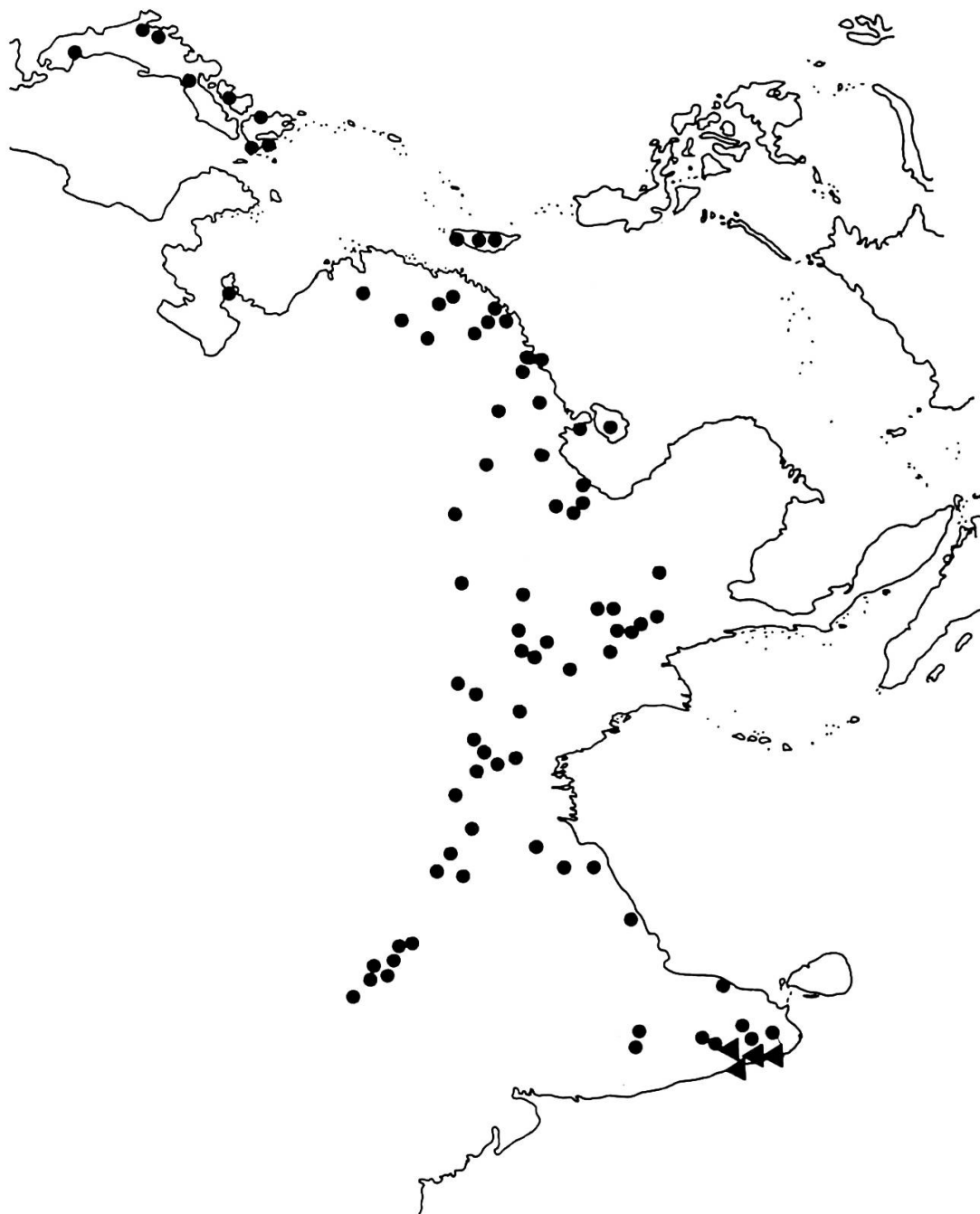
Map 2. ● *R. myriophylloides*.
▲ *R. gerardii*.
■ *R. repens*.



Map 3. ● *R. mexicana*.



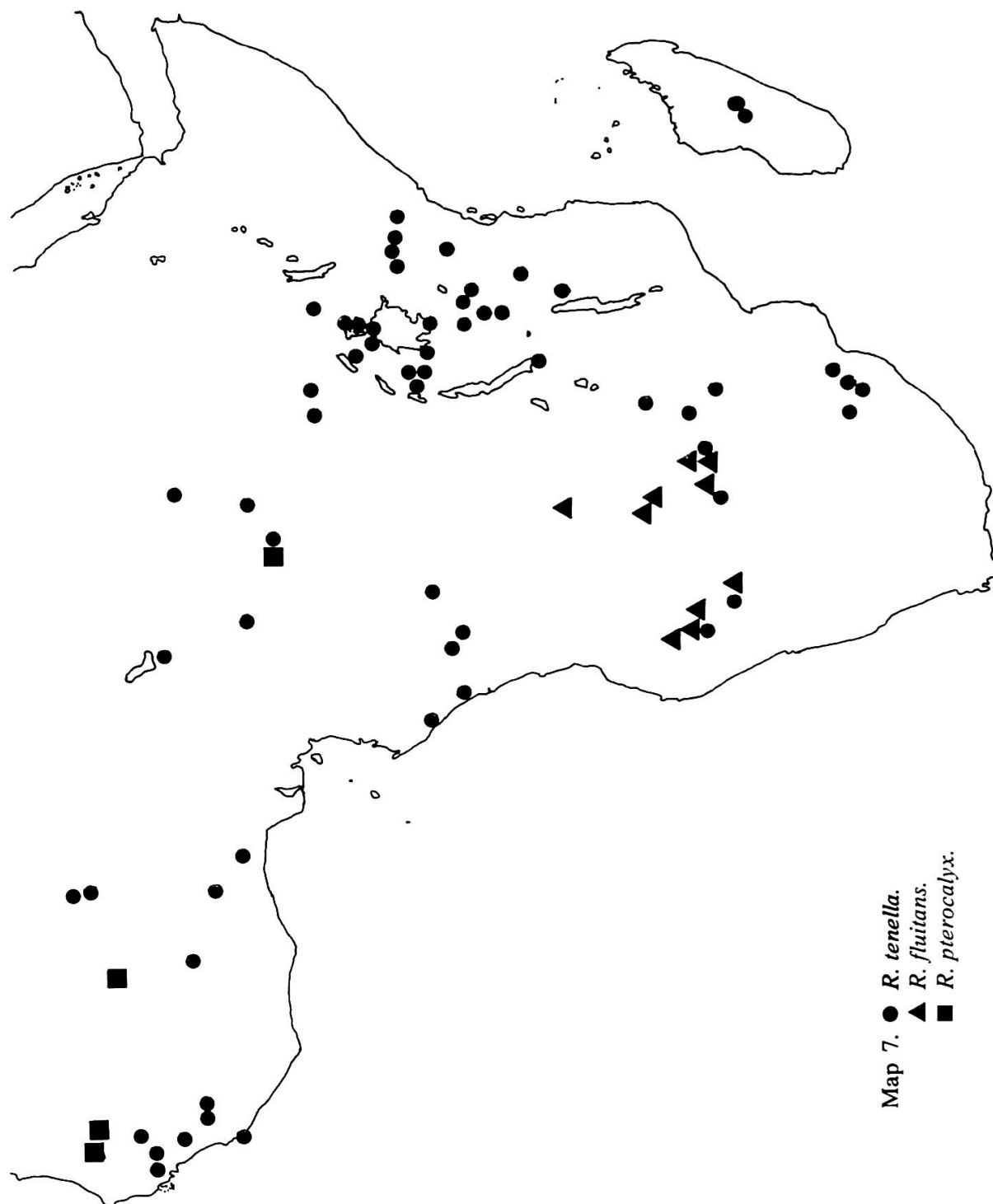
Map 4. ● *R. serpyllifolia*.
▲ *R. floribunda*.
■ *R. hexandra*.

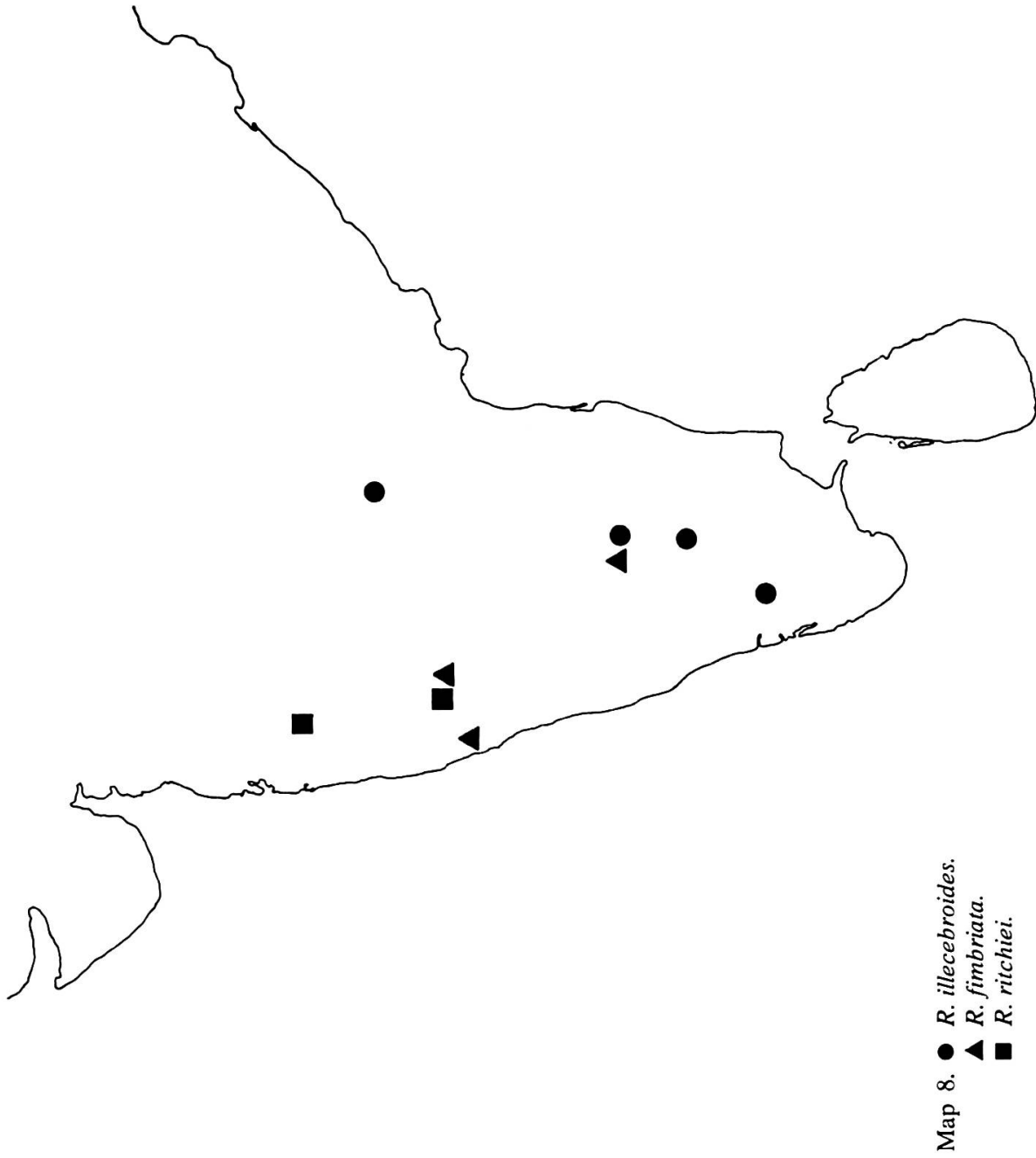


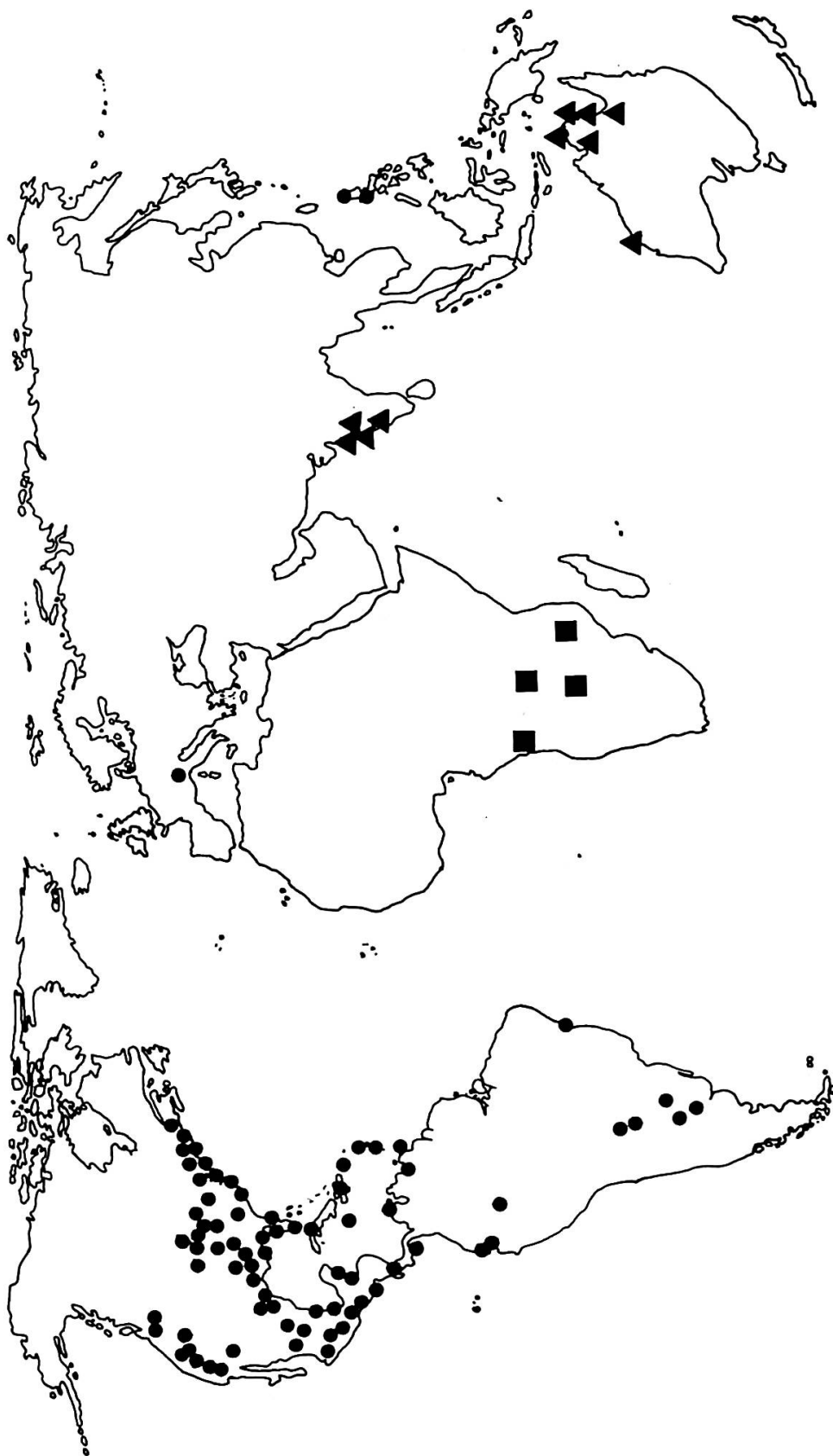
Map 5. ● *R. rotundifolia*.
▲ *R. macrandra*.



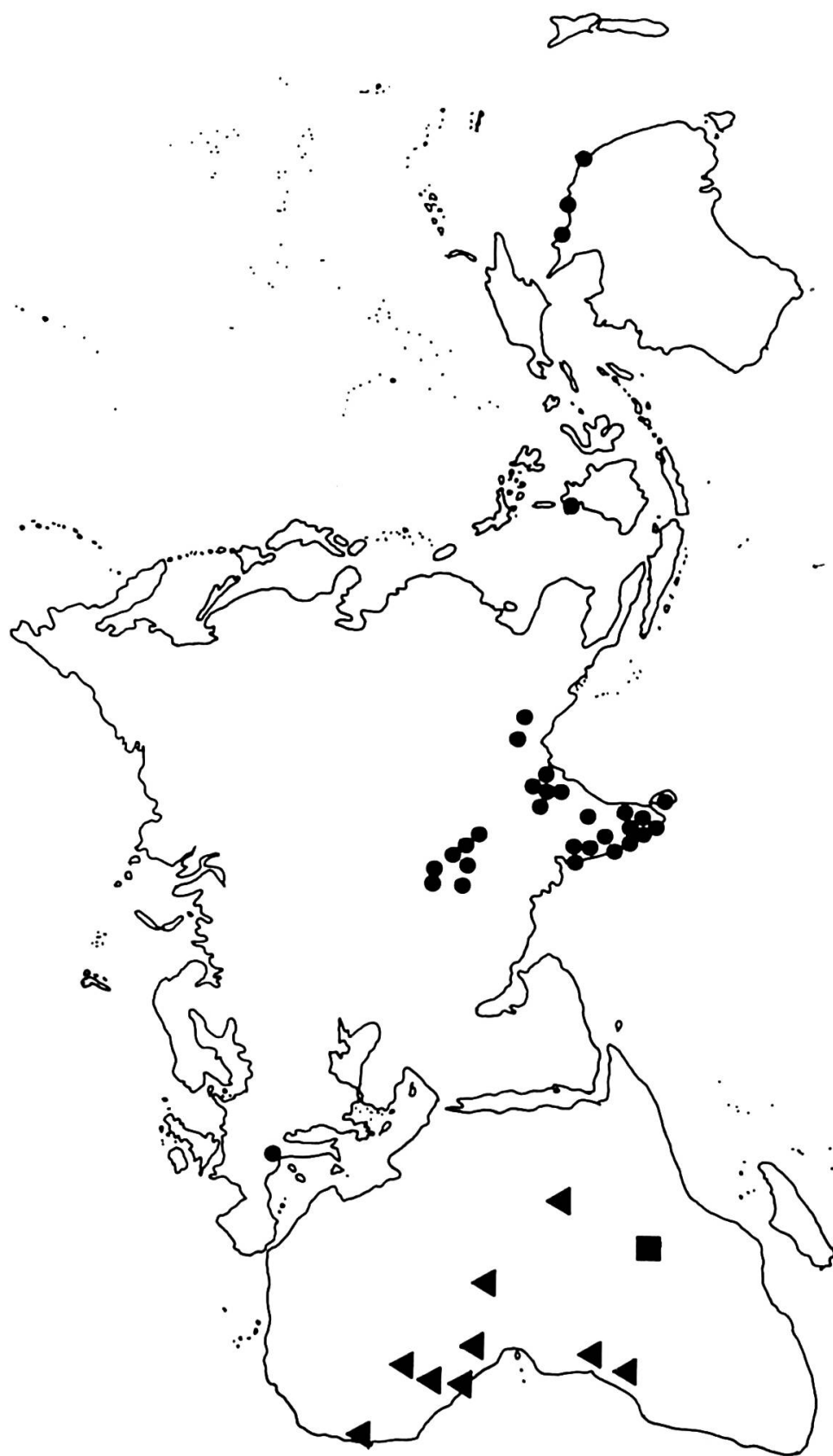
Map 6. ○ *R. elatinoides*.
 △ *R. thymoides*.
 □ *R. nummularia*.



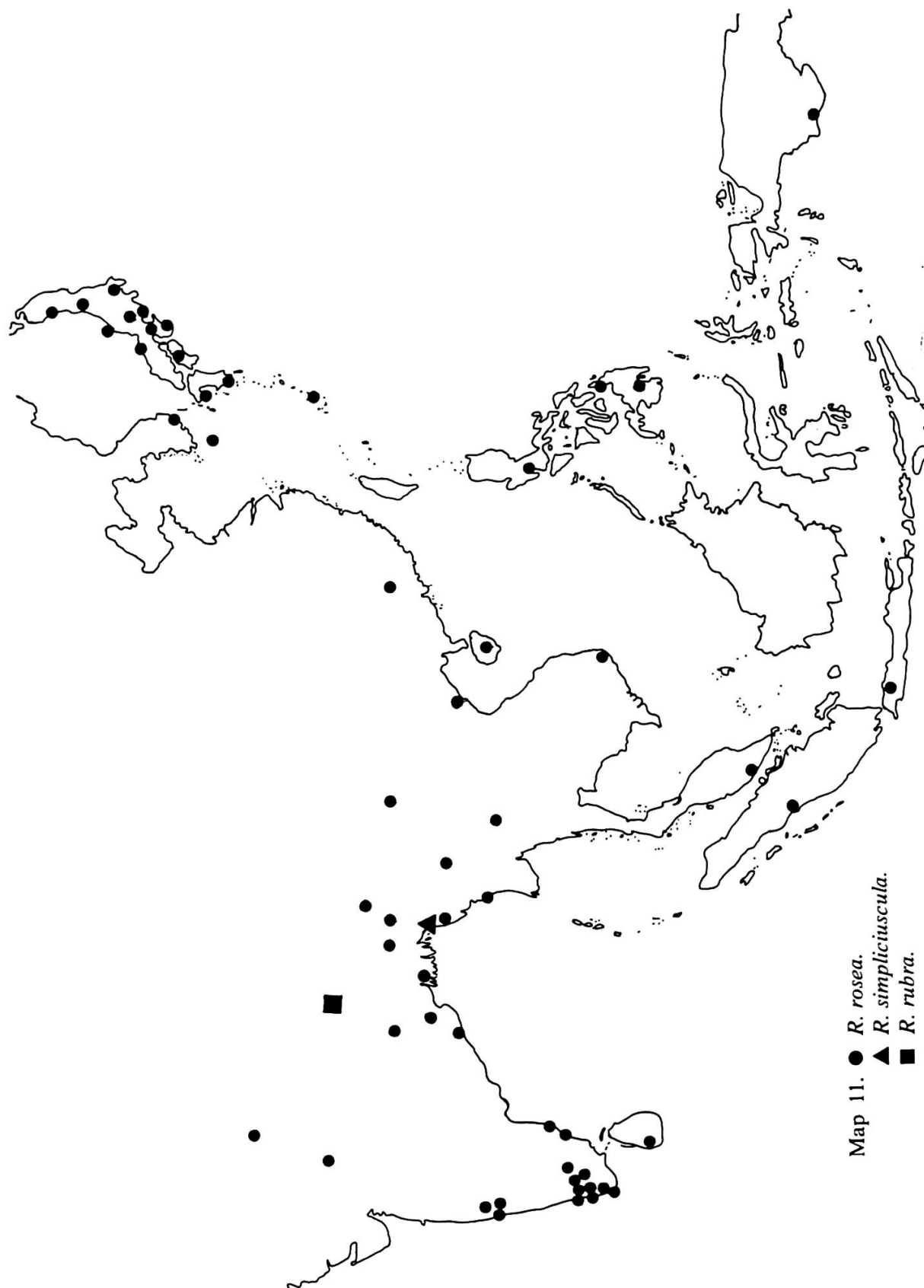




Map 9. ● *R. ramosior*.
▲ *R. occultiflora*.
■ *R. juniperina*.

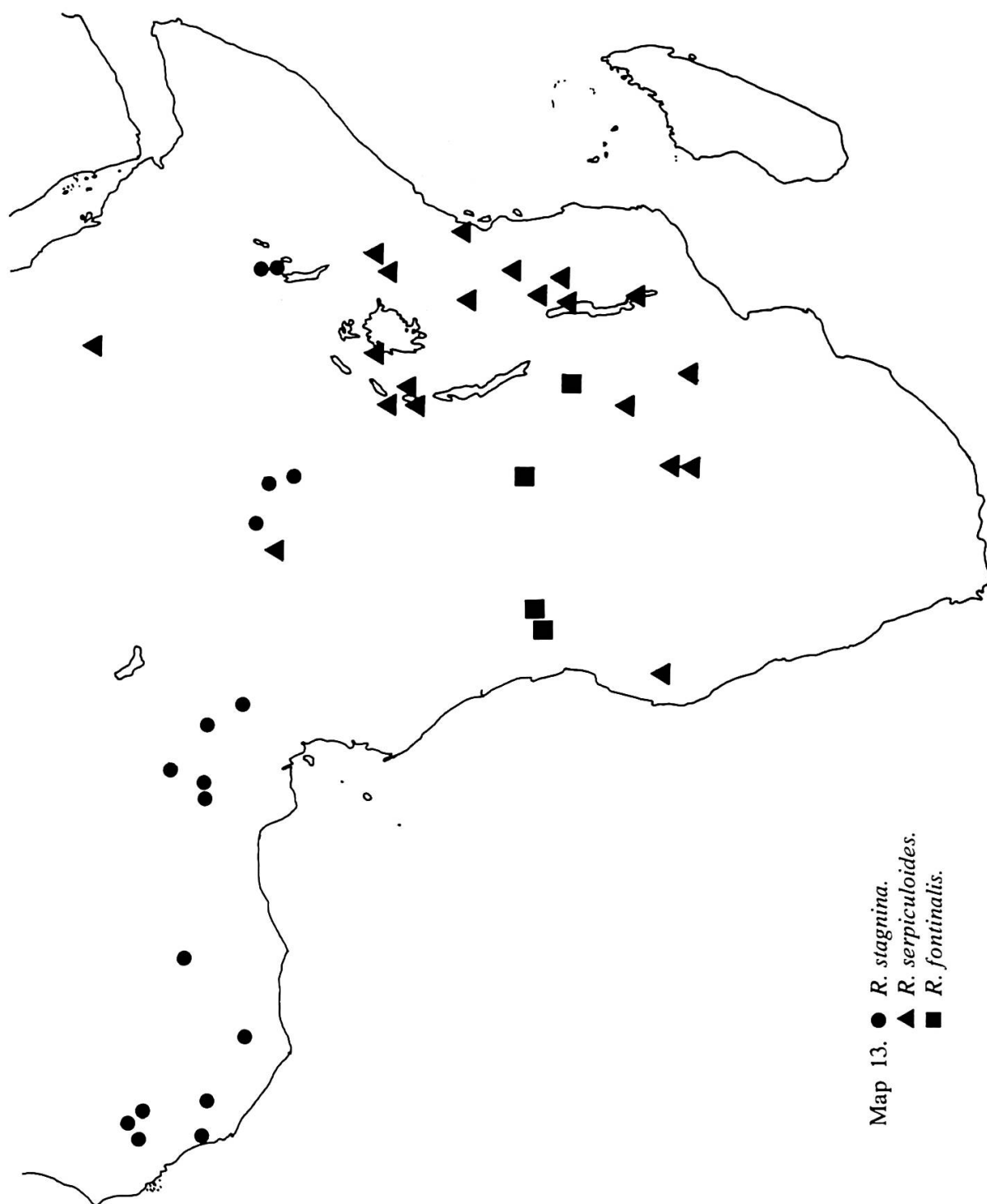


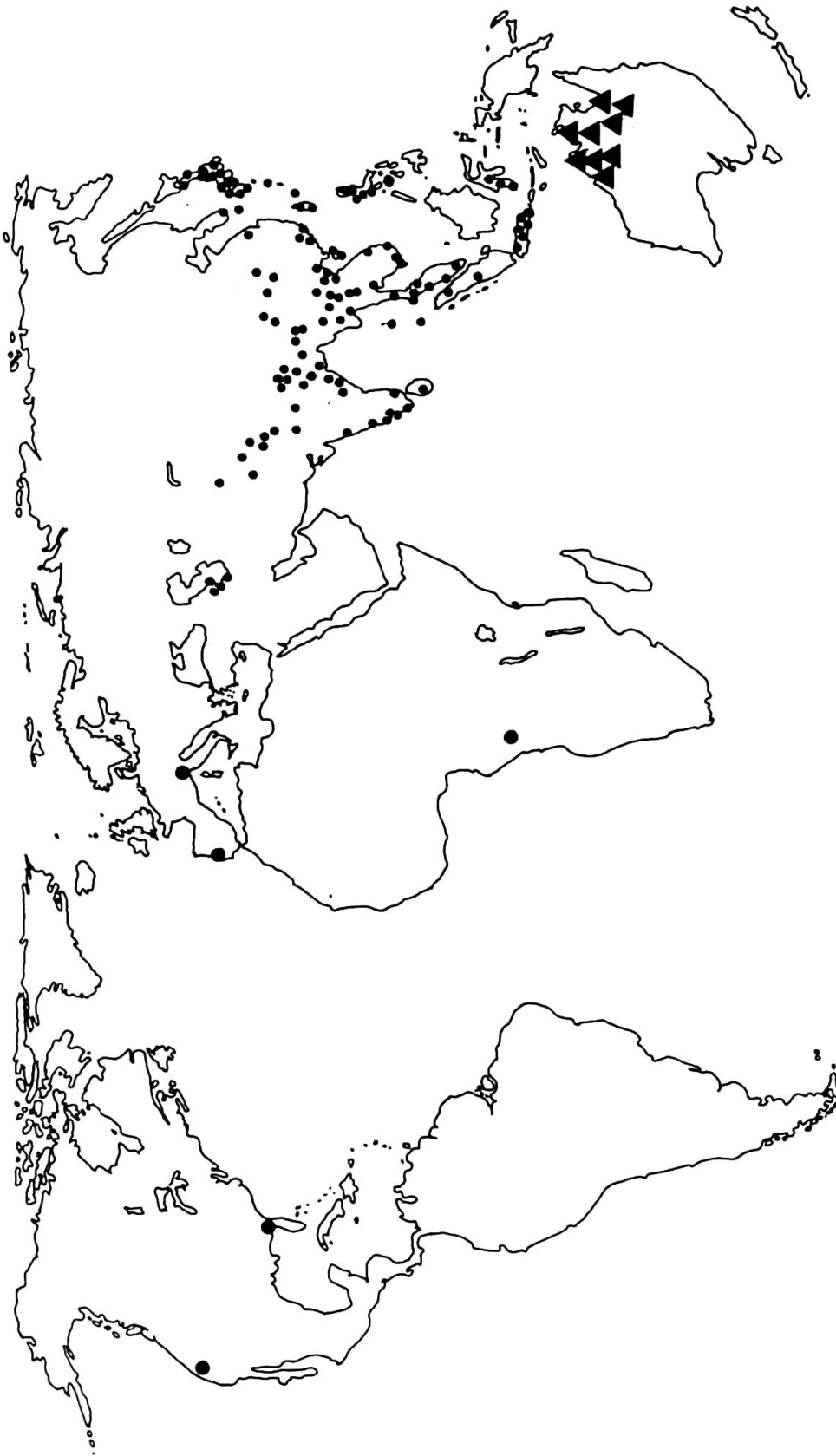
Map 10. ● *R. densiflora*.
▲ *R. welwitschii*.
■ *R. verdcourtii*.



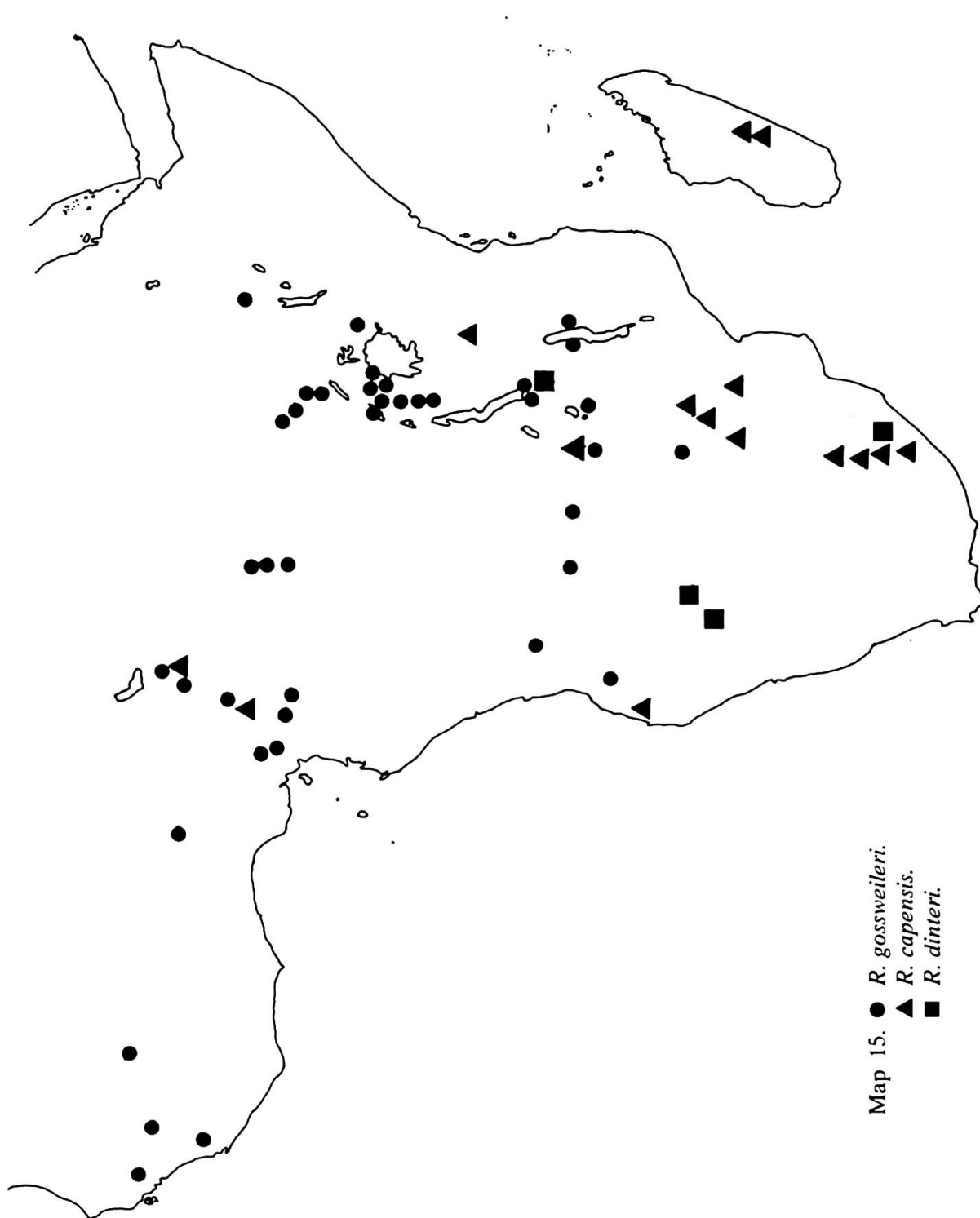


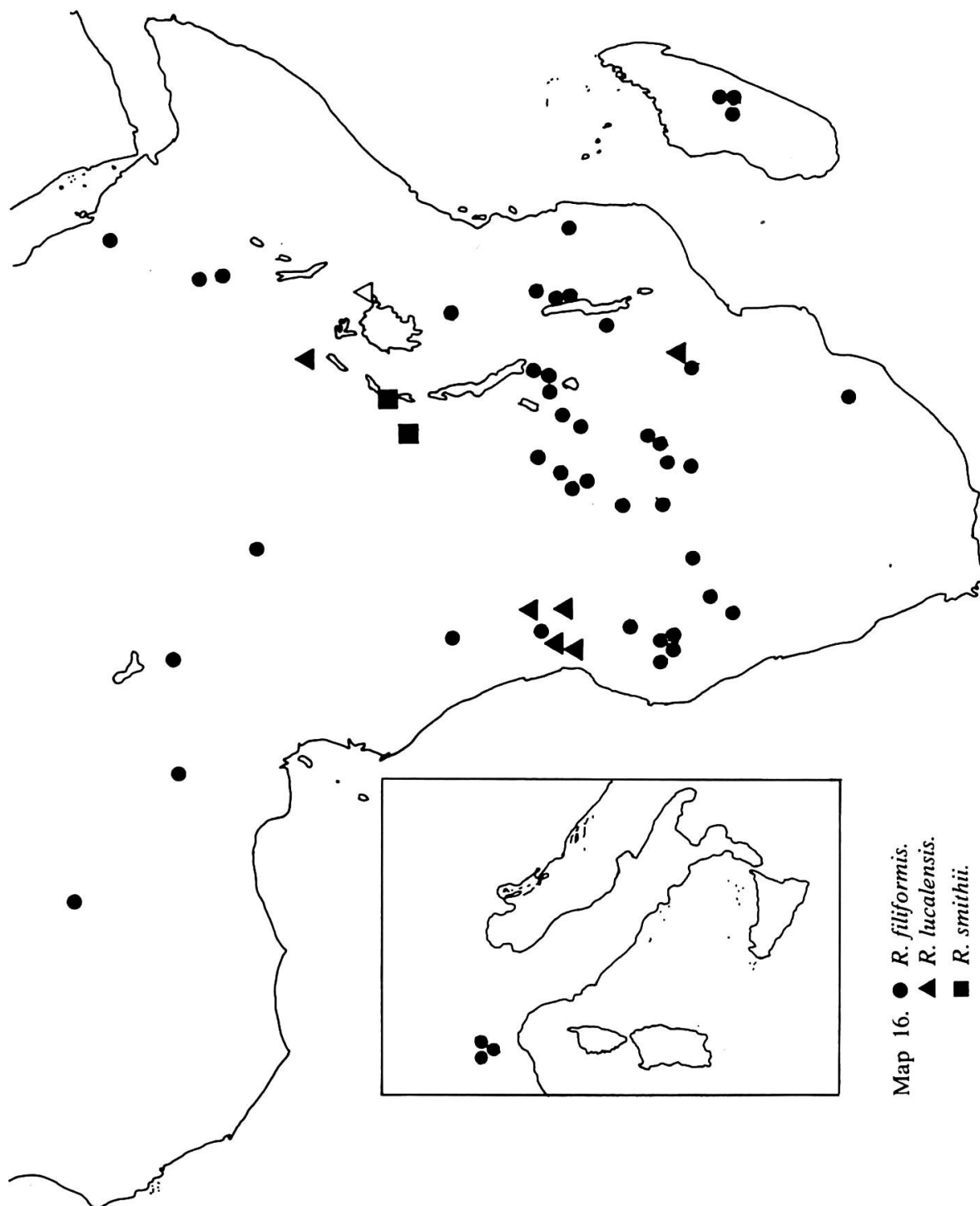
Map 12. ● *R. cordata*.
▲ *R. subrotunda*.
■ *R. malampuzhensis*.





Map 14. ● *R. indica*.
▲ *R. diandra*.





Abstract / Résumé

A formal taxonomic revision of the genus *Rotala* (Lythraceae) to the level of species with, key, synonymies, descriptions, distributions, notes, illustrations and maps. A total of 44 species are accepted. Two new names are used: ***Rotala rosea*** (Poirot) C. D. K. Cook, **comb. nova** for the species variously known as *R. pentandra*, *R. leptopetala*, *R. littorea* or *R. densiflora* var. *formosana*. ***R. malampuzhensis*** R. V. Nair ex C. D. K. Cook, is validated and typified. The name ***Rotala decussata*** DC. is proposed as a nomen rejiciendum.

Révision taxonomique complète du genre *Rotala* (Lythraceae) au niveau des espèces avec clé, synonymies, descriptions, répartitions, notes critiques, illustrations et cartes. Au total 44 espèces ont été retenues. Une combinaison nouvelle est effectuée: ***Rotala rosea*** (Poirot) C. D. K. Cook, **comb. nova** pour une espèce connue sous des noms divers comme: *R. pentandra*, *R. leptopetala*, *R. littorea* ou *R. densiflora* var. *formosana*. ***R. malampuzhensis*** R. V. Nair ex C. D. K. Cook est validé par la désignation d'un type. Le nom ***Rotala decussata*** DC. est proposé comme nomen rejiciendum.

References

- BENL, A. (1972). *Rotala macrandra* Koehne (Lythraceae). *Die Aquarien- und Terrarien-Zeitschrift (Stuttgart)* 25(6): 198-201.
- BLATTER, E. & F. HALLBERG (1918). A revision of the Indian species of *Rotala* and *Ammannia*. *J. Bombay Nat. Hist. Soc.* 25: 701-722.
- COOK, C. D. K. (1973). New and noteworthy plants from the northern Italian ricefields. *Ber. Schweiz. Bot. Ges.* 83(1): 54-65.
- (1978). The Hippuris Syndrome. In: STREET, H. E. (ed.), *Essays in Plant Taxonomy*: 163-176. Academic Press, London.
- FERNANDES, A. (1974). *Lythraceae africanae novae vel minus cognitae*. *Bol. Soc. Brot.*, sér. 2, 48: 126-131.
- & M. A. DINIZ (1955). *Lythraceae africanae novae*. *Bol. Soc. Brot.*, sér. 2, 29: 87-99; *ibid.*, (1957). 31: 151-160; *ibid.*, (1959). 33: 21-23.
- GRAHAM, S. A. (1964). The genera of Lythraceae in the southeastern United States. *J. Arnold Arbor.* 45: 235-250.
- KOEHNE, A. (publ. 1880, dated 1881). *Lythraceae, monographice describuntur: Rotala*. *Bot. Jahrb. (Syst.)* 1(2): 142-178.
- (1883). *Lythraceae, monographice describuntur, addenda et corrigenda*. *Bot. Jahrb. (Syst.)* 3: 386-389.
- (1885). The Lythraceae of the United States. *Bot. Gaz.* 10: 269-277.
- (1903). *Rotala*. In: ENGLER, A., *Das Pflanzenreich*, 17. Heft (IV. 216): 22-42. W. Engelmann, Leipzig.
- (publ. 1907, dated 1908). *Lythraceae, Nachträge, Rotala*. *Bot. Jahrb. (Syst.)* 41: 75-78.
- (1908). *Lythraceae, Nachträge II, Rotala*. *Bot. Jahrb. (Syst.)* 52; *Beibl.* 97: 48.
- LEEUEWEN, B. L. J. VAN (1971). A preliminary revision of the genus *Rotala* (Lythraceae) in Malesia. *Blumea* 19(1): 53-56.
- LOURTEIG, A. (1954). *Lythraceae Argentinae, Addenda IV, Rotala*. *Bol. Soc. Argentina Bot.* 5(3): 144-145.
- MITCHELL, S. A. (1976). A Summary of the family Lythraceae in the Northern Territory with additional comments on Australian material. *J. Adelaide Bot. Gard.* 1(1): 55-59.

- PANIGRAHI, S. G. (1975). *Studies in the generic delimitations of Rotala, Ammannia, Nesaea and Hionanthera*. M. Phil. Thesis, University of Reading.
- RAYNAL, A. (1967). Les Rotala d'Afrique occidentale et centrale dans l'herbier de Paris. *Adansonia* 7: 535-545.
- VOS, O. C. DE (1974). The anatomy of the shoot apex of *Rotala rotundifolia* (Roxb.) Koehne (Lythraceae). *Acta Bot. Neerl.* 23(1): 7-18.

Index

Accepted names in normal print, new names in **bold**, synonyms in *italics*.
The page reference to the main entry is in **bold** type; reference to illustration and maps are followed by an asterisk (*)

- | | | | |
|--|---------|---|--------------------|
| <i>Ameletia acutidens</i> Miq. | 109 | <i>Ammania littorea</i> Miq. | 86 |
| — <i>elatinoides</i> (DC.) Blume | 59 | — <i>mexicana</i> (Cham. & Schlecht.) Baillon | 33 |
| — <i>elongata</i> Blume | 109 | — <i>monoflora</i> Blanco | 74 |
| — <i>diandra</i> F. v. Müller | 117 | — <i>myriophylloides</i> S. T. Dunn | 29 |
| — <i>floribunda</i> (Wight) Wight | 43 | — <i>nana</i> Roxb. | 108 |
| — <i>indica</i> (Willd.) DC. | 12, 108 | — <i>obovata</i> Buch.-Ham. | 109 |
| — <i>orbiculata</i> Heyne | 49 | — <i>occidentalis</i> (Sprengel) DC. | 74 |
| — <i>polystachya</i> Wallich ex Wight & Arnott | 108 | — <i>orbiculata</i> Heyne | 49 |
| — <i>rotundifolia</i> (Buch.-Ham. ex Roxb.) Dalz. & Gibson | 49 | — <i>pentandra</i> Roxb. | 12, 38, 82, 86, 87 |
| — <i>rotundifolia</i> Wight | 54 | — <i>pentandra</i> var. " <i>alpha</i> " Wight | 96 |
| — <i>subspicata</i> (Bentham) Bentham | 49 | — <i>pentandra</i> var. <i>fimbriata</i> (Wight) Clarke | 80 |
| — <i>tenella</i> (Guill. & Perr.) Blume | 63 | — <i>pentandra</i> var. <i>illecebroides</i> (Arn. ex) Clarke | 72 |
| — <i>tenuis</i> Wight | 61 | — <i>peplodes</i> Sprengel | 109 |
| — <i>uliginosa</i> Miq. | 109 | — <i>polystachya</i> Wallich | 108 |
| <i>Ammannia catholica</i> Cham. & Schlecht. | 74 | — <i>pteroaulon</i> Edgeworth | 82 |
| — <i>cryptantha</i> Baker | 26 | — <i>pygmaea</i> S. Kurz | 33 |
| — <i>densiflora</i> Roth ex Roemer & Schultes | 12, 82 | — <i>ramosa</i> Hill. | 74 |
| — <i>dentifera</i> A. Gray | 74 | — <i>ramosior</i> L. | 74 |
| — <i>diandra</i> (F. v. Müller) Bentham | 117 | — <i>repens</i> Heyne | 87 |
| — <i>elatinoides</i> DC. | 59 | — <i>repens</i> Rottler ex Martius | 108 |
| — <i>floribunda</i> (Wight) Clarke | 43 | — <i>ritchiei</i> Clarke | 71 |
| — <i>hexandra</i> Wallich | 47 | — <i>rosea</i> Poiret | 86 |
| — <i>heyneana</i> Wallich | 80 | — <i>rotala</i> F. v. Müller | 33 |
| — <i>humilis</i> Micheaux | 12, 74 | — <i>rotala</i> Clarke | 23 |
| — <i>latifolia</i> Wallich, non L., nec Walp. | 12, 115 | — <i>rotundifolia</i> Buch.-Ham. ex Roxb. | 49 |
| — <i>leptopetala</i> Blume | 87 | — <i>rubra</i> Buch.-Ham. ex D. Don | 96 |
| | | — <i>simpliciuscula</i> S. Kurz | 100 |
| | | — <i>subrotunda</i> Wallich ex S. Kurz | 115 |

- Ammannia subspicata* Benth. 49
 — *tenella* Guill. & Perr. 63
 — *tenuis* (Wight) Clarke 61
 — *verticillaris* (L.) Baillon 23
 — *wallichii* (Hooker fil.) S. Kurz 29
- Boykiana humilis* (Micheaux) Rafin. 12, 74
Boykinia humilis (Micheaux) Rafin. 74
- Dithea densiflora* (Roth ex Roemer & Schultes) Miq. 12
- Eutelia ammannioides* R. Brown 33
- Hydrolythrum wallichii* Hooker fil. 12, 29
Hypobrichia nuttallii M. A. Curtis ex Torrey & Gray 12
- Micranthus serpyllifolius* Roth 61
- Nexilis indica* (Willd.) Rafin. 12, 108
Nimmonia floribunda Wight 12, 43
- Ortegioides decussata* Solander 33
- Peplis indica* Willd. 12, 108
 — *occidentalis* Sprengel 74
 — *portula* L. 12
- Quartina repens* (Hochst.) Endl. ex Walp. 45
 — *turfosa* A. Richard 12, 45
- Rhyacophila repens* Hochst. 12, 45
Rotala alata Koehne 96, 133
 — *apetala* F. v. Müller 33
 — *braceata* Blatter & Hallberg 41
 — *brevistyla* Baker fil. 63, 67
 — *capensis* (Harvey) A. Fernandes & Diniz 14, 15, 22, 35, 41, 118, 119, 120, 125, 126*, 128, 148*
- Rotala cataractae* Koehne 118, 132
 — *catholica* (Cham. & Schlecht.) B. van Leeuwen 74, 79
 — *congolensis* A. Fernandes & Diniz 118, 121, 124
 — *cordata* Koehne 15, 15, 21, 93, 94*, 95, 96, 97, 103, 145*
 — *cordifolia* Baker 26
 — *cordipetala* R. E. Fries 128
 — *cryptantha* (Baker) Koehne 26
 — *debilissima* Chiov. 118, 121
 — *decumbens* A. Fernandes 97
 — *decussata* Dc. 33, 38, 39, 91
 — *decussata* Hiern, non DC. 38, 91
 — *densiflora* (Roth ex Roemer & Schultes) Koehne 9, 10, 14, 15, 19, 20, 39, 82, 83*, 84, 86, 95, 97, 100, 103, 143*
 — *densiflora* var. *formosana* Hayata 87
 — *dentifera* (A. Gray) Koehne 74, 79
 — *diandra* (F. v. Müller) Koehne 9, 14, 15, 22, 110, 116*, 117, 147*
 — *diglossandra* Koehne 33, 39, 40
 — *dinteri* Koehne 14, 15, 22, 118, 119, 120, 125, 126*, 127, 128, 148*
 — *diversifolia* Koehne 93
 — *elatinoides* (DC.) Hiern 14, 15, 20 59, 60*, 139*
 — *elatinomorpha* Makino 109
 — *filiformis* (Bellardi) Hiern 10, 14, 15, 22, 118, 120, 121, 122*, 124, 127, 128, 133, 149*
 — *fimbriata* Wight 9, 13, 14, 15, 17, 80, 81*, 82, 86, 141*
 — *fischeri* Gamble 72
 — *floribunda* (Wight) Koehne 9, 10, 11, 13, 14, 15, 16, 43, 44*, 103, 104, 137*
 — *fluitans* Pohnert 14, 15, 19, 68*, 69, 70, 72, 140*
 — *fontinalis* Hiern 14, 15, 22, 118, 120, 128, 129*, 132, 146*
 — *fontinalis* Hiern 131
 — *fysonii* Blatter & Hallberg 72
 — *gerardii* Boutique 14, 15, 17, 23*, 24, 25, 135*
 — *gossweileri* Koehne 14, 15, 21, 104*, 105, 106, 108, 148*
 — *halophila* H. Perrier 33
 — *heteropetala* Koehne 118, 121
 — *heterophylla* Welw. ex A. Fernandes & Diniz 121, 124

- Rotala hexandra* Wallich ex Koehne 10, 11, 13, 14, 15, 17, **47**, 48*, 137*
- *hippuris* Makino 14, 15, 16, 17, **31**, 32*, 134*
- *hutchinsoniana* A. Fernandes 26
- *illecebroides* Arnott ex Koehne 14, 15, 18, **71***, **72**, 73, 141*
- *indica* (Willd.) Koehne 9, 10, 14, 15, 21, 62, 86, 100, 103, **108**, 109*, 114, 115, 116, 117, 147*
- *indica* var. *uliginosa* (Miq.) Koehne 109
- *indica* var. *koreana* Nakai 109
- *longistyla* L. S. Gibbs 26
- *lucalensis* A. Fernandes & Diniz 14, 15, 22, 118, 120, 129*, **130**, 132, 149*
- *macrandra* Koehne 9, 14, 15, 19, 50*, 51, **54**, 55, 56, 57, 138*
- *malampuzhensis* R. V. Nair 98
- *malampuzhensis* R. V. Nair ex C. D. Cook 18, 21, 86, **98**, 99*, 100, 145*
- *mexicana* Cham. & Schlecht. 9, 10, 14, 15, 16, 20, 21, **33**, 34*, 38, 38, 40, 41, 42, 43, 100, 125, 136*
- *milne-redheadii* A. Fernandes & Diniz 118, 127
- *minuta* A. Fernandes & Diniz 106, 108
- *myriophylloides* Welw. ex Hiern 9, 10, 14, 15, 17, 22, 25, **26**, 27*, 29, 118, 132, 135*
- *nashii* A. Fernandes 26
- *nummularia* Welw. ex Hiern 14, 15, 19, **56**, 57*, 139*
- *nummularia* Welw. ex Hiern 58
- *oblonga* Peter 63, 67
- *occultiflora* Koehne 9, 14, 15, 16, 20, **41***, 42, 43, 142*
- *pearsoniana* A. Fernandes & Diniz 26
- *pedicellata* A. Fernandes & Diniz 63, 67
- *pentandra* (Roxb.) Blatter & Hallberg 39, 86
- *peregrina* Perrier, pro parte 63
- *petaloidea* Wight ex Steudel 23
- *pterocalyx* A. Raynal 14, 15, 20, **67**, 68*, 69, 70, 140*
- *pusilla* Tul. 33
- *pygmaea* (S. Kurz) Rajagopal & Ramayya 33, 40
- *ramosior* (L.) Koehne 7, 9, 10, 14, 15, 18, **74**, 75*, 76, 79, 80, 142*
- Rotala repens* (Hochst.) Koehne 10, 11, 14, 15, 16, **45**, 46*, 47, 103, 135*
- *ritchiei* (Clarke) Koehne 14, 15, 18, 70, **71***, 141*
- *robynsiana* A. Fernandes & Diniz 118, 125, 128
- *rosea* (Poiret) C. D. K. Cook 8, 9, 10, 14, 15, 19, 20, 62, **86**, 87*, 90, 100, 144*
- *rotunda* A. Chevalier 67
- *rotundifolia* (Buch.-Ham. ex Roxb.) Koehne 9, 14, 15, 19, 45, **49**, 50*, 55, 56, 57, 103, 138*
- *roxburghiana* Wight 82
- *rubra* (Buch.-Ham. ex D. Don) Hara 9, 14, 15, 21, 94*, **96**, 97, 103, 133, 144*
- *serpiculoides* Welw. ex Hiern 14, 15, 17, **101**, 102*, 103, 104, 146*
- *serpyllifolia* (Roth) Bremek. 14, 15, 22, 60*, **61**, 137*
- *simpliciuscula* (S. Kurz) Koehne 9, 14, 15, 17, 18, 21, 99*, **100**, 101, 104, 144*
- *smithii* A. Fernandes & Diniz 14, 15, 22, 118, 120, **131**, 149*
- *sphagnoides* Perrier 118, 125
- *stagnina* Hiern 14, 15, 21, **104***, 107, 146*
- *stipulata* Blatter & Hallberg 47
- *stuhlmannii* Koehne ex Gilg 118, **133**
- *submersa* Dinter ex Pohnert 63, 67
- *subrotunda* (Wallich ex S. Kurz) Koehne 14, 15, 21, 110, **115**, 116*, 145*
- *subrotunda* var. *polystachya* (Wallich ex Wight & Arnott) Koehne 108, 115
- *tenella* (Guill. & Perr.) Hiern 14, 15, 20, **63**, 64*, 67, 69, 133, 140*
- *tenuis* (Wight) Koehne 61
- *tetragonocalyx* A. Fernandes & Diniz 69, 70
- *thymoides* Exell 14, 15, 19, 57*, **58**, 59, 139*
- *uliginosa* (Miq.) Nakai 109
- *urundiensis* A. Fernandes & Diniz 106, 108
- *verdcourtii* A. Fernandes 9, 14, 15, 19, 87*, **90**, 93, 143*
- *verticillaris* L. 12, 14, 15, 17, **23***, 24, 25, 134*
- *verticillaris* sensu Hiern 33
- *verticillata* Christm. 23
- *wallichii* (Hooker fil.) Koehne 9, 14, 15, 17, 27*, **29**, 30, 31, 134*

Rotala welwitschii Exell 14, 15, 18, 39, **91**,
92*, 108, 143*
— *wildii* A. Fernandes 118, 130

Sellowia uliginosa Roth ex Roemer &
Schultes 12, 82
Suffrenia capensis Harvey 125
— *filiformis* Bellardi 12, 121

Tritheca pentandra (Roxb.) Miq. 12, 86

Winterlia uliginosa (Roth ex Roemer &
Schultes) Sprengel 82

Publications en vente au Conservatoire botanique de Genève

Les prix sont en francs suisses. En italique les prix réduits dont jouissent les libraires et instituts scientifiques (* = stock limité)

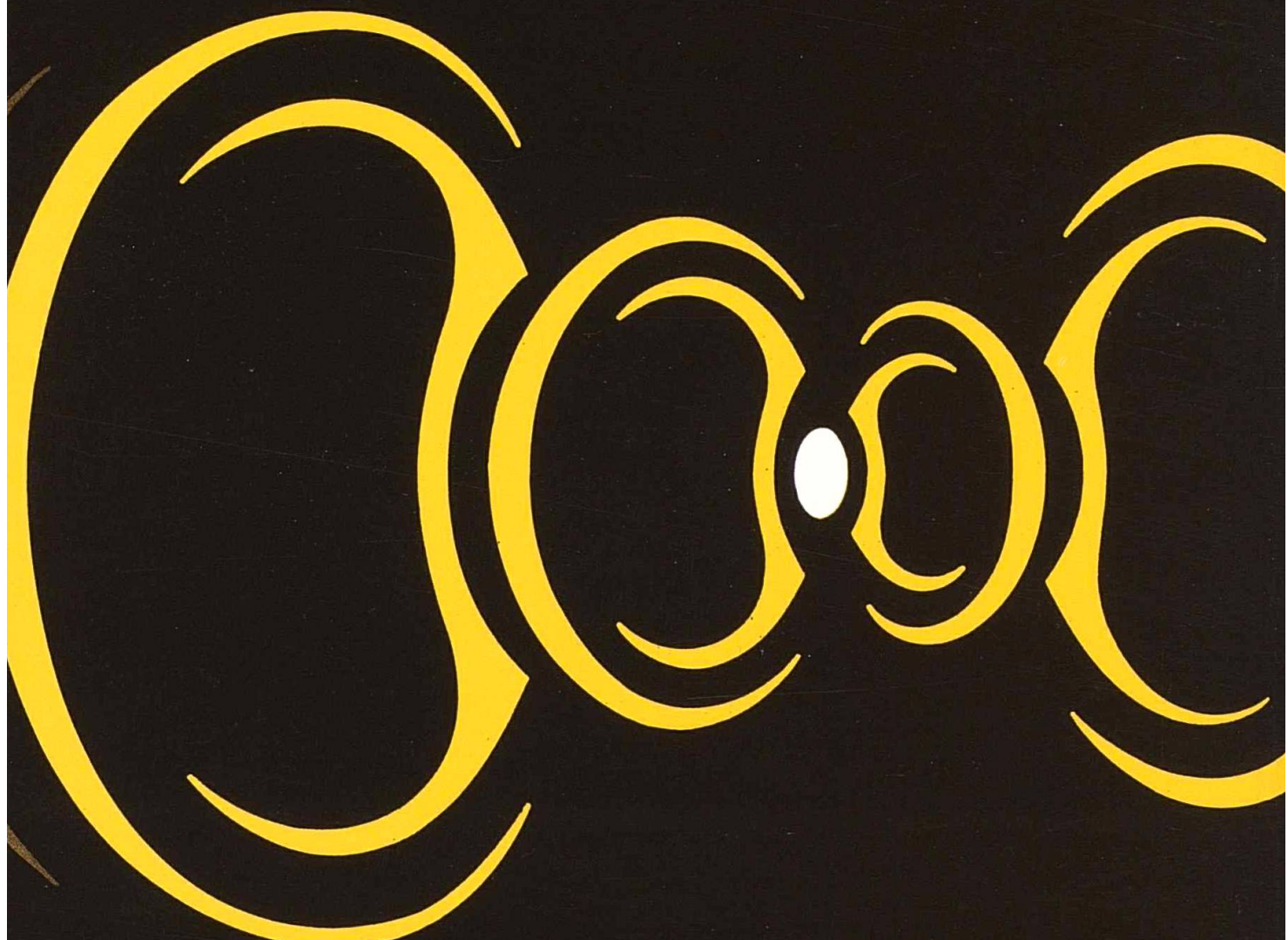
<i>Bulletin de l'Herbier Boissier</i>		
Vol. 1*-3*, [4-7 épuisés], le volume	75.—	50.—
<i>Mémoires de l'Herbier Boissier</i>		
Fasc. [1 épuisé], 2*-22*, la série	75.—	50.—
<i>Bulletin de l'Herbier Boissier, sér. 2</i>		
Vol. 1*-8*, le volume	75.—	50.—
<i>Annuaire du Conservatoire et du Jardin botanique de Genève</i>		
Vol. 1*-4*, [5 épuisé], 6-21, le volume	38.—	25.—
<i>Candollea</i>		
Vol. [1-18 épuisés], 19 et 20	75.—	50.—
Vol. 21 (1/2)-33 (1/2) le volume	150.—	100.—
le fascicule	75.—	50.—
<i>Boissiera</i> , le volume	115.—	75.—
Vol. 1-5, 7 & 9, épuisés		
Vol. 6* Hochreutiner: <i>La philosophie d'un naturaliste</i> (1941)	ISBN 2-8277-0021-2	
Vol. 8 Willis: <i>The Birth and Spread of Plants</i> (1949)	ISBN 2-8277-0023-9	
Vol. 10 Roberty & Vautier: <i>Les genres de Polygonacées; les genres de Convolvulacées</i> (1964)	ISBN 2-8277-0025-5	
Vol. 11 Baehni: <i>Mémoires sur les Sapotacées. III. Inventaire des genres</i> (1965)	ISBN 2-8277-0026-3	
Vol. 12 Weber: <i>Catalogue dynamique de la flore de Genève</i> (1966)	ISBN 2-8277-0027-1	
Vol. 13 Greuter & Rechinger: <i>Flora der Insel Kythera</i> (1967)	ISBN 2-8277-0028-X	
Vol. 14 <i>Les multiples fonctions d'un jardin botanique</i> (1969)	ISBN 2-8277-0029-8	
Vol. 15 Hainard: <i>Signification écologique et biogéographique de la répartition des essences forestières sur l'adret valaisan</i> (1969)	ISBN 2-8277-0030-1	
Vol. 16 Cusset: <i>Remarques sur des feuilles de dicotylédones</i> (1970)	ISBN 2-8277-0031-X	
Vol. 17 Damboldt: <i>Revision der Gattung Asyneuma</i> (1970)	ISBN 2-8277-0032-8	
Vol. 18 Bancilhon: <i>Contribution à l'étude taxonomique du genre Phyllanthus (Euphorbiacées)</i> (1971)	ISBN 2-8277-0033-6	
Vol. 19 Miège & Greuter (éds.): <i>Actes du VI^e Symposium de Flora europaea</i> (1971)	ISBN 2-8277-0034-4	
Vol. 20 Guittonneau: <i>Contribution à l'étude biosystématique du genre Erodium L'Hér. dans le bassin méditerranéen occidental</i> (1972)	ISBN 2-8277-0035-2	
Vol. 21 Deml: <i>Revision der Sektionen Acanthophaea Bunge und Aegacantha Bunge der Gattung Astragalus L.</i> (1972)	ISBN 2-8277-0036-0	
Vol. 22 Greuter: <i>Monographie der Gattung Ptilostemon (Compositae)</i> (1973)	ISBN 2-8277-0037-9	
Vol. 23 Küpfer: <i>Recherches sur les liens de parenté entre la flore orophile des Alpes et celle des Pyrénées</i> (1974)	ISBN 2-8277-0038-7	
Vol. 24a Miège & Stork (éds.): <i>Comptes rendus de la VIII^e réunion de l'AETFAT, vol. 1</i> (1975)	ISBN 2-8277-0039-5	
Vol. 24b Miège & Stork (éds.): <i>Comptes rendus de la VIII^e réunion de l'AETFAT, vol. 2</i> (1976)	ISBN 2-8277-0040-9	

Vol. 25	Agerer-Kirchhoff: <i>Revision von Astragalus L. sect. Astragalus (Leguminosae)</i> (1976).....	ISBN 2-8277-0041-7
Vol. 26	Herrnstadt & Heyn: <i>A monographic study of the genus Prangos (Umbelliferae)</i> (1977).....	ISBN 2-8277-0042-5
Vol. 27	Amandier & Gasquez: <i>Contribution à l'étude phyto-écologique et floristique du Vallon de la Rocheure (Parc National de la Vanoise)</i> (1978).....	ISBN 2-8277-0043-3
Vol. 28	Maréchal, Mascherpa & Stainier: <i>Etude taxonomique d'un groupe complexe d'espèces des genres Phaseolus et Vigna (Papilionaceae) sur la base de données morphologiques et polliniques, traitées par l'analyse informatique</i> (1978).....	ISBN 2-8277-0044-1
Vol. 29	Cook: <i>A revision of the genus Rotala (Lythraceae)</i> (1979).....	ISBN 2-8277-0045-X

Publication hors-série

Lebrun & Stork: <i>Index des cartes de répartition, plantes vasculaires d'Afrique</i> (1977)	40.—	25.—	ISBN 2-8277-0101-4
Amman & Meylan: <i>Flore des Mousses de la Suisse</i> (1918).....	115.—	75.—	ISBN 2-8277-0001-8
Autrand & Durand: <i>Hortus Boissieranus</i> (1896).....	10.—	6.—	ISBN 2-8277-0002-6
Barbey: <i>Epilobium genus</i> (1885).....	75.—	50.—	ISBN 2-8277-0003-4
Barbey: <i>Florae Sardoae compendium</i> (1885).....	75.—	50.—	ISBN 2-8277-0004-2
Boissier: <i>Diagnoses Plantarum Orientalium Novarum</i> , le fascicule	30.—	20.—	
sér. 1, fasc. 2 (1843), 12 (1853), 13 (1854)			ISBN 2-8277-0005-0
sér. 2, fasc. 3 (1856), 4 (1859), 5 (1856), 6 (1859)			ISBN 2-8277-0006-9
Boissier: <i>Flora Orientalis</i> , vol. 1*, 5*, 6*, le volume	300.—	200.—	ISBN 2-8277-0007-7
Boissier & Reuter: <i>Pugillus plantarum novarum Africae borealis Hispaniae-austalis</i> (1852)	45.—	30.—	ISBN 2-8277-0008-5
Crumière-Briquet: <i>Biographie J. Briquet (1870-1931)</i> (1935)	15.—	10.—	ISBN 2-8277-0009-3
Hochreutiner: <i>Etudes sur les Phanérogames aquatiques du Rhône et de Port Genève</i> (1896)	75.—	50.—	ISBN 2-8277-0010-7
Lachavanne & Wattenhofer: <i>Les Macrophytes du Léman</i> (1975).....	45.—	30.—	ISBN 2-8277-0011-5
Micheli: <i>Le Jardin du Crest, notes sur les végétaux cultivés en plein air au château du Crest près Genève</i> (1896) ...	23.—	15.—	ISBN 2-8277-0012-3
Miège (éd.): <i>Les Protéines des graines, genèse, nature, fonctions, domaines d'utilisation</i> (1975)	65.—		ISBN 2-8277-0013-1
Stefani, Major & Barbey: <i>Karpathos</i> (1895).....	38.—	25.—	ISBN 2-8277-0014-X
Stephani: <i>Species Hepaticarum</i> , vol. 1-6 (reprod. photostat. partielle), le vol.	230.—	150.—	ISBN 2-8277-0015-8

CODEN: BOISB2 29 1-156 (1979)
ISSN: 0373-2975



ISBN 2-8277-0045-X