

FLORA OF INDIA

VOLUME 1

RANUNCULACEAE — BARCLAYACEAE

BOTANICAL SURVEY OF INDIA

Editors

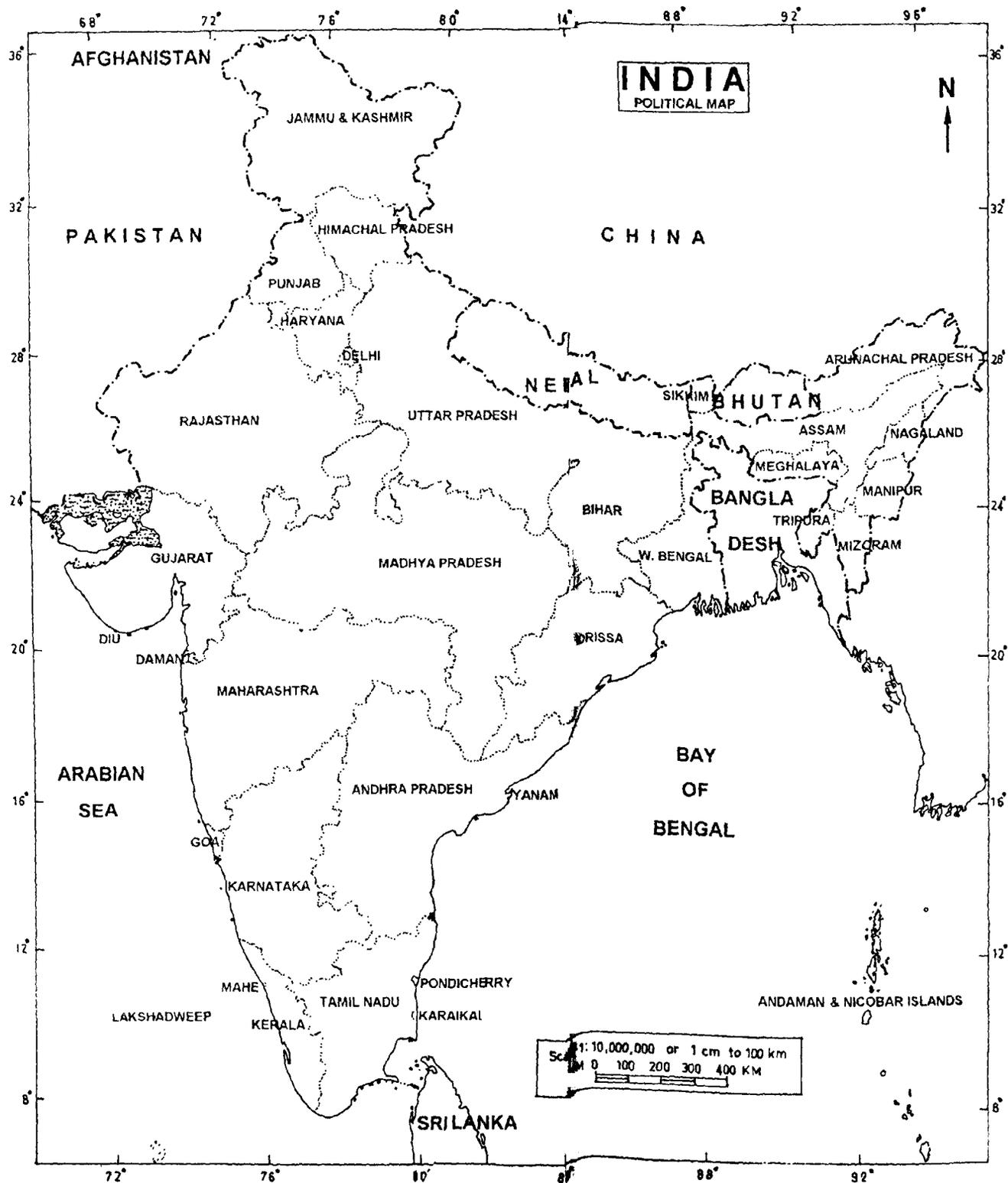
B.D. Sharma

N.P. Balakrishnan

R.R. Rao

and

P.K. Hajra



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भारतीय वनस्पति सर्वेक्षण
BOTANICAL SURVEY OF INDIA

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CALCUTTA

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Dedicated
to the
Central National Herbarium (CAL)
of Botanical Survey of India,
Indian Botanic Garden, Howrah
founded by
Dr. William Roxburgh
in the year 1793
completing its bicentennial
service to the Botany of India
this year

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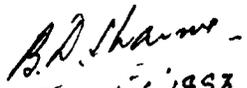
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FOREWORD

The principal aim of Botanical Survey of India, reorganised in 1956, is preparation of a modern up to date account of the Flora of India, to replace the monumental Flora of British India by J.D. Hooker and his collaborators, which served the Indian subcontinent well for a century, but has now become out of date and inadequate. Initially the emphasis in the department was on intensive and extensive floristic surveys and collections to provide enough materials for the final preparation of the flora of the country. This work carried out by a large team of enthusiastic young botanists covered a period of almost 3 decades. The results were the almost doubling of the stock in Indian herbaria and discovery of several new taxa, new additions, changes in identity and nomenclature and the most important of all providing adequate herbarium materials for detailed descriptions of a new flora for the country, various families were taken up by monographers and their results were published as Fascicles of Flora of India (1978-1988) in which 20 fascicles completing 31 families were published so far. It was soon found that such detailed monographic work involve considerable time and the flora of India consisting of about 17,000 species of Angiosperms would take at least 50 years to complete. Further the demand from general public, botanists, foresters, etc. of the country to provide them a modern workable tool for identification of Indian plants, made us to change our approach to a semimonographic flora to ensure sustained production and quick completion of the flora. Hence it was planned to prepare the flora in 32 volumes in the sequence of Bentham & Hooker's system of classification, by which almost all herbaria of India and neighbouring countries are arranged and the botanists of these countries are familiar with. The work started in 1986 has now shown encouraging results. The joint efforts of several monographers and editors of families have enabled us now to present the first volume covering families Ranunculaceae to Barclayaceae. Volume 2 (Papaveraceae to Caryophyllaceae) and Volume 3 (Portulacaceae to Erythroxylaceae) are in final stages and would follow soon. Works on subsequent volumes are in various stages of completion and are expected to come out in quick succession.

The department requests all botanists of the country to provide data, materials and suggestions in our efforts of national as well as international importance.

Calcutta
01.06.1993


1.6.1993

(B.D. Sharma)
Director

Botanical Survey of India
Calcutta

PREFACE

India, with a total area of about 329 million hectares bounded in the north by the mighty Himalayas, in the southeast by Bay of Bengal and in the southwest by Arabian Sea, exhibits diverse topography and climate ranging from the alpine Himalayas, the hot dry deserts of Rajasthan to the tropical evergreen forests of South-western Ghats, Assam and Andaman & Nicobar Islands. Such diversity in topography and climate coupled with the geographical position of the country at the trijunction of Central Asia, East Asia and South-east Asia, produced a flora which can be considered as one of the richest and most diverse in the world. It is estimated that about 45,000 species of plants occur in India, with the angiosperm flora consisting of about 17,000 species. Among these, about 40 - 45% are endemic to the region, largely concentrated in three major biogeographical zones, viz. the Western Himalayas, Eastern Himalayas and the Peninsular India. The most distressing aspect today is that an estimated 10% of the flora is threatened with extinction. The rapid depletion of natural vegetation due to natural factors, habitat destruction, deforestation and other anthropogenic activities on the fragile natural ecosystems, has caused considerable depletion in the natural populations of most endemics. Hence conservation of what remains in the flora assumes great importance and top priority. You cannot conserve what you do not know. Keeping this dictum in mind, in order to conserve we should know what we had, what we have today and what needs protection. Since taxonomy provides the basis for rare species protection by defining and naming the taxa that need protection, the present flora aims at this objective.

Botanical Survey of India, established in 1890 with Sir George King as its first Director, completes 100 years of active floristic exploration of India. It has been responsible for the development of a National Herbarium at Indian Botanic Garden, Calcutta and various regional herbaria at Dehra Dun, Pune, Coimbatore, Shillong, etc. Since the publication of the monumental work, the Flora of British India in seven volumes by Sir J.D. Hooker and his collaborators, completed during a span of 25 years from 1872 to 1897, the country never had a National Flora of its own, eventhough various regional and district floras have been published. The Botanical Survey of India, since its reorganisation in 1956 has been undertaking well-organised, systematic, intensive and extensive floristic surveys in various underexplored and unexplored regions of the country. As a result, a vast collection of herbarium specimens have been added to the Central National Herbarium (CAL) and different regional herbaria. Several new species, new national records and new distributional records have been added on and taxonomic nomenclatural problems of several groups have been sorted out. The plant taxonomy received an immense impetus in India due to the lead taken by the Botanical Survey of India. Several botanists, other than Botanical Survey of India, have also initiated taxonomical work in their respective research institutions or universities. As a consequence, several monographs, revisions, district and regional floras have been published during the last two decades.

The need for having a National Flora was felt in order to present up-to-date nomenclature, identity and distribution of plant species to cater to the evergrowing demands of scientists, planners and general public. The department embarked on this ambitious project for the preparation of a new Flora of India so as to meet the demand. Initially it was decided that the preparation of Flora of India should be preceded by detailed monographic work on each family and presented in a condensed form, and works on several families and genera were published in the form of Fascicles of Flora of India irrespective of any classificatory sequence. So far 20 fascicles have appeared in print from 1978 to 1990.

However, it was soon realised that monographic work was time consuming and to complete the flora of the country, as diverse and vast as India, with over 15,000 species of flowering plants, would take many years to accomplish. Till date, the botanists, foresters, university teachers, students, laymen etc. are to depend on more than a century old, outdated Flora of British India by J.D. Hooker and other regional floras for identification of plants in India and have always experienced difficulties not only for identification of plants but also with regard to correct nomenclature and their distribution in India. Therefore, Botanical Survey of India, the premier organisation in India for plant taxonomy, felt the need for presenting a modern flora of India covering various aspects of plants occurring within the present political boundaries of India. After in-depth deliberations with the eminent botanists of the country and abroad, it was decided that the data and plant material available at present in various publications, floras and herbaria should be assembled together and presented to serve as a compendium of the floristic wealth of the country aimed at practical utility. The department finally decided to prepare a National Flora, which would serve as an identification manual and work started in July, 1988. The guidelines, given below in condensed outlines, would help the reader to understand the methodology of presentation.

The Flora of India covering the present political boundaries of India is planned to be published in 32 volumes dealing with the entire Angiosperms from Ranunculaceae to Poaceae. An introductory volume to the Flora of India has been planned which will cover in general various aspects of flora and vegetation and other allied subjects. Bentham & Hooker's system of classification with delimitation and circumscription based on Cronquist's system, except for certain families, is followed in the delimitation of families. Each volume is being demarcated to accommodate 400 to 600 species on an average.

Family names are followed as per *Nomina Familiarum Conservanda* of International Code of Botanical Nomenclature (ICBN). Alternate names, if any, are given in brackets. Family descriptions are elaborate, so as to reflect the important features on world-wide basis. General distribution of the family along with total number of genera and species for the world and India are indicated in the next paragraph. If there are any important

monograph, revision or works on allied subject on the family or genera covering or useful for Indian region, these are cited in the following paragraph under '*Literature*' in alphabetical sequence of authors. Keys to genera, as well as to lower categories, are strictly dichotomous and of bracketed type. For large families, viz. Annonaceae, Menispermaceae, Brassicaceae, Rutaceae, Fabaceae, Asteraceae, Orchidaceae, Poaceae, etc., it may be necessary to arrange genera and keys to genera segregated into subdivisions of the family, like subfamilies, tribes, etc.

The genera are arranged serially in alphabetical sequence. Generic descriptions incorporate important characters of the genus on world-wide basis in a condensed form. The next paragraph contains distribution followed by total number of species in the world and in India. Important selected literature on the genus, with full references form the following paragraph named '*Literature*'.

The species are arranged serially and alphabetically. The correct name of the species appears in bold letters followed by its author's name and full reference to original publication. Basionyms, if any, are given with full citations. All important synonyms, connecting to Indian flora and Indian works are given. This is followed by Indian names, arranged in alphabetical sequence of abbreviated language names. A detailed taxonomic description of the species is provided for proper identification of the species. Phenological data gathered from herbarium specimens and correlated with those available in literature are indicated as Flowering (*Fl.*) and Fruiting (*Fr.*). Distribution of the species is given in two paragraphs. The first paragraph gives distribution in India, including general ecology and statewide distribution. The second paragraph provides world distribution, countrywise and/or phytogeographically. Uses of the species, if any, on economic, medicinal or ethnobotanical aspects are given under '*Notes*'. If there are any nomenclatural, taxonomic or phytogeographic interesting aspects these are also given under '*Notes*' with literature citation, if any.

Plants which are purely cultivated are listed at the end of the family with short descriptions and notes. Those exotic species which have run wild or get propagated naturally are included in the general account.

For the sake of uniformity, author's names are mostly abbreviated as given in 'Draft Index of Author Abbreviations' compiled at Kew.

Volumes will be published as and when they are ready, irrespective of the sequence.

In this series, we are now presenting Volume 1, containing 489 species covering families from Ranunculaceae to Barclayaceae.

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Calcutta

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ABBREVIATIONS

of

INDIAN LANGUAGES

Abhor	: Abhor	Kum.	: Kumaonese
And.	: Andaman	Lep.	: Lepcha
Asm.	: Assamese	Lus.	: Lushai
Beng.	: Bengali	Mal.	: Malayalam
Bhoj.	: Bhojpuri	Mani.	: Manipuri
Bhut.	: Bhutia	Mar.	: Marathi
Cachar	: Cachar	Mikir	: Mikir
Coorgi	: Coorgi	Miri	: Miri
Eng.	: English	Naga	: Naga
Garó	: Garó	Nep.	: Nepali
Garh.	: Garhwali	Or.	: Oriya
Goa.	: Goanese	Port.	: Portugese
Guj.	: Gujarati	Punj.	: Punjabi
Hindi	: Hindi	Raj.	: Rajasthani
Jain.	: Jaintea	Sans.	: Sanskrit
Jaun.	: Jaunsar	Sant.	: Santal
Kang.	: Kangri	Sind.	: Sindhi
Kan.	: Kannada	Tam.	: Tamil
Kash.	: Kashmiri	Tel.	: Telugu
Kh.	: Khasi	Tipp.	: Tippera (Tripura)
Kon.	: Konkani	Urdu	: Urdu

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19. *Podophyllum hexandrum* Royle
(Valley of Flowers, Uttar Pradesh, BSD).

RANUNCULACEAE

(M.A. Rau)

Herbs, annual or perennial, erect or stoloniferous, rarely shrubs or woody climbers. Leaves basal and cauline, alternate, rarely opposite, entire or palmately, ternately or pinnately dissected, sometimes compound, always exstipulate or petioles sometimes broadened into stipule-like auricles at base, very rarely free; leaf-bases often sheathing. Inflorescence 1-flowered, cymose, racemose, thyrsoid or paniculate. Flowers actinomorphic or zygomorphic, bisexual or unisexual; plants monoecious, polygamous or very rarely dioecious; all parts hypogynous. Sepals (3-) 5 (-8), mostly 5, free, sometimes showy and petaloid; uppermost sepal sometimes concave, boat-shaped or helmet-shaped, rarely spurred. Petals 5 (0-12) or more, free, in some funnel-shaped or sometimes spurred and often with subbasal nectar glands, sometimes with honey-scales or honey-leaves between perianth and stamens. Stamens usually many, rarely 8-20, spirally arranged, free, rarely outer staminodal and petaloid; anthers small, basifixed, extrorse or introrse, dehiscent longitudinally by slits. Carpels 1-many, spirally arranged, rarely few and whorled, free or sometimes shortly connate at base, unilocular; style short or elongated; stigma simple, sessile or decurrent ventrally on style; ovule solitary and basal, or few to many and marginal, erect or pendulous, anatropous, 1- to 2-tegmic, crassinucellar or tenuinucellar. Fruits aggregate of 1-seeded indehiscent achenes or few to many-seeded follicles, dehiscent along dorsal suture, rarely capsule-like (*Nigella*) or a berry (*Actaea*). Seeds small; endosperm copious, fleshy, embryo minute, rounded or linear; cotyledons undifferentiated.

Mostly in N. temperate and alpine regions, some in subtropical or tropical areas; ca 50 genera and 1900 species, 28 genera and 191 species in India.

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KEY TO THE GENERA

- 1a. Plants woody, erect or climbing; leaves opposite 2
 b. Plants herbaceous, erect, rarely climbing or creeping; leaves in basal rosette and/or alternate along the stem 3
- 2a. Plants climbing by means of twining petioles; terminal leaflet normal; petals absent 11. *Clematis*
 b. Plants climbing by means of tendrils; terminal leaflet modified into tendril; petals present 19. *Naravella*
- 3a. Carpels 1-ovuled; fruits achenes 4
 b. Carpels many-ovuled; fruits follicular or capsular (berries in *Actaea*) 14
- 4a. Sepals petaloid; petals absent 5
 b. Sepals and petals differentiated, both present 8
- 5a. Leaves cauline, compound; flowers in racemes or panicles; sepals not prominently coloured, small 27. *Thalictrum*
 b. Leaves all radical, lobed or dissected; flowers on scapes; sepals brightly coloured, large 6
- 6a. Achenes with long feathery styles 24. *Pulsatilla*
 b. Achenes with short styles, usually embedded in woolly hairs 7
- 7a. Scape with an involucre of 3 leafy bracts close to the flower 17. *Hepatica*
 b. Scape with an involucre of 2 - 3 leafy bracts at a distance from flower 4. *Anemone*
- 8a. Herbs with stems, annual or perennial, mostly terrestrial plants 9
 b. Herbs, stemless, perennial, terrestrial 11
- 9a. Petals 5 - 24, yellow or red; glands absent; terrestrial plants 3. *Adonis*
 b. Petals usually 5, yellow, white in some; glands present; mostly terrestrial, a few aquatic .10
- 10a. Achenes gibbous with empty pouches on either side and a long terminal beak, 2 - 3 times as long as the achene 9. *Ceratocephalus*
 b. Achenes not as above 25. *Ranunculus*
- 11a. Sepals deciduous or withering early 12
 b. Sepals persistent, enlarged after flowering 13
- 12a. Petals white or with pinkish tinge 7. *Callianthemum*
 b. Petals yellow 16. *Halerpestes*
- 13a. Flowers bisexual; petals 10 - 15 21. *Oxygraphis*
 b. Flowers unisexual; petals 5 23. *Paroxygraphis*
- 14a. Carpels connate towards the apex; fruits capsular 20. *Nigella*
 b. Carpels not connate towards apex; fruits follicular or a berry (in *Actaea*) 15
- 15a. Sepals petaloid; petals absent 16
 b. Sepals and petals differentiated, both present 17
- 16a. Leaves reniform, palmatisect; torus elongating after flowering 6. *Calathodes*
 b. Leaves reniform, simple, entire; torus not elongating after flowering 8. *Caltha*
- 17a. Flowers irregular (zygomorphic) 18
 b. Flowers regular (actinomorphic) 20
- 18a. Posterior sepal helmet-shaped, vaulted; petals 2 1. *Aconitum*
 b. Posterior sepal spurred; petals 1 or 4 19

- | | |
|--|-------------------------|
| 19a. Spur only from the posterior sepal; petal 1, upper 2 petals coalesced to form a nectary; lower petals absent; follicles solitary | 12. <i>Consolida</i> |
| b. Spur from the posterior sepal and upper 2 petals; petals 4; spurs of upper 2 petals included in sepal spur; lower petals present; follicles 3 - 5 | 14. <i>Delphinium</i> |
| 20a. Fruit a solitary berry | 2. <i>Actaea</i> |
| b. Fruits of follicles | 21 |
| 21a. Flowers with spurs | 5. <i>Aquilegia</i> |
| b. Flowers without spurs | 22 |
| 22a. Inflorescence racemose; racemes simple or paniculate | 23 |
| b. Inflorescence a cyme, dichasium or flowers solitary | 24 |
| 23a. Inflorescence a simple raceme; petals without glandular discs at apex | 26. <i>Souliea</i> |
| b. Inflorescence a panicle of racemes; petals with 2 rounded glandular discs at apex | 10. <i>Cimicifuga</i> |
| 24a. Carpels long-stalked | 13. <i>Coptis</i> |
| b. Carpels sessile | 25 |
| 25a. Flowers yellow | 28. <i>Trollius</i> |
| b. Flowers white or pale yellow | 26 |
| 26a. Carpels constantly 2, connate at base, divaricate above | 15. <i>Dichrocarpum</i> |
| b. Carpels 1 - 10, free | 27 |
| 27a. Stems simple, scapose; flowers solitary | 22. <i>Paraquilegia</i> |
| b. Stems branched, leafy; flowers in dichasia | 18. <i>Isopyrum</i> |

1. *Aconitum* L.

Herbs, perennial, biennial or rarely annual, usually erect, rarely scandent or twining. Leaves basal and on stems, simple, suborbicular or broadly ovate in outline, generally ternately palmate-partite or deeply divided or incised with lateral segments, again deeply divided or rarely pinnatisect. Flowers zygomorphic, in simple or branched racemes, often reduced to few or solitary. Sepals 5, petaloid, blue, yellow, reddish, purple or white; the uppermost larger, broader, hood-like, concave, boat-shaped or helmet-shaped, rarely spurred; the two upper lateral sepals obovate or suborbicular, flat; the two lower lateral sepals narrower and somewhat unequal, oblong or elliptic. Petals (honey-scales) 4 or 5, only 2 posterior ones developed and transformed into nectaries, with a slender grooved basal claw, broadening into a sac-like hooded limb, with terminal nectariferous spur, enclosed within the uppermost sepal, the anterior petals small or absent. Stamens numerous. Follicles usually 3 - 5, rarely 9 - 12, somewhat erect, sessile. Seeds many, with spongy rugose or wrinkled testa.

North temperate regions; ca 300 species, 27 in India.

Literature. STAPF, O. (1906) *Aconites of India - A monograph.* Ann. R. Bot. Gard. Calc. 10: 115 - 197, tt. 92 - 116.

KEY TO THE SPECIES

- 1a. Herbs, scandent or twining 2
 b. Herbs, erect 3
- 2a. Pedicels recurved; flowers nodding; lamina of leaves pubescent 6. *A. elwealii*
 b. Pedicels straight; flowers erect; lamina of leaves glabrous 18. *A. lethale*
- 3a. Annual herbs, with slender tap root; carpels 9 or more, up to 12 11. *A. gymnantrum*
 b. Perennial or biennial herbs, usually with a paired tap-root; carpels 3 - 5, rarely up to 8 4
- 4a. Flowers solitary or 2 at stem apex or up to 4 in a raceme 5
 b. Flowers in dense racemes or panicles 7
- 5a. Flowers always solitary; carpels 6 - 8 9. *A. fletcherianum*
 b. Flowers 1 - 2 at stem apex or 1 - 4 in a raceme; carpels 5 6
- 6a. Flowers 1 - 2 at stem apex; leaves mostly from hypogeous stem base; uppermost sepal helmet-shaped 15. *A. kashmiricum*
 b. Flowers 1 - 4 in a raceme; leaves mostly only basal; uppermost sepal boat-shaped 22. *A. naviculare*
- 7a. Perennial herbs 8
 b. Biennial herbs 10
- 8a. Follicles divergent; uppermost sepal helmet-shaped 17. *A. laeve*
 b. Follicles contiguous or erect; uppermost sepal ovate or boat-shaped, not helmet-shaped 9
- 9a. Uppermost sepal ovate with a long beak 23. *A. novoluridum*
 b. Uppermost sepal boat-shaped without a beak 19. *A. moschatum*
- 10a. Petals (honey-scales) hispid or hispidulous 11
 b. Petals (honey-scales) glabrous 16
- 11a. Carpels glabrous, drying black 12
 b. Carpels pubescent, if glabrate then not drying black 13
- 12a. Inflorescence a few-flowered raceme; sepals glabrous 10. *A. gammiei*
 b. Inflorescence a stiff dense raceme; sepals pubescent 7. *A. falconeri*
- 13a. Carpels 3 (rarely 4 - 5 in *A. laciniatum*) 14
 b. Carpels 5 15
- 14a. Flowers blue; uppermost sepal up to 6 mm broad 5. *A. deinorrhizum*
 b. Flowers reddish purple or dark red; uppermost sepal 13 - 15 mm broad 16. *A. laciniatum*
- 15a. Uppermost sepal horizontal, conspicuously beaked; carpels densely velvety with yellow hairs 21. *A. nakaoi*
 b. Uppermost sepal oblique, shortly beaked; carpels pubescent or glabrate, not as above 12. *A. heterophylloides*
- 16a. Carpels 3 17
 b. Carpels 5 18
- 17a. Flowers yellow, in panicles 1. *A. assamicum*
 b. Flowers blue, in terminal racemes 25. *A. soongoricum*
- 18a. Carpels glabrous 19
 b. Carpels pubescent 20
- 19a. Inflorescence a loose panicle; uppermost sepal obscurely beaked 3. *A. bisma*
 b. Inflorescence a dense raceme; uppermost sepal with long and slender beak 4. *A. chasmanthum*

20a. Leaves all or most from hypogeous base of stem	21
b. Leaves basal and cauline	23
21a. Sepals sparingly hairy; uppermost sepal helmet-shaped, rarely navicular	14. <i>A. hookeri</i>
b. Sepals pubescent; uppermost sepal mostly boat-shaped	22
22a. Leaves 1 - 2 at base, and only 1 - 2 higher up; lamina lacinate	27. <i>A. violaceum</i>
b. Leaves 4 - 5 (-8), mostly basal in loose rosettes; lamina with broad lobes	24. <i>A. rotundifolium</i>
23a. Lower leaves present at the time of flowering; leaves heteromorphous	13. <i>A. heterophyllum</i>
b. Lower leaves decayed at the time of flowering; leaves uniform	24
24a. Seeds broadly winged along raphe	2. <i>A. balfourii</i>
b. Seeds transversely lamellate, not winged along raphe	25
25a. Leaf-lamina glabrous, 3-partite	20. <i>A. nagarum</i>
b. Leaf-lamina finely pubescent, 5 or more partite	26
26a. Bracteoles linear, not dentate; flowers dirty blue; petal head ca 6 mm long	8. <i>A. ferox</i>
b. Bracteoles broad, dentate; flowers saturated blue; petal head 10 - 11 mm long	26. <i>A. spicatum</i>

1. *Aconitum assamicum* Lauener in Notes R. Bot. Gard. Edinb. 25: 28. 1963.

Herbs, biennial; stems simple, erect, up to 60 cm high, with long spreading golden hairs. Cauline leaves reniform. Inflorescence up to 15 cm long, paniculate. Flowers pale yellow. Sepals with long hairs. Petals (honey-scales) ca 1.5 cm long, more or less glabrous. Carpels 3, densely golden hairy.

Fl. Sept.

Distrib. India: E. Himalayas, 3900 - 4300 m. Arunachal Pradesh.

Endemic.

Notes. Closely related to *A. orochryseum* of Nepal and Bhutan.

2. *Aconitum balfourii* Stapf in Ann. R. Bot. Gard. Calc. 10: 160, t. 104. 1905. *A. ferox* auct. non Wallich ex Seringe; Wallich, Pl. As. Rar. 1: 35. 1830, p. p. & Cat. 167, no. 4721. 1831, p. p. *A. ferox* var. *atrox* Bruehl in Ann. R. Bot. Gard. Calc. 5: 110. 1895. *A. atrox* (Bruehl) Mukerjee in Bull. Bot. Surv. India 3: 101. 1962. Fig. 1

Hindi: *Haldu-mitha*.

Herbs, biennial; roots paired or ternate; stems erect, up to 1 m high, robust. Basal leaves decayed at the time of flowering; lower petioles up to 7.5 cm long. Inflorescence up to 30 cm long, many-flowered, with yellowish tomentum. Sepals blue, pubescent; uppermost helmet-shaped. Petals glabrous. Filaments hispidulous. Carpels 5, yellowish tomentose. Follicles oblong, loosely hairy. Seeds broadly winged along raphe.

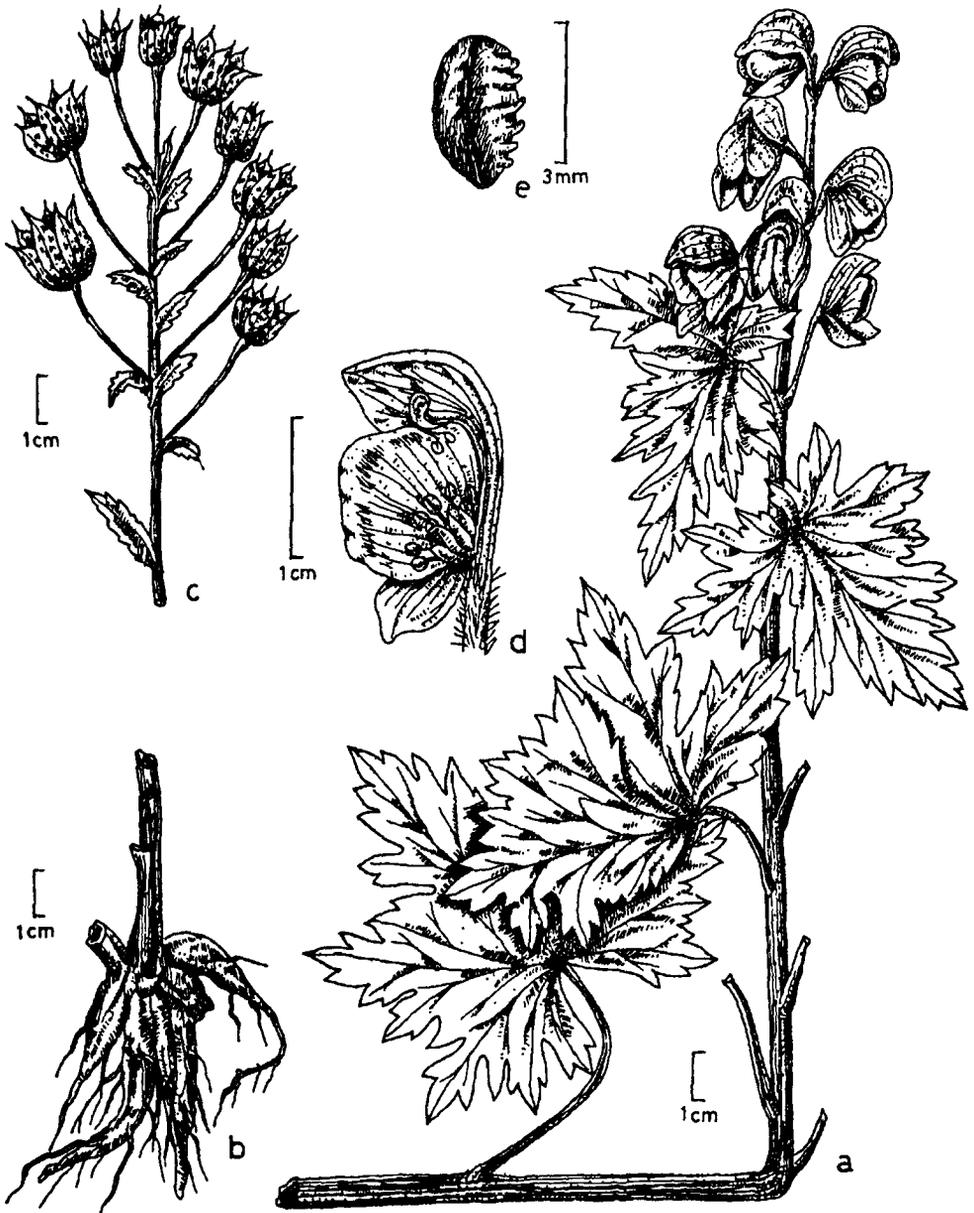


Fig. 1. *Aconitum balfourii* Stapf: a. habit; b. root; c. infructescence; d. flower, longitudinal sectional view; e. seed.

Fl. & Fr. Sept. - Oct.

Distrib. India: Subalpine W. Himalayas. Uttar Pradesh.

Nepal.

Notes. Roots used locally in medicine.

Stapf (l. c.) reports var. *rhombofolium* Stapf from Garhwal Himalayas in Uttar Pradesh.

3. *Aconitum bisma* (Buch.-Ham.) Rapaics in Nov. Kozlem. 6: 164. 1907, p. p.; Fletcher & Lauener in Notes R. Bot. Gard. Edinb. 20: 197, t. 166, f. 1. 1950. *Caltha bisma* Buch.-Ham. in Edinb. J. Sci. 1: 251. 1824. *A. palmatum* D. Don, Prodr. Fl. Nep. 196. 1825; Hook. f. & Thomson in Fl. Brit. India 1: 28. 1872. *A. ferox* subsp. *palmatum* (D. Don) Bruehl in Ann. R. Bot. Gard. Calc. 5: 111, t. 111, f. 9 - 13, 24, 25 & 31. 1896.

Nep.: *Bikuma, Seto-bikoma.*

Herbs, biennial; roots paired, tuberous; stems erect, simple, 60 - 150 cm high, stout, hollow, glabrous. Petioles slender, 4 - 10 cm long; lamina obcordate to reniform, up to 15 cm in diam., subglabrous, deeply 5-lobed; segments ovate, cuneate at base, sharply cut. Inflorescence a loose panicle, 10 - 20 cm long; pedicels 4 - 10 cm long. Sepals greenish blue or bluish white; uppermost sepal helmet-shaped, oblique, shortly beaked, ca 2.5 x 1.2 cm; upper lateral sepals obovate, ca 2 x 1.5 cm; lower lateral sepals elliptic, ca 15 x 7 mm. Petal head S-shaped, 5 - 6 mm long, glabrous; spur bulbous; lamina very short, ca 1 mm long. Nectaries and filaments glabrous. Carpels 5, glabrous. Follicles oblong, 2.5 - 4 cm long, 5 - 6 mm thick, glabrous. Seeds black, obscurely winged with plaited testa.

Fl. June - Aug.; *Fr.* Sept. - Oct.

Distrib. India: Moist Abies and Rhododendron forests on alpine Himalayas, 2700 - 3200 m. Uttar Pradesh (Garhwal), Sikkim, and Arunachal Pradesh.

Nepal, Bhutan and China (Tibet).

Notes. Extract from the roots of this non-poisonous plant is used medicinally (Stapf, l. c.).

Chromosome no. $2n = 48$ (Banerjee & Sharma in Form, Str. & Funct. in Plants, Meerut, 1975).

4. *Aconitum chasmanthum* Stapf ex Holmes, Mus. Rep. Pharm. Soc. Gr. Brit. 2. 1903; Stapf in Ann. R. Bot. Gard. Calc. 10: 142 - 144, t. 96. 1905.

Herbs, biennial; roots tuberous, paired, 3 - 5 cm long; stems 60 - 120 cm high, erect, stout, simple below, glabrous or hairy. Leaves many, basal ones long-petioled, upper ones short-petioled; petioles up to 7.5 cm long; lamina orbicular or reniform, 4 - 6 x 5 - 9 cm, palmately tripartite to the base; lobes more or less lacinate. Inflorescence a stiff dense raceme, up to 30 cm long, pubescent. Flowers ca 2.5 cm long, pale blue, often variegated with white; pedicels slender, adpressed to rachis when mature; bracteoles linear. Sepals blue or bluish white, glabrous; uppermost sepal helmet-shaped, ca 2 cm long, glabrous or slightly hairy; upper lateral sepals suborbicular; lower lateral sepals elliptic or oblong. Petals glabrous. Filaments glabrous or hairy on upper part, winged below; anthers brownish black. Carpels 5, glabrous. Follicles 5, free, oblong, glabrous or hairy. Seeds 3-winged.

Fl. & Fr. July - Sept.

Distrib. India: Alpine meadows of N. W. Himalayas. Jammu & Kashmir and Himachal Pradesh (inner valleys of Lahul and Sipti).

Pakistan.

Notes. The tubers contain a very poisonous alkaloid, *indaconitine*, a valuable drug for medicinal purposes. They are said to yield 4.25 to 4.5 % of the total alkaloid (Coventry, Wild Fl. Kashmir 19. 1930). This species belongs to the species aggregate described by Hook. f. & Thomson (in Fl. Brit. India 1: 29. 1872) under the name *A. napellus* (non L.). It has been stated that it is at times difficult to separate this species from *A. violaceum* var. *robustum* Stapf.

5. *Aconitum deinorrhizum* Stapf in Ann. R. Bot. Gard. Calc. 10: 158, t. 103. 1905.

Fig. 2.

Hindi: *Mohra* (Bashahr).

Herbs, biennial; roots paired; stem 1 - 1.5 m high, erect, simple, sparingly hairy. Leaves scattered; petioles slender, 5 - 7 cm long; lamina reniform, ca 15 cm in diam., 5-partite; lobes and teeth acute, finely pubescent. Inflorescence simple, racemose, 30 - 40 cm long, greyish pubescent; pedicels slender, up to 6 cm long. Sepals blue; uppermost sepal oblique, helmet or boat-shaped with a short beak, ca 2 x 0.6 cm; upper lateral sepals obovate, ca 1.5 x 1 cm; lower lateral sepals elliptic, 10 - 15 mm long. Petals densely hispidulous; head S-shaped, ca 8 mm long; spur recurved. Filaments hairy. Follicles 3, greyish pubescent. Seeds obconic, ca 3 mm long, transversely lamellate.

Fl. Aug. - Sept.

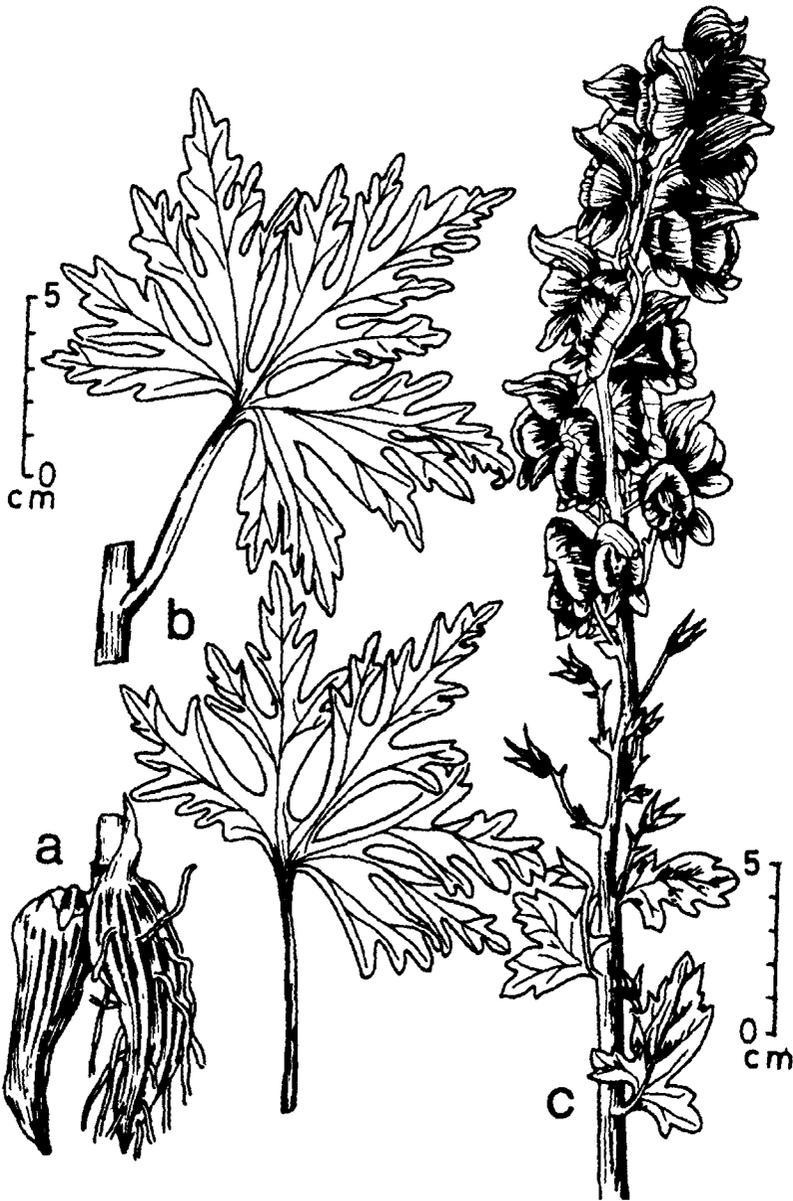


Fig. 2. *Aconitum delinorrhizum* Stapf : a. rootstock; b. cauline leaves; c. inflorescence; (from H.J. Chowdhery in Red Data Book of Indian Plants 1: 312. 1987).

Distrib. India: Alpine grassy slopes, 3000 - 3500 m. Jammu & Kashmir and Himachal Pradesh (Bashahr).

Notes. An important drug of the local trade (Sarin & Gupta in Bull. Bot. Surv. India 9: 282 - 293. 1967). A poison is prepared from the root (Stapf, l. c.).

6. *Aconitum elwesii* Stapf in Ann. R. Bot. Gard. Calc. 10: 174, f. 112a. 1905. *A. uncinatum* auct. non L.; Hook. f. & Thomson in Fl. Brit. India 1 : 28. 1872. *A. variegatum* Hook. f. & Thomson, Fl. Ind. 56. 1855.

Herbs, biennial; stems scandent, slender, weak, very long, sparingly branched, glabrous or puberulous. Basal leaves not seen; cauline leaves scattered, 6 - 12 cm in diam., pubescent; lamina ovate-cordate or rotund with wide sinus, palmately 3 - 5-partite; lobes cuneate-ovate, finely toothed; leaf-axils without bulbils. Inflorescences axillary or terminal, paniculate; flowers few to many; pedicels recurved. Sepals blue or violet, sparingly hairy; uppermost sepal narrowly helmet-shaped, arched, ca 2 x 1 cm, shortly (ca 8 mm) beaked; upper lateral sepals ca 1.5 x 1.3 cm; lower lateral sepals 10 - 13 x 4 - 5 mm; spur reflexed. Petals glabrous. Filaments winged. Follicles 5, glabrous; testa of seeds plaited.

Fl. & Fr. May - Sept.

Distrib. India: Climbing on shrubs in moist forests of alpine zones in E. Himalayas, ca 2400 m. Sikkim.

Nepal, Bhutan and China (Tibet).

7. *Aconitum falconeri* Stapf in Ann. R. Bot. Gard. Calc. 10: 163. 1905. *A. ferax* auct. non Wallich ex Seringe; Hook. f. & Thomson in Fl. Brit. India 1: 28. 1872, p.p.

Herbs, biennial; roots paired, tuberous, up to 12 cm long, ca 2.5 cm thick; stems erect, up to 2 m high, simple below, branched above, finely puberulous. Leaves scattered; lower petioles up to 12 cm long; upper leaf-blades palmately 3 - 5-partite; lobes narrowly cuneate-ovate or broadly deltoid or trapezoid, sparingly hairy. Inflorescence terminal, stiff, erect, dense raceme, finely pubescent with soft hairs or tomentose with spreading hairs; lower pedicels nearly 4 cm long; bracts pinnately lobed. Sepals blue with dark tips, pubescent, helmet-shaped, shortly beaked. Petals (honey scales) minutely hispid. Carpels 5, glabrous, black when dry. Follicles 5, erect, glabrous; seeds winged along raphe; testa plaited.

KEY TO THE VARIETIES

- 1a. Lobes of leaves narrowly cuneate-ovate; inflorescence finely pubescent with soft hairs 7.1. var. *falconeri*
 b. Lobes of leaves broadly deltoid or trapezoid; inflorescence tomentose with spreading hairs 7.2. var. *latilobum*

7.1. var. *falconeri**Fl. & Fr.* Aug. - Sept.*Distrib.* India: Himachal Pradesh.

Endemic.

7.2. var. *latilobum* Stapf in *Ann. R. Bot. Gard. Calc.* 10: 164. 1905.

Fig. 3.

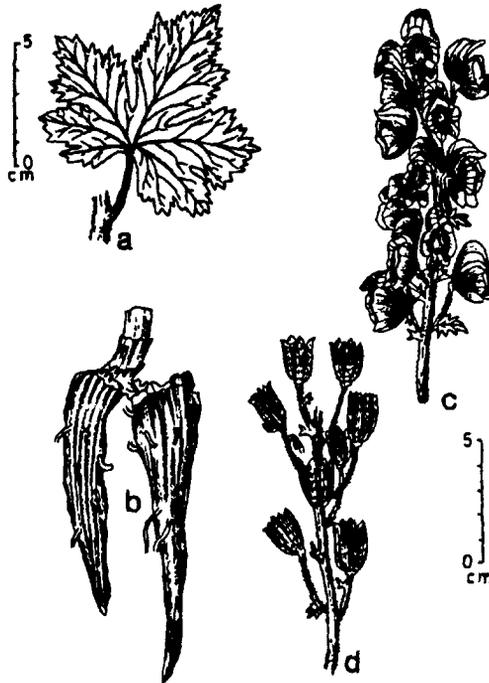


Fig. 3. *Aconitum falconeri* Stapf var. *latilobum* Stapf: a. cauline leaf; b. roots; c. inflorescence; d. infructescence; (from H.J. Chowdhery in *Red Data Book of Indian Plants* 2: 196. 1988).

Fl. & Fr. July - Sept.

Distrib. India: Himachal Pradesh.

Endemic.

8. *Aconitum ferox* Wallich ex Seringe in Mus. Helv. 1: 160, t. 15, ff. 43 - 44. 1823;
Hook. f. & Thomson in Fl. Brit. India 1: 28. 1872, p. p. **Fig. 4.**

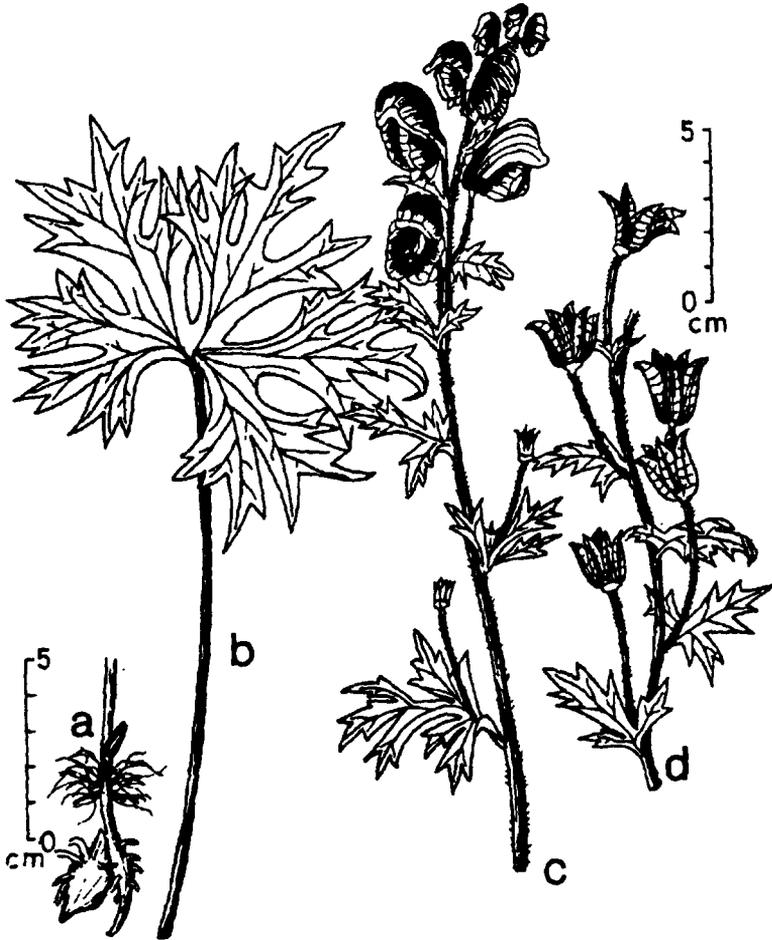


Fig. 4. *Aconitum ferox* Wallich ex Seringe: a. tuber; b. basal leaf; c. inflorescence; d. infructescence; (from H.J. Chowdhery in Red Data Book of Indian Plants 1: 314. 1987).

Herbs, biennial; stems erect, 1 - 2 m high, puberulous, leafy. Leaves palmately 5-fid, 8 - 15 cm in diam.; lobes 5, ovate, wedge-shaped, acuminate, deeply incised. Racemes 15 - 30 cm long, simple or sparingly branched below, tomentose, many-flowered; lower bracts lobed; upper entire; bracteoles linear; pedicels up to 5 cm long, thickened towards apex. Flowers 2 - 3 cm long, blue; uppermost sepal 2 - 2.5 x 0.8 - 1 cm, longer than high with short acute beak; upper lateral sepals ovate, ca 10 x 3 mm. Petal heads somewhat S-shaped, ca 6 mm long; spur recurved. Follicles 5, finely hairy.

Fl. & Fr. Aug. -Nov.

Distrib. India: Moist forests, amongst shrubs, 2100 - 3800 m. Sikkim.

Nepal and Bhutan.

Notes. Tubers used for poisoning arrows and as a medicine for its action as narcotic and sedative.

9. *Aconitum fletcherianum* Taylor in J. Roy. Hort. Soc. 77. 1952.

Herbs, perennial, with dwarf habit, 7 - 12 cm high; roots long, fusiform, breaking up below into cord-like strands. Leaves all radical, laxly rosulate; petioles slender, 3 - 14 cm long, glabrous; lamina orbicular-cordate to reniform, 3- to 5-partite nearly to base, 1 - 3 x 2 - 4 cm; ultimate lobes 3 - 4 mm broad, acute. Flowers solitary, bright blue purple or violet with a white outer edge; pedicel bearing ternately divided 0.7 - 1.5 cm long bracteole above the middle. Uppermost sepal boat-shaped, 2.5 - 3 x 1 - 1.2 cm; lateral sepals ovate or obovate, 2 - 2.5 cm long, broad. Petal head 4 - 5 mm long, funnel-shaped with a finger-like spur and rounded entire lamina. Filaments and anthers dark bluish or even blackish. Carpels 6 - 8, sparingly pubescent. Follicles not seen.

Fl. July - Oct.

Distrib. India: Alpine rocks, cliff edges, grassy slopes of E. Himalayas, 4000 - 4700 m. Arunachal Pradesh.

Bhutan.

Notes. A perennial dwarf plant with solitary flowers, very unusual for the subgenus *Lycotonomum*.

10. *Aconitum gammiei* Stapf in Bull. Misc. Inf. Kew 1907: 56. 1907. *A. dissectum* D. Don, Prodr. Fl. Nep. 197. 1825 (non Tausch. ex Reichenb. 1823, nec Watt 1902). *A. napellus* auct. non L.; Hook. f. & Thomson, Fl. Ind. 57. 1855 & in Fl. Brit. India 1: 29. 1872, quoad Wallich, Cat. n. 4724. *A. wallichianum* Lauener in Notes R. Bot. Gard. Edinb. 25: 30. 1963 26: 10. 1964.

Herbs, biennial; stems ca 70 cm high, simple or sparingly branched above, glabrous. Leaves few, remote, petiolate; lamina cordate, rotund, narrowly sinuate at base, 4 - 7 cm in diam., subcoriaceous, 3-partite to the base; lobes 1 - 3 mm broad, sharply falcate-toothed. Inflorescence terminal, racemose to paniculate, few-flowered, pink; uppermost sepal helmet-shaped, 2 - 2.2 x ca 0.8 cm, glabrous; upper lateral sepals broadly obovate, ca 1.5 x 0.7 cm. Petal head ca 7 mm, hispidulous; spur recurved. Filaments pilose. Carpels 5, ovoid, glabrous.

Fl. July - Sept.

Distrib. India: E. Himalayas, alpine shrubberies, open slopes, 3300 - 4800 m. Sikkim.

Nepal and China (Tibet).

Notes. The roots are much used as a medicine for stomach ailments.

11. *Aconitum gymnandrum* Maxim. in Bull. Acad. St. Petersb. 23: 308. 1877; Bruehl in Ann. R. Bot. Gard. Calc. 5 (2): 113. 1896.

Herbs, perennial; stems 15 - 20 cm high, villous with long white downwardly spreading hairs. Leaves broadly ovate in outline, 3 - 6 cm long, dissected into linear-oblong 2 - 3 mm broad lobes, pubescent above, white-villous beneath. Racemes densely flowered. Sepals blue; uppermost sepal boat-shaped, 15 - 20 x 4 - 5 mm; lateral sepals ca 15 x 5 - 7 mm. Petals glabrous; head ca 10 mm across, with an oblong spur in the upper half; the lower half expanded into a reniform 6 - 7 mm broad lamina. Carpels 9 - 12. Follicles cylindrical, ca 10 x 3 mm.

Fl. Sept.

Distrib. India: Alpine grassy slopes and open plains, 4200 - 4800 m. Sikkim.

China (Tibet).

12. *Aconitum heterophylloides* (Bruehl) Stapf in Ann. R. Bot. Gard. Calc. 10: 171. 1905. *A. ferox* Wallich ex Seringe var. *heterophylloides* Bruehl in Ann. R. Bot. Gard. Calc. 5: 110. 1896.

Nep.: *Nirbaushi*.

Herbs, biennial; roots paired, tuberous; stems erect, simple, up to 30 cm high. Leaves scattered, lower ones withered at flowering time; petioles 2.5 - 3.5 cm long; lamina ovate-reniform, 3 - 12 cm wide, 3-partite, roundly toothed, finely pubescent. Inflorescence racemose or paniculate, few to many-flowered; bracteoles linear or broad and foliaceous. Sepals blue or bluish white or white, pubescent; uppermost sepal oblique,

shortly beaked. Petals hispidulous. Filaments hispidulous in upper part. Carpels 5, sometimes 3, rarely 6 - 7. Follicles 3 - 5; seeds winged along raphe.

KEY TO THE VARIETIES

- 1a. Bracteoles linear; sepals blue or bluish white
 b. Bracteoles foliar; sepals white

- 12.1. var. *heterophylloides*
 12.2. var. *leucanthum*

12.1. var. *heterophylloides*

Fl. & Fr. June - Oct.

Distrib. India: E. Himalayas in alpine slopes, 4000 - 4500 m. Sikkim.

Nepal, Bhutan and China (S.E. Tibet).

12.2. var. *leucanthum* (Bruehl) Laucner in Notes R. Bot. Gard. Edinb. 26: 331. 1965. *Caltha nirbisia* Buch.-Ham. in Edinb. J. Sci. 251. 1824; Stapf in Ann. R. Bot. Gard. Calc. 10: 180, t. 114B. 1905. *A. leucanthum* (Bruehl) Stapf in Ann. R. Bot. Gard. Calc. 10: 173, t. 111. 1905 (non Reichenb. 1819). *A. ferox* Wallich ex Seringe subsp. *ferox* var. *leucanthum* Bruehl in Ann. R. Bot. Gard. Calc. 5: 110. 1896, p. p.

Fl. June.

Distrib. India: E. Himalayas. Sikkim.

Nepal, Bhutan and China (S.E. Tibet).

13. *Aconitum heterophyllum* Wallich [Cat. 167, no. 4722. 1831, nom. nud.] ex Royle, Illus. Bot. Himal. t. 13. 1833 & 56. 1834; Hook. f. & Thomson in Fl. Brit. India 1: 29. 1872.

Herbs, biennial; roots paired, 2.5 - 4 cm long, tuberous; stems downy, erect, simple or branched, 90 - 120 cm high. Leaves heteromorphous; basal leaves long-petioled; petioles 10 - 12 cm long; lamina orbicular-cordate or ovate-cordate with narrow sinus, 5-partite up to middle, with crenate lobes; upper cauline leaves sessile, ovate-clongate or varied in shape, sharply toothed, sessile or shortly petioled and stem-clasping, 5 - 8 x 2 - 6 cm. Inflorescence a slender raceme or a lax panicle; bracts ovate, acute, sharply toothed, up to 10 x 5 mm; upper 3-fid or entire; pedicels up to 3 cm long. Sepals greenish blue, marked with red or violet; uppermost sepal navicular, shortly beaked. Petals glabrous. Filaments pale green, glabrous or minutely hairy; anthers brown. Carpels 5, pubescent. Follicles 5, contiguous, green, downy. Seeds smooth.

Fl. & Fr. Aug. - Sept.

Distrib. India: W. Himalayas, among shrubs on grass, riverbeds and slopes, 3000 - 3500 m. Jammu & Kashmir, Himachal Pradesh and Uttar Pradesh.

Pakistan and Nepal (up to 83° E. Long.).

Notes. Chromosome number reported is $n = 8$ (Mehra & Remanandan in *Cytologia* 37: 281 - 294. 1972) from a population of Gulmarg in Kashmir. Numerous biotypes have been reported for this species.

A valuable non-poisonous medicinal plant; roots contain an alkaloid *atisine* used as febrifuge and tonic. Kapahi (in *J. Econ. Tax. Bot.* 14: 50. 1990) reports that a decoction of the plant serves as antiseptic and given to cure dyspepsia, especially when appetite is lost after illness. It also checks excessive menstrual flow. Fresh leaves used as cure to toothache.

14. *Aconitum hookeri* Stapf in *Ann. R. Bot. Gard. Calc.* 10: 147. 1905; Lauener in *Notes R. Bot. Gard. Edinb.* 26: 9. 1964. *A. pulchellum* Hand.-Mazz. in *Anz. Akad. Wiss. Wien, Math. Nat. Kl.* 62: 219. 1925.

Herbs, biennial; roots paired, tuberous; stems erect, low, 5 - 20 cm high, simple or branched, with long white or golden hairs. Leaves few, arising from hypogeous base of stem; upper leaves 1 - 2, reduced; petioles slender; lamina of lower leaves orbicular-cordate or reniform, 3- to 5-partite up to base, acutely toothed. Inflorescence a short lax few-flowered raceme, in some plants solitary; flowers 2.5 - 3 cm long. Sepals dark blue to blue-purple, caducous; uppermost sepal helmet-shaped. Petals and filaments dark blue, hispid or glabrous; petal head 4 - 6 mm across, dorsally pouched. Carpels 5, densely villous. Follicles 5, erect, oblong, truncate, densely hairy. Seeds smooth.

Fl. Aug.

Distrib. India: E. Himalayas, alpine meadows, open rocky slopes amongst Juniper scrubs, 4200 - 4800 m. Sikkim and Arunachal Pradesh.

Nepal, Bhutan and China (Tibet).

15. *Aconitum kashmiricum* Stapf ex Coventry, *Wild Flrs Kashmir* 3: 25, t. 13. 1930.

Kash.: *Pevak*.

Herbs, erect; tubers paired, 2 - 3 cm long, white inside; stems 10 - 30 cm high, erect, simple or branched at base, glabrous or pubescent above. Leaves few, glabrous, lower long-petioled; lamina ovate or cordate-orbicular, 2 - 4 cm in diam., incised into broad lobes with about 3 - 5 apiculate teeth. Flowers solitary or 2 at stem apices, 2 - 2.5 cm long, intense blue; pedicels erect, 1.5 - 5 cm long, pubescent; bracteoles 2, broadly ovate, deeply incised and toothed, often with short petioles. Uppermost sepal helmet-shaped with a small beak at tip; upper lateral sepals suborbicular; lower lateral sepals elliptic, smaller. Petal head ovoid, knob-like, narrowed to a point, black or green. Filaments hairy in upper part. Carpels 5, densely yellow-pubescent. Follicles 5, free, erect, hairy.

Fl. & Fr. Aug. - Sept.

Distrib. India: Alpine areas, 3500 - 4000 m. Jammu & Kashmir.

Endemic.

16. *Aconitum laciniatum* (Bruehl) Stapf in Ann. R. Bot. Gard. Calc. 10: 168, t. 108. 1905. *A. ferox* Wallich ex Seringe var. *laciniata* Bruehl in Ann. R. Bot. Gard. Calc. 5: 111. 1895, p. p. & 5: t. 111, ff. 7 - 8, 17, 30. 1896.

Nep.: *Kalo-bikhoma* (Darjeeling), *Soorjahaushi*.

Herbs, 0.5 - 1.5 m high; roots paired, tuberous; stems erect, simple, finely pubescent. Leaves scattered, basal ones decayed at flowering time; lamina fleshy, reniform, 7 - 15 cm in diam., 5-partite. Inflorescence a lax raceme or panicle of widely spaced few to many flowers. Sepals reddish purple or dark red, pubescent; uppermost sepal helmet-shaped, 2 - 2.5 x 1.2 - 1.5 cm; upper lateral sepals obovate, ca 1.6 x 1.4 cm; lower lateral sepals 1.5 x 0.5 cm. Petal head ca 12 mm long, hispidulous; spur shortly recurved. Filaments hispid. Carpels 3, rarely 4 - 5, densely pubescent. Follicles 3, divergent, linear-oblong, 18 - 25 x 5 - 6 mm, finely pubescent. Seeds transversely lamellate.

Fl. & F.: July - Sept.

Distrib. India: Grassy slopes amongst shrubs in alpine and subalpine zones, 3500 - 4500 m. West Bengal and Sikkim.

Nepal, Bhutan and China (Tibet).

Notes. Roots used medicinally and for poisoning arrows.

17. *Aconitum laeve* Royle, Illus. Bot. Himal. 56. 1834. *A. lycocotnum* auct. non L.; Hook. f. & Thomson, Fl. Ind. 55. 1855 & in Fl. Brit. India 1: 28. 1872.

Kash.: *Bika*.

Herbs, perennial; roots elongate, cylindric, non-tuberous, ultimately breaking into slender threads or strands; stems erect, up to 2 m high, glabrous or pubescent. Basal-leaves few; petioles up to 30 cm long, usually withering at flowering time; stem leaves distant; lamina of all leaves cordate or reniform, palmately deeply 5- to 9-partite, up to 30 cm wide. Inflorescence paniced, up to 50 cm long, leafy, hairy; floral leaves 3 5-partite, inciso-dentate; pedicels erect; bracts minute. Sepals white, yellowish or dull purple, hairy; uppermost sepals helmet-shaped with a short beak; upper lateral sepals orbicular, with a short broad claw; lower sepals elliptic, obtuse. Petals and filaments glabrous. Carpels 3, divergent, covered with yellowish hairs or glabrous. Follicles 3, divergent, glabrous or yellowish hirsute. Seeds transversely rugose.

KEY TO THE VARIETIES

- | | |
|---|--------------------------------|
| 1a. Hairs curled, sometimes straight on uppermost sepal | 17.1. var. <i>curvipilosum</i> |
| b. Hairs straight, spreading | 17.2. var. <i>laeve</i> |

17.1. var. *curvipilosum* Tamura & Lauener in Notes R. Bot. Gard. Edinb. 37: 433. 1979.

Distinguished by its curly hairs.

Fl. & Fr. Aug. - Sept.

Distrib. India: Jammu & Kashmir.

Endemic.

17.2. var. *laeve*

Fl. & Fr. May - Oct.

Distrib. India: W. Himalayas, usually in woods, partially shaded places, 2500 - 3500 m. Jammu & Kashmir.

Pakistan and Nepal.

18. *Aconitum lethale* Griffith, Notul. 4: 732. 1854 & Icon. Pl. Asiat. 460, f. 3. 1854. *A. palmatum* Hook. f. & Thomson in Fl. Brit. India 1: 28. 1872 (non D. Don 1825), the Mishmi plant only.

Mishmi: *Bhi, Bhis*.

Herbs, biennial; roots fusiform; stems scandent, flexuous, branched. Basal leaves unknown, upper scattered; petioles ca 5 cm long; lamina cordate-rotund or reniform, 3-partite, glabrous. Inflorescence a loose lax-flowered raceme; bracts foliaceous. Sepals blue (?); uppermost sepal helmet-shaped. Petals and filaments glabrous. Carpels 5, oblique-oblong, sparingly pubescent.

Fl. Aug.

Distrib. India: Arunachal Pradesh (Mishmi Hills in Lohit District).

Endemic.

19. *Aconitum moschatum* (Bruehl) Stapf in Ann. R. Bot. Gard. Calc. 10: 139 - 140. 1905. *A. ferox* Wallich ex Seringe subsp. *moschatum* Bruehl in Ann. R. Bot. Gard. Calc. 5: 109. 1896.

Herbs, perennial; roots cylindric, ultimately breaking into strands; stems up to 70 cm high, erect from a collar, covered by old leaf bases, unbranched up to top, ca 90 cm high. Leaves few, arising from collar; petioles up to 30 cm long; lamina orbicular-cordate or subreniform, ca 9 mm wide; cauline leaves 1 - 3, similar to basal leaves, but smaller, both palmately 5-partite. Inflorescence racemose, up to 40 cm long; axis viscid-tomentose; pedicels erect. Sepals variegated, purple outside, yellowish green at lower part, covered with yellow spreading hairs at base; uppermost sepal boat-shaped, without beak, 1.5 - 2 x 0.7 - 1 cm; upper lateral sepals obliquely obovate; lower lateral sepals obovate with round tips. Petals and filaments glabrous; anthers black. Carpels 3, contiguous, scattered hairy, oblique. Follicles 1 - 3, glandular hairy, ca 2 cm long; seeds transversely lamellate.

Fl. & Fr. Aug. - Sept.

Distrib. India: Jammu & Kashmir.

Endemic.

Notes. Chromosome no. $n = 8$ (Virjee, Dhar & Kachroo in Taxon 32: 321. 1983).

20. *Aconitum nagarum* Stapf in Ann. R. Bot. Gard. Calc. 10: 176. 1905.

Herbs, biennial; roots paired, tuberous; stems erect, up to 1 m high, simple. Basal leaves soon withering, upper scattered and few; lowest petioles up to 60 cm long; lamina cordate-reniform, 3-partite to the base, glabrous. Inflorescence a slender raceme, greyish pubescent. Sepals blue. Petals and filaments glabrous. Carpels 5, pubescent. Follicles oblong, divergent towards the apex; seeds transversely lamellate.

Fl. & Fr. Apr. - May.

Distrib. India: Arunachal Pradesh, Nagaland and Manipur.

Myanmar.

21. *Aconitum nakaoui* Tamura in Acta Phytotax. & Geobot. Kyoto 19; 73. 1962. *A. parabrachypodium* Lauener in Notes R. Bot. Gard. Edinb. 25: 7. 1963.

Herbs, biennial; stems slender, up to 90 cm high, bending over, hairy above, naked at base. Stem leaves 5- to 7-partite, 3 - 10 cm in diam.; lobes oblong, acute; ultimate segments linear. Inflorescence a lax subpaniculate raceme, 10 - 15 cm long; branches bearing 2 - 3 flowers; flowers rich blue-violet or pale purple with a reddish tinge. Uppermost sepal ca 2 x 1 cm, beaked and hooded; upper lateral sepals suborbicular, ca 1.5 cm in diam.; lower sepals ovate, ca 13 x 5 mm. Petals hispid, somewhat T-shaped; head 7 - 8 mm; spur bulbous, recurved. Carpels 5, with long yellowish hairs.

Fl. & Fr. Aug. - Oct.

Distrib. India: Among Rhododendron scrubs on rocky alpine slopes, 3800 - 4400 m. Arunachal Pradesh.

Bhutan and W. China.

22. *Aconitum naviculare* (Bruehl) Stapf in Ann. R. Bot. Gard. Calc. 10: 154. 1905. *A. ferox* Wallich ex Seringe var. *navicularis* Bruehl in Ann. R. Bot. Gard. Calc. 5: 111. 1895 & 5: t. 111, ff. 2 & 14. 1896.

Herbs, perennial; stems 5 - 25 cm high, glabrescent below, pubescent above. Leaves mostly basal, ca 3 cm in diam., subreniform, deeply 3-partite; lateral segments deeply 2-lobed, all divisions 2 - 3-lobed; lobes with obtuse or subacute teeth, finely pubescent; petioles 2 - 8 cm long. Inflorescence 1 - 4-flowered; pedicels erect, rather slender. Sepals reddish blue; uppermost sepal boat-shaped, 2 - 2.5 x 0.8 cm; upper lateral sepals obovate, 1.5 x 1 cm; lower lateral sepals ovate, ca 8 x 3 mm. Petal head 3 - 4 mm across; spur globose. Carpels 5. Follicles 10 - 12 mm long, hairy, bearing persistent sepals.

Fl. & Fr. July - Sept.

Distrib. India: Alpine meadows, Juniper scrubs and cliff edges, 3000 - 4500 m. Sikkim.

Bhutan and China (Tibet).

23. *Aconitum novoluridum* Munz in *Gentes Herb.* 6: 472. 1945; Lauener in *Notes R. Bot. Gard. Edinb.* 25: 29. 1963; *ibid.* 26: 9. 1964; *ibid.* 37: 117 - 118. 1978. *A. luridum* Hook. f. & Thomson, *Fl. Ind.* 55. 1855 & in *Fl. Brit. India* 1: 28. 1872 (non Salisb. 1816).

Herbs, perennial; rootstock rhizomatous, cylindrical, surrounded at apex by withered remains of petioles; stems erect, 0.5 - 1.5 m high, simple, slightly pubescent. Basal leaves few; petioles up to 30 cm long; lamina reniform-cordate, palmately 3 - 5-partite, 6 - 15 cm in diam.; segments cuneate-ovate, crenate, often withered at flowering time; cauline leaves 2 - 5-partite; segments 5 - 15 mm broad; all leaves hairy on both surfaces. Racemes up to 25 cm long, simple or with a few branches at base, densely yellowish pubescent; flowers dull red or yellowish inside and purplish outside; pedicels up to 5 mm long; lower bracts leafy, sessile, 3 - 5 partite; upper entire. Uppermost sepal ovate, with a long straight beak and dome-like back, 1.3 - 1.7 cm high, brown-tomentose; spur rounded, 4 - 5 mm long. Petals (honey scales) T-shaped, purplish, glabrous; head ca 5 mm across, positioned at right angles on 3 - 4 mm long claw. Filaments purplish red, glabrous. Carpels 3, oblique, contiguous; seeds transversely wrinkled or smooth.

Fl. & Fr. Aug. - Sept.

Distrib. India: Alpine and subalpine slopes among Fir forests or Juniper/Rhododendron scrubs, 3600 - 5000 m. West Bengal and Sikkim.

Bhutan and China (S.E. Tibet).

24. *Aconitum rotundifolium* Kar. & Kir. in *Bull. Soc. Nat. Mosc.* 15: 139. 1842. *A. napellus* auct. non L.; Hook. f. & Thomson in *Fl. Brit. India* 1: 28. 1872. *A. napellus* var. *rotundifolium* (Kar. & Kir.) Hook. f. & Thomson, l. c. 1: 29. 1872.

Herbs, biennial; roots paired, tuberous; stems erect or ascending from a hypogeous base, up to 40 cm high. Leaves mostly basal, 4 - 5 (rarely 8), arranged in a loose rosette; petioles up to 13 cm long; lamina orbicular-cordate or almost reniform, divided but not up to base, light green beneath. Inflorescence a few-flowered raceme. Flowers pale purplish blue or pinkish mauve. Uppermost sepal boat-shaped, pubescent. Petals and filaments glabrous. Carpels 5 (rarely 4 - 6), contiguous. Follicles softly hairy; seeds smooth.

Fl. & Fr. July - Sept.

Distrib. India: N. W. Himalayas, stony slopes, 3000 - 4500 m. Jammu & Kashmir and Himachal Pradesh.

Nepal, Pakistan, Afghanistan and Turkestan.

25. *Aconitum soongoricum* Stapf in Ann. R. Bot. Gard. Calc. 10: 141, t. 95. 1905.

Herbs, biennial; roots paired, tuberous; stems simple, erect, up to 70 cm high. Basal leaves long-petioled but usually decayed at flowering time; upper leaves scattered, shortly petioled; lamina 8 - 12 cm wide, 5-partite to the base. Inflorescence a terminal raceme; lower bracts foliaceous; pedicels slender, erect or appressed to axis. Flowers blue. Uppermost sepal with a long slender beak, pubescent. Petals and filaments glabrous. Carpels 3. Follicles frequently less than 3, often only one developing.

Fl. & Fr. July - Aug.

Distrib. India: N. W. Himalayas. Jammu & Kashmir.

Central Asian Highlands and China.

26. *Aconitum spicatum* (Bruehl) Stapf in Ann. R. Bot. Gard. Calc. 10: 165, t. 106 & 107. 1905. *A. ferox* auct. non Wallich ex Seringe; Hook. f. & Thomson, Fl. Ind. 56. 1855, p. p. & in Fl. Brit. India 1: 28. 1872, p. p. *A. ferox* var. *spicata* Bruehl in Ann. R. Bot. Gard. Calc. 5: 110. 1896.

Nep.: *Bikh* (Sikkim), *Bikha-bharyan* (Darjeeling).

Herbs, biennial, 1.5 - 2 m high; roots paired, tuberous; stems erect, robust, simple, greyish pubescent. Basal leaves decayed at flowering time; upper many; lamina fleshy, mostly orbicular-cordate or reniform, 6 - 12 cm in diam., deeply cut into ovate lobes which are further cut into toothed or pointed segments. Inflorescence a stiff racemose panicle, many-flowered, 15 - 40 cm long. Flowers 2 - 2.5 cm long, dark blue or violet blue, often white, tinged purple. Uppermost sepal helmet-shaped with a short beak, 2.5 x 1.3 cm, shortly (2 - 3 mm) beaked; upper lateral sepals orbicular, ca 1.5 cm across; lower sepals elliptic, ca 13 x 3 mm. Petals sparsely hispidulous or sometimes glabrous; head S-shaped, 10 - 11 mm long; spur recurved. Filaments mauve or white; anthers dark bluish purple. Follicles 5, swollen, oblong, ca 1 cm long, hairy. Seeds transversely lamellate.

Fl. & Fr. July - Sept.

Distrib. India: E. Himalayas, open alpine slopes or sheltered forests of Fir, Juniper or Rhododendron scrub, 3500 - 4500 m. West Bengal and Sikkim.

Nepal, Bhutan and China (S.E. Tibet).

Notes. Chromosome no. $n = 16$, $2n = 32$ (Banerjee & Sharma in Form. Str. & Funct. in Plants, Meerut 25. 1965). A note on Burkill's specimen in herb. CAL states: "Very common all the way from Kalipokhri to Phalut; now in full flower one large specimen had 190 flowers on it."

The poisonous roots contain valuable alkaloids (Stapf, l. c.).

27. *Aconitum violaceum* Jacquem. ex Stapf in Ann. R. Bot. Gard. Calc. 10: 144 - 146. 1905. *A. multifidum* Royle, Illus. Bot. Himal. 56. 1834 (non Koch & Reichenb. 1827).
A. napellus var. *multifidum* (Royle) Hook. f. & Thomson in Fl. Brit. India 1 : 29. 1872.

Herbs, biennial; roots paired, tuberous; stems 10 - 35 cm high, stout, erect or ascending from a hypogeous base, simple. Leaves very few, 1 or 2 on the hypogeous stem and 1 or 2 higher up on the stem; lamina orbicular, cordate or reniform, deeply 5-partite, 2.5 - 7.5 cm in diam.; secondary divisions laciniate, 1 - 3 mm wide. Inflorescence a short lax or dense raceme or a corymb or reduced to a solitary flower; bracts small, linear; flowers 2 - 2.5 cm long, blue or violet, pubescent; pedicels erect, hairy; bracteoles linear, small. Uppermost sepal boat-shaped, ca 2 cm long; upper lateral sepals suborbicular to subquadrate; lower lateral sepals oblong, obtuse, smaller. Petals glabrous; head T-shaped. Filaments hairy in upper part. Carpels 5. Follicles densely yellowish hairy.

KEY TO THE VARIETIES

- 1a. Stems 30 - 60 cm high; racemes stout, many-flowered; flowers blue, white variegated 27.1. var. *robustum*
 b. Stems 10 - 35 cm high; racemes short, few-flowered or reduced to a solitary flower; flowers blue or violet, not white variegated 27.2. var. *violaceum*

27.1. var. *robustum* Stapf in Ann. R. Bot. Gard. Calc. 10: 146. 1905.

Distinguished by its more robust habit, higher (up to 60 cm) stems, larger leaves, many-flowered racemes with stout rachis and the flowers variegated with white.

Fl. & Fr. Aug. - Sept.

Distrib. India: Alpine zones. Jammu & Kashmir.

Pakistan.

27.2. var. *violaceum*

Fl. & Fr. Aug. - Sept.

Distrib. India: Alpine slopes of W. Himalayas, 3000 - 4500 m. Jammu & Kashmir, Himachal Pradesh and Uttar Pradesh.

Pakistan and Nepal.

2. *Actaea* L.

Herbs, erect, perennial; rootstock horizontal, covered with leaf sheaths; stems glabrous. Leaves alternate, 3-4 times ternately compound; leaflets linear, obliquely cuneate at base, acute-acuminate at apex, serrate along margins; terminal leaflet often 3-lobed. Inflorescences short terminal racemes. Flowers crowded on the axis, actinomorphic, white. Sepals 3-5, petaloid, caducous. Petals 3-5(-10), spathulate. Stamens many; filaments long. Carpel single; stigma rounded, sessile. Fruit a berry, somewhat flattened; seeds many.

Northern temperate regions; ca 10 species, one in India.

Actaea acuminata Wallich [Cat. 167, no. 4726. 1831, nom. nud.] ex Royle, *Illus. Bot. Himal.* 57. 1834. *A. spicata* auct. non L.; Hook. f. & Thomson, *Fl. Ind.* 59. 1855 & in *Fl. Brit. India* 1: 29. 1872. *A. spicata* L. var. *acuminata* (Wallich ex Royle) Hara in *J. Jap. Bot.* 51: 132-133. 1976. Fig. 5

Herbs, erect, rhizomatous; stems 45-100 cm high, sheathed by ovate scales at base. Leaves 2-pinnately or ternately compound; terminal leaflet usually 3-lobed; petioles 2-10 cm long; leaflets ovate, acuminate, irregularly serrate along margins, 4-8 x 1.5-3 cm, pubescent at first, later glabrous; tips slender and even coiled in some. Racemes 2-6 cm long; pedicels up to 1.5 cm long, swollen at tip; flowers ca 1 cm across, white. Sepals elliptic, ca 5 x 2 mm, white. Petals ca 3 x 1 mm, whitish, weakly 3-nerved. Berry ellipsoid, 7-8 x 4-5 mm, blackish when ripe.

Fl. & Fr. May - Aug.

Distrib. India: As undergrowth in forests, along ravines and streamsides, 2500-3700 m. Jammu & Kashmir, Himachal Pradesh, Uttar Pradesh, Sikkim and Arunachal Pradesh.

Notes. The Himalayan plants have elongate and narrower leaflets which are long-acuminate and even coiled at apex and more sharply inciso-serrate along margins as compared to *A. spicata* L. and hence deserve distinct specific status.

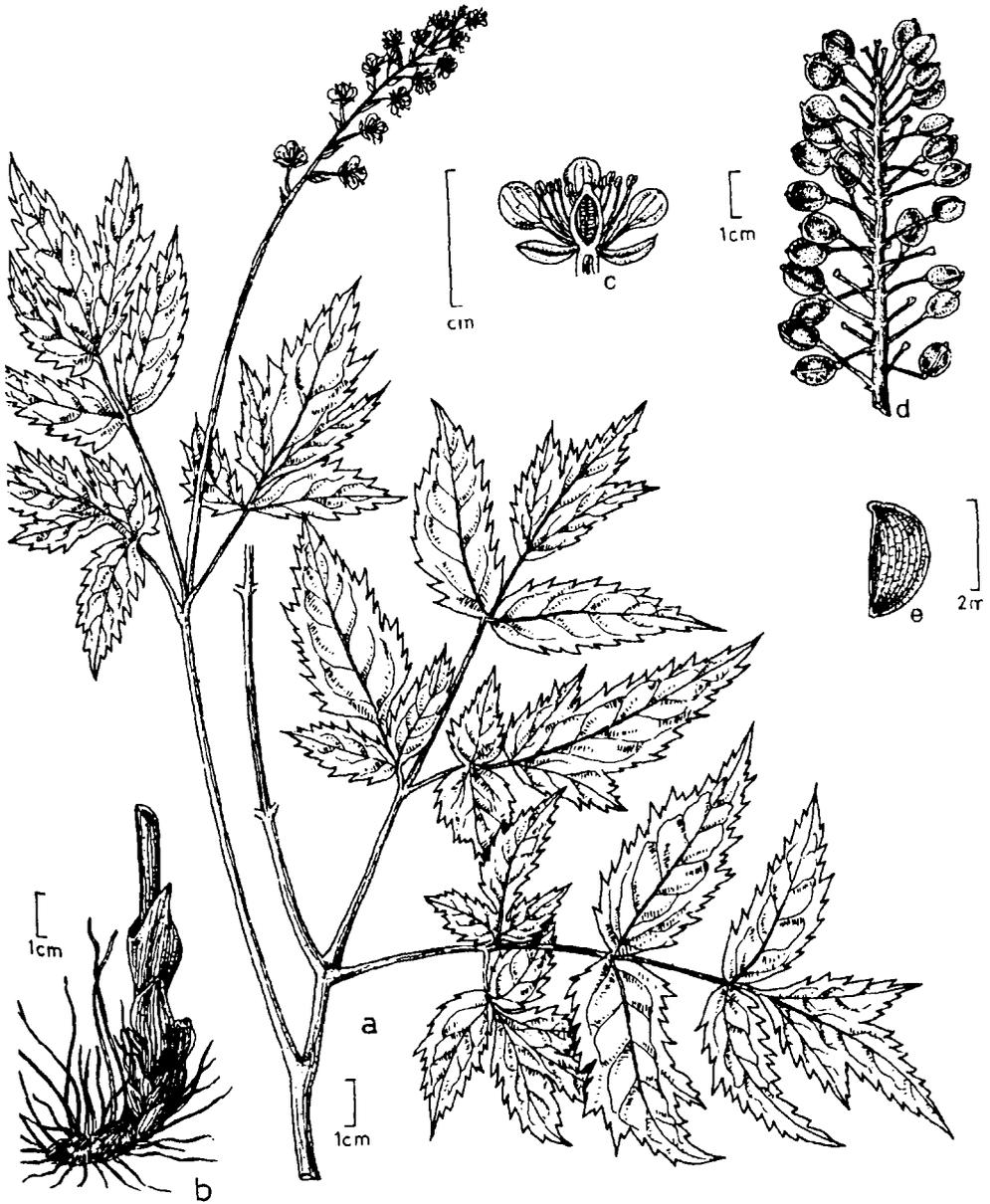


Fig. 5. *Actaea acuminata* Wallich ex Royle : a. flowering shoot; b. rootstock; c. flower, longitudinal sectional view; d. infructescence; e. seed.

3. Adonis L.

Herbs, erect, annual or perennial. Leaves basal and alternate on stems, pinnately compound; lobes much dissected into linear filiform or oblong-elliptic segments. Flowers solitary, terminal, actinomorphic, scarlet, reddish, purple or golden yellow, rarely white. Sepals 5 - 8, petaloid. Petals 5 - 24, without nectar pits or glands. Stamens many. Carpels many, with short style; ovule 1, pendulous. Achenes clustered, angular, turgid or flattened, sometimes pitted, with persistent style.

Temperate regions of Europe and Asia; ca 20 species, 3 species in India.

KEY TO THE SPECIES

- | | |
|---|----------------------------|
| 1a. Leaf segments oblong-elliptic; flowers reddish brown or purplish brown | 3. <i>A. nepalensis</i> |
| b. Leaf segments narrow, linear or filiform; flowers scarlet or golden yellow | 2 |
| 2a. Annual herbs; leaf segments filiform; flowers scarlet or shades of scarlet, if yellow with a dark centre; achene beaks straight | 1. <i>A. aestivalis</i> |
| b. Perennial herbs; leaf segments narrow, linear; flowers golden yellow, without dark purple centre; | 2. <i>A. chrysocyathus</i> |

1. *Adonis aestivalis* L., Sp. Pl. 771. 1753; Hook. f. & Thomson in Fl. Brit. India 1: 15. 1872. *A. inglisii* Royle, Illus. Bot. Himal. 53. 1834. *A. scrobiculata* Boiss., Fl. Or. 1: 17. 1867; Hook. f. & Thomson, l. c. 15.

Herbs, erect, up to 30 cm high; stems simple or branched, glabrous, leafy. Leaves decompose, pinnate with filiform segments. Flowers terminal, solitary, 1 - 2 cm across, scarlet with a dark purple eye or yellow with dark purple centre. Sepals glabrous. Petals 5 - 8, spreading, slightly larger than sepals. Achenes 5 - 6 mm long, clustered in an ovoid or oblong head, angular, pitted with a network of depressions and one or two teeth on the inner angle near the beak, surrounded near the broad base with a flattened winged collar.

Fl. & Fr. April - May.

Distrib. India: As a weed in cultivated fields, 1200 - 3000 m. Jammu & Kashmir, Himachal Pradesh and Uttar Pradesh.

Europe, N, Asia, C. Asia, Afghanistan, Pakistan and Nepal.

2. *Adonis chrysocyathus* Hook. f. & Thomson in Fl. Brit. India 1: 15. 1872. *A. pyrenacia* auct. non DC.; Hook. f. & Thomson, Fl. Ind. 26. 1855.

Herbs, perennial; rootstock horizontal, scaly; flowering stems erect, up to 30 cm high, increasing in length in fruiting. Radical leaves 6 - 16 cm long, deltoid, with

long-petioles, pinnately decompose; segments narrow, linear, subcuneate. Flowers large, 5 - 6 cm across, golden yellow. Sepals petaloid, 7 - 8, obovate, acute, many-nerved. Petals 16 - 24, spreading, narrowly obovate, obtuse, twice as long as sepals. Stamens many. Achenes in a dense ca 1.5 cm wide head, glabrous, not angular, ca 1.6 cm wide, flattened towards apex, turgid, convex dorsally, obtusely keeled; beak tapering, revolute, hooked.

Fl. May - June; *Fr.* July - Sept.

Distrib. Alpine zones in damp places, 3300 - 4500 m. Jammu & Kashmir, Himachal Pradesh and Uttar Pradesh.

W. Nepal and China (W. Tibet).

Notes. Some authors treat this under *Chrysocyathus falconeri* Chartek & Slavikova.

Poisonous plant, known to cause flatulence and eventual death to grazing animals, particularly horses.

3. *Adonis nepalensis* Simonovicz in Nov. Syst. Pl. Vasc. URSS. 7: 146 - 148. 1970 (1971); Hara in Fl. E. Himal. 3: 35. 1975.

Herbs, perennial, glabrous; flowering stems 5 - 15 cm high, increasing up to 30 cm in fruit, branched from base. Radical leaves long-petioled, 2- to 3-pinnatisect, elliptic to oblong-ovate, 2 - 10 x 1.5 - 3 cm; segments acute or subacute at apex; cauline leaves sessile, oblong-elliptic to ovate-elliptic. Flowers reddish brown, 2.5 - 4 cm in diam.; flowering peduncles short; pedicels up to 1 cm long. Sepals 5 - 6, elliptic, ca 7 x 4 mm, sometimes purplish. Petals 12 - 16, obovate, blunt, 8 - 12 x 4 - 5 mm, yellow or rarely dark blue. Achenes obovoid to subglobose, with short straight beaks, glabrous; beak short, straight; fruiting peduncles up to 1.5 cm long; fruiting heads ca 1 cm across.

Fl. & Fr. April - July.

Distrib. India: Alpine grassy slopes and ravines, 4000 - 4600 m. Sikkim.

Nepal and Bhutan.

4. *Anemone* L.

Herbs, perennial, rhizomatous; rootstock covered with persistent leaf-bases; stems erect, simple, branched or scapose. Leaves radical or cauline, 3- to 5-lobed or partite, petiolate. Flowers actinomorphic, solitary or several in cymes or umbels; flowering stems with an involucre of 2 - 3(-4) leafy bracts below flowers. Sepals single-whorled, 4 - 6(-14), petaloid. Petals (honey leaves) absent. Stamens numerous. Carpels many, with one ovule

in each. Achenes numerous in a head, ovoid, compressed or not, embedded in wool or not; style short, persistent, not feathery.

Cold temperate regions of N. hemisphere; ca 150 species, 17 in India.

Literature. BRUEHL, P. (1896) *Aconitum* L. In: Bruehl & King, A century of new and rare Indian plants. Ann. R. Bot. Gard. Calc. 5: 75 - 82. LAUENER, L. A. (1960) Notes on *Anemone obtusiloba* and its allies. Notes R. Bot. Gard. Edinb. 23: 179 - 201. ULBRICH, E. (1906-7) *Über die systematische Gliederung und geographische Verbreitung der Gattung Anemone* L. Bot. Jahrb. 37: 172 - 334, tt. 1 - 3.

KEY TO THE SPECIES

- | | |
|--|---------------------------|
| 1a. Achenes embedded in wool | 2 |
| b. Achenes not embedded in wool | 4 |
| 2a. Flowers many, in decomposed cymes | 17. <i>A. vitifolia</i> |
| b. Flowers few, 1 - 3 | 3 |
| 3a. Scapes glabrous; flowers small, 2 - 3 cm in diam., dull red | 1. <i>A. biflora</i> |
| b. Scapes silky hairy; flowers large, ca 5 cm in diam., white | 13. <i>A. rupicola</i> |
| 4a. Achenes strongly compressed | 5 |
| b. Achenes oblong-cylindric, not or slightly compressed | 10 |
| 5a. Flowers on scapes or in simple umbels | 6 |
| b. Flowers in branched umbels or in cymes | 7 |
| 6a. Flowers up to 5 cm in diam., rose, pink, purple or mauve; persistent old leaf bases shredding into long black-grey fibrous strands | 14. <i>A. smithiana</i> |
| b. Flowers ca 2.5 cm in diam., white or blue; persistent old leaf bases not as above | 2. <i>A. demissa</i> |
| 7a. Leaves 3-lobed or 3-sect | 8 |
| b. Leaves 5- to 7-lobed | 9 |
| 8a. Flowers in lax umbellate cymes; stamens 50 - 70; carpels 10 - 15 | 3. <i>A. elongata</i> |
| b. Flowers in lax dichasial cymes, not umbellate; stamens 20 - 35; carpels 3 - 6 | 10. <i>A. rauli</i> |
| 9a. Flowers 2 - 3 cm across; involucels similar to involucral leaves; sepals usually 5 - 8 | 8. <i>A. polyanthes</i> |
| b. Flowers 3 - 4 cm across; involucels much smaller than involucral leaves; sepals usually 4 | 15. <i>A. tetrasepala</i> |
| 10a. Flowers many in compound cymes | 11. <i>A. rivularis</i> |
| b. Flowers on simple scapes, few-flowered or flowers solitary | 11 |
| 11a. Involucral leaves stalked | 5. <i>A. griffithii</i> |
| b. Involucral leaves sessile | 12 |
| 12a. Leaves trifoliolate; terminal leaflet distinctly stalked | 12. <i>A. rupestris</i> |
| b. Leaves trisect or tridentate or pinnatisect, if trifoliolate terminal leaflet not stalked | 13 |
| 13a. Leaves lobed or toothed, never divided to base or midrib | 14 |
| b. Leaves divided more than halfway down or up to the base | 15 |
| 14a. Herbs densely hairy; achenes hirsute | 16. <i>A. trullifolia</i> |
| b. Herbs glabrous; achenes glabrous | 6. <i>A. howellii</i> |

- | | |
|---|-------------------------|
| 15a. Sepals slightly longer than receptacle | 4. <i>A. geum</i> |
| b. Sepals more than twice as long as the length of the receptacle | 16 |
| 16a. Carpels with profuse rigid hairs | 7. <i>A. obtusiloba</i> |
| b. Carpels glabrous or with a few rigid hairs | 9. <i>A. polycarpa</i> |

1. *Anemone biflora* DC., Syst. Nat. 1: 201. 1820; Hook. f. & Thomson in Fl. Brit. India 1 7. 1872. *A. coronaria* L. var. *biflora* (DC.) Finet & Gagnepain in Bull. Soc. Bot. Fr. 51: 60. 1904.

Herbs, with tuberous rootstock. Radical leaves 2- to 3-lobed, long-petioled; segments stalked; lobes obovate, obtuse. Scapes 5 - 20 cm long, glabrous, 1- to 2-flowered, rarely 3-flowered; involucre leaves many-partite; pedicels pubescent, secondarily involucrellate; involucels 2, lateral. Flowers small, 2 - 3 cm across, dull red in colour; receptacle hemispheric. Sepals 5, oblong-ovate, persistent, yellowish hairy outside. Achenes with short persistent styles concealed in dense wool.

Fl. Mar. - May; *Fl.* June - Aug.

Distrib. India: Jammu & Kashmir.

Pakistan, Afghanistan, Iran and Russia.

2. *Anemone demissa* Hook. f. & Thomson, Fl. Ind. 23. 1855 & in Fl. Brit. India 1: 9. 1872. *A. demissa* vars. *connectans*, *macrantha*, *monantha*, *umbellata* & *villosissima* Bruehl in Ann. R. Bot. Gard. Calc. 5: 81. 1896. *A. narcissiflora* L. var. *demissa* (Hook. f. & Thomson) Finet & Gagnepain in Bull. Soc. Bot. Fr. 51: 74. 1904, p. p.

Herbs with monopodial woody rootstock, surrounded by fibrous leaf remnants; stems (flower-bearing shoots) erect, ascending or decumbent. Radical leaves broadly ovate, 3-sect or twice ternately divided; segments more or less overlapping, broadly ovate or rhombic, cuneate, 1.5 - 2.5 cm across, coarsely crenate-serrate, densely villous; petioles 3 - 10 cm long, usually with white spreading hairs. Scapes 5 - 30 cm long, densely white hairy, 3 - 6-flowered in simple umbels, rarely 1-flowered; pedicels 2 - 4 cm long; involucre leaves 3, whorled, sessile, 3-partite or incised, 1 - 2 cm long. Flowers 2 - 3 cm across, white or pale blue to white inside and bluish or yellowish blue outside. Sepals elliptic, 7 - 15 x 3.5 - 5 mm. Filaments broadly linear to oblanceolate; anthers blackish. Carpels ovate or oblong, orbicular, elliptic, compressed, surrounded by ca 2 mm broad wing, 5 - 7 x 3.5 - 5 mm, glabrous; beak minute, hooked.

KEY TO THE VARIETIES

- 1a. Scapes erect, 10 - 30 cm long; leaf-lobes overlapping; flowers many in umbels 2.1. var. *demissa*
 b. Scapes suberect or decumbent, 5 - 12 cm long leaf-lobes not overlapping; flowers solitary 2.2. var. *monantha*

2.1. var. *demissa*

Fl. & Fr. July - Aug.

Distrib. India: Alpine meadows and clearings in forests and Rhododendron scrubs, 3200 - 4600 m. Sikkim.

Nepal, Bhutan, N. Myanmar and W. China.

Notes. Chromosome no. $2n = 14$ (Baumberger in Ber. Schw. Bot. Ges. 80: 17 - 96. 1970).

2.2. var. *monantha* Bruehl in Ann. R. Bot. Gard. Calc. 5: 82, t. 107 B. 1896.

Fl. & Fr. July - Aug.

Distrib. India: Sikkim.

Endemic.

Notes. Hara & Williams (in Enum. Fl. Pl. Nepal 2: 11. 1979) include var. *monantha* under the synonymy of *A. demissa*, but treats var. *villosissima* Bruehl separately in the list.

3. *Anemone elongata* D. Don, Prodr. Fl. Nep. 194. 1825; Hook. f. & Thomson in Fl. Brit. India 1: 10. 1872.

Herbs with fibrous rootstocks; stems erect, 30 - 100 cm high, slender, pubescent. Radical leaves reniform or semicircular in outline, cordate, deeply 3-partite or 3-sect, 4 - 12 cm from base to tip; lateral segments deeply 2-lobed, midsegment 3-lobed; lobes acute, inciso-dentate; petioles very long, 2 - 6 times the length of the lamina, sheathing at base. Scape elongate, twice or thrice divided with few-flowered lax umbellate cymes; involucreal leaves of the first, second and third order 2- to 3-leaved, mainly oblong or broadly cuneate, variously toothed, varying in shape, pubescence and serrations. Flowers white, 2 - 3 cm across. Sepals 5, obovate, glabrous. Stamens glabrous. Achenes 1 - 6, ca 1 cm long, flat, ovate or elliptic; beak short, straight; seeds conspicuously longitudinally ribbed.

Fl. & Fr. July - Sept.

Distrib. India: Uttar Pradesh, Sikkim, Meghalaya and Arunachal Pradesh.

Nepal and N. Myanmar.

Notes. Chromosome no. $2n = 16$ (Baumberger in Ber. Schw. Bot. Ges. 80: 17 - 96. 1970).

4. *Anemone geum* A. Leveille in Bull. Acad. Georg. B. 25: 25. 1915. *A. obtusifolia* var. *ovalifolia* Bruehl in Ann. R. Bot. Gard. Calc. 5: 78. 1896. *A. ovalifolia* (Bruehl) Hand.-Mazz., Symb. Sin. 7: 315. 1931.

Herbs, more or less villous. Scapes elongate and upright or short, ascending or procumbent. Leaves ovate, cordate, trisect or trifoliolate, 1 - 2.5 cm long; petioles 2 - 3 times as long. Sepals 5, 5 - 8 mm long, slightly longer than the androgynoeceum, yellow, bluish near the base. Carpels hairy, but some glabrous. Achenes much compressed, softly hairy.

Fl. & Fr. July - Aug.

Distrib. India: Himalayas in Uttar Pradesh, Sikkim and Arunachal Pradesh.

Nepal and W. China (S. Tibet).

Notes. Some authors treat this species as a synonym of *A. obtusiloba* D. Don.

5. *Anemone griffithii* Hook. f. & Thomson, Fl. Ind. 24. 1855 & in Fl. Brit. India 1: 8. 1872.

Herbs, with horizontal woody rootstock; stems slender, up to 15 cm high. Radical leaf solitary, 3-sect or 3-foliolate; leaflets ovate, 2- or 3-fid, cuneate at base, acute at apex, subacutely serrate or incised along margins, 1.5 - 3 x 1 - 3 cm, sparsely pubescent; petioles 5 - 15 cm long, 2 - 4 times as long as lamina, sheathing at base; cauline leaves 3, whorled, similar in shape to radical leaf, but petiole much shorter than lamina. Scapes 5 - 40 cm long; involucre bracts similar to leaves. Flowers 1 - 2 on slender hairy peduncle, 2 - 3 cm across, white or pinkish; pedicels 2 - 7 cm long; receptacle hemispheric, glabrous. Sepals 4 - 5, obovate, 0.7 - 1.25 x 0.5 - 0.7 cm wide, white, sometimes purple on margins, subglabrous. Stamens ca 30, glabrous; anthers elliptic; filaments filiform. Carpels 25 - 30, glabrous, compressed. Achenes ovoid, ca 4 x 2 mm, glabrous; beak minute.

Fl. & Fr. June - Sept.

Distrib. India: Streamsides and damp clearings, 1900 - 2800 m. Sikkim and Arunachal Pradesh.

Bhutan and China (E. Tibet).

6. *Anemone howellii* W. Smith & Jeffrey in Notes R. Bot. Gard. Edinb. 9: 78. 1916.

Herbs, glabrous, rhizomatous. Leaves all radical; petioles 8 - 12 cm long; lamina ovate, acuminate, cordate, 4 - 5-lobed, 5 - 7.5 x 4 - 5.5 cm. Scapes erect, up to 30 cm long, elongating in fruit, more or less pilose. Flowers ca 2 cm across. Sepals 5, obovate or suborbicular. Stamens ca 5 mm long; filaments glabrous. Achenes 15 - 20, compressed, thickened along margins, ca 2 mm long, glabrous.

Fl. & Fr. not known

Distrib. India: Arunachal Pradesh (Tirap District).

Endemic.

7. *Anemone obtusiloba* D. Don, Prodr. Fl. Nep. 194. 1825; Hook. f. & Thomson in Fl. Brit. India 1: 8. 1872. *A. discolor* Royle, Illus. Bot. Himal. t. 11, f.1. 1833 & 52. 1834.

Herbs, more or less villous; rootstock woody, fibrous, clothed with old leaf bases, dark coloured. Radical leaves densely tufted, suborbicular, deeply cordate, 1.5 - 5 cm across, 3-sect or 3-dentate or 3-foliolate, if 3-foliolate, then terminal leaflet not distinctly stalked. Cauline leaves divided more than half-way to their base or midrib, broader than long, ovate, reniform or suborbicular; petioles 3 - 15 cm long. Scapes erect, ascending or prostrate, 10 - 40 cm long, 1- to 3-flowered; involucre bracts similar to leaves but smaller, 3-partite; pedicels 1 - 12 cm long, slender. Sepals 5, elliptic, oblong or obovate, 0.5 - 2 x 0.7 - 1.2 cm, white or bluish on both sides or golden yellow and silky outside, up to 4 times longer than stamens and carpels. Stamens many. Carpels hairy, very variable in regard to hairiness and texture of hairs, sometimes glabrous. Achenes elliptic, somewhat compressed, 2.5 x 1.5 mm, tipped by a short hooked beak, densely strigose hairy.

KEY TO THE VARIETIES

- 1a. Flowers smaller than leaves; leaves more than 2 cm wide; sepals 10 - 20 mm long 7.1. var. *obtusiloba*
 b. Flowers distinctly larger than leaves; leaves less than 2 cm wide; sepals 5 - 10 mm long
 7.2. var. *potentilloides*

7.1. var. obtusiloba*Fl. & Fr.* April - July.*Distrib.* India: Open glades in Fir forests and alpine slopes, 3200 - 4000 m. Himachal Pradesh, Uttar Pradesh and Sikkim.

Pakistan, Nepal, Bhutan, China (S.E. Tibet) and Myanmar.

Notes. Chromosome no. $n = 7$ (Mehra & Remanandan in *Cytologia* 37: 282 - 283. 1972) for a Gulmarg population of *A. obtusiloba* var. *glabra* (?); $2n = 16$ (Sobti & Singh in *Proc. Indian Acad. Sci. B.* 24: 138 - 144. 1961).

One of the commonest Anemones, widely distributed in the Himalayas and highly variable in habit, indumentum, partition of leaf and colour of flowers.

7.2. var. potentilloides Lauener in *Notes R. Bot. Gard. Edinb.* 23: 179-201. 1959.*Fl. & Fr.* May - July.*Distrib.* India: Jammu & Kashmir.

Pakistan and China (W. Tibet).

8. *Anemone polyanthes* D. Don, *Prodr. Fl. Nep.* 194. 1825; Hook. f. & Thomson in *Fl. Brit. India* 1: 9. 1872. *A. narcissiflora* L. var. *polyanthes* (D. Don) Finet & Gagnepain in *Bull. Soc. Bot. Fr.* 51: 56 - 76. 1904.

Herbs, large, hairy; rootstock stout, woody; stems 20 - 25 cm high, densely silky. Radical leaves reniform-cordate, up to 12 cm across, 5 - 7-lobed; lobes deeply 3-fid, crenate; petioles up to 25 cm long, hairy. Scapes erect, stout, 30 - 40 cm long, bearing many-flowered umbels. Involucral leaves variable, more or less cut or incised; involucels of secondary branches similar. Flowers 2 - 3 cm across, white; pedicels ca 4 cm long, hairy. Sepals 5 - 8, elliptic, 2 - 3 cm long. Carpels with short erect style. Achenes ovoid with a short straight beak.

Fl. June - July; *Fr.* Sept. - Oct.*Distrib.* India: Rocky alpine slopes, Fir forests and clearings, 3000-4200 m. Jammu & Kashmir, Himachal Pradesh, Uttar Pradesh and Sikkim.

Pakistan, Nepal and Bhutan.

Notes. Chromosome no. $2n = 16$ (Baumberger in Ber. Schw. Bot. Ges. 80: 17 - 96. 1970).

9. *Anemone polycarpa* W.E. Evans in Notes R. Bot. Gard. Edinb. 13: 154. 1951. *A. rupestris* auct. non Wallich; Hook.f. & Thomson in Fl. Brit. India 1: 9. 1872, p.p. *A. obtusiloba* subsp. *saxicola* Bruehl in Ann. R. Bot. Gard. Calc. 5: 78, t. 105c, ff. 11 - 13. 1896.

Herbs, somewhat hairy; rootstock stout, fibrous. Leaves deeply lobed, glabrous; radical leaves 3-partite; segments narrow; petioles very long, 2 - 6 times the length of the lamina. Scapes erect, 1 - 3-flowered; pedicels with a whorl of dissected leaves at middle. Flowers golden yellow, solitary, terminal. Sepals elliptic, 2 - 3 times as long as the filaments and carpels. Achenes glabrous or with a few sparse rigid hairs; beak slightly curved at apex.

Fl. & Fr. July - Sept.

Distrib. India: Sikkim.

Nepal, Bhutan and W. China.

10. *Anemone rauli* Goel & Bhatt in J. Bombay Nat. Hist. Soc. 79: 641 - 643, ff. 1 - 7. 1982.

Herbs, erect, 50 - 75 cm high; stems 30 - 50 cm long, covered with fibrous remains of petioles at base, glabrous, villous at involucreal joints. Radical leaves palmately 3-lobed, deeply cordate, 9 - 20 cm across, subglabrous, chiefly hairy on nerves; segments sessile, unequally broadly obovate, deeply or shallowly 3-partite, cuneate, 5 - 10 x 4.5 - 9 cm; secondary segments again 3-lobed, irregularly coarsely serrate; petioles 12 - 32 cm long, narrowly sheathing at base. Inflorescences lax, dichasial cymes; involucre of the first order 2, sessile, 3 - 5 x 4 - 6 cm, broadly obovate, cuneate, subglabrous, hairy on nerves on both surfaces; segments trifid, cuneate, irregularly serrate; involucre of the second order and above smaller, 1.5 - 3 cm long; peduncles 5 - 15 cm long; pedicels 2.5 - 8 cm long; median pedicels smaller, slightly puberulous to pubescent above. Sepals 5, narrowly obovate, 9 - 15 x 4 - 6 mm, white, glabrous. Stamens 20 - 35; filaments 1.5 - 3 mm long, complanate to filiform, unequal; anthers 0.8 - 1.2 mm long; outer linear-elliptic, inner broadly ovate. Carpels 3 - 6, sessile, 3 - 3.5 mm long, glabrous, compressed, linear-ovate; style gently curved, tapering into obtuse stigmatic apex. Achenes 1 - 4, elliptic-ovate, flattened, 5 - 7 x 3 - 4 mm; beak slightly curved, contiguous to achene, narrowly winged; seeds flat, 5 - 6 x 2.5 mm, broadly lanceolate, dark brown, glabrous.

Fl. & Fr. July - Sept.

Distrib. India: Temperate Himalayan regions, common on grassy slopes and near streams, 2900 - 3300 m. Uttar Pradesh.

Endemic.

11. *Anemone rivularis* Buch.-Ham. in DC., Syst. Nat. 1: 211. 1817; Hook. f. & Thomson in Fl. Brit. India 1: 9. 1872. *A. wightiana* Wallich ex Wight & Arn., Prodr. 3. 1834; Wight, Icon. 3: t. 936. 1845. Fig. 6

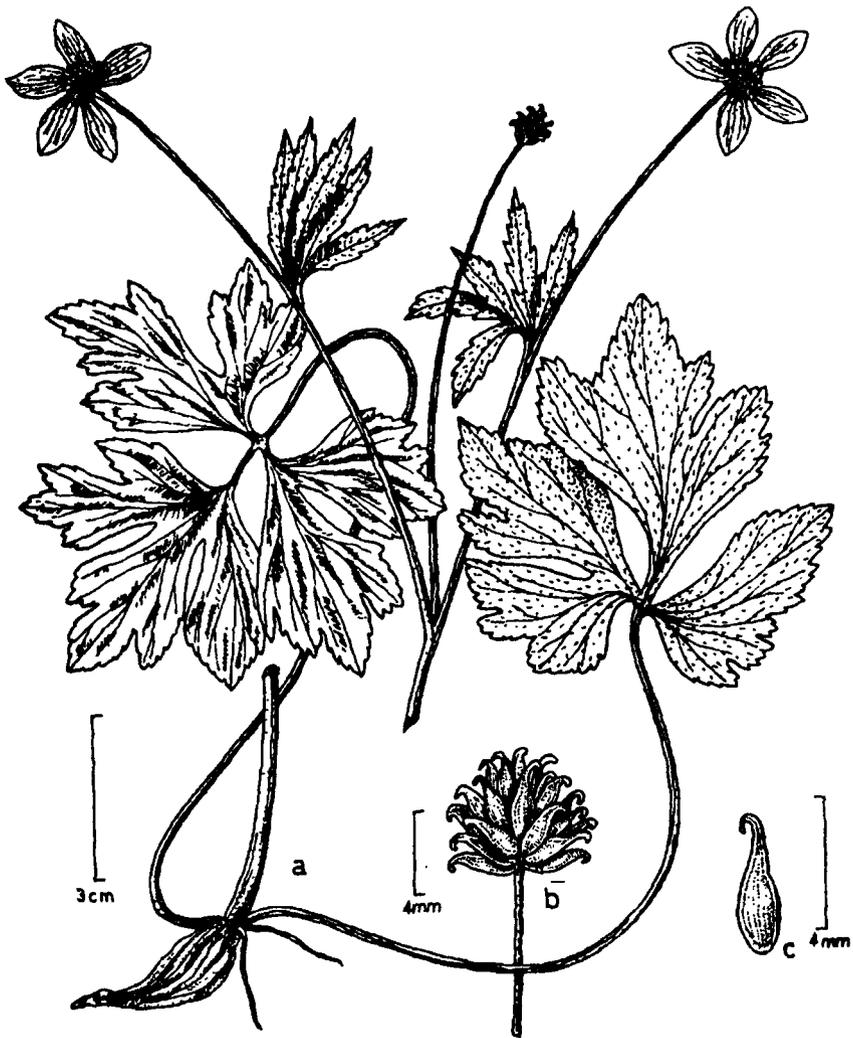


Fig. 6. *Anemone rivularis* Buch.-Ham. : a. plant, lower and upper portions; b. head of achenes; c. achene.

Herbs, perennial, up to 1 m high; rootstock stout, woody, sheathed in fibres. Radical leaves 3-partite, 10 - 12 cm wide in smaller specimens, 30 - 35 cm in larger ones, deeply 3- to 5-lobed, each lobe again 3 - 4-lobed, serrate, hairy on both surfaces; cauline leaves palmately finely dissected into many linear lobes; leaflets broadly elliptic or rhombic, cuneate at base, acute at apex, often deeply 3-lobed, serrate along margins, 4 - 7 x 3 - 5 cm, pubescent with stiff hairs; petioles 10 - 30 cm long. Scapes stout, 7 - 35 cm long; involucral leaves similar to leaves, deeply incised, serrate; segments linear, ca 2 mm broad; cymes compound, many-flowered; branches spreading, elongate, 2-bracteolate. Flowers white, blue or purplish outside, 2.5 - 4 cm in diam. Sepals 5 - 8, elliptic, obovate, obtuse, 4 - 10 mm long, silky outside. Filaments slender; anthers ovoid. Carpels many; styles curved at tip. Achenes broadly elliptic, ca 7 x 5 mm, compressed with ca 1 mm long glabrous hooked beaks.

Fl. & Fr. June - Oct.

Distrib. India: Streamsides and clearings in broad leaved forests. Himachal Pradesh, Uttar Pradesh, Sikkim and Tamil Nadu.

Sri Lanka, Myanmar and China.

12. *Anemone rupestris* Wallich [Cat. 167, no. 4696. 1831, nom. nud.] ex Hook. f. & Thomson, Fl. Ind. 21. 1855, p. p. & in Fl. Brit. India 1: 9. 1872, p. p.; Bruehl in Ann. R. Bot. Gard. Calc. 5: 79. 1896. *A. rupestris* var. *wallichii* Bruehl, l. c. 5: 80. 1896. *A. rupestris* var. *pusilla* Bruehl, l. c. 5: 81, t. 107, ff. 2, 5, 6 & 12. 1896. *A. rupestris* subsp. *gelida* (Maxim.) Lauener var. *wallichii* (Bruehl) Lauener in Notes R. Bot. Gard. Edinb. 23: 200. 1960.

Herbs, with slender fibrous rootstock covered upwards by a few fibrous old sheaths. Radical leaves 4 - 8, crowded; petioles 3 - 7 cm long, with membranous sheaths at base; lamina broadly ovate or ovate-oblong, 5 - 15 mm across, 3-partite, 3-sect or 3-foliolate, each divided into toothed segments, sparsely hairy on both surfaces. Scapes slender, 3 - 18 cm long; involucral leaves 3, whorled, inserted at the middle or above the middle of scape, sessile or connate at base, 5 - 12 mm long; pedicels 1.5 - 7 cm long. Flowers solitary, erect, 2 - 3 cm across, white or purplish or rarely reddish on lower surface. Sepals elliptic, 6 - 10 x 2 - 6 mm, white or purplish. Stamens 6 - 18; anthers bluish. Carpels asymmetric. Achenes elliptic, ca 2 mm long, compressed; beak ca 1 mm long, straight.

KEY TO THE SUBSPECIES

- | | |
|--|--|
| 1a. Lateral leaflets of mature leaves 3 - 9-toothed | 12.1. subsp. <i>gelida</i> var. <i>wallichii</i> |
| b. Lateral leaflets of mature leaves 10 - 21-toothed | 12.2. subsp. <i>rupestris</i> |

12.1. subsp. *gelida* (Maxim.) Lauener var. *wallichii* (Bruehl) Lauener in Notes R. Bot. Gard. Edinb. 23: 200. 1960. *A. rupestris* Wallich ex Bruehl in Ann. R. Bot. Gard. Calc. 5: 79. 1896, non Hook. f. & Thomson. *A. rupestris* Wallich ex Bruehl var. *pusilla* Bruehl, l. c. 81, t. 107A. 1896. *A. rupestris* var. *wallichii* Bruehl, l. c. 80. 1896.

Fl. & Fr. June - Sept.

Distrib. India: E. Himalayas. Sikkim.

Nepal, Bhutan and China (Tibet).

12.2. subsp. *rupestris*

Fl. & Fr. June - Oct.

Distrib. India: Alpine cliffs, open grassy slopes, 3500 - 4800 m. Sikkim.

Nepal, Bhutan and S. & W. China (Yunnan and Tibet).

Notes. See Lauener (l. c.) and Hara (in J. Jap. Bot. 48: 354. 1973) for discussions on the typification of *A. rupestris*.

13. *Anemone rupicola* Cambess. in Jacquem., Voy. Bot. 4: 5, t. 2. 1835; Hook. f. & Thomson in Fl. Brit. India 1: 8. 1872. Fig. 7

Herbs, up to 30 cm high, softly silky hairy; rootstock slender, woody. Radical leaves with 3-partite or 3-lobed lamina; segments shortly incised-serrate; petioles 4 - 20 cm long, sheathing at base. Scapes 3 - 20 cm long; involucral bracts 3-partite, similar to basal leaves in shape and serrations; pedicels 4 - 15 cm long; flowers solitary or rarely 2, nearly 6 cm across, white. Sepals 5 - 7, broadly elliptic, obovate, distantly nerved, 1.5 - 3 x 1 - 2 cm, purplish and downy outside, white inside. Carpels ovate; styles minute, short. Achenes compactly arranged in an ovoid woolly head.

Fl. & Fr. May-July.

Distrib. India: Alpine meadows amongst Juniper or Rhododendron scrubs, edges of cliffs etc., 2800 - 4800 m. Jammu & Kashmir, Himachal Pradesh, Uttar Pradesh and Sikkim.

Bhutan, Nepal, Pakistan, and W. China.

Notes. Hook. f. & Thomson (in Fl. Brit. India 1: 8. 1872) describes two varieties, *sericea* and *glabriuscula*, but they are probably only forms of this species.

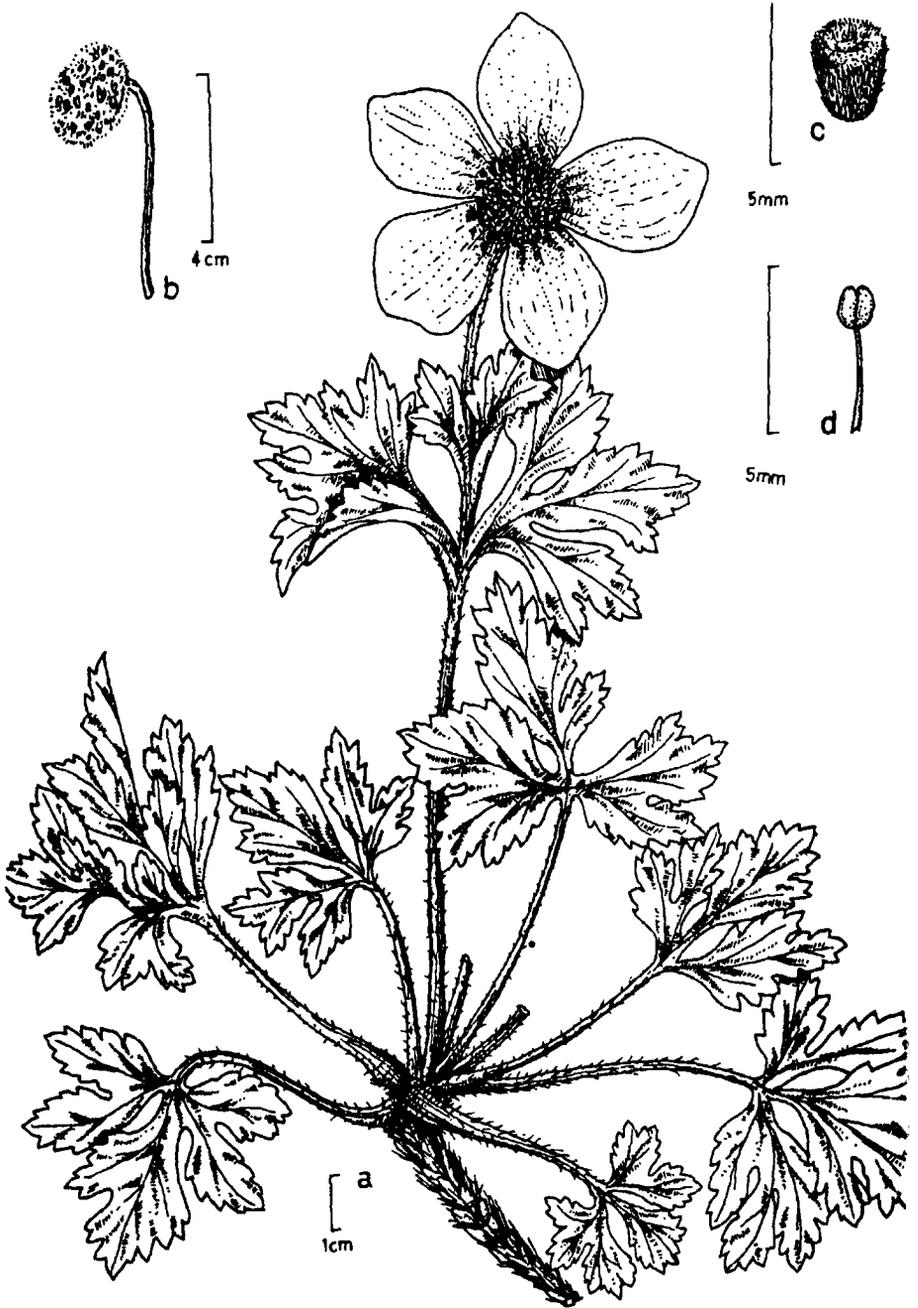


Fig. 7. *Anemone rupicola* Cambess.: a. habit; b. woolly head of achenes; c. carpel; d. stamen.

14. *Anemone smithiana* Lauener & Panigr. in Notes R. Bot. Gard. Edinb. 33: 491-492. 1975.

Rootstock slender, woody, densely surrounded by old persistent leaf-stalks, spreading into long blackish grey fibrous strands. Leaves all radical; petioles up to 30 cm long; lamina 3 to 5-lobed; lobes pinnatifid or pinnatisect. Scapes 1 to 3, 10 - 45 cm long; branches 2.5 - 5 cm long, bearing simple umbels with 3 - 10 flowers; involucre leaves hairy; pedicels ca 3 cm long, elongating in fruits. Flowers whitish, pink, purple or mauve, ca 5 cm across. Sepals ca 2.5 x 1 cm. Stamens numerous. Achenes 10 - 15, compressed; beak short, hooked.

Fl. & Fr. July - Oct.

Distrib. India: Alpine rocky ledges and turfs in Juniper or Rhododendron scrubs, 3600 - 4300 m. Sikkim.

Nepal, Bhutan and China.

15. *Anemone tetrasepala* Royle, Illus. Bot. Himal. 53. 1834; Hook. f. & Thomson in Fl. Brit. India 1: 10. 1872.

Herbs, up to 60 cm high, hairy or glabrous; rootstock woody, fibrous. Petioles of radical leaves up to 20 cm long, with sheathing bases; lamina deeply 5-partite, incised-serrate, deeply cordate, ca 15 x 50 cm. Scape stout, ca 50 cm high; cymes up to thrice branched, contracted or lax, up to 30 cm long; involucre leaves broadly cuneate, 6 - 8 x 2 - 3 cm; lobes linear-ovate, crenate only at tip; involucels much smaller, with entire lobes. Flowers 3 - 4 cm wide, white; buds pinkish. Sepals 4. Stamens many. Achenes with short hooked beaks.

Fl. & Fr. July - Aug.

Distrib. India: Jammu & Kashmir.

Pakistan.

Notes. Chromosome no. $2n = 14$ (Baumberger in Ber. Schw. Bot. Ges. 80: 17 - 96. 1970).

16. *Anemone trullifolia* Hook. f. & Thomson, Fl. Ind. 22. 1855 & Fl. Brit. India 1: 9. 1872.

Herbs, densely hairy; rootstock stout, bearing fibrous leaf-remains. Radical leaves simple, pubescent with silky hairs on both surfaces, broadly ovate, cuneate-obovate or orbicular, 3-lobed or subtrilobed, or oblong-elliptic and entire or with 3 coarse subacute

teeth at apex, 1.5 - 6 x 0.7 - 1.8 cm, 1 - 3 times as long as broad; lobes coarsely toothed; petioles up to 15 cm long. Scapes erect or ascending, 1 - 3-flowered, (3-)5 - 20(-50) cm long; involucre bracts sessile, not divided, entire or shallowly toothed, 10 - 30 x 3 - 10 mm; pedicels 1 - 6(-15) cm long. Flowers solitary or 1 - 3, golden yellow, often purplish outside. Sepals obovate or elliptic, 7 - 10(-15) x 3 - 8(-10) mm. Stamens many, much shorter than sepals. Carpels densely hirsute. Achenes strigose, narrowly ovate, ca 3 x 1 mm, compressed, densely brown hairy; beak ca 2 mm long, hooked.

KEY TO THE VARIETIES

- 1a. Leaves usually more than 3 times as long as broad; lamina linear-spathulate, entire or 3-toothed at apex, not clearly 3-lobed 16.1. var. *linearis*
- b. Leaves normally 1 - 2 times as long as broad; lamina broadly ovate, obovate or orbicular, clearly 3-lobed with toothed lobes 16.2. var. *trullifolia*

16.1. var. *linearis* (Bruehl) Hand.-Mazz. in Acta Hort. Gotob. 13: 178. 1939; Lauener in Notes R. Bot. Gard. Edinb. 23: 196. 1960. *A. obtusifolia* D. Don subsp. *trullifolia* (Hook. f. & Thomson) Bruehl var. *linearis* Bruehl in Ann. R. Bot. Gard. Calc. 5: 77, t. 106. f. 19. 1896.

Distinguished by its linear, spathulate leaves which are completely entire or tridentate at the apex and its lemon yellow flowers.

Fl. & Fr. July - Sept.

Distrib. India: Arunachal Pradesh.

W. China.

16.2. var. *trullifolia*

Fl. & Fr. May - Sept.

Distrib. India: Alpine pastures, marshes, open glades, 3200 - 4700 m. Sikkim.

Nepal, Bhutan, and S. & W. China.

17. *Anemone vitifolia* Buch.-Ham. ex DC., Syst. Nat. 1: 210. 1817; Hook. f. & Thomson in Fl. Brit. India 1: 8. 1872.

Herbs, stout, erect, branched, nearly 1 m high, white pubescent; rootstock woody; stems branched, erect, up to 1 m high. Radical leaves simple, orbicular-cordate, acute at apex, sharply toothed, deeply 3 - 7-lobed, 7 - 20 cm across, glabrous above, densely

white-tomentose beneath; lobes variously cut, sharply toothed; petioles 15 - 50 cm long. Scapes many-flowered, 20 - 50 cm long, bearing in the upper part an involucre of stalked bracts similar to leaves; umbellate cyme usually with 3 branches, one bearing a single flower and the other again ternately divided and involucrellate. Flowers white, large, 3 - 5 cm across. Sepals 5 - 8, ovate-elliptic, obtuse or acute, 1.5 - 2 x 0.7 - 1.2 cm, petaloid, white inside, purplish and silky pubescent outside. Stamens many. Carpels many, free. Achenes ellipsoid, ca 1 mm long, free, in large globose heads, densely covered by white woolly hairs when ripe.

Fl. July - Oct.; *Fr.* Sept. - Dec.

Distrib. India: Edges of evergreen temperate forests and along open grassy slopes, 1500 - 3000 m. Jammu & Kashmir, Himachal Pradesh, Uttar Pradesh, Sikkim and Arunachal Pradesh (Mishmi Hills).

Pakistan, Nepal, Bhutan, N. Myanmar and W. China.

Notes. Chromosome no. $n = 7$ (Mehra and Remanandan in *Cytologia* 37: 290. 1972) for a population from Bhagi, Simla in Himachal Pradesh).

5. *Aquilegia* L.

Perennial erect herbs; rootstock woody, erect, short. Leaves compound, 1 - 3-ternate, with entire segments. Flowers large, 2 - 5 cm wide, bisexual, actinomorphic, variously coloured, white, yellow, red or purple, usually drooping, some fragrant. Sepals 5, regular, petaloid, deciduous. Petals (honey leaves) 5, infundibular, each with a flat limb and backwardly produced hollow straight or recurved spur. Stamens many, the innermost staminodes without anthers and scale-like. Carpels 5 or more free, with long styles, persistent in fruit. Follicles several, free, many-seeded, with transverse striations; seeds with crustaceous to granulose testa.

North temperate zones; ca 100 species, 5 species in India confined to Himalayas.

KEY TO THE SPECIES

- | | |
|---|----------------------------|
| 1a. Leaves all basal; stems leafless or with one small leaf | 4. <i>A. nivalis</i> |
| b. Leaves basal and cauline; stems leafy | 2 |
| 2a. Spur much curved | 3 |
| b. Spur long and straight or only slightly hooked at tip | 4 |
| 3a. Sepals pubescent | 5. <i>A. pubiflora</i> |
| b. Sepals glandular-ciliate | 2. <i>A. kareliniana</i> |
| 4a. Herbs pubescent or glandular; sepals obtuse | 1. <i>A. fragrans</i> |
| b. Herbs glaucous; sepals ovate-acute | 3. <i>A. moorcroftiana</i> |

1. *Aquilegia fragrans* Benth. in Maund's Botanist 4: t. 181, f. 21. 1840; Munz in Gentes Herb. 7: 87. 1946. *A. vulgaris* L. subsp. *alpina* Hook. f. & Thomson in Fl. Brit. India 1: 24. 1872. *A. vulgaris* L. subsp. *pyrenaica* Hook. f. & Thomson, l. c. 24: 1872, p.p.

Perennial herbs; stems up to 1 m high, branched, leafy, softly pubescent or glandular hairy, often bluish green. Leaves 2-ternate; leaflets much cut. Flowers large, drooping, white, cream-coloured or pale blue, sweet-scented. Sepals 5, petaloid, obtuse. Petals 5; spurs long, slender, nearly straight or hooked. Carpels 5. Seeds black, minutely granular.

Fl. & Fr. June - Sept.

Distrib. India: Shaded slopes in subalpine regions, 2600 - 3700 m. Jammu & Kashmir and Himachal Pradesh.

Pakistan.

2. *Aquilegia kareliniana* C. Meyer ex Trautv. in Acta Hort. Petrop. 8: 53. 1883; Munz in Gentes Herb. 7: 59. 1946. *A. vulgaris* L. var. *karelinii* Baker in Gard. Chron. 2: 76. 1878; Bruehl in J. Asiat. Soc. Beng. 61(2): 288. 1893.

Perennial herbs, up to 80 cm high; stems glandular hairy. Leaves 2-pinnate; leaflets lobed, deeply dissected, glabrous above, sparsely hairy beneath. Flowers ca 5 cm across, violet or dark red. Sepals ovate, acuminate, glandular-ciliate. Petals sparsely hairy, spur recurved. Carpels 5, connate; styles glabrous.

Fl. & Fr. May - Aug.

Distrib. India: Uttar Pradesh (Nainital, Coll.?, May 1857 in CAL).

Russia.

3. *Aquilegia moorcroftiana* Wallich [Cat. 167, no 4713. 1831, nom. nud.] ex Royle, Illus. Bot. Himal. 55, t. 21. 1834; Munz in Gentes Herb. 7: 88. 1946. *A. vulgaris* L. subsp. *pyrenaica* Hook. f. & Thomson in Fl. Brit. India 1: 24. 1872, p. p. *A. vulgaris* L. subsp. *viscosa* Hook. f. & Thomson, l. c.

Herbs, perennial, tall, glabrous, often with rambling habit. Leaves 2-ternately compound, glaucous, often bluish green. Flowers large, drooping, white or purplish. Sepals 5, petaloid, ovate-acute. Petals 5; spur long, straight or slightly hooked at apex. Carpels 5. Seeds small, granular, black.

Fl. & Fr. June - Sept.

Distrib. India: Open slopes in alpine regions, 2500 - 5000 m. Jammu & Kashmir, Himachal Pradesh and Uttar Pradesh.

Pakistan, Nepal and China (S. Tibet).

4. *Aquilegia nivalis* (Baker) Bruehl in J. Asiat. Soc. Beng. 61(2): 300. 1893; Munz in Gentes Herb. 7: 24. 1946. *A. glauca* Lindl. var. *nivalis* Baker in Gard. Chron. 2(10): 76. 1878. *A. vulgaris* L. var. *jucunda* Hook. f. & Thomson in Fl. Brit. India 1: 24. 1872.

Herbs, up to 20 cm high; stems simple, short, leafless or few-leaved. Radical leaves few, long-petioled, 2-ternate; leaflets sessile, incised into broad blunt teeth. Cauline leaves 1 or 2, similar to radical leaves or usually absent. Flowers solitary, terminal, drooping, 3.5 - 5.5 cm across, dark purple. Sepals 5, petaloid, broadly ovate, orbicular, spreading. Petals 5, erect, funnel-shaped; spur much bent inwards. Stamens many, inner ones reduced to scales. Carpels 5 or more, free. Fruit a cluster of 5 follicles.

Fl. June - Aug.

Distrib. India: N.W. Himalayas, above 3000 m. Jammu & Kashmir.

Pakistan.

5. *Aquilegia pubiflora* Wallich [Cat. 167, no. 4714. 1831, nom. nud.] ex Royle, Illus. Bot. Himal. 55. 1834; Munz in Gentes Herb. 7: 43, t.12. 1946. *A. vulgaris* L. subsp. *parviflora* (Walp.) Hook. f. & Thomson in Fl. Brit. India 1: 24. 1872. *A. pubiflora* Wallich ex Royle var. *mussooriensis* Royle, l. c. *A. pubiflora* var. *subnuda* Bruehl in J. Asiat. Soc. Beng. 61(2): 311. 1893.

Herbs, perennial, softly pubescent; stems leafy, up to 75 cm high, erect, branched. Leaves bipinnately compound, glaucous, pubescent; leaflets 3, deeply 3-lobed, coarsely crenate. Flowers ca 2.5 cm across, solitary, drooping or in loose panicles with a few sessile foliaceous dissected bracts at the forks. Sepals 5, ovate-lanceolate, flat, pubescent, early caducous. Petals 5, yellowish green or nearly white or pale purple, base of each with a short obtuse curved spur projecting out between the sepals. Stamens many, inner ones modified into scales. Carpels 5, sessile, villous; styles long-linear, shorter than stamens; ovules many. Follicles ovate, many-seeded with persistent styles at apex.

Fl. & Fr. May - June.

Distrib. India: Jammu & Kashmir, Himachal Pradesh and Uttar Pradesh.

Nepal and Pakistan.

6. *Calathodes* Hook. f. & Thomson

Herbs, perennial, erect. Leaves basal and cauline, deeply palmatisect. Flowers actinomorphic, terminal, solitary on long scapes. Sepals 5, petaloid, yellow, caducous. Petals absent. Stamens numerous. Carpels many. Receptacle elongating after flowering between the insertion of the sepals and the head of follicles. Follicles 6-10; style persistent; seeds not spongy in chalazal part; endosperm fleshy.

Himalayas, China and Taiwan; 3 species, one in India.

Calathodes palmata Hook. f. & Thomson, Fl. Ind. 41. 1855 & in Fl. Brit. India 1: 22. 1872.

Herbs, erect, glabrous, 40 - 80 cm high; roots glabrous; stems simple or sparingly branched. Leaves palmately 3-partite; segments rhombic, sharply serrate, glabrous with unequally divided, inciso-dentate acute lobes; petioles 10 - 20 cm long with 1 - 2 cm long membranous sheathing auricles at base. Flowers large, ca 5 cm across. Sepals elliptic, 10 - 15 x 4 - 7 mm, golden yellow. Fruits unknown.

Fl. June.

Distrib. India: E. Himalayas, 2300 - 3100 m. Sikkim.

Nepal and Bhutan.

Notes. Sprague (in Kew Bull. 1919: 403. 1919) has pointed out that the fruiting branch shown by Oliver (in Hook., Ic. Pl. 20: t. 1935, 1890) with spur-like projections on the beak of follicles to which attention was drawn by Oliver, is actually that of another closely related Chinese species, *C. axycarpa* Sprague.

7. *Callianthemum* C. Meyer

Herbs, perennial, small, tufted or diffusely spreading; roots fibrous; rootstock covered by old leaf sheaths, stemless. Leaves radical, sheathing, tri-paripinnate, the divisions 2- or 3-pinnatifid; petioles long. Scape 1-flowered, erect, leafy or naked. Flowers actinomorphic, white or with pink tinge. Sepals 5, deciduous, shorter than petals. Petals (honey leaves) 5-20, spathulate, each with a nectar pit in lower half. Stamens many; anthers long. Carpels many, shortly stipitate; styles minute; ovule 1, pendulous. Fruit a 1-seeded follicle, ovoid or oblong, shortly stipitate in subglobose heads; styles curved.

KEY TO THE SPECIES

- | | |
|---|-----------------------------|
| 1a. Lamina of leaves deeply lobed; lobes dissected into slender linear segments | 2. <i>C. anemonoides</i> |
| b. Lamina of leaves shallowly lobed; lobes spreading and fan-shaped or overlapping | 2 |
| 2a. Radical leaves thick, rarely fully developed at flowering time; lobes overlapping | 1. <i>C. alatavicum</i> |
| b. Radical leaves fully developed at flowering time; lobes spreading, fan-like | 3. <i>C. pimpinelloides</i> |

1. *Callianthemum alatavicum* Freyn in Bull. P'Herb. Boiss. 6: 882. 1898.

Herbs, perennial. Scapes many, 5 - 25 cm long, decumbent or ascending, leafy in the middle. Radical leaves glabrous, rarely fully developed at the time of flowering; petioles long, bipinnatisect with lobes overlapping in young leaves. Flowers 2 - 2.5 cm wide. Sepals 5, green or purple. Petals 6 - 10, white, prominently veined. Achenes globose, rugose.

Fl. & Fr. May - July.

Distrib. India: Jammu & Kashmir.

Pakistan and Central Asia.

2. *Callianthemum anemonoides* (J. Zahlbr.) Endl. ex Heynh., Nomencl. Bot. 2: 106. 1846. *Ranunculus anemonoides* J. Zahlbr. in Flora 6: 220. 1823.

Herbs, stemless, 5 - 20 cm high, with long rambling leaves from the crown of rootstock. Basal leaves with up to 30 cm long petioles, subtriangular in outline, 2-pinnate; lobes deeply dissected into linear-oblong segments. Cauline leaves similar, but sessile, less divided and uppermost becoming almost like bracts. Scapes 10 - 15 cm long, mostly leafless. Flower at the tip of the scape, solitary, 3 - 3.5 cm across. Petals pink to white, with orange nectaries. Achenes in a globose cluster, very shortly beaked, 4.5 x 2 mm, strongly veined.

Fl. & Fr. June - July.

Distrib. India: Jammu & Kashmir.

Europe (alpine regions).

Notes. Known only by one collection from Kashmir of T. A. Rao 9282 (BSD), which matches perfectly well with a specimen of *C. anemonoides* from Austrian alps in Herb. DD.

3. *Callianthemum pimpinelloides* (D. Don ex Royle) Hook. f. & Thomson, Fl. Ind. 1: 26. 1855. *Ranunculus pimpinelloides* D. Don ex Royle, Illus. Bot. Himal. 53. 1834. *Callianthemum cachmerianum* Cambess. in Jacquem., Voy. Bot. 4: 5, t.3. 1844; Hook. f. & Thomson in Fl. Brit. India 1: 14. 1872.

Herbs, perennial, small, densely caespitose, glabrous, 10 - 15 cm high; roots fibrous. Leaves erect, 6 - 12 cm long at flowering time, later up to 25 cm long, pinnately or bipinnately lobed or cut; lobes 5 - 7, broadly ovate, 0.5 - 3 x 0.5 - 2 cm, spreading, deeply and subacutely toothed or lobed or lower pair pinnately divided, glabrous; petioles 6 - 10 cm long. Scapes leafy in the middle, 3 - 7 cm long. Flower solitary, 2 - 3 cm across, white or pale red. Sepals 5, elliptic, obtuse, 4 - 6 x 2 - 3 mm, reddish. Petals 5 - 12, almost twice as long as the sepals, obovate to spatulate, 7 - 15 x 2 - 5 mm, white, tinged purple outside with a nectariferous pit inside at the base. Stamens greenish. Carpels glabrous. Achenes in heads, ovoid, subglobose, tipped by a short beak, ca 3.5 x 2 mm, glabrous.

Fl. & Fr. April - July.

Distrib. India: Alpine cliff edges, meadows, damp turf and sandy ground, 2700 - 4000 m. Jammu & Kashmir, Himachal Pradesh, Uttar Pradesh and Sikkim.

Bhutan, Nepal, Pakistan, Afghanistan and China (Tibet and Yunnan).

8. *Caltha* L.

Perennial glabrous herbs in marshy and semi-aquatic places; rootstock stout, somewhat rhizomatous, creeping or ascending; roots axillary, fibrous; stems erect, up to 60 cm high, hollow, simple or branched. Leaves alternate, simple or lobed; radical leaves long-petioled; cauline leaves short-petioled to sessile; lamina oblong-ovate, obovate, elliptic-oblong, orbicular or reniform-deltoid, often cordate at base, entire, crenate or closely dentate, up to 25 cm across, glossy, (some species of S. Hemisphere have appendages at base of lamina). Flowers actinomorphic, yellow, rarely white or pink, usually in few-flowered loose cymose panicles or corymbs, sometimes flowers solitary or paired on scapes. Perianth 1-whorled, petaloid; segments 5 or more, alike, not differentiated into sepals and petals. Stamens 8-many, on flat receptacle. Carpels (2-) 5 - 10(-25), sessile, free; ovules many on ventral placentas. Follicles oblong, subcompressed. Seeds several in 2 rows along ventral suture, black.

Mostly in northern temperate and arctic regions, some in southern temperate regions; ca 10 species, 2 in India, confined to Himalayan regions.

Literature: HILL, A. (1918) The genus *Caltha* in southern hemisphere. Ann. Bot. (London) 32: 421 - 435. SMIT, P.G. (1973) A revision of *Caltha*. Blumea 21: 119 - 150.

KEY TO THE SPECIES

- | | |
|---|------------------------|
| 1a. Leaves reniform-deltoid, radical and cauline; flowers in corymbs, rarely solitary | 1. <i>C. palustris</i> |
| b. Leaves broadly ovate-cordate, all radical; flowers solitary or paired on scapes | 2. <i>C. scapoza</i> |

1. *Caltha palustris* L., Sp. Pl. 558. 1753; Hook. f. & Thomson in Fl. Brit. India 1: 21. 1872. *C. govaniiana* Wallich [Cat. 167. no. 4710. 1831, nom. nud.] ex Royle, Illus. Bot. Himal. 54. 1834. Fig. 8

Perennial, often forming extensive tufts; rootstock thick, tuberous, creeping, densely fibrous rooted; stems 10 - 60(-80) cm, erect, robust, hollow, branched. Leaves deltoid, reniform, deeply cordate at base, sharply crenate-dentate along margins, obtuse at apex, 3 - 12(-15) cm across, glabrous; radical leaves with 8 - 30(-60) cm long petioles; cauline leaves alternate, sessile or subsessile or with very short petioles, clasping the stems. Peduncles up to 80 cm high, with 1 or few or up to 25 flowers in corymbs. Flowers few, 2.5 - 5 cm across, bright yellow or pink. Sepals 5 - 8, petaloid, oblong-ovate, elliptic or broadly obovate, obtuse or rarely subacute, 12 - 15 x 3 - 20 mm. Stamens many, usually more than 40; filaments filiform; anthers rather large. Carpels 10 or more, free, linear-oblong; style continuous, straight; stigma entire or slightly bilobed. Follicles sessile, elongate-oblong, flattened with hard surfaces and transverse ridges, 6 - 18 x 3 - 5 mm, bearing straight 1.5 - 3 mm long beak, which is slightly curved at apex; seeds many, ovoid, constricted in middle, black.

KEY TO THE VARIETIES

- | | |
|--|----------------------------|
| 1a. Flowers white | 1.1. var. <i>alba</i> |
| b. Flowers yellow or magenta-pink or purple | 2 |
| 2a. Flowers yellow, several on each peduncle | 1.2. var. <i>palustris</i> |
| b. Flowers magenta-pink, one per peduncle | 1.3. var. <i>purpurea</i> |

1.1. var. *alba* (Cambess.) Hook. f. & Thomson, Fl. Ind. 40. 1855 & in Fl. Brit. India 1: 21. 1872. *C. alba* Cambess. in Jacquem., Voy. Bot. 6, t. 4. 1844.

Distinguishable by the white flowers. The roots are considered poisonous.

Fl. & Fr. May-Aug.

Distrib. India: N.W. Himalayas, along streamsides and marshy wetlands, 2500 - 3500 m. Jammu & Kashmir.

Pakistan and Afghanistan.

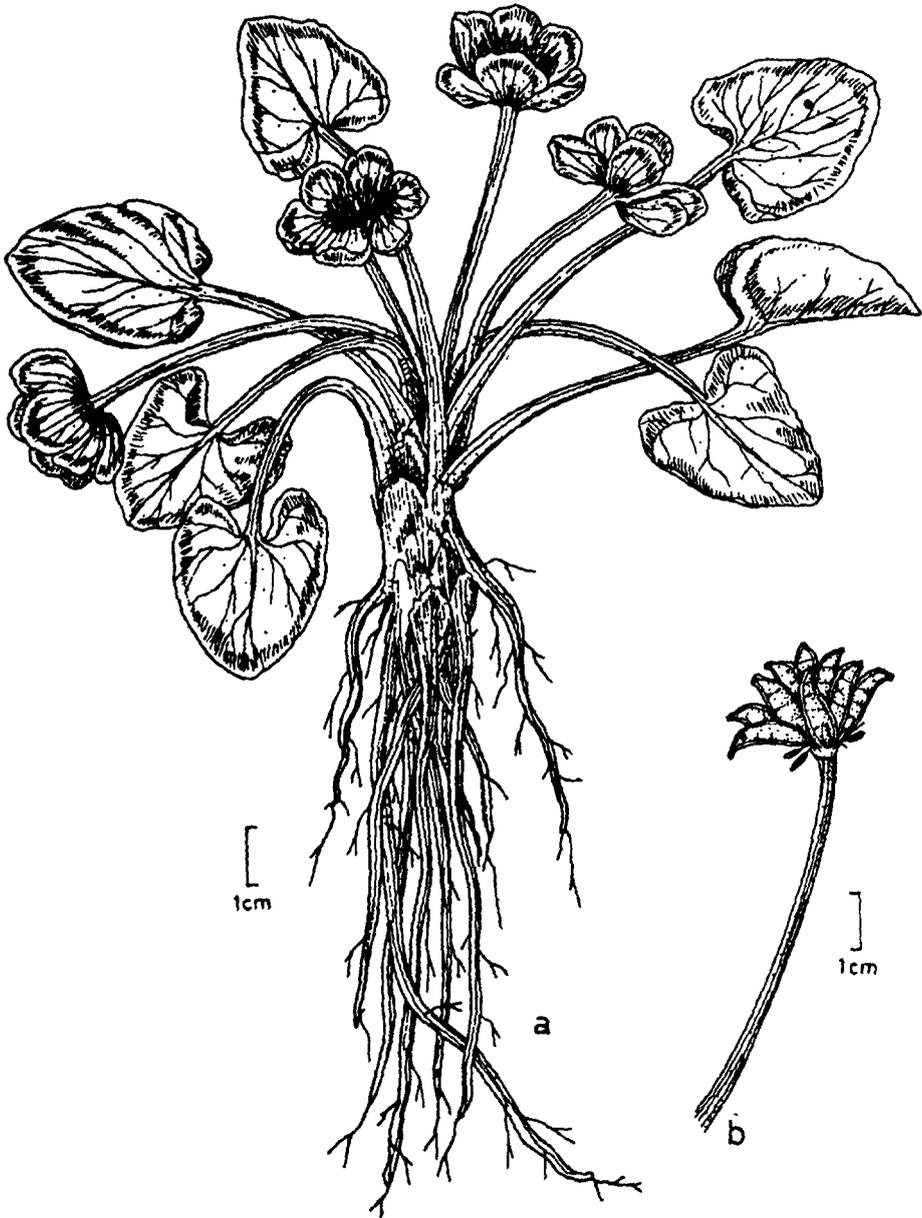


Fig. 8. *Caltha palustris* L. : a. habit, b. head of follicles.

1.2. var. *palustris*

C. himalensis D. Don, Prodr. Fl. Nep. 195. 1825. *C. palustris* var. *himalensis* (D. Don) Mukerjee in Bull. Bot. Surv. India 2: 105. 1960. *C. palustris* var. *normalis* Hook. f. & Thomson in Fl. Brit. India 1: 21. 1872.

Distinguishable by its yellow flowers and several-flowered peduncle.

Fl. & Fr. June-Sept.

Distrib. India: Marshy and damp places in alpine meadows, 2500-4600 m. Jammu & Kashmir, Himachal Pradesh, Uttar Pradesh and Sikkim.

Nepal, Bhutan, Europe, Asia and N. America.

1.3. var. *purpurea* Sparre & Fischer in Bull. Misc. Inf. Kew 8: 248. 1929.

Distinguishable by its magenta-pink flowers.

Fl. & Fr. July - Oct.

Distrib. India: Arunachal Pradesh.

Endemic.

2. *Caltha scaposa* Hook. f. & Thomson, Fl. Ind. 40. 1855 & in Fl. Brit. India 1: 21. 1872.

Erect herbs, 7 - 15 cm high; rootstock thick, with branched main roots. Leaves all radical; petioles up to 10 cm long with 2 - 3 cm long, narrow, membranous sheath at base; lamina broadly ovate-cordate, obtuse, entire or dentate, 1.5 - 3.5 x 1 - 3 cm. Scapes leafless or with one small leaf; flowers usually solitary or rarely 2, ca 2.5 across. Sepals 5 - 9, generally 6, yellow, obovate, obtuse, 10 - 15 x 6 - 8 mm. Stamens 20 - 40; filaments flattened. Carpels 10 - 20, unequal, linear-oblong, prolonging into style; stigma oblique, curved. Follicles with 1.5 - 3 mm long stalks, oblong, flattened, shortly beaked, ca 10 x 3 mm; seeds 3 - 6, ovoid, black.

Fl. & Fr. June-Aug.

Distrib. Damp meadows and marshy streamsides, 3800 - 4600 m. Uttar Pradesh, Sikkim and Arunachal Pradesh.

Nepal, Bhutan and China (Tibet, Yunnan).

9. *Ceratocephalus* Moench

Herbs, annual, short, like *Ranunculus* in habit but lacking in adventitious root system. Leaves whorled, laciniately palmatisect into linear lobes. Flowers actinomorphic, solitary. Perianth of 2 dissimilar whorls. Sepals 5. Petals (honey leaves) 5, yellow with nectariferous base. Receptacle elongated in fruit. Achenes characteristically gibbous with empty pouches on either side of the seed chamber and with a long terminal beak, 2 - 3 times as long as the achenes.

Europe and Mediterranean regions, extending to Central Asia and W. Himalayas; 2 species, both in India.

KEY TO THE SPECIES

- | | |
|--|---------------------------|
| 1a. Beaks of achenes broadly falcate with empty pouches far apart | 1. <i>C. falcatus</i> |
| b. Beaks of achenes narrowly straight with empty pouches close together and nearly touching each other | 2. <i>C. testiculatus</i> |

1. *Ceratocephalus falcatus* (L.) Pers., Syn. Pl. 1: 341. 1805. *Ranunculus falcatus* L., Sp. Pl. 556. 1753; Hook. f. & Thomson in Fl. Brit. India 1: 16. 1872. *Anemone cyanosurus* Griffith, Notul. 4: 735. 1854 & Icon. Pl. 4: t. 660, f. 1. 1854.

Herbs, annual, acaulescent, 2 - 10 cm high. Leaves all radical, 3-fid and once or twice forked into linear segments or pinnatifid; petioles margined, tapering towards base. Scapes 1 or more, from the middle of the leaves, longer than leaves, naked; flowers solitary, yellow, 1 - 1.5 cm in diam. Petals yellow. Stamens 5 - 15. Achenes numerous on elongated receptacle, 9 - 10 mm long, having broad falcate beak and two empty pouches of cells on either side, placed far apart.

Fl. & Fr. March - May.

Distrib. India: Cultivated fields and wastelands of subalpine regions. Jammu & Kashmir.

Pakistan, Afghanistan, West & Central Asia and Europe.

2. *Ceratocephalus testiculatus* (Crantz) Roth, Enum. 1: 1014. 1827. *Ranunculus testiculatus* Crantz, Stirp. Austr. 2. 1763.

Annual herbs, 3 - 12 cm high, less pubescent than *C. falcatus*, more or less glaucous. Leaves similar to those of *C. falcatus*. Flowers 5 - 10 mm across. Achenes 5 - 6 mm long with narrow straight beaks and empty pouches of cells on either side, placed close to and nearly touching each other.

Fl. & Fr. March - May.

Distrib. India: Commonly in cultivated fields and wastelands. Jammu & Kashmir.

Pakistan, Iran, Turkey and Central Europe.

10. *Cimicifuga* L.

Herbs, perennial, tall, erect. Leaves 2 - 5 times ternately compound. Flowers actinomorphic, yellow in slender axillary racemes or terminal panicles. Sepals 4 - 5, petaloid, deciduous. Petals (or staminodes) 4 - 5, fleshy, bifid with 2 rounded lobes at apex. Carpels 3 - 8, many-ovuled; styles thickened, elongate. Follicles 2 - 8, in clusters, dry, dehiscent with curved beaks

Northern temperate regions; ca 15 species, one in India.

Cimicifuga foetida L., Syst. Nat. ed. 12, 659. 1767; Hook. f. & Thomson in Fl. Brit. India 1: 30. 1872. *Actaea cimicifuga* L., Sp. Pl. 504. 1753. *Cimicifuga frigida* Royle, Illus. Bot. Himal. t. 14. 1833 & 57. 1834.

Herbs, perennial, erect, pubescent, 1 - 4 m high; stems branched, hairy. Leaves ternately compound, up to 25 cm long; leaflets broadly ovate or lanceolate, the terminal leaflet somewhat trilobed, rounded at base, acute at apex, coarsely serrate along margins, 4 - 8 x 2.5 - 6 cm, sparsely pubescent; petioles 2 - 20 cm long. Flowers crowded, 8 - 10 mm across, white. Sepals obovate, concave, 3 - 4 x 2 - 3 mm, greenish. Petals elliptic or ovate, ca 4 x 2 mm; terminal lobes pale, ca 1 mm long. Stamens many, white. Carpels stipitate. Follicles oblong, flat, with curved beak, ca 10 x 5 mm, papery, 6 - 8-seeded.

Fl. & Fr. July - Oct.

Distrib. India: Alpine shaded hillslopes, near streams and scrubs, 2400 - 3600 m. Jammu & Kashmir, Himachal Pradesh, Uttar Pradesh and Sikkim.

Pakistan, Nepal, Bhutan, N. Myanmar, China, Korea, Japan and N. Asia.

Notes. Chromosome nos. $n = 8, 16; 2n = 16, 32$. See Hasegawa (in J. Jap. Bot. 44: 76 - 84. 1969; 45: 150 - 160, 297 - 308 & 362 - 377. 1970) for detailed discussion on the cytotaxonomy of *C. foetida* and its allies.

The roots possess sudorific and antiperiodic and emeto-purgative properties and is used as a nerve sedative in neuralgia and rheumatic afflictions. The flowers and unripe fruits emit a foetid smell. The plant is also reported to be an insect repellent (Chopra & Hadhwar in Indian J. Agri. Sci. 10: 16. 1940).

11. Clematis L.

Climbers, woody, shrubby or herbaceous, rarely erect or straggling shrubs; branches furrowed. Leaves opposite or fascicled at nodes, simple, 3-foliolate, ternately, biternately or pinnately compound; petioles and petiolules often twining. Flowers actinomorphic, bisexual or unisexual, solitary or in fascicles at the nodes or in axillary or terminal, few-flowered to many-flowered cymes or panicles. Sepals 4 - 6(-8), petaloid, uniseriate, free or jointed by interlocking marginal tomentum at lower part, white, yellowish, reddish or purplish. Petals absent. Stamens numerous, staminodal in female flowers; filaments glabrous or hairy. Carpels (3-)5 many, each with one pendulous ovule; styles persistent, usually pilose. Fruit a head of sessile or stalked laterally compressed achenes, each with an elongated slender feathery persistent style; styles plumose with long straight hairs, or rarely short, stout and without plumose hairs.

Cosmopolitan, chiefly temperate and subtropical; ca 250 species, 32 species in India.

Literature. GREY-WILSON, C. (1989) *Clematis orientalis* (Ranunculaceae) and its allies. *Kew Bull.* 44: 33 - 60. GUPTA, A. L. (1961 - 64) Illustrations of Indian plants. *Clematis I - III.* *Bull. Natl. Bot. Gard. Lucknow* 54: t. 1 - 21. 1961; 80: t. 22 - 46. 1963; 97: t. 47 - 55. 1964. KAPOOR, S. L. (1962 & 1963) Flowering plants of India. *Clematis I & II.* *Bull. Natl. Bot. Gard. Lucknow* 78: 1 - 67. 1962; 124: 1 - 94, t. 1 - 6. 1966. KAPOOR, S. L., CHHAYA SHARMA & B. S. TRIVEDI (1989) A study of the pollen grains of Indian *Clematis* Linn. (Ranunculaceae). *Bull. Bot. Surv. India* 31: 50 - 62. KAPOOR, S. L., C. L. VERMA & B. S. TRIVEDI (1985) A study of leaf cuticle of Indian *Clematis* Dill. ex Linn. (Ranunculaceae). *Bull. Bot. Surv. India* 27: 197 - 218. KUNTZE, O. (1985) *Monographie der Gattung Clematis.* *Verh. Ber. Ver. Brand.* 26: 83 - 202.

KEY TO THE SPECIES

- | | |
|---|---------------------------|
| 1a. Leaves fascicled at nodes | 2 |
| b. Leaves opposite | 5 |
| 2a. Anthers densely bearded at back | 5. <i>C. barbellata</i> |
| b. Anthers glabrous | 3 |
| 3a. Flowers in axillary panicles of 3 - 7 flowers or solitary and axillary | 32. <i>C. zemuensis</i> |
| b. Flowers in axillary fascicles or sometimes reduced to one | 4 |
| 4a. Pedicels up to 2 cm long, tomentose, with 2 connate bracts above the middle | 21. <i>C. napaulensis</i> |
| b. Pedicels 3 - 8 cm long, glabrous, naked | 19. <i>C. montana</i> |

- 5a. Branches with 6 ribs 6
 b. Branches with more than 6 ribs 9
 6a. Leaves 3- to 5-foliolate 12. *C. grata*
 b. Leaves bipinnately or ternately compound 7
 7a. Stamens hairy 2. *C. acutangula*
 b. Stamens glabrous 8
 8a. Flowers solitary, axillary, blue or pale lilac 8. *C. cadmia*
 b. Flowers in axillary panicles, white 23. *C. puberula*
 9a. Filaments hairy 10
 b. Filaments glabrous 21
 10a. Branches glabrous or sparsely hairy 11
 b. Branches villous or densely tomentose 15
 11a. Petioles connate at base forming a broadly winged leathery expansion of nodes 9. *C. connata*
 b. Petioles not connate or winged 12
 12a. Leaves 3-foliolate 1. *C. acuminata*
 b. Leaves 1- or 2-pinnately or ternately compound 13
 13a. Inflorescence 3- to 5-flowered or flowers solitary; sepals notched or subtruncate at apex, glabrous along inner margins 13. *C. graveolens*
 b. Inflorescence a panicle of 5 - several flowers; sepals acute or subacute at apex, pubescent along inner margins 14
 14a. Leaflets long acuminate; filaments 2 - 3 times as long as anthers 17. *C. ladakhiana*
 b. Leaflets obtuse or acute; filaments less than 2 times as long as anthers 22. *C. orientalis*
 15a. Flowers solitary, axillary on long pedicels or terminal at ends of branches 16
 b. Flowers in panicles, 3- to many-flowered 17
 16a. Shrubs decumbent; branches erect; leaves pinnatisect; sepals glabrous inside, pubescent outside; filaments densely ciliate on lower half 26. *C. tangutica*
 b. Shrubs climbing; leaves biternate; sepals pubescent inside, glabrous or subglabrous outside; filaments slightly ciliate 28. *C. tibetana*
 17a. Sepals spreading 31. *C. wightiana*
 b. Sepals erect or suberect 18
 18a. Sepals conspicuously or inconspicuously ribbed outside 19
 b. Sepals not ribbed outside 20
 19a. Sepals 5 - 7 mm wide, narrowed at base; anthers twisted 7. *C. buchananiana*
 b. Sepals 8 - 11 mm wide, broad at base; anthers not twisted 30. *C. wattii*
 20a. Sepals hairy inside; inflorescence a panicle 14. *C. grewilflora*
 b. Sepals glabrous inside; inflorescence 3- to many-flowered 24. *C. roylei*
 21a. Connectives conspicuously produced beyond anther lobes (somewhat slightly so in *C. smilacifolia* ssp. *andamanica*) 22
 b. Connectives not or slightly produced beyond anthers 27
 22a. Leaves 1- or 2-ternate or ternately cut 23
 b. Leaves simple or 3-foliolate 24
 23a. Leaflets elliptic-oblong 6. *C. bourdillonii*
 b. Leaflets ovate-lanceolate 15. *C. hedyarifolia*

- 24a. Sepals hairy inside 25
 b. Sepals glabrous inside 26
- 25a. Leaves simple; leaflets acute or obtuse; sepals golden brown villous inside, not ribbed outside 10. *C. fulvicoma*
 b. Leaves 3-foliolate; leaflets with narrowly drawn out apex; sepals white velvety inside, ribbed outside 3. *C. andersonii*
- 26a. Leaves usually simple or very rarely 3-foliolate; filaments not constricted below anthers 25. *C. smilacifolia*
 b. Leaves 3-foliolate, sometimes simple near flowering region; filaments constricted just below anthers 20. *C. munrolana*
- 27a. Flowers solitary, axillary 29. *C. tongluensis*
 b. Flowers in 1-many-flowered inflorescence 28
- 28a. Branches glabrous 29
 b. Branches villous or appressed hairy 30
- 29a. Inflorescence a panicle, covered by scales near base; plants of N.E. India 18. *C. meyeriana*
 b. Inflorescence axillary or terminal, 1 - 3-flowered, not covered by such scales; plants of Nilgiri hills in Peninsular India 27. *C. theobromina*
- 30a. Leaves bipinnate or bipinnatisect 11. *C. gouriana*
 b. Leaves simple, 3-lobed or 3- to 5(-7)-foliolate 31
- 31a. Flowers 1 cm or less in diam. 4. *C. apiculata*
 b. Flowers 2-5 cm in diam. 16. *C. heynei*

1. *Clematis acuminata* DC., Syst. Nat. 1: 148. 1817 & Prodr. 1: 6. 1824; Hook. f. & Thomson in Fl. Brit. India 1: 5. 1872. *C. acuminata* var. *wallichii* and var. *sikkimensis* Hook. f. & Thomson in Fl. Brit. India 1: 5 & 6. 1872.

Slender woody climbers; roots thick, tuberous; branches purplish red, ribbed, glabrous or with a few scattered hairs. Leaves opposite, pinnately 3-foliolate, 13 - 18 cm long; petioles ribbed, 5 - 7 cm long; leaflets ovate-lanceolate or oblong-lanceolate, subcuneate, rounded or subcordate at base, irregularly distantly serrate along margins, acute to acuminate at apex, glossy, glabrous or sparsely pubescent, palmately 5-nerved; lateral leaflets 5 - 9 x 2.5 - 4 cm, with 5 - 10 mm long petiolules; terminal leaflets 8 - 11 x 3.5 - 7.5 cm, with 5 - 10 mm long petiolules. Inflorescences axillary, trichotomously branched panicles, few to many-flowered, glabrous or sparsely pubescent; peduncles 3 - 4 cm long, puberulous; bracts linear-lanceolate, 3 - 5 mm long; pedicels 2 - 3 cm long, puberulous. Flowers completely tomentose in bud, 2 - 3 cm across when fully open, pale yellow. Sepals 4, ovate or oblong-lanceolate, acute, erect or recurved at tip, 10 - 17 x 4 - 7 mm, yellow or pale cream-coloured, completely pubescent or only along the margins outside, puberulous inside. Filaments linear, up to 1 cm long, densely hairy; anthers straight, ca 3 mm long. Achenes ovate, compressed, ca 3 cm long, silky hairy; style up to 2 cm long, feathery-plumose, longer towards base.

KEY TO THE SUBSPECIES

- | | |
|---|--------------------------------|
| 1a. Leaflets oblong-lanceolate; sepals tomentose all over outside | 1.1. subsp. <i>acuminata</i> |
| b. Leaflets ovate-lanceolate; sepals tomentose only along margins outside | 1.2. subsp. <i>sikkimensis</i> |

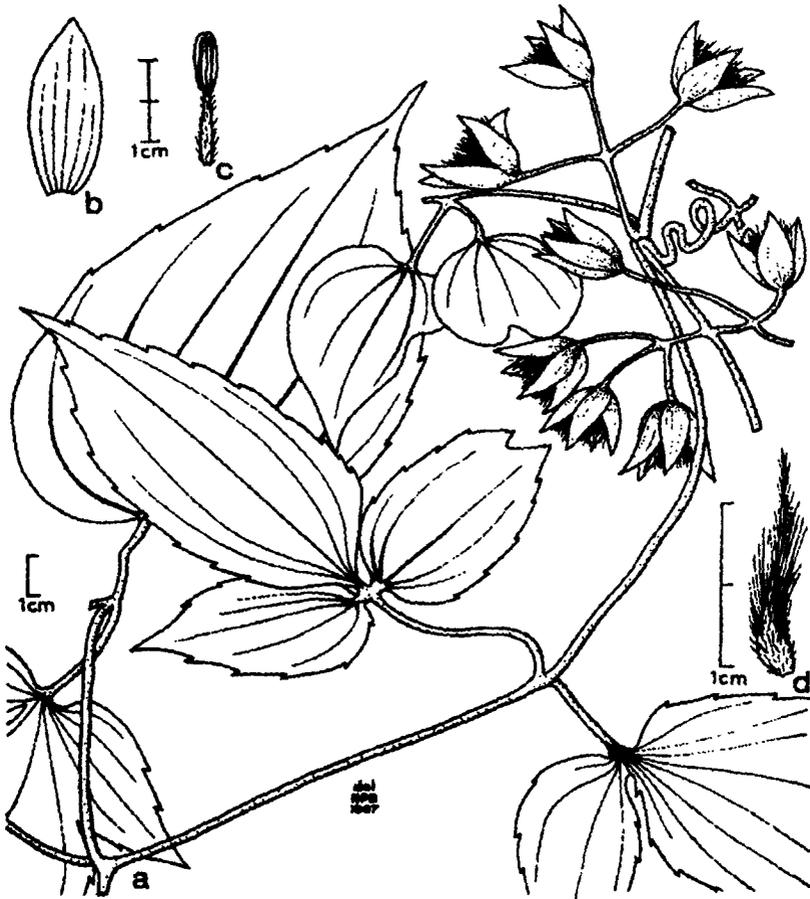


Fig. 9. *Clematis acuminata* DC. subsp. *acuminata* : a. branch; b. sepal; c. stamen; d. achene.

1.1. subsp. *acuminata*

Fig. 9.

C. acuminata DC. var. *wallichii* Hook. f. & Thomson, l. c.

Garh: *Khandmala*; Jain.: *Tilli-tyman-ka*

Fl. Oct. - Feb.; *Fr.* Nov. - Apr.

Distrib. India: Subtropical and temperate regions, edges of forests and streamsides, 500 - 2400 m. Himachal Pradesh, Uttar Pradesh (Garhwal), West Bengal, Sikkim, Arunachal Pradesh, Nagaland, Assam and Meghalaya.

Nepal, Bhutan and Myanmar.

1.2. subsp. *sikkimensis* (Hook. f. & Thomson) Bruehl in Ann. R. Bot. Gard. Calc. 5: 75. 1896. *C. acuminata* DC. var. *sikkimensis* Hook. f. & Thomson in Fl. Brit. India 1: 6. 1872. *C. sikkimensis* (Hook. f. & Thomson) Burkill in Rec. Bot. Surv. India 10: 229. 1925.

Fl. Nov. - Feb.; *Fr.* Feb. - June.

Distrib. India: Subtropical broad-leaved forests, 300 - 2400 m. West Bengal, Sikkim, Arunachal Pradesh, Nagaland and Meghalaya.

Nepal and Myanmar.

Notes. A variety under this subspecies, var. *clarkei* O. Ktze (based on *Kurz* 178 in CAL) with 3-flowered inflorescence has been recognised by Bruehl (l. c. 75. 1896) with an emended description to that of Kuntze (in Verh. Bot. Ver. Brandenb. 26: 167. 1885). This seems to be an aberrant form and unless more materials of this type is seen its distinctness remains doubtful.

2. *Clematis acutangula* Hook. f. & Thomson in Fl. Brit. India 1: 3. 1872.

Slender woody climbers; stems erect or weakly scandent; branches angled, deeply furrowed and ribbed, herbaceous or slightly woody, hairy at nodes, glabrous at internodes. Leaves opposite, bipinnate, ternate to biternate, 12 - 18 cm long; petioles 6 - 8 cm long, angled, puberulous; leaflets ovate or ovate-lanceolate, rounded or truncate at base, acute to acuminate at apex, coarsely crenate-serrate along margins, simple or shallowly 3-ribbed, 2.5 x 1.3 cm, puberulous; nerves 5, palmate, raised beneath; petiolules 2 - 4 cm long. Inflorescences axillary, sessile, 1 - 3-flowered; pedicels 2 - 5 cm long; bracts sessile, ovate-lanceolate, ca 5 mm long. Flowers ca 3 cm across, brownish yellow. Sepals 4 - 5, spreading, oblong-elliptic, acute, 1 - 1.5 x 0.4 - 0.6 cm, narrowly 3-winged on back, subglabrous, pubescent outside, with long hairs along margins.

Filaments linear, flat, ca 1 cm long, pilose; anthers ca 2 mm long; connective slightly produced, densely hairy. Achenes ovate or elliptic-ovate, acute, flat, margined, ca 3 x 2 mm; style brownish silky, up to 2.5 cm long.

Fl. June-Nov.; *Fr.* Sept.-Jan.

Distrib. India: Subtropical and temperate open pine forests and scrubs, 1500-2700 m. Meghalaya and Nagaland.

Bhutan.

3. *Clematis andersonii* (C.B. Clarke ex O. Ktze) Eichler in *Bibl. Bot. Stuttgart* 124: 47. 1958. *C. smilacifolia* Wallich var. *andersonii* C.B. Clarke ex O. Ktze, *Verh. Bot. Ver. Brandenb.* 26: 167. 1885.

Climbing shrubs; branches puberulous or glabrous. Leaves opposite, pinnately 3-foliolate; leaflets elliptic-lanceolate or oblong-elliptic, characteristically with a narrowly drawn out apex, coarsely toothed or entire, glabrous on both surfaces. Inflorescence axillary or terminal, 1-9-flowered. Flowers large, nearly 4 cm across. Sepals thick, velvety on both sides, ribbed outside. Filaments glabrous; connective produced beyond anther lobes. Mature achenes not seen.

Fl. & Fr. Oct. - Jan.

Distrib. India: West Bengal and Sikkim.

Endemic.

4. *Clematis apiculata* Hook. f. & Thomson in *Fl. Brit. India* 1: 4. 1872. *C. apiifolia* DC. var. *apiculata* (Hook. f. & Thomson) O. Ktze in *Verh. Bot. Ver. Brandenb.* 26: 167. 1885. Fig. 10.

Slender woody climbers; branches sulcate with more than 6 ribs, adpressedly or patently hairy. Leaves opposite, simple, 3-lobed or 3-foliolate; petioles 3 - 8 cm long, slender, hairy; lamina ovate-oblong, cordate or subcordate at base, entire, crenate or irregularly toothed, acuminate at apex, 2 - 8 x 1.5 - 5 cm, membranous, sparsely hairy on both surfaces; lateral petiolules 5 - 15 mm long. Inflorescence axillary, fasciculate or leafy panicle of many, ca 1 cm long flowers. Sepals oblong, 3 - 6 mm long, tomentose outside. Filaments short, linear, glabrous; anthers straight; connectives produced into a minute mucro. Achenes broadly ovate or obovate, margined, compressed, hairy, with up to 6 cm long feathery tails.

Fl. Oct. - Nov.; *Fr.* Dec. - Feb.

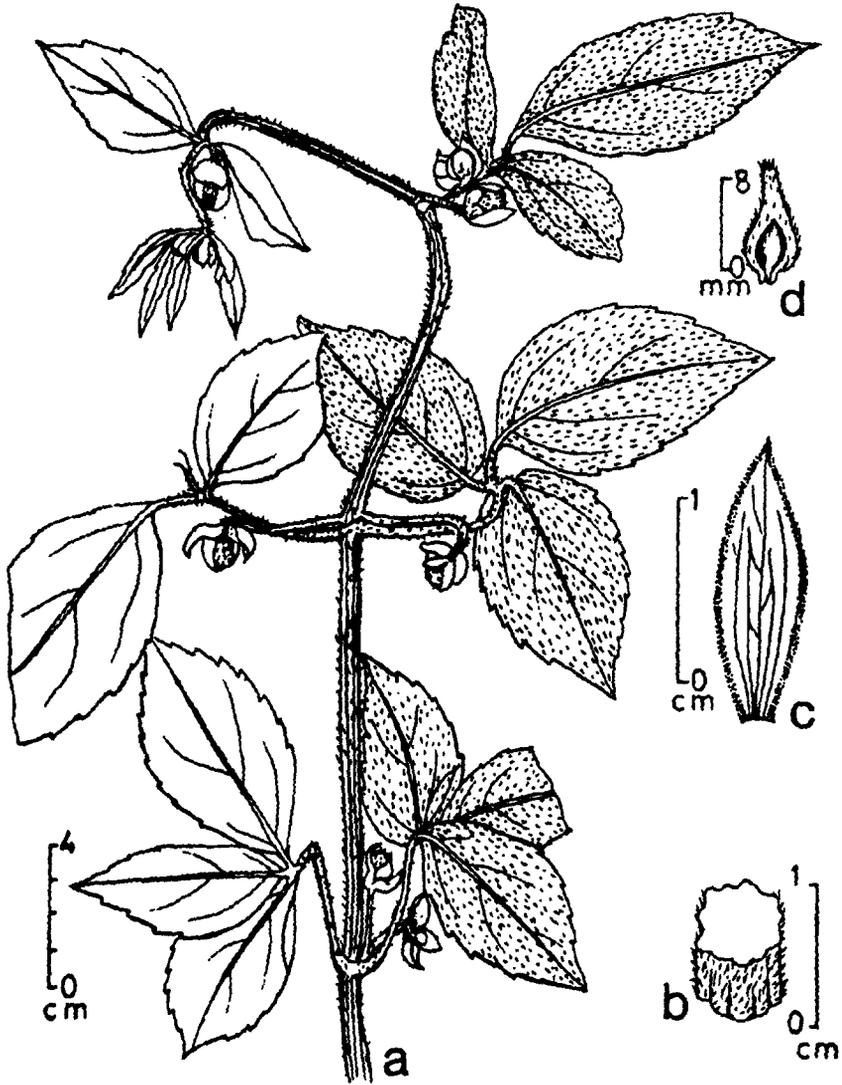


Fig. 10. *Clematis apiculata* Hook. f. & Thomson: a. branch; b. t.s. of stem; c. sepal; d. achene (from A.S. Chauhan in Red Data Book of Indian Plants 1: 316. 1987).

Distrib. India: Meghalaya and Manipur.

Endemic.

5. *Clematis barbellata* Edgew. in Trans. Linn. Soc. 20: 25. 1846; Hook. f. & Thomson in Fl. Brit. India 1: 3. 1872. *C. napaulensis* auct. non DC.; Royle, Illus. Bot. Himal. 51. 1834. *C. barbellata* var. *obtusata* Kitam. & Tamura in Fauna Fl. Nep. Himal. 127. 1955.

Large woody climbers; branches terete, glabrous or sparsely hairy. Leaves fascicled at nodes on short branchlets, in the axils of scales, 3-foliolate; leaflets ovate or ovate-lanceolate, lobed or not, usually at base of lateral leaflets, irregularly sharply serrate, usually glabrous on both surfaces. Flowers large, in axillary fascicles, dull purple; buds ovoid, acute; pedicels up to 10 cm long, elongating in fruits. Sepals 4, spreading, lanceolate, long-pointed at apex, more or less villous on both surfaces, purplish inside. Filaments broadly linear, fringed with long hairs; anthers densely bearded on back. Achenes broadly ovate, compressed, glabrous, with up to 5 cm long feathery tails.

Fl. Feb. - Aug.; *Fr.* June - Oct.

Distrib. India: Forests of N.W. Himalayas, 1500 - 3500 m. Jammu & Kashmir, Himachal Pradesh and Uttar Pradesh.

Pakistan and Nepal.

6. *Clematis bourdillonii* Dunn in Kew Bull. 1914: 81. 1914; Gamble, Fl. Pres. Madras 1: 3. 1915 (repr. ed. 1: 2. 1957).

Shrubs, climbing or straggling; branches glabrous or sparsely hairy. Leaves 1-2-ternate; leaflets oblong or elliptic, acute or obtuse, entire or sometimes coarsely toothed, 6-8 x 2.8-4.5 cm; nerves 3-5, ribbed and raised beneath. Inflorescence axillary or terminal, many-flowered panicles. Flowers ca 2 cm across, with up to 1.5-1.7 cm long pedicels. Sepals 4, reflexed, glabrous inside, villous outside. Filaments glabrous; connectives produced beyond anther lobes. Achenes with up to 5 cm long tails.

Fl. April - May; *Fr.* June - Aug.

Distrib. India: Evergreen forests of Western Ghats, 500 - 1000 m. Kerala.

Endemic, rare and endangered.

Notes. Chromosome no. $n = 24$ (Shobha & Ramachandran in Taxon 29: 165. 1980).

7. *Clematis buchananiana* DC., Syst. Nat. 1: 140. 1817 & Prodr. 1: 4. 1824 (as *buchaniana*); Hook. f. & Thomson in Fl. Brit. India 1: 6. 1872. *C. buchananiana* vars. *rugosa*, *tortuosa* and *vitifolia* Hook. f. & Thomson, l.c.

Garh.: *Alaka-loga*; Jain.: *Tillo-kynsaw-bla*; Kh.: *Mei-bytengdoh*; Kumaon.: *Ghani-la*.

Large woody climbers; branches sulcate, greyish or brownish pilose with long spreading fibrous hairs. Leaves ternate or rarely pinnate, 3-7-foliolate; petiolules ribbed, 5-7 cm long, pilose or brownish pubescent; bases of opposite petioles sometimes broadened, thickened and united; leaflets broadly ovate-lanceolate, orbicular, sometimes 2-3-lobed, rounded or subcordate and 5-7-nerved at base, acute or subacute at apex, coarsely crenate-serrate along margins, 5-15 x 4-12 cm, pubescent above, white or densely hoary beneath; petiolules 1-3 cm long, often twining. Inflorescence axillary, 3- to many-flowered, leafy panicles, thinly pilose; peduncles 4-9 cm long, ribbed, hairy; bracts and bracteoles in pairs at each node, foliaceous, ovate-lanceolate, variable in shape, 5-10 x 3-8 cm; pedicels 2-4 cm long. Flowers 4-6, erect, often with recurved tips. Sepals, ovate, oblong or oblong-lanceolate, acute or obtuse, 2-3 x 0.5-0.7 cm, many-ribbed outside, greenish yellow, white tomentose inside, densely brownish pubescent outside. Filaments linear, flat, ca 1 cm long, densely short hairy; anthers twisted, ca 5 mm long; connectives hardly prolonged above anthers. Achenes ovate or obovate, compressed, 4-5 x 2-3 mm, densely hairy, with up to 5 cm long feathery long silky tails.

Fl. & Fr. May - Jan.

Distrib. India: Evergreen subtropical and temperate forests on Himalayas and N.E. regions, 1000-3000 m. Jammu & Kashmir, Himachal Pradesh, Uttar Pradesh, West Bengal, Sikkim, Arunachal Pradesh, Nagaland, Manipur, Mizoram, Assam and Meghalaya.

Nepal, Bhutan, Bangladesh, N. Myanmar, Vietnam and China.

Notes. Chromosome no. $2n = 16$ (Bhattacharjee in Sci. & Cult. 42: 234. 1976).

A variable species with 2 varieties, var. *rugosa* Hook. f. & Thomson with prominently nerved leaves from Bhutan and var. *tortuosa* Hook. f. & Thomson with pinnate leaves from Sikkim have been described. They are scarcely distinguishable in populations, with interconnecting intermediaries.

8. *Clematis cadmia* Buch.-Ham. ex Hook. f. & Thomson, Fl. Ind. 5. 1855 & in Fl. Brit. India 1: 2. 1872.

Asm.: *Bon-jaluki*, *Bon-marich*.

Slender subherbaceous climbers; branches slender, scarcely woody, glabrous or softly hairy. Leaves ternately or biternately compound; leaflets ovate to narrow-lanceolate or rhomboid, entire or minutely crenulate, ciliate along margins, otherwise glabrous, 3 - 5-nerved from rounded cuneate or subcordate base, acuminate at apex; lateral nerves 1 - 3 pairs, distinct, arched, anastomosing. Flowers solitary, axillary, pale lilac to bluish; pedicels 8 - 15 cm long, bearing a pair of sessile ovate-acute bracts at middle, 1.5 - 3 x 0.5 - 3 cm. Sepals 4 - 6, spreading, elliptic-oblancoate, unequal, the largest 4 - 5 x 1.5 cm, bluish white, longitudinally veined, softly tomentose, 2.5 - 3.5 mm long, dehiscent laterally; connectives slightly prolonged beyond anther-lobes. Achenes many, broadly ovate-elliptic, compressed, ca 7 x 5 mm, appressed-pubescent, hooked at first, later becoming straight.

Fl. Dec. - April; *Fr.* Feb. - June.

Distrib. India: Tropical and subtropical forests, up to 1600 m. Uttar Pradesh, Sikkim, Meghalaya, Assam and Manipur.

Bhutan, Bangladesh and Myanmar.

Notes. Fruits and roots are eaten as condiment, a substitute for chillies (note on herbarium sheet of W.R. Fischer in Herb. CAL).

9. *Clematis connata* DC., Prodr. 1: 4. 1824; Hook. f. & Thomson in Fl. Brit. India 1: 6. 1872.

Large woody climbers, climbing by means of petioles; branches sulcate, glabrous, brownish. Leaves pinnate, 10 - 30 cm long; petiole-base winged, connate, forming 5 - 12 mm broad collar around the node; leaflets 3 - 7, distant, simple or somewhat 2 - 3-lobed, broadly ovate-cordate, elliptic or ovate-lanceolate, broadly rounded or cordate at base, sharply serrate, acute to acuminate at apex, 5 - 12 x 1.5 - 8 cm, glabrous or somewhat pubescent along nerves beneath, often with scattered hairs on both surfaces; basal nerves 1 - 6. Inflorescence a cymosely flowered 4 - 10 cm long panicle; peduncles 3 - 5 cm long; bracts lanceolate, often trilobed, 1 - 1.6 x 0.25 - 1.8 cm hairy on both surfaces, without ribs; pedicels up to 4 cm long; flowers nearly 5 cm across, showy, light yellowish creamy or white. Sepals 4, erect, not ribbed, ovate, acute, recurved or revolute at tips, 1 - 2 x 0.5 - 1 cm, brown outside, yellowish pubescent. Stamens 7.5 - 8 mm long; filaments linear, hairy; anthers ca 3 mm long. Achenes ovate or obovate, compressed, pubescent, with up to 5 cm long feathery silky hairy tails.

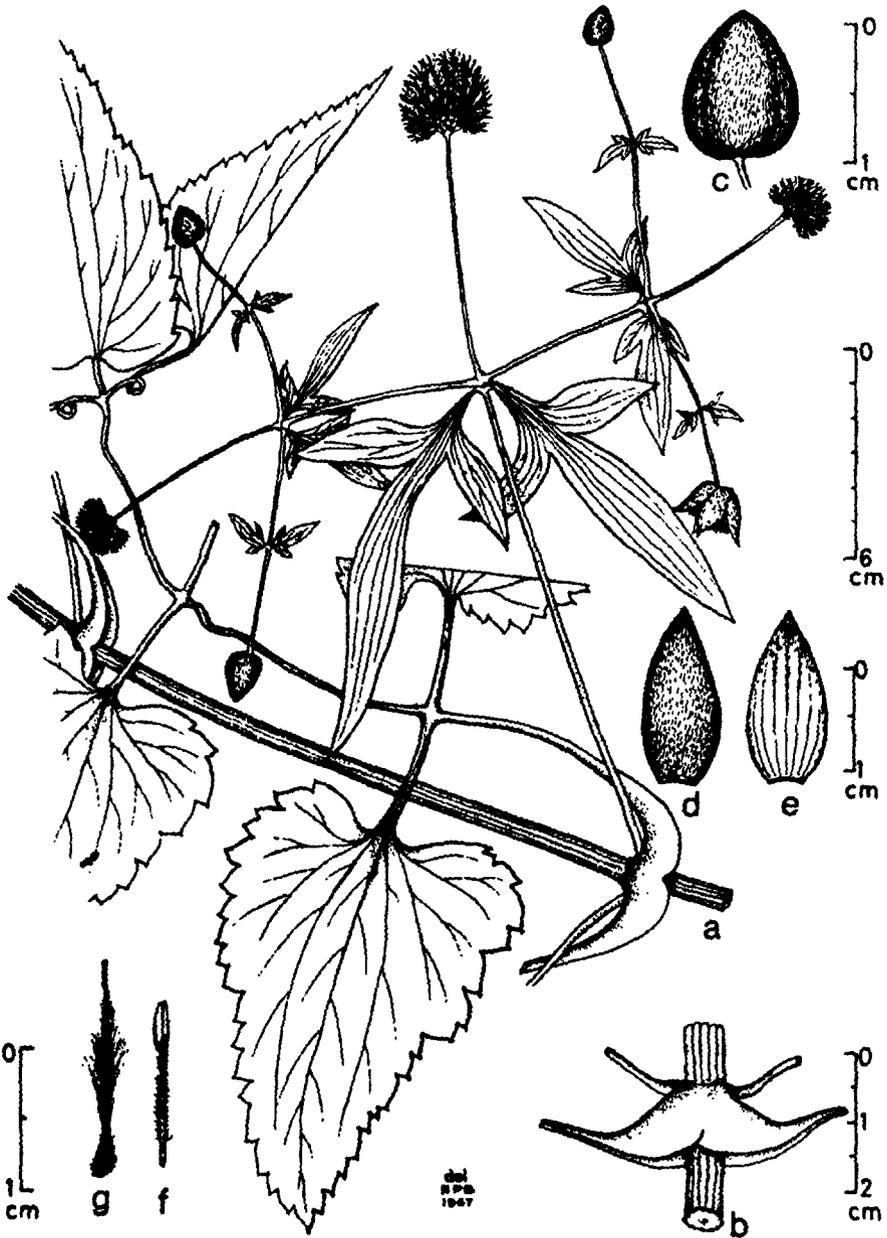


Fig. 11. *Clematis connata* DC. var. *connata*: a. flowering twig; b. node showing winged petiole base; c. bud; d. sepal, outer view; e. sepal, inner view; f. stamen; g. carpel.

KEY TO THE VARIETIES

- 1a. Leaves 3 - 7-foliolate; leaflets broadly ovate with cordate base, 5 - 10 x 1.5 - 9 cm; sepals oblong-ovate
9.1. var. *connata*
- b. Leaves 5 - 7-foliolate; leaflets lanceolate, slightly cordate at base, 5 - 8 x 1.5 - 3.2 cm; sepals lanceolate
9.2. var. *lanceolata*

9.1. var. *connata*

Fig. 11.

Fl. July - Oct.; *Fr.* Aug. - Oct.

Distrib. India: Himalayas, edges of forests, streamsides and often on roadsides, 500-3000 m. Jammu & Kashmir, Himachal Pradesh, Uttar Pradesh, West Bengal, Sikkim and Arunachal Pradesh.

Pakistan, Nepal, Bhutan and China (Tibet).

Notes. Chromosome no.: $n = 8$, $2n = 16$ (Bhattacharjee in *Sci. & Cult.* 42: 234. 1976).

9.2. var. *lanceolata* Biswas in *Indian J. For.* 81(1): 61 - 63. tt. 1 - 2. 1985.

Scandent shrubs; branches sulcate with more than 6 fibrovascular bundles, glabrous, brownish. Leaves 5 - 7-foliolate, 10 - 30 cm long; leaflets lanceolate, serrate, somewhat lobed or otherwise acute, 5 - 8 x 1.5 - 3.2 cm; basal nerves 1 - 6, glabrous or somewhat pubescent along nerves beneath in young leaves. Flowers light yellow, 3 - 9 in oppositely 4 - 9 mm long panicles; peduncles 3 - 5 cm long; bracts lanceolate, 1 - 1.6 x 0.28 - 0.8 cm, without ribs, hairy on both surfaces. Stamens 7.5 - 8 mm long; anthers ca 3 mm long; filaments hairy throughout. Achenes pubescent.

Fl. & Fr. Aug. - Oct.*Distrib.* India: Tehri Garhwal regions of Uttar Pradesh.

Endemic.

10. *Clematis fulvicoma* Rehder & Wilson in *Pl. Wilson.* 1: 327 - 328. 1913.

Climbing shrubs; branches sulcate, glabrous or sometimes scattered hairy. Leaves opposite, simple, up to 30 cm long; petioles (4-) 8 - 16 cm long, twining, ribbed, flattened at base; lamina entire, broad-ovate to elongate-ovate, truncate, subcordate, subcuneate or subpeltate at base, obtuse, acute or subacuminate at apex, 9 - 19 x 7 - 18 cm, subcoriaceous, glossy; main nerves 5 - 7 (-9), palmate from base, raised beneath.

Inflorescence axillary, 3 - 9 (-many)-flowered racemes; bracts minute and linear or sometimes larger and elliptic-lanceolate; peduncles ribbed and pubescent; pedicels 2 - 5 cm long, densely brown pubescent; flower-buds elliptic, acute, densely deep brown villous. Sepals 4 - 5, spreading or reflexed from base; oblong-lanceolate, acute or subobtusate, 7 - 18 x 2 - 6 mm, velvety tomentose outside with deep reddish brown tomentum, golden brown villous inside. Filaments linear, flat, glabrous; connectives produced beyond anthers. Achenes ovate, compressed, margined, grey hairy, with 3 - 7 cm long feathery tails.

Fl. Sept. - Jan.; *Fr.* Feb. - May.

Distrib. India: Open forests, near streams, 500 - 1500 m. Assam (Mikir hills) and Meghalaya.

Myanmar, Thailand and China.

11. *Clematis gouriana* Roxb. [Hort. Beng. 43. 1814, nom. nud.] ex DC., Syst. Nat. 1: 138. 1817 & Prodr. 1: 3. 1824; Hook. f. & Thomson in Fl. Brit. India 1: 4. 1872.

Hindi: *Belkun* (Dehradun), *Kanguli*; Kh.: *Jermei-Bytengdoh*; Mar.: *Mor-vel*; Tam.: *Attumeeskodi*, *Muravalli*; Tel.: *Veruvisa-madu* (Tribals).

Extensive climbers, often reaching great heights over tall trees; stem and branches 6 - 12 furrowed-ribbed, glabrous or sparsely hairy when young. Leaves 1 - 2-pinnately compound, up to 14 x 10 cm; leaflets 5 - 9, variable, elliptic-lanceolate or ovate, rounded or cordate at base, entire or serrate with a few teeth near apex at margins, acute or acuminate at apex, 2.5 - 7.5 x 1.5 - 3.5 cm, thin, smooth, glabrous or pubescent along nerves, 3 - 5-nerved; petioles not connate at base, twining, up to 6 cm long; petiolules slender, up to 2.5 cm long. Inflorescences axillary or terminal, crowded, dense, up to 15 cm long; pedicels up to 1.5 cm long. Flowers 1 - 1.5 cm across, greenish white or pale yellowish white, scented. Sepals 4, spreading from base, oblong-elliptic or obovate, rounded at apex, revolute along margins, ca 6 x 2 mm, pubescent. Stamens 30 - 35; filaments linear, flat, glabrous; connectives scarcely produced above anthers. Carpels 10 - 15; oblong or linear, hairy; styles up to 2.5 mm long; stigma clavate. Achenes narrowly ovoid-oblong, more or less compressed, 3 - 5 x 1 - 2 mm, densely hairy, with up to 5 cm long feathery tails.

Fl. Aug. - Feb.; *Fr.* Sept. - May.

Distrib. India: Tropical and subtropical forests, spreading on thickets and climbing on trees, up to 2000 m. Himachal Pradesh, Punjab, Haryana, Uttar Pradesh, Bihar, West Bengal, Sikkim, Arunachal Pradesh, Nagaland, Manipur, Tripura, Assam, Meghalaya, Orissa, Madhya Pradesh, Andhra Pradesh, Maharashtra, Karnataka, Kerala and Tamil Nadu.

Pakistan, Nepal, Bhutan, Bangladesh, Myanmar, W. & C. China and Sri Lanka.

Notes: Chromosome no. $2n = 16$ (Raghavan & Arora in Proc. Indian Acad. Sci. 46: 352-353. 1958).

Leaf paste is applied to wounds of cattle by Jatapus, Khonds and Savaras of Andhra Pradesh.

12. Clematis grata Wallich, Pl. Asiat. Rar. 1: 83, t. 98. 1830; Hook. f. & Thomson in Fl. Brit. India 1: 3 - 4. 1872. *C. cordata* Royle, Illus. Bot. Himal. 51. 1834.

Large robust climbers; branches grooved, somewhat pubescent, climbing by means of twisted petioles. Leaves pinnately compound, (3-) 5 (-7)-foliolate; leaflets variable, generally ovate-lanceolate, often cordate at base, acute or sometimes 2- to 3-lobed, irregularly toothed along margins, subglabrous above, tomentose beneath. Inflorescence axillary or terminal, paniculate, few- to many-flowered, leafy. Flowers up to 2.5 cm across, creamy-white, scented. Sepals 4(-5), spreading horizontally or downwards, oblong-ovate, obtuse, petaloid, somewhat tomentose outside, glabrescent or puberulous inside. Stamens many; filaments linear, flat, glabrous; connectives hardly produced beyond anthers. Achenes in heads, ovate, compressed, densely hairy with up to 3.5 cm long feathery tails.

Fl. & Fr. April - Jan. (varies in different localities).

Distrib. India: Overtopping shrubs and low trees on open sunny localities between 800 - 2700 m in W. Himalayas. Jammu & Kashmir, Himachal Pradesh and Uttar Pradesh.

Afghanistan, Pakistan, Nepal and S. China.

13. Clematis graveolens Lindley in J. Hort. Soc. 1: 307. 1846; Hook. f. & Thomson in Fl. Brit. India 1: 4-5. 1872. *C. parviflora* auct. non Edgew.; Hook. f. & Thomson, Fl. Ind. 9. 1855.

Kash.: *Hardand*.

Slender extensive climbers, much branched, up to 3 - 4 m; stems slender, tough, glabrous or sparsely hairy. Leaves pinnately or ternately decomposed; leaflets oblong, elliptic, lanceolate or narrowly ovate, dentate, incised or 3-lobed at base, 1 - 3.7 x 0.3 - 1.4 cm, glaucous-green, glabrous above, sparsely pubescent beneath; terminal leaflet longest. Inflorescences leafy, 3 - 7-flowered or flowers solitary and terminal on long peduncles, pubescent; bracts similar to leaves, often trifoliolate or unifoliolate; pedicels slender, 1.5 - 10 cm long, sparsely pubescent to glabrous. Flowers 3 - 5 cm across, lemon yellow with purplish brown or purplish stamens, strongly scented. Sepals 4, emarginate,

truncate or obtuse at apex, 11 - 18 x 5 - 10 mm, glabrous along inner margins, hairy along outside margins, silky pubescent inside. Filaments linear, 5 - 9 mm long, hairy throughout; anthers 2 - 3.5 mm long, glabrous. Achenes ovoid, hairy, with ca 4 cm long feathery tails.

Fl. June-Nov.; *Fr.* Sept.-Dec.

Distrib. India: W. Himalayas, open sunny places, edges of forests and roadsides, 1500 - 3000 m. Jammu & Kashmir, Himachal Pradesh, Uttar Pradesh.

Afghanistan, Pakistan, Nepal and China.

Notes. A poisonous plant. The pubescent margins of sepals are knit together while the flowers are in bud.

14. *Clematis grewiflora* DC., Syst. Nat. 1: 140. 1818 & Prodr. 1: 4. 1824 (as *grewiaeflora*); Hook. f. & Thomson in Fl. Brit India 1: 6. 1872. *C. loasaefolia* DC., Syst. Nat. 1: 140. 1818; Hook. f. & Thomson, l. c.

Large woody climbers; branches purplish red, closely ribbed, densely brown tomentose, more so at nodes. Leaves pinnate, 3 - 5-foliolate, 12 - 17 cm long, densely brown tomentose; petioles 3 - 4 cm long, ribbed, densely pilose; petiolules of lateral leaflets 5 - 15 mm long, of terminal leaflets 1.5 - 2 cm long; leaflets broadly ovate, often trilobed, cuneate, rounded or subcordate at base, crenate-dentate along margins, acute to acuminate at apex, 5 - 15 x 2 - 6 cm, coarsely scattered hairy on both surfaces, more on nerves beneath; main nerves 5, palmate, prominent beneath. Inflorescences axillary, many-flowered, trichotomously branched; peduncles densely hairy, ca 10 x 6 mm; pedicels 3 - 4 cm long, often twisted, densely hairy. Flowers greenish or whitish, 3 - 5 cm across. Sepals ovate or oblong-ovate, acute, 20 - 25 x 8 - 11 mm, densely brown hairy outside, puberulous inside. Filaments long-linear, flat, ca 2 cm long, densely ascending hairy; anthers ca 5 mm long, narrowly twisted. Achenes ovate, compressed, ca 2 cm long, velvety hairy, with up to 3.5 cm long, feathery white silky tails.

Fl. Oct. - Feb.; *Fr.* up to April.

Distrib. India: Himalayas, dry scrubs in subtropical and warm broad-leaved forests, 700 - 1800 m. Himachal Pradesh, Uttar Pradesh, Sikkim, Arunachal Pradesh, Nagaland, Assam and Meghalaya.

Nepal, Bhutan, N. Myanmar and China.

15. *Clematis hedysarifolia* DC., Syst. Nat. 1: 148. 1818 & Prodr. 1: 6. 1824, excl. cit. Bot. Reg. t. 599. 1822 (non O. Ktze, 1855); Hook. f. & Thomson in Fl. Brit. India 1: 4. 1872. *C. naravelioides* O. Ktze in Verh. Bot. Ver. Brandenb. 26: 119. 1855.

Mar.: *Bandrichi*.

Scandent woody shrubs; branches puberulous when young, later glabrous and about 12-ribbed. Leaves ternately pinnate; petioles long, twisting; leaflets 3-5, subequal, ovate-lanceolate, cordate or rounded at base, entire or coarsely dentate, acute to acuminate at apex, 5-10 x 2-6 cm, coriaceous, glabrous on both sides, prominently veined. Inflorescences axillary, lower ones paniculate, higher ones 3-flowered with the topmost one single-flowered. Flowers 1.5-2 cm across, greenish yellow. Sepals 4, ovate-oblong, densely hairy outside, ultimately deflexed. Filaments flat, ligulate, glabrous; anthers lateral with prolonged connectives. Achenes ovoid or oblong, compressed, hairy, tubercled at margins, with up to 5 cm long feathery tails.

Fl. Sept.-Dec.; *Fr.* Oct.-April.

Distrib. India: Wet deciduous or semievergreen forests, 500-1500 m. Gujarat, Maharashtra, Goa and Karnataka.

Notes. See A.S. Rao (in Bull. Bot. Surv. India 6: 19-21. 1964) for discussion on identity and nomenclature of this species.

16. *Clematis heynei* M.A. Rau, nom. nov. *C. triloba* Heyne in Roth, Nov. Sp. Pl. 251. 1821 (non Thunb. 1794); Hook. f. & Thomson in Fl. Brit. India 1: 3. 1872.

Hindi: *Bander-choti, Muhari*; Kan.: *Morhari, Sowgavalli*; Mar.: *Mogra-bel, Morvel, Ranjai*.

Extensive climbers; stems and branches sulcate, 12-ribbed, somewhat hairy. Leaves simple or pinnately 3-foliolate; leaflets ovate or orbicular, cuneate, rounded or cordate at base, acute at apex, entire or 3-lobed, 3-8 cm long, puberulous on both surfaces, 3-nerved at base; petioles slender, twining, 2-8 cm long; petiolules 6-18 mm long. Inflorescences axillary, 1-7-flowered; bracts foliaceous. Flowers 2-4 cm across, greenish white or creamy-white, fragrant. Sepals 4-8, stellately spreading, oblong, obovate, cuspidate, pubescent outside, glabrous inside. Filaments ligulate at base, glabrous; connectives scarcely prolonged. Achenes in heads, ovoid, compressed, villous, with ca 4.5 cm long feathery tails.

Fl. Sept. - Dec.; *Fr.* Oct. - April.

Distrib. India: On hillslopes climbing on shrubs, up to 500 m. Madhya Pradesh, Maharashtra and Karnataka.

Endemic.

Notes. The plant is often used as a remedy for leprosy, blood diseases and fevers. The stem fibres are used in the making of agricultural implements.

17. *Clematis ladakhiana* Grey-Wilson in Kew Bull. 44: 49, ff. 1 N-P, 4 D-F. 1989. *C. orientalis* var. *acutifolia* Hook. f. & Thomson, Fl. Ind. 9. 1855 & in Fl. Brit. India 1: 5. 1875. *C. orientalis* L. var. *longicaudata* sensu Mukerjee in Bull. Bot. Surv. India 1: 139. 1959, non Ledeb.

Shrubs, climbing or straggling; stems up to 2 - 3 m long, tinged with purplish brown, slightly pubescent to glabrous. Leaves pinnate with 5 - 7 leaflets or more or less bipinnate; leaflets narrow-lanceolate, entire or with 1 - 2 lobes in the lower part, caudate-acute at apex, (1.5-) 2.7 - 9 x 0.4 - 2 cm, glabrous or subglabrous above and beneath, glaucous green. Flowers axillary, yellow, often tinged or spotted with purplish brown or reddish brown outside; peduncles 0.6 - 4.7 cm long; bracts similar to leaves, generally with 3 - 5 leaflets; pedicels slender, 1.5 - 12 cm long, sparsely pubescent to subglabrous. Sepals narrow-lanceolate to elliptic, acute to acuminate, 15 - 25 x 4 - 10 mm, glabrous to subglabrous outside, pubescent along margins, densely pubescent inside. Filaments 6 - 10 mm long; anthers 2 - 3 mm long. Styles up to 4 cm long in fruit.

Fl. July - Sept.

Distrib. India: On walls, hedges and bushes, or scrambling amongst rocks, along river valleys, 2800 - 3800 m. Kashmir and Himachal Pradesh.

China (Tibet).

18. *Clematis meyeriana* Walpers in Nova Acta Leop. Nat. Cur. 19, suppl. 1: 297. 1843. var. *insularis* Sprague in Bull. Misc. Inf. Kew 1916: 44 - 47. 1916; Gupta in Bull. Natl. Bot. Gard. Lucknow 97: t. 51, ff. A-G. 1964; Kapoor in Bull. Natl. Bot. Gard. Lucknow 124: 40 - 41. 1966.

Woody climbers; branches almost glabrous. Leaves pinnately 3-foliolate; petioles twisted and coiled; leaflets linear-ovate, cordate at base, up to 14 x 6 cm, prominently 5-nerved at base, glabrous on both surfaces; petiolules up to 4.5 cm long. Panicles axillary, branched, many-flowered, covered by a number of overlapping scales at base. Flowers ca 2 cm across, sweet-scented. Sepals 4, narrowly elliptic, hairy along margins. Filaments as long as anthers, glabrous or sometimes minutely hairy; connectives slightly produced beyond anthers. Carpels profusely hairy. Achenes not hairy.

Fl. July.

Distrib. India: Nagaland.

Myanmar and China.

19. *Clematis montana* Buch.-Ham. ex DC., Syst. Nat. 1: 164. 1817 & Prodr. 1: 9. 1824; Hook. f. & Thomson in Fl. Brit. India 1: 2. 1872.

Hindi: *Chanti-ka-bel*; Jain.: *Jamai-thobawa*; Jaun.: *Kaunia-bali*.

Robust woody climbers; branches tough, terete, glabrous. Leaves fascicled at the nodes on short branches, ternately 3-foliolate; petioles 3.5 - 7.5 cm long; leaflets 3 or 4, variable; ovate, ovate-lanceolate or lanceolate, rounded at base, coarsely and distantly serrate or sometimes incised along margins, acute at apex, 1.5 - 7 x 1 - 3.5 cm, 3 - 5-nerved from base; tertiary nerves few, distant, indistinct, appressed hairy, especially beneath, more particularly on nerves or glabrescent; petiolules 3 - 8 mm long. Flowers 2 - 3 in axillary fascicles, sometimes reduced to one, on long pedicels, large, 4 - 8 cm across, showy, white, cream-yellow or purplish outside, scented; peduncles terete, 7 - 10 cm long, puberulous; pedicels 3 - 8 cm long, glabrous. Sepals 4, petaloid, widely spreading, valvate in bud, obovate or oblong-elliptic, obtuse, acute or narrowly acuminate, 1.5 - 2 x 0.7 - 1.25 cm, nerved, densely hairy or glabrous outside and softly tomentose along the border or hairy only near the tip, hairy or glabrous inside. Stamens many; filaments linear, glabrous; anthers yellow, introrse; connectives hardly projecting beyond anthers. Achenes in a cluster, ovate, obovate, compressed, acute at both ends, ca 5 x 4 mm, glabrous or sparsely hairy, with up to 4 cm long feathery cream-coloured tails.

KEY TO THE SUBSPECIES AND VARIETIES

- | | | |
|--|--|-----------------------------|
| 1a. Sepals glabrous inside | 19.1.1. subsp. <i>montana</i> var. <i>montana</i> | |
| b. Sepals hairy towards end or on inside | | 2 |
| 2a. Sepals obtuse or abruptly acute | | 19.2. subsp. <i>praecox</i> |
| b. Sepals narrowly acuminate | 19.1.2. subsp. <i>montana</i> var. <i>manipurensis</i> | |

19.1.1. subsp. *montana* var. *montana*

Fig. 12.

Fl. May - July; Fr. May - Sept.

Distrib. India: Subtropical and temperate forests, on scrubs in dry valleys, 2000 - 4000 m. Jammu & Kashmir, Himachal Pradesh, Uttar Pradesh, Sikkim, Meghalaya and Nagaland.

Pakistan, Nepal, Bhutan and China (W. Tibet).

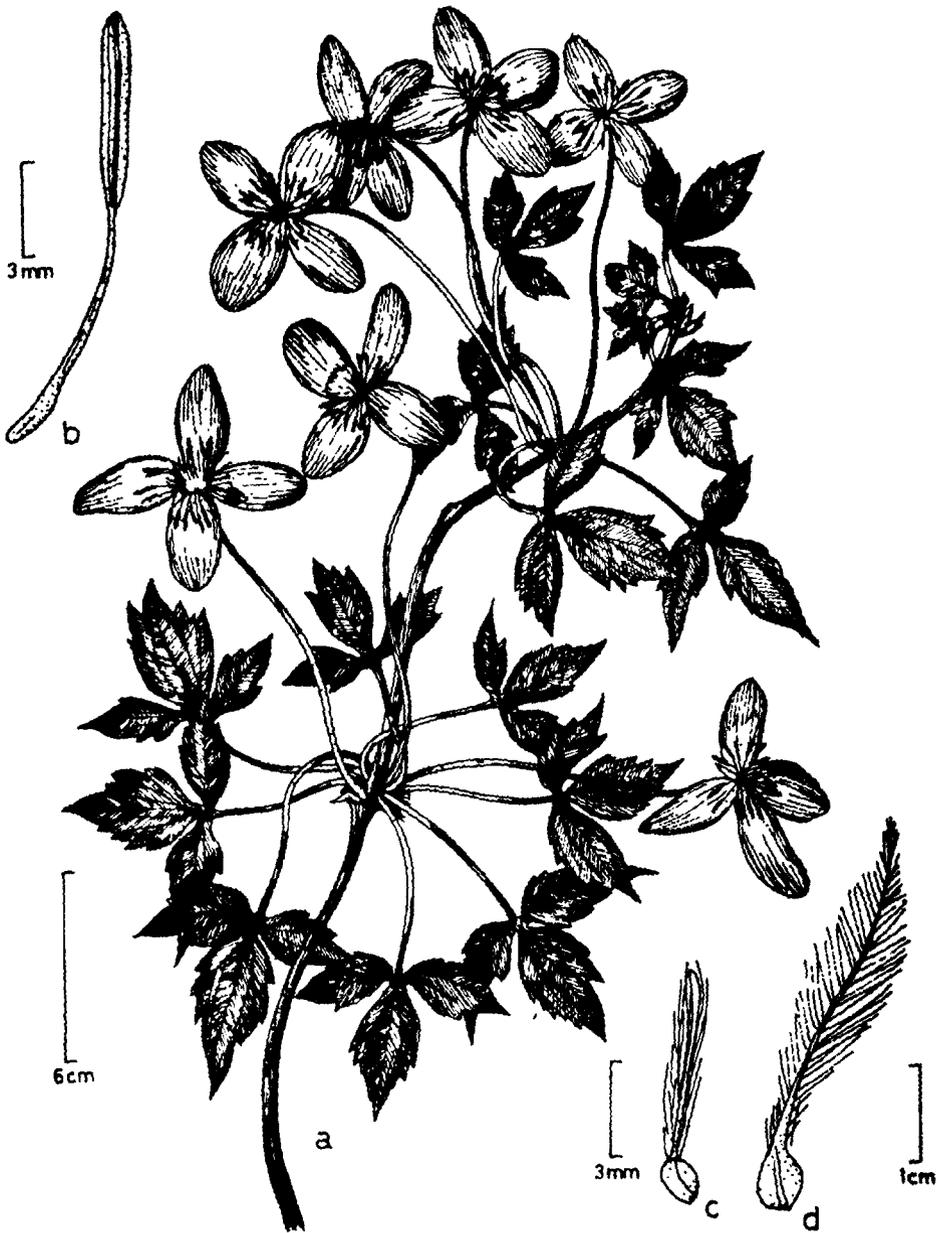


Fig. 12. *Clematis montana* Buch.-Ham. ex DC. var. *montana*: a. flowering branch; b. stamen; c. carpel; d. achene.

19.1.2. subsp. *montana* var. *manipurensis* Bruehl in Ann. R. Bot. Gard. Calc. 5: 74. 1896.

Fl. April - May; *Fr.* May - Oct.

Distrib. India: Manipur and Nagaland.

Myanmar.

19.2. subsp. *praecox* O. Kuntze in Verh. Bot. Ver. Brandenb. 26: 142. 1855.

Fl. & Fr. April - Nov.

Distrib. India: Sikkim and West Bengal.

Nepal and China (E. Tibet).

20. *Clematis munroiana* Wight, Illus. 1: 5, t. 1. 1831; Dunn in Gamble, Fl. Pres. Madras 1: 3. 1915 (repr. ed. 1: 2. 1957). *C. smilacifolia* auct. non Wallich; Hook. f. & Thomson in Fl. Brit. India 1: 3. 1872, p. p.

Shrubs, climbing; stems and branches glabrous. Leaves pinnately 3-foliolate or simple near flowering region; leaflets ovate or ovate-oblong or ovate-lanceolate, acute or obtuse, 5 - 7-nerved from base, entire or irregularly serrate, 4 - 12 x 2 - 8 cm, glabrous on both surfaces. Inflorescences axillary, 1 - 5-flowered. Flowers nodding, deep purple, ca 4 cm across; pedicels up to 10 cm long. Sepals 4 - 5, spreading or reflexed from base, velvety tomentose and maroon with whitish margins on outside, glabrous inside. Filaments linear, constricted just below anthers, glabrous; connective much produced beyond anther-thecae. Achenes ovate, compressed, margined, hairy with ca 6 cm long feathery tails.

Fl. June - Aug.; *Fr.* Oct. - Nov.

Distrib. India: Subtropical forests of Western Ghats, 900 - 2000 m. Karnataka, Kerala and Tamil Nadu.

Endemic.

21. *Clematis napaulensis* DC., Syst. Nat. 1: 164. 1817 & DC., Prodr. 1: 9. 1824; Hook. f. & Thomson in Fl. Brit. India 1: 2. 1872.

Garh.: *Kangalya*.

Slender bushy glabrous woody climbers. Leaves opposite, but crowded at nodes in older branches, simple or ternate; leaflets narrowly ovate-lanceolate, often 2 - 3-lobed, cuneate or rounded at base, acuminate at apex, 3 - 10 x 1 - 3 cm, glabrous or puberulous; lateral leaflets oblique. Flowers in axillary fascicles; bracts forming a bilobed cup at base of pedicels, 5 - 10 mm long; pedicels 2 - 4 cm long, tomentose, thick and elongate to 2 cm in fruit. Sepals 4, suberect, oblong-elliptic, 1.5 - 2 x 0.5 - 0.7 cm, greenish yellow outside, purplish inside, silky pubescent outside. Filaments purplish, flattened towards base, glabrous; connectives not produced beyond anther. Achenes ovate or obovate, compressed, margined, densely hairy with up to 4.5 cm long feathery tails.

Fl. Oct. - Feb.; *Fr.* Dec. - May.

Distrib. India: Subtropical forests, 1500 - 2000 m. Uttar Pradesh and Sikkim.

Nepal, Bhutan and China (Yunnan).

22. *Clematis orientalis* L., Sp. Pl. 543. 1753; Hook. f. & Thomson in Fl. Brit. India 1: 5. 1872; Grey-Wilson in Kew Bull. 44: 36, f. 2. 1989. *C. orientalis* L. var. *latifolia* & var. *obtusifolia* Hook. f. & Thomson, l. c. 5. 1872.

Large woody climbers or scramblers, up to 8 m long; stems and branches angular, whitish grey or tinged with purplish red, sparsely pilose. Leaves pinnate, up to 7-foliolate or somewhat bipinnate and up to 9-foliolate; petioles 2 - 10 cm long; leaflets oblong-lanceolate, elliptic or ovate or linear-oblong, simple or 2 - 3-lobed or deeply cleft, entire or sometimes trilobed, oblique, cuneate or rounded at base, obtuse or subacute at apex; (1-) 2.5 - 6.5 x 0.5 - 3.5(-5) cm, glabrous or sparsely pilose, greyish green or glaucous; petiolules 5 - 30 mm long, pilose. Inflorescences axillary or terminal, elongated, 3-many-flowered, leafy cymes; peduncles 0.5 - 9.5 cm long; pedicels slender, 0.5 - 5 cm long, curved at apex, pilose, elongating in fruit; bracts oblong, elliptic or ovate, 2 - 20 x 1 - 10 mm, entire, unifoliolate, pinnate or 2 - 3-lobed, shortly petiolate, greyish green; flower buds ovoid, acute, dark red. Flowers 3 - 5 cm across, pale yellow, greenish yellow or cream-coloured, sometimes purplish brown inside, tinged with red-violet outside, often mottled with purple. Sepals 4, ovate, oblong or elliptic, acute or subacute, 11 - 15 x 4 - 7.5 mm, spreading, recurved later, silky villous outside or on both surfaces. Stamens 20 - 40; filaments slender, broad at base, 4 - 8 mm long, yellow or dark purple; anthers 2.5 - 4 mm long. Carpels many, 5 - 11 mm long, ellipsoid or rhomboid; style 4 - 10 mm long, pubescent. Achenes rhomboid, laterally compound, ribbed at margins, 2 - 4 x 1 - 2 mm, dark brown, pubescent with 2.5 - 5 cm long hairy tails.

Fl. & Fr. July - Sept.

Distrib. India: W. Himalayas, on open alpine or subalpine hill slopes, amongst shrubs and rocks. Kashmir and Himachal Pradesh.

China, Pakistan, Afghanistan, Iran, Iraq, Turkey, Greece, Southern Russian States and S.E. Europe.

KEY TO THE VARIETIES

- 1a. Leaves and stems pubescent, rarely subglabrous; sepals pubescent to glabrescent outside 22.2. var. *orientalis*
 b. Leaves and stems subglabrous; sepals glabrous on the outside, except along margins 2
 2a. Leaflets almost as broad as long with obtuse to subobtuse lobes 22.1. var. *latifolia*
 b. Leaflets at least twice as broad, with acute lobes 22.3. var. *tenuifolia*

22.1. var. *latifolia* Hook. f. & Thomson, Fl. Ind. 9. 1855 & in Fl. Brit. India 1: 5. 1872. *C. globosa* Royle, Illus. Bot. Himal. 51. 1834. *C. orientalis* L. var. *globosa* (Royle) Mukerjee in Bull. Bot. Surv. India 1: 140. 1959.

Leaflets ovate or broadly oblong to suborbicular in outline, generally as broad as long, lobed or toothed just below the apex, rarely subentire, obtuse at apex, 1.5 - 3 x 0.7 - 3 cm, glabrous above and beneath, except scattered hairs on midrib and lateral nerves beneath. Inflorescence a dichasium, 3 - many-flowered; peduncles 1.5 - 6.8 cm long. Sepals 10 - 13 mm long, glabrous outside, except along the margins.

Fl. & Fr. Aug. - Sept.

Distrib. India: Alpine and subalpine slopes, 3000 - 3500 m. Kashmir (Ladakh) and Himachal Pradesh (Spiti).

Endemic to N.W. Himalayas.

22.2. var. *orientalis*

Leaves very variable in shape and size, lanceolate, elliptic or ovate, often with 2 lobes on either side towards base, obtuse or sometimes acute, 1 - 1.5 x 0.5 - 3.5 cm, pubescent above and beneath, rarely entirely glabrous above. Inflorescence a dichasium, rarely a thyrse, usually many-flowered, occasionally reduced to 3 flowers; peduncles up to 6 cm long. Sepals 8 - 15 mm long, pubescent on both sides, rarely subglabrous outside.

Fl. & Fr. July - Sept.

Distrib. India: Temperate and alpine slopes, 2800 - 3500 m. Kashmir.

Afghanistan, Iran, Iraq, Kazakhstan, Turkestan and Turkey.

Notes. In Kashmir this variety is sometimes found growing in the same localities together with var. *tenuifolia*.

22.3. var. tenuifolia (Royle) Grey-Wilson in Kew Bull. 44: 42. 1989. *C. tenuifolia* Royle, Illus. Bot. Himal. 51. 1834.

Leaflets linear-lanceolate, at least twice as long as broad, entire or with 1 - 2 short lobes on either side towards the base or with several serrate teeth, acute at apex, 1.5 - 4 x 0.3 - 0.6(-1) cm, glabrous on both sides. Inflorescence a dichasium, 3 - many-flowered, very occasionally the uppermost peduncles carrying a single flower only; peduncles 2 - 6.7 cm long. Sepals 13 - 18 mm long, sparsely pubescent to subglabrous outside.

Fl. & Fr. July - Sept.

Distrib. India: Temperate and alpine slopes, 2900 - 3500 m. Kashmir.

N. Pakistan and Afghanistan.

23. Clematis puberula Hook. f. & Thomson in Fl. Brit. India 1: 4. 1872.

Slender climbers; stems deeply grooved, downy; branches adpressed pubescent. Leaves opposite, ternately or biternately pinnate; leaflets ovate or ovate-lanceolate, entire or distantly toothed or 2- or 3-lobed, acute or acuminate, ca 7 x 3 cm, hairy below, puberulous on upper surface, 7-nerved. Inflorescence-axillary, 3 - 15-flowered panicles, sometimes only one maturing; pedicels slender; lower bracts foliaceous. Flowers 2 - 3 cm across, white. Sepals 4 - 5 spreading, linear-oblong, elliptic-spathulate, obtuse, 5 - 15 x 3 - 5 mm, whitish, villous outside with a tomentose border, glabrous inside. Filaments narrow, flat, glabrous; anthers short; connectives not produced beyond anther. Achenes compressed, silky hairy.

Fl. Sept. - Dec.

Distrib. India: Open dry places, climbing on shrubs, 1000 - 2000 m. Uttar Pradesh, Meghalaya and Nagaland.

Bhutan and N. Myanmar.

24. Clematis roylei Rehder in J. Arn. Arb. 22: 575. 1941. *C. nutans* Royle, Illus. Bot. Himal. 51. 1834; Hook.f. & Thomson in Fl. Brit. India 1: 5. 1872 (non Crantz 1763).

Climbing shrubs; branches villous or sparsely so. Leaves pinnately 3 - 5-foliolate, 2-pinnate or decomposed, 10 - 20 cm long; leaflets ovate-lanceolate or ovate-elliptic, rounded or oblique at base, entire or crenate or serrate-dentate along margins, acute to acuminate and simple or cleft at apex, 2 - 14 x 1 - 9 cm, hairy on both surfaces; petioles twining. Inflorescences axillary, 3 to many-flowered, pubescent panicles; pedicels up to 3 cm long. Flowers cream-white or pale yellow, 4 - 8 cm in diam. Sepals 4 - 5, erect or spreading, broadly oblong, recurved or revolute at tips, villous outside with tomentose

margins, glabrous inside, Filaments linear, 1.5 - 2 cm long, hairy towards base only; anthers mucronate; connectives not much produced. Achenes ovoid-ellipsoid, compressed, silky hairy with 2 - 2.5 cm long feathery tails.

India and Nepal.

KEY TO THE VARIETIES

- | | |
|---|--------------------------|
| 1a. Leaves normally 5-foliolate, very rarely 3-foliolate; sepals spreading | 24.1. var. <i>patens</i> |
| b. Leaves usually 3-foliolate, rarely 5-foliolate; sepals erect or suberect | 24.2. var. <i>roylei</i> |

24.1. var. *patens* (Haines) Kapoor in Bull. Natl. Bot. Gard. Lucknow 124: 64. 1966.
C. nutans Royle var. *patens* Haines, For. Fl. Chotanagpur 140. 1910.

Fl. Nov. - Dec.

Distrib. India: Bihar (Singhbum)

Endemic and rare, known only from type locality.

24.2. var. *roylei*

Hindi: *Nakchikni* (Dehra Dun); Sant.: *Bonga-khanti*.

Fl. Sept. - Feb.; *Fr.* Dec. - April.

Distrib. India: Shaded places in forests along banks of rivers or streams, 500 - 2200 m. Himachal Pradesh, Uttar Pradesh, Bihar, Madhya Pradesh, Orissa and Andhra Pradesh.

Nepal.

25. *Clematis smilacifolia* Wallich in Asiat. Res. 13: 402. 1820; Hook. f. & Thomson in Fl. Brit. India 1: 3. 1872. *C. loureiriana* auct. non DC.; Merr. in Trans. Amer. Phil. Soc., n.s. 24(2): 154. 1935, p. p.

Tall extensive woody climbers; branches stout, glabrous, closely sulcate, purplish or puberulous particularly at nodes and petioles. Leaves simple or sometimes 1 - 3-foliolate, broadly ovate or elliptic-ovate, broadly cordate or rounded at base, entire or slightly serrate, subacute or mucronate or rarely obtuse at apex, 6 - 18 x 1.8 - 14 cm, subcoriaceous, glabrous, often purplish beneath; veins usually 7 - 9, distinctly raised beneath; upper leaves smaller, narrower and cuneate at base; petioles 2 - 15 cm long, flattened at base, often twining above, ribbed, glabrous. Inflorescences axillary or terminal 3-many-flowered, trichotomously branched panicles; peduncles 4 - 5 cm long, sulcate, thinly dark

brownish hairy; bracts foliaceous, linear, elliptic-lanceolate or spatulate, 1.5 - 2 x 0.5 cm, sparsely hairy on both surfaces; pedicels 3 - 16 cm long, ribbed, puberulous. Flowers ca 3.5 cm across, cream-white or purplish brown. Sepals 4, sometimes 5 - 8, spreading, ovate, oblong-lanceolate or oblanceolate, acute to subacute, 1.6 - 2 x 0.4 - 0.5 cm, becoming reflexed, ribbed, greenish brown and densely brown tomentose outside, pale purple and subglabrous inside. Filaments linear, flat, 4 - 15 x ca 0.5 mm, white, glabrous; anthers 1 - 6.5 mm long, often twisted; connectives elongated into an acuminate ca 2 mm long point. Achenes elliptic-ovate to obovate or suborbicular, flat, asymmetric, 4 - 11 x 3 - 5 mm, hairy, broadly margined, with up to 7 cm long feathery tails.

Notes. Merrill (l.c.) reduced *C. smilacifolia* Wallich to *C. loureiriana* DC. However, Eichler (quoted by Kapoor in Bull. Natl. Bot. Gard. Lucknow 78: 50. 1962) states that these two species are quite distinct and *C. loureiriana* DC. does not occur in India.

KEY TO THE SUBSPECIES

- 1a. Anthers 4 - 6.5 mm long; connectives produced for less than 0.5 mm beyond anther-thecae; achenes broadly ovate or almost orbicular, 4 - 6 mm long 25.1. subsp. *andamanica*
- b. Anthers 1 - 4 mm long; connectives produced for 0.5 - 2 mm beyond anther-thecae; achenes elliptic-ovate or obovate, 6 - 11 mm long 25.2. subsp. *smilacifolia*

25.1. subsp. *andamanica* Kapoor in Kew Bull. 19: 331 - 333, f. 1. 1965.

Fl. & Fr. Sept. - March.

Distrib. India: Tropical evergreen forests. Andaman & Nicobar Islands.

Endemic.

25.2. subsp. *smilacifolia*

Kan.: *Hottuhambu*; *Kh.:* *Mei-long-kadup*; *Nep.:* *Halure-lahera, Pinari-lahera.*

Fl. Sept. - Feb.; *Fr.* Jan. - March.

Distrib. India: Common in damp shaded places in subtropical evergreen forests, 500 - 2500 m. Sikkim, Nagaland, Meghalaya, Orissa, Andhra Pradesh, Karnataka and Tamil Nadu.

Notes: Chromosome no. $n = 24$ (Shobha & Ramachandran in Taxon 28: 165. 1980).

26. *Clematis tangutica* (Maxim.) Korsh in Bull. Acad. Sci. Petersb. 9: 399, 575. 1898; Grey-Wilson in Kew Bull. 44: 53. 1 U-V, 4 A-C. 1989. *C. orientalis* L. var. *tangutica* Maxim., Fl. Tangut. 1: 3. 1889; Hook. in Bot. Mag. t. 710. 1900.

Shrubs, decumbent, straggling, climbing or rarely erect; stems up to 3 - 4 m long, green when young; branches straight, finely pubescent. Leaves pinnatisect with 5 - 7 leaflets, rarely more or less bipinnate, glabrous; leaflets distant, ovate to narrow-elliptic or ovate-lanceolate, acute or acuminate, serrate or incised with 7 acute teeth along each margin, 1.8 - 5.7 x 0.4 - 1.6 cm, sparsely pubescent above, pubescent to subglabrous beneath. Flowers solitary, terminal or axillary, on long pedicels at nodes or terminating branches, sometimes 2 - 3 together, lemon yellow, tinged with brown or purplish brown outside, bell-shaped, nodding; peduncles 6 - 30 mm long; bracts like leaves, but smaller, trilobed; pedicels 4 - 32 mm long, slender, sparsely pubescent or glabrous. Sepals elliptic-lanceolate to oblong, acute, acuminate or obtuse, 1.8 - 3.4 x 0.7 - 1.6 cm, scarcely spreading, finely white - silky pubescent outside, glabrous and pale yellow inside. Filaments 5 - 10 mm long, densely ciliate in lower half; anthers 2 - 3 mm long. Achenes up to 5.5 cm long, beaked, compressed, pubescent.

Fl. & Fr. July - Aug.

Distrib. India: Kashmir.

China and Central Asia.

Notes. Grey-Wilson (l. c.) describes 2 subspecies, subsp. *obtusiuscula* (Rehder & Wilson) Grey-Wilson from China and subsp. *mangolica* Grey-Wilson from Mangolia. Kashmir plants belong to subsp. *tangutica*.

27. *Clematis theobromina* Dunn in Bull. Misc. Inf. Kew 1914: 181. 1914; Gamble, Fl. Pres. Madras 1: 3. 1915 (repr. ed. 1: 2. 1957); Vajravelu in Jain & Sastry, Indian Pl. Red Data Book 1: 141. 1984.

Climbing shrubs, glabrous. Leaves opposite, simple or pinnately 3-foliolate; lamina large, up to 20 cm long, ovate or ovate-elliptic, acute, rounded or subcordate or subpeltate at base, 5 - 9-nerved. Inflorescence axillary or terminal, 1 - 5-flowered panicles; bracts foliaceous. Sepals 4 - 6, petaloid, spreading, oblong, obtuse velvety brown tomentose outside, densely villous inside with golden brown hairs. Filaments glabrous; connectives not or slightly produced. Achenes hairy with long feathery tails.

Fl. & Fr. Nov. - Mar.

Distrib. India: Evergreen forests, 1800 - 2400 m. Tamil Nadu (Nilgiri hills).

Endemic, rare and threatened.

Note. Chromosome no. $n = 24$ (Shobha & Ramchandran in Taxon 29: 165. 1980).

28. *Clematis tibetana* O. Ktze in Verh. Bot. Ver. Brandenb. 26: 172. 1885; Grey-Wilson in Kew Bull. 44: 46. 1989. *C. vernayii* C.E.C. Fischer in Kew Bull. 1937: 97. 1937.

Climbing shrubs, up to 2 m tall; stems pubescent, green when young, becoming purplish, finely pubescent to glabrous. Leaves pinnate, with 5 - 7(-9) leaflets; rachis and petioles pubescent; leaflets narrow-lanceolate, acute, entire or deeply 2 - 5-fid, 1.3 - 5 x 0.4 - 2.5 cm, glabrous or sparsely pubescent beneath. Flowers axillary, solitary or 2 - 3(-5) together, nodding, bell-shaped, yellow or greenish yellow, flushed or spotted with rusty brown, bronze or purplish yellow outside; peduncles 0.3 - 7 cm long, usually rather sparsely pubescent; bracts similar to leaves, with only 3 - 5 leaflets; pedicels slender, 3 - 14 cm long, sparsely pubescent or glabrous. Sepals lanceolate to elliptic, acute or long-acuminate, 15 - 35 x 5 - 14 mm, moderately thick, leathery, glabrous or subglabrous outside, densely silky pubescent inside and on margins. Filaments 4 - 10 mm long, slightly hairy; anthers 1.5 - 3.5 mm long. Achenes silvery hairy, with ca 3.5 cm long feathery tails.

Fl. & Fr. Aug. - Sept.

Distrib. India: Alpine W. Himalayas, amongst bushes, along walls, riverside gravels and boulders, 3300 - 5000 m. Uttar Pradesh.

China (Tibet).

Notes. Grey-Wilson (l. c.) treats *C. vernayii* C.E.C. Fischer as a subspecies with 3 varieties, none of them occur in India, but are reported from Nepal and China (Tibet).

29. *Clematis tongluensis* (Bruehl) Tamura in Acta Phytotax. & Geobot. Kyoto 19: 77. 1962. *C. montana* var. *tongluensis* Bruehl in Ann. R. Bot. Gard. Calc. 5: 74. 1896.

Climbing shrubs; branches glabrous or puberulous. Leaves usually opposite, occasionally clustered at nodes, pinnately 3-foliolate; leaflets elongate-ovate or ovate-lanceolate or broadly ovate, simple or 2 - 3-lobed, sparsely puberulous on both surfaces. Flowers solitary, axillary; pedicels 12 - 25 cm long. Sepals 4, spreading ovate-acuminate, 4 - 6 x 1 - 2 cm, generally glabrous outside, with a broad tomentose border, hairy all over inside or rarely sparsely hairy inside. Filaments glabrous; connectives not produced; anthers purple. Achenes broadly ovate, compressed, hairy, with ca 3 cm long feathery tails.

KEY TO THE VARIETIES

1a. Branches puberulous; leaflets broadly ovate; sepals sparsely hairy inside; achenes larger

29.1. var. *khasiana*

b. Branches glabrous; leaflets ovate-lanceolate; sepals hairy inside; achenes small

29.2. var. *tongluensis*

29.1. var. *khasiana* (Bruehl) Kapoor in Bull. Natl. Bot. Gard. Lucknow 124: 75. 1966.

C. montana var. *khasiana* Bruehl in Ann. R. Bot. Gard. Calc. 5: 74. 1896.

Asm.: *Goropsai*.

Fl. April - May; *Fr.* May - Sept.

Distrib. India: Meghalaya

Endemic.

29.2. var. *tongluensis*

Fl. June - Aug.; *Fr.* July - Oct.

Distrib. India: Eastern Himalayas in temperate broad leaved forests on shrubs and bamboos, 2300 - 3500 m. W. Bengal and Sikkim.

Bhutan.

30. *Clematis wattii* J.R. Drumm. & Craib in Kew Bull. 1915: 421. 1915; Gupta in Bull. Natl. Bot. Gard. Lucknow 54: t. 20. 1960 & 80: t. 46. 1963; Kapoor in Bull. Natl. Bot. Gard. Lucknow 78: 58 - 60. 1962 & 124: 80 - 81. 1966.

Climbers; branches, leaves, petioles and inflorescence axes all densely villous or tomentose-villous; branches ribbed. Leaves 5-foliolate, up to 25 cm long; leaflets simple or 2 3-lobed, 5 7-nerved from base. Inflorescence laxly 3 9-flowered; bracts foliaceous. Sepals 4, oblong, oblanceolate or obovate, ca 2.6 x 0.8 cm, yellow, densely villous outside. Filaments hairy; connectives slightly produced beyond anthers. Achenes brown, ca 4 mm long, compressed, hairy at margins, with ca 3 cm long feathery tails.

Fl. & Fr. Jan. - March.

Distrib. India: Assam and Manipur.

Myanmar and Thailand.

31. *Clematis wightiana* Wallich [Cat. no. 4674. 1828, nom. nud.] ex Wight & Arn., Prodr. 2. 1834; Hook. f. & Thomson in Fl. Brit. India 1: 5. 1872.

Large woody climbers; branches up to 12-ribbed, covered by greyish or brownish hairs. Leaves pinnately 3 - 5-foliolate; leaflets oblong-ovate or elongate or orbicular, sometimes 3 - 5-lobed, irregularly dentate along margins, up to 8 cm long, softly brown silky villous on both sides; nerves thick, prominent beneath; petioles up to 12 cm long, more or less silky hairy. Inflorescence axillary, paniculate; bracts and bracteoles ovate to linear. Flowers 3 - 6 cm across, white or pale creamy or golden yellow. Sepals 4, ovate, spreading from base, somewhat ribbed, softly tomentose outside, glabrous inside. Filaments silky hairy along the middle; connective not prolonged beyond anther-thecae. Achenes ovate, compressed, densely silky hairy, with 3 - 5 cm long feathery tails.

Fl. Nov. - Mar.; *Fr.* Jan. - May.

Distrib. India: Subtropical evergreen forests of Western Ghats, 800 - 2000 m. Maharashtra, Karnataka, Tamil Nadu and Kerala.

32. *Clematis zemuensis* W. Smith in Rec. Bot. Surv. India 4: 66. 1911.

Slender climbers; branches glabrous or hairy. Leaves fascicled at nodes, bipinnate or biternate; leaflets ovate, obliquely rounded at base, lobed or not, coarsely serrate, 1.5 - 4 x 1 - 2.5 cm, finely pubescent on both surfaces. Inflorescence paniced, axillary, 3 - 7-flowered but in some reduced to one at maturity; pedicels erect, 5 - 8 cm long. Flowers 2 - 3 cm across, yellowish white. Sepals 4 - 6, spreading, elliptic, acute, ca 15 x 5 mm, sparsely hairy outside, glabrous inside. Filaments glabrous; connectives slightly produced beyond anther-thecae. Achenes pubescent, with feathery tails.

Fl. July - Aug.

Distrib. India: Margins of subtropical and temperate *Rhododendron* - *Juniperus* forests, 2000 - 3500 m. Sikkim.

Nepal and Bhutan.

12. *Consolida* (DC.) S.F. Gray

Herbs, annual; stems erect, simple or branched, hairy. Leaves palmately laciniate; lobes linear, flat, more or less ciliate; lower leaves long-petioled. Inflorescences racemose or paniculate; pedicels subtended by bracts and each with 2 bracteoles; flowers zygomorphic. Sepals 5, petaloid, the posterior one spurred, lateral and lower pairs not spurred. Petal one, formed by the fused upper petals modified into a nectary (or called "honey-leaf"), 3-lobed, its spur extending into the sepal spur; lower petals absent.

Stamens many, in 5 spiral series; filaments broad; anthers short. Carpel 1, developed into a hairy oblique, cylindrical or flattened follicle.

North temperate and mediterranean regions to N. W. Himalayas; about 40 species, 3 in India.

Literature. MUNZ, P. A. (1967) A synopsis of the Asian species of *Consolida* (Ranunculaceae). J. Arn. Arb. 48: 159 - 202.

KEY TO THE SPECIES

- 1a. Bracteoles usually placed below the middle of the pedicel, not reaching the base of the flower; sepals 12 - 14 mm long; spur more than 12 mm long 1. *C. ambigua*
- b. Bracteoles usually placed above the middle of the pedicel, reaching to and beyond the base of the flower; sepals 6 - 11 mm long; spur less than 11mm long 2
- 2a. Spur 9 - 11 mm long; follicles oblong-cylindric, 15 mm or more long 2. *C. orientalis*
- b. Spur 6 - 7 mm long; follicles oblong-flattened, ca 10 mm long 3. *C. schlagintweitii*

1. *Consolida ambigua* (L.) Ball & Heywood in Fedde, Repert. Spec. Nov. 66: 151. 1962. *Delphinium ambiguum* L., Sp. Pl. ed. 2, 749. 1763.

Herbs, subglabrous below, more or less pubescent above, single-stemmed, 30 - 100 cm high, generally branched above, some hairs with swollen bases. Basal leaves with up to 2.5 cm long petioles; lamina ovate, 2 - 5 x 1.5 - 4 cm, divided into linear-lanceolate, mucronate, ca 2 mm wide segments; cauline leaves gradually reduced upwards, the uppermost sessile, often 1 - 2 cm long. Inflorescences somewhat lax-paniculate, each branch ending in a few to many-flowered raceme; lower bracts multifid to entire, the uppermost 2 - 3 mm long; bracteoles 2, usually below the middle of pedicels, linear-elliptic, 2 - 5 mm long; pedicels 1 - 3 cm long. Flowers blue to rose or white, 2 - 2.5 cm across. Upper sepals ovate, attenuate at base, narrowed into an obtuse apex, 12 - 14 x 5 - 6 mm, more or less pubescent; spur 12 - 15 mm long, straight or slightly curved; lateral sepals broadly elliptic, 12 - 15 x 5 - 10 mm. Petals 3-lobed; the central lobe oblong, with 2 short rounded lobules, ca 6 mm long; the two lateral lobes rounded, 15 - 16 mm long; spur nectariferous, up to 16 mm long. Stamens 6 - 7 mm long; filaments abruptly dilated at base, glabrous. Follicles cylindric, narrowed to apex, ca 2 x 0.5 cm; style ca 2 mm long; scales ca 2.5 mm long, black.

Fl. & Fr. Mar. - April.

Distrib. India: In cultivated fields often as an escape. Jammu & Kashmir and Tamil Nadu (Nilgiris).

Iraq, Transcaucasia and Honan Island.

2. *Consolida orientalis* (Gay) Schroed., Abh. Zool.-Bot. Ges. Wien 4(5): 25. 1909. *Delphinium orientalis* Gay in Desm. Cat. Dordogne 12. 1840.

Stems erect, up to 1 m high, simple or branched, retrorsely strigose below, crisped pubescent above; some hairs gland-tipped, some swollen at base. Basal leaves long-petioled, crowded, multifid, 2 - 4 cm long; segments linear-oblong or linear-lanceolate, 1 - 2.5 mm wide, more or less ciliate; upper leaves sessile with linear segments. Flowers 1.5 - 2.5 cm across, dark purple, violet or white, in few- to many-flowered racemes, rather dense at flowering, lax in fruiting; bracts green, the lower dissected into linear lobes, the upper entire, linear, 5 - 20 mm long; pedicels 5 - 40 mm long, 2-bracteolate near the apex. Sepals orbicular-ovate to narrowly ovate, ca 10 - 12 mm long, abruptly narrowed at base into a pubescent claw, obtuse or rounded at apex, more or less pubescent. Petal nectariferous, 3-lobed, 8 - 10 mm long; midlobe ovate to oblong-ovate, 2-lobed; lateral lobes rounded, dilated at base with some gland-tipped hairs at upper end; anthers ca 1.5 mm long, yellow. Follicles oblong-cylindric, abruptly narrowed at apex, 14 - 2 x 5 mm, strigose with some hairs gland-tipped; style 1.5 - 2 mm long; seeds obpyramidal, angular, 1.5 - 2 mm long, with several undulating transverse rows of short scales, brownish black or reddish brown.

Fl. & Fr. May - Sept.

Distrib. India: Cultivated fields and fallow lands, up to 1500 m. Jammu & Kashmir and Himachal Pradesh.

Pakistan, Afghanistan, Iran, Transcaucasia, S.E. Europe, China and Russia (Central Siberia).

3. *Consolida schlagintweitii* (Huth) Munz in J. Arn. Arb. 48: 191, f. 4c. 1967. *Delphinium schlagintweitii* Huth in Bull. Herb. Boiss. 1: 329. 1893; Mukerjee in Bull. Bot. Surv. India 2: 295. 1960.

Plants erect, up to 1 m high, glabrescent below, pubescent above with some hairs having yellow swollen bases; stems slender, branched. Cauline leaves subsessile, 2 - 5 cm long, multipartite into 1 - 3 cm long, 0.5 - 1.5 mm wide linear more or less strigose lobes. Inflorescence a few-flowered rather dense raceme, with stiff short, some retrorse, pubescence; lower bracts multipartite, upper entire, subulate, ca 5 mm long; pedicels suberect, 1 - 1.5 cm long at flowering, up to 5 cm in fruit; bracteoles 2, placed at the upper part of the pedicel, almost touching the flower, 2.5 - 3 mm long. Sepals oblong to ovate, unguiculate, 6 - 7 mm long, deep violet; the lateral pair ovate, subglabrous, except

the ciliate claw; the lower pairs narrowed, rather pointed, pubescent; spur straight, 6 - 7 mm long, ca 1.5 mm thick at base, somewhat strigose. Petals ca 11 mm wide, 3-lobed; midlobe ca 3 mm high with 2 lobules, the lateral lobes spreading. Follicles oblong, more or less flattened, ca 10 x 3.5 mm, densely hairy; style ca 1 mm long.

Fl. & Fr. July - Aug.

Distrib. India: Jammu & Kashmir.

Endemic, rare and only type collection known so far.

13. *Coptis* Salisb.

Perennial herbs. Leaves all radical or on erect stem, ternately dissected. Flowers 1 to 6, on leafless scapes, white. Sepals 5 - 6, petaloid, deciduous. Petals 5 - 6, small, hooded or linear. Carpels 1 to many, distinctly stalked. Follicles stalked, dehiscent. Seeds with crustaceous black testa.

North temperate and arctic regions; ca 15 species, one in India.

Coptis teeta Wallich in Trans. Med. & Phys. Soc. Calc. 7: 347. 1838; Hook. f. & Thomson in Fl. Brit. India 1: 22 - 23. 1872; Katakai & Chauhan in Jain & Sastry, Indian Pl. Red Data Book 142, f. 1. 1984.

Hindi: *Mamira*; Mishmi: *Tita*.

Rootstock horizontal, woody, densely fibrous, bitter. Leaves ternatisect, glabrous; petioles 15 - 30 cm long; leaflets ovate-lanceolate, 5 - 8 cm long, incised. Scape slender, 1 - few-flowered, as long as leaves; flowers small, white, pedicelled; bracts leafy. Sepals oblong or lanceolate, acute. Petals narrow, ligulate, shorter than sepals. Follicles 6 - 8, stalked.

Fl. & Fr. July - Sept.

Distrib. India: Usually in peaty soil in shaded places. Arunachal Pradesh.

China (Tibet)

Notes. The *Mishmi Teeta*. The bitter rootstock yields a very valuable drug, useful as general tonic and as a cure for intermittent fever and stomach diseases. See Mudgal & Jain (in Bull. Bot. Surv. India 22: 179-180. 1980) for further details.

14. Delphinium L.

Herbs, perennial, rarely annual or biennial; roots tuberous or not; stems erect or reduced. Leaves radical or cauline or both, palmately lobed, often further divided or dissected. Flowers zygomorphic, usually in terminal racemes or panicles, sometimes only 1 or 2 on a stem; pedicels subtended by leafy bracts and one or two bracteoles. Sepals 5, petaloid, the uppermost (posterior) sepal spurred, the laterals in two similar pairs. Petals (honey leaves) 4, in 2 unlike pairs, the upper pair produced into nectariferous spurs that extend into the sepal spur and the upper part or lamina more or less cleaver-shaped; the lower pair with a slender claw and an expanded lamina which is often vertical to the claw. Stamens included, numerous in 8 spiral series; filaments broadened at base; anthers short. Carpels 3 - 5, usually free. Follicles 3 - 5, free, erect or divergent; seeds obpyramidal, winged or not at angles, variously beset with overlapping scales in transverse rows or ridges on surface.

North temperate regions; ca 200 species, 24 species in India, mainly in Himalayan regions.

Literature. MUNZ, P.A. (1967-68) A synopsis of the Asian species of *Delphinium* sensu stricto. J. Arn. Arb. 48: 249 -302, 476 - 545 & 49: 73 - 166, 233 - 259.

KEY TO THE SPECIES

- | | |
|--|--------------------------|
| 1a. Roots tuberous, clustered, short, vertical; flowers small, crowded in dense racemes; pedicels up to 1 cm long; sepals ca 1 cm long | 2 |
| b. Roots not tuberous, mostly slender or cylindrical, rhizome-like; flowers larger in lax racemes; pedicels longer than 1 cm; sepals more than 1 cm long | 4 |
| 2a. Pedicels with some spreading hairs; spur curved into a hook at the end | 22. <i>D. uncinatum</i> |
| b. Pedicels with closely appressed hairs; spur straight, not hooked at the end | 3 |
| 3a. Upper sepal 6 - 9 mm long, bearded; spur 5 - 7 mm long | 13. <i>D. kohatense</i> |
| b. Upper sepal 10 - 13 mm long, glabrous; spur 14 - 16 mm long | 19. <i>D. roylei</i> |
| 4a. Plants mostly very hairy; sepals veiny, dry and papery in age, more or less persistent; spur thick, 4 - 10 mm in diam. at base | 5 |
| b. Plants usually less hairy; sepals not so veiny and papery, caducous; spur slender | 12 |
| 5a. Spur equal to or exceeding the sepals in length | 6 |
| b. Spur much shorter than the upper sepal | 7 |
| 6a. Flowers few in lax corymbs or racemes; sepals hairy on both surfaces; upper petal sparsely hairy at tip; spur 10 - 20 cm long; follicles hairy | 24. <i>D. viscozum</i> |
| b. Flowers in 10 - 30 cm long racemes; sepals usually glabrous on inner surface; upper petal glabrous; spur ca 10 mm long; follicles villous | 23. <i>D. vestitum</i> |
| 7a. Inflorescence crowded, subcapitate to elongate with pedicels adpressed to axis | 6. <i>D. densiflorum</i> |
| b. Inflorescence lax, either racemose or corymbose or 1-flowered; pedicels not adpressed to axis | 8 |

- 8a. Upper sepal mostly 15 - 20 mm long 9
 b. Upper sepal mostly 20 - 30 mm long 10
- 9a. Plants up to 10 cm high; flowers 1 - 2; sepals glabrous inside 14. *D. lacostei*
 b. Plants 40 - 100 cm tall; flowers several; sepals hairy inside and outside 23. *D. vestitum*
- 10a. Leaves deeply finely dissected into many narrow lobes, mostly 1.5 - 2 mm wide 9. *D. glaciale*
 b. Leaves not so finely dissected 11
- 11a. Plants not glandular hairy in upper parts; bracteoles mostly near to the flower on pedicels 2. *D. brunonianum*
 b. Plants not glandular hairy in upper parts; bracteoles placed away from flower base on pedicels 5. *D. cashmerianum*
- 12a. Leaves dissected into linear, more or less oblong, 2 - 3 mm wide, ultimate segments 13
 b. Leaves with broader, lanceolate to ovate, over 5 mm wide, ultimate segments 19
- 13a. Spur 1.5 - 2 times as long as the upper sepal 3. *D. caeruleum*
 b. Spur not markedly longer than sepals 14
- 14a. Upper sepals 12 - 15 mm long; upper petals much darker than sepals 10. *D. incisum*
 b. Upper sepals 16 - 25 mm long; upper petals not darker than sepals 15
- 15a. Flowers several in an inflorescence; sepals largely 8 - 15 mm long 16
 b. Flowers mostly one to a stem; sepals 15 - 25 mm long 17
- 16a. Pedicels mostly 1 - 2 cm long, with a somewhat recurved tip; bracteoles 2 - 3 mm long, placed below the middle on the pedicel; follicles densely strigose 12. *D. koelzii*
 b. Pedicels 1 - 4 cm long, not recurved at tip; bracteoles 2 - 4 mm long, placed near the middle on the pedicel; sepals 12 - 15 mm long; follicles sparsely hairy to subglabrous 7. *D. denudatum*
- 17a. Plants glabrous or subglabrous on stems and inflorescence axes 11. *D. kamaonense*
 b. Plants strigose to hirsute on stems and/or inflorescence axes 18
- 18a. Flowers solitary on each stem; spur 10 - 15 mm long 17. *D. nortonii*
 b. Flowers 3 - 6 in open subcorymbose inflorescences; spur 20 - 25 mm long 4. *D. candelabrum*
- 19a. Petals darker than sepals, almost black 20
 b. Petals not darker than sepals 21
- 20a. Stems 10 - 15 cm high, mostly glabrous; pedicels glandular-pubescent; sepals glabrous outside; spur 12 - 15 mm long; seeds not winged 18. *D. pyramidale*
 b. Stems 4 - 15 dm high, mostly retrorse-pubescent; pedicels not glandular-pubescent; sepals hairy outside; spur 18 - 20 mm long; seeds winged along sides 21. *D. stapeliosum*
- 21a. Spur obviously longer than the blade of the upper sepal, downwardly curved almost into a half circle 8. *D. drepanocentrum*
 b. Spur not or scarcely longer than the blade of the upper sepal; spur not curved thus 22
- 22a. Spur considerably shorter than the blade of the upper sepal 16. *D. malabaricum*
 b. Spur about as long as the blade of the upper sepal 23
- 23a. Inflorescence with some glandular hair 20. *D. scabriflorum*
 b. Inflorescence lacking glandular hairs 24
- 24a. Bracteoles placed near the middle of the pedicel; sepals densely pubescent, deep blue; spur 20 - 22 mm long; stamens 8 - 9 mm long; seeds rounded in outline 1. *D. altissimum*
 b. Bracteoles placed near the flower at tip of the pedicel; sepals minutely strigulose, rich purple to deep maroon; spur 12 - 15 mm long; stamens 5 - 6 mm long; seeds angled 15. *D. ludlowii*

1. *Delphinium altissimum* Wallich [Cat. 167, n. 4718. 1831, nom. nud.] Pl. Asiat. Rar. 2: 25, t. 128. 1831; Hook. f. & Thomson in Fl. Brit. India 1: 26. 1872. *D. altissimum* subsp. *wallichii* var. *nipalensis* Bruehl in Ann. R. Bot. Gard. Calc. 5: 101. 1896.

Perennial herbs; roots elongate, fleshy, branched or simple; stems 1 - 1.5 m high, few-branched above, terete, glabrous at base, sparsely strigulose above. Leaves scattered; lower petioles longer than upper, up to 30 cm long, slightly sheathed at base; lamina pentagonal in outline, cordate at base, up to 15 cm across, palmately 5-partite for up to 1 - 20 cm from base; segments broadly cuneate-obovate, acute, 3-lobed, often with more short lobes or large coarse broad teeth, subglabrous above, pubescent on nerves beneath; uppermost leaves trifid. Inflorescence lax with a many-flowered central dense raceme and some few-flowered lateral branches, strigose with long white hairs, not glandular-hairy; bracts lanceolate to linear, leafy, 2 - 3 cm long, pubescent; pedicels 1 - 2(-5) cm long, divaricate; bracteoles 2, linear-lanceolate, 4 - 5 x 0.5 mm, placed above the middle on the pedicel. Sepals deep blue, densely pubescent; upper sepal obovate, acute, 13 - 15 x 7 - 8 mm; spur 18 - 22 mm long, 3 - 4 mm wide at base, slightly curved; lateral and lower sepals oblong-obovate, obtuse, ca 15 x 8 - 10 mm. Petals purple to rich purple, darker than sepals, the upper blades oblong, somewhat oblique, bidentate at apex, ca 11 mm long; spur subulate, 17 - 18 mm long; lamina of lower petals oblong-ovate, 5 - 6 x 4 - 5 mm, deeply bifid, ciliate; claw ca 7 mm long. Stamens 8 - 9 mm long, glabrous; anthers rounded-oblong, ca 1 mm long. Follicles 3, cylindrical, divergent, pubescent, ca 12 x 3 mm, with ca 2.5 mm long beak; seeds obovoid, round in cross-section.

Fl. & Fr. July-Sept.

Distrib. India: Old cultivated fields, open slopes and streamsides along edges of forests, 1400-2500 m. Arunachal Pradesh and Meghalaya.

Nepal and Bhutan.

2. *Delphinium brunonianum* Royle, Illus. Bot. Himal. 56. 1834; Hook. f. & Thomson in Fl. Brit. India 1: 27. 1872. *D. moschatum* Munro ex Hook. f. & Thomson, Fl. Ind. 53. 1855. **Fig. 13.**

Hindi: *Laskar* (HP)

Perennial herbs, up to 1 m high, with a musky odour when fresh; rootstock slender; stems erect, simple and glabrous or downy below, somewhat branched and glandular pubescent above, purplish in colour, leafy. Lower petioles up to 15 cm long, sheathed at base, upper shorter; lamina reniform. 3 - 8 cm across, more or less hairy beneath along veins, 5-fid or deeply partite up to middle; lobes always folded in a wedge-shaped manner, never flat, crenate or dentate into ovate subobtusate teeth or short lobes; upper leaves becoming leafy bracts. Inflorescence few-flowered, corymbose or racemose;

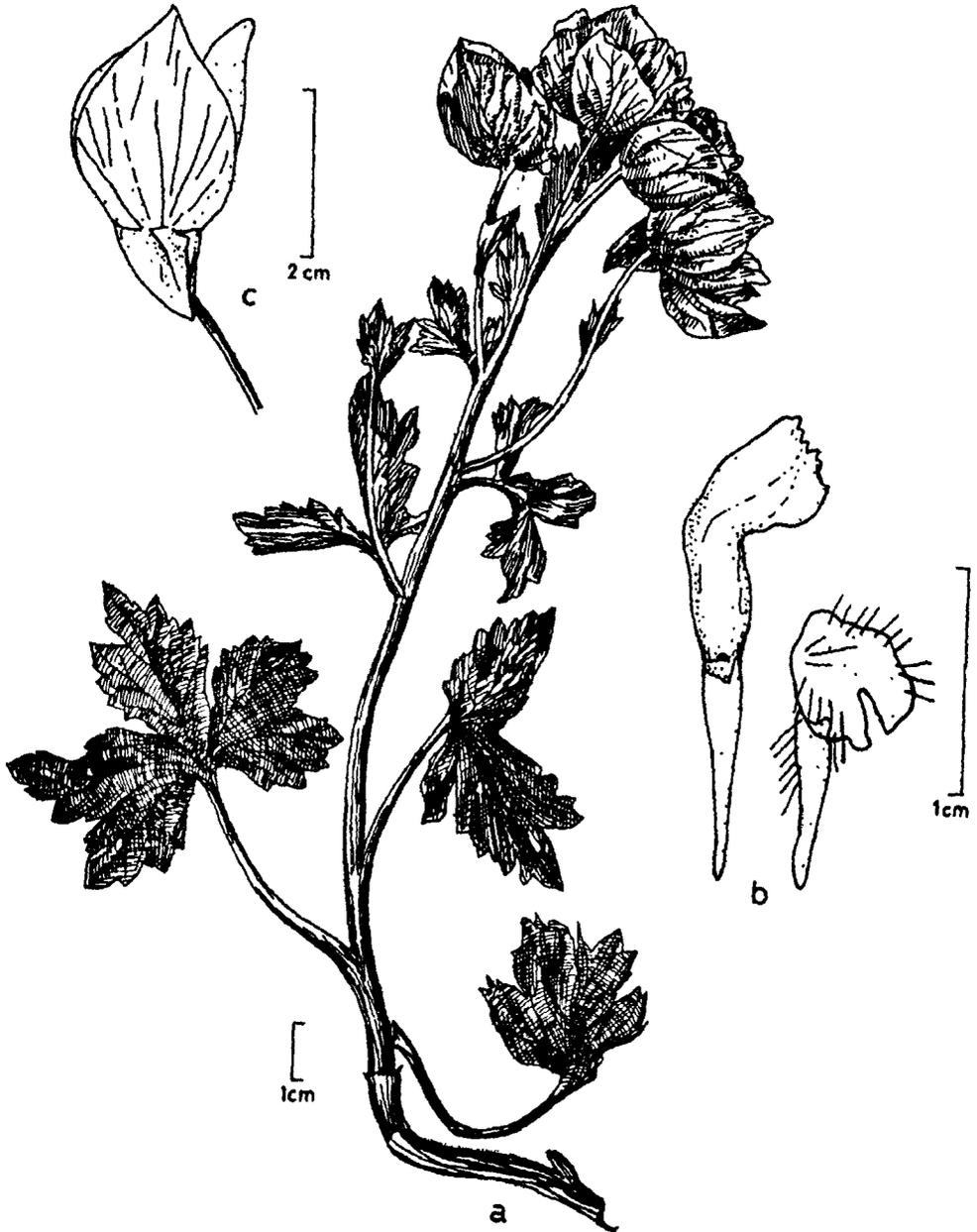


Fig. 13. *Delphinium brunonianum* Royle : a. flowering twig; b. upper sepal and petal with spur; c. bracteole and outer sepals

Pedicels erect, up to 15 cm long; basal bracts 3 - 5-partite; upper ones simple, oblong or linear; bracteoles placed near to the flower, 5 - 15 mm long, hairy, lanceolate or ovate, entire or toothed or trilobed. Sepals royal blue to pale blue, membranous, veiny, persistent, soft pubescent with white hairs; upper sepal round-ovate, obtuse, 20 - 30 mm long and wide; spur almost straight, saccate, 12 - 15 mm long, ca 8 mm wide at base, narrowed to a conical blunt tip; lateral sepals broadly ovate, 25 - 35 mm long, obtuse; lower sepals ovate-orbicular, 2.5 - 3 x 1.8 - 2.2 cm. Petals dark blue or almost black with white apex, with 2 lanceolate lobules at tip; spur 1 - 1.2 mm long; lower petals strongly oblique; the rounded blade 6 - 7 x 4 mm, bearded at base, ciliate; the claw 6 - 7 mm long. Stamens 7 - 8 mm long, strongly expanded, glabrous; anthers ca 1 - 2 mm long. Follicles viscidly pubescent, 4 - 5, ca 12 mm long; seeds ca 1 mm long, winged at angles.

Fl. & Fr. Aug.-Sept.

Distrib. India: Alpine W. Himalayas, 3500 - 6000 m. Jammu & Kashmir, Himachal Pradesh and Uttar Pradesh.

Nepal, Pakistan, Afghanistan and China (Tibet).

Notes. Roots used as incense in Gompas of Lahul area (Kapahi in J. Econ. Tax. Bot. 14: 51. 1990).

3. *Delphinium caeruleum* Jacquem. ex Cambess. in Jacquem., Voy. Bot. 4: 7, t. 6. 1835; Hook. f. & Thomson in Fl. Brit. India 1: 25. 1872. *D. grandiflorum* L. var. *kunawarensis* Bruehl in Ann. R. Bot. Gard. Calc. 5: 98. 1896.

Perennial herbs; stems erect, 10 - 15(-40) cm high, branched from base, spreading, somewhat deflexed, pubescent. Basal leaves with petioles up to 10 cm long; upper cauline leaves with shorter petioles; lamina suborbicular, 2 - 4 cm in diam., 5- to 7-partite; lobes incised or pinnatifid almost to base into linear-lanceolate, 5 - 20 x 2 - 3 mm segments. Flowers ca 2.5 cm long, solitary or few in racemes; pedicels 2 - 8 cm long; bracteoles linear, 5 - 8 mm long, placed near or above the middle of pedicels. Sepals densely pubescent, pale to intense blue; lamina of uppermost sepal ovate, acute, 12 - 16 x 8 - 9 mm; spur straight, acute at apex, 18 - 22 x 2 - 3 mm, subhorizontal; lateral sepals oblong-ovate, 14 - 17 x 5 - 8 mm; lower petals ovate, ca 7 x 5 mm, entire, pointed or notched at apex, pubescent at base. Petals bluish, glabrous; upper petals slightly oblique, ca 7 mm long, entire, narrow or rounded at apex; spur 14 - 15 mm long; lower petals oblong-obovate, 7 x 5.5 mm with a round hairy patch near the base, entire or cleft for about 2 mm; claw ca 4.5 mm long. Stamens 5 - 6 mm long; anthers dark, ca 1 mm long. Follicles 3 - 5, pubescent, ca 8 mm long with about 2 - 3 mm long beak.

Fl. & Fr. July - Oct.

Distrib. India: Grassy and rocky slopes in alpine regions, 3800 - 5800 m. Himachal

Pradesh and Sikkim.

Nepal, Bhutan and China (Tibet).

4. *Delphinium candelabrum* Ostenf. in Hedin, South. Tibet 6(3): 80. 1922; Munz in J. Arn. Arb. 48: 509, f. 8I. 1967. Grierson & Long, Fl. Bhutan 1(2): 312. 1984.

Perennial low herbs; rootstock slender from a thickened branched elongate root; stem dark, slender, branched or simple, subglabrous or scattered spreading hairy, 5 - 15 cm high. Leaves subsulate from base; lower petioles 2 - 7 cm long, very slender, strigulose, dilated at base; lamina rounded, 1 - 2 cm in diam., palmatisect to base; lobes again divided into linear-oblong 3 - 5 x 1 - 2 mm wide segments, subtruncate and mucronate at apex, long pubescent beneath; cauline leaves 1 to few, remote, the upper reduced to trifoliate bracts. Flowers 3 - 6, subcorymbose; bracts 5 - 10 cm long, simple or compound-laciniate; pedicels 4 - 8 cm, arcuate-ascending, slender, somewhat spreading-villous; bracteoles placed near the middle of pedicels, entire and linear, ca 10 x 1 mm, sometimes 3-partite. Sepals blue-purple, often drying brownish, white- or yellow-villous; lamina of upper sepal broadly ovate, 20 - 24 x 18 - 20 mm; spur often slightly upcurved or straight, ca 17 - 20 x 4 - 5 mm; lateral sepals asymmetrically oblong-elliptic, 20 - 25 x 10 - 12 mm; lower sepals ovate-elliptic, rounded apiculate at tip, 22 x 15 mm. Petals dark violet; upper petals straight, 10 - 15 x ca 3 mm, curved and emarginate at apex with a few stiff hairs, rounded or erose at apex; spur ca 17 mm long; lamina of lower petals at right angles to the claw, rounded or broadly elliptic, 6 - 8 x 4 - 6 mm, shallowly bifid at apex, sparsely pubescent, short-bearded at lower half; claw ca 6 mm long. Stamens glabrous, ca 7 mm long; anthers ca 1 mm long, dark. Carpels 3, hairy.

Fl. & Fr. Aug. - Oct.

Distrib. India: Alpine slopes, 4500 - 5200 m. Sikkim.

Bhutan and China (Tibet).

5. *Delphinium cashmerianum* Royle, Illus. Bot. Himal. 55. 1834, t. 12. 1833; Hook. f. & Thomson in Fl. Brit, India 1: 26. 1872. *D. aitchisonii* Huth in Bot. Jahrb. 20: 395. 1895; Mukerjee in Bull. Bot. Surv. India 2: 293. 1960.

Perennial herbs, up to 50 cm high; rootstock slender, woody; stems strigosely hairy or subglabrous, simple or branched. Basal leaves with up to 15 cm long petioles dilated at base; lamina reniform, pentagonal, 2 - 10 cm across, somewhat strigulose, palmately 5- to 7-lobed halfway to the base; lobes toothed or lobulate into ovate or ovate-lanceolate, obtuse to acuminate lobules. Inflorescence a few-flowered corymb or panicle; flowers bluish-purple; pedicels slender, 1 - 8 cm long, strigosely hairy; bracteoles linear or setaceous to broadly lanceolate, 5 - 10 mm long, usually placed away from flower. Sepals bluish purple, sometimes pinkish, persistent, pubescent outside, reticulately veined;

upper sepal 20 - 30 x 12 - 15 mm, obtuse; spur blue, normally straight, conical, 12 - 15 mm long, 5 - 12 mm wide at base, tapering to a blunt apex; lateral sepals 15 - 25 x 6 - 12 mm, obtuse; lower sepals rhombic-obovate, 15 - 25 x 6 - 16 mm. Petals dark purple to light blue; upper pair slightly oblique; blade ca 13 mm long, glabrous, erose or bidentate along margins; spur 8 - 11 mm long; lower petals oblique, oblong-ovate, long-bearded and ciliate, ca 8 x 5 mm, cleft almost to half-way; claw 7 - 8 mm long. Stamens 6 - 7 mm long, glabrous; anthers ca 1 mm long, dark. Follicles 3 - 7, hairy, 13 - 15 x 4 mm with 2 - 3 mm long beak; seeds covered with horizontal row of scales.

Fl. & Fr. Aug. - Sept.

Distrib. India: Alpine and subalpine slopes, shaded places, 2800 - 3800 m. Jammu & Kashmir, Himachal Pradesh, Punjab and Uttar Pradesh.

Pakistan and China (Tibet).

6. *Delphinium densiflorum* Duthie ex Huth, Bot. Jahrb. 20: 393. 1895; Mukerjee in Bull. Bot. Surv. India 2: 294. 1961. *D. densiflorum* var. *platycentrum* Bruehl in Ann. R. Bot. Gard. Calc. 5: 103, t. 102. 1896.

Perennial herbs; rootstock rhizomatous, subcylindric; stem erect, strict, mostly simple, 30 - 50 cm high, fistulose, leafy throughout, retrorse-strigose, more or less glandular. Lower petioles fleshy, sheathing at base, 5 - 17 cm long, sparsely hairy, upper shorter; leaf-blades reniform to suborbicular, 5 - 10 cm across, mostly 5-partite, hairy; segments cuneate-obovate, trifid above, the lobes or teeth blunt to almost rounded; uppermost leaves becoming bracts. Inflorescence densely racemose, with 1.5 - 5 cm long pedicels adpressed to axis and covered by trifid bracts; bracteoles 2, placed at the middle or slightly above on the pedicels, adpressed, linear-lanceolate, 1 - 2 cm long, villous. Sepals grey-blue to deep blue, white hairy; upper sepal ovate, obtuse, ca 22 x 14 mm; spur subsaccate, 6 - 8 x 6 mm; lateral sepals oblong-elliptic, ca 2 x 1 cm, rounded-obtuse; lower sepals rhombic-ovate, obtuse, asymmetric, ca 22 x 15 mm. Petals black, ca 14 mm long; spur ca 6 mm long; lower petals oblique, oblong-ovate, ca 7 x 4 mm, cleft up to 3 mm, with 8 - 9 mm long claw, bearded. Stamens 8 - 9 mm long, glabrous; anthers ca 2 mm, dark. Follicles 3, villous; seeds winged on angles, ca 2 mm, brown.

Fl. & Fr. Aug. - Oct.

Distrib. India: Western Himalayas, 3000 - 5000 m. Uttar Pradesh.

Nepal and China (Tibet).

7. *Delphinium denudatum* Wallich [Cat. no. 4719. 1830, nom. nud.] ex Hook. f. & Thomson, Fl. Ind. 49. 1855 & in Fl. Brit. India 1: 25. 1872. *D. pauciflorum* Royle, Illus. Bot. Himal. 55. 1834 (non D. Don, 1825).

Perennial much-branched herbs, 40–80 cm high; stems subglabrous to coarsely strigose above, terete. Lower leaves with up to 15 cm long petioles dilated at base; cauline leaves remote, gradually reduced upwards with much shorter petioles; lamina suborbicular, 3- to 5-partite; lobes obovate, deeply coarsely lacinate into suboblong lobes or teeth. Inflorescence an open panicle of few-flowered racemes, sparsely flowered; bracts linear, 5–15 mm long; pedicels 1–4 cm long; bracteoles 2, placed near the middle of the pedicel, 2–4 mm long; flowers fragrant, blue or violet. Upper sepal ovate, acute, 12–13 x 6–7 mm, pubescent; spur 14–15 mm long, 3–4 mm wide at base, subacute at tip; lateral sepals oblong-ovate, rounded at apex, ca 13 x 7–8 mm, pubescent on midline; lower sepals oblong-ovate, 14–15 x 7 mm, rounded at apex, pubescent. Upper petals white with blue tinge at apex, the blade 8–9 mm long, glabrous, bidentate, oblique; spur 13–15 mm long; lower petals blue or violet, the claw ca 5 mm long; blade elliptic, bearded, ca 6 mm long, cleft almost half way. Stamens somewhat violet, glabrous, 5–6 mm long; anthers bluish, ca 0.8 mm long. Follicles 3, sparsely strigose or subglabrous, 10–16 x 3–3.5 mm with 2–3 mm long beak; seeds obpyramidal, ca 1 mm long; dark, covered with irregularly arranged rows of scales.

Fl. & Fr. April–June.

Distrib. India: Open slopes on alpine and subalpine regions, 1800–4000 m. Jammu & Kashmir, Himachal Pradesh, Punjab and Uttar Pradesh.

Pakistan.

Notes. Chromosome no. $n = 10$ (Sarkar et al. in *Taxon* 31: 576. 1982).

8. *Delphinium drepanocentrum* (Bruehl ex Huth) Munz in *J. Arn. Arb.* 49: 94, f. 13L. 1968. *D. altissimum* Wallich var. *drepanocentrum* Bruehl ex Huth in *Bot. Jahrb.* 20: 419. 1895. *D. altissimum* Wallich subsp. *drepanocentrum* (Bruehl ex Huth) Bruehl & King in *Ann. R. Bot. Gard. Calc.* 5: 101. 1896. *D. umbrosum* Hand.-Mazz. subsp. *drepanocentrum* (Bruehl) Chowdhury ex Mukerjee in *Bull. Bot. Surv. India* 2: 295. 1961.

Perennial herbs, woody at base; stems up to 60 cm high, simple, pubescent with deflexed yellowish or brownish hairs. Basal leaves absent at anthesis; cauline leaves with 5–20 cm long soft-hairy petioles; lamina somewhat pentagonal with a deep sinus at base, 3–5-lobed up to 1–2 cm from base, rather long hairy above and on nerves beneath, gradually reduced upwards, becoming trifoliolate 2–3 cm long bracts in inflorescence; lobes broad rhombic, cuneate at base, further shallowly divided into 3 lobules. Inflorescence racemose, up to 30 cm long, 5–20-flowered, more or less retrorse-hairy and glandular; upper bracts linear to lanceolate, 1–2 cm long; pedicels erect, 1–4 cm long; bracteoles linear, subulate, 7–8 mm long, ca 1 mm wide, subtending the flower. Sepals

mauve to dull purple, coarsely appressed hairy; upper sepal ovate, 12 - 15 x 8 - 10 mm, obtuse; spur 20 - 25 mm long, ca 2.5 mm wide at base, narrowed to apex, downwardly curved into a half-circle or merely decurved-spreading; lower sepals oblong-elliptic, 10 - 11 mm long, ca 5 mm wide, rounded at tip. Petals bluish; upper petal slightly oblique, ca 9 x 2.5 mm, glabrous, pointed; spur slender, ca 20 mm long; lower lamina oblong, 6 - 7 x 3 - 4 mm, bifid for about 4 mm into 2 linear-lanceolate lobes, bearded at tips; the claw ca 5 mm long. Stamens ca 5 mm long, glabrous; anthers dark, ca 1 mm long. Follicles 3, 15 - 18 mm long, ca 3 mm wide, somewhat hairy; seeds obovoid, angled, scarcely 1 mm long with transverse rows of brownish scales.

Fl. & Fr. July - Aug.

Distrib. India: Alpine open and bushy slopes, 3500 - 5000 m. Sikkim.

Nepal and Bhutan.

9. *Delphinium glaciale* Hook. f. & Thomson, Fl. Ind. 53. 1855 & in Fl. Brit. India 1: 27. 1872.

Perennial herbs with musky odour; rootstocks woody; stems 6 - 15 cm high, simple, leafy, pubescent with spreading hairs, some glandular with swollen bases. Leaves reniform, 2 - 5 cm wide, deeply 3-partite; segments cuneate at base, lanceolate, acute at apex, sparsely pubescent; petioles broad and sheathed at base, up to 5 cm long. Flowers subglobose, few, up to 5 in corymbs; bracts multifid, up to 2 cm long; pedicels erect, stout, 2 - 6 cm long; bracteoles 3 or more, much divided, 10 - 15 mm long, placed scattered on pedicels. Sepals pale blue, membranous, veined; upper sepal broadly ovate or obovate, acute, 2.5 - 3 x 2 cm; spur 12 - 15 cm long, 7 - 8 mm wide at base, saccate, slightly curved; lateral sepals broadly ovate, 1.8 - 2.3 x 1.5 - 1.7 cm, semicircular on lower edge, straight on upper edge; lower sepals round-rhombic, ca 30 mm long and wide. Petals black; upper petals upwardly curved, 12 - 15 x 2 - 3 mm, bearded, sharply bilobed at apex; spur ca 13 mm long; lower petals oblong, ca 6 x 3 mm, bifid up to middle into acute lobes, ciliate-pubescent near base. Stamens 8 - 9 mm long, ciliate and much widened at base; anthers dark, ca 2 mm long. Follicles 5, subglabrous, 11 - 13 mm long; seeds winged along 3 angles, ca 1.5 mm long.

Fl. & Fr. July - Oct.

Distrib. India: Alpine scrubs and slopes, 4500 - 6000 m. Sikkim.

Nepal and Bhutan.

10. *Delphinium incisum* (Hook. f. & Thomson) Wallich [Cat. 4717. 1828, nom. nud.] ex Munz in J. Arn. Arb. 48: 520, f. 9G. 1967. *D. elatum* L. var. *incisum* (Hook. f. & Thomson) Hook. f. & Thomson in Fl. Brit. India 1: 26. 1872. *D. ranunculifolium* Hook. f. & Thomson var. *incisum* Hook. f. & Thomson, Fl. Ind. 51. 1855.

Plants up to 1 m high; stems slender, somewhat angled, retrorsely pilose to strigose. Cauline leaves scattered, pentagonal in outline, 5 - 10 cm wide, somewhat strigose on both sides, paler beneath, 5-fid nearly to the base; segments somewhat rhombic, 3-lobed up to below the middle; each lobe incised into a few oblong-mucronate lobules, up to 1 cm long, 1.5 - 3 mm wide; petioles somewhat sheathed at base, up to 10 cm long; the upper petioles becoming shorter to about almost absent. Inflorescence racemose few-branched, each branch rather few-flowered, fairly compact; bracts leafy, dissected or the upper entire, linear-oblong, up to 8 mm long; pedicels erect, ascending, strigose, mostly 1 - 2 cm long; bracteoles linear-oblong, strigose, 4 - 6 mm long. Sepals bluish, strigose; upper sepal, ovate, obtuse, 14 - 15 x 11 - 12 mm; spur spreading, decurved, ca 17 mm long, 2 - 3 mm wide at base, blunt; lateral sepals rounded-obovate, ca 13 x 12 mm; lower sepals ca 13 x 7 mm, subacute. Petals black; upper petal slightly oblique, ca 9 x 2 mm, entire, glabrous; spur ca 16 mm long; lower petals oblong, ca 6 x 3 mm, with 2 short unequal oblong ciliate lobes, bearded at base; claw ca 6 mm long. Stamens 6 - 8 mm long, glabrous. Carpels 3, densely pubescent.

Fl. July.

Distrib. India: Uttar Pradesh (Kumaon).

Nepal.

11. *Delphinium kamaonense* Huth in Bull. Herb. Boiss. 1: 33. 1893; Munz in J. Arn. Arb. 48: 521, f. 9, I & J. 1967. *D. grandiflorum* L. var. *kamaonense* Huth ex Bruehl & King in Ann. R. Bot. Gard. Calc. 5: 98. 1896.

Perennial herbs, with thick rootstock; stems up to 50 cm high, branched, subglabrous, leafy. Lower petioles 3 - 8 cm long, hairy, dilated at base; lamina 2 - 4 cm wide, 5-partite and each lobe 5-fid; each segment cuneate and lacinate ultimately into oblong lobes of 2 - 3 mm wide; upper leaves with 1 - 2 cm long and 1 - 1.5 mm wide linear lobes. Inflorescences open racemes, branching divaricately; upper bracts linear, entire, up to 1 cm long; pedicels much longer than flowers, bibracteolate above the middle; bracteoles linear, 3 - 5 mm long. Sepals deep blue with a dark brown subapical spot, slightly pilose, up to 2 cm long; upper sepal ovate, suborbicular, obtuse, ca 17 x 12 mm; spur straight or slightly curved, 12 - 15 cm long, ca 3.5 mm wide at base; lateral sepals elliptic-oblong, obtuse, 12 - 13 x 8 - 9 mm; lower sepals ca 14 x 7 mm, oblong-ovate. Upper petals light brown, oblique, entire, ca 8 x 3 mm, glabrous; spurs ca 14 mm long; lower petals blue, yellow bearded, obovate, obtuse, bifid at apex, ca 7 mm long; claw ca 5 mm long. Stamens 5 - 6 mm long, glabrous; anthers dark, ca 1 mm long. Follicles densely pilose.

Fl. July - Aug.

Distrib. India: Western Himalayas, 3000 - 4600 m. Uttar Pradesh (Kumaon).

Nepal.

12. *Delphinium koelzii* Munz in J. Arn. Arb. 48: 522, f. 9H. 1967.

Slender perennial herbs; stems up to 1 m high, simple or few-branched above, strigulose. Lower leaves mostly withered by anthesis; blades commonly 2 - 8 cm long, multipartite, each division pinnately lacinate into 1 - 2 mm wide lobes, subglabrous above, somewhat strigulose beneath; petioles up to 5 cm long, dilated at base; middle cauline leaves several, short-petioled to sessile. Inflorescences lax corymbose racemes, strigulose; terminal branch about 8-flowered; lateral branches with fewer flowers; bracts linear, sub-setaceous, up to 5 mm long; pedicels divergent with more or less recurved tip, mostly 1 - 2 cm long; bracteoles 2 - 3 mm long, placed below the middle on the pedicel. Sepals reddish violet to blue, somewhat strigulose; upper sepal ovate, obtuse, ca 10 x 5 mm; spur ca 13 mm long, ca 3 mm wide at base, straight, blunt; lateral sepals oblong, obtuse, ca 10 x 6 mm; lower sepals rounded, 10 - 11 mm long, ca 6 mm wide. Upper petals oblique, 8 - 9 mm long, toothed at apex; spur ca 13 mm long; lower petals ca 5 mm long, bearded, obovate, divided for about 3 mm; claw ca 5 mm long. Stamens 5 - 6 mm long, glabrous; anthers dark, ca 1 mm long. Follicles 3, densely strigulose.

Fl. & Fr. June - July.

Distrib. India: Himachal Pradesh.

Endemic.

13. *Delphinium kohatense* (Bruehl) Munz in J. Arn. Arb. 48: 280, f. 4A. 1967. *D. saniculifolium* Boiss. var. *kohatense* Bruehl in Bruehl & King in Ann. R. Bot. Gard. Calc. 5: 95, t. 117, ff. 1-2. 1896. *D. saniculifolium* Boiss. var. *gilgetense* Bruehl in Ann. R. Bot. Gard. Calc. 5: 95. 1896. *D. saniculifolium* auct. non Boiss.; Hook. f. & Thomson in Fl. Brit. India 1: 25. 1872.

Perennial herbs, with tuberous roots; stems slender, terete, mostly few-branched above, 20 - 50 cm high, sparsely strigulose at lower parts, densely so above. Lower leaves 2 - 4 cm wide, somewhat strigulose, trifid up to base; segments cuneate, the lateral segments deeply lobed into 5 subequal pinnately few-lobed or toothed parts, the ultimate lobes 1 - 3 mm wide, mucronate; petioles 2 - 7 cm long, slender, somewhat dilated at base; cauline leaves few, remote, reduced. Racemes lax, about 10-flowered, slender, strigulose; bracts linear, 2 - 3 mm long; pedicels ascending, 5 - 25 mm long; bracteoles lanceolate, placed near the base of the pedicel. Sepals pale blue, blunt, upper sepals

5 - 8 x 3 mm, strigulose; spur cylindric, obtuse, 5 - 7 mm long; lateral sepals 7.5 - 8 x 2.5 mm; lower sepals ca 8 x 3 mm, oblong-ob lanceolate. Upper petals ca 7.5 mm long, pale, oblique, the bearded lamina with ca 1 mm long terminal lobes; spur ca 5 mm long; lower petals ca 8 mm long, bearded, divided for about 2.5 mm. Stamens 4.5 - 5.5 mm long; filaments bluish, somewhat ciliate on expanded lower part; anthers less than 1 mm long. Follicles 3, pubescent at apex.

Fl. & Fr. July - Aug.

Distrib. India: In dry places, below 3500 m. Jammu & Kashmir.

Pakistan and Afghanistan.

14. *Delphinium lacostei* Danguy in J. Bot. Morot. 21: 50. 1908; Munz in J. Arn. Arb. 18: 486, f. 6H. 1967.

Perennial herbs with slender rootstock; stems 4 - 10 cm high, glabrous or with retrorsely spreading hairs. Leaves several, all radical, more cauline; petioles 2 - 8 cm long, shortly sheathed at base, pubescent; lamina reniform to suborbicular, 2 - 5 cm broad, sparsely pubescent beneath, 3 - 5-partite for up to 5 - 10 mm from base; segments broadly cuneate-obovate, shallowly 3-lobed and with a few ovate-mucronate teeth at apex. Flowers 2 at the apex of stems, blue; bracts leaf-like, trilobed, shortly broad-ovate, slightly hairy; pedicels ca 1 cm long; bracteoles oblong-linear, 5 - 7 mm long, subtending the flower. Sepals glandular and hairy outside; upper sepal ovate, obtuse, 6 x 10 mm; spur straight, 10 - 11 x 5 - 7 mm wide at base, obtuse at tip; lateral sepals subelliptic, obtuse, ca 14 x 6 mm, pubescent along the middle; lower sepals more or less symmetric, obtuse, ca 15 x 6 mm. Petals dark, upper petal oblique, with 2 teeth and long-ciliate apex, ca 10 mm long; spur ca 12 mm long; lower petals obliquely oblong, ca 6 x 2 mm, white-ciliate, yellow-bearded at base; claw ca 6 mm long. Stamens 5 - 6 mm long, glabrous; anthers dark, ca 1.2 mm long. Follicles 4 - 5, glabrous or hairy.

Fl. & Fr. July - Aug.

Distrib. India: Himachal Pradesh.

Pakistan.

15. *Delphinium ludlowii* Munz in J. Arn. Arb. 49: 105, f. 14K. 1968; Grierson & Long, Fl. Bhutan 1(2): 312. 1984. *D. ludlowianum* Chowdhury ex Mukerjee in Bull. Bot. Surv. India 2: 293-296. 1960, nom. nud.

Stems 75 - 100 cm high, rather slender, remotely leafy, pubescent with deflexed hairs towards top. Leaves suborbicular, 10 - 15 cm in diam., gradually reduced towards inflorescence into leafy bracts, strigulose on both sides, 5-fid to about 1 cm from base;

middle segments cuneate-rhombic, ternately pinnatisect into 3 broad lobes for halfway to the midrib, these shallowly and rather coarsely toothed; the teeth oblong, mucronate, 3 - 5 x 2 - 3 mm; lateral segments deeply bifid, coarsely toothed; petioles up to 12 cm long, slender, subglabrous, slightly sheathed at base. Inflorescence lax, 6 - 20-flowered raceme, 10 - 25 cm long, closely strigulose; bracts petiolate, lanceolate, 1 - 2.5 x 2 - 6 mm; pedicels arched, 1 - 5 cm long; bracteoles subtending the flower, linear-spathulate, 5 - 7 x 1 mm. Sepals blue, purplish or pale maroon, minutely pubescent; uppermost sepal broadly oblong-ovate with an extended blunt tip, 12 - 15 x 10 - 12 mm; spur spreading, 12 - 17 mm long, 4 - 5 mm wide at base, rather abruptly narrowed to an acute tip; lateral sepals oblong-obovate, subtruncate, 11 - 13 x 5 - 8 mm; lower sepals ca 13 mm long, 6 - 7 mm wide, pointed. Petals bluish, upper petals oblong, curved upwards, narrowed and bidentate at apex, ca 10 x 3 mm, glabrous; spur 11 - 13 mm long; lower petals obliquely oblong, 3 - 5 x 2 - 3 mm, bilobed almost halfway, subglabrous; claw ca 5 mm long. Stamens 5 - 6 mm long, glabrous; anthers dark, oblong, ca 1 mm long. Follicles 3, divergent, glabrous, 12 - 13 mm long, ca 3 mm wide, styler base ca 2.5 mm at apex; seeds angled.

Fl. & Fr. June - Oct.

Distrib. India: Streamsides and shaded ravines, among stones and boulders in forests, 2700 - 3700 m. Sikkim.

Bhutan.

16. *Delphinium malabaricum* (Huth) Munz in J. Arn. Arb. 49: 106, f. 142. 1968; Billore & Singh in Indian For. 98: 407 - 408. 1972. *D. dasycaulon* var. *malabaricum* Huth in Bot. Jahrb. 20: 435. 1895. *D. dasycaulon* auct. non Fresen; Hook. f. & Thomson in Fl. Brit. India 1: 25. 1872.

Perennial herbs with woody cylindrical rhizome; stems 30 - 100 cm high, slender, glabrous to retrorse pubescent below, pale to bright yellowish strigose in inflorescence, simple or few-branched above, remotely few-leaved. Lower petioles 10 - 25 cm long, glabrous to somewhat pubescent, strongly sheathed at base; cauline petioles reduced, upper very short. Leaf blades somewhat reniform, 3 - 10 cm across, glabrous or nearly so above, with few to many stiff hairs along margin and the veins beneath, 5- to 7-fid for up to half their length; segments broadly cuneate-obovate, mostly bifid, then coarsely toothed with broad entire or dentate teeth with mucronate tips; middle cauline leaves more deeply divided with entire or 3-toothed segments. Inflorescences consisting of 1 to few, rather densely several-flowered racemes; lower bracts leafy, trifid, 2 - 4 cm long; upper bracts linear, entire, 6 - 10 mm long; pedicels divergent, 5 - 20 mm long, strigose; bracteoles subulate, placed near the base or middle of pedicels. Sepals bright blue with a somewhat subterminal spot, strigose to subglabrous; upper sepal ovate, 10 - 14 x 5 - 7 mm; spur subconic, obtuse, 7 - 12 x 3 - 4 mm; lateral sepals elliptic-obovate, truncate-rounded at apex, 13 - 16 x 7 - 9 mm; lower sepals narrowly obovate, 11 - 13 x 5 - 7 mm. Upper petals slightly oblique, obtusely bilobed at apex, ca 10 mm long, glabrous; spur

ca 7 mm long; lower petals rounded to oblong, bilobed up to base, ca 7 x 5 mm, short-ciliate and strigulose; claw ca 5 mm long. Stamens 6 - 7 mm long, ciliate; anthers bluish, rounded, less than 1 mm long. Follicles strigulose or glabrous, divergent, ca 1 cm long; seeds with papillose scaly covering or rugulose and without scaly covering.

KEY TO THE VARIETIES

- 1a. Plants with bright yellowish tomentum; spur 10 - 12 mm long; follicles glabrous; seeds rugulose without scaly covering **16.1. var. ghaticum**
 b. Plants with pale yellowish tomentum; spur 7 - 9 mm long; follicles strigulose; seeds with papillose scaly covering **16.2. var. malabaricum**

16.1. var. ghaticum Billore in Indian For. 99: 436 - 439, f. 1. 1973.

Fl. & Fr. Aug. - Sept.

Distrib. India: Maharashtra.

Endemic.

16.2. var. malabaricum

Fl. & Fr. Aug. - Sept.

Distrib. India: Maharashtra (Khandala, Purandhar).

Endemic.

17. *Delphinium nortonii* Dunn in Bull. Misc. Inf. Kew 1927: 247. 1927; Munz in J. Arn. Arb. 48: 528, f. 10E. 1967.

Perennial herbs, 7 - 10 cm high, densely hairy; stems many from the rootstock, single-flowered. Basal leaves orbicular, long-petioled; lamina palmately 3-partite; segments palmately laciniately incised; cauline leaves few. Flowers large on long peduncles, 4 - 5 cm long. Sepals short; spur 1 - 1.5 cm long, gradually attenuating. Lateral petals bifid, shortly golden hairy; lower petals bidentate. Filaments glabrous. Carpels 3, velvety.

Fl. June.

Distrib. India: E. Himalayas, 4000 - 5000 m. Sikkim.

Nepal and China (Tibet).

18. *Delphinium pyramidale* Royle, *Illus. Bot. Himal.* 56. 1834. *D. ranunculifolium* Hook. f. & Thomson, *Fl. Ind.* 51. 1855. *D. elatum* L. var. *ranunculifolium* (Hook. f. & Thomson) Hook. f. & Thomson in *Fl. Brit. India* 1: 26. 1872.

Perennial herbs, nearly up to 2 m high; stems thick, glabrous, leafy, branched at the inflorescence regions. Lower petioles up to 40 cm long, upper shorter; lamina ca 15 cm wide, 3- to 5-partite, deeply segmented. Inflorescence a group of many-flowered racemes, the upper leaves passing off into bracts. Flowers blue or purplish. Sepals as long as the spur; spur 12 - 15 mm long, straight or decurved. Petals bluish black, lower ones bearded. Stamens 7 - 8 mm long, glabrous. Follicles 3, glabrous or pubescent.

Fl. & Fr. July - Sept.

Distrib. India: W. Himalayas, 2000 - 3500 m. Jammu & Kashmir, Himachal Pradesh and Uttar Pradesh.

Pakistan, Nepal and China (Tibet).

19. *Delphinium roylei* Munz in *J. Arn. Arb.* 48: 292-293. 1967. *D. incanum* Royle, *Illus. Bot. Himal.* 55. 1834 (non E.D. Clarke, 1812); Hook. f. & Thomson in *Fl. Brit. India* 1: 25. 1872.

Herbs, up to 1 m high; roots tuberous; stems simple or branched above, hoary. Lower leaves withering soon; lamina 5 - 8 cm wide, palmately multi-partite; lobes cuneate, sharply incised; petioles up to 10 cm long; upper leaves with shorter petioles or sessile. Flowers in branched racemes, many-flowered. Sepals broadly elliptic, deep purplish blue; spur of upper sepal 13 - 14 mm long, much longer than sepal, straight. Upper petals pale blue; lower ones deep blue, bearded. Stamens 5 - 7 mm long, glabrous. Follicles 3, strigose; seeds with transverse row of scales.

Fl. Aug. - Sept.

Distrib. India: Open slopes of alpine ranges in Kashmir between 1500 - 4200 m. Jammu & Kashmir and Orissa (Mahendragiri).

Notes. Paul (in *Geobios* 2: 27. 1975) records this species from Mahendragiri in Orissa at about 1500 m altitude.

20. *Delphinium scabriflorum* D. Don, *Mem. Wern. Soc.* 3: 413. 1821; Munz in *J. Arn. Arb.* 49: 114. 1968. *D. carela* D. Don, *Prodr. Fl. Nep.* 195. 1825.

Perennial from a woody rootstock; stems 60 - 120 cm high, slender, branched above, remotely spreading hairy, some glandular. Leaves pentagonal in outline. Lower leaves with petioles up to 30 cm long; lamina of lower leaves open-cordate, 5 - 15 cm across,

5-fid to near the base or 1 - 2 m above; the segments subcuneate below, incised-lobed, stiff-pubescent on both sides; locules oblong-ovate, 2 - 5 mm wide; petioles 10 - 20 cm long, scarcely sheathed at base. Upper leaves gradually reduced. Racemes open, 8 - 12-flowered, with few-flowered branches from below, densely short hairy with some hairs glandular; lower bracts foliose, divided, up to 3 cm long; the upper simple, entire, linear to lanceolate, 1 - 2 cm long; pedicels arched-spreading, 1 - 5 cm long, densely pubescent; bracteoles linear-lanceolate; 0.5 - 1 cm long. Sepals dark blue to blue-violet, with rather stiff appressed hairs; upper sepal orbicular-ovate, ca 1.5 x 1 cm; spur ca 1.8 cm long, ca 3 mm wide; lateral sepal unequally obovate, ca 1.5 x 0.8 cm. Petals blue or light purple; upper laminae oblique, ca 12 x 3 mm, glabrous, bidentate; spur 1.5 - 1.6 cm long; lower laminae oblong, bifid at apex into 2 unequal oblong-lanceolate lobes, 5 - 6 x 3 - 4 mm, white ciliate; claw ca 6 mm long, bearded. Stamens 6 - 7 mm long; anthers elongate, ca 1.5 mm long. Follicles 3 - 4, cylindrical, subglabrous or pilose, with short beaks; seeds not winged.

Fl. June - Aug.

Distrib. Mossy rocks near streams along open or wooded hillsides, 1800 - 2200 m. Meghalaya.

Nepal and Bhutan.

21. *Delphinium stapeliosum* Bruehl ex Huth, Bot. Jahrb. 20: 419. 1895. *D. stapeliosum* var. *khasianum* Bruehl in Ann. R. Bot. Gard. Calc. 5: 102. 1896.

Slender, erect herbs, up to 1.5 m high, branched above, hairy; stems leafy. Lower leaves with petioles up to 25 cm long; lamina up to 15 cm wide, palmately 5-fid; segments cuneate, 3-fid above, 5 - 7 x 3 - 5 mm. Flowers in lax racemes; pedicels ascending; bracteoles oblanceolate, 6 - 10 x 2 - 3 mm. Sepals bluish purple or reddish; spur 15 - 20 mm long, spreading. Petals blue-black, lower ones bearded; lamina of lower petals ovate, 6 - 7 x 3 mm, deeply bifid into lanceolate lobes, pubescent. Stamens 5 - 6 mm long, glabrous. Follicles 3, pubescent. Seeds winged along edges.

Fl. & Fr. Sept. - Nov.

Distrib. India: Moist coniferous forests and grassy slopes, 2000 - 3000 m. Meghalaya.

Nepal, Bhutan, N. Myanmar and China (Tibet).

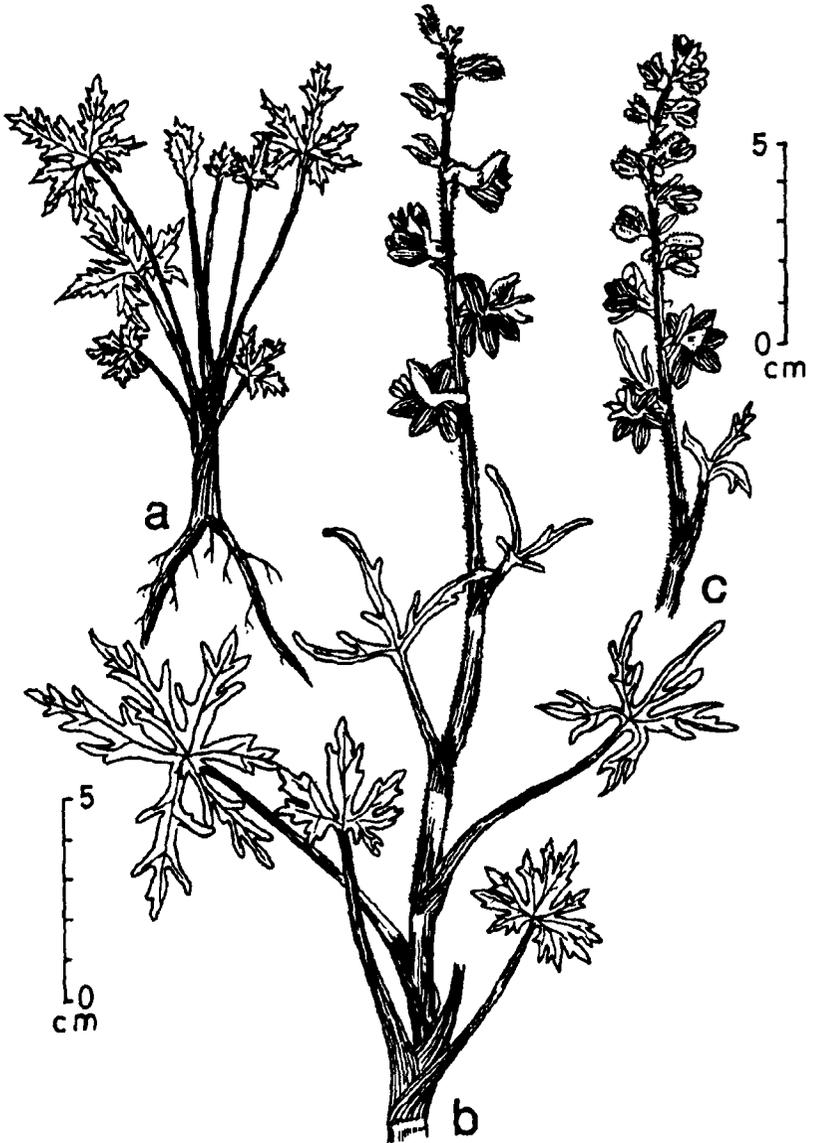


Fig. 14. *Delphinium uncinatum* Hook. f. & Thomson: a. habit; b. flowering shoot; c. inflorescence (from H.J. Chowdhery in Red Data Book of Indian Plants 2: 198. 1980).

22. *Delphinium uncinatum* Hook. f. & Thomson in Fl. Brit. India 1: 24. 1872.

Fig. 14.

Stems simple, up to 90 cm high, densely hairy above. Basal leaves crowded; petioles 2 - 12 cm long, dilated at base; lamina deeply 3 - 5-partite; segments pinnately dissected; cauline leaves with narrower lobes. Flowers in racemes or panicles, shortly pedicellate. Sepals bluish purple; spur 7 - 10 mm long, hooked. Lower petals bearded. Stamens ca 5 mm, glabrous. Follicles 3, glabrous or hairy.

Fl. & Fr. Aug. - Oct.

Distrib. India: W. Himalayas, 1200 - 2000 m. Jammu & Kashmir.

Pakistan and Afghanistan.

23. *Delphinium vestitum* Wallich ex Royle, Illus. Bot. Himal. 55. 1834; Hook. f. & Thomson in Fl. Brit. India 1: 26. 1872. *D. vestitum* var. *sphenolobum* Bruehl ex Huth in Bot. Jahrb. 20: 415. 1895.

Erect herbs, rootstocks slender; stems 40 - 100 cm high with long spreading deflexed hairs. Leaves mostly basal with hairy petioles, up to 25 cm long; lamina suborbicular, and toothed, hairy on both surfaces. Flowers in long dense racemes. Sepals purplish blue or pale violet; spur as long as sepals, 15 - 20 x 5 - 7 mm long. Petals black, bearded. Stamens ca 8 mm long, glabrous. Follicles 3, hairy. Seeds narrowly winged, not squamate.

Fl. & Fr. Aug. - Oct.

Distrib. India: W. Himalayas, 2000 - 4000 m. Jammu & Kashmir, Himachal Pradesh and Uttar Pradesh.

Notes. See Lauener (in Notes R. Bot. Gard. Edinb. 38: 125-128. 1980) for discussions on typification.

24. *Delphinium viscosum* Hook. f. & Thomson, Fl. Ind. 52. 1855 & in Fl. Brit. India 1: 27. 1872. *D. conocentrum* D. Chatterjee in Kew Bull. 1948: 57. 1948. *D. trilobatum* Huth in Bull. Herb. Boiss. 1: 330. 1893.

Perennial herbs; stems erect, 20 - 60 cm high, with short yellowish glandular hairs. Lower leaves with petioles up to 20 cm long, upper ones shorter; lamina suborbicular, reniform, 3 - 10 cm across, palmately 5 - 7-lobed; lobes cuneate, toothed at apex, 7 - 15 mm broad. Flowers few, in lax corymbs or racemes; pedicels 2 - 10 cm long, glandular-hairy, ascending; bracts oblong, 3 - 5 cm long, entire or lobed; bracteoles similar, 1 - 2

cm long, borne near flowers. Sepals violet-blue to purple; lamina of upper sepal broadly ovate, 18 - 23 mm long and broad; spur incurved; lateral sepals 22 - 25 mm long and broad. Petals dark purple, lower bearded; lamina of upper petals 12 - 15 x 3 mm, divided into 2 narrow lobes; lamina of lower petals oblong, ca 10 x 3 mm, bifid up to middle into linear lobes, stiff pubescent. Stamens 6 - 7 mm long, glabrous. Follicles 3, glabrous. Seeds winged on angles.

Fl. & Fr. July - Oct.

Distrib. India: Alpine cliff edges in E. Himalayas, 3600 - 4700 m. Sikkim.

Bhutan and Nepal.

15. *Dichrocarpum* Wang & Hsiao

Perennial herbs; stems surrounded at base with fleshy scales. Leaves palmately compound, rarely ternately 5 - 15-foliolate. Flowers actinomorphic, in terminal scapes longer than leaves, leafy at top, a dichasium but usually reduced to a single flower. Sepals 5 - 6, petaloid, deciduous. Petals nectariferous, long-clawed with shorter blade. Stamens 10 or more. Carpels 2, connate at base. Follicles constantly 2, connate at base, erect at first, later much divaricate, spreading, borne on a slender pedicel thickened at base.

Temperate Himalayas and E. Asia; 16 species, one in India.

Literature. TAMURA, M. & L. A. LAUENER (1968) A revision of *Isopyrum*, *Dichrocarpum* and their allies. *Notes R. Bot. Gard. Edinb.* 28: 267 - 273.

Dichrocarpum adiantifolium (Hook. f. & Thomson) Wang & Hsiao in *Acta Phytotax. Sin.* 9: 323. 1964. *Isopyrum adiantifolium* Hook. f. & Thomson, *Fl. Ind.* 42. 1855 & in *Fl. Brit. India* 1: 23. 1872.

Slender herbs, 15 - 35 cm high. Leaves ternately compound; petioles up to 6 cm long; lobes broadly obovate, crenate, 5 - 10 mm long; petiolules up to 2 cm long. Flowers solitary, white. Sepals elliptic or obovate, 7 - 9 x 2 - 4 mm, white. Lamina of petals linear-elliptic or obovate, ca 0.7 mm across; claw 2 - 3 mm long. Stamens 10 - 12. Carpels 2. Follicles 2, cylindrical, 7 - 9 x 1.5 mm.

Fl. & Fr. March - July.

Distrib. India: E. Himalayas, on mossy rocks and near waterfalls, 1300 - 3000 m. W. Bengal, Sikkim and Meghalaya.

Nepal and Myanmar.

Notes. Some authors treat this under *Isopyrum* (Hara in Enum. Fl. Pl. Nepal 2: 9. 1979).

16. *Halerpestes* Greene

Creeping herbs, without proper stems; rootstock with many long articulating stolons; roots fibrous. Radical leaves oblong or orbicular, 3-lobed. Flowers solitary on scapes. Sepals 5, turning brown and withering or caducous. Petals 5-10, yellow, deciduous. Stamens many. Carpels many. Achenes thin, numerous on rounded or oblong capitula, with striations on surface. Seeds thin, with papery surface.

Temperate Eurasia and N. America; 7 species, 2 in India.

KEY TO THE SPECIES

- 1a. Leaves orbicular, crenately incised; achenes 80 - 130, on oblong capitulum 1. *H. sarmentosa*
 b. Leaves oblong, tridentate, variously lobed or deeply incised; achenes 40 - 50, on roundish capitulum 2. *H. tricuspis*

1. *Halerpestes sarmentosa* (Adams) Kumarov in Kumarov & Klob., Als. Key Pl. Far East USSR. 1: 550. 1931; Chatterjee in J. Bombay Nat. Hist. Soc. 56: 670. 1960. *Ranunculus sarmentosus* Adams in Mem. Soc. Nat. Mosc. 9: 244. 1834. *R. cymbalariae* Hook. f. & Thomson in Fl. Brit. India 1: 17. 1872, p. p. (non Pursh).

Creeping herbs, almost stemless. Leaves orbicular, crenately lobed. Flowers solitary on leafless scapes. Achenes 80 - 130, on oblong receptacle.

Fl. & Fr. July - Aug.

Distrib. India: Himalayas, 3500 - 5000 m. Jammu & Kashmir, Uttar Pradesh and Sikkim.

Nepal, Pakistan, Afghanistan and Russia.

2. *Halerpestes tricuspis* (Maxim.) Hand.-Mazz. in Acta Hort. Gotob. 13: 135. 1939; Chatterjee in J. Bombay Nat. Hist. Soc. 56: 670. 1960. *Ranunculus tricuspis* Maxim., Fl. Tangut. 12. 1889. *R. cymbalariae* Hook. f. & Thomson in Fl. Brit. India 1: 17. 1872, p. p.

Leaves all basal, broadly ovate or orbicular in outline, 0.5 - 1.5 cm long and broad, shallowly or deeply tripartite; segments oblong or oblanceolate, obtuse, sometimes lobed, glabrous; petioles 1 - 2 cm long. Flowers yellow, 8 - 10 mm across; scapes 2 - 2.5 cm long, one-flowered. Sepals narrowly ovate, ca 4 mm long, spreading, greenish. Petals

obovate, 4 - 5 x 1.75 mm, yellow. Achenes 40 - 50, on round capitula, obovoid, ca 1 mm long, faintly striate; style persistent, straight or slightly hooked.

Fl. & Fr. July - Sept.

Distrib. India: Alpine Himalayas, in shallow water and marshy areas, 3000 - 5000 m. Jammu & Kashmir, Himachal Pradesh, Uttar Pradesh and Sikkim.

Bhutan, Nepal, China, Mangolia and Russia.

Notes. The nomenclature and taxonomy of this group are complicated. The size and shape of the leaves are highly variable, and perhaps, are influenced by the conditions of the habitat. Further studies are needed. All the variants are treated under a single species here, as done by Hara (in *Fl. E. Nepal*, 3rd repr. 37 - 39. 1975). Some authors treat this species as a synonym of *Ranunculus tricuspis* Maxim. (Hara, *Enum. Fl. Pl. Nepal* 2: 43. 1979).

17. *Hepatica* Mill.

Herbs, perennial, similar to *Anemone* in habit, but differing chiefly in possessing a calyx-like involucre or 3 leaves close to the flower. Leaves 3 - 5-lobed, with entire or crenate-dentate lobes. Flowers subtended by a calyx-like involucre of 3 small entire bracts.

Temperate Eurasia to W. Himalayas, ca 10 species; one in India.

Hepatica falconeri (Thomson) Juz. in *Fl. USSR*. 7: 284. 1937. *Anemone falconeri* Thomson in Hook., *Icon. Pl. t.* 899. 1852; Hook. f. & Thomson in *Fl. Brit. India* 1: 9. 1872.

Herbs, perennial, softly hairy, 10 - 15 cm high; rootstock covered by scales. Radical leaves ca 12 cm long, including petiole; lamina reniform-cordate, deeply 3-partite; lobes cuneate at base; lobules crenate-obtuse, mucronulate. Scapes arising from amidst leaves, hairy, erect, as long as or longer than radical leaves bearing an involucre of usually 3 sessile entire leaves just below the flower. Flowers ca 1.5 cm across, shortly pedicelled. Sepals 5 - 6, white. Filaments expanded at base. Achenes oblong, angled, silky hairy.

Fl. & Fr. April - June.

Distri. India: N. W. Himalayas. Jammu & Kashmir and Himachal Pradesh.

Central Asia.

18. *Isopyrum* L.

Herbs, perennial. Leaves ternately compound. Flowers solitary or in dichasial cymes. Sepals 5, petaloid. Petals (honey leaves) small or absent. Stamens many, shorter than sepals. Carpels 2 - 5. Fruit of up to 20 sessile free follicles.

N. Temperate regions; ca 30 species, 2 in India.

Literature. TAMURA, M. & L. A. LAUENER (1968) A revision of *Isopyrum*, *Dichrocarpum* and allies. Notes R. Bot. Gard. Edinb. 28: 267 - 273.

KEY TO THE SPECIES

- | | |
|--|--------------------------|
| 1a. Leaves 2-ternately compound; leaflets deeply dissected; petals tubulose | 1. <i>I. anemonoides</i> |
| b. Leaves 3- to 4-ternately compound; leaflets not deeply dissected; petals flat to shortly concave or cymbiform, not tubulose | 2. <i>I. ludlowii</i> |

1. *Isopyrum anemonoides* Kar. & Kir. in Bull. Soc. Nat. Mosc. 15: 135. 1842. *I. thalictroides* auct. non L.; Hook. f. & Thomson in Fl. Brit. India 1: 33. 1872.

Herbs, slender, delicate, glabrous, up to 20 cm high, without any fibrous base; stems simple, leafless below, branched and leafy above. Basal leaves petiolate, twice ternately compound; leaflets deeply 3-lobed; lobes ovate, cuneate. Cauline leaves similar but subsessile, conspicuously stipitate. Flowers in cymes, 1 - 2 cm across, white, pale lilac inside. Petals shortly stalked, tubulose; nectaries orange. Filaments and anthers yellow. Follicles 2 - 4, slender, free, broadly ovate, compressed.

Fl. & Fr. May - July.

Distrib. India: Alpine N. W. Himalayas, usually in cold deserts. Jammu & Kashmir and Himachal Pradesh.

Central Asia.

2. *Isopyrum ludlowii* Tamura & Lauener in Notes R. Bot. Gard. Edinb. 28: 272. 1968.

Herbs, 8 - 20 cm high, branched, papillose-pilose above, glabrous below. Radical leaves 3 - 5, up to 12 cm long, 3 - 4-ternate; leaflets oblong or obovate, 1.2 - 5 x 1 - 4.5 cm, entire or 3-lobed to 3-partite; segments elliptic or obovate-oblong, 0.7 - 1.2 cm wide, cuneate at base, obtuse or rounded at apex, papillose-pilose; petioles 3.5 - 8 cm long; primary petiolules 8 - 30 mm long; secondary petiolules 2 - 13 mm long; tertiary petiolules up to 6 mm long. Cauline leaves subopposite, 2 - 3-ternate, ca 2.5 cm long; leaflets 2 - 7 x 1.5 - 5 cm, often 3-partite with entire segments; stipules free, ovate to lanceolate,

acute or acuminate, 1 - 8 mm long; upper cauline leaves 2-ternate; lower ones similar but smaller with shorter petioles and petiolules. Inflorescence with each branch 1-3-flowered; pedicels 2.5 - 3 cm long, elongating to 6 cm long, papillose pilose. Sepals 5, elliptic or ovate-elliptic, subcuneate at base, obtuse or subacute at apex, ca 10 x 5 mm. Petals 5, oblong or oblong-obovate, flat or concave-cymbiform, shortly stipitate at base, shortly bilobed at apex, 2.5 - 2.8 x 1.2 - 1.7 mm. Stamens 4 - 5 mm long; filaments filiform, somewhat dilated; anthers elliptic, ca 0.5 mm long. Carpels 4 - 5, attenuate at both ends; styles elongate, ca 1.5 mm long; stigma somewhat incurved.

Fl. & Fr. June - Aug.

Distrib. India: W. Himalayas, 3000 - 3100 m. Jammu & Kashmir.

Endemic.

19. *Naravelia* DC., nom. cons.

Climbing shrubs, similar to *Clematis*. Leaves opposite, 3-foliolate, with terminal leaflet usually forming a tendril. Flowers in axillary or terminal panicles, actinomorphic, bisexual. Sepals 4 - 5, caducous. Staminodes 6 - 12, petaloid. Stamens many. Carpels with one ovule. Achenes linear, stipitate with persistent twisted feathery tails.

Indo-malesia; 4 species, one in India.

Naravelia zeylanica (L.) DC., Syst. Nat. 1: 167. 1817; Hook. f. & Thomson in Fl. Brit. India 1: 6. 1872. *Artogene zeylanica* L., Sp. Pl. 542. 1753. Fig. 15

Beng.: *Chagul-bati*, *Murcha*.

Climbers, woody, up to 12 m long; young parts pubescent; roots tuberous. Leaves 2 - 3-foliolate, ca 15 cm long; petioles up to 4.5 cm long; petiolules up to 2 cm long; terminal leaflet transformed into a 3-fid hooked tendril, up to 12 cm long; lateral leaflets broadly ovate, rounded or cordate at base, pubescent beneath, glabrous above. Flowers numerous, in divaricately branched, up to 15 cm long panicles, 1.2 - 1.8 cm across. Sepals 4 - 5, elliptic to broadly ovate, ca 6 x 3 cm, caducous, pubescent outside. Petals 6 - 12, linear to spatulate, narrower than sepals, ca 7 x 1 mm, greenish yellow, glabrous. Stamens numerous; filaments ligulate, glabrous; connectives produced beyond antherlobes. Staminodes 10 - 14, petaloid. Achenes on ca 1 mm long stalks, ca 7 x 1 mm, red, sparsely hairy, with long twisted feathery 3.5 - 5 cm long tails.

Fl. & Fr. Oct. - Feb.

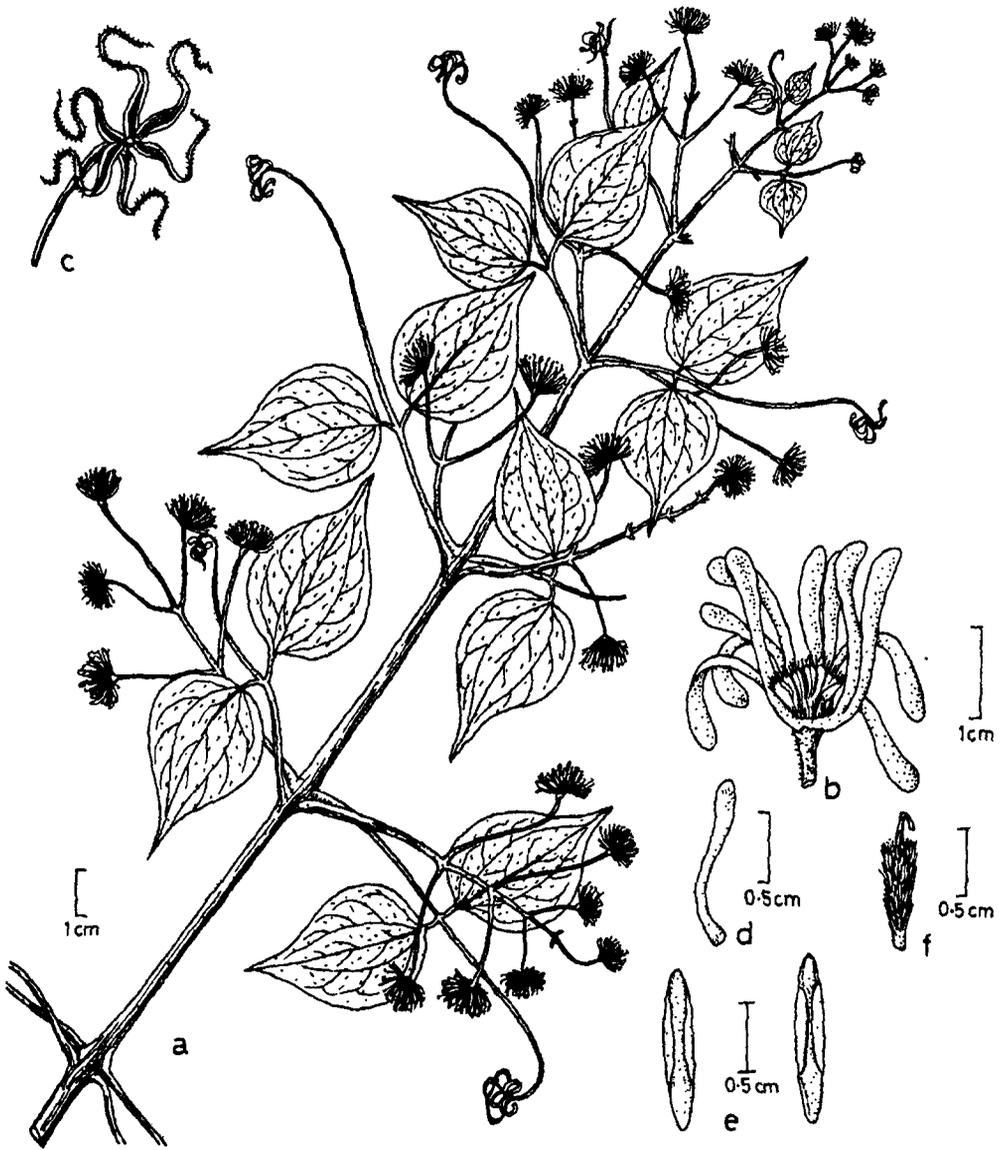


Fig. 15. *Naravelia zeylanica* (L.) DC. : a. branch; b. flower; c. achenes with twisted tails; d. petal; e. stamens; f. carpel.

Distrib. India: Margins of tropical and subtropical forests, up to 1000 m. Uttar Pradesh, Bihar, West Bengal, Assam, Meghalaya, Orissa, Madhya Pradesh, Maharashtra, Andhra Pradesh, Karnataka, Tamil Nadu and Kerala.

S. & S.E. Asia.

20. *Nigella* L.

Annual herbs. Leaves 2 - 3-pinnatisect or decomposed; lobes linear. Flowers often with an involucre of 5 leaves, protandrous. Sepals 5, petaloid, shortly clawed. Petals (honey leaves) 5 - 8, opposite to and smaller than sepals, 2-lipped, pocket-like, nectariferous. Stamens many. Carpels 5, connate up to apex; styles free. Fruit of 5 united follicles, many-seeded.

Europe, Mediterranean regions and C. Asia; 20 species, one in India, usually cultivated, rarely as escape.

Nigella sativa L., Sp. Pl. 753. 1762. var. *indica* (Roxb.) DC., Syst. Nat. 1: 330. 1817. *N. indica* Roxb., Fl. Ind. 2: 646. 1824.

Beng.: *Kala-jeera*, *Mugrala*; Hindi: *Krishna-jeera*, *Kala-jeera*, *Karounjee*; Kan.: *Kari-jeeringe*; Mal. & Tam.: *Karum-jeerakam*.

Stems erect, hispid or glabrous. Leaves decomposed; segments linear, divergent. Sepals 5, ovate-oblong, shortly clawed, white. Petals shortly stipitate; exterior side of lip of nectaries ovate, deeply 2-cleft, interior entire and acute. Carpels 5, as long as stamens. Follicles united longitudinally, tuberculate on back with subequal beak. Seeds ovoid to subtrigonal, rugulose-tuberculate.

Fl. & Fr. Jan. - Dec.

Distrib. India: Widely cultivated for its seed, frequently seen naturalised.

Notes. Roxburgh (l. c.) states that it is a native of 'Hindoostan'. It is doubtfully distinct from the widely cultivated European *N. sativa* L.

21. *Oxygraphis* Bunge

Dwarf perennial stemless herbs with 1-flowered scapes. Leaves all basal, entire or remotely crenate, dentate or lobed. Scape 1-flowered, leafless; flowers actinomorphic, yellow. Sepals 5, enlarging and persistent in fruit. Petals 10 - 15, each with a nectariferous pit at base of the claw. Stamens many. Achenes many, in a globose head, laterally compressed.

Temperate Asia; 5 species, one in India.

Oxygraphis endlicheri (Walp.) Bennet & Chandra in Indian For. 108: 374. 1982.
Callianthemum endlicheri Walp., Repert. 1: 33. 1842. *Ranunculus polypetalus* D. Don in
 Royle, Illus. Bot. Himal. 54, t. 11, f.2. 1834 (non Rafin. 1817). *Oxygraphis polypetala* (D.
 Don) Hook. f. & Thomson in Fl. Brit. India 1: 21. 1872. *O. glacialis* auct. non Bunge;
 Hook. f. & Thomson, Fl. Ind. 27. 1855 & in Fl. Brit. India 1: 21. 1872. **Fig. 16**



Small tufted herbs; rootstocks surrounded by fibrous leaf remains. Leaves all radical, ovate or orbicular, crenate, truncate or subtruncate at base, obtuse or subacute at apex, 5 - 15 mm across; petioles 3 - 4 cm long. Scapes several or solitary, 1.5 - 4 (-10) cm long, 1-flowered. Flowers ca 2.5 cm across, yellow. Sepals 5, ovate, rounded or subcordate at base, 3 - 7 x 2 - 4 mm. Petals oblong-spathulate, 4 - 10 x 1.5 - 2 mm, yellow. Achenes ribbed along outer and inner angles with a distinct rib on each side.

Fl. & Fr. June - July.

Distrib. India: Clearings of forests, damp places in alpine meadows and grassy slopes, 3300 - 5000 m. Jammu & Kashmir, Himachal Pradesh, Uttar Pradesh and Sikkim.

Nepal and Bhutan.

22. *Paraquilegia* J.R. Drumm. & Hutch.

Perennial, densely caespitose herbs; rhizome erect, branched above, covered at base by old leaf-bases; stems simple. Radical leaves 2 - 4-ternately compound. Flowers showy, large for the size of the plant, 3 - 4 cm across, actinomorphic, solitary. Sepals 5, petaloid. Petals 5, clawed, or more or less sessile, flat, obovate, emarginate at apex, concave at base. Stamens many. Carpels 5 - 8(-10). Follicles ca 5, erect, free.

Central Asia, Afghanistan and Himalayas; 8 species, 2 in India.

Literature. DRUMMOND, J. R. & J. HUTCHINSON (1920) A revision of *Isopyrum* (Ranunculaceae) and its allies. Kew Bull. 1920: 145 - 169.

KEY TO THE SPECIES

- 1a. Seeds puberulous
b. Seeds glabrous

1. *P. anemonoides*
2. *P. microphylla*

1. *Paraquilegia anemonoides* (Willd.) Ulbrich in Fedde, Rep. Beih. 12. 369. 1922. *Aquilegia anemonoides* Willd. in Mag. Ges. Naturf. ser. 5, 401, t. 9. 1811. *Isopyrum grandiflorum* Hook. f. & Thomson in Fl. Brit. India 1: 23. 1872, p. p. (non Fisch. ex DC.). *Paraquilegia grandiflora* (Hook. f. & Thomson) J.R. Drumm. & Hutch. in Bull. Misc. Inf. Kew 1920: 156. 1920.

Stems densely tufted, 10 - 20 cm high; rootstock stout, clothed with rigid bristles. Leaves glabrous, glaucous; leaflets obovate, 3 - 8 mm across, ternately lobed, ultimate lobes 1 - 2 mm broad, obtuse; petioles 3 - 10 cm long. Scapes 6 - 10 cm long, bearing a pair of oblanceolate or ternate bracts, 1 - 1.5 cm above the middle. Flowers solitary, 2 - 3 cm across, pale lavender to blue or white. Sepals obovate, obtuse or acute, 1.5 - 3 x 1

cm. Petals obovate, ca 6 x 3 mm. Stamens yellow. Follicles oblong, subcompressed, ca 7 x 3 mm on ca 2 mm long stalks. Seeds puberulous.

Fl. & Fr. July - Aug.

Distrib. India: W. Himalayas, on mountain cliffs and ravines, 3500 - 4500 m. Jammu & Kashmir, Himachal Pradesh and Uttar Pradesh.

Pakistan and China (Tibet).

2. *Paraquilegia microphylla* (Royle) J.R. Drumm. & Hutch. in Kew Bull. 1920: 157, f.2. 1920. *Isopyrum microphyllum* Royle, Illus. Bot. Himal. t. 11, f. 4 a - b, 1833 & ibid. 58. 1834. *I. grandiflorum* Hook. f. & Thomson in Fl. Brit. India 1: 23. 1872, p. p. (non Fisch. ex DC.).

Stems caespitose, rigid, 10 - 15 cm long, bristly hairy. Leaves glabrous, 2 - 3-ternate. Flowers showy, 2 - 3 cm across, deep blue or pale lavender or white. Seeds glabrous.

Fl. & Fr. June - Sept.

Distrib. India: W. Himalayas, in alpine meadows, 3300 - 5000 m. Jammu & Kashmir, Himachal Pradesh and Uttar Pradesh.

Pakistan, Nepal and China (Tibet).

Notes. The above two species are very similar in habit and floral characters, except for the seeds and hence regarded by some as conspecific.

23. *Paroxygraphis* W. Smith

Dwarf perennial stemless herbs. Leaves all radical, entire, ovate-cordate. Scape solitary, erect, 1-flowered. Flowers unisexual, dioecious. Sepals 5, persistent. Petals 5, elliptic, clawed at base, yellow. Male flowers with 10 stamens. Female flowers with 10 - 15 carpels, inserted on a convex receptacle. Achenes 10 - 15, in globose heads, laterally compressed.

Himalayas, monotypic.

Paroxygraphis sikkimensis W. Smith in Rec. Bot. Surv. India 4: 344. 1913.

Herbs, perennial, dioecious, tufted, glabrous, stemless; flowering stems 5 - 20 mm long; roots slender, crowned by scales and leaf-bases. Leaves 2 - 10, all radical; petioles 5 - 20 mm long; lamina broadly ovate, slightly cordate at base, obtuse at apex, entire, 1.5 - 3 x 1 - 2.5 cm, glabrous. Scape solitary, erect. Sepals 5, oblong to obovate, obtuse,

ca 2 x 1.5 mm, 3-nerved, persistent. Petals 5, elliptic, clawed at base, ca 2 x 0.75 mm, yellow. Male flowers with 10 stamens, without any vestige of carpellary insertion. Female flowers with 10 - 15 carpels, lax, inserted on a convex receptacle; style straight, persistent. Achenes 10 - 15, disjunct, easily falling off at maturity, obovate, compressed, ca 2 - 5 mm across.

Fl. & Fr. June - Aug.

Distrib. India: E. Himalayas, alpine meadows and damp rocky soil, 3400 - 4000 m. Sikkim.

Nepal and Bhutan.

24. *Pulsatilla* Miller

Caespitose perennial herbs; rootstock stout, covered by leaf-bases. Leaves usually 2 - 4-pinnatisect. Cauline leaves usually sessile and united at base. Scapes erect; flowers solitary; involucre leaves sessile, connate at base, pinnatifid. Sepals usually 5 - 6, silky beneath; nectar-secreting staminodes present. Petals absent. Achenes with long feathery tails.

Temperate Eurasia; ca 30 species, one in India.

Pulsatilla wallichiana (Royle) Ulbrich in Not. Bot. Gart. Berlin 9: 226. 1925. *Anemone wallichiana* Royle, Illus. Bot. Himal. 52. 1834. *A. albana* Hook. f. & Thomson in Fl. Brit. India 1: 7. 1872 (non Stev. 1812). *P. duthiei* Gandoger in Bull. Soc. Bot. Fr. 46: 417 - 418. 1899.

Erect herbs, up to 30 cm high; rootstock ca 1 cm thick, covered by scales. Radical leaves up to 18 cm long, twice pinnatisect; ultimate lobes tridentate. Involucre leaves ca 3 cm long, on a stout scape, connate at base, softly hairy with narrow lobes. Flowers solitary at the ends of scapes, red. Sepals 5 - 6, erect, ca 2 cm long, ca 1 cm wide, oblong, with reflexed tips. Achenes with ca 3 cm long feathery tails.

Fl. & Fr. June - Aug.

Distrib. India: W. Himalayas, 3600 - 3900 m. Jammu & Kashmir and Himachal Pradesh.

Pakistan.

25. *Ranunculus* L.

Terrestrial and aquatic herbs, annual or perennial; rootstock tuberous or horizontal; roots often fibrous; stems erect, decumbent or prostrate or creeping, stoloniferous. Leaves radical and cauline, whorled or alternate on stems, often ternately lobed or dissected, sometimes into capillary segments (in aquatic forms), rarely entire, often with membranous stipular auricles. Flowers actinomorphic, solitary or few in corymbose panicles, white or yellow. Sepals 3 - 5, green or petaloid, often caducous. Petals (honey leaves) as many as sepals or more, usually 5, each with a nectariferous pit at base. Stamens 4 - many. Carpels 4 - many, superior, free; style short; ovule 1, ascending. Fruit a head or spike of achenes, smooth, tubercled or spinous, compressed or inflated, apiculate or beaked.

Cosmopolitan, mostly in temperate regions and on cold tropical mountains; ca 400 species, 33 in India.

Literature. COOK, C. D. K. (1966) A monographic study of *Ranunculus*, subgenus *Batrachium* (DC.) A. Gray. Mitt. Staatss. Munchen 6: 47 - 237. MEIKLE, R. D. (1959) The *Batrachian* *Ranunculi* of the Orient. Notes R. Bot. Gard. Edinb. 23: 11 - 21.

KEY TO THE SPECIES

- | | |
|--|------------------------------|
| 1a. Aquatic herbs; leaves submerged and much dissected into capillary lobes (subg. <i>Batrachium</i>) | 2 |
| b. Terrestrial herbs, a few aquatic but with aerial laminate leaves | 5 |
| 2a. Flowers yellow | 10. <i>R. flavidus</i> |
| b. Flowers white | 3 |
| 3a. Nectar-pit elongated | 28. <i>R. sphaerospermus</i> |
| b. Nectar-pit lunate | 4 |
| 4a. Achenes 60 - 90, ca 1 mm long | 23. <i>R. rionii</i> |
| b. Achenes 20 - 40, 1.5 - 2 mm long | 31. <i>R. trichophyllus</i> |
| 5a. Herbs annual | 6 |
| b. Herbs perennial | 11 |
| 6a. Achenes emarginate, smooth, not tuberculate or spinous, in cylindrical heads | 26. <i>R. scleratus</i> |
| b. Achenes marginate, tubercled or spinous, in globose heads | 7 |
| 7a. Achenes tubercled all over the surface | 8 |
| b. Achenes tubercled or hooked along borders only | 10 |
| 8a. Flowers 1.5 - 1.8 cm across; sepals sparsely setulose | 17. <i>R. muricatus</i> |
| b. Flowers less than 1.5 cm across; sepals glabrous | 9 |
| 9a. Sepals shorter than petals, cuneate at base | 4. <i>R. bikramii</i> |
| b. Sepals as long as petals, rounded or subcordate at base | 32. <i>R. trilobatus</i> |
| 10a. Radical leaves simple | 2. <i>R. arvensis</i> |
| b. Radical leaves 3-partite | 25. <i>R. sardosus</i> |

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|--|-----------------------------|
| 11a. Leaves undivided or rarely lobed | 12 |
| b. Leaves divided or prominently lobed | 14 |
| 12a. Decumbent herbs | 15 <i>R. lobatus</i> |
| b. Erect herbs | 13 |
| 13a. Achenes flat, pitted; flowers large, ca 3 cm wide | 14. <i>R. lingua</i> |
| b. Achenes inflated, not pitted; flowers less than 1.5 cm wide | 21. <i>R. pulchellus</i> |
| 14a. Aquatic herbs | 18. <i>R. natans</i> |
| b. Terrestrial herbs | 15 |
| 15a. Achenes tubercled | 16 |
| b. Achenes not tubercled | 17 |
| 16a. Leaves less than 1 cm wide, crenate; sepals nearly equalling petals | 9. <i>R. ficarilifolius</i> |
| b. Leaves 3 - 4 cm wide; sepals much shorter than petals | 33. <i>R. wallichianus</i> |
| 17a. Achenes with intramarginal rib, strongly flattened | 18 |
| b. Achenes not margined, turgid | 21 |
| 18a. Achenes dotted | 19 |
| b. Achenes not dotted | 20 |
| 19a. Stems procumbent; lobes of leaves scarcely segmented | 7. <i>R. diffusus</i> |
| b. Stems erect; lobes of leaves deeply divided | 30. <i>R. subpinnatus</i> |
| 20a. Receptacle of fruit pilose | 6. <i>R. cantoniensis</i> |
| b. Receptacle of fruit glabrous | 13. <i>R. laetus</i> |
| 21a. Stems creeping, stoloniferous | 22 |
| b. Stems erect or decumbent | 24 |
| 22a. Nectary scales forked or circular and surrounding the nectary pits; receptacles hirsute | 12. <i>R. hyperboreus</i> |
| b. Nectary scales cup-shaped, laterally connate to the ventral sides of the petal lamina; receptacles glabrous | 23 |
| 23a. Flowers densely covered with reddish-brown hairs on outside, 1.5 - 2.5 cm diam. | 24. <i>R. rufoscapalus</i> |
| b. Flowers not covered with hairs, less than 1 cm in diam. | 20. <i>R. pegaeus</i> |
| 24a. Rootstocks slender or small, not fibrous | 25 |
| b. Rootstocks tuberous or densely fibrous | 28 |
| 25a. Leaves flabellate | 8. <i>R. felkii</i> |
| b. Leaves not flabellate | 26 |
| 26a. Sepals shaggy | 27. <i>R. sikkimensis</i> |
| b. Sepals silky | 27 |
| 27a. Herbs, 12 - 20 cm high, flaccid | 1. <i>R. adoxifolius</i> |
| b. Herbs, 3 - 10 cm high, forming small mats | 5. <i>R. brotherusii</i> |
| 28a. Carpels glabrous | 29 |
| b. Carpels sparingly hairy to densely pubescent | 30 |
| 29a. Basal leaves rotund | 16. <i>R. munronianus</i> |
| b. Basal leaves linear | 29. <i>R. stewartii</i> |
| 30a. Radical leaves linear, deeply cut, lacinate | 3. <i>R. aucheri</i> |
| b. Radical leaves broad, rotund or reniform or palmatipartite | 31 |
| 31a. Lobes of radical leaves lanceolate | 19. <i>R. palmatifidus</i> |
| b. Lobes of radical leaves coarsely toothed or crenate | 32 |

- 32a. Stems many-flowered, rarely 1-flowered in some alpine forms
 b. Stems 1-flowered

11. *R. hirtellus*
 22. *R. reniformis*

1. *Ranunculus adoxifolius* Hand.-Mazz. in Acta Hort. Gotob. 13: 152. 1939; Naitani & Aswal in Indian J. For. 7: 75, ff.A-B. 1984. *R. affinis* auct. non R. Br.; Hook. f. & Thomson in Fl. Brit. India 1: 18. 1872, p. p. *R. caespitosus* Wallich ex Hook. f. & Thomson in Fl. Brit. India 1: 18. 1872 (non Thuill. 1799).

Perennial herbs, suberect, subcaespitose; roots numerous; stems ascending, 4 - 10 (-20) cm high, slender, flaccid, sparingly branched. Basal leaves ovate-cordate to sub-orbicular, 1 - 2.5 cm long, sparsely silky pubescent with narrowly ternate lobes; terminal leaflet broadly ovate, 3-partite, slender-stalked; lateral leaflets shortly stalked; segments 2 - 4-partite; petioles slender at base; cauline leaves similar but smaller and less divided; upper ones subsessile. Flowers yellow, ca 1 cm across, usually solitary; pedicels 1.5 - 4 cm long, sparsely pubescent. Sepals 5, broadly ovate, 2.5 - 3.5 mm long, spreading, sparsely pubescent. Petals obovate, 3.5 - 4.5 x 2.5 - 3.5 mm, yellow. Achenes subglobose, ca 1 mm long, forming oblong, glabrous heads, ca 5 mm across; receptacles glabrous.

Fl. & Fr. June - Aug.

Distrib. India: Himalayas, in damp alpine grasslands and moist sandy soil, 3500 - 4000 m. Jammu & Kashmir, Himachal Pradesh and Sikkim.

Pakistan, Nepal and China (Tibet).

2. *Ranunculus arvensis* L., Sp. Pl. 780. 1753; Hook. f. & Thomson in Fl. Brit. India 1: 20. 1872.

Annual herbs; stems erect, up to 60 cm high, usually glabrous, sometimes pubescent. Radical leaves simple, ovate, crenate, withering early; cauline leaves 3-partite; segments again cut into linear entire or dentate lobes. Flowers ca 1 cm across, pale greenish yellow; pedicels terete. Sepals oblong-spathulate. Receptacles pubescent. Achenes 5 - 10, in one whorl, 6 - 8 mm long, flat, obovate, plano-compressed, covered by hooked spines along borders; beak 3 - 5 mm long, straight.

Fl. & Fr. Feb. - May.

Distrib. India: W. Himalayas. Jammu & Kashmir, Himachal Pradesh and Uttar Pradesh.

Pakistan, Afghanistan, N. & W. Asia to Europe.

3. *Ranunculus aucheri* Boiss. in Ann. Sci. Nat. 351. 1841 & Fl. Orient. 1: 34. 1867.

Perennial herbs, adpressed hirsute; roots fibrous, cylindric. Basal leaves ovate, 3-sect; segments stalked, deeply cut into linear-laciniate lobes. Flowers solitary or in divaricate corymbs. Sepals spreading, persistent. Petals broadly obovate, ca 1 cm long; nectar-scales conspicuous. Carpels flat, sparsely hairy; style hooked at tip. Achenes compressed.

Fl. & Fr. May - July.

Distrib. India: W. Himalayas. Jammu & Kashmir.

Afghanistan and Iran.

4. *Ranunculus bikramii* Aswal & Mehrotra in Indian J. For. 7: 62 - 63, ff. 1 - 5. 1984.

Annual herbs, erect or decumbent with fibrous rootstock; stems often tufted, 12 - 16 cm high, purplish, sparsely spreading to appressed hairy. Radical leaves arising from fibrous rootstocks, long-petioled, reniform, deeply 3-lobed, glabrous; each lobe further divided into 3 - 5 smaller lanceolate to ovate-lanceolate acute segments or lobules; median cauline leaves shortly petioled, deeply 3-lobed or partite; each lobe again 3 - 5-lobed or partite; uppermost cauline leaves sessile, 3 - 5-partite; segments linear-lanceolate to lanceolate, acute. Flowers yellow, solitary, terminal, ca 1.2 - 1.8 cm across; pedicels densely covered with yellowish hairs. Sepals 5, ovate-lanceolate, acute or obtuse, 6 - 8 mm long, glabrous, purplish. Petals 5, 8 - 10 mm long, streaked with purple. Achenes numerous, in globose heads, inflated with straight or slightly hooked styles at the tip.

Fl. & Fr. July - Sept.

Distrib. India: W. Himalayas, ca 4600 m. Himachal Pradesh (Lahul Valley).

Endemic.

5. *Ranunculus brotherusii* Freyn in Bull. Herb. Boiss. 6: 885. 1898. *R. affinis* Hook. f. & Thomson in Fl. Brit. India 1: 18. 1872, p. p. (non *R. Br.*). *R. brotherusii* Freyn var. *dasycarpus* (Maxim.) Hand.-Mazz. in Acta Hort. Gotob. 13: 149. 1939; Mukerjee in Bull. Bot. Surv. India 2: 102. 1960. *R. brotherusii* Freyn var. *latisectus* H. Riedl in Kew Bull. 34: 362. 1979.

Perennial herbs; stems solitary or caespitose, erect, up to 25 cm high, simple or branched, slender, with appressed white hairs or glabrous. Basal leaves several, reniform, 1 - 2 (-5) x 0.8 - 2.2 (-5) cm, deeply 3-lobed or ternate, appressed hairy; middle lobes ovate, partially 3-lobed; lateral lobes deeply 2-lobed, sessile, oblong-ovate, cordate

or cuneate at base; petioles 1 - 8 cm long, vaginate, pilose. Cauline leaves sessile, 2 - 4-partite, sparsely hirsute beneath, glabrous above; lacinae linear. Flowers 1 - 2, ca 1 cm across, yellow. Sepals spreading, ovate to broadly oblong, membranous, yellowish green, pilose with appressed hairs. Petals 5, narrowly to broadly obovate, tapering to a tubular claw, 4 - 6 mm across, silky; nectaries pocket-like or forked. Anthers ca 1 mm long, dorsifixed and obovoid, latrorse; filaments dilated. Carpels glabrous. Achenes ca 1.5 mm long, glabrous or hirsute, on a compact oblong-ovoid to cylindrical 4 - 6 mm long head; beaks slender, straight or incurved, ca 0.5 mm long, glabrous or pubescent.

KEY TO THE VARIETIES

- | | |
|--------------------------------------|------------------------------|
| 1a. Leaves ternate; carpels glabrous | 5.1. var. <i>brotherusii</i> |
| b. Leaves 3-lobed; carpels hairy | 5.2. var. <i>tanguticus</i> |

5.1. var. *brotherusii*

Fl. & Fr. April - Sept.

Distrib. India: Himalayas, alpine moist open meadows and scrub forests, 2500 - 4500 m. Jammu & Kashmir, Himachal Pradesh, Uttar Pradesh, Sikkim and Arunachal Pradesh.

Nepal, China (Tibet) and Russia.

5.2. var. *tanguticus* (Maxim.) Tamura in *Acta Phytotax. & Geobot. Kyoto* 23: 31 & 106. 1969. *R. affinis* var. *tanguticus* Maxim., *Fl. Tangut.* 14. 1889.

Fl. & Fr. June - July.

Distrib. India: E. Himalayas, 3000 - 4300 m. Sikkim.

W. China (Tibet).

6. *Ranunculus cantoniensis* DC., *Prodr.* 1: 43. 1824. *R. napaulensis* DC., *Prodr.* 1: 39. 1824. *R. trilobatus* D. Don, *Prodr. Fl. Nepal.* 194. 1825 (non Desf. 1978). *R. fibrosus* Wallich ex Hook. f. & Thomson, *Fl. Ind.* 37. 1855. *R. pennsylvanicus* auct. non L. f.; Hook. f. & Thomson in *Fl. Brit. India* 1: 19. 1872, p. p. *R. riparius* Edgew. in *Trans. Linn. Soc.* 20: 18. 1846. Fig. 17.

Herbs, erect or prostrate and rooting at base, 0.2 - 1 m high, profusely branched, hirsute. Radical leaves 3-foliolate or ternatisect, appressed pubescent; petioles broad and sheathing at base, 20 - 30 cm long; leaflets 4 - 8 x 5 - 10 cm, tripartite and deeply cut into narrow oblanceolate, coarsely toothed segments, palmately nerved. Cauline leaves

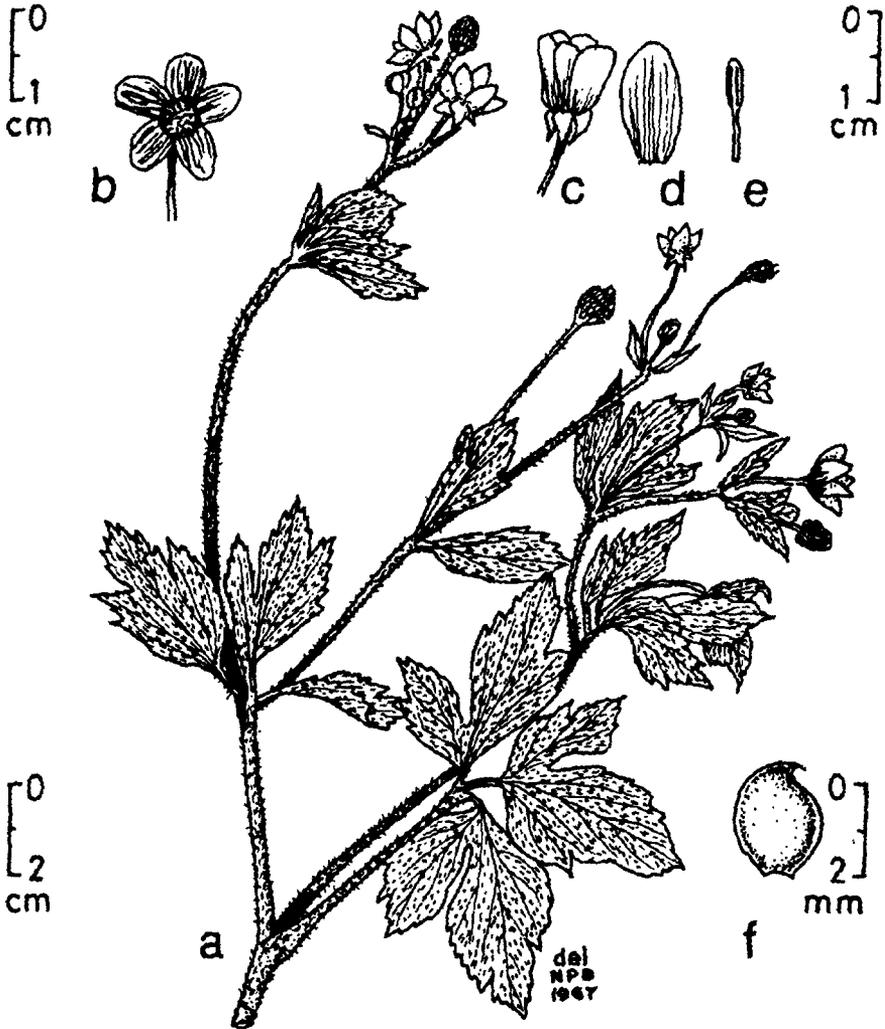


Fig. 17. *Ranunculus cantoniensis* DC.: a. branch; b. & c. flower; d. petal; e. stamen; f. achene.

trifoliolate, progressively shorter, from stalked to sessile; petioles up to 4 - 5 cm long; leaflets ternisect, irregularly serrate along margins, 4 - 6 x 5 - 7 cm, palmately nerved; petiolules 1 - 5 cm long. Flowers solitary, 1.5 - 1.9 cm across, yellow; pedicels terminal, leaf-opposed, 2 - 4 cm long. Sepals 5, elliptic-oblong, subobtuse, ca 5 x 3 mm, reflexed, membranous along margins, hirsute. Petals 5, oblong, obovate, 7 - 8 x 3 - 5 mm, yellow to creamy white, distinctly many-nerved, glabrous. Filaments many, linear, ca 2 mm long; anthers ca 1 mm long, deep yellow. Receptacle subglobose, narrow, ca 4 x 3 mm, hairy. Achenes many, in globose or oblong heads, broadly elliptic, cuneately suborbicular, compressed, surrounded by a narrow intramarginal rim, ca 2 mm across, shortly beaked, glabrous or minutely granular, margined.

Fl. & Fr. April - Dec.

Distrib. India: N.W. Himalayas to N. E. India, subtropical to temperate regions, on grassy slopes and often as a weed in irrigated fields, 1000 - 2500 m. Jammu & Kashmir, Himachal Pradesh, Uttar Pradesh, Sikkim, Arunachal Pradesh and Meghalaya.

Pakistan, Nepal, Bhutan, China, Indo-china, Korea and Japan.

Notes. The two subspecies, subsp. *riparius* and subsp. *napaulensis* recognised by H. Reidl (in Kew Bull. 34: 364. 1979) cannot be maintained as these show continuous gradations within the broad range of the species.

7. *Ranunculus diffusus* DC., Prodr. 1: 38. 1824; Hook. f. & Thomson in Fl. Brit. India 1: 19. 1872, p. p. excl. synonyms *R. napaulensis* DC. & *R. subpinnatus* Wight & Arn.

Kh.: *Bat-niang-ser*.

Perennial prostrate or decumbent herbs, highly variable in habit; stems sometimes procumbent, densely brownish hirsute with spreading hairs all over. Leaves nearly as broad as long, ovate to orbicular, cordate, divided into 3 obovate lobes; lobes scarcely segmented, cuneate, shallowly and sharply deltoid-dentate, pubescent beneath; petioles up to 10 cm long, densely hirsute; auricles scarious, brown, 8 - 10 mm long. Flowers solitary, axillary, small, white or yellowish. Sepals elliptic, 3.5 - 1.5 mm long, spreading. Petals obovate, 3.5 - 6 x 2 - 3 mm, yellow. Achenes in globose heads, suborbicular, acute, compressed, distinctly angled, 1.5 - 2 mm in diam., pitted at middle, smooth at margins, with intramarginal rib; style hooked; receptacle globose.

Fl. & Fr. April - Oct.

Distrib. India: Himalayas, in evergreen subtropical or temperate forests, on damp ground and in ditches, 1300 - 2700 m. Jammu & Kashmir, Himachal Pradesh, West Bengal, Sikkim and Meghalaya.

Nepal, Bhutan, Myanmar and China.

Notes. Exists in numerous forms and is a taxonomically difficult group.

8. *Ranunculus felixii* A. Leveille in Fedde, Repert. Spec. Nov. 12: 281. 1913 & Cat. Pl. Yunnan 224. 1917.

Perennial herbs. Radical leaves flabellate; lobes linear; cauline leaves with filiform segments. Flowers yellow. Receptacle oblong. Carpels tomentose.

Fl. & Fr. July - Sept.

Distrib. India: Himalayas. Jammu & Kashmir and Sikkim.

China.

9. *Ranunculus ficariifolius* A. Leveille & Venoit in Bull. Soc. Bot. Fr. 51: 289. 1904. *R. flaccidus* Hook. f. & Thomson in Fl. Brit. India 1: 20. 1872 (non Pers. 1795).

Perennial tufted prostrate or decumbent herbs, occurring in dense patches; stems very slender, often rooting at nodes. Leaves small, broadly ovate, reniform or suborbicular, 3 - 15 mm long and broad, acute or subacute, truncate or cordate at base, 5 - 7-toothed along margins, glabrous; petioles 0.3 - 5 cm long, sheathing at base. Flowers solitary, small, leaf-opposed, ca 1 cm across, yellow, on scapes opposite to leaf. Sepals reflexed, elliptic, 1.5 - 5 mm. Petals obovate, 2.5 - 3.5 x 1.5 - 3 mm, yellow. Achenes 6 - 12, pubescent, with small tubercles, ellipsoid, compressed, surrounded by a narrow rim, glabrous, ca 1.75 - 1 mm; style weakly hooked, short, reflexed, deciduous.

Fl. & Fr. June - July.

Distrib. India: Himalayas, in marshy places by the side of streams, 1200 - 3200 m. Uttar Pradesh and Sikkim.

Nepal, Bhutan and China.

10. *Ranunculus flavidus* (Hand.-Mazz.) C. Cook in Watsonia 5: 29. 1963. *Batrachium flavidum* Hand.-Mazz., Meded. Gotob. Bot. Tradg. et Acta Hort. Gotob. 13: 168. 1939.

Aquatic herbs; stems branched, glabrous, rooting at nodes; roots filiform. Leaves all submerged, flaccid, 1.5 - 3 cm long; ultimate segments filiform. Flowers terminal, solitary, 10 - 15 mm in diam., yellow. Sepals 5, obovate, rotund, concave, 4 - 5 mm long, glabrous. Petals 7 - 8 x 4 - 5 mm, yellow, with lunate nectar-pit. Stamens ca 20. Achenes obovoid, ca 2.5 mm long, transversely rugose, in globose heads, with minute style; receptacle pilose; stalks up to 8 cm long.

Fl. & Fr. June - Sept.

Distrib. India: W. Himalayas, in stagnant or running water. Jammu & Kashmir.

China.

11. *Ranunculus hirtellus* Royle, *Illus. Bot. Himal.* 53. 1834; Hook. f. & Thomson in *Fl. Brit. India* 1: 18. 1872.

Perennial herbs, erect or decumbent, distinctly pubescent; rootstock fibrous, shortly fusiform; stems ascending, decumbent or erect, 5 - 16 cm long, pilose. Basal leaves usually 3 - several; lamina reniform to orbicular or broadly ovate, 5 - 18 x 6 - 22 mm, medially to deeply 3-partite; segments rarely more than 3-toothed; middle lobes often very large, broadly oblong to obovate, entire or tricuspidate, up to 6 x 4 cm; lateral lobes obliquely ovate, coarsely toothed or entire; leaf bases cordate to truncate; petioles 1.5 - 8 cm long, vaginate at base. Cauline leaves vaginate and amplexicaul at base, entire or simply 3-partite; lobes narrow, linear-lanceolate. Flowers 1 - 1.5 cm across, solitary or several, yellow; pedicels sulcate, 0.5 - 6 cm long, pilose. Sepals oblong, 3 - 5 mm long, navicular, hairy. Petals 5, oblong to broadly ovate, clawed, sometimes asymmetrical, obtuse or rounded, 5 - 6 mm long, 1.5 - 5 mm broad; nectaries cup-shaped or forked. Anthers 0.8 - 1.2 mm long, basifixed; filaments flattened. Achenes oblong to suborbicular, 1.5 - 1.7 mm long, somewhat inflated, glabrous, on ovoid ca 4 mm long and broad pilose or glabrous receptacle, very hairy when young; stylar beak thick, ca 1 mm long, straight or curved, glandular hairy.

Fl. & Fr. June - Oct.

Distrib. India: Himalayas, temperate and subalpine slopes, 2000 - 4500 m. Jammu & Kashmir, Himachal Pradesh, Uttar Pradesh and Sikkim.

Nepal, Pakistan, Afghanistan and China (Tibet).

12. *Ranunculus hyperboreus* Rottb., *Skrift. Kjoeb. Selsk.* 10: 458. 1770; Hook. f. & Thomson in *Fl. Brit. India* 1: 18. 1872.

Herbs, perennial, small, highly variable in habit; roots often tuberous; stems slender, creeping or floating, stoloniferous, rarely glabrous or upper part of stem sometimes

covered with soft hairs. Leaves ovate, orbicular or reniform, 3- to 7-lobed; petiole short. Flowers solitary, axillary, ca 5 mm across, yellow or whitish. Sepals 3, reflexed. Petals equal to sepals; nectary scales forked or circular and surrounding the nectary-pits. Receptacle hirsute. Achenes numerous, ovoid, obscurely rimmed, in dense heads; beak short, obtuse.

Fl. & Fr. May - Sept.

Distrib. India: Himalayas, at high altitudes. Jammu & Kashmir, Himachal Pradesh and Uttar Pradesh.

Nepal, Pakistan and Russia.

13. *Ranunculus laetus* Wallich ex D. Don in Royle, *Illus. Bot. Himgal.* 53. 1834; Hook. f. & Thomson in *Fl. Brit. India* 1: 19. 1972.

Herbs, perennial; stems erect, much-branched, hairy or subglabrous; radical leaves 7 - 10 cm across, covered with softly appressed hairs; lamina 3-partite or dissected into narrow oblong sharply 2 - 5-toothed lobes; lobes long and narrow; segments spreading only at maturity. Flowers ca 3 cm wide, yellow. Sepals ca 6 x 4 mm, hairy. Petals 8 - 12 x 7 - 10 mm. Achenes on globose heads, smooth, flattened, dotted when young, cuneate at base, dark at centre, thin and paler along margins; style persistent, somewhat straight; receptacle glabrous.

Fl. & Fr. July - Sept.

Distrib. India: Himalayas, temperate and subalpine regions in damp fields and ditches, also at low altitude in Orissa, 1500 - 3500 m. Jammu & Kashmir, Himachal Pradesh, Sikkim and Orissa.

Nepal, Pakistan, Afghanistan, China (Tibet), Central Asia and Russia.

Notes. Paul (in *Geobios* 2: 27. 1975) reports the species from Galesar in Balasore District of Orissa at about 1500 m.

Banerjee & Mukherjee (in *Castanea* 37: 290 - 293. 1972) reported floral variations in respect of receptacle and in number of carpels. According to them, these anomalies in reduction of the number of carpels (4 to 5) and flattening of receptacle of *R. laetus* indicate resemblance to Winteraceae and Degeneriaceae.

14. *Ranunculus lingua* L., *Sp. Pl.* 775. 1753; Hook. f. & Thomson in *Fl. Brit. India* 1: 16. 1872.

Herbs, perennial, erect or stoloniferous, in semi-aquatic habitats, glabrous or sparsely appressed pubescent; rootstock thick, stout, articulate, creeping; stems erect, glabrous. Basal leaves ovate, cordate, long-petiolate, soon withering. Cauline leaves oblong-lanceolate, entire, or subserrate, amplexicaul at base, attenuate at apex, up to 20 cm long, parallel-veined, ribbed. Flowers few, (2-)3 - 5 cm across, bright yellow. Sepals patently villose. Petals dichotomously veined. Carpels many, 80 - 100, on elongate receptacle. Achenes obovate, ca 2.5 mm long, subcompressed, submarginate, pitted; beak short, erect.

Fl. & Fr. June - July.

Distrib. India: W. Himalayas, ca 2000 m. Jammu & Kashmir, Himachal Pradesh.

Asia and Europe.

Notes. An attractive plant with its parallel-veined long leaves and large yellow flowers. Very variable in its wide range of distribution. European forms with high polyploid chromosome numbers of $2n = 128$ are known.

15. *Ranunculus lobatus* Cambess. in Jacquem. , *Voy. Bot.* 5, t. 1B. 1844; Hook. f. & Thomson in *Fl. Brit. India* 1: 17. 1872.

Herbs, perennial; stems decumbent. Radical leaves with thick, somewhat fleshy lamina, orbicular, crenate, 2 - 3 cm wide. Flowers yellow, 1.5 - 3 cm wide. Achenes margined, somewhat compressed, terminated by the long straight style as beak.

Fl. & Fr. June - Aug.

Distrib. India: Himalayas. Jammu & Kashmir.

China (W. Tibet).

16. *Ranunculus munronianus* J.R. Drumm. in *Bull. Misc. Inf. Kew* 1925: 279. 1925.

Herbs, perennial, up to 20 cm high; rootstock tuberous; stems erect or decumbent. Radical leaves with long petioles (up to 14 cm long); lamina rotund, 3-lobed; lobes ca 3 cm wide, crenate. Cauline leaves similar, but shortly petioled. Flowers axillary, yellow. Sepals 5, ovate, obtuse, ca 3 mm long. Petals 5, cuneate, obtuse, 4 - 5 mm long. Achenes subinflated, glabrous, with short apiculate style.

Fl. & Fr. June - July.

Distrib. India: W. Himalayas, 3000 - 4000 m. Jammu & Kashmir and Himachal Pradesh.

Pakistan and China (W. Tibet).

17. *Ranunculus muricatus* L., Sp. Pl. 780. 1753; Hook. f. & Thomson in Fl. Brit. India 1: 20. 1872.

Herbs, annual, glabrescent, erect or diffusely branched; stems 10 - 30 cm high. Radical leaves long-petioled, suborbicular, reniform, 3 - 5 cm across, 3-fid; lobes variously cut, coarsely crenate-lobate, cordate at base. Cauline leaves 3-partite, cuneate at base. Flowers ca 1 cm across, solitary, leaf-opposed, yellow. Sepals reflexed, shorter than petals, sparsely setulose. Petals oblong-obovate. Achenes many in globose heads, ovate, flattened, 7 - 8 mm long, with numerous scattered tubercles on the surface; beak 2 - 3 mm long, nearly straight, slightly shorter than the achene.

Fl. & Fr. April - Oct.

Distrib. India: Cold temperate regions of Himalayas and Peninsular India. Jammu & Kashmir, Himachal Pradesh and Tamil Nadu.

Pakistan, Iran, Greece and Russia to Europe.

Note. The herb is poisonous and is used in intermittent fevers and asthma in Kashmir (Kumar & Naqshi in J. Econ. Tax. Bot. 14: 72. 1990).

18. *Ranunculus natans* C. Meyer in Ledeb. Fl. Alt. 2: 315. 1830. *R. hyperboreus* Rottb. var. *natans* (C. Meyer) Regel in Bull. Sci. Nat. Mosc. 34: 43. 1861; Hook. f. & Thomson in Fl. Brit. India 1: 18. 1872.

Herbs, aquatic, floating; stems branched, prostrate, rooting at nodes. Leaves petiolate, reniform, broadly 3- to 5-lobate; lobes rounded at apex; all leaves with 2 scarious auricles at base. Flowers ca 1 cm across, yellow. Sepals 5, deciduous. Petals 5, slightly longer than sepals. Receptacle glabrous. Achenes glabrous.

Fl. & Fr. June - July.

Distrib. India: W. Himalayas. Jammu & Kashmir.

Nepal, Pakistan, Afghanistan, Central Asia, China, Mongolia and Russia (Siberia).

19. *Ranunculus palmatifidus* H. Riedl in Kew Bull. 34: 362 - 363. 1979.

Herbs, perennial, 30 - 50 cm high; rootstock fibrous; stems single or paired, slender, 1.5 - 2.5 mm thick, branched above, striate when dry. Basal leaves subreniform, palmati-partite, 5 - 10 cm wide, laxly pilose, densely ciliate along margins; middle segment lanceolate, broader below the middle, 4 - 6 x 0.8 - 1.2 cm; lateral segments lobed; petioles 10 - 20 cm long, striate, pilose, vaginate at base. Cauline leaves subsessile or sessile, lobed; lobes narrowly linear-lanceolate, 2.5 - 7 x 0.2 - 0.5 cm, shortly sheathing at base. Flowers 2 - 2.2 cm across; peduncles long, densely strigulose. Sepals ovate or elliptic, subacute to obtuse, 5 - 6 x 2 - 4 mm, spreading, densely villous. Petals obovate-truncate, inversely triangular, undulate along margins, 9 - 11 mm across. Filaments 2 - 2.5 mm long, flat; anthers equal to filaments. Receptacle glabrous. Achenes in verticels of 4 - 5(-6), on ovate-oblong 7 - 10 mm long and ca 6 mm wide heads, subglobose, inflated, ca 2 mm in diam., glabrous; beak 0.7 - 0.8 mm long, curved.

Fl. & Fr. July - Sept.

Distrib. India: W. Himalayas. Jammu & Kashmir and Himachal Pradesh.

20. *Ranunculus pegasus* Hand.-Mazz. in Acta Hort. Gotob. 13: 141. 1939; Hara, Fl. E. Himal. 3: 37. 1975. *R. hyperboreus* auct. non Rottb.; Hook. f. & Thomson in Fl. Brit. India 1: 18. 1872, p. p.

Herbs, perennial, dwarf, glabrous; roots somewhat thickened proximally; fibrous roots few; stems creeping, stoloniferous, up to 20 cm long, rooting at nodes with rosulate leaves; internodes 1 - 8 cm long. Basal leaves pentagonal to reniform, 2 - 9 x 2 - 10 cm, medially to deeply 3-lobed or ternate; middle lobes ovate to oblong-lanceolate, entire or rarely 3-dentate, 2 - 5 x 1 - 4 cm; lateral lobes simple or 3-partite; petioles slender, 2 - 4 cm long. Scapes slender, naked, 1 - 3.5 cm long, single-flowered. Flowers yellow, small, less than 1.5 cm wide. Sepals 5, broadly obovate, navicular, concave, 1.5 - 2 mm long, ca 1.5 mm wide, glabrous. Petals 5, narrowly elliptic, clawed at base, rounded at apex, ca 2.5 x 1.5 mm. Anthers 0.2 - 0.6 mm long, basifixed, latrorse; filaments flattened. Achenes broadly obovate, lenticulate, ca 1 mm long, glabrous, in broadly ovoid or globose 2 - 3 mm long heads with glabrous receptacles.

Fl. & Fr. June - Aug.

Distrib. India: Himalayas. Himachal Pradesh, Uttar Pradesh and Sikkim.

Nepal and China (W. Tibet).

21. *Ranunculus pulchellus* C. Meyer in Ledeb. Fl. Alt. 2: 333. 1830; Hook. f. & Thomson in Fl. Brit. India 1: 17. 1872. *R. pulchellus* C. Meyer var. *sericeus* Hook. f. & Thomson, l. c.

Herbs, perennial, erect, 25 - 35 cm high, branched; roots fusiform; stems erect, ascending or sometimes decumbent, 3 - 30 cm long, simple or branched, sericeous. Basal leaves 1 - 5; blades oblong, reniform or ovate-elliptic, entire or 3-lobed, or in some deeply cut, crenate, 20 - 35 x 3 - 10 mm; leaf-bases round or subtruncate; petioles 1.5 - 12 cm long, clearly longer than the blades, sheathing at base. Lower and middle leaves narrowly elliptic or deeply 3-lobed, sheathing at base, sometimes all leaves linear-elliptic, up to 9 x 0.4 cm. Flowers solitary or 2 - 3 per leaf, 0.6 - 1 cm across, yellow; pedicels sulcate, 0.5 - 8 cm long, sericeous. Sepals 5, patent, oblong-elliptic, 4 - 6 x 3 - 5 mm, purplish along margins, blackish at tip, hairy. Petals 5 (-8), obovate to broadly ovate, entire or slightly emarginate, 6 - 9 mm across, yellow; nectaries cup-shaped, with projected borders or rather forked. Anthers 0.8 - 1.6 mm long, basifixed; filaments flattened. Achenes obovoid, ca 1.5 mm long, inflated, glabrous on oblong or cylindrical 4 - 9 mm long head; stylar beak ca 0.7 mm long, straight or curved; receptacle glabrous.

Fl. & Fr. June - Oct.

Distrib. India: Himalayas, alpine and subalpine regions, damp sandy soil in meadows and cliff edges, 3500 - 4500 m. Jammu & Kashmir, Himachal Pradesh and Sikkim.

Nepal, China (Tibet), Afghanistan, Iran and Russia.

Notes. Very variable in habit; several intermediates occur and the varieties like *longicaulis*, *potanii*, *sericeus* and *stracheyanus* as recognised by Hook. f. & Thomson (1872) and Hara (in Enum. Fl. Pl. Nepal 2: 20. 1979) are difficult to maintain.

22. *Ranunculus reniformis* Wallich ex Wight & Arn., Prodr. 3. 1834; Hook. f. & Thomson in Fl. Brit. India 1: 16. 1872.

Herbs, perennial, erect, up to 50 cm high; rootstock stout, horizontal, densely fibrous; stem softly hairy; branches few, 1-flowered. Radical leaves long-petioled; lamina thick, ovate or orbicular, truncate or cordate at base, coarsely crenate, 3 - 7 cm across. Cauline leaves few, with narrow lobes. Flowers ca 2.5 cm across, yellow. Petals 12 - 15, ovate-oblong. Achenes in a globose head, oblong, turgid, with straight beaks.

Fl. & Fr. Throughout the year.

Distrib. India: W. Ghats of Peninsular India, grassy slopes, 1600 - 2400 m. Tamil Nadu and Kerala.

Endemic and rare.

23. *Ranunculus rionii* Lager in Flora (Regensb.) 31: 49. 1848.

Herbs, short-lived annuals, aquatic. Leaves all submerged, capillary, 3 - 4 cm long; laminate leaves absent. Flowers white, ca 1 cm wide; pedicels much longer than leaves. Petals less than 5 mm long; nectar-pits lunate. Receptacle hairy, elongated in fruit. Achenes 60 - 90, subglobose, up to 1 mm long, glabrous or nearly so.

Fl. & Fr. April - Aug.

Distrib. India: W. Himalayas. Jammu & Kashmir.

Pakistan, C. & S. Europe and S.E. Russia.

24. *Ranunculus rufosepalus* Franch. in Ann. Sci. Nat. ser. 6, 15: 217. 1883.

Herbs, perennial, often forming mats; rootstock short, with cord-like fibres; stems ascending, glabrous or with scattered reddish brown hairs. Radical leaves long-petioled, 4- to 5-palmately lobed; terminal lobes almost orbicular; cauline leaves sessile or dissected. Flowers 1.5 - 2 cm across, yellow. Sepals covered with dense reddish brown hairs outside. Petals 5, broadly ovate. Achenes glabrous.

Fl. & Fr. June - Aug.

Distrib. India: W. Himalayas. Jammu & Kashmir.

Pakistan, C. Asia and Russia.

25. *Ranunculus sardosus* Crantz, Strip. Austr. 2: 84. 1763; Mukherjee & Sinha in Bull. Bot. Surv. India 20: 158, f. 1. 1978.

Herbs, annual, pubescent, 10 - 45 cm high; rootstock corm-like, feebly developed; roots not fleshy. Basal leaves 3-partite; middle lobes abruptly contracted into a stalk, all variously dentate and lobed; petioles 3 - 6 cm long. Lower cauline leaves resembling the basal, but smaller; upper cauline leaves sessile with linear-lanceolate lobes. Flowers 1.2 - 2.5 cm across. Petals pale yellow. Achenes 2.5 - 3 mm long, minutely punctate with small obtuse tubercles near the margins, or sometimes smooth; beak ca 0.5 mm long, curved upwards.

Fl. & Fr. March - Aug.

Distrib. India: West Bengal (Howrah).

Europe.

Notes. The herb when eaten in excess by cattle may prove fatal (Kumar & Naqshi in *J. Econ. Tax. Bot.* 14: 72. 1990).

26. *Ranunculus scleratus* L., *Sp. Pl.* 776. 1753; Hook. f. & Thomson in *Fl. Brit. India* 1: 19. 1872.

Hindi: *Jaldhania*.

Herbs, annual, erect, somewhat fleshy, glabrous or sparsely pubescent, up to 60 cm high; stems hollow, deeply furrowed outside. Radical leaves petioled, reniform, 2.5 - 5 cm across, 3-partite at base; segments obovate, bluntly 3 - 5-toothed; petioles 2.5 - 15 cm long, progressively shortened and ultimately sessile in cauline leaves; auricles scarious, 5 - 7 mm long. Cauline leaves obovate, unlobed or bluntly 3 - 5-toothed or shortly 3-partite. Flowers several, ca 1 cm across, bright yellow, diffusely racemose. Sepals elliptic, ca 3 x 1.5 mm, pubescent, somewhat reflexed, caducous. Petals as long as sepals or shorter, yellow. Achenes small, obovoid, ca 0.75 mm long, compressed, pale at margin, numerous in a cylindrical or oblong, 7-8 mm long head; beak minute.

Fl. & Fr. Feb. - March.

Distrib. India: Himalayas, warm valleys and plains of N. India, weed in irrigated fields, ditches and river banks, 1400 - 1600 m. Jammu & Kashmir, Himachal Pradesh, Punjab, Uttar Pradesh, Madhya Pradesh, Bihar, West Bengal, Assam and Manipur.

Japan, China, Myanmar, Nepal, Pakistan, Iran, Syria, Egypt, Europe and Russia.

Notes. According to *Fl. U.S.S.R.* 7: 408. 1937, one of the most poisonous species of *Ranunculus*.

27. *Ranunculus sikkimensis* Hand.-Mazz. in *Acta Hort. Gotob.* 13: 155. 1939. *R. nivalis* auct. non L.; Hook. f. & Thomson in *Fl. Brit. India* 1: 19. 1872.

Herbs, perennial, erect, up to 8 cm high. Radical leaves 3- to 5-lobed or partite, 1 - 2 cm across, glabrous; petioles broadly membranous at base. Cauline leaves shortly petioled on lower ones and becoming sessile upwards. Flowers solitary, yellow; pedicels yellow pubescent. Sepals shaggy, densely yellow pubescent.

Fl. & Fr. June - Sept.

Distrib. India: E. Himalayas, ca 4800 m. Sikkim.

Endemic.

28. *Ranunculus sphaerospermus* Boiss. & Blanche in Boiss., *Diagn. ser. 2: 6. 1856. R. peltatus* Schrank subsp. *sphaerospermus* (Boiss. & Blanche) Mickle in *Notes R. Bot. Gard. Edinb. 23: 13. 1959. R. aquatilis* L. var. *sphaerospermus* (Boiss. & Blanche) Boiss., *Fl. Orient. 1: 23. 1867.*

Herbs, aquatic. Leaves all submerged, floating leaves absent; submerged leaves capillary, with spreading and rigid segments. Flowers 1.5 - 2.5 cm across, cream-white. Nectaries elongated, pyriform. Fruiting peduncles much longer than leaves. Achenes ca 1 cm or less, somewhat rounded and glabrous.

Fl. & Fr. July - Sept.

Distrib. India: W. Himalayas. Jammu & Kashmir.

Nepal, Pakistan, China (Tibet), Egypt, Turkey and S.E. Europe.

29. *Ranunculus stewartii* H. Riedl in *Kew Bull. 34: 364. 1979.*

Herbs, perennial, 10 - 20 cm high; rhizome ca 5 mm thick, elongate, erect; stems single or paired, simple, erect, ascending, slender. Basal leaves ternate, 2 - 4 x 1.2 - 2.6 cm, obliquely truncate at base. *Cauline leaves decreasing in size, trifid; lobes oblong-lanceolate to oblong-obovate, dissected or slightly lobed. Flowers solitary, 2.3 - 3 cm across; peduncles pilose. Sepals broadly elliptic, broadly elliptic-lanceolate, subacute, 7 - 8 x 3.5 - 5 mm, hairy along margins. Petals broadly ovate, undulate along margins, 9 - 12 x 12 - 15 mm, yellow. Filaments subfiliform, ca 3 mm long; anthers ca 1.2 mm long. Receptacle ellipsoid, glabrous. Achenes broadly elliptic, subcompressed, 1 - 1.2 mm long, indistinctly marginate, on globose or subglobose heads.

Fl. & Fr. Aug. - Sept.

Distrib. India: W. Himalayas. Jammu & Kashmir.

Endemic.

30. *Ranunculus subpinnatus* Wight & Arn., *Prodr. 4. 1834; Hook. f. & Thomson in Fl. Brit. India 1: 19. 1872, as a synonym under R. diffusus; Dunn in Gamble, Fl. Pres. Madras 1: 4. 1915.*

Herbs, perennial, erect, usually leafless when in flower. Leaves deeply 3-lobed; lobes cuneate, deeply incised; petioles deep violet. Flowers solitary, 1.5 - 2.5 cm across, pale yellow; peduncles terminal or leaf-opposed. Sepals spreading, hairy. Achenes ovate, acute, compressed, with intramarginal rib at variable distance from margin, finely and evenly pitted.

Fl. & Fr. Aug. - Oct.

Distrib. India: W. Ghats of Peninsular India, usually on grassy slopes, 1800 - 2500 m. Tamil Nadu and Kerala.

Endemic.

31. *Ranunculus trichophyllus* Chaix in Villars, Hist. Pl. Dauph. 1: 335. 1786. *R. aquatilis* L. var. *trichophyllus* (Chaix) Hook. f. & Thomson in Fl. Brit. India 1: 16. 1872.

Herbs, aquatic, perennial. Leaves all submerged, divided into many capillary segments, 2 - 3 cm long, dark green; laminate leaves absent; petioles ca 5 mm long, sheathed at base with an auricle of the same length. Flowers white, 1.2 - 1.5 cm across; pedicels solitary in leaf axils, 2.5 - 3.5 cm long. Sepals elliptic, ca 3.5 mm long, reflexed. Petals obovate, 5 - 6 x 2 - 2.5 mm, white, yellow near the base; nectar-pit lunate. Achenes 25 - 30, obovoid, ca 1.5 mm long, strongly ribbed, hispid; fruiting peduncles shorter than leaves, distinctly curved.

Fl. & Fr. May - Aug.

Distrib. India: Himalayas, temperate and subalpine regions, in ponds and slow-flowing streams, 3500 - 4500 m. Jammu & Kashmir, Himachal Pradesh, Uttar Pradesh and Punjab.

China (Tibet), Nepal, Pakistan, Eurasia, Africa and N. America.

32. *Ranunculus trilobatus* Desf., Fl. Atlant. 1: 437, t. 113. 1798; Som Deva & Naithani in Indian J. For. 7: 337 - 388, ff. A - G. 1984 (non D. Don, 1825).

Herbs, annual, 5 - 25 cm high; roots fibrous to slightly thick, not tuberous; stems erect, not creeping, rooting at nodes, slightly hairy to almost glabrous. Leaves mostly crowded at the base; the lowest simple, the next 3-partite; segments simple, cuneate-obovate, dentate; the upper with more numerous linear-oblong lobes. Flowers 10 - 15 mm across, yellow. Sepals obovate, 5 - 7 mm long. Petals as long as sepals; nectary at base covered by a flap, which is more or less free laterally. Receptacle pubescent. Achenes strongly compressed with numerous small tubercles, ca 2 mm long; beak short, triangular.

Fl. & Fr. June - Aug.

Distrib. India: W. Himalayas, ca 1125 m. Uttar Pradesh (Bajjnath in Almora).

Mediterranean regions in Greece, Albania, Italy, Malta, Portugal and Spain.

33. *Ranunculus wallichianus* Wight & Arn., Prodr. 4. 1834; Hook. f. & Thomson in Fl. Brit. India 1: 20. 1872.

Herbs, perennial, decumbent or trailing, often rooting at nodes. Radical leaves 3-partite, 4 - 8 cm across; segments stalked, 3-lobed, crenate; petioles hairy; lamina hairy on both surfaces. Cauline leaves stalked, 3-lobed. Flowering scapes opposed to cauline leaves, 4 - 8 cm long, pale yellow. Sepals reflexed. Achenes 10 - 15, rounded, flat, pitted, with a few blunt tubercles.

Fl. & Fr. June - Oct.

Distrib. India: W. Ghats of peninsular India. Karnataka, Tamil Nadu and Kerala.

Endemic.

26. *Souliea* Franchet

Herbs, rhizomatous, perennials. Leaves all basal, only 2 on stems, petiolate, peltate, tripinnate. Flowers solitary or rarely 2 on erect scapes, actinomorphic. Sepals 4 - 5, petaloid. Petals 4 - 8, smaller than sepals. Stamens many. Carpels (1-) 10, erect in flower, later spreading; styles elongate, thickened. Follicles stalked.

China and E. Himalayas, monotypic.

Souliea vaginata (Maxim.) Franch. in J. de Bot. 68 - 70. 1898. *Isopyrum vaginata* Maxim. in Fl. Tangut. 1: 18, t. 30, ff. 1 - 10. 1896. *Coptis ospriocarpa* Bruehl in Ann. R. Bot. Gard. Calc. 5: 89. 1896.

Stems erect, at first 10 - 15 cm high, becoming up to 60 cm long in fruits, glabrous, reddish, surrounded at base by 2 large (2 - 4 cm long) sheathing membranous scales. Leaves long-petiolate, 3-ternatisect, 15 - 20 cm across, pale beneath; primary segments obovate or rhombic or trapezoid, pinnate into acutely toothed leaflets. Flowers in a simple terminal raceme. Sepals obovate, 5 - 6 x 3 - 4 mm, white, tinged purple. Petals smaller than sepals, white, suborbicular, ca 3 mm across. Follicles oblong, cylindric, 3.5 - 4 x 0.4 cm, stipitate, prominently veined; seeds numerous, ovoid; testa not crusted and without wings.

Fl. & Fr. April - Oct.

Distrib. India: E. Himalayas, broad-leaved forests and forest clearings, in damp places, 2800 - 4000 m. Sikkim.

Bhutan and W. China.

27. *Thalictrum* L.

Herbs, perennial; stems branched, erect or rambling. Leaves pinnate or ternate with 3 - 7 leaflets, often repeatedly ternatisect with numerous leaflets; petioles sheathing or auricled or stipitate at base; stipels often present. Flowers small, actinomorphic, erect or pendent in diffuse racemes or panicles, rarely few-flowered, axillary, bisexual or sometimes polygamous and plant dioecious. Sepals 4 - 5, inconspicuous or petaloid, greenish or yellowish-white or purplish. Petals absent. Stamens 5 - many, conspicuous. Carpels (1-) 5 - 10; ovule 1 in each, pendulous. Achenes sessile or stalked in heads, ribbed, margined or winged; styles persistent or caducous.

Temperate and alpine regions of N. Hemisphere; ca 150 species, 21 in India.

Literature. LECOYER, J. C. (1885) Monographie du genre *Thalictrum* L. Bull. Soc. Bot. Belge 24: 78 - 324, tt. 2 - 5.

KEY TO THE SPECIES

- | | |
|---|-----------------------------|
| 1a. Leaves simple, simply ternate or 3-foliolate | 2 |
| b. Leaves biternately or pinnately compound or decomposed | 4 |
| 2a. Achenes sessile | 4. <i>T. dalzellii</i> |
| b. Achenes stalked | 3 |
| 3a. Stipules adnate to petiole | 11. <i>T. obovatum</i> |
| b. Stipule free | 20. <i>T. virgatum</i> |
| 4a. Plants usually not more than 30 cm high | 5 |
| b. Plants more than 30 cm high | 8 |
| 5a. Achenes many, more than 12; beak long, straight, hooked at tip | 18. <i>T. saniculiforme</i> |
| b. Achenes few, less than 12; beak short, not hooked at tip | 6 |
| 6a. Stems surrounded by scales at base; flowers 2 - 3, axillary | 20. <i>T. squamiferum</i> |
| b. Stems not surrounded by scales at base; flowers many in racemes or panicles | 7 |
| 7a. Stems very short, up to 10 cm long; leaves all or mostly radical; flowers in racemes; stigma not incurved | 1. <i>T. alpinum</i> |
| b. Stems longer, up to 30 cm long; leaves radical and cauline; flowers in panicles; stigma incurved | 5. <i>T. elegans</i> |
| 8a. Anthers beaked, apiculate or mucronate | 9 |
| b. Anthers without beak or mucro at apex | 16 |
| 9a. Achenes sessile | 10 |
| b. Achenes short or long-stalked | 12 |
| 10a. Flowers polygamous; anthers beaked; achenes usually 2 - 5 | 8. <i>T. foliolosum</i> |
| b. Flowers bisexual; anthers apiculate; achenes more than 5 | 11 |
| 11a. Herbs glandular pubescent | 7. <i>T. foetidum</i> |
| b. Herbs not glandular pubescent | 10. <i>T. minus</i> |
| 12a. Achenes with stalks as long as or longer than achenes | 13 |
| b. Achenes with stalks much shorter than achenes | 15 |

- | | |
|---|----------------------------|
| 13a. Leaflets 3 - 5 mm in diam.; achenes abruptly deflexed against stalk | 17. <i>T. rutifolium</i> |
| b. Leaflets more than 1 cm in diam.; achenes not so deflexed | 14 |
| 14a. Flowers ca 2.5 cm across, pink, lilac or purple in dense rigid panicles | 2. <i>T. chelidoni</i> |
| b. Flowers less than 1.5 cm across, greenish white, in lax weak panicles | 15. <i>T. reniforme</i> |
| 15a. Panicles laxly many-flowered; flowers ca 2 cm across, greenish white | 3. <i>T. cultratum</i> |
| b. Panicles 1- to few-flowered at ends of branches; flowers less than 1 cm across, purplish | 19. <i>T. secundum</i> |
| 16a. Achenes sessile | 17 |
| b. Achenes stalked | 19 |
| 17a. Beaks of achenes long, hooked at tip | 14. <i>T. punduanum</i> |
| b. Beaks of achenes short | 18 |
| 18a. Achenes ca 3 mm long; veins not prominent | 6. <i>T. falconeri</i> |
| b. Achenes ca 6 mm long, strongly ribbed | 9. <i>T. javanicum</i> |
| 19a. Flowers greenish | 13. <i>T. platycarpum</i> |
| b. Flowers white | 20 |
| 20a. Leaflets membranous, ca 3 cm broad | 12. <i>T. pedunculatum</i> |
| b. Leaflets thick, 0.6 - 1.5 cm broad | 16. <i>T. rostellatum</i> |

1. *Thalictrum alpinum* L., Sp. Pl. 545. 1753; Hook. f. & Thomson in Fl. Brit. India 1: 18. 1872. *T. alpinum* L. var. *microphyllum* (Royle) Hand.-Mazz., Symb. Sin. 311. 1931.

Herbs, perennial, glabrous; stems very short or up to 10 cm long, naked. Leaves all radical, 4 - 10 cm across, pinnate or bipinnate; leaflets small, broadly obovate, often 3-lobed or 3-partite, pale beneath; lobes subacute or rounded at apex, glabrous; veins prominent beneath. Scapes simple, 8 - 20 cm long, bearing small greenish flowers in racemes; pedicels short, reflexed in fruit. Sepals 4, elliptic, 2 - 3 x 1 mm. Stamens 5 - 10; anthers beaked. Achenes 5 - 7, supported on reflexed stalks, elliptic or narrowly oblong, obscurely ribbed, shortly attenuate, stalked at base; styles triangular, erect at first, later elongated and recurved.

Fl. & Fr. May - Aug.

Distrib. India: Himalayas, temperate and alpine grassy slopes, 3500 - 4570 m. Jammu & Kashmir, Himachal Pradesh, Uttar Pradesh and Sikkim.

Bhutan, Nepal, Pakistan, China (Tibet), Europe and N. America.

Notes. Widely distributed in the arctic-alpine regions of the Northern Hemisphere and is known as highly variable. Hara (in Fl. E. Himal. 3rd report: 40. 1975) states that this species seems to show the widest range of variation in the Himalayas. Hara (in Enum. Fl. Nepal 2: 21. 1979) merged the varieties *acaule* and *microphyllum* with the species.

2. *Thalictrum chelidonii* DC., Prodr. 1: 11. 1824; Hook. f. & Thomson in Fl. Brit. India 1: 11. 1872, p. p.

Herbs, perennial, much branched; stems 0.5 - 2 m high. Leaves 2-pinnate, 8 - 30 cm long; leaflets ovate or suborbicular, coarsely crenate or lobed, 1 - 4 cm long, pale beneath. Flowers in racemes or panicles, ca 2.5 cm long, deflexed in fruit. Sepals ovate, 8 - 15 x 5 - 10 mm, pink, lilac or purple. Stamens many; anthers shortly mucronate. Achenes numerous, obliquely obovate, 5 - 6 x 3 - 4 mm, compressed, membranous, with 3 branched veins on each side, glabrous or minutely puberulous; beak 1 - 4 mm long.

Fl. & Fr. July - Sept.

Distrib. India: Himalayas, 2400 - 3600 m. Jammu & Kashmir, Himachal Pradesh, Uttar Pradesh and Sikkim.

Bhutan, Nepal and China (Tibet).

3. *Thalictrum cultratum* Wallich, Pl. Asiat. Rar. 2: 26. 1831; Hook. f. & Thomson in Fl. Brit. India 1: 11. 1872.

Herbs, perennial, glabrous; stems erect, branched, up to 1 m high. Leaves 2-pinnate, sheathing and auricled at base; leaflets obovate-cuneate, bluntly toothed, ca 1 cm across, glandular hairy. Flowers in lax panicles, ca 2 cm across, greenish white. Sepals elliptic, 4 - 6 x 1.5 - 2 mm, greenish, tinged purple. Stamens many; anthers with long point. Achenes shortly stipitate, obliquely obovate, broader near apex, 4 - 6 x 2 - 5 mm, prominently 3-ribbed on both faces, compressed, glabrous or glandular pubescent; beak straight or hooked.

Fl. & Fr. July - Sept.

Distrib. India: Himalayas, 2400 - 3600 m. Jammu & Kashmir, Uttar Pradesh and Sikkim.

Bhutan, Nepal and China.

4. *Thalictrum dalzellii* Hook., Icon. Pl. t. 868. 1852; Hook. f. & Thomson in Fl. Brit. India 1: 13. 1872; Ansari in Red Data Book Indian Pl. 3: 210, f.1. 1990.

Herbs, erect, up to 30 cm high. Leaves 3-foliolate, somewhat sheathing at base; stipules free, oblong; leaflets reniform-cordate, ca 5 cm long; lobes crenate-toothed. Flowers white, fascicled at ends of branches. Sepals 4, petaloid. Anthers not tipped; filaments slender. Achenes sessile, prominently ribbed, margined.

Fl. & Fr. Aug. - Sept.

Distrib. India: W. Ghats of Peninsular India. Maharashtra and Karnataka.

Endemic.

5. *Thalictrum elegans* Wallich ex Royle, *Illus. Bot. Himal.* 51. 1834; Hook. f. & Thomson in *Fl. Brit. India* 1: 10. 1872.

Herbs; stems slender, 15 - 40 cm high. Leaves 2 - 3-pinnate, glaucous beneath; leaflets elliptic-obovate, 2 - 5 x 1 - 2 mm, bluntly 3-lobed or partite, glabrous or minutely glandular on veins beneath. Flowers in racemose, sparingly branched panicles. Sepals elliptic, ca 3 x 1.75 mm, greenish purple. Anthers obliquely obovate, somewhat inflated, narrowly winged on back, 4 - 7 x 2.5 - 4 mm, purplish, glabrous, borne on slender 2 - 3 mm long stalk; beak incurved.

Fl. & Fr. July - Oct.

Distrib. India: Himalayas, alpine cliff edges, rocky slopes, moraines, 3000 - 4500 m. Jammu & Kashmir, Himachal Pradesh, Uttar Pradesh and Sikkim.

Bhutan, Nepal, Pakistan and China (Tibet).

6. *Thalictrum falconeri* Lecoyer in *Bull. Soc. Bot. Belge* 24: 192. 1885.

Herbs, up to 80 cm high. Leaves 3- to 5-pinnate; petioles sheathing at base, stipellate; leaflets ovate, somewhat cordate or rounded at base, 3-dentate at apex, up to 2 cm long. Flowers small, greenish, polygamous or plants monoecious; pedicels 3 - 10 cm long. Perianth segments 4, not differentiated into sepals and petals. Stamens 10 - 15; filaments filiform; anthers blunt. Achenes sessile, ovate, with a short beak.

Fl. & Fr. Not known.

Distrib. India: Himachal Pradesh, Uttar Pradesh, Sikkim and Meghalaya.

Notes. This species is considered by some authors to be not specifically distinct from *T. foliolosum* DC. No material is available in Indian herbaria.

7. *Thalictrum foetidum* L., *Sp. Pl.* 545. 1753. *T. minus* var. *foetidum* (L.) Hook. f. & Thomson in *Fl. Brit. India* 1: 14. 1872. *T. vaginatum* Royle, *Illus. Bot. Himal.* 52. 1834.

Stems up to 75 cm high, glandular pubescent. Leaves ternately compound; segments orbicular or obovate, tridentate; upper leaf surface almost glabrous; lower leaf surface glandular punctate, hairy on nerves. Inflorescence leafy, lax-flowered, pendulous; leaflets obovate, rounded or cuneate at base, acutely lobed or toothed along margins, 5 - 10 x 3 - 8 mm; veins very prominent and glandular pubescent beneath. Sepals elliptic, ca

3.5 x 2 mm. Anthers apiculate. Achenes elliptic, ovate-oblong, with subulate beak, 2 - 2.5 mm, slightly compressed, finely glandular pubescent; beak oblique.

Fl. & Fr. June - Aug.

Distrib. India: Himalayas, subalpine and alpine slopes, 3200 - 4000 m. Jammu & Kashmir, Himachal Pradesh, Uttar Pradesh and Sikkim.

Nepal, Pakistan, Afghanistan, China, Japan and N. Asia to Europe.

8. *Thalictrum foliolosum* DC., Syst. Nat. 1: 175. 1818; Hook. f. & Thomson in Fl. Brit. India 1: 14. 1872.

Hindi: *Mamiraq, Pizari.*

Herbs, robust, bushy, up to 3 m tall; stems branched, often presenting a rambling habit. Leaves pinnately decomposed; petioles sheathing and auricled at base; stipules present; leaflets broadly ovate, acute or obtuse, bluntly toothed or lobed at apex, 1.5 - 4 x 1 - 3 cm; lobes oblong-ovate, 3-lobed into orbicular lobes. Flowers polygamous, in large panicles. Sepals obovate, ca 4 x 2 mm, white outside, greenish or purplish inside, caducous. Stamens many, much longer than sepals; filaments filiform; anthers 2 - 3 mm long, acute or mucronate. Achenes few, usually 2 - 5, sessile, oblong, ellipsoid, acute at both ends, ca 3 mm long, strongly prominently ribbed, glabrous; style deciduous.

Fl. & Fr. June - Oct.

Distrib. India: Himalayas, NE. India, Gangetic plains, E. Ghats and Deccan plateau. Himachal Pradesh, Uttar Pradesh, Bihar, West Bengal, Sikkim, Nagaland, Manipur, Meghalaya, Orissa, Madhya Pradesh, Andhra Pradesh and Tamil Nadu.

Nepal, China (Tibet) and Myanmar.

Notes. An extract from the root is used medicinally (Caius in J. Bombay Nat. Hist. Soc. 39: 729. 1937).

9. *Thalictrum javanicum* Blume, Bijdr. 2. 1825; Hook. f. & Thomson in Fl. Brit. India 1: 13. 1872. *T. glyphocarpum* Wight & Arn., Prodr. 2. 1834.

Herbs, erect, glabrous, up to 1 m high. Leaves ternately decomposed; leaflets crenate or 3-lobed, ca 1.5 cm across; veins raised on lower surface; stipules well developed. Flowers small, in terminal panicles. Perianth segments white or purple, woolly at top. Stamens hardly exerted; filaments club-shaped, broadened at apex;

anthers ca 1 mm long, obtuse, shorter than filaments. Achenes sessile, oblong, ellipsoid, 3 - 6 mm long, strongly ribbed; beak ca 0.75 mm long, shortly hooked.

Fl. & Fr. June - Oct.

Distrib. India: Himalayas. Himachal Pradesh, Uttar Pradesh, Madhya Pradesh, Bihar, Sikkim, Meghalaya, Andhra Pradesh, Karnataka and Tamil Nadu.

Java.

10. *Thalictrum minus* L., Sp. Pl. 546. 1753; Hook. f. & Thomson in Fl. Brit. India 1: 14. 1872.

Herbs, up to 1 m high, glabrous or glandulose. Leaves ternately decomposed, pinnate, sheathing at base; stipels absent; leaflets very variable, ovate or somewhat obovate and cuneate at base, trilobed or trifid. Panicles much branched, leafless. Flowers purplish, bracteate, pendulous. Filaments filiform; anthers apiculate. Achenes 6 - 8, sessile, ribbed; stylar beak oblong, broad at base, oblique.

Notes. A highly variable species; the typical European form has not been recorded from India but the following two varieties are generally recognised, though some authors prefer to merge them in the species. The variety *majus* has also been treated at the subspecific level by some.

KEY TO THE VARIETIES

- | | |
|-----------------------------|--------------------------|
| 1a. Leaflets 5-lobed at tip | 10.1. var. <i>elatum</i> |
| b. Leaflets 3-lobed at tip | 10.2. var. <i>majus</i> |

10.1. var. *elatum* (Jacq.) Lecoyer in Bull. Bot. Soc. Belg. 24: 202. 1885. *T. elatum* Jacq., Hort. Vindob. 3: 49. 1776.

Leaflets much elongated, ca 3 cm long, 5-lobed.

Fl. & Fr. June - Sept.

Distrib. India: W. Himalayas. Himachal Pradesh and Uttar Pradesh.

China.

10.2. var. majus (Jacq.) Hook. f. & Thomson, Fl. Ind. 17. 1855 & in Fl. Brit. India 1: 14. 1872. *T. majus* Jacq., Fl. Austr. 5: 9, t. 430. 1796. *T. maxwellii* Royle, Illus. Bot. Himal. 52. 1834.

Robust herbs; stems much branched, glabrous. Leaflets oblong, acute and 3-lobed at tip, 2.5 - 3 cm long. Flowers yellow. Anthers shortly beaked.

Fl. & Fr. July - Sept.

Distrib. India: W. Himalayas, rock crevices in temperate and subalpine regions, up to 3700 m. Jammu & Kashmir, Himachal Pradesh and Uttar Pradesh.

China (W. Tibet).

11. *Thalictrum obovatum* Blatter in J. Asiat. Soc. Beng. n. s. 26: 339. 1931.

Herbs, up to 45 cm high, erect, glabrous. Leaves 3-foliolate; uppermost leaves 2 or 1-foliolate; leaflets reniform with a deep sinus, crenate or irregularly lobed or dentate, ca 3 cm across, glabrous; stipules adnate to petiole. Flowers in leafy panicles, crowded at ends of branches, white, scented. Perianth parts 4 - 5, shorter than stamens. Stamens many; filaments flat; anthers club-shaped. Achenes stipitate, flat.

Fl. & Fr. July - Aug.

Distrib. India: W. Ghats. Maharashtra.

Endemic.

12. *Thalictrum pedunculatum* Edgew. in Trans. Linn. Soc. 20: 27. 1846; Hook. f. & Thomson in Fl. Brit. India 12. 1872.

Herbs, up to 60 cm high, glabrous. Leaves 3-ternate; leaflets ca 3 cm broad, 3 to 7-lobed; petiole-base with membranous sheathing stipules, ovate, obtuse, dentate or lobed. Flowers white, 2 - 3 cm across, in terminal few-flowered panicles; pedicels long, 3 - 10 cm long. Sepals elliptic, petaloid, white. Stamens much shorter than sepals; anthers not pointed; filament linear. Carpels 10 - 12, linear-oblong, shortly stipitate. Achenes linear-oblong, 1.5 - 2 cm long, prominently ribbed, long-stipitate; beak incurved.

Fl. & Fr. April - July.

Distrib. India: N.W. Himalayas, 1800 - 2400 m. Jammu & Kashmir, Himachal Pradesh, Punjab and Uttar Pradesh.

Pakistan and Afghanistan.

13. *Thalictrum platycarpum* Edgew. in Trans. Linn. Soc. 20: 27. 1846; Hook. f. & Thomson in Fl. Brit. India 1: 12. 1872.

Herbs, up to 60 cm high, glabrous. Leaves 3-ternate; leaflets 3 - 7-lobed, ca 3 cm broad; petiole base with membranous sheathing stipules, ovate, obtuse, dentate-lobed. Flowers white, 2 - 3 cm across, in terminal, few-flowered panicles; pedicels 3 - 10 cm long. Sepals elliptic, petaloid, white. Stamens much shorter than sepals; anthers not pointed; filaments linear. Carpels 10 - 12, linear-oblong, shortly stipitate. Achenes linear-oblong, 1.5 - 2 cm long, prominently ribbed, long-stipitate; beak incurved.

Fl. & Fr. April - July.

Distrib. India: N. W. Himalayas, 1800 - 2400 m. Jammu & Kashmir, Himachal Pradesh, Punjab and Uttar Pradesh.

Pakistan and Afghanistan.

14. *Thalictrum punduanum* Wallich, Pl. Asiat. Rar. 2: 26. 1831; Hook. f. & Thomson in Fl. Brit. India 1: 13. 1872.

Herbs, erect, up to 60 cm high. Leaves ternate or biternate, long-petioled with sheathing and auricled bases; upper leaves 3-foliolate; leaflets orbicular or broadly obovate, 2.5 - 5 cm across, 5-lobed, coarsely crenate, rounded or cordate at base, finely reticulate, glaucous or glandular-pubescent below; petioles 5 - 10 mm long. Flowers white, in leafless much-branched corymbose panicles. Sepals narrowly elliptic, ca 5 x 3 mm. Stamens with filiform filaments; anthers oblong-elliptic, acute at apex. Achenes 20 - 30, almost sessile or shortly stipitate, ellipsoid, oblong, ca 2.5 mm, strongly ribbed, glandular pubescent; beak 0.5 - 1 mm long.

KEY TO THE VARIETIES

- | | |
|--|-------------------------------|
| 1a. Leaves viscidly pubescent; achenes glandular hairy | 14.1. var. <i>glandulosum</i> |
| b. Leaves glaucous; achenes not glandular pubescent | 14.2. var. <i>punduanum</i> |

14.1. var. *glandulosum* Hook. f. & Thomson in Fl. Brit. India 1: 13. 1872.

Fl. & Fr. Aug. - Sept.

Distrib. India: Meghalaya.

Endemic.

14.2. var. punduanum

Fl. & Fr. July - Aug.

Distrib. India: Himalayas, 1500 - 2300 m. Uttar Pradesh and Sikkim.

Nepal and Myanmar.

15. *Thalictrum reniforme* Wallich, Pl. Asiat. Rar. 2: 26. 1831; Hook. f. & Thomson in Fl. Brit. India 1: 11. 1872. *T. neurocarpum* Royle, Illus. Bot. Himal. 51. 1834.

Herbs, large, profusely branching with a rambling habit. Leaves 2-ternately compound; leaflets of lower branches orbicular-cordate, with a narrow sinus, crenate or somewhat lobed, 4 - 5 cm across, glabrous. Panicles of small greenish flowers on spreading branches. Filaments short; anthers apiculate. Achenes 6 - 8, with ventral suture, strongly curved, ribbed, with stalks as long as achenes; beak straight.

Fl. & Fr. June - Oct.

Distrib. India: Himalayas, 2400 - 3800 m. Himachal Pradesh, Uttar Pradesh and Sikkim.

Nepal and Bhutan.

16. *Thalictrum rostellatum* Hook. f. & Thomson, Fl. Ind. 15. 1855 & in Fl. Brit. India 1: 12. 1872.

Herbs, rigid; stems slender, 50 - 100 cm high. Leaves ternately decompose, 5 - 15 cm across; lower pinnules often with 3 leaflets; leaflets mostly suborbicular, with 3 - 5 blunt teeth at apex, 7 - 10 (-15) mm across, crenate, pale and glandular beneath; petiole-base broad and sheathing; leaf segments with ca 1 mm long stipels. Flowers few, terminal or on short lateral shoots. Stamens ca 15; anthers acute; filaments filiform. Achenes 5 - 6, sessile, narrowly ellipsoid, ca 3 mm long, somewhat compressed, distinctly 6 - 7-ribbed, tapering to a persistent hooked beak.

Fl. & Fr. June - Aug.

Distrib. India: Himalayas, 2100 - 3000 m, streamsides, margins of pine forests. Himachal Pradesh, Uttar Pradesh and Sikkim.

Nepal and Bhutan.

17. *Thalictrum rutifolium* Hook. f. & Thomson, Fl. Ind. 14. 1855 & in Fl. Brit. India 1: 12. 1872 (as *nutaefolium*).

Herbs, glabrous; stems 10 - 60 cm high. Leaves pinnately decompose, glaucous; petioles sheathing, auricled; leaflets 3 - 5 mm long, deeply and bluntly lobed; stipules present. Flowers in axillary short racemes or narrow panicles, green. Sepals ovate, ca 2 x 1 mm, greenish. Stamens usually 5; anthers apiculate. Achenes 5, on abruptly deflexed stalks, narrowly ellipsoid, 5 - 6 mm long, 1 - 1.5 mm broad, prominently 7 - 8-ribbed; beak strongly recurved.

Fl. & Fr. June - Aug.

Distrib. India: Himalayas, 3600 - 4500 m. Jammu & Kashmir, Himachal Pradesh, Uttar Pradesh and Sikkim.

Nepal, Bhutan and China (Tibet).

18. *Thalictrum saniculliforme* DC., Prodr. 1: 12. 1824; Hook. f. & Thomson in Fl. Brit. India 1: 13. 1872 (as *saniculaeforme*). *T. radiatum* Royle, Illus. Bot. Himal. 52. 1834.

Herbs, wiry, erect; stems ca 30 cm high, glabrous. Leaves 1 - 3, mostly radical, long-petioled, 15 - 25 cm across; upper ones smaller, 3 - 4-ternate; stipules free; leaflets broadly ovate or obovate, rounded or subcordate at base, obtusely or rounded toothed or lobed, ca 2 cm across, glabrous. Flowers small, white, in panicles; peduncles as long as leaves, divaricately branched, few-flowered. Sepals elliptic, ca 5 x 2 mm, white. Filaments filiform; anthers pointed. Achenes numerous, sessile or very shortly stalked, arranged in heads, ellipsoid, ca 2 mm long, 3-ribbed on each face; style as long as achenes, hooked at apex.

Fl. & Fr. July - Oct.

Distrib. India: Temperate Himalayas, amidst mosses on tree trunks and rocks, also in Western Ghats of Peninsular India in Shola forests and adjacent grasslands, 1800 - 2500 m. Himachal Pradesh, Uttar Pradesh, Sikkim, Karnataka and Tamil Nadu.

Endemic.

19. *Thalictrum secundum* Edgew. in Trans. Linn. Soc. 20: 26. 1846. *T. pauciflorum* Royle, Illus. Bot. Himal. 52. 1834; Hook. f. & Thomson in Fl. Brit. India 1: 11. 1872.

Fig. 18.

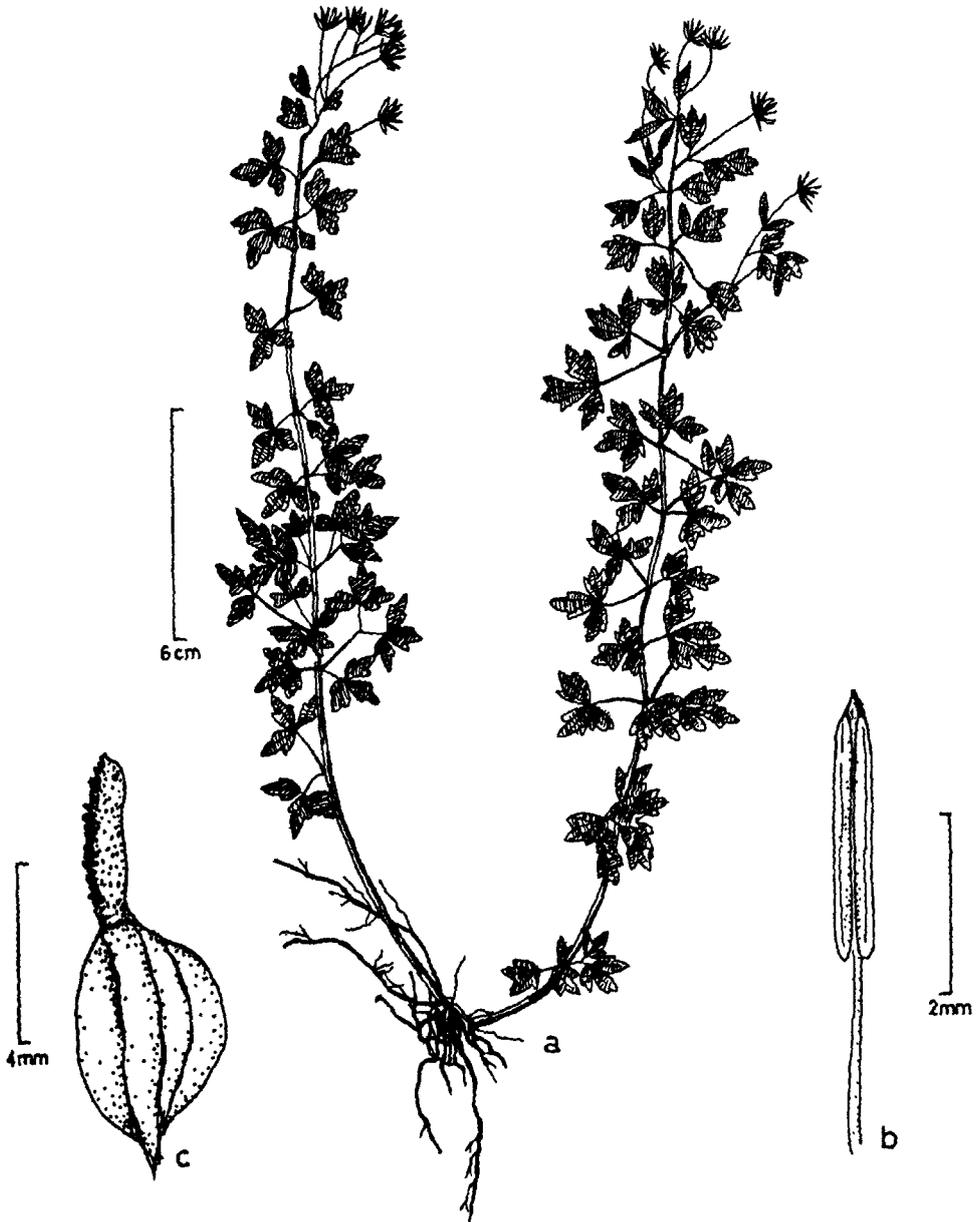


Fig. 18. *Thalictrum secundum* Edgew.: a. habit; b. stamen; c. achene.

Herbs, erect, glabrous, 30 - 90 cm high, with long branches. Leaves subsessile, 2-ternate or 2- to 3-pinnate, uniform in size all along the stem; leaflets obovate, cuneate, 3- to 4-lobed, pale beneath. Flowers small, purplish, in few-flowered panicles at ends of branches. Sepals narrow. Stamens many; anthers with short apical projections. Achenes small, 3 - 4 mm long, including short stalk and beak.

Fl. & Fr. June - Oct.

Distrib. India: W. Himalaya, 2500 - 4000 m. Jammu & Kashmir, Himachal Pradesh and Uttar Pradesh.

Nepal.

20. *Thalictrum squamiferum* Lecoyer in Bull. Bot. Soc. Bot. Belg. 26: 229. 1877.

Herbs, erect; stems 10 - 15 cm high, surrounded at base by scales. Leaflets 2 - 3 mm across, glaucous. Flowers 2 - 3, axillary. Sepals 2 - 3 mm long, purplish. Stamens 5 - 10; connective elongated above anther-thecae. Style triangular, almost winged at base. Achenes spreading, ellipsoid, 3-nerved on each side.

Fl. & Fr. June - July.

Distrib. India: E. Himalayas, alpine zones, ca 4570 m. Sikkim.

Bhutan and China (Tibet).

21. *Thalictrum virgatum* Hook. f. & Thomson, Fl. Ind. 14. 1855 & Fl. Brit. India 1: 12. 1872.

Herbs, erect, 30 - 50 cm high, glabrous. Leaves simple or simply ternate, subsessile; lamina broadly obovate or orbicular, 1 - 3 cm across, deeply and obtusely toothed or lobed above, rounded or cordate at base, glabrous above, glaucous beneath; petioles 5 - 10 mm long. Flowers small, in spreading panicles, white. Sepals narrowly elliptic, 5 - 15 x 3 - 6 mm. Anthers rounded at apex. Achenes many, shortly stalked, prominently 1-ribbed, somewhat compressed, narrowly elliptic, ca 2 x 0.5 mm, glabrous, shortly stalked, tapering to ca 0.5 mm long beak.

Fl. & Fr. May - Sept.

Distrib. India: Himalayas, wet places in grasslands and rocks, 1800 - 3600 m. Uttar Pradesh and Sikkim.

Bhutan and Nepal.

28. Trollius L.

Herbs, perennial, erect, glabrous; rootstock stout, clothed at apex with fibres; stems simple. Leaves palmatisect, mostly basal. Flowers terminal, solitary, actinomorphic, up to 5 cm across, yellow. Sepals 5 - 8, petaloid. Petals (honey leaves) 10 - 12 (rarely 3 - 4), very small, obovate, with nectar pit above basal claw, equalling or shorter than stamens. Stamens numerous. Carpels many. Follicles membranous, with prominent beak; seeds many, in 2 series.

N. temperate and arctic regions; ca 25 species, 3 species in India.

Literature. DOROSZEWSKA, A. (1974) The genus *Trollius* Linn. A taxonomic study. *Monogr. Bot. (Polsk.)* 41: 167.

KEY TO THE SPECIES

- | | |
|--|----------------------|
| 1a. Nectariferous staminodes short-clawed, thin along upper edges | 1. <i>T. acaulis</i> |
| b. Nectariferous staminodes long-clawed, thickened along upper edges | 2 |
| 2a. Leaf segments distinct, with apiculate serratures | 2. <i>T. farreri</i> |
| b. Leaf segments overlapping, with scarcely apiculate serratures | 3. <i>T. pumilus</i> |

1. *Trollius acaulis* Lindley, *Bot. Reg. Misc.* 56. 1842; Hook. f. & Thomson in *Fl. Brit. India* 1: 22. 1872.

Rootstock stout, with thick fibres; stems leafy, simple, up to 20 cm high, elongating considerably in fruit. Radical leaves long-petioled, palmately 5-partite; segments oblong-lanceolate, incised, frilled along margins in some; petioles with sheathing bases. Cauline leaves similar, but with much shorter petioles. Flowers solitary, 5 - 6 cm wide, yellow-orange. Sepals 6 - 8, petaloid, caducous. Petals (honey leaves) 12 - 16, short-clawed, thickened along upper edges, shorter than the numerous stamens. Carpels many, ripening into membranous beaked follicles.

Fl. & Fr. May - July.

Distrib. India: W. Himalayas, alpine slopes, 3000 - 4300 m. Jammu & Kashmir, Himachal Pradesh and Uttar Pradesh.

Nepal and Pakistan.

2. *Trollius farreri* Stapf in Bot. Mag. 152, t. 9143. 1928.

Stems erect, 15 - 20 cm high, one-leaved near the base. Leaf segments dissected, distinct; laciniae once-serrate, apiculate. Flowers golden yellow.

Fl. & Fr. June - July.

Distrib. India: E. Himalayas. Arunachal Pradesh.

China.

3. *Trollius pumilus* D. Don, Prodr. Fl. Nep. 195. 1825; Hook. f. & Thomson in Fl. Brit. India 1: 22. 1872. *T. sikkimensis* (Bruehl) Dorosz., Monogr. Bot. (Polsk.) 41: 32. 1974. *T. pumilus* D. Don subsp. *normalis* var. *sikkimensis* Bruehl in Ann. R. Bot. Gard. Calc. 5: 88. 1896. *T. gammieanus* Stapf in Bot. Mag. sub. t. 9143, in clavi. 1928.

Stems erect, (5-) 10 - 20 (-25) cm in flower, up to 30 cm in fruit, mostly leafless above the base, rarely 1- to 2-leaved in basal half; lamina of basal leaves ovate or reniform, 2 - 5 cm long and broad, 3-lobed; primary leaf segments usually overlapping upwards, rhombic, obovate, deeply pinnatisect; ultimate lobes linear-lanceolate, finely acuminate, acutely dentate, ca 4 - 7 x 2 - 3 mm; petioles 5 - 15 cm long, with auricles narrowed at base. Flowers solitary, 2 - 3 cm across, yellow. Sepals 5 - 6, usually persistent. Petals 10 - 12, linear-oblong, narrowly obovate or spatulate, long-clawed, thin along margins, 3.5 - 5 mm long. Follicles many, membranous, oblong, slightly compressed, 7 - 8 x 2 mm; beak ca 2 mm long.

Fl. & Fr. May - Oct.

Distrib. India: Himalayas, damp alpine meadows and peaty marshes, 3000 - 4500 m. Uttar Pradesh and Sikkim.

Nepal, Bhutan and China (Tibet).

Notes. According to some authors, *T. sikkimensis* (Bruehl) Dorosz. is distinct from *T. pumilus* D. Don.

CIRCAEASTERACEAE

(R. R. Rao and P. K. Hajra)

Herbs, annuals, weak, glabrous with persistent cotyledon. Leaves in a rosette at the apex of short stem (elongated hypocotyle), dentate; venation dichotomous, open; nodes unilacunar; vessels simply perforate. Flowers solitary in upper leaf-axils, bisexual, actinomorphic, shortly pedicellate. Sepals 2(-3), valvate, membranous, persistent. Petals absent. Stamens (1-)2(-3), free, alternate with sepals, rarely reduced to one and the other sepaloid; anthers small, as long as wide, 2-locular, dehiscing longitudinally. Carpels 1 - 3, superior, free, linear-oblong, 1-locular, 1-ovuled; style very short; stigma sessile. Fruit a cluster of indehiscent prickly achenes. Seeds with copious endosperm; embryo linear-oblong.

Temperate N. W. & E. Himalayas to W. & N. W. China; monotypic family.

Literature. BHATTACHARYYA, U. C. (1964) *Circaeaster agrestis* Maxim. (Circaeasteraceae) - a new record from North Garhwal Himalaya. Bull. Bot. Surv. India 6: 297 -298., ff. 1 - 7. DIELS, L. (1932) *Circaeaster* eine hochgradig reduzierte Ranunculaceae. Bull. Bot. Centrbl. 49: 55 - 60. FOSTER, A. S. (1963) The morphology and relationships of *Circaeaster*. J. Arn. Arb. 44: 299 - 321, tt. 1 - 6.

Circaeaster Maxim.

Characters and distribution of the family. Monotypic.

Circaeaster agrestis Maxim. in Bull. Acad. St. Petersb. 27: 556. 1881; Hook. f. in Fl. Brit. India 5: 101. 1886. **Fig. 19.**

Herbs, 5 - 15 cm high, erect, simple, slender; cotyledons 2, linear, elliptic-oblong, entire, 5 - 10 x 1.5 - 2 mm, 1-nerved. Leaves in solitary false whorls, crowded, spathulate, rhombic-obovate, cuneate at base, obtuse or subacute at apex, entire with cuspidately toothed outer margin, 1.5 - 3.6 cm long, membranous, pale green with open dichotomous venation. Peduncles ca 1 mm long at flowering time, up to 10 mm in fruit. Sepals ovate-oblong, minute, scale-like, 0.5 - 1 mm long. Stamens 2, ca 2 mm long; filaments linear, flattened; anthers subglobose. Ovary ca 4 mm long, acute at tip, with hooked bristles; stigma linear, minute. Achenes ellipsoid, ca 3 mm long, covered with fine hooked hairs, diverging when mature. Seeds oblong.

Fl. & Fr. July - Oct.

Distrib. India: Shaded moist places in Juniperus or Rhododendron scrubs, 2500 - 3350 m. Uttar Pradesh, Sikkim and Arunachal Pradesh.

Nepal, Bhutan and W. China.

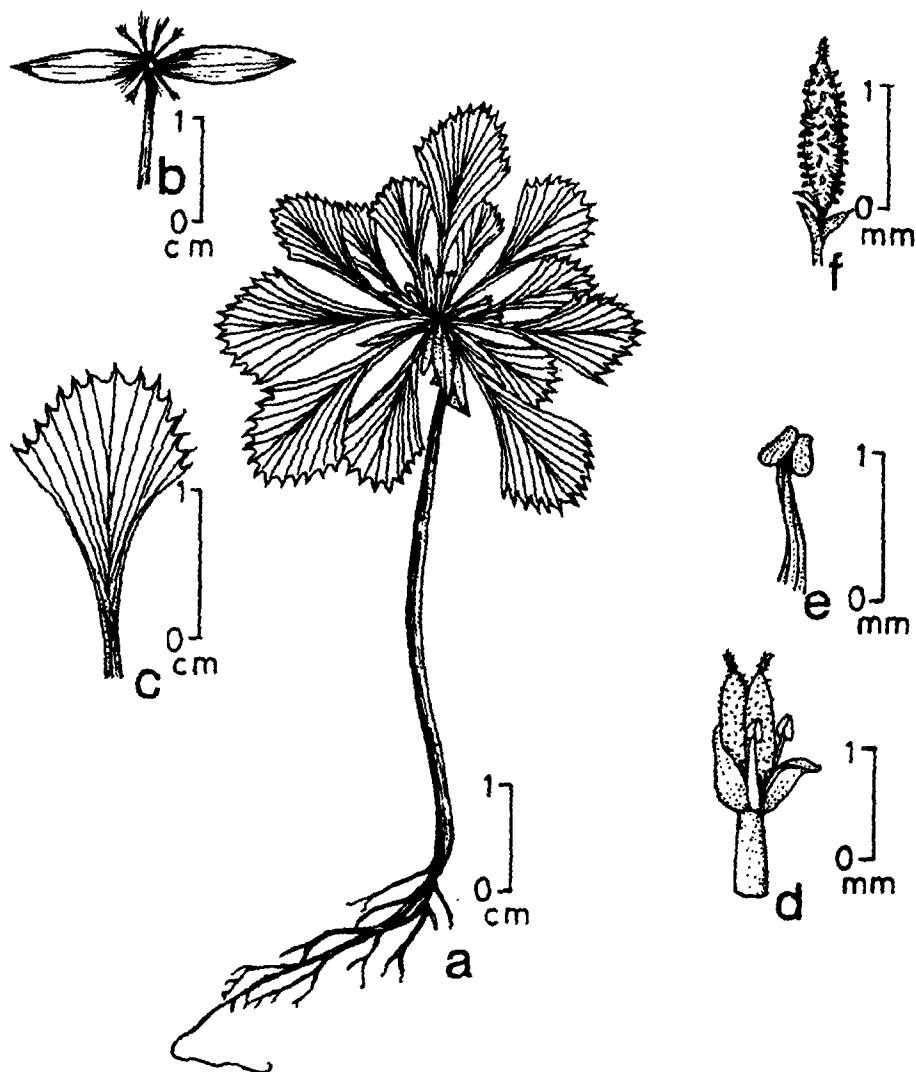


Fig. 19. *Circaeaster agrestis* Maxim. : a. plant; b. cotyledons; c. leaf; d. flower; e. stamen; f. achene (from Bhattacharya in Bull. Bot. Surv. India 6: 297. 1964).

PAEONIACEAE

(M. A. Rau)

Herbs or undershrubs, perennial, erect or spreading, stout with leafy stems. Leaves alternate, petiolate, bipinnate or 1-2 ternately compound with sublobed segments, exstipulate. Flowers usually solitary or sometimes few, paniced, large, 8-12 cm across, bisexual, actinomorphic. Sepals 5, free, subfoliaceous, persistent. Petals 5 (-10), larger than sepals, imbricate, variously coloured (white, pink or red). Stamens numerous (40-75), spirally arranged, centrifugal; filaments elongated; anthers basifixed, 2-loculed, extrorse, dehiscing by longitudinal slits. Carpels 1-5, free, girdled below by a fleshy disc; style short; stigma sessile, thick, 2-lipped. Fruit a cluster of feathery 2-many seeded follicles. Seeds large, ovoid or subglobose with fleshy copious endosperm, arillate.

Asia, Europe and N. America; one genus and ca 33 species, one species in India.

Notes. Previously treated under Ranunculaceae, *Paeonia* is regarded as a rather isolated primitive genus of the Ranales (Hutchinson, *Evol. & Phyl. Fl. Pl.* 477. 1969) and included in a distinct family Paeoniaceae under the Ranunculales. Nakai (in *J. Jap. Bot.* 24: 8-14. 1949) placed it in the order Paeoniales, and this has been accepted by some authors.

Literature. RAU, M. A. (1978) Paeoniaceae. In: *Fasc. Fl. India* 1: 5-8.

Paeonia L.

Characters and distribution of the family.

Paeonia emodi Wallich ex Royle, *Illus. Bot. Himal.* 57. 1834; Hook. f. & Thomson in *Fl. Brit. India* 1: 30. 1872. *P. emodi* var. *glabrata* Hook. f. & Thomson in *Fl. Brit. India* 1: 30. 1872. Fig. 20.

Hindi: *Udsalap*; Kash.: *Mid*; Punj.: *Mamekh*.

Herbs, erect, up to 1 m high; roots fleshy, tuberous; stems somewhat woody. Leaves alternate, 1-2-ternate; leaflets decurrent, entire or incised, ultimate segments oblong or lanceolate, acute or acuminate, glabrous. Flowers usually in axils of upper leaves, on long peduncles; buds globose, 2-3 cm in diam.; open flowers nearly 10 cm across; bracts foliaceous. Sepals 5-8, usually white. Stamens many. Follicles 1 or 2, each 3-4 cm long, somewhat curved, strigose with yellowish brown hairs to glabrate. Seeds shiny black, smooth, ca 1 cm long.

Fl. & Fr. March - June.

Distrib. India: W. Himalayas, 1500 - 3000 m. Jammu & Kashmir, Himachal Pradesh and Uttar Pradesh.

Pakistan.

Notes. In its wide range of distribution in the W. Himalayas, *P. emodi* exhibits monocarpellary as well as bicarpellary follicles. While follicles are mostly strigose, glabrous ones are occasionally met with and there are intergrading forms. In view of this, the var. *glabrata* Hook. f. & Thomson is reduced to synonymy.

Roots, leaves and seeds are used in local medicine. Infusion of flowers given to control diarrhoea. The roots are used for uterine diseases (Kumar & Naqshi in J. Econ. Tax. Bot. 14: 72. 1990).

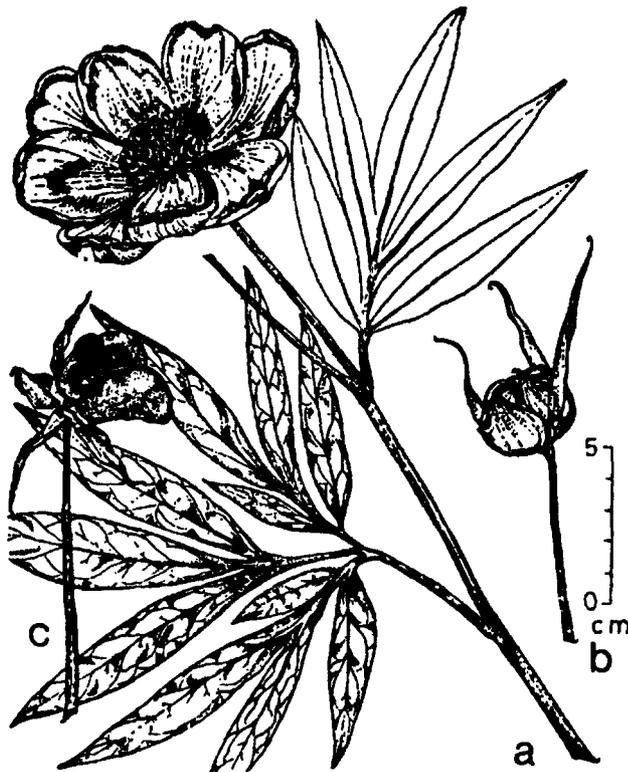


Fig. 20. *Paeonia emodi* Wallich ex Royle : a. part of plant with flower; b. flower bud; c. dehiscent follicle with seeds (from Fasc. Fl. India 1: 6. 1978)

DILLENIACEAE

(N. C. Majumdar)

Trees, shrubs, climbers or herbs with radical leaves. Leaves simple, alternate or spirally arranged, rarely opposite, entire or dentate, usually with numerous prominent parallel lateral nerves; stipules absent, or if present, wing-like, mostly caducous. Flowers solitary, clustered or in panicles, actinomorphic, bisexual, hypogynous, generally yellow or white. Sepals 5 (4-6), free, imbricate or spirally arranged, persistent, often accrescent, thickened and fleshy in fruit. Petals usually 3 - 5, free, imbricate, often crumpled in bud, caducous. Stamens numerous, rarely 7 - 10, free or basally connate into bundles, centrifugal in development, usually persistent; staminodes often present; filaments thickened apically; anthers 2-locular, basifixed, oblong, opening by apical pores or longitudinal slits. Carpels 1 - 20, superior, free or somewhat coherent along the central axis; styles free, elongate and divergent; ovules 1 - many, anatropous, campylotropous or amphitropous, on axile placenta. Fruiting carpels dehiscent and follicular or indehiscent and baccate, enclosed within a subglobose pseudocarp composed of the enlarged somewhat fleshy imbricate sepals. Seeds 1 or few, arillate or exarillate; testa crustaceous; endosperm copious, fleshy, oily and proteinaceous; embryo minute, linear, straight.

Tropical and subtropical regions of the world, centred in Australia, rare in Africa; 14 genera and ca 400 species, 3 genera and 12 species in India.

Literature. ABEDIN, S. (1973) Dilleniaceae. In: Fl. W. Pakistan 42: 1 - 4. HOOGLAND, R. D. (1951) Dilleniaceae. In: Fl. Males. I, 4: 141 - 174. MAJUMDAR, N. C. (1979) Dilleniaceae. In: Fasc. Fl. India 2: 1 - 16. SASTRY, R.L.N.(1958) Pollen morphology and embryology of some Dilleniaceae. Bot. Notiser 111: 495 - 511.

KEY TO THE GENERA

- | | |
|---|---------------------|
| 1a. Herbs, usually stemless, with large radical leaves | 1. <i>Acrotrema</i> |
| b. Trees, shrubs or woody climbers, without radical leaves | 2 |
| 2a. Trees; flowers solitary or in clusters, white or yellow; stamens with cylindric filaments and parallel locules; receptacle cical; fruits globose, indehiscent, enclosed by enlarged sepals | 2. <i>Dillenia</i> |
| b. Shrubs or woody climbers; flowers in terminal panicles, white to reddish white; stamens with filaments thickened upwards and obliquely divergent locules; receptacle flat; fruits of several dehiscent shiny follicles, not enclosed in enlarged calyx | 3. <i>Tetracera</i> |

1. *Acrotrema* Jack

Herbs, perennial; stems stout, woody, horizontal. Leaves all radical or on short stem, simply dentate or pinnatisect; petioles with broad membranous, caducous wings. Flowers in short terminal racemes with membranous bracts, yellow. Sepals 5. Petals 5. Stamens 15 - numerous, in 3 bundles, alternating with carpels. Carpels usually 3, slightly coherent along the axis; styles linear, recurved; ovules 2 - 6 or 10 - 20. Follicles dehiscent irregularly. Seeds with white membranous aril.

Tropical S. & S.E. Asia; ca 10 species, one in India.

Literature. DICKISON, W. C. (1971) Comparative morphological studies in Dilleniaceae. VII. Additional notes on *Acrotrema*. *J. Arn. Arb.* 52: 319 - 331.

Acrotrema arnottianum Wight, *Illus.* 1: 9, t.3. 1840; Hook. f. & Thomson in *Fl. Brit. India* 1: 32. 1872.

Mal.: *Nilampunna*.

Herbs, stems very short or absent. Leaves obovate-oblong, rounded or cordate at base, obtuse at apex, more or less sharply dentate along margins, 15 - 30 x 7 - 12 cm; young leaves floccose; mature leaves with long soft hairs and at times glabrescent; petioles 2 - 8 cm long, broadly winged from above to base. Flowers bright yellow, many, on 9 - 14 cm long peduncles; pedicels 5 - 15 cm long, clothed with long hairs. Sepals obovate, 8 - 9 mm long, scarlet or pink with long white hairs. Petals obovate, ca 8 mm long, yellow. Stamens numerous; anthers spathulate. Carpels ca 8 mm long, many-ovuled. Follicles many-seeded or by abortion few-seeded.

Fl. April - Aug.; *Fr.* July - Oct.

Distrib. India: Southern Western Ghats, moist places under bushes along edges of ditches in moist deciduous and evergreen forests, up to 800 m. Tamil Nadu and Kerala.

Endemic.

2. *Dillenia* L.

Trees. Leaves large, sometimes stipulate; petioles channelled above. Flowers showy, solitary or in terminal racemes, sometimes fasciculate on short shoots; bracts and bracteoles caducous, if present. Sepals 5, spreading and herbaceous at first, persistent, tightly packed, enlarged and fleshy in fruit. Petals 5, yellow or white, larger than sepals, caducous. Stamens numerous, free; filaments equal or unequal in length; anthers linear with parallel loculi opening by apical pores or longitudinal slits; the inner ones erect and introrse; the outer ones recurved and extrorse. Carpels 5 - 20, borne on a conical

receptacle; styles radiating; ovules 4 - 80. Pseudocarps indehiscent, enclosed by enlarged thickened sepals; seeds exarillate.

Madagascar and Seychelles in Africa and India to S.E. Asia, Australia and Fiji Islands; ca 60 species, 7 species in India.

Literature. BRANDIS, D. (1900) The Indian species of *Dillenia*. *Indian For.* 26: 429 - 431. CORNER, E. J. H. (1978) The inflorescence of *Dillenia*. *Notes R. Bot. Gard. Edinb.* 36: 341 - 353. HOOGLAND, R. D. (1952) A revision of the genus *Dillenia*. *Blumea* 7: 1 - 145, ff. 1 - 11.

KEY TO THE SPECIES

- | | |
|---|-------------------------|
| 1a. Flowers 15 - 20 cm across; carpels 14 - 20; fruits 8 - 10 cm across | 4. <i>D. indica</i> |
| b. Flowers 3 - 12 cm across; carpels 5 - 12; fruits up to 3.5 cm across | 2 |
| 2a. Stamens equal in length | 3. <i>D. bracteata</i> |
| b. Stamens unequal, inner ones longer | 3 |
| 3a. Flowers white | 6. <i>D. retusa</i> |
| b. Flowers yellow | 4 |
| 4a. Flowers up to 5 cm across; anthers opening by longitudinal slits | 5 |
| b. Flowers 10 - 12 cm across; anthers opening by apical pores | 6 |
| 5a. Flowers 2.5 - 3 cm across; pedicels without bracteoles | 5. <i>D. pentagyna</i> |
| b. Flowers 4 - 5 cm across; pedicels with caducous bracteoles | 7. <i>D. scabrella</i> |
| 6a. Outer sepals 15 x 12 mm; inner ones 18 x 14 mm; outer stamens ca 7 mm long | 1. <i>D. andamanica</i> |
| b. Outer sepals at least 25 x 18 mm; inner ones 30 x 20 mm; outer stamens at least 10 mm long | 2. <i>D. aurea</i> |

1. *Dillenia andamanica* C.E. Parkinson in *Indian For.* 61: 425, t.29. 1935. *D. pilosa* auct. non Ham. (1827), nec Roxb. (1832); Kurz in *J. Asiat. Soc. Beng.* 41(2): 291. 1872.

Trees, up to 30 m tall, deciduous. Leaves narrowly obovate to oblanceolate, with 40 - 45 pairs of nerves, acute at base, obtuse at apex, entire or dentate along margins, 25 - 45 x 10 - 15 cm, strigose mainly on nerves beneath; petioles 0.5 - 2 cm long. Flowers solitary or in pairs on up to 3 cm long shoots, ca 12 cm across; pedicels 1 - 3.5 cm long, bracteate, more or less strigose hirsute. Sepals sericeous outside, ciliate along margins. Petals obovate, 5 x 3 cm, yellow. Inner stamens with reflexed apex, ca 13 mm long. Carpels 8 (rarely 6), arranged around the conical receptacle, each with 15 - 20 ovules; styles recurved, ca 10 mm long. Fruits ca 2.5 cm across, subglobose, orange in colour.

Fl. & Fr. March - July.

Distrib. India: Andaman & Nicobar Islands.

Endemic.

2. *Dillenia aurea* J. E. Smith in Exot. Bot. 2: 65, t. 93. 1806; Hook. f. & Thomson in Fl. Brit. India 1: 37. 1872. *D. pulcherrima* Kurz in J. Asiat. Soc. Beng. 40(2): 46. 1871.

Beng.: *Chamaggai*; Or.: *Rai*.

Fig. 21.

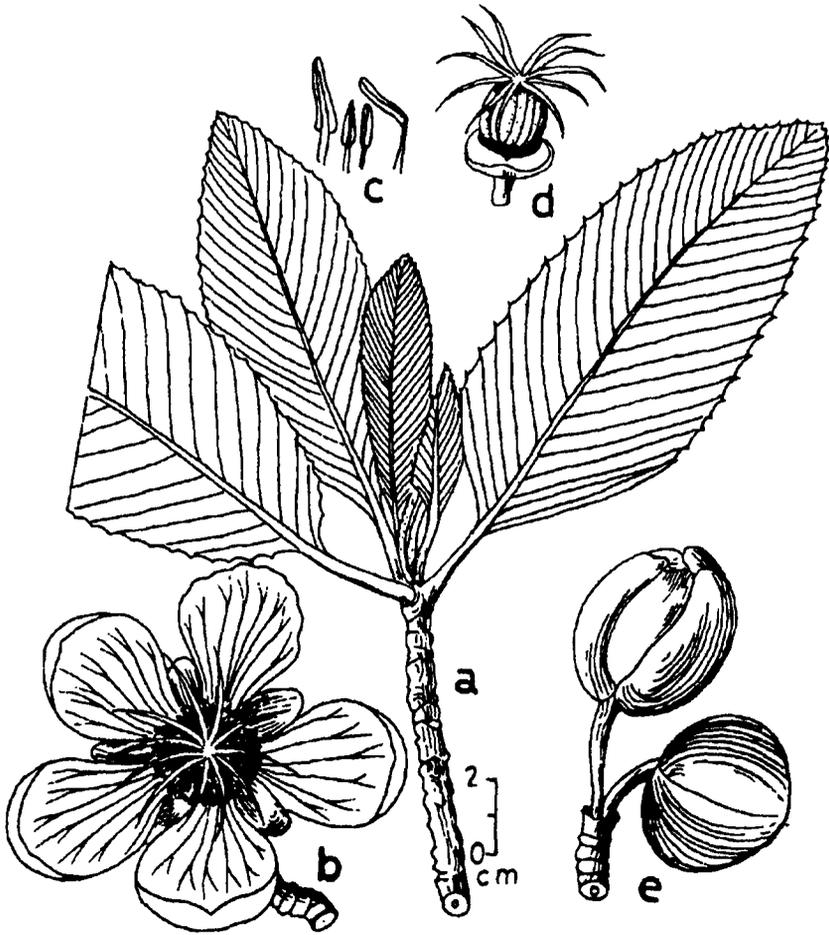


Fig. 21. *Dillenia aurea* J.E. Smith: a. branch with young leaves; b. flower; c. stamens; d. pistil; e. fruits

Trees, up to 15 m tall, deciduous. Leaves elliptic-oblong, rounded or truncate at apex, entire or slightly undulate-dentate along margins, 20 - 40 x 10 - 25 cm; nerve endings often with small tufts of hairs; petioles 3 - 6.5 cm long. Flowers solitary or rarely in pairs, 10 - 12 cm across. Sepals coriaceous, ciliate along margins. Petals obovate, yellow. Inner stamens with reflexed apex, 16 - 21 mm long. Carpels 10 - 12, each with 19 - 22 ovules; styles spreading, ca 2 cm long. Fruits subglobose, 3 - 3.2 cm across, yellow. Seeds obovoid, ca 4 x 3 mm, glossy, dark brown.

Fl. & Fr. March - July.

Distrib. India: Uttar Pradesh, Bihar, West Bengal, Orissa, Madhya Pradesh and Andaman & Nicobar Islands.

Myanmar and N. E. Thailand.

3. *Dillenia bracteata* Wight, *Icon.* 2: 4, t.358. 1840; Hook. f. & Thomson in *Fl. Brit. India* 1: 37. 1872. *Wormia bracteata* (Wight) Hook. f. & Thomson, *Fl. Ind.* 68. 1855.

Kan.: *Betta-kanigala*; Mal.: *Kattu-punna*; Nep.: *Tantare, Tantri*; Tam.: *Kolikkay*; Tel.: *Sirutekku*.

Trees, 10 - 20 m tall, with tomentose young shoots; branches with leaf scars clasping branches for half the circumference. Leaves elliptic to obovate, cuneate at base, acute or obtuse at apex, entire or serrate along margins, 15 - 45 x 5 - 20 cm, hirsute, especially on nerves beneath, glabrescent at maturity; lateral nerves 16 - 20 pairs, appressed hirsute on nerves beneath; petioles 1 - 5 cm long. Flowers yellow, 2.5 - 3 cm across, in racemes or in 2 - 7-flowered clusters on round projections on older branches; pedicels thickened at apex, 4 - 10 mm long; bracts sessile, lanceolate or spatulate, acute, 8 - 12 x 3 - 4 mm, hirsute, early caducous; bracteoles 1 - 2 or absent, lanceolate, ca 5 x 2 mm. Sepals ovate, acute or obtuse, 8 - 12 x 5 - 9 mm, coriaceous, reddish, silky pubescent. Petals obovate, rounded at apex, 15 - 20 x 5 - 10 mm, yellow. Stamens ca 9 mm long, in 2 series, the outer numerous, inwardly curved, the inner outwardly reflexed; anthers linear, rounded or slightly emarginate at apex, opening by small slits, pinkish blue. Carpels 5, arranged around narrow conical receptacle, each with 30 ovules in two rows; styles ca 9 mm long. Pseudocarps orange, subglobose, enclosed within sepals, 2.5 - 3 cm across; fruiting carpels ca 8 x 5 mm, each 1 - 2-seeded. Seeds ovoid, 5 x 4.5 mm, dark reddish brown to black, arillate, glabrous.

Fl. & Fr. Dec. - June.

Distrib. India: Western Ghats, tropical and subtropical evergreen or semievergreen forests, up to 1000 m. Tamil Nadu and Kerala.

Endemic.

Notes. Timber reddish brown, valuable for construction work.

4. *Dillenia indica* L., Sp. Pl. 535, 1753; Hook. f. & Thomson in Fl. Brit. India 1: 36. 1872. Fig. 22.

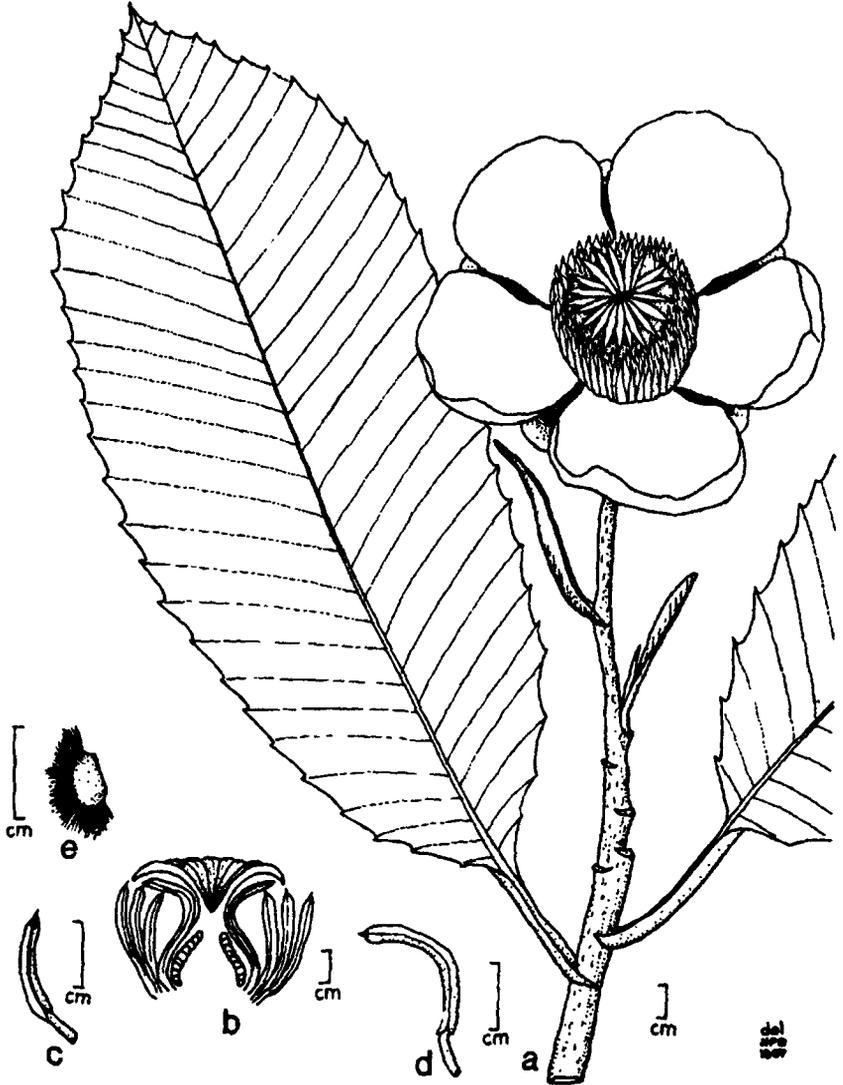


Fig. 22. *Dillenia indica* L. : a. twig with flower; b. longitudinal section of pistil; c. & d. stamens; e. seed.

Asm.: *Otingha*; Beng. & Hindi: *Chalta*; Kan.: *Betta-kanagala*; Mal.: *Chalita*, *Syalita*; Mar.: *Mota-karnal*; Nep.: *Mechiapal*, *Panchkhul*, *Panchphal*, *Ramphal*; Tam.: *Uva*; Tel.: *Uva*, *Pedda-kalinga*.

Evergreen trees, up to 25 m tall; bark smooth, peeling off in small thin hard scales; branches appressed silky hairy. Leaves oblong-lanceolate, elliptic to oblanceolate, attenuate at base, acute to acuminate at apex, more or less serrate-dentate along margins, 15 - 40 x 5 - 12 cm, glabrous above, strigose especially on nerves beneath; lateral nerves 30 - 50 pairs, prominent beneath; petioles 2.5 - 7.5 cm long. Flowers white, fragrant, solitary, terminal, 15 - 20 cm across; pedicels 4 - 8 cm long, silky hairy; bracts solitary, median on pedicels, lanceolate, ca 5 mm long. Sepals 5, obovate, elliptic, 4 - 6 x 3 - 5 cm, fleshy. Petals obovate, rounded at apex, 7 - 9 x 5 - 6 cm, white with green veins. Outer stamens 13 - 15 mm long, inner ones 20 - 22 mm long, reflexed at apex; filaments white, 5 - 10 mm long. Carpels 14 - 20, each with 40 - 80 ovules on adaxial double placentas; styles flattened, oblanceolate to linear-lanceolate, 18 - 25 mm long, spreading, white. Pseudocarps yellowish green, globular with enclosed sepals, 10 - 12 cm in diam.; fruiting carpels ca 3.5 x 1.5 cm, each with 5 seeds embedded in pulp. Seeds reniform, compressed, ca 6 x 4 mm, reddish, becoming black, echinate with ca 2 mm long hairs along margin.

Fl. May - Aug.; *Fr.* Sept. - Feb.

Distrib. India: Tropical and subtropical regions, up to 800 m in N.E. region, Gangetic plains, Central India and Western Ghats. Uttar Pradesh, Bihar, West Bengal, Assam, Meghalaya, Orissa, Madhya Pradesh, Maharashtra, Andhra Pradesh, Karnataka, Tamil Nadu and Kerala.

Sri Lanka, Bangladesh, Myanmar, Thailand, Cambodia, Vietnam to Malesia.

5. *Dillenia pentagyna* Roxb., Pl. Corom. 1: 21, t.20. 1795; Hook. f. & Thomson in Fl. Brit. India 1: 38. 1872.

Asm.: *Akshi*; Beng.: *Karkotta*; Hindi: *Kallai*; Kan.: *Kadukanigala*, *Kanigala*; Mal.: *Kodapunna*, *Naithekkku*, *Punna*; Nep.: *Tatri*; Or.: *Rai*; Tam.: *Naitekku*; Tel.: *Chinnakalinga*, *Raduvana*.

Deciduous trees, 10 - 15 (-25) m tall. Leaves oblong-lanceolate, oblong-obovate, obtuse or cuneate at base, obtuse at apex, nearly entire to dentate along margins, 20 - 50 x 10 - 20 m; leaves on young plants much larger; lateral nerves 25 - 50 pairs, parallel, pubescent on nerves; petioles 1.5 - 5 cm long, with persistent wing-like stipules. Flowers 2 - 7, umbellate on short up to 3 mm long leafless shoots, yellow, fragrant, 2.5 - 3 cm across; pedicels 2.5 - 6 cm long; bracts hairy. Sepals 5, orbicular, elliptic, 8 - 12 mm long, brown, thick, accrescent. Petals 5, obovate, 15 - 20 mm long, bright yellow. Stamens in 2 series; outer series with 60 - 90 stamens, each 2.5 - 4 mm long; inner series with up to 10

stamens, each 6 - 9 mm long with reflexed apex in bud. Carpels 5 (-6), arranged on narrow conical receptacle, unilocular, oblong-lanceolate, 3.5 - 4 x ca 1.4 mm; styles ca 4 mm long. Fruits drooping, subglobose, ca 15 x 13 mm, indehiscent, fleshy, yellow, orange or red, 1(-2)-seeded. Seeds ovoid, ca 5 x 3.5 mm, black, glabrous, exarillate.

Fl. Jan. - May; *Fr.* March - June.

Distrib. India: Tropical and subtropical regions, up to 900 m in E. Himalayas, N.E. regions, Gangetic plains, Deccan and W. Ghats. Uttar Pradesh, Bihar, West Bengal, Sikkim, Assam, Meghalaya, Orissa, Madhya Pradesh, Maharashtra, Goa, Andhra Pradesh, Karnataka, Kerala and Andaman & Nicobar Islands.

Myanmar, China, Vietnam, Thailand, Java, Celebes and Lesser Sunda Islands.

6. *Dillenia retusa* Thunb. in Trans. Linn. Soc. 1: 200, t. 19. 1791; Hook. f. & Thomson in Fl. Brit. India 1: 37. 1872.

Evergreen trees, up to 20 m tall. Leaves obovate, obtuse to retuse at apex, 10 - 20 x 7 - 11 cm, glabrous above, strigose on nerves beneath; petioles 1.3 - 2.2 cm. Flowers 6 - 8 cm across, few, in racemes; pedicels 1 - 3 cm long, without bracteoles. Inner 3 sepals larger, orbicular to ovate, ca 2 x 2 cm, silky hairy outside. Petals obovate. Outer stamens 6 - 7 mm long; inner ones ca 1 cm long, with reflexed apices. Carpels 5 - 6, each with 22 - 34 ovules in 2 rows; styles 7 - 8 cm long. Fruits subglobose, 2 - 3 cm across, enclosed in persistent enlarged thickened sepals, orange in colour. Seeds many, ovoid, ca 3 x 2 mm, exarillate.

Fl. & Fr. April - Sept.

Distrib. India: Karnataka and Tamil Nadu.

Sri Lanka.

7. *Dillenia scabrella* Roxb. ex Wallich, Pl. As. Rar. 1: 20, t. 22. 1830; Hook. f. & Thomson in Fl. Brit. India 1: 38. 1872.

Asm.: *Banji-ou*, *Daine-oksi*; *Beng.:* *Hargeza*.

Deciduous trees, up to 30 tall. Leaves ovate to narrowly obovate, obtuse to acute at apex, more or less dentate along margins, 15 - 30 x 6 - 14 cm, more or less scabrid above, strigose on nerves beneath; lateral nerves 35 - 45 pairs; petioles 2.5 - 6 cm long. Sepals ovate. Petals ca 2.5 x 1 cm, bright yellow. Outer stamens 4 - 5 mm long, inner ones 9 - 10 mm long, with reflexed apices. Carpels 5 - 7, glabrous, each with 8 - 10 ovules; styles recurved to spreading, ca 8 mm long. Fruits orange in colour, ca 24 mm across with enclosed sepals. Seeds obovoid, ca 5 x 3.5 mm, glossy black, glabrous.

Fl. & Fr. Jan. - July.

Distrib. India: N.E. regions. Assam and Meghalaya.

Nepal, Myanmar, Laos, Cambodia and Vietnam.

3. *Tetracera* L.

Shrubs, lianas or sometimes stragglers with flexuous branches. Leaves simple, often scabrid; petiole short, furrowed. Inflorescence few- to many-flowered panicles, terminal or axillary. Flowers fragrant, actinomorphic, bisexual, often with bracts. Sepals 4 - 5, rarely up to 15, imbricate, persistent, often reflexed in fruit. Petals 3 - 5, white or reddish white, emarginate at apex, caducous. Stamens numerous, subequal; filaments free, broadened at apex with broad connectives; anther-thecae downwardly divergent. Carpels 2 - 4 or solitary, free, each with a short straight style and 4 - 10 ovules in a single row. Fruiting carpels follicular, 1 - 4, ovoid to globose, each with a short beak, 1 - 2-seeded, coriaceous, dehiscing by longitudinal slits into 2 halves. Seeds glossy, dark brown or blackish, fleshy, fimbriate or lacinate.

China, S. & S.E. Asia to Australia, Africa and America; ca 40 species, 4 in India.

Literature. HOOGLAND, R. D. (1953) The genus *Tetracera* (Dilleniaceae) in the eastern Old World. *Reinwardtia* 2: 185 -224, ff. 1 - 10.

KEY TO THE SPECIES

- | | |
|---|--|
| 1a. Inflorescence up to 12-flowered, without leaves at base; carpels 2 - 4 | 2 |
| b. Inflorescence 30 or more flowered, with 1 - 5 small leaves at base; carpel 1, rarely 2 | 3 |
| 2a. Sepals glabrous outside, sericeous inside, except the margins | 1. <i>T. akara</i> |
| b. Sepals glabrous | 2. <i>T. indica</i> |
| 3a. Follicles glabrous | 3. <i>T. sarmentosa</i> subsp. <i>andamanica</i> |
| b. Follicles hirsute | 4. <i>T. scandens</i> |

1. *Tetracera akara* (Burm. f.) Merr. in Philip. J. Sci. 19: 366. 1921. *Calophyllum akara* Burm. f., Fl. Ind. 121. 1768. *T. laevis* auct. non Vahl; Hook. f. & Thomson in Fl. Brit. India 1: 31. 1872.

Mal.: *Akara-patsjoti*.

Large lianas, up to 25 m long, creeping or climbing; stems up to 6 cm thick. Leaves elliptic-lanceolate, acute to acuminate at apex, entire or slightly undulate or dentate with mucronate teeth along margins, 6 - 15 x 3 - 8 cm, glabrous, coriaceous, glossy green above; lateral nerves 6 - 10 pairs; petioles 5 - 8 mm long. Flowers white, turning maroon when

old, 2.5 - 3 cm across, usually 5 - 8, in axillary or terminal, up to 8 cm long panicles; peduncles 5 - 20 mm long; pedicels 10 - 25 mm long; bracts lanceolate, acute, ca 2 x 1 mm; bracteoles lanceolate, ca 1 x 0.5 mm. Sepals 4, 8 - 10 x 6 - 8 mm, often reflexed in fruit, green or reddish green, glabrous outside, densely whitish yellow sericeous inside, ciliate along margins. Petals 3 - 4, 12 - 15 x 6 - 8 mm, white or greenish white. Stamens ca 230, yellowish white with grey tips, 7 - 8 mm long; filaments yellowish white at base, grey at tip. Carpels 3 (-4), glabrous, ca 1.5 x 1 mm, with ca 5 mm long style; each with 10 ovules. Follicles almost globose, ca 10 mm across, with 1 - 3 mm long beak, glabrous. Seeds ovoid, ca 2 x 3 mm, glossy black; aril ca 6 mm long, fimbriate.

Fl. Dec - May; *Fr.* Jan. - July.

Distrib. India: Partially shaded places in tropical evergreen lowland moist forests, up to 750 m. Kerala.

Sri Lanka, Cambodia, Malaysia, Java, Borneo and Celebes.

2. *Tetracera indica* (Houtt. ex Christm. & Panz.) Merr., *Interpr. Rumph. Herb. Amboin.* 367. 1917. *Assa indica* Houtt. ex Christm. & Panz., *Pfl. Syst.* 4: 40, t. 26. 1779. *T. assa* DC., *Syst.* 1: 402. 1818; Hook. f. & Thomson in *Fl. Brit. India* 1: 31. 1872.

Shrubs or lianas, up to 5 m tall. Leaves elliptic to oblong or obovate, 5 - 12 x 3 - 6 cm, slightly glossy above. Flowers usually 4 - 7, in terminal panicles on short branches. Sepals 4, 8 - 10 x 7 - 9 mm. Petals 3 - 5, usually 4, reddish white. Stamens 6 - 8 mm long. Carpels with a few stiff hairs on the back. Follicles globose, ca 10 mm across with 2 - 6 mm long beaks. Seeds ca 3.5 x 2.5 mm; aril finely fimbriate.

Fl. & Fr. Feb. - Oct.

Distrib. India: N.E. region. Assam.

China, Myanmar, Cambodia, Vietnam, Thailand, Malaysia, Java and Sumatra.

3. *Tetracera sarmentosa* (L.) Vahl subsp. *andamanica* (Hoogl.) Hoogl. in *Blumea* 9: 588. 1959. *T. asiatica* (Lour.) Hoogl. subsp. *andamanica* Hoogl. in *Fl. Males.* I, 4: 144. 1951, cum descr. angl. *Delima sarmentosa* L. var. *glabra* Hook. f. & Thomson in *Fl. Brit. India* 1: 31. 1872. Fig. 23.

! Shrubs, up to 3 m tall, or lianas, up to 6 m long, much branched; young branches and inflorescences strigose with sparse or dense divergent tufts of 3 - 12 hairs. Leaves elliptic, obovate or oblong, rounded or cuneate at base, acute to obtuse at apex, subentire or shallowly serrate in upper part, 5 - 12 x 2 - 6 cm, sparsely stigose on nerves and midrib beneath; lateral nerves 10 - 14 pairs, scabrid with minute papillose hairs on both surfaces, sparsely hirsute between nerves above and on nerves beneath; petioles 1 - 2 cm long.



Fig. 23. *Tetracera sarmentosa* (L.) Vahl subsp. *andamanica* (Hoogl.) Hoogl. : a. twig with flowers; b. stamen; c. carpel; d. follicle; e. seed with aril.

Flowers 7 - 10 mm across; pedicels 2 - 7 mm long. Sepals 5, broadly elliptic, outer 2 ca 2 x 1.5 mm, inner 3 ca 4 x 3 mm, hirsute outside. Petals 3, white or yellowish white, obovate, 3 - 4 x 2 - 3 mm. Stamens 100 - 125, each 3 - 4 mm long. Carpels ovoid, ca 2 x 1.5 mm; style ca 3 mm long. Follicles ovoid, 6 - 10 x 5 - 6 mm, with 2 - 5 mm long beaks, glossy purplish, 1(-2)-seeded. Seeds ovoid, ca 4 x 3 mm, black; aril pale, up to 5 mm long, fimbriate above.

Fl. May - Oct.; *Fr.* June - Feb.

Distrib. India: West Bengal, Sikkim, Assam, Meghalaya, Nagaland and Andaman & Nicobar Islands.

Myanmar and Malaysia.

4. *Tetracera scandens* (L.) Merr., Interpr. Rumph. Herb. Amboin. 365. 1917. *Tragia scandens* L. in Stickm., Herb. Amboin. 18. 1754. *Delima sarmentosa* L. var. *hebecarpa* (DC.) Hook. f. & Thomson in Fl. Brit. India 1: 31. 1872. *D. hebecarpa* DC., Prodr. 1: 70. 1824.

Shrubs, up to 2 m tall, or lianas, up to 30 m long. Leaves oblong to obovate, 6 - 15 x 3 - 7 cm. Flowers up to 200, in terminal panicles. Sepals 4, sometimes 5, ca 3 x 2 mm, scabrid-strigose outside, ciliate along margins. Petals 3, each 3 - 5 x 2 - 3.5 mm, white, yellowish or reddish white. Stamens 65 - 80, each ca 3 mm long. Carpels densely hairy. Follicles ca 10 x 6 mm, with 1 - 3 mm long beaks, 1 - 2-seeded. Seeds ca 4 x 3 mm, glossy black; aril 2 - 3 mm long, fimbriate.

Fl. & Fr. March - April.

Distrib. India: Andaman & Nicobar Islands.

China and Malaysia.

Notes. Though no specimen is available in CAL, Hoogland (l.c.) has reported its occurrence in the above islands. The two specimens (*Lobb* 133) at CAL represent the collection made by Lobb in March 1868 from plants cultivated in the Botanic Garden, Howrah. One of them is flowering and the other early fruiting. The source of this introduction seems to be from Singapore, Malaysia (*Lobb* s. n. in K), on behalf of the firm James Veitch & Sons.

EXCLUDED SPECIES

1. *Dillenia mansonii* (Gage) Hoogl. in Blumea 7: 83. 1952. *Wormia mansonii* Gage in J. Asiat. Soc. Beng. 2 (n.s.): 73. 1906.

Distrib. India: Assam.

Notes. Hoogland (l.c.) remarked on a specimen from Assam (*Masters* 1737, July 1845 in CAL) as follows: "The specimen is sterile and referred here with doubt."

2. *Dillenia repanda* Roxb., Fl. Ind. 2: 652. 1832.

According to Hoogland (l.c.) this species described from Deccan peninsula has insufficient description and no type. Perhaps, this could be a variant of *D. bracteata* Wight.

MAGNOLIACEAE

(D.C.S. Raju)

Trees or shrubs, glabrous, rarely hairy, aromatic. Leaves spirally arranged, simple, entire or sometimes lobed, penninerved, evergreen or deciduous; stipules large, enclosing the young buds, later caducous, leaving a scar on the nodes of branches, sometimes adnate to the petiole and leaving a scar on the upper surface of petiole. Flowers solitary, usually bisexual, very rarely unisexual, large, terminal or pseudo-axillary; the parts hypogynous; peduncles bearing one or more spathaceous caducous bracts, leaving annular scars. Perianth spirally arranged or in one whorl of sepals and 2 - 4 whorls of petals, usually 3-merous or rarely 5-merous; segments usually 9 or more, rarely fewer, homochlamydous or heterochlamydous, generally white or red, mostly fragrant. Stamens numerous, spirally arranged, free, sometimes not differentiated into anther and filament; staminodes absent; anthers linear or oblong, 2-locular, dehiscing introrsely or rarely extrorsely; connective usually apically produced. Gynoecium sessile or stipitate; carpels numerous, rarely few and sometimes reduced to 2, spirally arranged on an elongated axis; stigma ventrally decurrent; ovules 2 to several, biseriate on ventral suture, bitegmic, crassinucellar, anatropous. Fruiting carpels apocarpous or sometimes syncarpous, consisting of follicles on elongated axis, mostly dry, rarely fleshy, dehiscent by dorsal and/or ventral suture, or indehiscent, rarely samaroid. Seeds large, with elongate funicle, usually with an outer stomate ariloid sarcotesta and inner woody integument; endosperm copious, oily, fleshy; embryo minute; cotyledons hardly differentiated.

Temperate, subtropical and tropical regions of S.E. Asia, from Himalayas to Japan and Malesia, Eastern U.S.A., West Indies, C. America and E. Brazil; 10 genera and ca 225 species, 3 genera and 24 species in India.

Notes. The family has disjunct distribution in Indian subcontinent. Most of the species are found in N.E. India, including E. Himalayas and one species endemic to Nilgiris in South India. *Michelia champaca* L. and *Magnolia grandiflora* L. are cultivated near places of worship and in gardens, respectively.

Literature. AGABABIN, V. S. (1972) Pollen morphology of the family Magnoliaceae. Grana 12(3): 166 - 176. BHANDARI, N. N. (1971) Embryology of the Magnoliales and comments on their relationships. J. Arn. Arb. 52: 1 - 39, 285 - 304. BARANOVA, M. (1972) Systematic anatomy of the leaf epidermis in the Magnoliaceae and some related families. Taxon 21: 447 - 469. CANRIGHT, J. E. (1952) The comparative morphology and relationships of the Magnoliaceae. I. Trends of specialization in the stamens. Amer. J. Bot. 39: 484 - 497. CANRIGHT, J. E. (1953) The comparative morphology and relationships of the Magnoliaceae. II. Significance of pollen. Phytomorphology 3: 355 - 365. CANRIGHT, J. E. (1955) The

comparative morphology and relationships of Magnoliaceae. IV. Wood and nodal anatomy. *J. Arn. Arb.* 36: 119 - 140. CANRIGHT, J. E. (1963) Contributions of pollen morphology to the phylogeny of some ranalean families. *Grana* 4: 64 - 72. DANDY, J. E. (1927) The genera of Magnoliaceae. *Kew Bull.* 1927: 257 - 264. GOLDBLATT, P. (1974) A contribution to the knowledge of cytology in Magnoliales. *J. Arn. Arb.* 55: 453 - 457. GOOD, R. (1925) The past and present distribution of the Magnoliaceae. *Ann. Bot.* 39: 409 - 430. HAYASHI, Y. (1960) On the microsporogenesis and pollen morphology in Magnoliaceae. *Sci. Rep. Tohoku Univ.* IV (26.1): 45 - 52. JANAKI AMMAL, E. K. (1952) The race history of Magnolias. *J. Gen. Pl. Breed.* 12: 82 - 92. KENG, H. (1978) The delimitation of the genus *Magnolia* (Magnoliaceae). *Gard. Bull. Sing.* 31: 127 - 131. KING, G. (1891) The Magnoliaceae of British India. *Ann. R. Bot. Gard. Calc.* 3: 197 - 226. LEPPIK, E. E. (1975) Morphogenic stagnation in the evolution of *Magnolia* flowers. *Phytomorphology* 25: 451 - 464. NOOTEBOOM, H. P. (1988) Magnoliaceae. In: *Fl. Males.* I, 10: 561 - 605. PALIWAL, G.S. & N.N. BHANDARI (1962) Stomatal development in some Magnoliaceae. *Phytomorphology* 12: 409 - 412. PANT, D. D. & K. L. GUPTA (1966) Development of stomata and foliar structure of some Magnoliaceae. *J. Linn. Soc. Bot.* 59: 265 - 277. TUCKER, S. C. (1977) Foliar sclereids in the Magnoliaceae. *Bot. J. Linn. Soc.* 75: 325 - 356. WHITAKER, T. W. (1933) Chromosome number and relationships in the Magnoliales. *J. Arn. Arb.* 14: 376 - 385.

KEY TO THE GENERA

- | | |
|---|-----------------------|
| 1a. Flowers usually axillary; gynoecium stipitate | 2. <i>Michella</i> |
| b. Flowers usually terminal; gynoecium sessile | 2 |
| 2a. Stipules free from petiole, deciduous; perianth yellow; fruit a woody loculicidal capsule, composed of 2 - 8 concrescent carpels | 3. <i>Pachylarnax</i> |
| b. Stipules mostly adnate to the petiole, usually persistent; perianth white or reddish pink; fruit not capsular, composed of 20 - many free carpel | 1. <i>Magnolia</i> |

1. *Magnolia* L.

Trees or shrubs. Stipules adnate to or free from the petiole. Leaves simple, alternate, entire. Flowers terminal, usually solitary, bisexual. Perianth parts 9 - 21, usually 3 - 5-merous, subequal or the outer ones small and sepaloid. Anthers dehiscing introrsely or latrorsely; connective usually produced. Gynoecium sessile; carpels numerous or few, free or united at base; ovules usually 2 or rarely more. Fruiting carpels few. crowded, dehiscing along dorsal or ventral suture, sometimes woody and circumscissile, the upper portion falling away singly or in masses, with seeds remaining attached to a silky cord.

Tropical and subtropical regions of Asia from E. Himalayas to S. China, Malesia, S.E. North America, Mexico, West Indies and S. America; ca 120 species, 11 species in India.

Notes. The genus as circumscribed here includes the genera *Talauma* Juss. and *Manglietia* Blume.

Magnolia grandiflora L. is commonly cultivated, particularly in gardens of hill stations.

The funicle of the seeds lengthen by the uncoiling of the spiral vessels.

Literature. DANDY, J. E. (1950) A survey of the genus *Magnolia* together with *Manglietia* and *Michelia*. In: *Camellias and Magnolias*, Reb. Cont. 1950: 64 - 81. KENG, H. (1978) The delimitation of the genus *Magnolia* (Magnoliaceae). *Gard. Bull. Singapore* 31(2): 127 - 131.

KEY TO THE SPECIES

- | | |
|---|--------------------------|
| 1a. Petals variously coloured | 2 |
| b. Petals always white | 5 |
| 2a. Flowers yellow | 3 |
| b. Flowers pink or red | 4 |
| 3a. Leaves large, ca 60 x 12 cm; petals 6 | 5. <i>M. griffithii</i> |
| b. Leaves small, ca 15 x 6 cm; petals 9 | 8. <i>M. hookeri</i> |
| 4a. Leaves tomentose beneath; petals pink; connective produced | 2. <i>M. campbellii</i> |
| b. Leaves glabrous; petals red; connective produced | 7. <i>M. hodgsonii</i> |
| 5a. Perianth parts usually 12 | 6 |
| b. Perianth parts never more than 9 | 7 |
| 6a. Flowers not fragrant; sepals reflexed; connected not produced | 11. <i>M. rabaniana</i> |
| b. Flowers fragrant; sepals not reflexed; connective produced | 9. <i>M. insignis</i> |
| 7a. Leaves ovate; fruits small | 4. <i>M. globosa</i> |
| b. Leaves elliptic-oblong; fruits large | 8 |
| 8a. Petioles long; flowers large | 10. <i>M. pterocarpa</i> |
| b. Petioles short; flowers small | 9 |
| 9a. Lamina glabrous; fruits club-shaped | 6. <i>M. gustavii</i> |
| b. Lamina tomentose on ventral surface; fruits globose | 10 |
| 10a. Sepals red; stamens few | 3. <i>M. caveana</i> |
| b. Sepals green; stamens many | 1. <i>M. andamanica</i> |

1. *Magnolia andamanica* (King) Raju & Nayar in *Indian J. Bot.* 3: 171. 1980.
Talauma andamanica King in *J. Asiat. Soc. Beng.* 58: 372. 1890; C.E. Parkinson, *For. Fl. Andaman Isl.* 73. 1923.

Large shrubs or small trees, up to 4 m high; branchlets glabrous. Leaves oblong-lanceolate, narrowed at base, acuminate at apex, 17 - 36 x 6 - 13 cm, subcoriaceous, dark green, glabrous, glossy above; lateral nerves 10 - 15 pairs; petioles up to 2.5 cm long, pubescent. Flowers solitary, terminal, fragrant, ca 6 cm across; peduncles up to 2.5 cm long. Sepals 3, concave, pinkish purple. Petals 6, ovate or obovate. Stamens ca 60, each ca 13 mm long, oblong. Carpels ca 50, rhomboid. Fruits globose. Seeds ca 1 cm across.

Fl. & Fr. Apr. - Dec.

Distrib. India: Andaman Islands.

Myanmar.

2. *Magnolia campbelli* Hook. f. & Thomson, Fl. Ind. 77. 1855 & in Fl. Brit. India 1: 41. 1872.

Asm.: *Lal-champ*; Nep.: *Goge-champ*, *Lal-champ*.

Trees, up to 45 m high, deciduous. Leaves unfolding after flowers, elliptic-oblong, subobovate to ovate, cordate-rounded at base, acute or acuminate at apex, 20 - 30 x 8 - 14 cm, glaucous pubescent or silky beneath; lateral nerves 14 - 16 pairs; petioles ca 3.5 cm long, pilose; stipules pilose; stipular scars 5 - 7 mm. Flowers appearing before leaves, solitary, terminal, erect, ca 15 cm across; bracts large, spathaceous, enclosing the buds, ovate to obovate, ca 5 x 4 cm, covered with golden yellow tomentum, caducous. Perianth parts 12 - 16, obovate, 9 - 11 x ca 5 cm; outer ones yellow, inner ones white with purple or pink at base. Stamens numerous, free, purplish; filaments short, ca 6 mm long; anthers up to 2.5 cm long; connectives produced into an appendage. Carpels numerous, sessile, exserted above the stamens, purplish, ovoid, with a stigmatic crest set with papillae. Fruiting receptacle cylindrical, ca 15 x 3 cm; ripe carpels obovoid, laterally compressed, ca 1.5 x 1 cm. Seeds 2, compressed, obovoid, ca 8 x 5 mm.

Fl. & Fr. Feb. - Oct.

Distrib. India: E. Himalayas, broad-leaved forests, 1000 - 3000 m. Sikkim, Arunachal Pradesh and Manipur.

Myanmar and China (Tibet).

Notes. This species and its many cultivars are valued as ornamental and often cultivated on hills of Tamil Nadu.

3. *Magnolia caveana* (Hook. f. & Thomson) Raju & Nayar in Indian J. Bot. 3: 170. 1980. *Manglietia caveana* Hook. f. & Thomson, Fl. Ind. 76. 1855 & in Fl. Brit. India 1: 42. 1872.

Asm.: *Pana-sopa*, *Phul-sopa*; Kh.: *Larsaj-kyntheri*.

Large trees; trunks ca 3 m in circumference at breast height. Leaves oblong-elliptic or ovate-oblong, rounded or obtuse at base, obtuse or mucronate at apex, 10 - 22 x 5 - 9 cm, coriaceous, shiny above, glaucous beneath; lateral nerves 10 - 15 pairs; petioles 3 - 5 cm long; stipules very sparingly rusty silky pubescent. Flowers 10 - 15 cm across, white, fragrant. Sepals 3, dull red with green veins, 5 - 7.5 cm long. Petals 9, gradually narrower inwards, white, fleshy. Stamens ca 30, ca 1 cm long, narrow, finely pointed. Carpels

numerous, congested, each with 6 ovules. Fruit ovoid, ca 6 x 4.5 cm; ripe carpels dehiscent along dorsal suture. Seeds red, ca 2 cm long.

Fl. & Fr. March - July.

Distrib. India: N.E. India, up to 900 m. Arunachal Pradesh, Assam, Nagaland and Meghalaya.

Endemic.

4. *Magnolia globosa* Hook. f. & Thomson, Fl. Ind. 77. 1855 & in Fl. Brit. India 1: 40. 1872.

Nep: *Kokre-champ*.

Small trees; branches brown; young branches tomentose, old ones glabrous. Leaves ovate-elliptic, rounded or obtuse at base, acute and shortly mucronate at apex, 12.5 x 7.5 - 15 cm, subcoriaceous, glaucous and brownish tomentose on nerves beneath; lateral nerves ca 8 pairs; petioles 1.5 - 4 cm long; stipular scar about as long as petiole. Flower buds globose, appearing with leaves, ca 3.5 cm across; flowers pendulous, 12 - 15 cm across, white or cream-coloured, odorous. Perianth parts ca 9, broadly obovate, ca 6 x 4 cm. Stamens numerous, crimson-coloured; filaments ca 3 mm long; anthers oblong, truncate at apex, ca 1 cm long. Gynoecium ellipsoid, ca 2 x 1 cm. Fruiting receptacle 3 - 5.5 x 2 cm; ripe carpels 12 - 20, elliptic-ovoid, compressed, angular, rounded at base, ca 2 mm long beaked at apex, 1 - 1.5 x 0.7 cm, dorsally dehiscent. Seeds 2, rounded at base.

Fl. & Fr. May - Aug.

Distrib. India: E. Himalayas, broad-leaved forests. 2300 - 3200 m. West Bengal, Sikkim and Arunachal Pradesh.

Nepal, Bhutan and S.W. China.

Notes. Cultivated as an ornamental tree in temperate gardens.

5. *Magnolia griffithii* Hook. f. & Thomson, Fl. Ind. 77. 1855 & in Fl. Brit. India 1: 41. 1872. *Michelia griffithii* (Hook. f. & Thomson) Finet & Gagnepain in Mem. Soc. Bot. France 1(4): 42. 1906. *Magnolia pealiana* King in Ann. R. Bot. Gard. Calc. 210, t. 59. 1891.

Asm.: *Bar-gahori-sopa, Gahoni-sopa, Gauri-sopa, Kala-sopa, Pan-sopa*; *Naga:* *Lakap*.

Evergreen trees, ca 30 m tall; young branchlets thickly rusty-pilose. Leaves oblong to elliptic, cuneate at base, acute at apex, 15 - 35 x 10 - 15 cm, glabrous above, densely felted tomentose beneath; lateral nerves 20 - 28 pairs; petioles ca 1.2 cm long. Flower buds ca 5 cm long, enclosed in silky bracts; flowers 8 - 14 cm across, pale white to yellow, slightly fragrant; peduncles 2.5 - 3.5 cm long. Sepals 3. Petals 6. Stamens many. Carpels many, ca 3 mm long; styles slender and slightly recurved. Fruiting receptacle 12.5 - 25 cm long; seeds 1 - 2 in each carpel, reddish brown.

Fl. & Fr. March - Sept.

Distrib. India: E. Himalayas and N.E. India. Arunachal Pradesh and Assam.

Bangladesh and Myanmar.

6. *Magnolia gustavii* King in Ann. R. Bot. Gard. Calc. 3: 209, t. 61. 1891; Raju in J. Assam Sci. Soc. 8: 23. 1965.

Asm.: *Khorakia-sopa*.

Evergreen trees, 20 - 30 m tall. Leaves elliptic-lanceolate, acute at both ends, 12 - 20 x 3 - 5 cm, chartaceous, quite glabrous; lateral nerves 14 - 16 pairs. Flower buds oblong-ovoid, ca 3.5 cm long; flowers solitary, 7.5 - 10 cm across; pedicels ca 4 cm long; bracts spathaceous, ovate. Sepals 3, lanceolate, membranous. Petals 6, coriaceous. Stamens ca 30; filaments short; anthers ca 1.4 cm long. Gynoecium oblong; carpels numerous, enclosed by stamens, ovoid, pubescent when young. Fruiting carpels oblong.

Fl. & Fr. May - Jan.

Distrib. India: Assam.

Endemic.

7. *Magnolia hodgsonii* (Hook. f. & Thomson) Keng in Gard. Bull. Singapore 31(2): 129. 1978. *Talauma hodgsonii* Hook. f. & Thomson, Fl. Ind. 74. 1855 & in Fl. Brit. India 1: 40. 1872. **Fig. 24.**

Asm.: *Boromthuri*, *Dat-bhola*; Kh.: *Dieng-soy-pydem*; Mikir: *Boromthari-arong*; Nep.: *Balu-kath*, *Chiuri*, *Hare*.

Evergreen trees, 8 - 18 m tall; branches few, spreading; bark grey, warty. Leaves oblanceolate to obovate-oblong, cuneate to acute at base, acuminate to rounded and suddenly apiculate at apex, 20 - 50 x 10 - 22.5 cm, thinly coriaceous, glabrous; lateral nerves 15 - 25 pairs, parallel, ridged beneath; petioles 2.5 - 7 cm long, terete, swollen at base, with stipular scars along the entire length. Flower buds subglobose or ovoid, 2.5 -

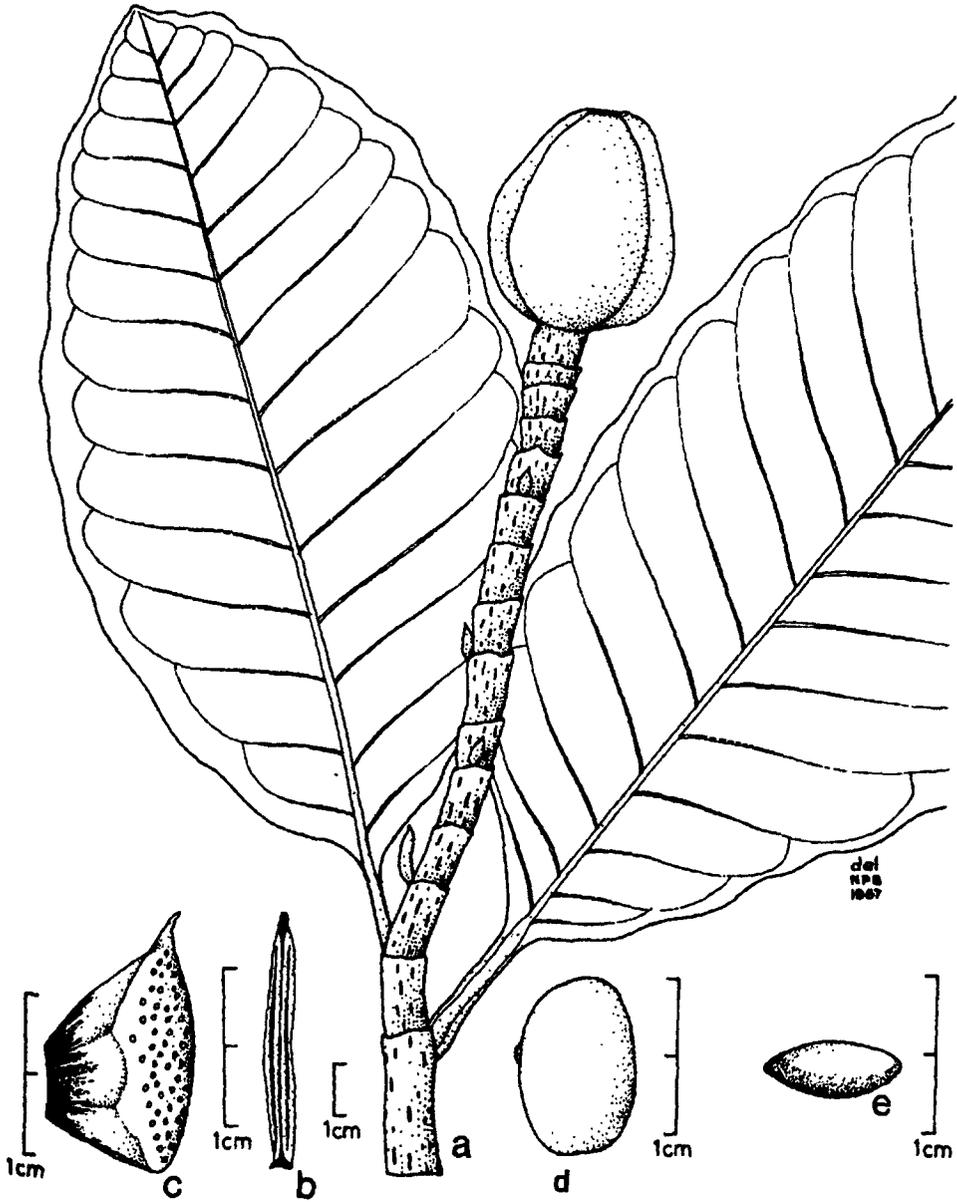


Fig. 24. *Magnolia hodgsonii* (Hook. f. & Thomson) Keng : a. twig with flower bud; b. stamen; c. follicle; d. seed, lateral view; e. seed, end view.

7.5 cm across; flowers white or pale pink, sweet-scented, never fully opening, 7 - 10 cm across. Sepals 3, oblong, obtuse, ca 3 x 2.5 cm, greenish white, fleshy. Petals 6 - 9, in 2 - 3 series, similar to sepals in shape, purplish and greenish white at base. Stamens sessile, linear-lanceolate, ca 1.5 cm long, ca 2.5 cm wide, yellowish, greyish velvety; connective produced beyond anthers, acute, glabrous. Carpels sessile, closely embracing and imbricating on gynophore, glabrous. Fruiting receptacles ovoid or ellipsoid, 10 - 15 cm long, 6 - 9 cm thick; ripe carpels ovoid, sharply beaked, 3 - 4 cm long, ca 1 cm broad; ca 6 mm thick, dehiscent on ventral suture, separating from the axis, leaving deep square pits and seeds suspended by elastic silky cords from the upper ends of the pits. Seeds 3 - 4 in each carpel, oblong, plano-convex, ca 9 mm long, ca 7 mm broad, ca 3 mm thick, red, shiny.

Fl. April - June; *Fr.* Aug.- Sept.

Distrib. India: Tropical and subtropical E. Himalayas and N.E. India, warm broad-leaved forests, up to 1000 m. West Bengal, Sikkim, Arunachal Pradesh, Assam and Meghalaya.

Nepal, Bhutan, Bangladesh and Myanmar.

8. *Magnolia hookeri* (Cubitt & Smith) Raju & Nayar in Indian J. Bot. 3: 171. 1980. *Manglietia hookeri* Cubitt & Smith in Rec. Bot. Surv. India 4: 273. 1913.

Asm.: *Pana-sopa*, *Phul-sopa*.

Large trees. Leaves elliptic or oblanceolate, acute at base, acuminate at apex, 15 - 20 x 2.5 - 6.2 cm, membranous or very thinly coriaceous, minutely ferruginous pubescent beneath when young, glabrous when mature; lateral nerves 10 - 14 pairs; petioles 2.5 - 6 cm long; stipules lanceolate, 5 - 7.5 cm long, brown silky outside. Flowers 12.5 - 15 cm across, fragrant. Sepals oblanceolate, 6 - 7.5 x 1.8 cm, green, tinged pink. Petals white, turning to pale yellow. Carpels ca 2 cm across, with 3 - 4 ovules. Fruits ovoid, 5 - 7.5 x 3 - 5 cm. Seeds 3 - 4 per carpel.

Fl. & Fr. March - July.

Distrib. India: N.E. India. Meghalaya and Manipur.

Myanmar.

9. *Magnolia insignis* Wallich, Tent. Fl. Nep. 3, t.1. 1824 & in Pl. Asiat. Rar. 2: 78, t. 182. 1832. *Manglietia insignis* (Wallich) Blume var. *latifolia* Hook. f. & Thomson and var. *angustifolia* Hook. f. & Thomson in Fl. Brit. India 1: 42. 1872. **Fig. 25.**

Asm.: *Pan-sopa*, *Phul-sopa*; *Kh.:* *Dieng-rhi-basaw*.

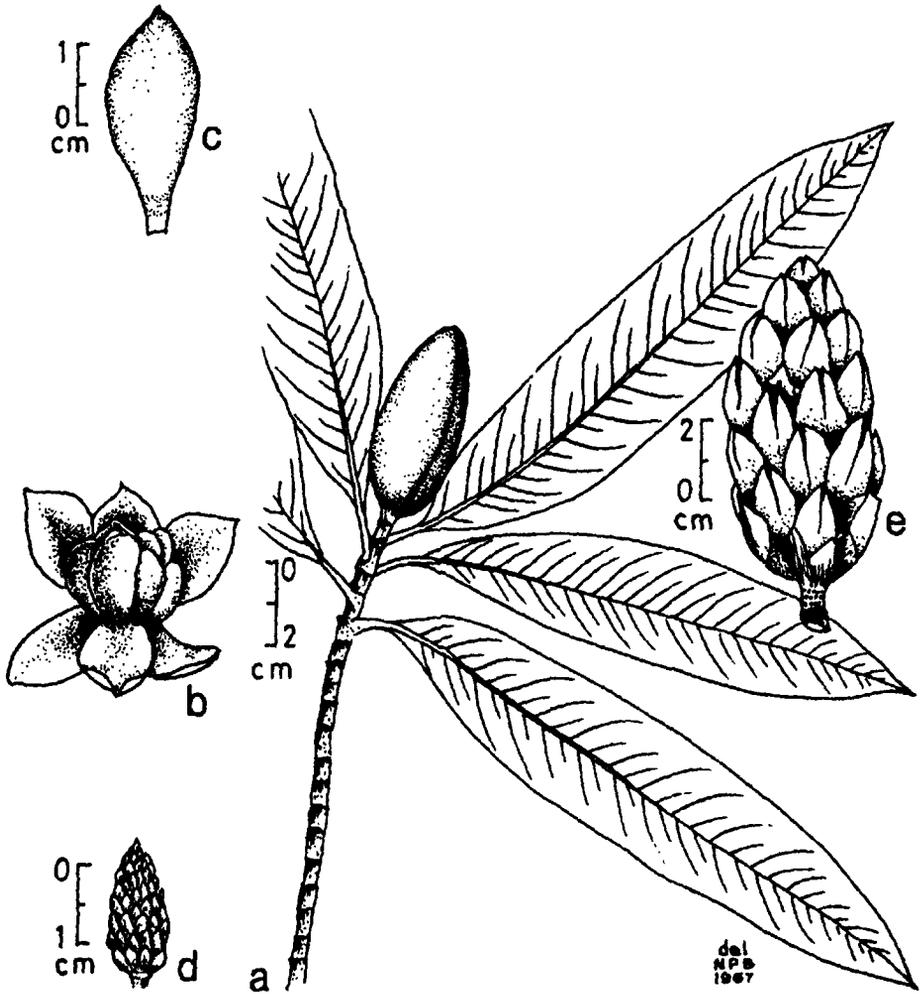


Fig. 25. *Magnolia insignis* Wallich: a. twig with bud; b. flower; c. petal; d. carpels; e. fruit.

Evergreen trees, 25 - 30 m tall. Leaves elliptic-lanceolate, cuneate at base, acute or acuminate at apex, 15 - 22.5 x 5 - 7.5 cm, coriaceous, glabrous, shiny above; lateral nerves 16 - 20 pairs, alternating with shorter ones, laxly reticulate; midrib raised beneath, grooved above; petioles 2.5 - 3.5 cm long. Flower buds ovoid to ellipsoid, 3 - 4 cm long, 1.5 - 2 cm thick; flowers 10 - 15 cm across, pale pink, fragrant. Sepals 3, subequal, obovate, cuneate at base, obtuse to subobtuse at apex, 4 - 6 x 2 - 4 cm, pink. Petals 9, white or pinkish, fleshy. Anthers sessile or nearly so at the base of the gynoecium; filaments linear, 8 - 10 mm long, yellow; connective produced into an acicular appendage. Gynoecium sessile; carpels ca 40 or more, imbricating, beaked; ovules 4 - 6 in each. Fruiting receptacle narrowly ovoid to subcylindric, 5 - 8 x 4 - 5 cm, bright purple when fresh; ripe carpels persistent on gynophore, woody, dorsally dehiscent. Seeds 4 - 6 in each, suspended by a silky cord, faceted, 5 - 6 x 3 - 4 mm, bright red.

Fl. May - July; *Fr.* Sept. - Jan.

Distrib. India: Subtropical and temperate E. Himalayas and N. E. India, from 400 to 1500 m. Sikkim, Assam, Manipur and Meghalaya.

Endemic.

Notes. Timber is good for cabinets.

10. *Magnolia pterocarpa* Roxb., Pl. Corom. 3: 62, t. 266. 1820. *Liriodendron grandiflorum* Roxb., Fl. Ind. 2: 654. 1832. *Magnolia sphenocarpa* Hook. f. & Thomson, Fl. Ind. 78. 1855 & in Fl. Brit. India 1: 41. 1872.

Kh.: *Dieng-soh-dkhar*; Nep.: *Patpate-champ*.

Evergreen trees, up to 30 m tall; branchlets pubescent when young. Leaves elliptic to obovate, attenuate at base, obtuse or subacute at apex, 18 - 35 x 9 - 18 cm, coriaceous, glabrous and shiny above, rusty tomentose beneath when young; lateral nerves 16 - 20 pairs; petioles 2 - 5 cm long, glabrous; stipules 10 - 12.5 cm long, greenish white, caducous; stipular scars about as long as petiole. Flower buds ovoid, 5 - 6 cm long; flowers white, fragrant, 12.5 - 15 cm across. Perianth parts 9, outer 3 sepaloid, 7.5 - 5 cm long, green outside, greenish white inside, coriaceous; inner 6 petaloid, dull white, thinner. Stamens numerous; filaments short; anthers ca 2 cm long, introrse. Gynoecium ovoid, ca 3.5 cm in diam. Fruiting receptacle ellipsoid, ca 15 x 7 cm; ripe carpels oblong, 2.5 - 4 x 1.3 cm, narrowed at apex into a flattened lanceolate ca 3.5 x 1 mm beak. Seeds 2, orange.

Fl. & Fr. April - Nov.

Distrib. India: E. Himalayas and N. E. India, up to 500 m. West Bengal, Sikkim, Assam and Meghalaya.

Myanmar.

Notes. Wood is used in making tea chests.

11. *Magnolia rabaniana* (Hook. f. & Thomson) Raju & Nayar in *Indian J. Bot.* 3: 171. 1980. *Talauma rabaniana* Hook. f. & Thomson, *Fl. Ind.* 74. 1855 & in *Fl. Brit. India* 1: 40. 1872.

Asm.: *Laimakhan-phang*; *Naga:* *Kobraichung*.

Trees, 20-25 m tall; branchlets tomentose when young. Leaves elliptic or oblanceolate, attenuate at base, shortly acuminate at apex, 20-35 x 5-10 cm, coriaceous, glabrous, shiny above; lateral nerves 12-24 pairs; petioles ca 2.5 cm long. Flowers solitary, terminal, 5-7.5 cm long, white; pedicels ca 2.5 cm long; bracts densely adpressed tomentose. Sepals 3, suborbicular, caducous. Petals 9, in 3 whorls, broadly elliptic-ovate; outer whorl reflexed, inner ones concave, smaller. Stamens numerous; filaments short; anthers oblong, ca 1.5 cm long. Gynoecium sessile; carpels ca 20. Fruiting carpels woody, dehiscent by ventral suture; pits shallow, rhomboidal.

Fl. & Fr. April - Oct.

Distrib. India: N. E. India. Assam and Meghalaya.

Endemic.

2. *Michelia* L.

Trees or shrubs, evergreen or deciduous. Stipules adnate to or free from petiole. Leaves spirally arranged, coriaceous, closely reticulate, glabrous or pubescent on nerves beneath; stipules adnate to or free from the petiole; petiole with a stipular scar or not. Flowers axillary or subaxillary on short small-leaved shoots or very rarely terminal, solitary or paired, bisexual, fragrant. Perianth parts 6-21 in 2 or more series, 3-6-merous, not differentiated into sepals and petals, mostly subequal. Stamens 20 or more, many-seriate, flat; anthers introrse or latrorse, dehiscing laterally or sublaterally; connective produced into an appendage. Gynoecium stipitate; carpels numerous or few, rarely one, usually free, sometimes concrescent; ovules 1-2 or rarely more in each carpel; style subulate, decurrent. Fruiting carpels free or rarely concrescent, laxly spaced on an elongate spike, dehiscing along dorsal suture or rarely tardily irregularly dehiscent with the fleshy carpels rotting away, leaving cartilaginous hook-like midribs, persistent on axis. Seeds 1 or more in each carpel, pendulous by a long elastic stalk.

Subtropical and temperate Asia from India, Sri Lanka, Bangladesh, Bhutan, Myanmar to China, Japan, Thailand and Malesia; ca 50 species, 12 species in India.

Notes. The genus as circumscribed here includes the genera *Alcimandra* Dandy and *Paramichelia* Hu.

Literature. HU, CHANG-CHIH (1940) *Paramichelia*, a new genus of Magnoliaceae. *Sunyatsenia* 4: 142 - 145.

KEY TO THE SPECIES

- | | |
|--|-------------------------|
| 1a. Perianth parts always more than 4 cm long | 2 |
| b. Perianth parts usually less than 4 cm long | 5 |
| 2a. Petioles glabrous; lamina of leaves ovate-lanceolate | 4. <i>M. doltsopa</i> |
| b. Petioles velutinous; lamina of leaves elliptic to lanceolate | 3 |
| 3a. Perianth parts always more than 12; filaments short | 11. <i>M. velutina</i> |
| b. Perianth parts usually 9 - 12; filaments up to 3 cm long | 4 |
| 4a. Leaves 9 - 13 x 4 - 5 cm; pedicels ca 2 cm long | 2. <i>M. cathcartii</i> |
| b. Leaves 15 x 3.7 cm; pedicels ca 6 mm long | 12. <i>M. wardii</i> |
| 5. Carpels few, never more than 5 | 5. <i>M. glabra</i> |
| b. Carpels many, always more than 5 | 6 |
| 6a. Leaves 4 - 6 cm broad, shiny above | 9. <i>M. oblonga</i> |
| b. Leaves less than 4 cm broad, not shiny above | 7 |
| 7a. Leaves ovate-lanceolate, all or for greater part widest below the middle; fruitlets oblong | 3. <i>M. champaca</i> |
| b. Leaves not ovate, for greater part widest above the middle; fruits roundish | 8 |
| 8a. Leaves quite glabrous; perianth parts linear-oblong | 6. <i>M. kisoa</i> |
| b. Leaves with indumentum on lower surface; perianth parts broadly ovate-oblong | 9 |
| 9a. Lamina of leaves more than 15 cm long | 10 |
| b. Lamina of leaves 10 - 15 cm long | 11 |
| 10a. Branchlets glabrous; leaves firmly coriaceous; perianth parts 9 | 7. <i>M. mannii</i> |
| b. Branchlets rusty tomentose; leaves membranous; perianth parts more than 15 | 1. <i>M. baillonii</i> |
| 11a. Branchlets brownish tomentose; leaves elliptic; species of W. Ghats of Pen. India | 8. <i>M. nilagrica</i> |
| b. Branchlets red-silky; leaves obovate; species of N.E. India | 10. <i>M. punduana</i> |

1. *Michelia baillonii* (Pierre) Finet & Gagnepain in *Mem. Soc. Bot. France* 1(4): 46. 1905. *Magnolia baillonii* Pierre, *Fl. For. Cochinch.* 1: t. 2. 1879. *Talauma phellocarpa* King in *Ann. R. Bot. Gard. Calc.* 3: 205, t. 47. 1891. *Paramichelia baillonii* (Pierre) Hu in *Sunyatsenia* 4: 144. 1940.

Large trees, up to 25 m tall; branches rusty pilose. Leaves lanceolate to oblong-elliptic, cuneate at base, acute to acuminate at apex, 15 - 20 x 5 - 7 cm, membranous, glabrous above, minutely pubescent on midrib beneath; petioles up to 3 cm long. Flower-buds ellipsoid, ca 2.5 x 0.5 cm; pedicels up to 1.5 cm long; bracts deltoid, spathaceous, 2 - 2.5 cm long. Perianth parts 15 - 18, white, outer few narrowly lanceolate, ca 2.2 x 0.5 cm. Stamens 7 - 8 mm long; connective produced above, apiculate. Carpels ca 30, densely covered with greyish hairs; stalk up to 5 - 6 mm long. Fruiting carpels

subcylindric, up to 10 cm long; seeds bright red.

Fl. & Fr. May - Nov.

Distrib. India: Assam.

Myanmar, S.W. China and Indo-china.

2. *Michelia cathcartii* Hook. f. & Thomson, *Fl. Ind.* 79. 1855 & in *Fl. Brit. India* 1: 42. 1872. *Alcimandra cathcartii* (Hook. f. & Thomson) Dandy in *Bull. Misc. Inf. Kew* 1927: 260. 1927.

Kh.: *Dieng-rai*; *Nep.*: *Tite-champ*.

Evergreen trees; bark dark grey; branches rusty tomentose when young. Leaves elliptic-lanceolate, cuneate or narrowly rounded at base, acute to acuminate at apex, 9 - 13 x 4 - 5 cm, chartaceous, shiny, glabrous above, pilose on midrib beneath; lateral nerves 10 - 15 pairs, slender, not conspicuous; petioles slender, up to 1 cm long, densely yellow hairy; stipules 1.5 - 2 cm long, densely silky hairy. Flowers terminal, creamy-white, reddish when dry, 7 - 10 cm across, fragrant; buds oblong, rounded at both ends; pedicels stout, ca 2 cm long. Perianth parts 9, outer ones obovoid, ca 4.5 x 1.5 cm, inner ones narrow. Stamens ca 40 or more; anthers up to 3 cm long; filaments short; connective produced into a spatulate ca 3 mm long appendage. Gynoecium stipitate, ca 7 mm long; carpels sessile, densely imbricate when young, ca 30 on a cylindrical column, ovoid, ca 3 x 2.5 mm; stigma recurved. Fruiting receptacles 7- 10 cm long; ripe carpels ovoid, suborbicular, compressed, ca 1 cm across, dehiscing by dorsal suture. Seeds 2 - 3.

Fl. & Fr. March - Aug.

Distrib. India: E. Himalayas and N.E. regions, evergreen oak forests, 1500 - 2200m. West Bengal, Sikkim, Nagaland and Meghalaya.

Myanmar and Vietnam.

Notes. Timber is useful for house building.

3. *Michelia champaca* L., *Sp. Pl.* 536. 1753; Hook. f. & Thomson in *Fl. Brit. India* 1: 42. 1872. *M. rheedii* Wight, *Illus.* 1: 14. 1840.

Asm.: *Tita-sopa*; *Beng. & Hindi*: *Champa*; *Kan.*: *Chembiga*; *Kh.*: *Shap, Tita-sopa*; *Mal.*: *Chembagam*; *Naga*: *Ching-kappa*; *Nep.*: *Aule-champ, Champ*; *Tam.*: *Chembagam*; *Tel.*: *Champakum*.

Evergreen trees, up to 25 m tall; bark thick, grey; young branches sericeous. Leaves ovate to elliptic-lanceolate, acute to cuneate at base, finely long-acuminate at apex, 8 - 25 x 4 - 10 cm, thinly coriaceous, shiny and glabrous above, minutely pubescent beneath, especially on midrib; lateral nerves 12 - 18 pairs; tertiaries finely reticulate in square or rectangular pattern; petioles up to 3 cm long, subglabrous; stipules adnate to the petiole, subglabrous, up to 3 cm long; stipular scars 1 - 2 cm long; leaf-buds lanceolate, ferruginous pubescent outside. Flowers axillary, rarely terminal, solitary, 3.5 - 6 cm across, pale yellow, becoming orange, fragrant; flower-buds ovoid; pedicels up to 1.5 cm long, minutely tomentose; bracts spathaceous, broadly ovate, ca 2.5 cm long, silky outside. Perianth parts 12 - 15, oblanceolate, oblong-lanceolate, ca 4 x 1 cm, gradually narrowed towards centre, fleshy. Stamens numerous, subclavate; filaments short; connective appendage ca 1 mm long; anthers up to 8 mm long. Gynoecium stipitate, 1.5 - 2 cm long, glabrous; carpels numerous, ovoid-oblong, 8 - 10 x 4 mm; stigmatic crest recurved, ca 2 mm long. Fruiting receptacles 8 - 15 cm long; ripe carpels woody, laxly arranged, ovoid to ellipsoid, 1 - 2 cm long, white-speckled. Seeds many, enclosed by fleshy red aril.

Fl. & Fr. March - July.

Distrib. India: Tropical and subtropical forests, up to 600 m, often planted near temples. Himachal Pradesh, Uttar Pradesh, Bihar, West Bengal, Sikkim, Arunachal Pradesh, Assam, Nagaland, Manipur, Mizoram, Tripura, Meghalaya and Orissa.

Nepal, Bhutan, Bangladesh, Myanmar, S.W. China to Malesia.

Notes. Heartwood is light olive-brown, very durable and useful for cabinet and building work, seasons and polishes very well.

Ornamental tree, often planted near temples.

4. *Michelia doltsopa* Buch.-Ham. ex DC., Syst. Nat. 1: 448. 1818 & Prodr. 1: 79. 1824. *Magnolia excelsa* Wallich, Tent. Fl. Nep. 5: t.2. 1824. *Michelia excelsa* (Wallich) Blume, Fl. Jav. 9. 1828; Hook. f. & Thomson in Fl. Brit. India 1: 43. 1872. *Michelia manipurensis* Watt ex Brandis, Indian Trees 8. 1905. *Michelia calcuttensis* Parment. in Bull. Soc. Fr. Belg. 27: 213, 282. 1896.

Asm.: *Sopa*; Kl.: *Dieng-rai*; Nep.: *Pulney-champ*, *Seto-champ*, *Rani-champ*.

Trees, 16 - 25 m tall, deciduous; bark dark grey, corky with irregular lines of thick lenticels; branchlets densely ferruginous tomentose; buds greyish-brown sericeous. Leaves ovate-lanceolate to elliptic, cuneate to slightly rounded at base, acute to acuminate at apex, 15 - 29 x 5 - 9 cm, thinly coriaceous, glabrous and shiny above, glaucous and minutely pubescent beneath; lateral nerves 7 - 10 pairs, arched; tertiaries closely reticulate; petioles 2 - 3 cm long, glabrous; stipules oblong-acuminate, 4 - 5 cm long, silky

outside; stipular scars 5 - 7 mm long. Flowers axillary, sometimes spuriously terminal, faintly scented, white, ca 10 - 13 cm across when fully open; buds lanceolate, apiculate, ca 3.5 cm long, silky outside; bracts 2, spathaceous, oblong-ovate, 4 - 6 x 2 - 3 cm; pedicels 4 - 8 mm long. Perianth parts 12, obovate to spatulate, 5 - 6 x 2 - 3.5 cm, white, outer ones larger, gradually narrower towards centre. Stamens 50 - 80, yellowish; filaments short; anthers up to 1 cm long; connective produced into short appendage. Gynoecium stipitate; stalk 5 - 8 mm long; carpels 40 - 60, ca 1.5 x 1 mm, minutely tomentose; ovules 2 - 4 in each carpel; style recurved. Fruiting receptacles elongate, up to 15 cm long; ripe carpels obliquely ovoid, slightly compressed, shortly beaked, ca 1.5 x 1 x 0.6 cm, ventrally dehiscent, lenticellate. Seeds 1 - 2, compressed, faceted, red, oily.

Fl. & Fr. March - Oct.

Distrib. India: E. and N.E. regions, evergreen subtropical forests, 1000 - 2500 m. West Bengal, Sikkim, Arunachal Pradesh, Manipur and Meghalaya.

Endemic.

Notes. The timber is remarkably durable and suitable for furniture and plankings.

5. *Michelia glabra* Parment. in Bull. Soc. Fr. Belg. 27: 214, 283. 1896. *Michelia kingii* Dandy in J. Bot. 66: 321. 1928. *Michelia montana* auct. non Blume; Kanjilal et al., Fl. Assam 1: 25. 1934.

Asm.: *Pan-sopa*.

Evergreen trees; bark grey, with horizontal wrinkles; branches glabrous. Leaves oblong-elliptic or obovate, cuneate at base, abruptly acuminate at apex, 10 - 18 x 4 - 8 cm, coriaceous, glabrous, shiny above; lateral nerves 8 - 12 pairs; petioles slender, thickened at base, up to 2 cm long, glabrous. Flowers axillary, solitary or sometimes 2 from a short peduncle, ca 4 cm across, white; pedicels slender, 2 - 2.5 cm long, pubescent; buds cylindrical; bracts caducous, leaving 3 - 4 annular scars at middle of pedicel. Perianth parts 9 or fewer, biseriate, oblong to oblanceolate, 2.5 x 0.6 cm. Stamens few; anthers up to 1 cm long. Gynoecium stipitate, glabrous; carpels 3 - 5, lax at anthesis. Fruiting carpels usually only one maturing, sessile or shortly stalked, ellipsoid to obovoid, 4 - 7 x 4.5 cm, lenticellate. Seeds 2 or 3, reddish brown, faceted, suspended by an elastic cord.

Fl. & Fr. Aug. - Nov.

Distrib. India: West Bengal, Sikkim, Assam and Meghalaya.

Bangladesh.

6. *Michelia kisopa* Buch.-Ham. ex DC., Syst. Nat. 1: 448. 1818; Hook. f. & Thomson in Fl. Brit. India 1: 44. 1872.

Nep.: *Cholsi*.

Deciduous trees, 10 - 20 m tall, glabrous, except for grey sericeous buds; bark plain, grey; branchlets lenticelled. Leaves ovate-elliptic, abruptly cuneate or rarely rounded at base, acute to gradually acuminate at apex, 12 - 23 x 3 - 10 cm, thinly coriaceous, glabrous on both surfaces, shiny above, dull beneath, turning yellow before falling; lateral nerves 10 - 15 pairs, slightly arched; reticulations fine and close; petioles 2 - 4 cm long; stipules oblong, ca 1.5 cm long, grey or rusty pubescent outside; stipular scars 1 - 2.5 cm long. Flowers axillary, short stalked, pale yellow, rarely white, 3 - 4 cm across, sweet-scented; buds ca 1.2 cm long; bracts 2, fleshy, grey pubescent outside. Perianth parts 12 - 15, obovate or oblanceolate, 2 - 3 x 0.7 cm, glabrous. Stamens shorter than gynoecium. Carpels silky hairy; styles recurved. Fruiting receptacles 5 - 10 cm long; ripe carpels sessile, ellipsoid, compressed, 8 - 10 x 7 - 8 mm, closely lenticellate. Seeds 3 - 4, large.

Fl. July - Sept.; *Fr.* Oct. - Jan.

Distrib. India: Subtropical forests, 1400 - 1800 m. Uttar Pradesh and Sikkim.

Nepal.

7. *Michelia mannii* King in Ann. R. Bot. Gard. Calc. 3: 218. 1891; Kanjilal et al., Fl. Assam 1: 25. 1934.

Asm.: *Kothalua-sopa*.

Trees, evergreen, medium-sized, glabrous; branches lenticellate. Leaves oblanceolate to obovate, acute at base, subacute at apex, 10 - 18 x 5 - 10 cm, firmly coriaceous, glabrous, shiny above, somewhat dull beneath; lateral nerves ca 10 pairs; tertiaries distinctly reticulate beneath; petioles 2 - 2.5 cm, finely channelled, swollen at base; stipules narrowly oblong. Flowers axillary, solitary on short pedicels, 6 - 8 cm across, white; buds oblong, ca 2.8 cm long, smooth. Sepals 3, linear, 1.5 - 8 x 0.3 - 4 cm. Petals 6, oblanceolate in 2 series, inner series smaller. Stamens as long as or overtopping the gynoecium; filaments short; anthers up to 1.6 cm long. Gynoecium stipitate; carpels ca 60, sessile, ca 1 x 1 mm, pale tomentose; style short; stigma recurved, glabrous. Fruiting receptacles 12 - 17 cm long, fleshy; ripe carpels oblong or obovoid, ca 2.5 cm long, sparsely lenticellate, 2-seeded.

Fl. Oct. - Dec.; *Fr.* April - May.

Distrib. India: Arunachal Pradesh and Assam.

Bangladesh.

8. *Michelia nilagirica* Zenk., Pl. Ind. 21, t.30. 1855; Hook. f. & Thomson in Fl. Brit. India 1: 44. 1872. *Michelia pulneyensis* Wight, Illus. 1: 14. 1840. *Michelia ovalifolia* Wight, Illus. 1: 13. 1840.

Tam.: *Shembuga*.

Small trees; branches tomentose when young, dark when dry. Leaves elliptic, shiny above, olivaceous to black on undersurface; lateral nerves 8 - 12 per side; petioles up to 2 cm long; stipules oblong, sericeous. Flowers white; peduncles up to 8 mm long. Perianth parts 9 - 12, oblanceolate, each 3 - 5 x 1.2 - 1.5 cm. Stamens ca 60, seriate, crowded at the base of gynophore; filaments short; anthers up to 8 mm long; connective produced into an appendage. Gynoecium stipitate; carpels ca 40, ca 1 cm in diam. Seed one with smooth testa.

Fl. & Fr. March - Aug.

Distrib. India: Tamil Nadu and Karnataka.

Sri Lanka.

9. *Michelia oblonga* Wallich ex Hook. f. & Thomson, Fl. Ind. 81. 1855 & in Fl. Brit. India 1: 43. 1872.

Asm.: *Bor-sopa*, *Ful-sopa*, *Kothal-sopa*; Garo: *Bewa-champhe*, *Chambi-sirsang*; Kh.: *Dieng-ta-rai*.

Trees, ca 50 m high, usually buttressed at base; bark grey, rough, warty, 2 - 4 cm thick, aromatic. Leaves oblanceolate, obovate-oblong, acute at base, shortly acuminate at apex, 8 - 15 x 4 - 6 cm, coriaceous, shiny above, glaucous beneath; lateral nerves 10 - 12 pairs; tertiaries laxly reticulate, conspicuous on both surfaces; petioles 1.5 - 2.5 cm long, swollen at base; stipules narrowly oblong, as long as petiole. Flowers axillary, solitary, white, scarcely scented; buds ovoid, elongate, ca 2.5 cm long; pedicels short, annulate. Perianth parts 12, white, fading to pale yellow, narrowly obovate-lanceolate, 2.5 - 3.5 cm long. Stamens ca 50; filaments ca 2.5 mm long; anthers 1.5 - 2 cm long. Carpels 40 or more, ovoid, ca 1.25 x 1 mm, glabrous; stylar crest as long as ovary. Fruiting receptacle up to 15 cm long; ripe carpels sessile, lax, obovoid, ca 20 x 12 mm, woody, lenticellate, beaked, speckled.

Fl. Feb. - May; Fr. July - Oct.

Distrib. India: N.E. region, evergreen forests, plains to 1200 m. Assam and Meghalaya.

Bangladesh.

10. *Michelia punduana* Hook. f. & Thomson, Fl. Ind. 81. 1855 & in Fl. Brit. India 1: 43. 1872. **Fig. 26.**

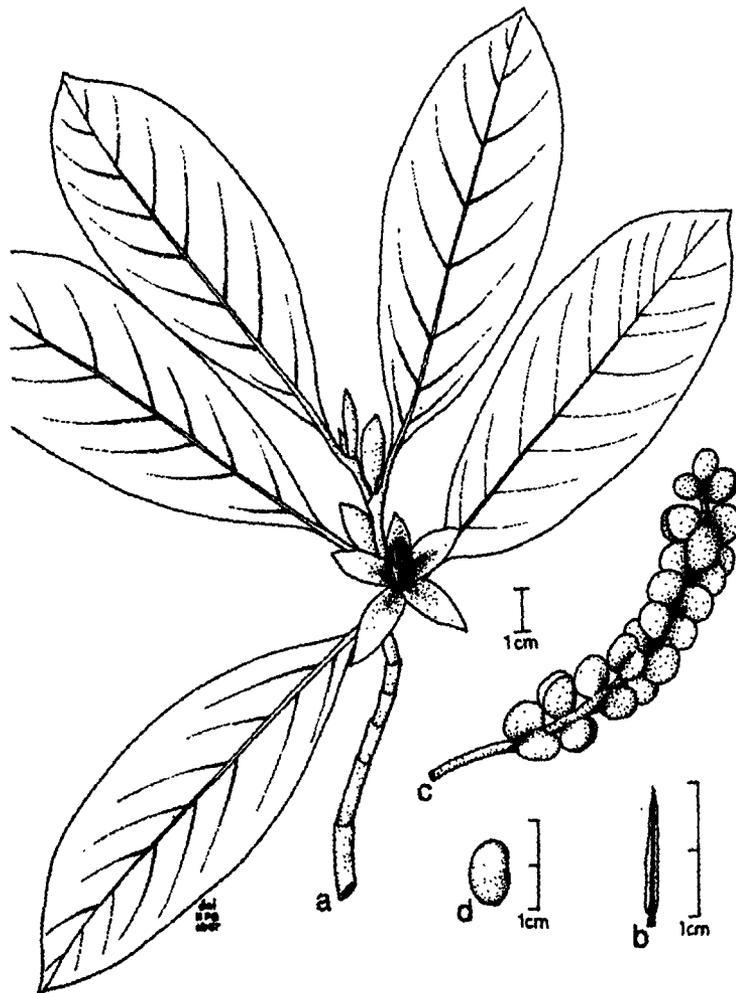


Fig. 26. *Michelia punduana* Hook. f. & Thomson : a. twig with flowers; b. stamen; c. fruit; d. seed.

Kh.: *Dieng-soh-niar*; Nep.: *Champ*.

Tall trees; bark grey with horizontal wrinkles; young parts brown silky, soon glabrate. Leaves oblong, obovate or elliptic-oblong, acute to cuneate at base, caudate-acuminate at apex, 7.5 - 15 x 3.5 - 5 cm, coriaceous, glabrous on both surfaces, shiny above, pale or subglaucous beneath; lateral nerves 8 - 12 pairs, obscure; reticulations visible on both surfaces; petioles stout, 1.2 - 1.5 cm; stipules about as long as petiole, narrowly oblong; stipular scars 0.7 - 1.2 cm long. Flowers axillary, solitary, rarely in pairs, 2.5 - 5 cm across, white, not much scented; buds ovoid, pointed, 2 - 2.5 cm long, densely silky. Perianth parts 9 - 12, outer ones obovate-cuneate, inner ones narrowly oblanceolate, acute. Stamens many, shorter than gynoecium. Carpels ca 50, beaked. Fruiting spikes 5 - 10 cm long; ripe carpels obovate or subglobose, compressed, not beaked, 8 - 10 mm across, lenticellate. Seed solitary, aromatic, with scarlet red aril and black testa.

Fl. & Fr. Oct. - March.

Distrib. India: E. Himalayas and N. E. India, subtropical forests. 1000 - 1600 m. Arunachal Pradesh, Manipur and Meghalaya.

Bangladesh.

11. *Michelia velutina* DC., Prodr. 1: 79. 1824. *M. lanuginosa* Wallich, Tent. Fl. Nep. 8. 1824; Hook. f. & Thomson in Fl. Brit. India 1: 43. 1872.

Kh.: *Dieng-lali*; Nep.: *Gogoi-champ*, *Guay-champ*, *Phurse*.

Trees, up to 30 m tall, deciduous; bark thick, plain, corky, grey; branchlets velutinous when young. Leaves lanceolate to elliptic, acute or sometimes rounded at base, acuminate at apex, 16 - 24 x 4 - 7.5 cm, thinly coriaceous, shiny and glabrous above, densely silky greyish pubescent on lower surface, turning yellow before falling; lateral nerves 14 - 18 pairs, slender, closely reticulate; petioles 1.2 - 1.5 cm long, grey-tomentose; stipules oblong; stipular scars 3 - 5 mm long. Flowers pale white, fragrant, axillary, solitary, 5 - 7 cm across; pedicels short, stout; bracts 2, spatheaceous, oblong, densely grey silky velutinous. Perianth parts 12 - 18, elliptic to oblanceolate, 3 - 5 x 0.8 - 1 cm, fleshy. Stamens 30 - 70, uniseriate, caducous; filaments short, glabrous; anthers up to 8 mm long, twisted when dry. Gynoecium with up to 1 cm long stalk, conical, 10 - 14 x 6 mm, densely velutinous; carpels 45 - 60 or more, ovoid, 3 - 4 x 2 mm, woolly; style slender, beaked, ls. glabrous, dark brown when dry. Fruiting receptacles 8 - 10 cm long; ripe carpels slightly compressed, 1.5 - 2.2 x 1 - 1.5 cm, dark brown with tuberculate lenticels. Seeds large, 1 - 3, angular, deep orange; testa hard and brown.

Fl. & Fr. July - Dec.

Distrib. India: E. Himalayas and N. E. India, subtropical forests, 1200 - 2000 m. West Bengal, Sikkim, Nagaland and Meghalaya.

Nepal.

Notes. Sometimes cultivated for its useful timber.

12. *Michelia wardii* Dandy in J. Bot. 65: 222. 1929.

Large trees. Leaves oblanceolate, narrowly oblong to elliptic-oblong, decurrent into petiole at base, acuminate to acute at apex, glabrous above, glaucescent and glabrous to thinly adpressed pubescent on nerves beneath; petioles ca 1.2 cm long; stipules adpressed grey-tomentose; peduncles ca 6 mm thick. Perianth parts 9 - 12, cream-coloured, 3 - 6.5 cm long, pubescent outside. Carpels numerous, adpressed pubescent when young.

Fl. & Fr. July - Sept.

Distrib. India: Arunachal Pradesh.

China (Tibet).

3. *Pachylarnax* Dandy

Trees; bark rough with longitudinal furrows. Stipules free from petiole. Leaves alternate, somewhat crowded towards ends of branchlets. Flowers terminal, usually solitary, rarely in pairs. Perianth parts 9 - 15, subequal, 4 - 5-merous. Stamens numerous; anthers introrse; connective produced into a short appendage. Carpels concrescent, 5 - 8; ovules 4 - 8 in each carpel. Fruits capsular, thick-walled woody, dorsally dehiscent. Seeds up to 6 in each carpel.

N. E. India, Indo-china, Malaya and Sumatra; 2 species, one in India.

***Pachylarnax pleiocarpa* Dandy in J. Bot. 71: 313. 1933; Kanjilal et al., Fl. Assam 1(1): 19. 1934.**

Large trees. Leaves elliptic-oblong to oblanceolate, cuneately attenuate at base, obtuse or rounded at apex, 15 - 22.5 x 5 - 7.5 cm, thickly coriaceous, glabrous, shiny green above, pale beneath; petioles up to 3 cm long, flattened on upper surface; stipules elliptic-oblong, caducous. Flower buds narrowly ovoid-oblong, covered by 1 - 3 caducous bracts; flowers ca 10 cm across, fragrant; pedicels 2 - 2.5 cm long. Perianth parts 13 - 15, fleshy, yellowish or cream-coloured. Stamens 1.2 - 1.8 cm long; filaments short. Ovules 4 - 8 in each carpel. Fruits 7.5 - 10 x 6.5 - 7.5 cm. Seeds orange-coloured, ca 5 cm across.

Fl. & Fr. Aug. - Oct.

Distrib. India: Assam.

Endemic.

Notes. Wood is hard, takes fine polish and is used for cabinet making.

ILLICIACEAE

(D. C. S. Raju, R. R. Rao and P. K. Hajra)

Shrubs or small trees, glabrous. Leaves alternate or subverticillate at branch ends, simple, entire, pinnately nerved; stipules absent. Flowers solitary, axillary or supra-axillary, rarely cauliflorous, bisexual; pedicels bracteate, sometimes 1-2-bracteolate. Perianth segments spirally arranged, free, 7 - 33; the outermost ones small, bracteole-like; inner ones becoming larger and ligulate or suborbicular, imbricate; the innermost ones often reduced. Stamens few to many, usually 4 - 50, several to 1-seriate; filaments free; anthers oblong, basifixed or adnate, introrso-lateral; thecae often separate; the connective sometimes glandular, not produced but sometimes apiculate at apex. Carpels obliquely attached to torus, (5-)12 - 15(-20), free, uniseriate, laterally compressed, narrowed into style, 1-ovuled; style subulate, recurved, persistent; ovule solitary, attached ventrally near base, bitegmic, crassinucellar, anatropous. Fruit a follicetum consisting of a single whorl of free follicles, dehiscent ventrally. Seeds glossy with copious oily endosperm and minute embryo; cotyledons hardly differentiated.

N.E. India, Japan, Korea, E. China to Malaya, Borneo, Philippines, Southeast U.S.A., E. Mexico and West Indies; one genus and ca 40 species, 4 species in India.

Notes. A natural unigeneric family of great phylogenetic antiquity, formerly kept as a tribe under Magnoliaceae by De Candolle (*Prodr.* 1: 77. 1824) and Hook. f. (*Fl. Brit. India* 1: 39. 1872). However, Hutchinson (*Fam. Fl. Pl.* ed. 2. 125. 1958 & *Gen. Fl. Pl.* 1: 57. 1964) follows Hu (in *Bull. Chin. Bot. Soc.* 1: 86. 1935) and treats it as a separate family in Magnoliales. More recently Dahlgren (*Bot. Notiser* 128: 124. 1974) treated Illiciaceae under a separate order Illiciales.

Literature. BAILEY, I.W. & C.G. NAST (1948) Morphology and relationships of *Illicium*, *Schisandra*, and *Kadsura*. *J. Arn. Arb.* 29: 77. SMITH, A.C. (1947) The families Illiciaceae and Schisandraceae. *Sargentia* 7: 1 - 244.

Illicium L.

Description and distribution as for family.

KEY TO THE SPECIES

- | | |
|--|-----------------------|
| 1a. Follicles clavate with subapical beaks | 4. <i>I. simonsii</i> |
| b. Follicles narrowed to apex, with apical beaks | 2 |

- 2a. Inner perianth segments thin, narrowly oblong, ciliate, much longer than outer ones 3. *I. manipurense*
 b. Inner perianth segments fleshy, rounded, eciliate, not much longer than outer ones 3
 3a. Perianth segments ca 7; filaments as long as anthers; stamens 9 - 13 1. *I. cambodianum*
 b. Perianth segments ca 24; filaments shorter than anthers; stamens 20 - 24 2. *I. griffithii*

1. *Illicium cambodianum* Hance in J. Bot. 14: 240. 1876; Subbarao & Kumari in Bull. Bot. Surv. India 6: 105-106, f. 1. 1964. Fig. 27.

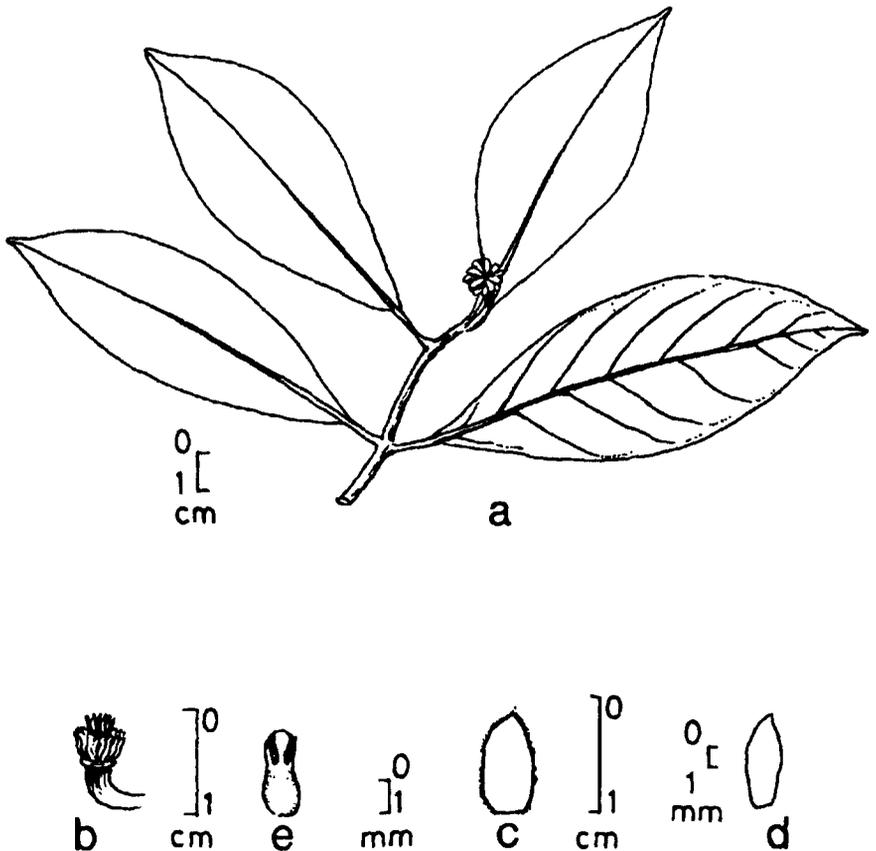


Fig. 27. *Illicium cambodianum* Hance; a. twig with flowers; b. flower showing an droecium; c. outer perianth segment; d. inner perianth segment; e. stamen.

Trees; young branchlets rugose, subterete or slightly angled. Leaves pseudoverticillate, in clusters of 2 - 3, at distal nodes, elliptic-obovate, entire or slightly recurved at margins, cuspidate-acuminate at apex, 8 - 12.5 x 3 - 4.5 cm, subcoriaceous, olivaceous to brown; midrib slightly impressed above, prominent beneath; lateral nerves 6 - 10 pairs; petioles 5 - 12 mm long. Flowers pink, axillary or subterminal, solitary; pedicels 5 - 10 mm long, rugulose, shorter than petioles; bracts caducous. Perianth segments 7; outer ones ovate-oblong or rounded, blunt at apex, obscurely ciliolate; inner ones smaller, fleshy, eciliolate. Stamens 9 - 13, uniseriate, 2 - 3 mm long; filaments as long as anthers, ligulate, fleshy with truncate connectives. Carpels 12 - 13, free, in single whorl, erect, narrowed into a slender style, ca 5 mm long.

Fl. & Fr. April - June.

Distrib. India: Subtropical forests, 900-1200 m. Arunachal Pradesh (Subansiri).

Myanmar and Cambodia.

2. *Illicium griffithii* Hook. f. & Thomson, Fl. Ind. 74. 1855 & in Fl. Brit. India 1: 40. 1872.

Trees or shrubs, 3 - 5 m tall, glabrous, usually evergreen; branches angular, shiny. Leaves ovate, elliptic-oblong to narrowly obovate or elliptic to obovate, cuneate at base, acuminate at apex, 5 - 13 x 2 - 5 cm, coriaceous, shiny, pellucid-dotted above, dull brown beneath; petioles up to 15 mm long, terete, channelled above. Flowers axillary or subterminal, solitary or in clusters of 2 - 3, bracteate; pedicels 1 - 2.5 cm long. Perianth segments ca 24; outer ones ovate or suborbicular, 3.5 - 10 cm across, papery, sparsely ciliolate; inner ones oblong-obovate, rounded at apex, 4 - 5 x 2.5 - 3 mm, fleshy, eciliolate. Stamens biseriate, normally 20 - 40, rarely more, 2 - 2.5 mm long; filaments ligulate, shorter than anthers, fleshy; anthers ca 2 mm long, subtruncate. Carpels 12 - 20, free, ellipsoid, flattened, ca 4.5 mm long; style subulate, recurved, up to 3 mm long. Follicles ovoid, compressed, narrowed at apex into a stout subulate incurved beak. Seeds flattened, ca 7.5 x 2.5 mm, brown.

Fl. April - June; *Fr.* July - Nov.

Distrib. India: Subtropical forests, 1200-1800 m. Arunachal Pradesh, Nagaland, Manipur and Meghalaya.

Bangladesh, Bhutan and Myanmar.

3. *Illicium manipurense* Watt ex King in Ann. R. Bot. Gard. Calc. 3: 200. 1891.

Shrubs or small trees, 5 - 7 m tall. Leaves broadly elliptic-oblong, cuneate at base, shortly acuminate at apex, coriaceous, dull green; petioles ca 1.5 cm long. Flowers

axillary, solitary, bracteate at base; pedicels ca 2.5 mm long. Perianth segments ca 23 - 27; outer ones oblong, 8 - 14 x 5 - 6 mm, ciliolate; inner ones 18 - 21, ligulate, 13 - 15 x ca 2.4 mm, ciliate. Stamens 18, biseriate; anthers ca 2 mm long; connective truncate or cuspidate. Carpels 7 - 8, free, flattened, ellipsoid, 4 - 5 mm long; style 2 - 3 mm long.

Fl. & Fr. March-July.

Distrib. India: Manipur.

Myanmar.

4. *Illicium simonsii* Maxim. in Bull. Acad. Sci. St. Petersburg. 32. 480. 1888. *I. fargesii* Finet & Gagnepain in Bull. Soc. Bot. Fr. 52: 29. 1905.

Trees or shrubs, up to 9 m tall; young branches pale brown; bud-scales lanceolate. Leaves elliptic-lanceolate or elliptic-oblong to lanceolate, attenuate at base, caudate-acuminate at apex, 6 - 12.5 x 2.5 - 3.5 cm, thinly coriaceous, dull brown beneath. Flowers ca 2 cm across, axillary, crowded towards apices of branchlets, bracteate; bracts suborbicular; pedicels ca 3 cm long at anthesis. Perianth segments 14 - 23; outer ones 2 - 5, elliptic-oblong, 5 - 11 x 4 - 7 mm, ciliolate; inner ones 12 - 18, ligulate, 8 - 15 x 2 - 4 mm, ciliolate, pale yellow, fragrant. Stamens 16 - 18, 2 - 3-seriate, free; filaments ca 2 mm long; anthers oblong, obtuse. Carpels 8 - 13, 3 - 4.5 cm long, flattened; style subulose. Seeds flattened, suborbicular, ca 6 x 4.5 mm, ca 3 mm thick.

Fl. & Fr. Feb.-June.

Distrib. India: Montane forests of E. Himalayas and N.E. regions. Arunachal Pradesh, Nagaland, Manipur and Meghalaya.

China.

SCHISANDRACEAE

(R.R. Rao and P.K. Hajra)

Shrubs, woody, climbing or scrambling; branches alternate, usually lenticellate in older parts. Leaves simple, alternate or crowded, sometimes pellucid-punctate, entire or crenate-serrate, exstipulate, pinnately veined. Flowers small, axillary, solitary, paired or sometimes fascicled and glomerulate on main branches or on ultimate shoots or on old woods, unisexual, actinomorphic; parts hypogynous; plants monoecious or dioecious; pedicels ebracteolate or several bracteolate; torus often highly modified, globose or broadly columnar. Perianth segments 9 - 16, spirally arranged, free, 2-many seriate, usually with gradual transition from sepaloid to petaloid segments; the outer smallest; the next ones gradually larger. Male flowers: Stamens 5 - 60 (-many), entirely covering the receptacle, spirally arranged on torus immersed in cavities or not; filaments short, connate at base; anthers 2-locular, extrorse or introrse, longitudinally dehiscent; connectives often widened, not produced apically. Female flowers: Carpels 20 - 30, rarely many, free, spirally arranged on torus, only partially closed, 1-locular; style short, with ventrally arranged stigma; ovules 2 - 5, ventral, bitegmic, crassinucellar, anatropous or campylotropous. Fruitlets aggregate, composed of modified elongated torus and sessile juicy drupaceous or berry-like indehiscent subglobose carpels. Seeds 1 - 5, rarely more; endosperm copious, oily; embryo minute, straight; cotyledons divaricate.

Temperate and tropical S. India, N.E. India, China, W. Malesia and South-east U.S.A.; 2 genera and ca 47 species, 2 genera and 6 species in India

Literature. SMITH, A. C. (1947) The families Illiciaceae and Schisandraceae. *Sargentia* 7: 1 - 224.

KEY TO THE GENERA

- 1a. Torus columnar, covered completely by widely patent fleshy filaments, covering up to the apex; stigma broad, not subulate; fruitlets crowded in a head 1. *Kadsura*
- b. Torus either columnar, with erecto-patent filaments not covering up to apex, or semiglobose with rather distant cavities in which all or majority of anthers are embedded; stigma narrow, subulate; fruitlets scattered on elongated axis 2. *Schisandra*

1. *Kadsura* Juss.

Shrubs, climbing, usually glabrous; branchlets terete or subterete; bud scales papyraceous to coriaceous. Leaves alternate, entire or distantly serrate-dentate along margins, usually cuspidate or acuminate at apex, usually coriaceous, opaque to pellucid-glandular, pinnately nerved. Flowers solitary, axillary, or sometimes arising from ultimate shoots below the leaves or fascicled in axils of scales near the base of short lateral branchlets from old wood; pedicels terete, short. Perianth segments 9 - 24, imbricate in about 3 - many series, white, yellow or red. Male flowers with 5 - 15 or more stamens spirally arranged on columnar torus, covering up to apex; filaments very short, free or subconnate; anthers free or partially immersed in fleshy head of confluent filaments; thecae small with broad connectives. Female flowers with many densely imbricate carpels; stigma broad, sessile; ovules 2 - 4. Fruits globose, a head of indehiscent fleshy 1-seeded fruitlets. Seeds 1 - 2, suspended.

India, China, Japan to W. Malesia; ca 22 species, one in India.

Literature. VIJAYARAGHAVAN, M. R. & USHA DHAR (1975) *Kadsura heteroclita* - microsporangium and pollen. *J. Arn. Arb.* 56: 1 - 224.

Kadsura heteroclita (Roxb.) Craib, *Fl. Siam Enum.* 1: 28. 1925. *Uvaria heteroclita* Roxb., *Fl. Ind.* 2: 663. 1832. *K. roxburghiana* Arn. in *Mag. Zool. Bot.* 2: 546. 1838; Hook. f. & Thomson in *Fl. Brit. India* 1: 45. 1872. *K. wightiana* Arn. in *Mag. Zool. Bot.* 2: 546. 1838; Hook. f. & Thomson, l. c. *K. wattii* C.B. Clarke in *J. Linn. Soc. Bot.* 25: 4. 1889.

Fig. 28.

Kh.: *Mi-ja-ngew*

Shrubs, climbing, evergreen, glabrous; branches densely white lenticellate. Leaves oblong-lanceolate or broadly elliptic-ovate, rounded or cuneate at base, distantly dentate-serrate along margins, acute or subacute at apex, 9 - 14 x 3 - 5 cm, soft and fleshy when fresh, glabrous, pale beneath; lateral nerves 10 - 15 pairs; petioles 1 - 1.5 cm long. Flowers axillary, solitary, white or light yellowish, ca 1.3 cm across; pedicels stout, 1 - 1.5 cm long; bracteoles many, ciliate, passing into perianth lobes. Perianth segments 9 - 12, imbricate in ca 3 rows, orbicular, concave; outer ones ca 7 x 5 mm; inner ones smaller. Male flowers: Stamens 12 - 15 or rarely more; outer filaments very short, free; inner ones longer, connate, fleshy; anthers free or partially immersed in fleshy head of confluent filaments. Female flowers: Carpels many, imbricate, angular, 1.5 - 2.5 x 1.5 - 2.5 mm, densely packed on a subglobose head of 6 - 8 mm diam; stigmatic crest obscurely ciliolate, terminated by minute elliptic or suborbicular appendage; ovules 2 - 4 in each carpel. Fruiting head globose or subglobose, 2.5 - 4.5 cm in diam., on 4 - 6 cm long pedicels; fruitlets oblong or globose, cuneate or more or less coalescing at base, faceted, 1 - 2 x 0.5 - 1.5 cm, indehiscent, fleshy, scarlet-red. Seeds suborbicular, compressed, ca 8 mm in diam.

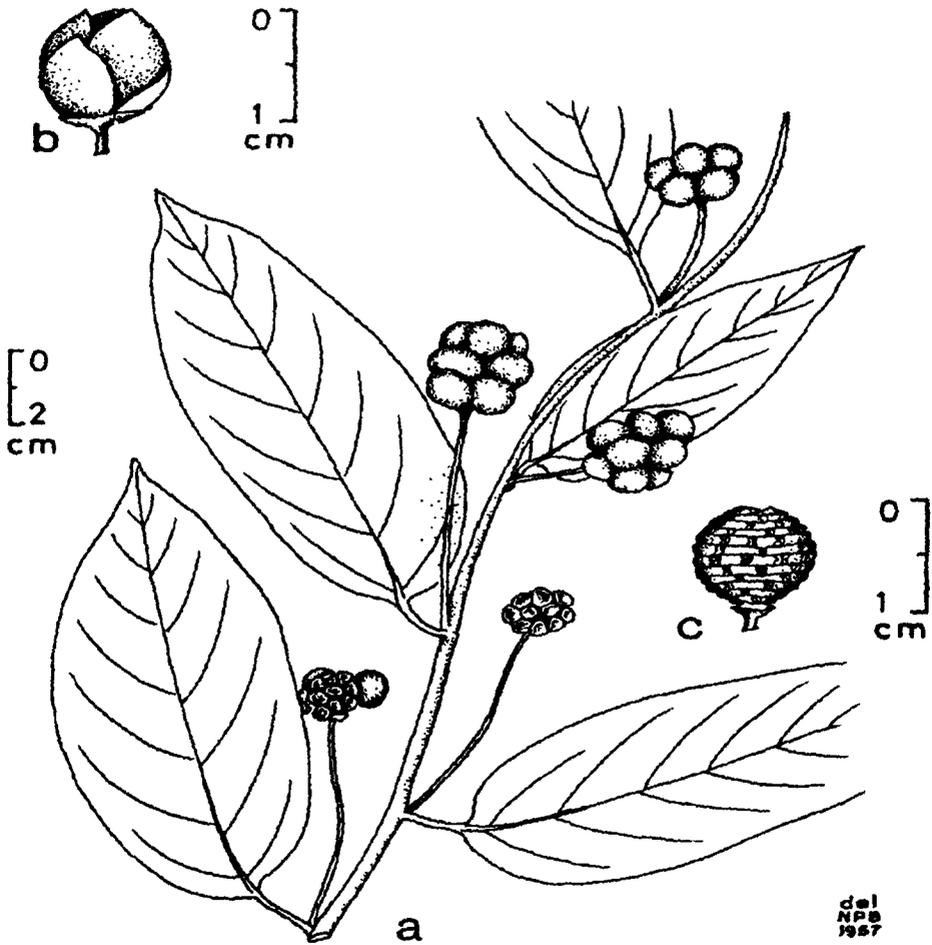


Fig. 28. *Kadsura heteroclita* (Roxb.) Craib: a. branch with fruits; b. flower; c. stamens and carpels in globose head.

Fl. & Fr. Apr. - Dec.

Distrib. India: Subtropical moist evergreen forests, 500 - 1500 m. West Bengal, Sikkim, Assam, Manipur, Meghalaya and Western Ghats of Tamil Nadu and Kerala.

Bangladesh, Bhutan, China, Myanmar, Indo-china, Thailand, Sumatra and Sri Lanka.

2. *Schisandra* Michx.

Shrubs, trailing or scrambling, dioecious or monoecious, usually glabrous; branches terete, striate or angled, sometimes narrowly winged. Leaves alternate on long shoots, crowded on short shoots, entire or denticulate, thin, pellucid-punctate. Flowers solitary in leaf-axils or fascicled on old wood; pedicels slender, terete, often 1 - 4-bracteolate or sometimes ebracteolate. Perianth segments 5 - 20, usually 2- or 3-seriate, yellow or reddish, often pellucid-glandular. Male flowers: Torus either broadly columnar, with broad naked apex, surrounded by erecto-patent stamens or globose, provided with cavities in which the majority of anthers are embedded; anthers free, suberect; outer ones on short filaments; inner ones sessile. Female flowers: Torus shortly stalked, globose; carpels many, sessile, each tapering above into an elongate flattened appendage. Fruitlets on much elongated torus, ellipsoid to obovoid, rounded. Seeds 1 - 2, ellipsoid, subglobose or reniform.

N. America, tropical and warm temperate Asia; ca 25 species, 5 in India.

KEY TO THE SPECIES

- | | |
|--|--------------------------|
| 1a. Stamens in shallow or circular pits or cavities on subglobose or obovoid torus; anthers at length, free or reflexed or remaining immersed in cavities | 2 |
| b. Stamens on elongate or ovoid torus, not in cavities or pits; anthers sessile or stalked | 3 |
| 2a. Perianth segments 6 - 10 in male flowers and 8 - 16 in female flowers | 4. <i>S. propinqua</i> |
| b. Perianth segments 11 - 17 in male flowers and 17 - 20 in female flowers | 3. <i>S. plena</i> |
| 3a. Perianth segments yellowish, 5 - 10 mm across; carpels 20 - 24 | 2. <i>S. neglecta</i> |
| b. Perianth segments white, pale pink, red or crimson, 10 - 18 mm across; carpels 70 - 120 | 4 |
| 4a. Leaves oblong-lanceolate, subglauous beneath; perianth segments usually white or sometimes pale pink; old ones turning to brownish; carpels appendaged at apex | 1. <i>S. grandiflora</i> |
| b. Leaves oblong-dentate, pale beneath; perianth segments usually red, scarlet or crimson; old ones reddish; carpels not appendaged at apex | 5. <i>S. rubriflora</i> |

1. *Schisandra grandiflora* (Wallich) Hook. f. & Thomson in *Fl. Brit. India* 1: 44. 1872. *Kadsura grandiflora* Wallich, *Tent. Fl. Nep.* 10, t. 14. 1824. **Fig. 29.**

Nep.: *Singhatta-lahara*



Fig. 29. *Schisandra grandiflora* (Wallich) Hook. f. & Thomson : a. twig with flowers; b. fruiting column with fruitlets.

Climbers, woody, glabrous, apparently dioecious. Leaves lanceolate, ovate or oblong-lanceolate, attenuate at base, distantly toothed along margins, acuminate at apex, 7 - 15 x 2 - 6 cm, somewhat fleshy, pale beneath; petioles 1.5 - 3.5 cm long. Flowers ca 2.5 mm across, solitary, sometimes with 1 - 2 secondary bracts, fragrant. Male flowers: Pedicels 1 - 4 cm long; perianth segments 7 - 8 in 3 series, broadly elliptic or obovate, 1 - 1.8 x 0.5 - 1.5 cm, white or pale pink; staminal column ovoid or cylindrical above, 7 - 15 mm long; anthers ovoid, 2 - 3 mm long on 1 - 2 mm long filaments; connectives thickened. Female flowers: Pedicels 1.5 - 6 mm long; perianth as in male; carpels many-seriate, ovoid, ca 1.5 x 0.75 mm with ca 0.5 mm long appendage. Fruiting column 15 - 20 cm long, 3 - 6 mm thick, fleshy, usually bearing 30 - 80, ovoid-ellipsoid, 7 - 9 x 5 - 6 mm, red fruitlets. Seeds ellipsoid.

Fl. & Fr. April - Sept.

Distrib. India: Temperate forests of N.W. & E. Himalayas, 2100 - 4000 m. Himachal Pradesh, Uttar Pradesh, West Bengal and Sikkim.

Nepal and Bhutan.

2. *Schisandra neglecta* A.C. Smith in *Sargentia* 7: 127. 1947. *S. elongatum* auct. non Blume; Hook. f. & Thomson, *Fl. Ind.* 85. 1855. *S. elongata* sensu Hook.f. & Thomson in *Fl. Brit. India* 1: 44. 1872 (excl. basionym).

Kh.: *Soh-mijarian*; *Nep.*: *Singhatta-lahara*

Climbers, deciduous, woody; branchlets thin, lenticelled, scaly at base. Leaves ovate or oblong-lanceolate, rounded or cuneate and somewhat unequal at base, entire, denticulate or sometimes sinuous along margins, acute or shortly acuminate at apex, 5 - 15 x 2 - 7 cm, membranous, glabrous above, minutely verrucose and subglaucous beneath; lateral nerves 4 - 6 pairs; petioles channelled above, 1.5 - 2 cm long. Flowers yellowish, 1.5 - 2 cm across; pedicels 1.5 - 5 cm long, slender. Perianth segments 7 - 8, orbicular, subsimilar, 5 - 16 mm across, green outside, yellowish inside. Male flowers: Stamens spirally arranged; outer ones on ca 0.5 mm long filaments, often monadelphous below; anthers 1 - 2 mm long with a thick connective. Female flowers: Carpels 20 - 24 on 1.5 - 1.8 mm long column, ellipsoid, 1 - 2 x 1 mm. Fruiting column 4 - 12 cm long; fruitlets 10 - 30, sessile, oblong-ellipsoid or globose, not beaked, 5 - 7 x 3 - 4 mm. Seeds 1 - 2.

Fl. & Fr. Apr. - Sept.

Distrib. India: Subtropical forests, up to 2200 m. West Bengal, Sikkim and Meghalaya.

Nepal, Bhutan, China and Myanmar.

3. *Schisandra plena* A.C. Smith in *Sargentia* 7: 154. 1947.

Shrubs, glabrous, apparently dioecious; young branches brownish purple, somewhat striated or wrinkled, 1 - 3.5 mm thick. Leaves elliptic or ovate-oblong, rarely sublanceolate, obtuse or subtruncate at base, entire or obscurely and distantly denticulate along margins, acuminate or cuspidate at apex, 7 - 17 x 3 - 8.5 cm, chartaceous or papyraceous; midrib prominent beneath; lateral nerves 5 - 7 pairs. Flowers solitary or in pairs, sometimes aggregated in clusters of 3 - 8 in axils of fugacious bracts; pedicels slender, 4 - 10 mm long, 2 - 4-bracteolate. Male flowers: Perianth segments 3 - 5-seriate, 11 - 17, entirely papyraceous or inner ones subcarinose, often inconspicuously pellucid-glandular, outer ones oblong-deltoid, 1.5 - 6 x 2 - 5 mm; staminal column obovoid, 4.5 - 6 mm long, composed of 5 - 8 stamens. Female flowers: Perianth segments 17 - 20, like in male flowers; carpels 26 - 33, on ellipsoid, subglobose column. Fruiting column on ca 1.5 cm long pedicels; fruitlets subglobose, 8 - 11 x 6 - 10 mm. Seeds 2, flattened-ellipsoid, superposed.

Fl. Apr. - May; *Fr.* Aug. - Sep.

Distrib. India: Mixed forests, 600 - 1500 m. Arunachal Pradesh.

China.

4. *Schisandra propinqua* (Wallich) Baill. ex A.C. Smith in *Sargentia* 7: 149. 1947.

Kadsura propinqua Wallich, Tent. Fl. Nep. 11, t. 15. 1824. *S. axillaris* Hook. f. & Thomson in Fl. Brit. India 1: 45. 1872.

Climbers, woody; stems slender, lenticellate, dark brown; branchlets succulent, angular, brown, verrucose and lenticellate. Leaves narrowly oblong-lanceolate or ovate-lanceolate, slightly unequally cuneate or rounded at base, acuminate at apex, 6 - 15 x 1.5 - 5 cm, somewhat fleshy, glabrous, shiny dark green above, pale and minutely gland-dotted beneath, glandular-toothed along margins; lateral nerves 6 - 12 pairs. Flowers axillary, solitary, 1.2 - 2 cm across, yellowish or dull scarlet, slightly fragrant, sessile or on up to 2.3 cm long bracteolate pedicels. Perianth segments orbicular to ovate or obovate, concave in bud. Filaments connate into a globose brick-red fleshy mass, ca 7 mm across; anthers 9 - 16 or more, embedded in the mass of filaments. Fruiting column 2.5 - 15 cm long; rachis fleshy, cylindrical; fruitlets fleshy, subsessile, globose, shortly stalked, 1 - 2-seeded.

KEY TO THE VARIETIES

- 1a. Branchlets plain, thin; lateral nerves 6 - 8 pairs; flowers dull scarlet; pedicels slender, of male flowers 4 - 23 mm, long, of female flowers 5 - 26 long; stamens usually 9 - 12; fruiting column comparatively slender, shorter, 2.5 - 5 cm long 4.1. var. *intermedia*

Branchlets verrucose, thick; lateral nerves 8 - 12 pairs; flowers yellowish; pedicels stout, of male flowers 3 - 15 mm long, of female flowers 5 - 13 mm long; stamens 10 - 16; fruiting column comparatively robust, longer, 10 - 15 cm long

4.2. var. *propinqua*

4.1. var. *intermedia* A.C. Smith in *Sargentia* 7: 152. 1947. *S. axillaris* Hook. f. & Thomson, l. c.

Fl. Aug. - Sept.; *Fr.* Oct. - Nov.

Distrib. India: Meghalaya.

Myanmar.

4.2. var. *propinqua*

Fl. July - Sept.; *Fr.* Oct. - Nov.

Distrib. India: Uttar Pradesh, Sikkim, Arunachal Pradesh and Meghalaya.

Nepal.

5. *Schisandra rubriflora* Rehder & Wilson in *Sargent, Pl. Wils.* 1: 412. 1913. *S. phenanthera* sensu Kanjilal et al., *Fl. Assam* 1(1): 28. 1935; non Rehder & Wilson 1913.

Shrubs, climbing or rambling, 3 - 6 m tall; branches robust, glabrous, lenticellate, brownish purple or brownish grey. Leaves obovate or oblong-obovate, attenuate at base, entire or distantly sinuate-denticulate or minutely callose mucronate along margins, acuminate at apex, 6 - 15 x 3 - 7 cm, dark green above, pale green beneath; lateral nerves 5 - 8 pairs; petioles channelled above, 2 - 4 cm long, glabrous. Flowers axillary, solitary, brownish red, 2 - 3 cm across; pedicels slender, 2 - 5 cm long, glabrous. Male flowers: Perianth segments 5 - 7, outer ones narrowly obovate, cuneate at base, obtuse at apex, ca 10 x 5 mm, inner ones broadly obovate, narrowed at base, rounded at apex, 10 - 12 x 7 - 9 mm; torus conical-ovoid, 8 - 10 mm long; stamens 10 or more, 4.5 - 6 mm long; filaments distinctly flattened, 3 - 4.5 mm long, ca 1 mm wide; anther-thecae separated by broadened connective. Female flowers: Perianth segments 5, broadly obovate or suborbicular, 10 - 12 x 8 - 12 mm; torus conical, ovoid, 9 - 10 mm long; carpels many, obovoid, ca 2 mm long; stigma sessile, ciliate. Fruiting column pendulous, cylindrical, 10 - 15 cm long, on 6 - 8 cm long stalk, crimson; rachis thick, becoming reddish when old; fruitlets subglobose, 10 - 12 mm in diam. Seeds 2 in each fruitlet, suborbicular, reniform, slightly compressed, 3 - 3.5 mm across.

Fl. & Fr. July - Sept.

Distrib. India: Eastern Himalayas, 1800 - 2600 m. Arunachal Pradesh.

China and Myanmar.

TETRACENTRACEAE

(R. S. Rao and P. K. Hajra)

Trees, deciduous with alternately long and short shoots; short shoots conspicuously marked by concentric scars of fallen leaves and bud scales and terminated by a bud enclosed by stipular flanges adnate to petiole; each short shoot bearing a single subterminal leaf and solitary inflorescence. Leaves simple, deciduous, alternate, rounded-ovate, crenate-dentate, palmately nerved. Inflorescence a catkin-like pendulous spike, short pedunculate, close to petiole near apex of short shoot. Flowers bisexual, numerous, hypogynous, opposite to sepals; anthers basifixed, erect. Ovary superior, consisting of 4 united carpels; each carpel unilocular with 2 placentas; styles 4, free, subulate, erect and becoming sharply recurved due to unequal growth of carpels; ovules ca 6 per carpel. Fruit a cluster of 4 laterally compressed follicles, each dehiscing ventrally. Seeds ca 5 per follicle, pendulous, compressed ellipsoid or fusiform, shortly winged at each end; endosperm copious, oily; embryo minute, subglobose or ellipsoid, obscurely cleft at apex.

India, Nepal, Bhutan, S.W. China and Myanmar; monotypic.

Literature: RAO, R.S. & P.K. HAJRA (1990) Tetracentraceae. In: Fasc. Fl. India, 20: 173-175.

Tetracentron Oliver

Description as for family.

Tetracentron sinense Oliver in Hook., Ic. Pl. 19: t. 1892. 1889. *T. sinense* Oliver var. *himalense* Hara & Kanai in J. Jap. Bot. 39: 195. 1964; Nayar & Ramam. in Bull. Bot. Surv. India 15: 232. 1976. **Fig. 30.**

Small trees, 15 - 25 m high, much-branched above; young branches lenticellate, purpurescent; short shoots up to 3 cm long; outer bud scales oblong-elliptic, obtuse or acute at apex, entire, 10 - 13 x 4 - 5 mm, scarios along margins; inner bud scales mucronate at apex, 13 - 15 x 3 - 5 mm; stipular flanges papyraceous or scarios, linear, subacute at apex, 5 - 15 mm long. Leaves ovate or elliptic-ovate, deeply shallowly cordate with rounded sinus or often truncate or shortly acuminate at apex, 5 - 15 x 4 - 10 cm, glabrous, chartaceous or papyraceous, deep green above, light green beneath; veins 5 - 7, spreading from base; petioles 1.5 - 3.5 cm long. Spikes 9 - 18 cm long, slender, pendant; peduncles 8 - 15 mm long. Flowers sessile, ca 3 mm across, green; bracts minute, obtuse, ca 0.5 mm long. Sepals broadly ovate, deltoid or suborbicular, 1 - 1.5 mm across, green.

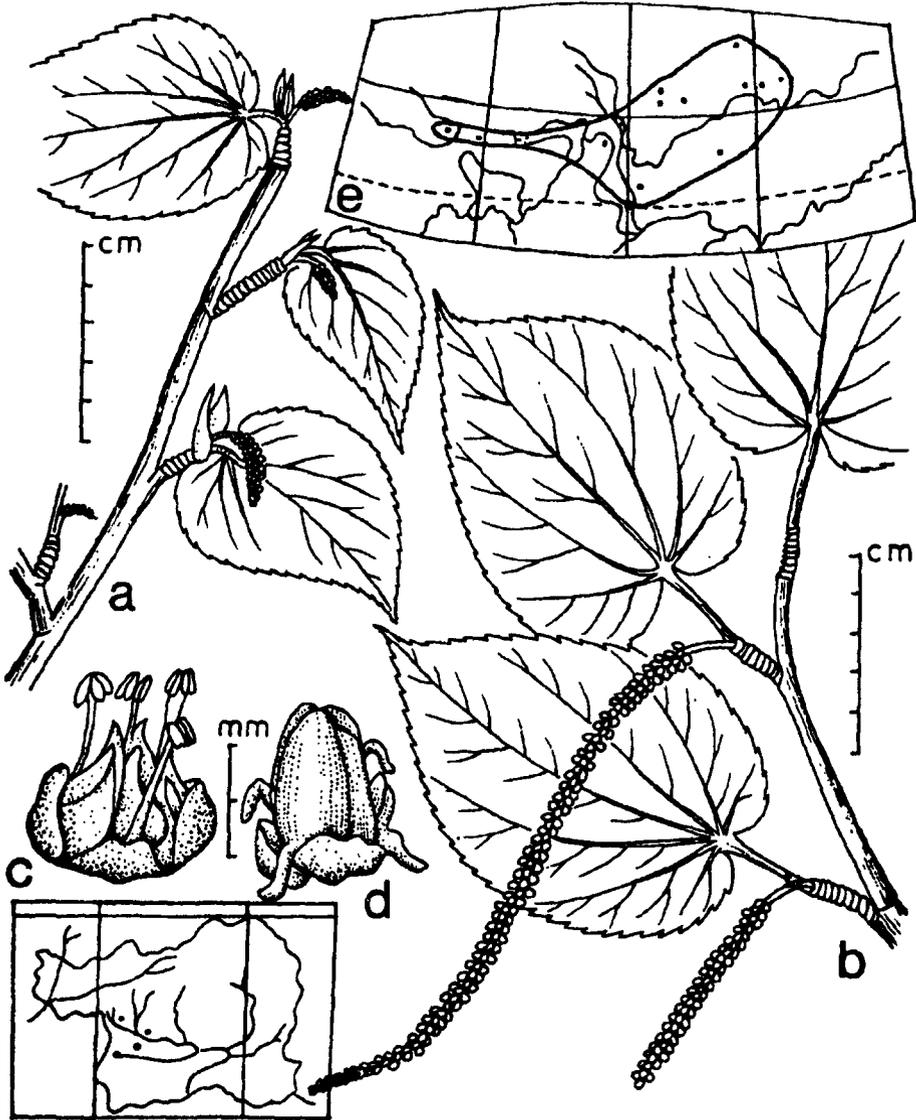


Fig. 30. *Tetracentron sinense* Oliver: a. branch with young inflorescence; b. branchlets with mature inflorescence; c. flower with stamens and carpels; d. young fruit; e. map showing world distribution; f. map showing distribution in India (Arunachal Pradesh - Kameng Dist.) - from Fasc. Fl. India 20: 175, 1990.

Stamens 2 - 3 mm long; styles ca 1 mm long; ovules slightly compressed. Follicles oblong, depressed at apex, 3 - 4.5 mm long. Seeds 2 - 3.5 mm long including wings.

Fl. & Fr. April - June.

Distrib. India: Eastern Himalayas in broad-leaved forests, 2200 - 3300 m. Sikkim, Arunachal Pradesh.

Nepal, N. Myanmar and S.W. China.

EUPTELEACEAE

(D. C. S. Raju, R. R. Rao and P. K. Hajra)

Trees or shrubs with perulate buds. Leaves alternate, simple, finely serrate, long-petioled, pinnately veined, deciduous, exstipulate. Inflorescence a fascicle of 6-12 flowers in axils of deciduous bracts; flowers bisexual or plants polygamo-dioecious, pedicelled. Perianth absent or rarely very minute. Stamens many, usually 10-15, in one whorl near the margin of disc (expanded torus); filaments free, filiform; anthers short, oblong or linear, basifixed; connective produced apically; pollen 3-colpate. Carpels 8-20 or rarely less, in a single whorl, free or loosely united at base, flattened with papyraceous wings, obovate or oblong, not completely closed; stigma sessile, as a crest, lateral on upper side of carpel opposite to the insertion of ovules. Fruit a cluster of samaras, ellipsoid or obovoid, flattened. Seeds 1-3, closely packed; endosperm copious, oily; embryo minute, smaller than endosperm, straight; cotyledons as wide as radicle.

N.E. India, C. & S.W. China, Japan; one genus and 2 species, one species in India.

Literature: NAST, G.G. & I.W. BAILEY (1946) Morphology of *Euptelea* and comparison with *Trichodendron*. *J. Arn. Arb.* 27: 186-192. PRAGLOWSKI, J. (1974-75) The pollen morphology of *Trichodendraceae*, *Tetracentraceae*, *Cercidiphyllaceae* and *Eupteleaceae* with reference to taxonomy. *Pollen et Spores* 16: 449-467. SMITH, A.C. (1946) A taxonomic review of *Euptelea*. *J. Arn. Arb.* 27: 175-185.

Euptelea Sieb. & Zucc.

Description as for family

Euptelea pleiosperma Hook. f. & Thomson in *J. Linn. Soc.* 7: 240, t. 2. 1864 & in *Fl. Brit. India* 1: 39. 1872.

Trees or shrubs, 2-15 m tall; branchlets alternate, slender, with small scattered elliptic lenticels, marked at each year's growth by numerous concentric scars of bud scales; main branchlets often elongate with numerous short lateral shoots; vegetative buds axillary, covered by 15-20 outer broadly deltoid scales and conduplicate innermost scales; sterile bracts of floriferous buds 10-15; fertile bracts 6-12, shiny, black. Leaves broadly elliptic to ovate, broadly cuneate at base, acute to shortly acuminate at apex, finely toothed along margin, 7.5-10 x 7-7.5 cm, glabrous above, pale and sparsely

pubescent beneath; lateral nerves 6 - 8, very oblique; petioles 3 - 4.5 cm long. Flowers maturing before development of leaves; pedicels slender, minute at anthesis, elongating up to 2 cm in fruit. Disc 0.5 - 1.5 mm in diam., pubescent along margins. Stamens 6 - 14 or more; filaments free, 2 - 8 mm long; anthers linear-oblong, 5 - 10 mm long; connective produced into a short acute appendage. Carpels 6 - 17; ovules usually 2, often 1 or 3. Fruitlets winged, samaroid, 5 - 11 x 4 - 6 mm, reddish or purplish; stalks 5 - 15 mm long. Seeds (1-) 2 (-3).

Fl. & Fr. March - July.

Distrib. India: E. Himalayas, margins of evergreen forests in open thickets, near streams, 1000 - 3000 m. Arunachal Pradesh.

S.W. & C. China and Japan.

ANNONACEAE

(Debika Mitra)

Trees, shrubs or climbers. Leaves simple, alternate, distichous, exstipulate, entire, coriaceous, glossy above, glaucous beneath. Inflorescences axillary or extra-axillary, leaf-opposed or cauliflorous, sympodial or the flowers solitary, or a few to many in fascicles. Flowers bisexual or rarely unisexual, large or small, often scented, the parts hypogynous. Perianth heterochlamydous. Sepals usually 3 (2-4), free or connate at base, usually valvate, rarely calyptrate, sometimes persistent in fruit. Petals 6 (3 + 3), rarely 12, 8, 4, or 3, rarely the inner ones absent, valvate, rarely imbricate, usually free, sometimes partly united at the bases or apices at young stage, variable in size and shape. Stamens numerous, free, spirally arranged on the torus, rarely 3 or 6 and whorled, hypogynous; filaments very short, inconspicuous and connectives conspicuous; anthers usually adnate, sometimes basifixed, extrorse; locules concealed (Uvarioid type) or not concealed (Miliusoid type) by the apically produced connectives. Carpels apocarpous, spirally arranged, or whorled, numerous, sometimes few, unilocular, oblong, cylindrical or terete; ovules 1 to many, when many in 2 ventral or parietal placentas, anatropous, crassinucellar; style present or absent; stigma usually capitate or grooved, sometimes 2-lobed or peltate. Torus usually convex, conical, dome-shaped or flat, sometimes concave. Ripe carpels many, free (united syncarp only in *Annona*), globose, ellipsoid to cylindrical, sometimes moniliform and constricted between seeds, usually berries, rarely capsules or follicles. Seeds 1 to many, in 1 - 2 rows; testa thin, crustaceous, shiny; endosperm copious, ruminant, hard or fleshy; embryo minute or small, linear, straight; cotyledons not broadened, undifferentiated.

Lowland evergreen tropical forests of America, Asia to Australia; ca 122 genera and ca 1200 species, 24 genera and 120 species in India.

Literature. HUTCHINSON, J. (1923) A contribution towards a phylogenetic classification of flowering plants. II. The genera of Annonaceae. Bull. Misc. Inf. Kew 1923: 241 - 261. KING, G. (1893) The Annonaceae of British India. Ann. R. Bot. Gard. Calc. 4: 1 - 169, pt. 1 - 220. KOEK-NORMAN, J., L. Y. TH. WESTRA & P. J. M. MAAS (1990) Studies in Annonaceae. XIII, The role of morphological characters in subsequent classifications of Annonaceae: A comparative study. Taxon 39: 16 - 32. MITRA, DEBIKA (1982) Annonaceae: Tribe Uvarieae. In: Fasc. Fl. India 10: 1 - 21. SETTEN, A. K. van P. J. M. MAAS (1990) Studies in Annonaceae. XIV. Index to generic names of Annonaceae. Taxon 39: 675 - 690. SINCLAIR, J. (1955) A revision of the Malayan Annonaceae. Gard. Bull. Str. Settlm. ser. 3, 14(2): 149

R. F. (1974) A phylogenetic classification of the Annoniflorae. *Aliso* 8: 147 - 209. WALKER, J. W. - 516.
 THORNE, (1971) Pollen morphology, phyto geography and phylogeny of Annonaceae. *Contrib. Gray Herb.*
 No. 202: 1 - 130.

KEY TO THE TRIBES

- | | |
|---|-----------------|
| 1a. Ripe carpels united, forming many-loculed syncarpous fruits | 1. Annonineae |
| b. Ripe carpels free, forming apocarpous fruits | 2 |
| 2a. Anther-locules not concealed at top by overlapping connectives (stamens Miliusoid); sepals and outer petals not distinguishable (except in <i>Alphonsea</i>) | 2. Miliuseae |
| b. Anther-locules concealed at top by overlapping connectives (stamens Uvarioid); sepals and outer petals distinguishable | 3 |
| 3a. Sepals imbricate, rarely valvate; petals imbricate in one or both series (in bud) | 5. Uvarieae |
| b. Sepals valvate; petals valvate in both series | 4 |
| 4a. Petals spreading in flowers or the apices free, almost similar and equal | 4. Unoneae |
| b. Petals, outer sometimes spreading, inner ones not spreading but remaining erect, dissimilar and unequal | 5 |
| 5a. Inner petals usually triquetrous, sometimes ovate- elliptic (in <i>Anaxagorea</i>), touching each other vertically | 6. Xylopleae |
| b. Inner petals connivent, arching over the stamens and carpels forming a dome (mitriform) | 3. Mitrephoreae |

KEY TO THE GENERA IN TRIBES

Tribe 1. ANNONINEAE

- | | |
|--------------|------------------|
| Single genus | 1. <i>Annona</i> |
|--------------|------------------|

Tribe 2. MILIUSEAE

- | | |
|--|----------------------|
| 1a. Inner petals mitriform, vaulted over stamens and carpels | 4. <i>Orophea</i> |
| b. Inner petals not mitriform, nor vaulted over stamens and carpels | 2 |
| 2a. Outer petals dissimilar to the sepals; both sets of petals subequal and larger than sepals | 2. <i>Alphonsea</i> |
| b. Outer petals small and similar to the sepals; inner ones larger | 3 |
| 3a. Anther-connectives rounded or apiculate at the apex | 3. <i>Milium</i> |
| b. Anther-connectives truncate at the apex | 5. <i>Phacanthus</i> |

Tribe 3. MITREPHOREAE

- | | |
|-----------------------|-----------------------|
| 1a. Flowers unisexual | 9. <i>Pseuduvaria</i> |
| b. Flowers bisexual | 2 |

- | | |
|---|--------------------------|
| 2a. Inner petals longer than outer ones | 8. Popowia |
| b. Inner petals shorter than outer ones | 3 |
| 3a. Flowers axillary; inner petals coriaceous, short and broadly clawed at base; stigma usually bifid | 6. Goniiothalamus |
| b. Flowers extra-axillary; inner petals thin, narrowly clawed; stigma capitate | 7. Mitrephora |

Tribe 4. UNONEAE

- | | |
|---|--------------------------|
| 1a. Ripe carpels moniliform with several seeds in a single row; petals usually 6, sometimes 4, 3 or 2. | 13. Desmos |
| b. Ripe carpels not moniliform; petals always 6 (rarely 7 - 8 in <i>Artabotrys</i>) | 2 |
| 2a. Petals conniving at the concave base covering the stamens and carpels | 3 |
| b. Petal flat, spreading from the base, not covering the stamens and carpels | 5 |
| 3a. Peduncles flattened and hooked | 10. Artabotrys |
| b. Peduncles not flattened, nor hooked | 4 |
| 4a. Trees; lateral nerves of leaves forming intra-marginal loops; ovules many in 2 rows | 12. Cyathocalyx |
| b. Climbers; lateral nerves of leaves not forming intra-marginal loops; ovules 1 - 2 | 14. Friesodielsia |
| 5a. Stamens ca 3 mm long; connectives apiculate, pointed; flowers strongly scented | 11. Cananga |
| b. Stamens less than 3 mm long; connectives flat-topped or convex; flowers usually not scented | 6 |
| 6a. Carpel 1 | 16. Mezzettia |
| b. Carpels 2 or more | 7 |
| 7a. Flowers densely tomentose, axillary, sessile or subsessile; ripe carpels subsessile | 15. Melogyne |
| b. Flowers glabrous or pubescent, rarely tomentose, usually extra-axillary or tubercled on woody outgrowths, rarely axillary, pediceled; ripe carpels stalked | 17. Polyalthia |

Tribe 5. UVARIEAE

- | | |
|--|-------------------------|
| 1a. Climbers or scandent shrubs; sepals valvate | 2 |
| b. Trees or shrubs; sepals imbricate | 3 |
| 2a. Flowers not opening wide when mature; petals imbricate only at tips, less than 1 cm long | 18. Cyathostemma |
| b. Flowers opening wide when mature; petals imbricate, more than 1 cm long | 21. Uvaria |
| 3a. Flowers axillary or fascicled on the tubercles; anthers sunk in the truncate and quadrate connectives; ovules usually many | 19. Sageraea |
| b. Flowers extra-axillary; anthers not sunk in the convex connectives; ovule 1 | 20. Trivalvaria |

Tribe 6. XYLOPIEAE

- | | |
|---|------------------------|
| 1a. Flowers axillary; anthers septate; pollen grains macroscopic | 24. Xylopia |
| b. Flowers leaf-opposed, terminal or extra-axillary; anthers not septate; pollen grains microscopic | 2 |
| 2a. Trees; flowers solitary; ripe carpels follicular | 22. Anaxagorea |
| b. Climbers; flowers in cymes or in branched panicles; ripe carpels berries | 23. Fissistigma |

Tribe 1. ANNONINEAE

Monotypic.

1. *Annona* L.

Trees or shrubs. Flowers bisexual, axillary, leaf-opposed or terminal, solitary or fascicled. Sepals 3, small, valvate. Petals 6 (3 + 3), valvate, coriaceous; outer ones lanceolate or ovate, concave at base, fleshy; inner ones rudimentary or absent. Stamens numerous; anthers narrow, dorsal, ovoid at top of the connectives. Carpels many, subconnate; ovule 1, erect, basal; style oblong. Ripe carpels confluent into a many-loculed ovoid or globose fruit, sometimes with spines. Seeds many, enclosed by a membranous aril.

India, Africa, Central America, S. America and West Indies; ca 110 species, 5 species in India. Widely cultivated throughout the tropics.

KEY TO THE SPECIES

- | | |
|--|-------------------------|
| 1a. Petals 6, the inner 3 conspicuous | 2 |
| b. Petals 3, inner rudimentary or absent | 3 |
| 2a. Fruits smooth | 2. <i>A. glabra</i> |
| b. Fruits muricate | 3. <i>A. muricata</i> |
| 3a. Leaves elliptic, velvety outside; fruits smooth | 1. <i>A. cherimola</i> |
| b. Leaves oblong or lanceolate, almost glabrous; fruits not smooth | 4 |
| 4a. Leaves acuminate; fruits reticulate, areolate | 4. <i>A. reticulata</i> |
| b. Leaves obtuse; fruits tuberculate | 5. <i>A. squamosa</i> |

1. *Annona cherimola* Miller, Gard. Dict. ed.8, no.5. 1768.

Trees, young branches fulvous tomentose. Leaves ovate to ovate-lanceolate, sometimes elliptic, usually rounded at base, obtuse or obtusely acuminate at apex, 10 - 14 x 3.5 - 6.5 cm, velvety-tomentose beneath, sparsely pubescent above. Flowers usually solitary, sometimes 2 - 3 together, extra-axillary or leaf-opposed; pedicels 1 - 1.3 cm long, tomentose. Sepals 3, almost triangular, 2 - 3 x ca 5 mm, brown tomentose outside. Petals 6 (3 + 3); outer ones prominent, oblong to linear-oblong, keeled inside, 2 - 3 x ca 0.5 cm, velvety tomentose, greenish yellow or rufous on upper surface, pale yellow or whitish inside, purple at base; inner ones minute, squamose, ovate or triangular, keeled outside, usually flesh-coloured or purple. Stamens numerous, ca 1 mm long, convex at top of the connective. Carpels numerous, linear-oblong, ca 1.5 mm long, with straight hairs; stigma sessile, spathulate. Ripe carpels united into a globose or subglobose fruit, smooth or slightly areolate; stalks ca 2 cm long. Seeds many.

Fl. June - July; *Fr.* Nov. - Jan.

Distrib. India: Tamil Nadu, cultivated.

Central America, S. America and West Indies.

Notes. Fruits edible.

2. *Annona glabra* L., Sp. Pl. 537. 1753; Bailey, Cycl. Hort. 1: 293. 1958; Kadavil & Antony in J. Swamy Bot. Club 5(2): 117 - 118, ff. 1 - 6. 1988. *A. palustris* L., Sp. Pl. ed.2, 757. 1762.

Mal.: *Kattatha*.

Shrubs or small trees, 3 - 7 m tall; roots profusely branched, with soft aerenchymatous thick corky pith. Leaves simple, alternate, oblong-lanceolate to ovate-lanceolate, obtuse at base, acuminate at apex, entire, 13 - 20 x 5 - 8 cm, coriaceous, glabrous; petioles 1.5 - 2 cm long. Flowers solitary, cauline. Sepals 3, valvate, semiorbicular or ovate, 5 x 7 mm. Petals 6 (3 + 3); outer larger, ovate, 2 - 2.6 x 1.5 - 2 cm, cream-coloured with reddish patches inside; inner smaller, elliptic-oblong, 1.5 - 2 x 1 - 1.3 cm, cream-coloured with red and yellow patches inside. Stamens many, arranged on a ca 4 mm long torus; anthers hooded. Carpels numerous, arranged on torus. Fruit ovoid or subglobose, 4.5 - 8 x 4 - 6 cm, green, smooth, glabrous, sweet-scented and yellow when mature, not edible. Seeds numerous, elliptic, black, with ruminant endosperm.

Fl. & Fr. Jan. - April.

Distrib. India: West Coast of peninsular India, common along backwaters of Kumarakom Bird Sanctuary in Kerala, naturalised in Kerala.

Native of tropical America and West Indies.

Notes. Roots are used for making corks. Fruits eaten by birds.

3. *Annona muricata* L., Sp. Pl. 1: 536. 1753;

Kan.: *Mulluramaphale*; Tam.: *Mullu-sitha-pazham*.

Trees, small; branches glabrous. Leaves obovate-oblong, acute at base, shortly acuminate, 11 - 14 x 4 - 5 cm, glabrous; petioles 4 - 5 mm long, glabrous. Flowers solitary, axillary; pedicels 1.2 - 1.5 cm long, glabrous, minutely bracteate at base or a little above the base. Sepals 3, triangular, 3 - 5 x 5 - 6 mm, glabrous, persistent. Petals 6 (3 + 3). ovate-acute, yellow, thick, glabrous; outer ones 3 - 3.2 x 2 - 2.5 cm; inner ones ca 1.5 x 1 cm. Stamens numerous, 4 - 5 mm long, linear; filaments broad at base, with capitate top

of the connective. Carpels many, linear, ca 4 mm long, slightly curved, strigose; style broad at base; stigma entire. Ripe carpels 6 - 8 cm long, muricate, dull green, warty, covered with long curved spines; stalks 2 - 3 cm long, stout. Seeds many, reddish brown.

Fl. & Fr. April - Oct.

Distrib. India: Assam, Maharashtra, Andhra Pradesh, Karnataka, Tamil Nadu and Andaman and Nicobar Islands.

Central America and West Indies.

4. *Annona reticulata* L., Sp. Pl. 1: 573. 1753; Hook. f. & Thomson in Fl. Brit. India 1: 78. 1872.

Beng.: *Nona*; Eng.: *Custard Apple*; Hindi: *Ramphal*; Kan.: *Ramphala*; Or.: *Neua*; Mal.: *Manilanilam*; Tam.: *Aninuna*; Tel.: *Ramphalam*.

Trees, 4 - 12 m tall; branches glabrous. Leaves oblong-lanceolate, rounded at base, acute to acuminate at apex. 10 - 20 x 3 - 5 cm, minutely pubescent beneath when young, later glabrous; petioles 1 - 1.5 cm long, glabrous. Flowers in extra-axillary or terminal cymes, 2 - 3 together; pedicels 1.5 - 2 cm long; bracts basal and median. Sepals 3, broadly ovate, shortly acuminate, 1.5 - 3 x 2 - 3 mm, pubescent outside. Petals apparently 3, but 3 minute ones represent the inner whorl; outer ones narrowly oblong, triquetrous, concave at base, acute at apex, keeled inside, 1.5 - 2 x 0.4 - 0.5 cm, pubescent outside, reddish at base inside; inner ones ca 2 mm long. Stamens numerous, ca 1 mm long; anther-thecae narrow, with ovoid top on the connectives. Carpels many, ovoid to linear, ca 1 mm long, 1-ovuled; style oblong; stigma entire. Fruits ovoid to subglobose, 5 - 10 cm in diam., reticulate, areolate, many-loculed, many-seeded, yellowish brown to reddish green. Seeds black, arillate.

Fl. May - July; *Fr.* Sept. - Jan.

Distrib. India: Cultivated and often naturalised, up to 1200 m. Delhi, Uttar Pradesh, Bihar, West Bengal, Assam, Orissa, Madhya Pradesh, Maharashtra, Andhra Pradesh, Karnataka, Kerala and Tamil Nadu.

Native of Central America and W. Indies.

5. *Annona squamosa* L., Sp. Pl. 1: 537. 1753; Hook. f. & Thomson in Fl. Brit. India 1: 78. 1872.

Asm.: *Atta-kolbal*; Beng.: *Ata*; Eng.: *Sugar Apple*; Hindi: *Sitaphal*, *Saripha*; Kan.: *Amrytaphala*; Mal.: *Atta*, *Sitapazham*; Nep.: *Shariphal*; Or.: *Ato*; Tam.: *Atta*, *Cilta*; Tel.: *Gandagatramu*, *Sitapalam*.

Small trees or shrubs, 3 - 6 m tall; branches pubescent when young, glabrous with age. Leaves elliptic-oblong, acute to cuneate at base, obtuse or slightly acute at apex, 8 - 14 x 2.5 - 5 cm, glabrous, but pubescent on the nerves when young; petioles 0.6 - 1.5 cm long, glabrous. Flowers axillary, solitary or a few together, leaf-opposed; pedicels 1 - 3 cm long, glabrous, bracteate at base and sometimes at the middle; bracts 1 - 3 mm long, pubescent. Sepals 3, broadly ovate, shortly acuminate, 2 - 3 x 3 - 4 mm, pubescent outside. Petals apparently 3, but with 3 minute ca 1 mm long inner whorl; outer ones narrowly oblong, keeled inside, 1.5 x 0.3 - 0.5 cm, thick, greenish white or yellow, reddish at base inside, pubescent outside; inner ones rudimentary or absent. Stamens numerous, ca 1 mm long; anther-thecae narrow, with ovoid top of connectives. Carpels many, ca 1 mm long, subconnate, ovoid, pubescent, 1-ovuled; style oblong; stigma entire. Fruits ovoid-globose, 8 - 9 cm in diam., tuberculate with rounded tips, glaucous; pulp white, edible. Seeds many, black, shiny, arillate.

Fl. May - Aug.; *Fr.* Sept. - Jan.

Distrib. India: Cultivated and almost naturalised. Delhi, Uttar Pradesh, Bihar, West Bengal, Assam, Orissa, Madhya Pradesh, Rajasthan, Gujarat, Maharashtra, Andhra Pradesh, Karnataka, Kerala and Tamil Nadu.

Native of Central America and West Indies.

Tribe 2. MILIUSEAE

Small trees or shrubs, sometimes tall trees (*Alphonsea*). Sepals and petals valvate; outer petals sepaloid (except in *Alphonsea*); inner petals usually free, sometimes mitri-form or vaulted over stamens and carpels (only in *Orophea*). Stamens few; anther-thecae not concealed by the connectives; connectives flat-topped or pointed.

2. *Alphonsea* Hook. f. & Thomson

Tall trees. Leaves coriaceous, shiny above, glabrous. Flowers bisexual, 1 to several, fasciated, leaf-opposed or extra-axillary; buds conical; bracts usually present. Sepals 3, valvate, small. Petals 6 in 2 series, valvate, subequal or the inner smaller, saccate at base; outer ones not sepaloid. Stamens indefinite, miliusoid; connectives apiculate, produced, not concealing the anther-thecae. Carpels 1 - 8; ovules 4 - 10 in two rows; stigma almost sessile. Ripe carpels many, subsessile or stalked, thick-walled, glabrous, tomentose or verrucose.

India, Bangladesh, Sri Lanka, Myanmar and Cambodia, Thailand, Malaysia, Borneo, Indonesia and New Guinea; ca 30 species, 5 species in India.

KEY TO THE SPECIES

- | | |
|--|---------------------------|
| 1a. Leaves 20 - 26 cm long; pedicels ca 2 cm long | 4. <i>A. ventricosa</i> |
| b. Leaves 7 - 15 cm long; pedicels 1 cm long or short | 2 |
| 2a. Leaves lanceolate; ripe carpels tuberculate | 3 |
| b. Leaves elliptic or oblong; ripe carpels not tuberculate | 4 |
| 3a. Leaves obtuse; petals ca 5 mm long | 3. <i>A. sclerocarpa</i> |
| b. Leaves long-acuminate; petals ca 7 mm long | 5. <i>A. zeylanica</i> |
| 4a. Petals thick, ca 10 mm long; tips reflexed | 1. <i>A. lutea</i> |
| b. Petals thin, 4 - 5 mm long; tips not reflexed | 2. <i>A. madraspatana</i> |

1. *Alphonsea lutea* (Roxb.) Hook. f. & Thomson, Fl. Ind. 153. 1855 & in Fl. Brit. India 1: 89. 1872. *Uvaria lutea* Roxb., Corom. Pl. 1: t. 36. 1795 & Fl. Ind. 2: 666. 1832.

Fig. 31.

Trees; young branches brown pubescent. Leaves ovate to oblong or elliptic, almost rounded at base, obtusely acuminate at apex, 10 - 15 x 3.5 - 7 cm, glabrous above, sparsely pubescent beneath; petioles 4 - 5 mm long, pubescent when young. Flowers in dense fascicles, leaf-opposed, subcapitate; pedicels 5 - 7 mm long, densely brown tomentose; bracts minute, at the base and a little above the base of the pedicels. Sepals 3, connate into a 3-angled shallow cup, 2 - 3 mm long, tomentose outside, glabrous inside. Petals 6 (3 + 3), subequal, ovate, acute, ca 10 x 6 mm, thick, tomentose outside, glabrous inside, reflexed at tips. Stamens many, ca 1.5 mm long; connectives broad, slightly and bluntly produced. Carpels few, oblong, ca 2.5 mm long, strigose; stigma sessile, capitate. Ripe carpels few, broadly ovoid, obtuse at both ends, ca 1.5 cm long, puberulous; stalk very short. Seeds 3 - 6, in 2 rows.

Fl. April - May; *Fr.* Aug. - Sept.

Distrib. India: Arunachal Pradesh, Assam, Orissa, Maharashtra, Karnataka and Tamil Nadu.

Sri Lanka and Myanmar.

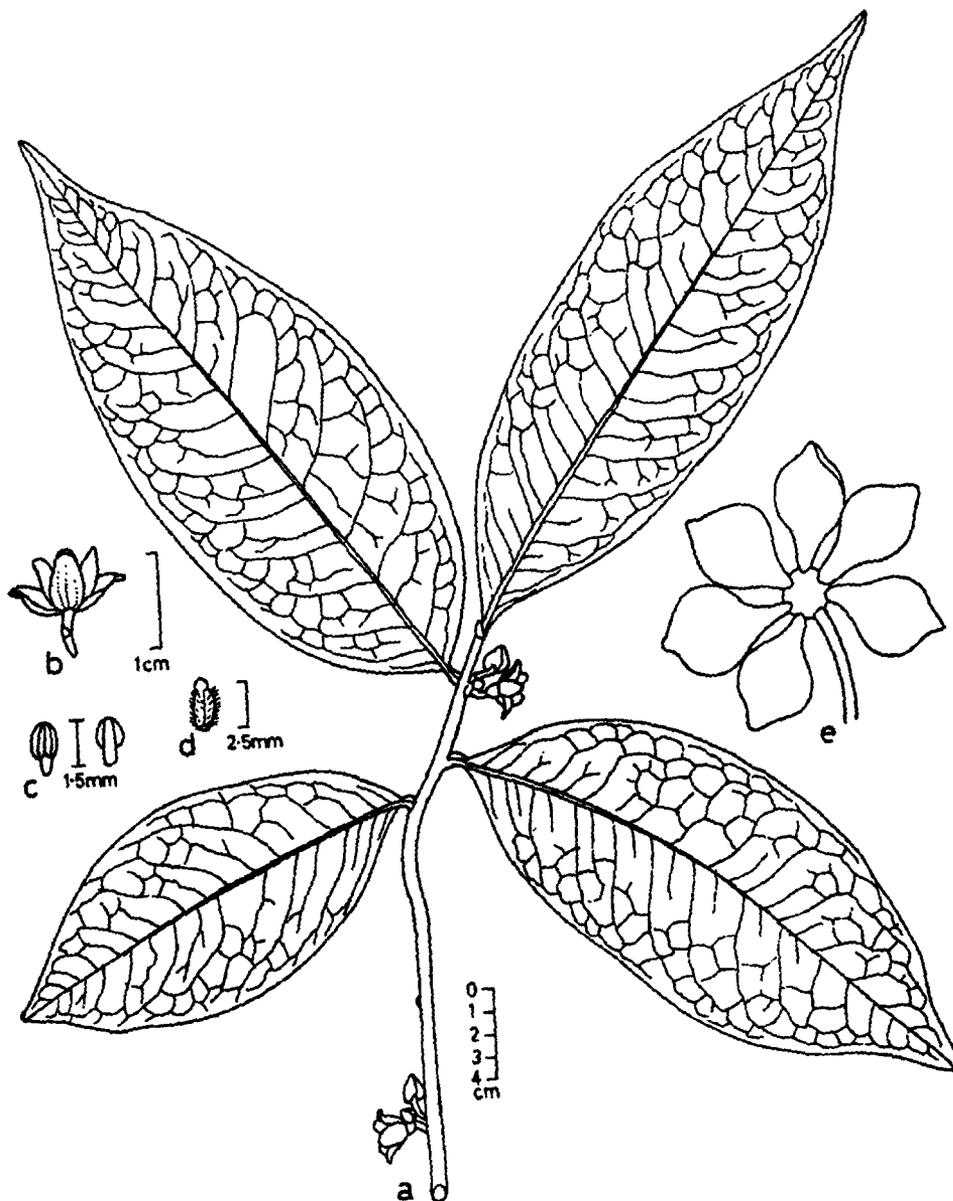


Fig. 31. *Alphonsea lutea* (Roxb.) Hook. f. & Thomson : a. twig with flowers; b. flower; c. stamens, front and back views; d. carpel; e. ripe carpels.

2. *Alphonsea madraspatana* Beddome, Icon. Pl. Ind. Or. t. 92. 1868 - 1874; Hook. f. & Thomson in Fl. Brit. India 1: 89. 1872.

Trees. Leaves ovate-lanceolate to elliptic-lanceolate, rounded or cuneate at base, obtuse, 7 - 9 x 2.8 - 3.5 cm, rugulose, glabrous or slightly puberulous; petioles ca 5 mm long, rugulose, glabrous or slightly puberulous. Flowers 1 - 6, fascicled on leaf-opposed, supra-axillary peduncle; pedicels 7 - 10 mm long, puberulous, bracteate below the middle. Sepals 3, ovate, very small. Petals 6 (3 + 3), subequal, ovate, acute, 4 - 5 x 4 mm, bright yellow, puberulous outside, thin. Stamens 12 in 2 series, ca 1 mm long; filaments short; connectives flat at top. Carpels few (3 - 4), oblong, ca 2 mm long, pubescent; ovules ca 8 in two rows; stigma globose. Ripe carpels ovoid, 1 - 2 cm long, yellow, tomentose; stalk 1 - 2 mm long, stout. Seeds few, in two rows.

Fl. May; *Fr.* Aug.

Distrib. India: Orissa, Andhra Pradesh and Tamil Nadu.

Endemic.

3. *Alphonsea sclerocarpa* Thwaites, Enum. Pl. Zeyl. 11. 1858; Hook. f. & Thomson in Fl. Brit. India 1: 89. 1872.

Trees; branches rugose, glabrous. Leaves narrowly lanceolate, narrow at base, obtuse at apex, 6 - 7.5 x 1.5 - 2.5 cm, glabrous. Flowers fascicled on very short axillary peduncle; pedicels 5 - 6 mm long, pubescent. Sepals 3, very small, united at base, orbicular, reflexed, pubescent. Petals 6 (3 + 3), ovate, acute, ochraceous; outer ones ca 5 x 3 - 4 mm; inner ones smaller, pubescent. Stamens 15, in 2 - 3 rows, ca 1 mm long; connectives flat at top. Carpels 3 - 6, oblong, ca 2 mm long, pubescent; ovules ca 8; stigma sessile, capitate. Ripe carpels 3 - 5, subglobose, 1.5 - 2 cm across, minutely fulvous tomentose, tuberculate; stalk 5 - 8 mm long, stout. Seeds more than 2, biseriate.

Fl. March; *Fr.* Aug. - Oct.

Distrib. India: Andhra Pradesh, Tamil Nadu and Kerala.

Sri Lanka.

4. *Alphonsea ventricosa* (Roxb.) Hook. f. & Thomson, Fl. Ind. 152. 1855 & in Fl. Brit. India 1: 89. 1872. *Uvaria ventricosa* Roxb., Fl. Ind. 2: 658. 1832.

Trees; branches brown tomentose when young. Leaves oblong to elliptic-oblong, rounded or subacute at base, long-acuminate at apex, 20 - 26 x 5 - 8.5 cm, pubescent on midrib when young, glabrous with age; petioles 4 - 6 mm long, puberulous. Flowers in few-flowered racemes, greenish white, odorous; pedicels ca 2 cm long, brown tomentose;

bracts ovate, tomentose, basal and median on pedicels. Sepals 3, very small, broadly ovate, connate below, tomentose outside, densely ciliate at margins. Petals 6 (3 + 3), oblong-ovate, acute, brown tomentose outside; outer petals ca 10 x 7 mm; inner ones smaller. Stamens many, oblong, ca 1.5 mm long; connectives slightly apiculate at top. Carpels ca 10, oblong, ca 3 mm long, villous; stigma subsessile, capitate. Ripe carpels 4 - 5, ovoid or subglobose, 2.5 - 3.5 cm long, minutely pubescent, yellowish when ripe; stalk ca 2.5 cm long, stout. Seeds many in 2 rows; testa horny, brown.

Fl. March; *Fr.* July - Aug.

Distrib. India: Bihar, West Bengal, Assam and Meghalaya.

Bangladesh.

5. *Alphonsea zeylanica* Hook. f. & Thomson, Fl. Ind. 153. 1855 & in Fl. Brit. India 1: 89. 1872.

Trees; young branches puberulous. Leaves narrowly lanceolate, acute at base, long-acuminate at apex, 5.5 - 8.5 x 1.5 - 2.5 cm, glabrous, puberulous on the midrib beneath when young; petioles 4 - 5 mm long, glabrous. Flowers few, in leaf-opposed or extra-axillary fascicles; pedicels 7 - 10 mm long, pubescent; bracts small, basal and submedian. Sepals 3, minute, connate at base, tomentose outside. Petals glabrous inside, yellowish green; outer petals ca 7 x 5 mm; inner ones smaller. Stamens many, ca 1.5 mm long; connectives apiculate at top. Carpels 5 - 6, oblong, ca 1 mm long, pubescent; style depressed; stigma bilobed. Ripe carpels subglobose, ca 1 cm across, brown tomentose, slightly and irregularly tuberculate; stalk stout. Seeds 4 - 6 in two rows.

Fl. & *Fr.* not known.

Distrib. India: Tamil Nadu (Tirunelveli Dist.).

Sri Lanka.

3. *Milium* Leschen. ex DC.

Small trees or shrubs, sometimes scandent, dioecious or polygamous. Leaves ovate or elliptic, membranous, pubescent or glabrate. Flowers usually bisexual, sometimes unisexual, axillary or often apparently extra-axillary due to the development of young shoots on the peduncle, solitary or 2 - 3-flowered fascicles or cymes; bracts ovate, elliptic or obovate, the upper ones often foliaceous. Sepals 3, valvate. Petals 6 (3 + 3), free, valvate in buds; outer petals sepaloid, subequal to sepals; inner ones larger, thickened and subsaccate at base, cohering when young by their margins, at length free. Torus elongated. Stamens definite or indefinite; anthers ovoid, extrorse; connectives concealing the anther-thecae, rounded at top, sometimes apiculate. Carpels indefinite, linear-

oblong; ovules 1 - 10; style oblong or very short; stigma club-shaped. Ripe carpels many, globose or oblong, thin-walled, stalked or subsessile. Seeds 1 - many.

India, Sri Lanka, Bhutan, Bangladesh, Myanmar, Cambodia, Laos, Vietnam, Thailand, Borneo, Indonesia, Australia and New Zealand; ca 40 species, 14 species in India.

KEY TO THE SPECIES

- | | |
|---|--------------------------|
| 1a. Pedicels less than 1 cm long | 2 |
| b. Pedicels more than 1 cm long | 6 |
| 2a. Leaves 12 - 25 cm long | 3 |
| b. Leaves up to 10 cm long | 4 |
| 3a. Sepals ca 10 mm long; inner petals ovate | 2. <i>M. dolichantha</i> |
| b. Sepals 3 - 4 mm long; inner petals oblong-lanceolate | 6. <i>M. longiflora</i> |
| 4a. Young branches strigose | 3. <i>M. eriocarpa</i> |
| b. Young branches glabrous or pubescent | 5 |
| 5a. Leaves ovate or ovate-lanceolate; midrib glabrous above | 8. <i>M. montana</i> |
| b. Leaves oblong-elliptic or oblong-lanceolate; midrib pubescent above | 5. <i>M. indica</i> |
| 6a. Leaves ca 10 cm long or shorter | 7 |
| b. Leaves more than 10 cm long | 8 |
| 7a. Stamens many, in a few series | 14. <i>M. wightiana</i> |
| b. Stamens 8 - 12, uniseriate | 10. <i>M. nilagirica</i> |
| 8a. Leaves tomentose | 9 |
| b. Leaves pubescent or glabrous | 10 |
| 9a. Sepals ca 1 mm long; sepals and outer petals linear-lanceolate | 12. <i>M. tomentosa</i> |
| b. Sepals 2 - 4 mm long; sepals and outer petals ovate | 13. <i>M. velutina</i> |
| 10a. Pedicels 5 - 8 cm long | 7. <i>M. macrocarpa</i> |
| b. Pedicels 1 - 2.5 cm long | 11 |
| 11a. Inner petals ovate, not more than 1.5 cm long, pubescent | 11. <i>M. tectona</i> |
| b. Inner petals ovate, not more than 1.5 cm long, pubescent | 12 |
| 12a. Pedicels pubescent; flowers sometimes unisexual, polygamous | 4. <i>M. globosa</i> |
| b. Pedicels glabrous; flowers always bisexual | 13 |
| 13a. Inner petals ca 1.5 cm long, united at base, thin; stalk of ripe carpels ca 10 mm long | 1. <i>M. andamanica</i> |
| b. Inner petals ca 0.5 cm long, free, thick; stalk of ripe carpels ca 4.5 mm long | 9. <i>M. mukerjeeana</i> |

1. *Milusa andamanica* (King) Finet & Gagnepain in Bull. Soc. Bot. Fr. 53(4): 151. 1906. *Phaeanthus andamanicus* King in J. Asiat. Soc. Beng. 61(2): 122. 1892 & in Ann. R. Bot. Gard. Calc. 4: 153, t. 201A. 1893.

Undershrubs; branches reddish. Leaves elliptic or elliptic-lanceolate, slightly narrowed at base, acuminate at apex, 13 - 15.5 x 5 - 6 cm, glabrous; petioles 4 - 5 mm long,

glabrous. Flowers bisexual, solitary, rarely in pairs, extra-axillary; pedicels 1 - 1.5 cm long, glabrous with a few small pubescent bracts at the base. Sepals 3, very small, semi-orbicular, persistent. Petals 6 (3 + 3); outer petals slightly larger than the sepals; inner ones united at base, broadly ovate, subacute, 15 x 6 mm, thin, sparsely pubescent. Stamens numerous, ca 1 mm long; filaments prominent; connectives apiculate at top. Carpels many, linear-oblong, curved, ca 3 mm long, pubescent; ovules 2 in each; style linear, curved; stigma flat. Ripe carpels many, subglobose, ca 1.5 cm long, 2 - 3 cm across, glabrous; stalk slender, 8 - 10 mm long. Seeds 2 in each, plano-convex, pale.

Fl. May - June; *Fr.* Nov. - Dec.

Distrib. India: Evergreen forests, up to 100 m. Andaman & Nicobar Islands.

Endemic.

2. *Milium dolichantha* Craib in Bull. Misc. Inf. Kew 1920: 108. 1920.

Small trees; young branches densely brown or reddish brown-pubescent or puberulous. Leaves oblong or oblong-lanceolate, slightly unequal and cuneate or rounded at base, long-acuminate at apex, 12 - 20 x 5 - 7.5 cm, sparsely pubescent on nerves above, pubescent with straight hairs on nerves below; petioles ca 3 mm long, pubescent. Flowers bisexual, usually in pairs, axillary or in axils of fallen leaves; pedicels 7 - 8 mm long, rusty pubescent; bracts 2, linear-lanceolate, ca 8 mm long, pubescent, submedian and basal. Sepals 3, free, narrowly lanceolate, acute, ca 10 x 1.5 mm, rusty pubescent. Petals 6 (3 + 3), rusty pubescent; outer petals like the sepals; inner ones valvate, ovate, ca 2.5 mm long (in bud). Stamens intermixed with straight hairs. Carpels not seen.

Fl. & Fr. not known.

Distrib. India: Assam and Arunachal Pradesh.

Endemic.

3. *Milium eriocarpa* Dunn in Gamble, Fl. Pres. Madras 1: 21. 1915. *Milium indica* Leschen. ex DC. var. *tomentosa* Hook. f. & Thomson in Fl. Brit. India 1: 86. 1872.

Shrubs, erect or scandent, 2 - 4 m tall, much-branched; young branches strigose. Leaves ovate-oblong or elliptic-oblong to oblong-lanceolate, rounded at base, obtuse, acute or slightly acuminate at apex, 4.5 - 9 x 2.4 - 2.8 cm, glabrous above or pubescent on both surfaces with straight hairs, especially on midrib and margins; petioles 1 - 2 mm long, tomentose. Flowers greenish pink, bisexual, solitary, axillary; pedicels absent or 2 - 3 mm long, pubescent; pedicels ca 3 mm long, reddish; bracts at the middle or below, triangular, ca 2 mm long. Sepals 3, free, triangular or ovate, acute, 2 - 3 mm long, glabrous, strigose along margins. Petals 6 (3 + 3); outer petals like the sepals, lanceolate, 3 - 4

mm long; inner ones coherent at the base up to the middle when young, then free, ovate, acute, 10 - 17 x 3 - 5 mm, glabrous. Stamens many, ca 1 mm long; connectives short, rounded, apiculate, not concealing the anthers. Carpels few, oblong, ca 2 mm long, grey tomentose; stigma sessile, spatulate, glabrous. Ripe carpels many, obliquely ellipsoid or oblong, short-stalked or sessile, apiculate, pubescent.

Fl. May - Sept.; *Fr.* July - Nov.

Distrib. India: In hilly regions of Tamil Nadu and Karnataka.

Endemic.

4. *Milusa globosa* (DC.) Panigr. & S. C. Mishra in *Taxon* 33: 713. 1984. *Guatteria globosa* DC. in *Mem. Soc. Phys. Hist. Natur. Geneve* 5: 41 ('43') (pre-print? 1831); et period. edit. : (?) 218, before 21 Nov. 1832. *Hyalostemma roxburghiana* Wallich, *Cat. no.* 6434. 31 Oct. 1832, nom. illeg. *Milusa roxburghiana* (Wallich) Hook. f. & Thomson, *Fl. Ind.* 150. 1855 & in *Fl. Brit. India* 1: 87. 1872. *Uvaria dioica* Roxb., *Fl. Ind.* ed.2, 2: 659. 14 Jan. 1832 (as '*dioeca*'). Fig. 32.

Asm.: *Chhag-loti*, *Clarg-lodoi*, *Tippera-totsi*; *Jain.*: *Dieng-jwat*.

Small trees or large shrubs, 3 - 12 m tall, dioecious or polygamous; young branches softly pubescent. Leaves bifarious, ovate-lanceolate or oblong-lanceolate, rounded or acute at base, abruptly acuminate at apex, 10 - 18 x 3.5 - 6 cm, thinly coriaceous, shiny above, glabrous except the puberulous midrib above, pubescent beneath, glabrous with age; lateral nerves ca 10 pairs; petioles 1 - 2 mm long. Flowers bisexual or unisexual, solitary or 2 - 3 together, axillary, extra-axillary or leaf-opposed, drooping, ca 1.5 cm long, red; pedicels 1.5 - 2.5 cm long, pubescent; bracts 1 - 3, basal or a little above the base, linear-lanceolate, acuminate. Sepals 3, linear-lanceolate, acuminate, reflexed, 3 - 6 x ca 1 mm, rusty tomentose outside. Petals 6 (3 + 3); outer petals similar to sepals; inner ones ovate, saccate at base, obtuse to subacute at apex, cohering laterally up to middle when young, later free, 1 - 1.5 x 0.4 - 0.8 cm, blood red with dark veins, sparsely pubescent. Stamens many, ca 1 mm long; connectives dome-shaped at top, dark red; anther-thecae contiguous, extrorse. Carpels many, ca 2 mm long, intermixed with hairs, ovate or oblong; stigma sessile, capitate. Ripe carpels many, ovoid, subglobose to oblong, 7 - 10 mm long, 10 - 18 mm across, slightly pubescent; stalks slender, 1 - 1.5 cm long. Seeds usually 1, sometimes few, ovoid, ca 4 x 3 mm.

Fl. Dec. - May; *Fr.* Aug. - Sept.

Distrib. India: Evergreen forests, up to 800 m. West Bengal, Sikkim, Arunachal Pradesh, Assam, Nagaland, Tripura and Meghalaya.

Bhutan and Bangladesh.

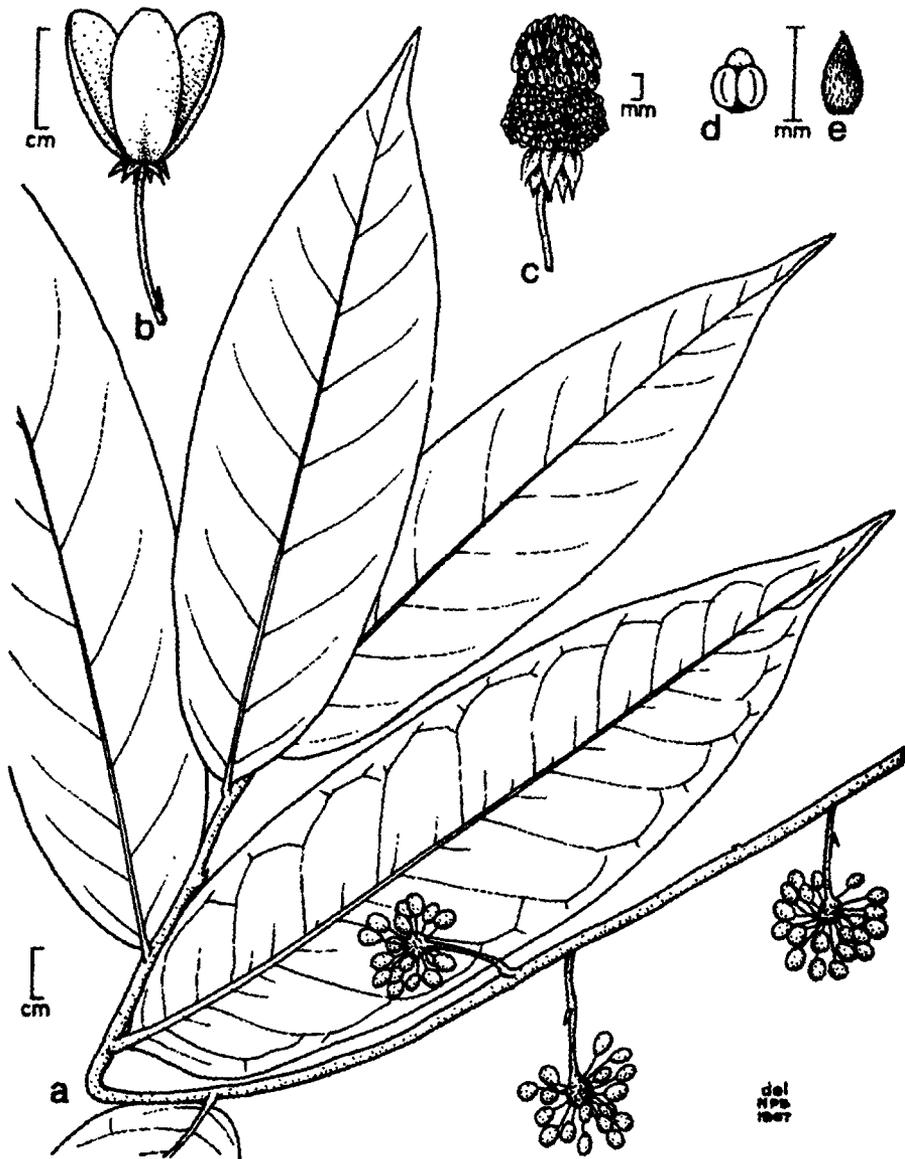


Fig. 32. *Millusa globosa* (DC.) Panigr. & S.C. Mishra: a twig with fruits; b. flower; c. flower with petals removed; d. stamen; e. carpel.

5. *Miliusa indica* Leschen. ex DC. in Mem. Soc. Phys. & Hist. Nat. Geneve 5: 213, t. 3. 1832; Hook. f. & Thomson in Fl. Brit. India 1: 86. 1872.

Shrubs or small trees, 2 - 7 m tall; young parts fusco-pubescent. Leaves oblong elliptic or oblong-lanceolate, rounded or subcordate at base, obtuse or acute at apex, 4 - 9 x 1.5 - 3 cm, glabrous above, except the pubescent sunken midrib, pubescent with straight hairs beneath; petioles 1 - 2 mm long, swollen at base, pubescent. Flowers bisexual, axillary, solitary; pedicels 3 - 6 mm long; bracts 2, at the lower half of the pedicel. Sepals 3, ovate, acute, reflexed, ca 1.5 x 1 mm, pubescent outside. Petals 6 (3 + 3); outer petals like the sepals, broadly ovate; inner ones ovate, subacute, united up to the middle from saccate base, 1.2 - 1.6 x 0.7 cm. Stamens numerous, ca 1 mm long, with connectives rounded-apiculate at top. Carpels many, linear-oblong, ca 2 mm long, densely pilose, 1 - 2-ovuled; style short; stigma subclavate. Ripe carpels numerous, subsessile, ovoid or obovoid, silky pubescent. Seeds 2, yellow, smooth.

Fl. June - July; *Fr.* Oct. - Nov.

Distrib. India: West Bengal, Karnataka, Tamil Nadu and Kerala.

Sri Lanka.

6. *Miliusa longiflora* (Hook. f. & Thomson) Finet & Gagnepain in Bull. Soc. Bot. Fr. 53(4): 153. 1906. *Saccopetalum longiflorum* Hook. f. & Thomson, Fl. Ind. 151. 1855 & in Fl. Brit. India 1: 88. 1872.

Trees; branches puberulous. Leaves obovate-elliptic, ovate-oblong or oblong-lanceolate, rounded or cuneate at base, shortly acuminate at apex, 12 - 25 x 5 - 11 cm, glabrous above except the gland-dotted midrib, appressed pubescent beneath; petioles 5 - 8 mm long, slightly pubescent, gland-dotted. Flowers bisexual, solitary or 2 - 3 together, axillary or in axils of fallen leaves, precocious; pedicels 5 - 7 mm long, pubescent; bracts basal. Sepals 3, linear-lanceolate, acute, 3 - 4 x 1 - 1.5 mm, pubescent. Petals 6 (3 + 3); outer petals like the sepals; inner ones oblong-lanceolate, subsaccate at base, tapering to obtuse apex, 18 - 30 x 4 - 10 mm, reddish at base, puberulous outside, velvety inside; midrib prominent inside. Stamens many, ca 1 mm long; connectives rounded at top. Carpels 6 or more, ovoid, ca 2 mm long, pubescent, 6 - many-ovuled; style linear; stigma broad, concave. Ripe carpels many, black, subglobose, 2 - 3 cm across, glabrous; stalks 1.5 - 1 cm long, glabrous. Seeds many.

Fl. March.

Distrib. India: Tropical and subtropical forests. Bihar, West Bengal, Sikkim and Karnataka.

Bangladesh and Bhutan.

7. *Miliusa macrocarpa* Hook. f. & Thomson, Fl. Ind. 150. 1855 & in Fl. Brit. India 1: 86. 1872.

Nep.: *Kalikat*.

Small trees; branches glabrous. Leaves lanceolate or narrowly oblong, acute at base, long-acuminate at apex, 12 - 20 x 4 - 6 cm, glabrous; petioles 3 - 5 mm long, glabrous. Flowers bisexual, in few-flowered cymes or solitary, extra-axillary or leaf-opposed; pedicels 4 - 8 cm long, glabrous; bracts absent or small, a little above the base of pedicel, ovate-lanceolate, pubescent. Sepals 3, ovate, acute, 8 - 10 x 6 mm, fleshy, glabrous, granulate outside, dull rusty-pubescent inside. Petals 6 (3 + 3); outer petals like the sepals, ovate, acute, ca 10 x 7 mm, glabrous outside, tomentose inside; inner ones broadly ovate or oblong, obtuse or subacute, 10 - 20 x 5 - 8 mm, pink with reddish brown veins, glabrous except a few fugacious hairs near the margin and top of the inner surface. Stamens many, ca 1.5 mm long; connectives flat, blunt with dots; filaments prominent. Carpels many, oblong-spathulate, ca 2.5 mm long, with pubescent dots; style short, linear; stigma broad, blunt. Ripe carpels many, oblong or obovoid, 12 - 16 x 7 mm, dark purple; stalk as long as fruitlets. Seeds 1 - 2.

Fl. April - May; *Fr.* Aug. - Nov.

Distrib. India: Subtropical forests, 1200 - 1700 m. West Bengal, Sikkim, Arunachal Pradesh and Meghalaya.

Bhutan.

8. *Miliusa montana* Gard. ex Hook. f. & Thomson, Fl. Ind. 148. 1855; Beddome, Icon. t. 84. 1868 - 74. *Miliusa indica* Leschen. ex DC. var. *montana* (Gard. ex Hook. f. & Thomson) Hook. f. & Thomson in Fl. Brit. India 1: 86. 1872. *M. indica* Leschen. ex DC. var. *strigosa* Hook. f. & Thomson in Fl. Brit. India 1: 86. 1872.

Shrubs; young branches pubescent. Leaves ovate or ovate-lanceolate, slightly unequal and rounded at base, acute to shortly acuminate at apex, 5 - 7 x 2 - 2.7 cm, glabrous above, pubescent with straight hairs beneath when young; petioles 1 - 2 mm long, pubescent. Flowers bisexual, solitary, leaf-opposed, white, fragrant; pedicels 7 - 15 mm long, almost glabrous; bracts basal and submedian. Sepals 3, ca 1 mm long, pubescent outside. Petals 6 (3 + 3); outer petals like the sepals, linear-lanceolate, acute, ciliate; inner ones connate up to the middle, ovate, acute, 1 - 2 cm long, thin, veined, almost glabrous. Stamens many, ca 1 mm long; connectives slightly apiculate at top. Carpels few, ovate, curved, ca 1 mm long, glabrous; stigma sessile, capitate. Ripe carpels many, subglobose, 7 - 10 mm across, red, glabrous; stalk ca 5 mm long.

Fl. April - June; *Fr.* Aug. - Sept.

Distrib. India: Subtropical hill forests. Tamil Nadu and Kerala.

Sri Lanka.

9. *Millusa mukerjeeana* D. Mitra & P. Chakrab. in Bull. Bot. Surv. India (ined.)
Fig. 33.

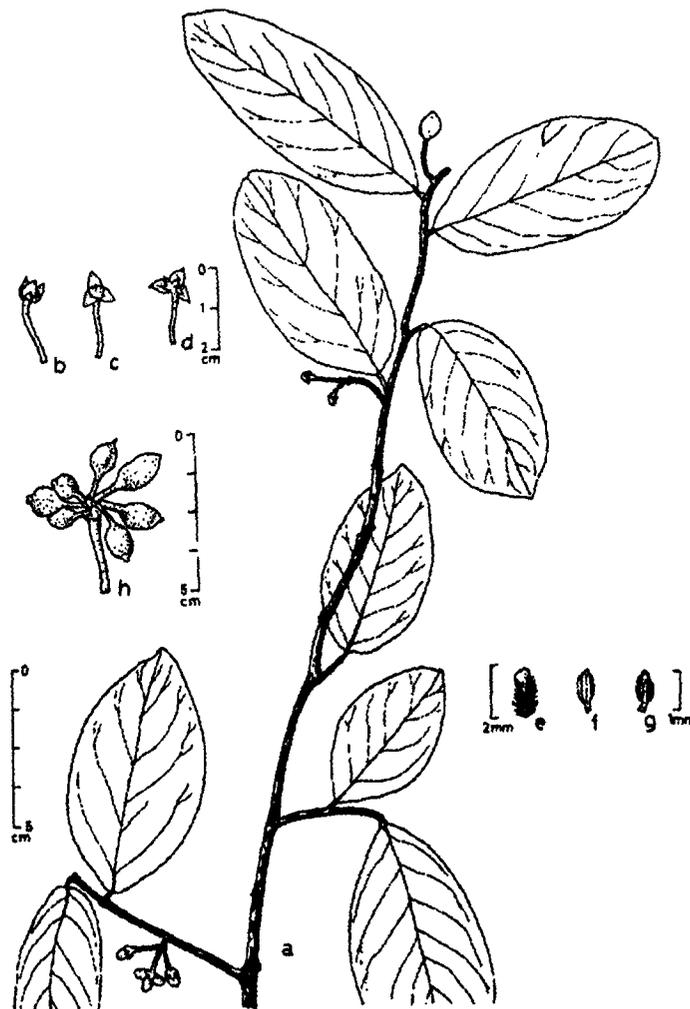


Fig. 33. *Millusa mukerjeeana* D. Mitra & P. Chakrab.: a. branch with flowers; b. flower; c. inner petals; d. sepals and petals; e. carpel; f. & g. stamens, front and back views; h. ripe carpels.

Small trees, 3 - 8 m tall; young branches puberulous. Leaves oblanceolate to lanceolate, cuneate at base, obtuse to acuminate at apex, 9 - 16.5 x 4 - 5 cm, glabrous; lateral nerves 10 - 12 pairs; petioles 2 - 3 mm long. Flowers bisexual, solitary or 2 - 3 together, axillary, greenish yellow; pedicels slender, 1.5 - 2 cm long; bracts 2, minute, basal and submedian, caducous. Sepals 3, valvate, ovate, acute, ca 1 x 1 mm, pubescent outside. Petals 6 (3 + 3), valvate; outer petals like the sepals in size and shape; inner ones free, ovate, acute, ca 5 x 4 mm, very thick, pubescent outside. Torus conical. Stamens ca 1 mm long; filaments short, flattened; connectives small, apiculate at top, not concealing the anther-thecae. Carpels many, oblong, ca 2 mm long, strigose; ovules 3 - 4; style absent; stigma capitate. Ripe carpels many, globose to oblong, 5 - 10 mm across, baccate, red; stalks 4 - 5 mm long. Seeds 1 - 3, transversely ridged, convex above.

Fl. & Fr. April - Nov.

Distrib. India: Hill forests. Andaman & Nicobar Islands.

Endemic.

10. *Millusia nilagirica* Beddome, Icon. Pl. Ind. Or. t. 88. 1868 - 74; Hook. f. & Thomson in Fl. Brit. India 1: 87. 1872.

Large shrubs or small trees, 3 - 5 m tall; young branches rugose. Leaves ovate, lanceolate or elliptic-lanceolate, subcuneate at base, shortly acuminate at apex, 5 - 10 x 2 - 4 cm, glabrous; petioles 3 - 7 mm long. Flowers purplish green, bisexual, solitary, axillary or extra-axillary; pedicels 5 - 10 mm long, glabrous; bracts 2 - 3, basal, minute, glabrous. Sepals 3, minute, ovate, ciliate along margins towards apex, otherwise glabrous. Petals 6 (3 + 3); outer petals like the sepals; inner ones oblong, acute, ca 10 x 2 mm, thick, glabrous except the thickened margins towards the apex. Stamens 8 - 12, uniseriate, ca 1 mm long; connectives blunt at top. Carpels ca 13, oblong, ca 2 mm long; ovules 1 - 2, on ventral sutures; style very short; stigma sessile, oblong or globose. Ripe carpels many, globose or subglobose, apiculate, red, glabrous; stalks 5 - 7 mm long.

Fl. March - June; *Fr.* July - Dec.

Distrib. India: Subtropical evergreen hill forests, at 1200 - 1500 m. Kerala and Tamil Nadu.

Endemic.

11. *Millusia tectona* Hutch. ex C.E. Parkinson, For. Fl. Andaman Isl. 75. 1923. *Saccopetalum tectonum* (Hutch. ex C.E. Parkinson) Chatterjee in Kew Bull. 1948: 59. 1948.

Hindi: *Jungli-saguan*.

Trees, straight-stemmed, 15 - 25 m tall; branches glabrous. Leaves ovate to elliptic-oblong, rounded and often slightly cordate at base, acutely or obtusely acuminate at apex, 10 - 15 x 4 - 6 cm, glabrous; petioles 2 - 4 mm long. Flowers bisexual, solitary or paired in axils of fallen leaves on leafless branches; pedicels 1 - 1.5 cm long, appressed pubescent; bracts and bracteoles early caducous. Sepals 3, ovate-lanceolate, subacute, 6 - 7 x 2.5 - 3 cm, pubescent, minutely gland-dotted, many-nerved. Petals 6 (3 + 3); outer petals sepaloid, larger; inner ones ovate-lanceolate, saccate at base, subacute or obtuse at apex, 3 - 3.5 x 1 mm, velvety tomentose, reddish; midrib prominent, with parallel lateral nerves. Stamens many, ca 1 mm long; connectives obscurely apiculate. Carpels many, 1.5 - 2 mm long, densely hairy, 4 - 7-ovuled; stigma subglobose, rugulose. Ripe carpels ca 8 - 10 mm across.

Fl. May - June.

Distrib. India: Deciduous forests. Andaman & Nicobar Islands.

Java.

Notes. Wood apparently resembling teak, but very unlike it.

12. *Miliusa tomentosa* (Roxb.) Finet & Gagnepain in Bull. Soc. Bot. Fr. 53(4): 153. 1906. *Uvaria tomentosa* Roxb., Pl. Corom. 1: t.35. 1795 & Fl. Ind. 2: 667. 1832. *Saccolatum tomentosum* (Roxb.) Hook. f. & Thomson in Fl. Brit. India 1: 88. 1872.

Hindi: *Kari, Kirua*; Kan.: *Heccara*; Or.: *Gonthipolato*; Tam.: *Perivuvay*; Tel.: *Budda-dudduca*.

Large trees, deciduous, 15 - 20 m tall; bark longitudinally fissured; young parts tomentose, glabrescent. Leaves ovate or oblong-ovate, rounded or subacute at base, obtuse or acute at apex, 8 - 17 x 5 - 8 cm, tomentose above when young, glabrous with age except midrib, tomentose beneath; petioles 2 - 5 mm long, tomentose. Flowers bisexual, solitary or a few together, leaf-opposed or subterminal, greenish yellow; pedicels 3 - 7 cm long, tomentose, very slender, bracteate at base. Sepals 3, linear-lanceolate, ca 1 mm long, tomentose. Petals 6 (3 + 3); outer petals sepaloid, linear-lanceolate, 4 - 7 mm long; inner ones oblong-ovate, saccate at base, obtuse, 1.5 - 2 x 0.5 cm, tomentose. Stamens many, ca 1 mm long; connectives apiculate at top. Carpels many, broadly ovate, ca 1.5 mm long; ovules 4 - 6; stigma sessile, globose. Ripe carpels many, subglobose, tapering to base, 2 - 3 cm in diam., succulent, tomentose, purple; stalks 1 - 1.5 cm long, stout, tomentose when young. Seeds 4 - 5.

Fl. March - May; *Fr.* May - July.

Distrib. India: Deciduous forests. Rajasthan, Bihar, Orissa, Maharashtra, Andhra Pradesh, Karnataka and Tamil Nadu.

Nepal and Sri Lanka.

13. *Millusa velutina* (Dunal) Hook. f. & Thomson, Fl. Ind. 151. 1855 & in Fl. Brit. India 1: 87. 1872. *Uvaria velutina* Dunal, Monogr. Anon. 91. 1817. *Uvaria villosa* Roxb., Fl. Ind. 2: 664. 1832.

Mal.: *Kana-kaitha*, *Viluni*.

Large trees; young branches densely golden tomentose. Leaves ovate or oblong-elliptic, obliquely cordate at base, acute to acuminate at apex, 10 - 31 x 4 - 12 cm, velvety tomentose on both sides; petioles 2 - 7 mm long, tomentose. Flowers bisexual, few, in leaf-opposed cymes, pale yellow or greenish; pedicels 4 - 7.5 cm long, tomentose; bracts minute, basal. Sepals 3, ovate, acute, 2 - 4 mm long, velvety in bud, densely tomentose afterwards. Petals 6 (3 + 3); outer petals sepaloid, 3 - 4 x 1 - 1.5 mm; inner ones broadly ovate, slightly acute, 6 - 10 x 6 mm, dark brown, densely tomentose outside, glabrous inside. Stamens many, ca 1.5 mm long; connectives bluntly apiculate; filaments strong and stout. Carpels many, oblong, ca 2 mm long, velutinous, 2-ovuled; stigma subsessile, concave, bilobed. Ripe carpels many, ovoid or ellipsoid, 1.5 - 2.5 cm in diam., bluish purple, tomentose; stalks 5 - 10 mm long. Seeds 1 - 2.

Fl. Feb. - May; Fr. June - Oct.

Distrib. India: Jammu & Kashmir, Uttar Pradesh, Bihar, West Bengal, Assam, Meghalaya, Orissa, Madhya Pradesh and Andhra Pradesh and Kerala (?).

Myanmar, Cambodia, Laos, Vietnam and Thailand.

14. *Millusa wightiana* Hook. f. & Thomson, Fl. Ind. 149. 1855 & in Fl. Brit. India 1: 87. 1872.

Small evergreen trees, 10 - 15 m tall; branches glabrous. Leaves narrowly oblong to lanceolate, slightly cuneate at base, abruptly obtusely acuminate at apex, 4.5 - 9.5 x 1.5 - 5 cm, coriaceous, glabrous, somewhat pubescent on nerves beneath; petioles ca 2 mm long, glabrous. Flowers pink, bisexual, solitary, axillary; pedicels 1.5 - 2.5 cm long, glabrous; bracts 3, basal and one a little above the base. Sepals 3, minute, reflexed. Petals 6 (3 + 3); outer petals like the sepals; inner ones ovate-oblong, cuneate at base, subacute at apex, 10 - 15 x 6 - 8 mm, connate at base, veined, puberulous outside. Stamens many, in a few series, ca 1 mm long, much broader; connectives apiculate at top. Carpels many, oblong, ca 2 mm long, 1 - 2-ovuled, pubescent with straight hairs; style short; stigma oblong. Ripe carpels many, pisiform, oblong, ca 1 cm across, glabrous, granulate; stalks 4 - 7 mm long. Seeds 1 - 2.

Fl. Jan. - March; Fr. May - Aug.

Distrib. India: Evergreen forests of Western Ghats. Kerala and Tamil Nadu.

Endemic.

4. *Orophea* Blume

Erect shrubs or small trees. Leaves membranous, pellucid-dotted. Flowers bisexual, axillary or supra-axillary, solitary or a few together in cymes or 2-seriate in racemes. Sepals 3, valvate. Petals 6 (3 + 3), larger than sepals; outer petals shorter than inner ones, ovate, free; inner ones clawed, cohering by the margins of limb into a mitriform cap, vaulted over the sexual organs. Stamens 3 - 9 (-12), alternating with staminodes or not, miliusoid; connectives slightly produced at top or not. Carpels 3 - 15, hairy; ovules 1 - 4; style short or absent; stigma sessile. Ripe carpels elongate-cylindric or globose, fleshy, red. Seeds 1 - 4.

India, Sri Lanka, Bangladesh, Myanmar, S. China, Thailand, Cambodia to Malesia and New Guinea; ca 60 species, 10 species in India.

Literature. KEBLER, P. J. A. (1988) Revision der Gattung *Orophea* Blume (Annonaceae). *Blumea* 33: 1 - 80, ff. 1 - 12.

KEY TO THE SPECIES

- | | |
|---|---------------------------|
| 1a. Inner petals revolute | 2 |
| b. Inner petals not revolute | 3 |
| 2a. Leaves 6 - 9 cm long; stamens 6, uniseriate; ripe carpels globose | 4. <i>O. monosperma</i> |
| b. Leaves 10 - 14 cm long; stamens 12, biseriate; ripe carpels torulose | 8. <i>O. torulosa</i> |
| 3a. Stamens 6, all fertile | 4 |
| b. Stamens 8 - 12, some imperfect | 6 |
| 4a. Pedicels ca 5 mm long | 6. <i>O. salacifolia</i> |
| b. Pedicels 10 - 20 mm long | 5 |
| 5a. Leaves ovate-elliptic or lanceolate; main lateral nerves ca 10 pairs | 5. <i>O. polycarpa</i> |
| b. Leaves ovate-oblong; main lateral nerves 4 - 7 pairs | 10. <i>O. zeylanica</i> |
| 6a. Inner petals 10 - 15 mm long | 3. <i>O. katschallica</i> |
| b. Inner petals 5 - 7 mm long | 7 |
| 7a. Ripe carpels oblong | 8 |
| b. Ripe carpels globose | 9 |
| 8a. Flowers and pedicels densely brown tomentose; ripe carpels not curved | 1. <i>O. erythrocarpa</i> |
| b. Flowers and pedicels pubescent; carpels curved at tip | 2. <i>O. hexandra</i> |
| 9a. Flowers 2 - 3 together; ripe carpels not apiculate at apex | 7. <i>O. thomsonii</i> |
| b. Flowers solitary; ripe carpels apiculate at apex | 9. <i>O. uniflora</i> |

1. *Orophea erythrocarpa* Beddome in Trans. Linn. Soc. Lond. 20: 5. 1846 & in Madras J. Sci. 22(2): 71. 1861 & Icon. Pl. Ind. Or. t. 68. 1869; Hook. f. & Thomson in Fl. Brit. India 1: 91. 1872.

Medium-sized trees; young parts softly pubescent. Leaves elliptic, rounded at base, acuminate at apex, 8 - 13 x 3 - 4.5 cm, glabrous above, pubescent beneath, especially on midrib; petioles ca 4 mm long, pubescent. Flowers 3 - 4 together, axillary or supra-axillary; pedicels 1 - 2 cm long, villous; bracts at the base and above middle. Sepals 3, minute, orbicular, tomentose. Petals 6 (3 + 3); outer petals ovate, acute, ca 4 x 3 mm, brown tomentose outside, glabrous inside; inner ones clawed; limb trapezoid, 5 - 6 mm long, tomentose. Stamens 12 in 2 rows, ca 1.5 mm long; outer 6 imperfect, very small; connectives slightly apiculate at top. Carpels 4 - 6, ovate-oblong, ca 1.5 mm long, densely strigose; ovules 2; stigma sessile. Ripe carpels oblong, acute at both ends, ca 2.5 cm long, red. Seed 1, scrobiculate.

Fl. & Fr. Jan. - July.

Distrib. India: Evergreen forests. Andaman & Nicobar Islands (?), Tamil Nadu and Kerala.

Endemic.

2. *Orophea hexandra* Blume, Bijdr. 1: 18. 1825. *O. acuminata* DC. in Mem. Soc. Phys. Geneve 5: 215. 1832; Hook. f. & Thomson in Fl. Brit. India 1: 91. 1872.

Shrubs or small trees, 5 - 6 m tall; branches densely pubescent when young. Leaves ovate, ovate-lanceolate to oblong-lanceolate, rounded at base, acuminate at apex, 10 - 13.5 x 3.5 - 6.3 cm, glabrous above and softly pubescent on midrib and nerves beneath; lateral nerves 7 - 9 pairs; petioles 2 - 3 mm long, pubescent. Flowers greenish white, ca 6 mm long, axillary or supra-axillary, solitary or 2 - 3-flowered subracemes; pedicels ca 1 cm long, pubescent; bracts few at base, one at the middle, subulate, pubescent. Sepals 3, ovate, ca 1 mm long, densely pubescent. Petals 6 (3 + 3); outer petals ovate-cordate, ca 5 x 4 mm long, pubescent; inner trapezoid with long claw, vaulted and cohering; limb ca 7 mm long, glabrous, except the pubescent margin and tip. Stamens 9 (3 + 6), ca 1.5 mm long; outer row with 3 sterile ones and inner row with 6 fertile ones; connectives slightly projecting at top. Carpels 4 - 6, oblong, ca 2 mm long, densely strigose, 2-ovuled; styles short; stigma globose. Ripe carpels solitary, nearly sessile, oblong, 2.5 - 3 cm long, curved and beak-shaped at tip, minutely appressed pubescent; stalks ca 1 cm long. Seed solitary, narrowly cylindrical.

Fl. Dec. - Jan.; *Fr.* Feb. - April.

Distrib. India: Andaman & Nicobar Islands.

Myanmar, Indo-china to Malesia.

3. *Orophea katschallica* Kurz in J. Bot. 4: 323 - 324. 1875, emend. Thoth. in Indian For. 92(8): 530, t.1. 1966.

And. (Onge): *Tonyoge*.

Trees, 8 - 10 m tall; young branches puberulous at first, then glabrous. Leaves oblong-lanceolate or elliptic, subcuneate or rounded at base, acuminate at apex, 11 - 18.5 x 4.5 - 7.5 cm, glabrous above, slightly appressed-puberulous beneath; petioles ca 4 mm long, puberulous when young. Flowers solitary or 2 - 4 together, extra-axillary, 5 - 12 mm across, creamy white; peduncle 1 - 2 cm long; pedicels 5 - 7 mm long, pubescent; bract placed at the middle, ovate-lanceolate to subulate, 1 - 1.5 mm long. Sepals 3, ovate, acute or triangular, ca 3 mm long, pubescent outside, subglabrous inside. Petals 6 (3 + 3); outer petals ovate, acute, 5 - 7 x 5 - 6 mm, veined, minutely pubescent outside and at tips inside; inner ones clawed, mitriform, 1 - 1.5 cm long; claw slender, glabrous; limb rhomboid, acuminate, pubescent. Stamens 9 in two rows of 3 outer staminodes and 6 inner fertile ones; connectives slightly produced. Carpels 3, narrowly ovoid, densely hirsute, 6 - 10-ovuled; stigma sessile, truncate. Fruits consisting of 3 carpels, each cylindric or linear-oblong, narrow at base, constricted between seeds, pointed at apex, 5 - 10 cm long. Seeds 6 - 8, linear-oblong, 6 - 13 x 3 - 6 mm, pale brown with minute transverse furrows.

Fl. June - Sept.; *Fr.* Dec. - Jan.

Distrib. India: Andaman & Nicobar Islands.

Endemic.

Notes. Kurz's description (1875) of the species is incomplete, particularly with regard to certain floral parts and fruits. King (in Ann. R. Bot. Gard. Calc. 4: 103 - 104. 1893) described the stamens and pistil. Still the fruit characters were unknown, which were described by Thothathri (l. c.), who gave a complete description with illustration for the species.

The Onges, the tribal community living in Little Andaman Island, use the leaves of this plant as insect repellent while going for collection of honey. Before climbing the trees to collect honey, they chew some fresh leaves and rub the juice thus obtained over their body. Then they chew some more leaves and climb the trees keeping the leaves in their mouth. On reaching the honey comb they spit the juice on to the comb, which is found to drive away all bees and help them in preventing bites.

4. *Orophea monosperma* (Kurz) Craib in Bull. Misc. Inf. Kew 1915: 434. 1915. *Melodorum monospermum* Kurz, Rep. Veg. Andaman Isl. 29. 1870. *Orophea polycarpa* Hook. f. & Thomson in Fl. Brit. India 1: 91. 1872, p. p. (non DC.).

Shrubs; young branches densely pubescent. Leaves ovate-elliptic, slightly acute or rounded at base, acuminate at apex, 6 - 9 x 3 - 4 cm, glabrous above, softly pubescent on the midrib and lateral nerves beneath; petioles ca 2 mm long. Flowers solitary or 2 - 3 together, usually axillary; pedicels 1 - 1.2 cm long, tomentose; bracts at the base and middle of the pedicels. Sepals 3, broadly ovate, acute, ca 1.5 x 1 cm, connate along, slightly ciliate along margins, pubescent outside. Petals 6 (3 + 3), reddish green to greenish yellow; outer petals ovate, acute, concave at base, 2 - 3 x 1 mm, ciliate along margins, pubescent outside; inner ones twice as long as the outer ones, thick, clawed, short, pubescent at margins and tip; limb revolute, ca 7 mm long. Stamens 6, uniseriate; filaments short; connectives flat at top. Carpels 9 - 12, oblong, glabrous, 2-ovuled; stigma sessile, oblong, beak-shaped. Ripe carpels few, globose, reddish, glabrous; stalks ca 5 mm long. Seeds 1 - 2.

Fl. March - June; *Fr.* July - Sept.

Distrib. India: Andaman Islands.

Endemic.

Notes. A plant of this species is in cultivation at Indian Botanic Garden, Howrah.

5. *Orophea polycarpa* DC. in Mem. Soc. Phys. Geneve 5: 39. 1832; Hook. f. & Thomson in Fl. Brit. India 1: 91. 1872. *O. gracilis* King in Mat. Fl. Malay. Pen. 1: (4): 332. 1872 & Ann. R. Bot. Gard. Calc. 4: 107, t. 149 A. 1893. Fig. 34.

Trees, 5 - 10 m high; young branches densely pubescent. Leaves ovate-elliptic or lanceolate, slightly acute or rounded at base, acuminate at apex, 6 - 12.5 x 3 - 5.5 cm, glabrous above, softly puberulous on midrib and veins beneath; lateral nerves 6 - 8 pairs; petioles 4 - 5 mm long, glabrous. Flowers greenish yellow, 10 - 12 mm long, solitary or 2 - 3 together, extra-axillary; pedicels ca 1 cm long, pubescent; bracts subulate, ca 1 mm long, positioned at base or at middle of pedicels. Sepals 3, ovate, connate at base, obtuse at apex, ca 1 x 0.5 mm, pubescent on the outer surface and ciliate along margins. Petals 6 (3 + 3); outer petals ovate, acute, 2 - 3 x 0.5 - 1 mm, glabrous, ciliate along margins; inner clawed, vaulted over the stamens and carpels, twice as long as outer ones; limb connate at first, later free, 4 - 5 mm long, thick. Carpels 9 - 12, oblong, ca 1 mm long, glabrous; ovules 2; style bent. Ripe carpels few, globose, ca 1 cm in diam., glabrous, glossy; stalks stout, ca 5 mm long. Seeds 1 - 2, transversely grooved.

Fl. March - April; *Fr.* June - Aug.

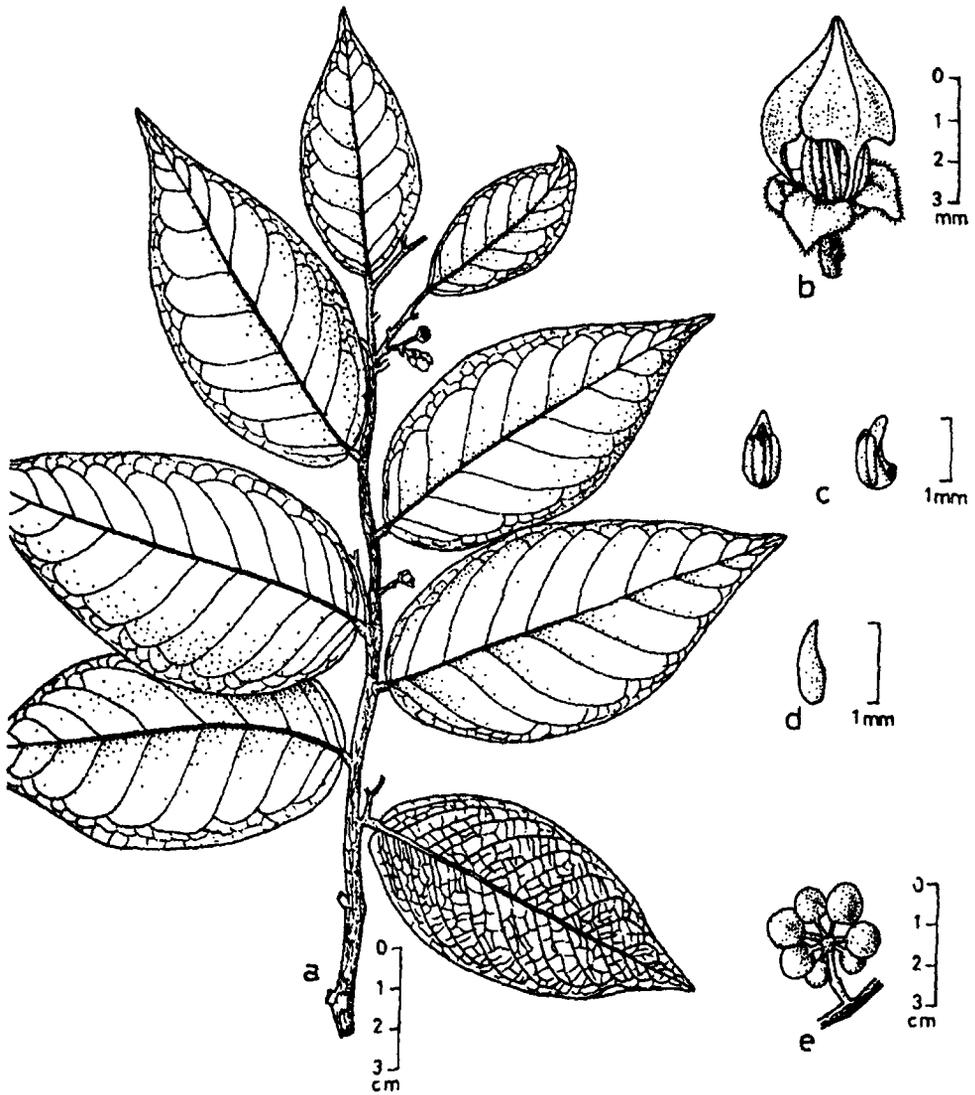


Fig. 34. *Orophea polycarpa* DC. : a. flowering twig; b. flower; c. stamens, front and side views; d. carpel; e. ripe carpels.

Distrib. India: Meghalaya and Andaman & Nicobar Islands.

Myanmar, Thailand and Cambodia.

6. *Orophea salacifolia* Hutch. in Bull. Misc. Inf. Kew 1923: 371. 1923.

Small trees; branches slightly flexuous, almost glabrous. Leaves broadly oblong-elliptic, rounded at base, acuminate at apex; petioles 3 - 4 mm long, sparsely pubescent. Flowers solitary, sometimes in pairs; pedicels ca 5 mm long, tomentose, with a few bracts at the base. Sepals 3, broadly triangular, acuminate, 2 - 2.5 x 2 - 2.5 mm, appressed pilose. Petals 6 (3 + 3); outer petals twice as long as sepals, pilose outside; inner ones clawed, connivent above, longer than outer ones. Stamens 6, curved, ca 1 mm long; connectives shortly produced. Carpels few, ca 1 mm long, glabrous; stigma sessile, globose. Ripe carpels not seen.

Fl. not known.

Distrib. India: Andaman & Nicobar Islands.

Endemic.

7. *Orophea thomsonii* Beddome in Trans. Linn. Soc. Lond. 20: 5. 1846 & in Madras J. Sci. 22(2): 72. 1861 & Icon. Pl. Ind. Or. t. 68. 1869 - 74; Hook. f. & Thomson in Fl. Brit. India 1: 91. 1872.

Small trees or large shrubs; branches glabrous. Leaves ovate-elliptic, cuneate at base, long-acuminate at apex, 5 - 6.5 x 2.5 - 3.5 cm, glabrous, except midrib beneath; petioles 2 - 5 mm long. Flowers axillary, 2 - 3 together; peduncle strigose; pedicels very short, slender, pubescent; bracts minute, basal. Sepals 3, ovate-orbicular, very small, strigose. Petals 6 (3 + 3); outer petals similar to sepals; inner ones clawed, ca 5 mm long, puberulous at apex, reddish inside. Stamens 10 - 12, biseriate; connectives not concealing the anther-thecae, blunt. Carpels 5 - 6, ovoid, strigose, 2-ovuled; style short; stigma produced. Ripe carpels few, pisiform.

Fl. Oct.; *Fr.* Feb. - March.

Distrib. India: Hilly regions of W. Ghats. Tamil Nadu.

Endemic.

8. *Orophea torulosa* Hutch. in Bull. Misc. Inf. Kew 1923: 115. 1'

Trees; branches glabrous. Leaves broadly elliptic, rounded at base, abruptly long-acuminate, 10 - 14 x 4 - 6 cm, glabrous above, sparsely pilose on the lower surface; petioles

ca 3 mm long, transversely rugose or sparsely setose. Flowers usually in pairs, axillary, subsessile or minutely pediceled. Sepals 3, triangular, acuminate, ca 2 x 2mm, appressed pilose. Petals 6 (3 + 3); outer petals broadly ovate, acute, ca 3 x 2 mm, densely ciliolate along margins, sparsely puberulous outside, glabrous inside; inner ones clawed, short; limb ca 5 mm long, broader at base, connivent above, recurved at tips, sparsely puberulous. Stamens 12, biseriate, ca 1 mm long, subglobose or squarish; connectives triangular. Carpels ca 7, kidney-shaped, glabrous, compressed; stigma projecting forward like a beak. Ripe carpels ca 7 cm long, torulose; segments ca 1 cm long. Seed 1 in each segment.

Fl. April; *Fr.* Aug.

Distrib. India: Andaman & Nicobar Islands.

Endemic.

9. *Orophea uniflora* Hook. f. & Thomson, *Fl. Ind.* 111. 1855 & in *Fl. Brit. India* 1: 90. 1972.

Shrubs or small trees; branchlets and buds glabrous. Leaves elliptic-oblong or lanceolate, acute at base, obtusely acuminate at apex, 4 - 8 x 2 - 3.5 cm, thinly coriaceous, glabrous; petioles slender, 3 - 4 mm long, glabrous. Flowers usually solitary, axillary; pedicels slender, 7 - 20 mm long, glabrous; bracts many at the base and above the middle on pedicels. Sepals 3, suborbicular, ciliate. Petals 6 (3 + 3); outer petals ovate to orbicular, 5 - 7 x 4 - 5 mm, glabrous; inner ones trapezoid, tapering into a narrow claw, ca 6 mm long; limb coherent by their thickened tips. Stamens 12 in 2 rows, ca 0.5 mm long; connectives not concealing the anthers, acute at tip. Carpels 6, oblong, ca 0.5 mm long, 2-ovuled; stigma subsessile, oblong. Ripe carpels few together, globose, apiculate, glabrous, brownish black, short-stalked. Seeds 1 - 2.

Fl. Aug. - Oct.; *Fr.* Jan. - Feb.

Distrib. India: Karnataka, Kerala and Tamil Nadu.

Endemic.

10. *Orophea zeylanica* Hook. f. & Thomson, *Fl. Ind.* 111. 1855 & in *Fl. Brit. India* 1: 91. 1872. *O. malabarica* Sasidharan & Sivarajan in *Blumea* 35: 269-271, f. l. 1990, syn. nov.

Small trees or shrubs, 1 - 2 m high; young branches yellow pubescent. Leaves ovate or elliptic-oblong, almost rounded at base, shortly and obtusely acuminate at apex, 6.5 - 8 x 3 - 4.5 cm, dark green above, pale beneath, puberulous beneath when young, later glabrous; lateral nerves 4 - 7 pairs; petioles ca 2 mm long, glabrous. Flowers solitary

or 2 - 3 together, axillary or extra-axillary; pedicels 1 - 2 cm long, pubescent when young; bracts small, at the base of pedicels. Sepals 3, ovate-orbicular, acute, ca 1 x 1 mm, connate at base, pubescent. Petals 6 (3 + 3); outer ones almost orbicular, 3 - 4 mm across, veined, downy; inner ones clawed, 4 - 5 mm long, glabrous, except the pubescent margin. Stamens 6, in one row, ca 0.5 mm long; connectives slightly pointed at the apex. Carpels 9 (3 - 15), obovate, ca 1.5 mm long, glabrous, 2-ovuled; stigma capitate, subsessile. Ripe carpels globose, ca 7.5 mm in diam.; stalks 2 - 3 mm long. Seeds 1 - 2.

Fl. May; *Fr.* Sept.

Distrib. India: Evergreen forests, up to 800 m. Maharashtra, Karnataka and Kerala.

Sri Lanka.

5. *Phaeanthus* Hook. f. & Thomson

Trees or climbers. Leaves with obliquely ascending nerves. Flowers bisexual, solitary, terminal or 2 - 3 in extra-axillary fascicles. Sepals 3, small, valvate. Petals 6 (3 + 3); outer small, like the sepals; inner larger, flat or triquetrous. Stamens numerous, narrow-oblong; anther-thecae not fully concealed by the truncate connectives; filaments about the same length as the anthers. Carpels many; ovules 1 - 2, subbasal, ascending; style distinct; stigma club-shaped. Ripe carpels several, stalked. Seed 1.

India, Myanmar, Cambodia, Malaysia, Borneo, Indonesia, Philippines and New Guinea; ca 20 species, one in India.

Phaeanthus malabaricus Beddome, *Icon. Pl. Ind. Or.* t. 76. 1868 - 74; Hook. f. & Thomson in *Fl. Brit. India* 1: 72. 1872; Mohanan et al. in *J. Econ. Tax. Bot.* 5: 399, t.1. 1984.

Shrubs or small trees, 2 - 5 m tall; young parts ferruginous pubescent. Leaves obovate or oblong-lanceolate, more or less cordate at base, caudate-acuminate at apex, 12 - 16 x 3 - 5 cm, glabrous, pubescent only on midrib beneath; lateral nerves 5 - 10 pairs; petioles 3 - 4 mm long, ferruginous. Flowers pale yellow to reddish, ca 1 cm long, solitary or in pairs, extra-axillary or leaf-opposed; peduncles ca 2 cm long; pedicels ca 1 cm long, ferruginous; bracts 2, minute, basal. Sepals 3, valvate in bud, ovate or orbicular, slightly cuneate at base, acute at apex, ca 3 mm long, densely ferruginous pubescent. Petals 6 (3 + 3); outer petals like the sepals, ovate, acute, ca 7 x 4 mm long; inner ones cymbiform, oblong-acute, inflexed, 7 - 10 x 4 - 6 mm, thickly fleshy. Stamens many, less than 1 mm long; connectives truncate at top, not completely covering the anthers. Carpels many, linear-oblong, ca 1.5 mm long, densely pubescent; ovules 1 - 2 on the ventral suture; style club-shaped; stigma hairy. Ripe carpels 15 - 20, globose, ca 8 mm across, rarely puberulous; stalks ca 5 mm long.

Fl. Feb. - May; *Fr.* July - Sept.

Distrib. India: Evergreen forests of North Kerala.

Endemic, rare.

Tribe 3. MITREPHOREAE

Shrubs or trees. Sepals and petals valvate. Petals usually dissimilar; inner petals clawed, connivent, arching over the reproductive organs, forming a dome (mitriform), usually shorter than the outer ones, sometimes longer (in *Popowia* and *Pseuduvaria*). Stamens many; connectives flat-topped.

6. *Goniothalamus* (Blume) Hook. f. & Thomson

Shrubs or small trees. Leaves coriaceous, with prominent nerves forming intramarginal loops. Flowers solitary or few in fascicles, axillary or extra-axillary or sometimes cauliflorous; pedicels with basal scaly distichous bracts. Sepals 3, valvate, several-nerved, free or cup-shaped, often persistent in fruit. Petals 6 (3 + 3), valvate, coriaceous; outer petals erect, flat; inner ones smaller, shortly and broadly clawed at base, with upper part broadened and cohering in a narrow conical vaulted cap over the stamens and carpels. Stamens many, linear-oblong; anther-thecae remote, dorsal; pollen grains large; connectives produced into oblong or truncate processes. Carpels many, cylindrical; style linear; stigma simple or bifid; ovule solitary or 2, superposed, subbasal. Ripe carpels subsessile. Seed 1, sometimes 2 - 4.

India, Sri Lanka, Bangladesh, Bhutan, Myanmar, Thailand, Cambodia, Malaysia, Indonesia, Philippines, New Guinea and Pacific Islands; ca 115 species, 10 species in India.

Literature. NGUYEN, Tien Ban (1974) On the taxonomy of the genus *Goniothalamus* (Bl.) Hook. f. & Thoms. I & II. Bot. Zhurnal URSS. 59: 547 - 555 & 660 - 672.

KEY TO THE SPECIES

- | | |
|---|-------------------------|
| 1a. Ripe carpels distinctly ridged when dry | 4. <i>G. meeboldii</i> |
| b. Ripe carpels not ridged | 2 |
| 2a. Connectives of stamens apiculate at top | 3 |
| b. Connectives of stamens flat or convex at top | 7 |
| 3a. Outer petals linear-lanceolate, 6 - 11 cm long | 2. <i>G. macranthus</i> |
| b. Outer petals ovate, ovate-lanceolate or oblong-lanceolate, less than 8 cm long | 4 |
| 4a. Outer petals ovate-lanceolate, 3 - 8 cm long | 3. <i>G. malayanus</i> |
| b. Outer petals ovate or oblong-lanceolate, 4 cm or less long | 5 |

- | | |
|--|-----------------------------|
| 5a. Stigma entire | 5. <i>G. rhynchantherus</i> |
| b. Stigma bifid | 6 |
| 6a. Outer petals broadly ovate, ca 2 cm long | 10. <i>G. wynaadensis</i> |
| b. Outer petals oblong-lanceolate, 3 - 4 cm long | 7. <i>G. simonsii</i> |
| 7a. Outer petals 3 - 3.5 cm long | 8. <i>G. thwaitesii</i> |
| b. Outer petals not more than 3 cm long | 8 |
| 8a. Leaves 25 cm or longer | 6. <i>G. sesquipedalis</i> |
| b. Leaves below 25 cm long | 9 |
| 9a. Leaves oblong-lanceolate; ripe carpels shortly stalked | 1. <i>G. cardiopetalus</i> |
| b. Leaves lanceolate; ripe carpels almost sessile | 9. <i>G. wightii</i> |

1. *Goniothalamus cardiopetalus* (Dalz.) Hook. f. & Thomson, Fl. Ind. 107. 1855 & in Fl. Brit. India 1: 75. 1872. *Polyalthia cardiopetala* Dalz. in Hook. Kew J. Bot. Lond. 2: 39. 1850. **Fig. 35.**

Shrubs or small trees, 3 - 5 m tall; young branches puberulous. Leaves oblong-lanceolate or oblanceolate, cuneate at base, abruptly acuminate at apex, slightly undulate along margins, 10 - 23 x 2.5 - 7.5 cm, coriaceous, glabrous, brownish beneath; lateral nerves 8 - 15 pairs, prominently raised beneath, looping near margins; petioles 5 - 10 mm long, glabrous. Flowers solitary or superposed, axillary; pedicels 5 - 10 mm long, pubescent when young; bracts minute at the base of pedicels. Sepals 3, almost orbicular, connate up to middle, free at tips, ca 6 mm across, brownish pubescent. Petals 6 (3 + 3); outer petals cucullate, oblong-ovate, clawed at base, acute at apex, 10 - 15 x 4 - 6 mm, brown tomentose; inner ones triangular, united into a mitriform column, 6 - 9 x 5 mm. Stamens many, ca 2 mm long; connectives capitate at top. Carpels many, linear-oblong, ca 3 mm long, brown-pubescent, 1-ovuled; styles 2 - 3 mm long, bifid, elongate, curved; stigma bilobed. Ripe carpels ellipsoid, ca 1.5 x 0.7 cm; seed 1.

Fl. Jan. - March; *Fr.* July - August.

Distrib. India: Karnataka, Tamil Nadu and Kerala.

Endemic.

Notes. Wood used for posts.

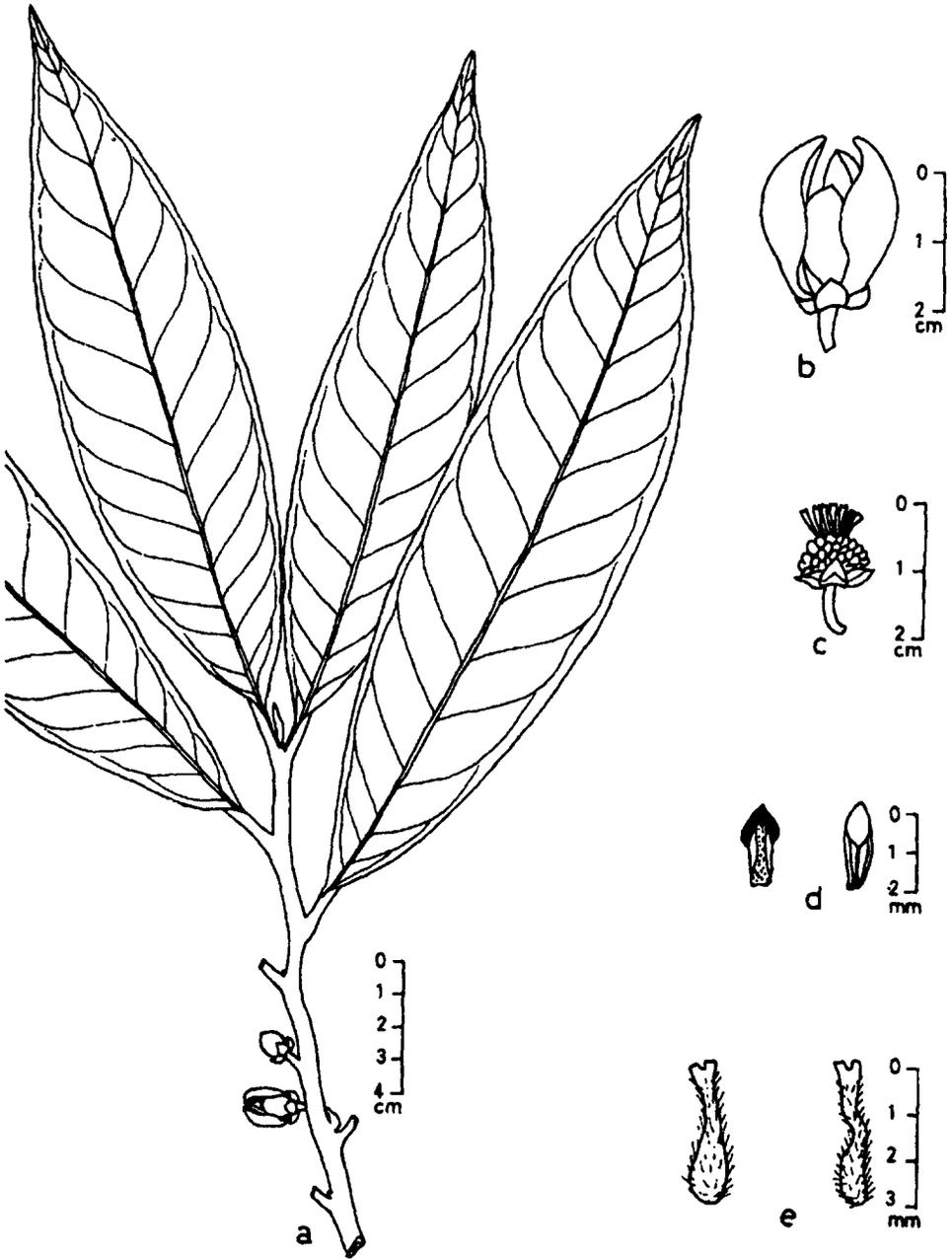


Fig. 35. *Goniiothalamus cardiopetalus* (Dalz.) Hook. f. & Thomson : a. flowering twig; b. flower; c. flower with petals removed; d. stamens, back and front views; e. carpels.

2. *Goniothalamus macranthus* (Kurz) Boerl. in Icon. Bogor. 1: 137. 1899. *Unona macrantha* Kurz, Andaman Rep. 1: app. B.1. 1867, nom. nud. *Melodorum macranthum* Kurz in J. Asiat. Soc. Beng. 41: 291.1872.

Small trees or shrubs; branches glabrous. Leaves oblong to elliptic-oblong, cuneate at base, obtuse or abruptly acuminate at apex, 10 - 19 x 4 - 8 cm long, glabrous; petioles 1 - 1.5 cm long, glabrous or puberulous on both surfaces when young. Flowers solitary, axillary, drooping; pedicels 1 - 2 cm long, puberulous or glabrous; bracts few, at the base of pedicels, caducous. Sepals 3, united at base, ovate or triangular, acute to subacute, 8 - 10 x 7 - 9 mm, brown pubescent at the tip inside. Petals 6 (3 + 3), greenish white, becoming yellowish; outer petals narrowly linear-lanceolate or broadly lanceolate, slightly clawed at base, subacute at apex, 6 - 11 x 0.7 - 1.5 cm, thickly coriaceous, with a distinct midrib, pubescent on both sides, densely hairy at the base and ridge outside; inner ones clawed, triquetrous, cohering by their edges, vaulted at base, ca 2 x 0.4 - 0.6 cm, brown tomentose. Stamens many, linear, 3.5 - 4 mm long; connectives apiculate at top, pubescent. Carpels many, cylindrical, narrowly oblong, curved, ca 5 mm long, rufous pubescent, 4-ovuled; style cylindrical, pubescent; stigma slightly bifid. Ripe carpels many, cylindrical, with 2 or 3 constrictions between seeds, apiculate at apex, 3.5 - 6 cm long, slightly verrucose; stalks ca 1.5 cm long, verrucose. Seeds 1 - 4, compressed, ovoid, smooth.

KEY TO THE VARIETIES

- | | |
|--|-------------------------------|
| 1a. Outer petals broadly lanceolate, 6 - 7 cm long | 2.1. var. <i>brevipetalus</i> |
| b. Outer petals linear-lanceolate, 8 - 11 cm long | 2.2. var. <i>macranthus</i> |

2.1. var. *brevipetalus* D. Mitra in Bull. Bot. Surv. India (ined.).

Fig. 36.

Differs from var. *macranthus* in the size and shape of the sepals and petals. Here the sepals are triangular with subacute tips, ca 1 cm long and broad; outer petals are broadly lanceolate, 6 - 7 cm long, ca 1.5 mm broad.

Fl. May.

Distrib. India: Andaman & Nicobar Islands (Mangunj hill jungle, *King's coll.* s. n. in CAL).

Endemic.

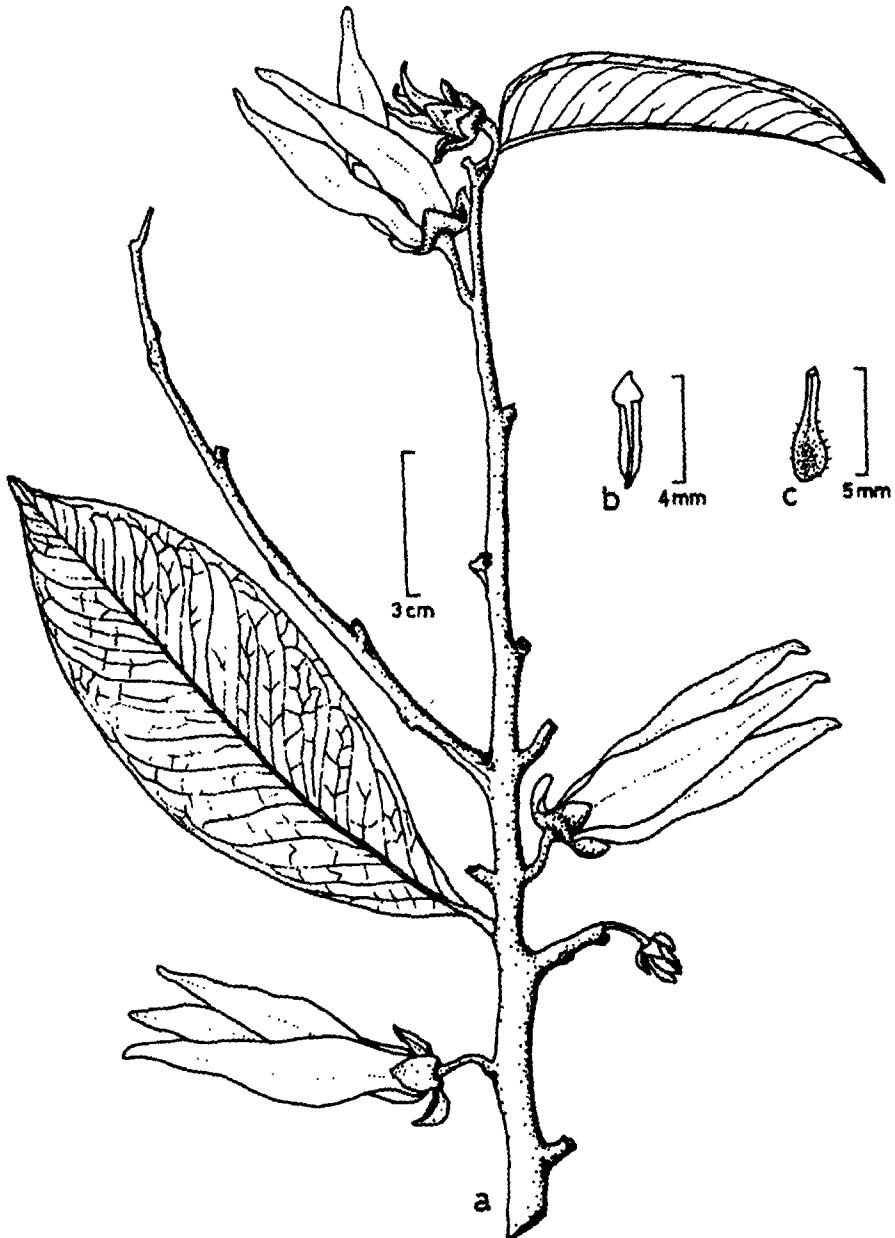


Fig. 36. *Goniothalamus macranthus* (Kurz) Boerl. var. *brevipetalus* D. Mitra : a. flowering twig; b. stamen; c. carpel

2.2. var. macranthus*Fl.* July - Aug.; *Fr.* Nov.*Distrib.* India: West Bengal and Andaman & Nicobar Islands.

Endemic.

3. *Goniothalamus malayanus* Hook. f. & Thomson, Fl. Ind. 107. 1855 & in Fl. Brit. India 1: 75. 1872; King in Ann. R. Bot. Gard. Calc. 4: 94, t. 128 B. 1893; Rao in J. Econ. Tax. Bot. 7: 635. 1985.

Trees, ca 10 m tall; branches ashy. Leaves elliptic-oblong to obovate, attenuate-acute at base, cuspidate-acuminate at apex, recurved along margins, 8 - 20 x 3 - 7 cm, glabrous, except pubescent-glabrescent midrib below; petioles 0.5 - 1 cm long. Flowers solitary, axillary or from the axils of fallen leaves, fragrant; pedicels 1 - 1.8 cm long, brown pubescent; bracts 1 - 3 at the base of the pedicel, brown pubescent. Sepals broad-triangular, connate at base, acute at apex, ca 6 mm long, appressed golden brown pubescent outside, glabrous inside. Outer petals 3, ovate-lanceolate, shortly clawed at base, 3 - 8 x 1.5 - 2.5 cm, greenish yellow, coriaceous; inner petals 3, adnate to 2/3 from apex, clawed, acute, densely silvery white or golden sericeous pubescent outside, glabrous inside, except the pubescent thickened margin. Stamens many, closely packed, ca 1.5 mm long; connectives flat-topped or convex. Carpels many, densely pubescent, 2 - 3 mm long; style 3 - 4 mm long. Ripe carpels oblong, sometimes one constricted, apiculate and stipitate, 2.5 - 3.5 cm long; stalk ca 5 mm long. Seeds 2 - 5, ovoid, shiny red-brown.

Fl. May.*Distrib.* India: Inland evergreen forests. Andaman & Nicobar Islands (Great Nicobar Island, Navydera, May, 16, 1980, *D. K. Hore* 7597 in PBL).

Malaya, Sumatra, Borneo and Sarawak.

4. *Goniothalamus meeboldii* Craib in Fedde, Repert. Spec. Nov. 12: 391. 1913.

Shrubs; young branches reddish, minutely puberulous, glabrous with age. Leaves oblong or narrowly oblong-lanceolate, cuneate at base, acute at apex, 10 - 22 x 4 - 6 cm, sometimes unequal; petioles 4 - 5 mm long, glabrous. Flowers not known. Ripe carpels many, oblong with ridges and furrows when dry, minutely verrucose, 2 - 2.4 cm long, glabrous; stalks verrucose, 1 - 2 cm long. Seed 1 in each carpel.

Fr. Nov. - Dec.*Distrib.* India: Andaman & Nicobar Islands.

Myanmar.

Notes. Ripe carpels are closely similar to *Polyalthia crassa* Parker, but leaves are thicker. Flowers are necessary to determine their relationship.

5. *Goniothalamus rhynchantherus* Dunn in Bull. Misc. Inf. Kew 1914: 182. 1914; Gamble, Fl. Pres. Madras 1: 19. 1915.

Trees, 10 - 15 m tall, all parts except the flowers glabrous. Leaves ovate or oblong, obtusely cuneate at base, shortly obtusely acuminate at apex, 9 - 16 x 3.5 - 5.8 cm, glabrous; lateral nerves faint; petioles 6 - 9 mm long. Flowers yellowish green, solitary, axillary; peduncles 1 - 2.5 cm long; pedicels 3 - 3.5 cm long; bracts 1 - 4, small, caducous. Sepals 3, free, ovate, subacute, 5 - 10 x ca 7 mm, slightly pubescent outside and sparsely puberulous and reddish inside. Petals 6 (3 + 3); outer petals oblong-ovate, acute, coherent at first, later free, 10 - 25 x 7 - 12 mm, brown-pubescent; inner ones half as long as the outer, connate at the top like a crown and separated below, lightly pubescent. Stamens many, ca 4 mm long, densely hairy. Carpels few, awl-shaped, ca 5 mm long, strigose, 2-ovuled; styles linear; stigma pointed, entire. Ripe carpels oblong to obovate, ca 1 cm long, stalked, glabrous; stalks 2 - 3 mm long.

Fl. June - Oct.; *Fr.* Oct. - Jan.

Distrib. India: Evergreen forests. Tamil Nadu and Kerala.

Endemic.

6. *Goniothalamus sesquipetalis* (Wallich) Hook. f. & Thomson, Fl. Ind. 108. 1855 & in Fl. Brit. India 1: 73. 1872. *Guatteria sesquipetalis* Wallich, Pl. Asiat. Rar. 3: t. 266. 1832.

Fig. 37.

Kh.: Laikhami, Skum-synsar, Soh-umsynrang; *Lus.:* Kham; *Nep.:* Sane.

Shrubs, glabrous. Leaves linear-oblong or lanceolate, narrow or cuneate at base, abruptly and obtusely acuminate at apex, 20 - 40 x 4.5 - 10.5 cm, coriaceous, glabrous, pellucid-punctate; lateral nerves 16 - 20 pairs, impressed above, interarching 5 - 8 mm from recurved margin; petioles 1 - 1.5 cm long. Flowers solitary, axillary or extra-axillary, greenish yellow; pedicels 3 - 5 mm long; bracts 2 - 6 at the base of pedicels, 2 - 4 mm long, slightly pubescent. Sepals 3, free, ovate, acute, 5 - 8 x 4 - 6 mm, thin, puberulous, persistent. Petals 6 (3 + 3); outer petals ovate-lanceolate, 12 - 20 x 3 - 5 mm, slightly pubescent at base outside; inner petals shortly clawed and free in lower part, cohering and forming an ovate-acuminate cone at apex, 10 - 14 x 4 - 5 mm, pubescent. Stamens many, ca 1.5 mm long; connectives peltate at top. Carpels few, linear, ca 4 mm long, golden strigose; style slightly recurved; stigma funnel-shaped. Ripe carpels few, ovoid,

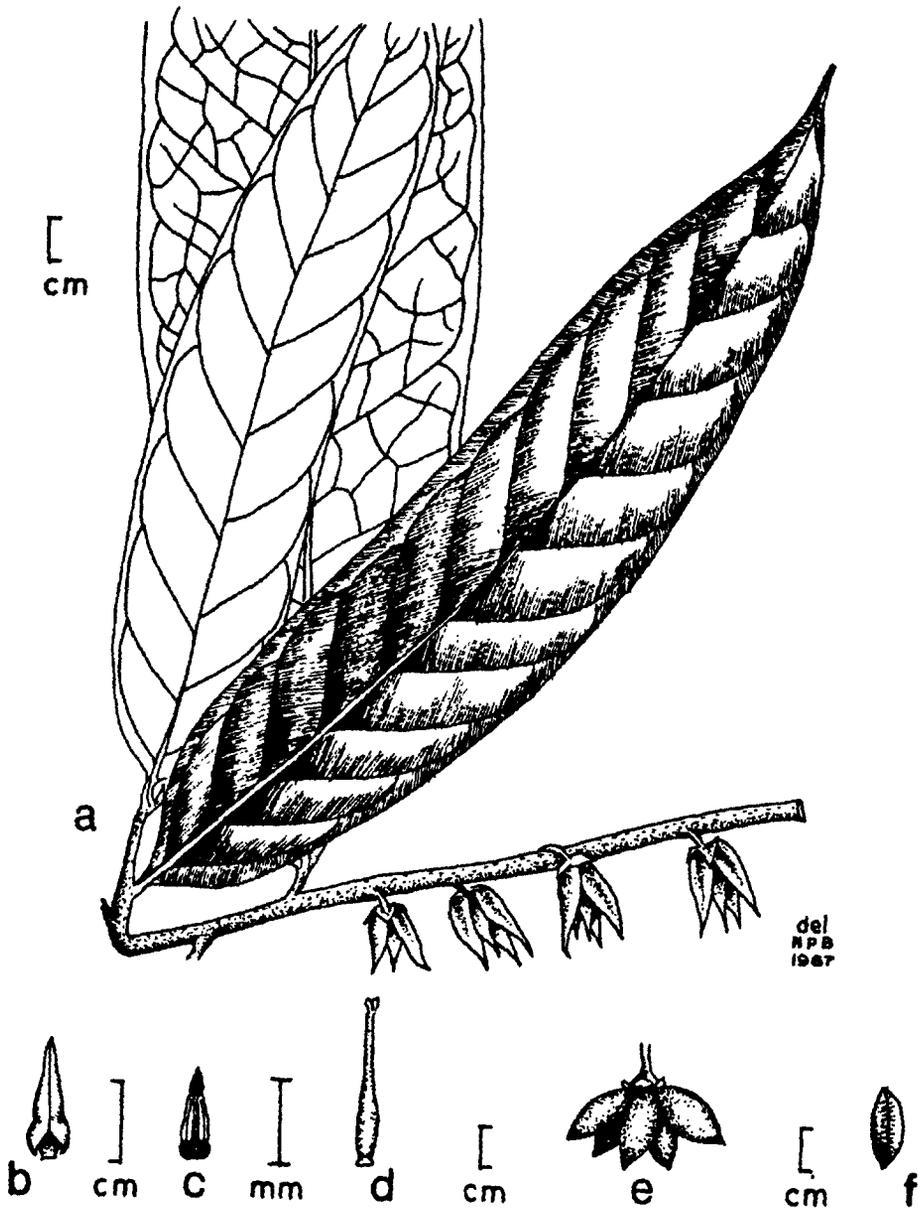


Fig. 37. *Goniothalamus sesquipedalis* (Wallich) Hook. f. & Thomson: a. twig with flowers; b. inner petals; c. stamens; d. carpel; e. fruit; f. seed.

acute-mucronate at apex, 1.7 - 2.5 x 1 cm, granular, orange-red when mature; stalk short, ca 1.5 mm long, with persistent sepals at apex. Seed 1 in each carpel.

Fl. April - June; *Fr.* Sept. - Dec.

Distrib. India: Subtropical forests, 300 - 1200 m. Sikkim, Assam, Nagaland, Manipur and Meghalaya.

Bangladesh, Bhutan and Myanmar.

7. *Goniothalamus simonsii* Hook. f. & Thomson, *Fl. Ind.* 108. 1855 & in *Fl. Brit. India* 1: 74. 1872.

Trees or large shrubs, ca 2 m high; young branches brown tomentose. Leaves narrow-elliptic or obovate-oblong, rounded or subacute at base, caudate-acuminate at apex, 20 - 38 x 7 - 14 cm, glabrous above, brown pubescent at the midrib and nerves beneath, minutely punctate; lateral nerves 13 - 20 pairs, anastomosing at their ends to form a continuous intramarginal nerve; petioles 1 - 1.5 cm long, brown pubescent. Flowers solitary, axillary; peduncles ca 1 cm long, pubescent; bracts few, ovate-triangular, 7 - 15 x 8 - 10 mm, pubescent, with prominent veins, persistent. Petals 6 (3 + 3); outer petals oblong-lanceolate, 3 - 4 x 1 - 1.7 cm, thick, cream-coloured, pubescent with prominent midrib; inner petals forming a triquetrous cone, shorter than the outer, connate at the top, free below, brown-pubescent outside. Stamens numerous, ca 3 mm long; connectives acute at top, pubescent. Carpels many, linear-oblong, ca 3 mm long, pubescent; style cylindrical; stigma prominently bifid. Ripe carpels oblong, mucronate, ca 1.6 cm long, on a much elongated torus.

Fl. May - June; *Fr.* July.

Distrib. India: Shaded places, especially near streams, 500 - 1000m. Assam and Meghalaya.

Endemic.

8. *Goniothalamus thwaitesii* Hook. f. & Thomson, *Fl. Ind.* 106. 1872 & in *Fl. Brit. India* 1: 72. 1872.

Trees, 6 - 10 m tall; young branches appressed yellow pubescent; old branches glabrous, glaucous. Leaves elliptic to oblong-lanceolate, cuneate at base, obtusely acuminate at apex, 8 - 15 x 3 - 4.5 cm, thinly coriaceous, glabrous; lateral nerves 8 - 12 pairs, faint; petioles 7 - 10 mm long, slightly verrucose. Flowers solitary, axillary; pedicels 1.5 - 2 cm long, glabrous, with deciduous bracts at base. Sepals 3, connate at base, broadly ovate, acute or obtuse, 5 - 7 x 5 - 10 mm, sparsely pubescent outside, glabrous inside, persistent. Petals 6 (3 + 3); outer petals broadly and shortly clawed at base, ovate-

lanceolate, tapering to an obtuse tip, 2.5 - 3.5 x 7 - 11 mm, thick, minutely glandular, glabrate; inner petals smaller, triangular, forming a cone with acute tips, 8 - 10 mm long, subsericeous. Stamens many, linear, truncate, ca 1 mm long; connectives almost rounded, flat, pubescent. Carpels many, sickle-shaped, ca 4 mm long, strigose; styles filiform, curved, glabrous; stigma subulate, entire. Ripe carpels ovoid, obtuse at both ends, ca 1 cm across, sessile or shortly stalked, 1-seeded.

Fl. & Fr. Aug. - Oct.

Distrib. India: Evergreen forest above 800 m. Tamil Nadu and Kerala.

Sri Lanka.

9. *Goniothalamus wightii* Hook. f. & Thomson, Fl. Ind. 106. 1855 & Fl. Brit. India 1: 76. 1872.

Tam.: *Pulittal*.

Small trees, 5 - 7 m tall; branches glabrous; young branches puberulous. Leaves linear-lanceolate, cuneate at base, shortly acuminate at apex, 7 - 13 x 2 - 3 cm, coriaceous, glabrous, pellucid-dotted; petioles 6 - 10 mm long, glabrous. Flowers purple with yellow tinge, solitary, axillary; pedicels subclavate, 7 - 12 mm long, pubescent with deciduous hairs; bracts few at the base, 3 - 4 mm long, densely brown-pubescent. Sepals 3, broadly ovate, subacute, 4 - 7 x 4 - 5 mm, puberulous, persistent. Petals 6(3 + 3); outer petals ovate, acute, shortly and broadly unguiculate, 10 - 17 x 6 - 12 mm, appressed brown pubescent; inner ones forming a cone, broadly unguiculate, 5 - 8 x 4 - 5 mm, brown silky. Stamens many, ca 2 mm long; connectives almost rounded-truncate or slightly convex at apex, minutely pubescent. Carpels 14 - 18, ovoid to oblongoid, ca 3 mm long, strigose; style shorter than carpels; stigma bifid, flat. Ripe carpels many, almost sessile, ellipsoid, acute, apiculate at apex, 1.5 - 2.5 cm long, glabrous, blackish-brown. Seed 1 in each carpel.

Fl. Apr. - May; *Fr.* July - Oct.

Distrib. India: Subtropical evergreen forests, 1000 - 1500 m. Tamil Nadu and Kerala.

Endemic.

10. *Goniothalamus wynaadensis* (Beddome) Beddome, Icon. Pl. Ind. Or. 1: 13, t. 61. 1868 - 1874; Hook. f. & Thomson in Fl. Brit. India 1: 74. 1872. *Atrutegea wynaadensis* Beddome in Madras J. Lit. & Sci. ser.3, 1: 37, f.1. 1864.

Tam.: *Kayannan*.

Shrubs or small trees, 3 - 5 m tall; young parts minutely fusco-pubescent, then glabrous. Leaves oblong to oblong-lanceolate, attenuate at base, abruptly acuminate at apex, 10 - 24 (-35) x 3 - 5.5 cm; petioles 6 - 8 mm long. Flowers yellowish green, ca 1.5 cm long, solitary, axillary or from small tubercles on old wood; pedicels ca 5 mm long, with 2 - 3 minute basal bracts. Sepals 3, almost orbicular, obtuse or sometimes acute, 4 - 5 mm across. Petals 6 (3 + 3); outer petals broadly ovate, subacute, 1.5 - 2 x ca 0.5 cm long, prominently veined; inner ones ca 7 x 3 mm, closely connivent, glabrous inside, densely hairy at the tips inside. Torus hairy. Stamens many; connectives prolonged beyond the anthers into blunt tips. Carpels many, oblong, ca 4 mm long, hairy; style linear-elongate; stigma bifid; ovule solitary from ventral suture above the base. Ripe carpels many, elliptic to oblong, apiculate, 1.2 - 1.5 cm long, shortly stalked, 1-seeded.

Fl. Jan. - July; *Fr.* Aug. - Nov.

Distrib. India: Evergreen forests, Kerala.

Endemic.

7. *Mitrephora* Hook. f. & Thomson

Trees. Leaves coriaceous, strongly ribbed. Flowers bisexual or rarely unisexual, usually terminal or leaf-opposed, extra-axillary. Sepals 3, orbicular or ovate, valvate. Petals 6 (3 + 3), valvate in buds; outer ones larger than inner, ovate, elliptic-oblong, veined; inner ones usually thin, narrowly long-clawed at base, mitriform and cohering by their edges above, free below. Stamens many, oblong, cuneate; anther-thecae remote, concealed by the flat-topped connectives. Carpels oblong or clavate, ventrally furrowed; ovules up to 4, 2-seriate; styles oblong or clavate; stigma capitate. Torus hairy. Ripe carpels globose or ovoid, stalked or sessile, 2 - 3-seeded.

Sri Lanka, India, Bangladesh, Myanmar, Indo-china, E. Asia to Malesia, Australia and New Zealand; ca 25 species, 5 species in India.

KEY TO THE SPECIES

- | | |
|---|--------------------------|
| 1a. Outer petals lanceolate | 2 |
| b. Outer petals broadly elliptic or ovate | 3 |
| 2a. Leaves 6 - 10 cm long, glabrous; outer petals narrowly clawed at base, downy | 4. <i>M. heyneana</i> |
| b. Leaves 12 - 26 cm long, softly tomentose beneath; outer petals not clawed at the base, densely brown tomentose | 5. <i>M. tomentosa</i> |
| 3a. Shrubs; outer petals less than 1 cm long | 1. <i>M. andamanica</i> |
| b. Trees; outer petals more than 1 cm long | 4 |
| 4a. Sepals 4 - 5 mm long; outer petals ca 3 times as long as broad | 2. <i>M. grandiflora</i> |
| b. Sepals ca 10 mm long; outer petals ca as long as broad | 3. <i>M. harae</i> |

1. *Mitrephora andamanica* Thoth. & D. Das in J. Bombay Nat. Hist. Soc. 54(3): 430 - 431, t.1. 1968. Fig. 38.

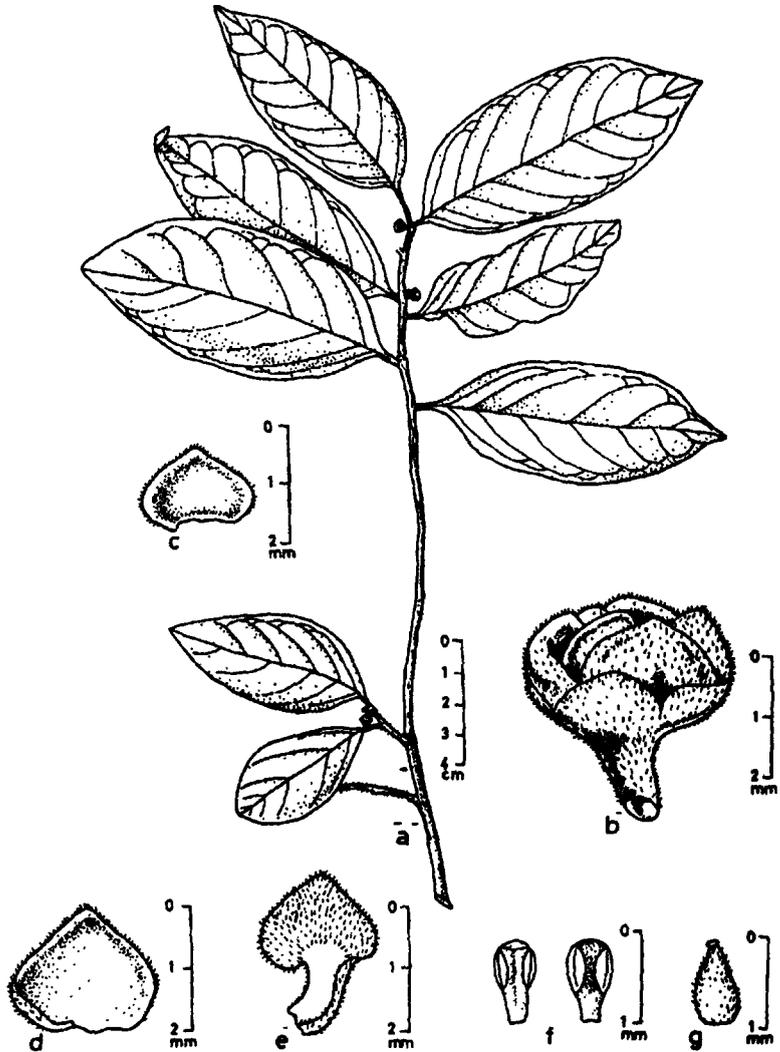


Fig. 38. *Mitrephora andamanica* Thoth. & D. Das : a. flowering twig; b. flower; c. sepal; d. outer petal; e. inner petal; f. stamens, back and front views; g. carpel.

Shrubs, 1 - 1.5 m high; branches puberulous. Leaves ovate-elliptic to oblong, narrowed at base, acute at apex, 8.5 - 13 x 3.5 - 5.5 cm, glabrous above, puberulous on midrib and nerves beneath; petioles ca 3.6 mm long, puberulous. Flowers 1 - 2, extra-axillary or leaf-opposed; pedicels 1 - 2 mm long, pubescent; bracts ovate, acute, pubescent outside. Sepals 3, free, triangular, 1.5 - 2 cm long, pubescent outside. Petals 6 (3 + 3); outer petals broadly ovate, acute, concave at base, 3 - 4 x ca 3.5 mm, pubescent outside, ciliate; inner petals distinctly clawed, 3 x 2 - 3 mm. Stamens numerous, 0.75 - 1 mm long; connectives flat at top. Carpels 3, oblong, 0.75 - 1 mm long, angled; ovules 2 - 3; stigma discoid. Ripe carpels not known.

Fl. April.

Distrib. India: Andaman & Nicobar Islands.

Endemic.

2. *Mitrephora grandiflora* Beddome, *Fl. Sylv.* 1: t. 75. 1869 - 73 & in *Icon. Pl. Ind. Or.* 1: t. 101. 1868 - 1874; Hook. f. & Thomson in *Fl. Brit. India* 1: 78. 1872.

Trees, 7 - 12 m tall; young parts golden pubescent. Leaves elliptic or ovate-lanceolate, rounded at base, acute or slightly acuminate at apex, 6.5 - 14 x 3 - 6 cm, coriaceous, glabrous; nerves pubescent beneath; petioles ca 1 cm long, pubescent when young. Flowers solitary or 2 - 3 in leaf-opposed cymes; pedicels ca 1 cm long, brown pubescent; bracts single, basal, ferruginous. Sepals 3, connate at base, broadly ovate or orbicular, 4 - 5 mm across, yellowish brown pubescent. Petals 6 (3 + 3); outer petals broadly elliptic, acute, 3.5 x 1 - 2 cm, white or yellow, pubescent outside, almost glabrous and veined inside; inner ones triangular, long-clawed, 1 - 1.5 x 0.3 - 0.5 cm, white-streaked with red; limb triangular, forming a mitriform cap over stamens and carpels, early caducous. Torus convex. Stamens many, oblong, ca 1 mm long; connectives flat at top. Carpels many, oblong-ovate, ca 2 mm long, strigose; stigma club-shaped. Ripe carpels many, globose, tomentose. 1 - 2-seeded.

Fl. & Fr. Jan. - April.

Distrib. India: Evergreen forests. Karnataka, Kerala and Tamil Nadu.

Endemic.

3. *Mitrephora harae* Ohashi in Hara, *Fl. E. Himalaya* 97. 1966 (as *haraii*).

Nep.: *Kalikot*.

Trees, 3 - 14 m tall; branches at first densely ferruginous tomentose, later glabrous. Leaves narrowly elliptic to ovate-elliptic, obtuse or attenuate at base, gradually or shortly

caudate-acuminate at apex, 6 - 7 x 2 cm, glabrous above, appressed fulvous pubescent beneath, with short dense hairs; petioles ca 5 mm long. Flowers 2, 4 - 5 cm across, upper one well-developed; pedicels 4 - 6 mm long, appressed fulvous-pubescent. Sepals 3, suborbicular to broadly ovate, acute at apex, 6 - 8 mm across, ferruginous tomentose outside, sparsely pubescent inside. Petals 6 (3 + 3); outer petals broadly elliptic or oblong-obovate, rounded at base, acute at apex, 2 - 2.3 x 1.2 - 1.8 cm, distinctly veined, pilose hairy outside; inner petals clawed, triangular, purplish, sparsely pubescent outside at the middle and above; basal claw 5 - 10 x 3 - 3.5 mm; upper limb triangular, 7 - 8 x 10 - 14 mm. Stamens many, 1.2 - 1.6 mm long. Carpels many, ellipsoid, ca 2 mm long, densely appressed hirsute; ovules 4 - 8. Ripe carpels not seen.

Fl. March - April.

Distrib. India: Subtropical evergreen forests, 300 - 1200 m. Sikkim.

Bhutan.

4. *Mitrephora heyneana* (Hook. f. & Thomson) Thwaites, Enum. Pl. Zeyl. 8. 1864; Hook. f. & Thomson in Fl. Brit. India 1: 77. 1872. *Orophea heyneana* Hook. f. & Thomson, Fl. Ind. 110. 1855.

Trees, 10 - 16 m tall; branches puberulous when young, later glabrous. Leaves ovate-lanceolate, rounded at base, narrowed to an acute to acuminate apex, 6.5 - 10 x 2.5 - 4 cm, almost glabrous; petioles 4 - 5 mm long, glabrous. Flowers yellowish with pink tinge, solitary or 2 - 3 together in axillary or leaf-opposed cymes; pedicels 3 - 5 mm long; bracts many, minute, distichous. Sepals 3, triangular, ovate or orbicular, ca 3 mm across, brown-pubescent. Petals 6 (3 + 3); outer petals ovate-lanceolate, narrowly clawed at base, pointed, 10 - 15 x 5 - 6 mm, yellow, veined, downy on both surfaces; inner ones trapezoid, acute, clawed, 5 - 7 x 3 - 4 mm, yellow with pink streaks and spots, villous. Torus strigose. Stamens many, oblong-cuneate, ca 1 mm long; connectives round and flat. Carpels 6 - 9, oblong, strigose; style short; stigma subcapitate. Ripe carpels few or 8 - 9 together, sessile or subsessile, obovoid to subglobose, apiculate, sometimes constricted between seeds, 7 - 12 mm in diam., yellow-pubescent. Seeds 1 - 3.

Fl. March - July; *Fr.* Sept. - Dec.

Distrib. India: Tropical evergreen forests. Tamil Nadu and Kerala.

Sri Lanka.

5. *Mitrephora tomentosa* Hook. f. & Thomson, Fl. Ind. 113. 1855 & in Fl. Brit. India 1: 76. 1872.

Trees, usually small, sometimes up to 20 m tall; young branches tomentose. Leaves ovate to oblong-lanceolate, rounded at base, acute to acuminate at apex, 12 - 26 x 4 - 9 cm, softly tomentose beneath, glabrous above except the midrib; lateral nerves 10 - 15 pairs, slender, oblique; petioles 5 - 8 mm long, tomentose when young, glabrous at maturity. Flowers 5 - 7 cm across, in few-flowered leaf-opposed cymes; pedicels 7 - 10 mm long, brown tomentose; bracts orbicular, large, at the base of sepals. Sepals 3, connate at base, broadly ovate, acute, 5 - 7 mm across, brown tomentose. Petals 6 (3 + 3); outer petals broadly lanceolate, acute, 2 - 3.5 x 1 - 1.5 cm, densely brown tomentose outside, yellow with faint purple veins inside. Stamens many, oblong-cuneate, ca 1.5 mm long; connectives flat at top. Carpels few, ovate, ca 1 mm long, strigose; stigma sessile, blunt. Ripe carpels many, subglobose, ca 1.5 cm across, densely brown tomentose; stalks 2 - 3 cm long, tomentose. Seeds 2, plano-convex.

Fl. March - May; *Fr.* Aug. - Oct.

Distrib. India: Evergreen tropical and subtropical forests. Assam, Nagaland and Meghalaya.

Bangladesh and Myanmar.

8. *Popowia* Endl.

Small trees. Leaves subgranular in texture, glabrous, pubescent or tomentose. Flowers bisexual, small, solitary or few in fascicles, extra-axillary or leaf-opposed; buds subglobular. Sepals 3, valvate, ovate or orbicular. Petals 6 (3 + 3), valvate; outer petals like the sepals, but larger; inner ones larger than outer, thick, concave, connivent, slightly clawed at base, acute at tip, sometimes inflexed. Stamens short, cuneate; connectives flat-topped or slightly concave, straight or curved; stigma capitate. Ripe carpels many, globose or ovoid, stalked or sessile. Seeds 1 - 4, shiny.

India, Myanmar, Thailand, Malaysia, Indonesia to Australia and Africa; ca 50 species, 3 in India.

KEY TO THE SPECIES

- | | |
|--|-------------------------|
| 1a. Leaves lanceolate or oblong-lanceolate, 5 - 7 x 2 - 3 cm | 1. <i>P. beddomeana</i> |
| b. Leaves oblong or elliptic, 8 - 14 x 4 - 6 cm | 2 |
| 2a. Sepals and petals strigose | 2. <i>P. helferi</i> |
| b. Sepals and petals pubescent | 3. <i>P. parvifolia</i> |

1. *Popowia beddomeana* Hook. f. & Thomson in *Fl. Brit. India* 1: 68. 1872. *P. ramosissima* Beddome, *Icon. Pl. Ind. Or.* t. 75. 1868 - 1874, excl. synonym. Fig. 39.

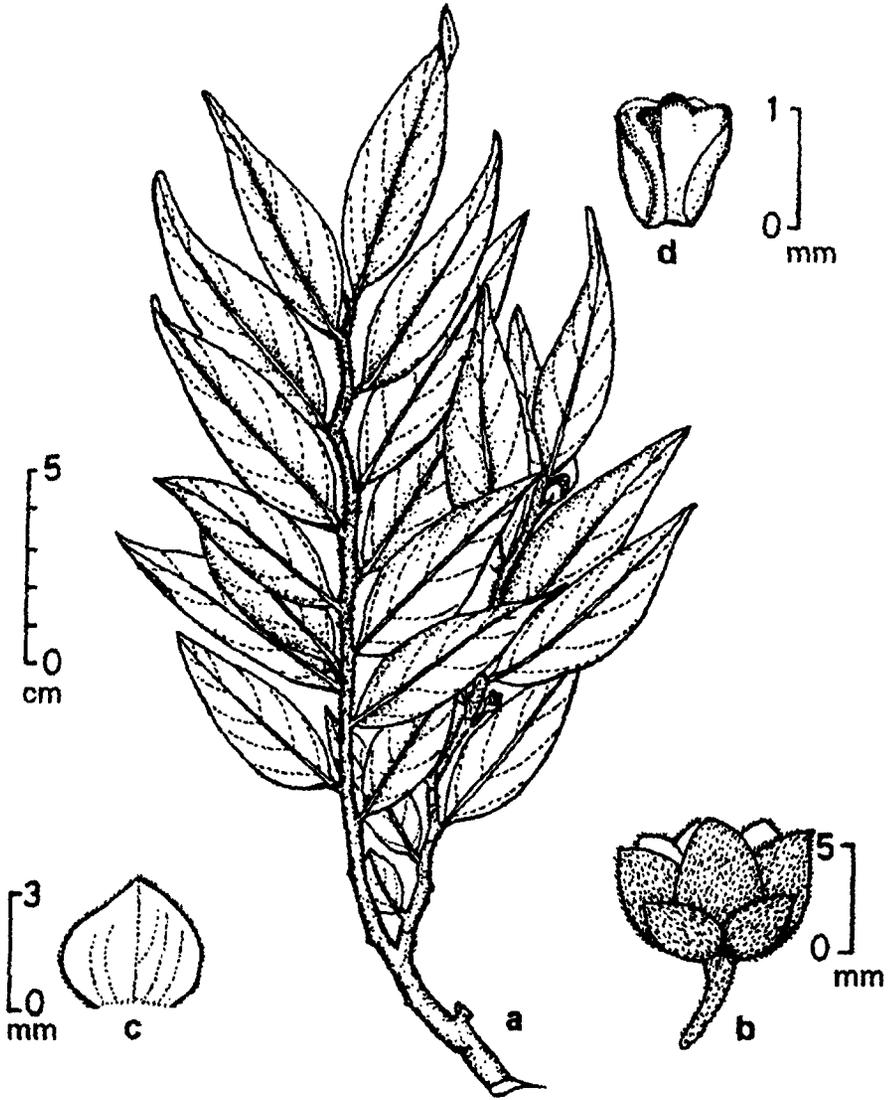


Fig. 39. *Popowia beddomeana* Hook. f. & Thomson: a. flowering twig; b. flower; c. sepal; d. stamen (from A.N. Henry & V. Chitra in Red Data Book of Indian Plants 1: 29. 1987).

Trees, 2 - 4 m tall; branches brown tomentose when young, turning glabrous later. Leaves ovate-lanceolate or oblong-lanceolate, narrow at base, caudate-acuminate at apex, 5.5 - 7 x 2 - 3 cm, coriaceous, glabrous above, tomentose beneath at base; petioles ca 2 cm long, tomentose. Flowers ca 5 mm across, solitary, sometimes paired, extra-axillary; pedicels very short, tomentose; bracts small, submedian. Sepals 3, connate at base, ovate, acute, ca 2 mm long, tomentose outside. Petals 6 (3 + 3), thick, tomentose outside, glabrous inside; outer petals smaller, broadly ovate, ca 3 mm long; inner ones concave, clawed, thick, inflexed at tip. Stamens ca 24 or indefinite, short, cuneate; anther-thecae dorsal, remote; connectives truncate or capitate. Carpels 4 - 7, small, ovate-elongate, tomentose; ovules 1 - 2; styles short; stigma flat, sometimes curved. Ripe carpels few, berries, globose, stalked.

Fl. March - May; *Fr.* Sept.

Distrib. India: Evergreen forests, 100 - 1100 m. Tamil Nadu and Kerala.

Endemic to southern Western Ghats.

2. *Popowia helferi* Hook. f. & Thomson in *Fl. Brit. India* 1: 69. 1872.

Small spreading trees; branches coarsely hairy. Leaves narrow-oblong, rounded or suboblique at base, abruptly acute or obtusely acuminate at apex, 8 - 12 x 4 cm, glabrous above, puberulous on the midrib beneath; petioles ca 2 mm long, subpilose. Flowers extra-axillary, minute, globose; peduncles 2 - 6 mm long, tomentose. Sepals 3, ovate, strigose. Petals 6 (3 + 3); outer petals smaller than inner ones, ovate, strigose; inner ones orbicular, concave, densely strigose, inflexed at tip. Stamens 15. Carpels 6, densely strigose; ovule solitary, subbasal.

Fl. April.

Distrib. India: Andaman & Nicobar Islands.

Endemic and rare.

3. *Popowia parvifolia* Kurz in *J. Bot.* 13: 324. 1875.

Small trees; young branches with reddish brown or golden silky hairs. Leaves ovate to elliptic-lanceolate, acute or sometimes rounded at base, obtuse to bluntly acuminate at apex, 9 - 14 x 4 - 6 cm; young leaves sparsely appressed pubescent beneath, glabrous with age; petioles ca 2 mm long, glabrous. Flowers solitary or in pairs, small, axillary; pedicels ca 3 mm long, pubescent; bracts minute. Sepals 3, very small, connate at base, ovate to rounded, pubescent outside. Petals 6 (3 + 3), minutely pubescent; outer petals smaller than inner, ovate; inner ones triangular to ovate. Stamens many, small, cuneate; connectives flat-topped. Ripe carpels many, globose, glabrous; stalks long. Seeds 1 or 2.

Fl. March; *Fr.* Aug.

Distrib. India: Andaman & Nicobar Islands.

Endemic.

9. *Pseuduvaria* Miquel

Shrubs or trees. Leaves straight, with almost parallel nerves. Flowers small, unisexual, solitary or fascicled in the axils of present or fallen leaves. Sepals 3, valvate, membranous. Petals 6 (3 + 3), valvate; outer petals 3, like the sepals but larger; inner ones narrow, linear, clawed; limbs usually hastate or rhomboid, united at the top forming a mitriform hood; glands sometimes present on the inner surface of the limbs. Stamens very small; connectives flat-topped, projecting over the anther-thecae, without carpels in male flowers, in female flowers often with a ring of staminodes, or sometimes with 1 or 2, fertile or reduced stamens (i.e. with 2 pollen sacs only). Carpels tomentose, elongated, incurved; stigma sessile, subcapitate with U-shaped split on top and grooved inside. Ripe carpels many, densely and minutely tomentose, stalked or sessile, smooth or warted. Seeds 1 - several.

India, Bangladesh, Indo-china, Myanmar, Thailand, Malaysia, Indonesia, Philippines and New Guinea; ca 17 species, one in India.

Pseuduvaria prainii (King) Merr. in Philip. J. Sci. (Bot.) 10: 255. 1915. *Mitrephora prainii* King in J. Asiat. Soc. Beng. 61(2): 88. 1892.

Trees; young branches tawny pubescent, later glabrous. Leaves elliptic-oblong, cuneate at base, abruptly and shortly acuminate at apex, 12.5 - 22 x 5 - 8 cm, glabrous on both surfaces, except the pubescent midrib; petioles 5 - 7 mm long, pubescent. Flowers unisexual, solitary or 2 - 3 together from the axils of the leaves or fallen leaves; pedicels 1 - 2 cm long, pubescent; bracts at the base or also at middle. Sepals 3 (4, according to King, l. c.), broadly ovate, acute, 1.5 - 3 x 3 mm, tomentose outside, glabrous inside. Petals 6 (3 + 3), (8, according to King, l. c.); outer petals ovate-orbicular, subacute, 4 - 5 mm across, tomentose outside, glabrous inside; inner ones longer and narrower than outer, ca 6 x 3 mm; limb trapezoid, densely tomentose, glabrous inside at base; claw narrow, as long as the limb, tomentose on both surfaces. Stamens in the male flowers numerous, cuneate, ca 1 mm long; connectives truncate, concealing the apices of anthers. Ripe carpels few, subglobose, truncate at both ends, rugulose, minutely pubescent; stalk 7 - 10 mm long. Seeds ca 5.

Fl. March - April; *Fr.* Sept. - Dec.

Distrib. India: Andaman & Nicobar Islands.

Endemic.

Tribe 4. U N O N E A E

Scandent shrubs to lofty trees. Sepals and petals valvate, similar or subsimilar, equal to subequal, connate at base, free at apices, sometimes clawed at base (in *Cyathocalyx* and *Artobotrys*); inner petals flat, terete or filiform. Stamens many; anther-thecae concealed by the flat-topped, sometimes long-apiculate (*Cananga*) connectives. Ripe carpels large or small, 1 - many-seeded, rarely moniliform (in *Desmos*).

10. *Artobotrys* R. Brown

Shrubs, climbing by means of persistent hook-like peduncles. Leaves shiny, coriaceous. Flowers bisexual, solitary or several fascicled on woody, hooked-recurved leaf-opposed peduncles. Sepals 3, valvate. Petals 6 (3 + 3), 6 - 9 in *A. hexapetalus*, valvate, clawed, concave at base; inner ones connivent at base, covering stamens and carpels. Stamens oblong, cuneate; connectives flat at top. Carpels few or many; style oblong or columnar; ovules 2, erect, collateral. Ripe carpels many, subsessile, ovoid, berried. Seeds 2, rarely 1.

Sri Lanka, India, Bangladesh, Myanmar, Cambodia, Thailand to E. Asia, Malaysia and Australia, also in Africa; ca 100 species, 6 in India.

KEY TO THE SPECIES

- | | |
|--|---------------------------|
| 1a. Petals similar in 2 series, flat and lanceolate | 2 |
| b. Petals unequal; outer lanceolate, inner cylindrical | 4 |
| 2a. Petals less than 2.5 cm long; sepals long-acuminate, ca 1 cm long | 2. <i>A. cubittii</i> |
| b. Petals 3 cm or more long; sepals acute, less than 1 cm long | 3 |
| 3a. Leaves thinly coriaceous; petals glabrous, ca 1 cm broad | 3. <i>A. hexapetalus</i> |
| b. Leaves thickly coriaceous; petals brown tomentose, ca 5 mm broad | 6. <i>A. zeylanicus</i> |
| 4a. Pedicels 7 - 12 mm long; peduncles hooked with fasciculate branches | 4. <i>A. nicobarianus</i> |
| b. Pedicels ca 5 mm long; peduncles hooked without fasciculate branches | 5 |
| 5a. Leaves 10 - 13 cm long, shortly caudate-acuminate; outer petals ca 2 cm long | 1. <i>A. caudatus</i> |
| b. Leaves 15 - 20 cm long, obtusely acuminate; outer petals 2.5 - 4.5 cm long | 5. <i>A. speciosus</i> |

1. *Artobotrys caudatus* Hook. f. & Thomson, Fl. Ind. 129. 1855 & in Fl. Brit. India 1: 55. 1872.

Asm.: *Dhup-lota*; Nep.: *Kali-lahara*.

Woody climbers; young branches pubescent, glabrous with age. Leaves elliptic to oblong-lanceolate, cuneate at base, shortly bluntly caudate-acuminate at apex, 10 - 15 x 4 - 5 cm, slightly recurved at margins, glabrous; lateral nerves 8 - 12 pairs, looped to an intra-marginal nerve; petioles 3 - 8 mm long. Flowers fascicled on hooked peduncles; peduncles axillary, laterally compressed, 2 - 2.5 cm long, slightly pubescent when young; pedicels ca 5 mm long, bracteate at base, pubescent. Sepals 3, connate at base, ovate to triangular-ovate, acute or slightly acuminate at apex, ca 3 mm long, appressed-pubescent. Petals 6 (3 + 3), dissimilar, yellow, linear, clawed, pubescent; outer petals narrow-lanceolate, 2 - 3 mm broad; inner ones cylindrical, smaller and narrower, ca 1 mm broad, widening at concave base to 3 - 4 mm. Stamens many, ca 1.5 mm long; connectives broad and obtuse at apex, slightly produced; anthers oblong-linear. Carpels ca 8, subglobose, pubescent, intermixed with small straight hairs. Ripe carpels 4 - 5, elliptic, ca 5 cm long, dark purple. Seeds 2, compressed, rugose, with shallow grooves along the faces and edges, ca 3 x 1.5 cm, brown.

Fl. March - May; *Fr.* Nov.

Distrib. India: Evergreen tropical and subtropical forests, up to 1200 m. Assam and Meghalaya.

Bangladesh and Bhutan.

2. *Artabotrys cubittii* Chatterjee in J. Bombay Nat. Hist. Soc. 19: 1. 1940.

Bushy climbers, 2 - 2.5 m long; branchlets rufous-tomentose when young, glabrous with age. Leaves elliptic-lanceolate, narrow at base, acute or shortly acuminate at apex, 10 - 24 x 4 - 8 cm, hispid to densely rufous-hispid when young, glabrous with age; petioles 3 - 7 mm long. Flowers 1 - 4 fascicled on the hooked peduncle at the middle and apex; peduncle somewhat flat, appressed rufous-pubescent; pedicels 8 - 15 cm long; bracts basal, pubescent. Sepals 3, united at base, free at tips, ovate, long-acuminate, 7 - 10 mm long, revolute, rufous-hispid on both sides. Petals 6 (3 + 3), clawed, 18 - 25 x 7 - 10 mm; limb ovate-lanceolate, concave at base, obtuse at apex, slightly tomentose on both surfaces, densely tomentose at base outside. Stamens numerous, oblong-cuneate, ca 2 mm long; connectives broad, flattened, acute at apex. Carpels 12, pyramidal-ovoid, ca 4 mm long, acute at apex; style constricted at base; stigma entire. Ripe carpels 6 - 7, ovoid, narrowed at both ends, shortly beaked at tip, 3 - 3.5 x 1 - 1.5 cm; stalks short. Seeds 1 - 2, elliptic, plano-convex, 1.5 - 1.7 cm; testa stoney.

Fl. March; *Fr.* July.

Distrib. India: Assam, Manipur and Meghalaya.

Myanmar.

3. *Artabotrys hexapetalus* (L. f.) Bhandari in Baileya 12(4): 147. 1964. *Annona hexapetala* L. f., Suppl. Pl. 270. 1781. *Annona uncinata* Lam., Encycl. 2: 127. 1786. *Artabotrys odoratissimus* R. Brown in Edward's Bot. Reg. 5: t. 423. 1819 (non Blume 1825); Hook. f. & Thomson in Fl. Brit. India 1: 54. 1872. *Uvaria odoratissima* (R. Brown) Roxb., Fl. Ind. 2: 66. 1824. *Artabotrys uncinatus* (Lam.) Merr. in Philip. J. Sci. (Bot.) 7: 234. 1912. Fig. 40.

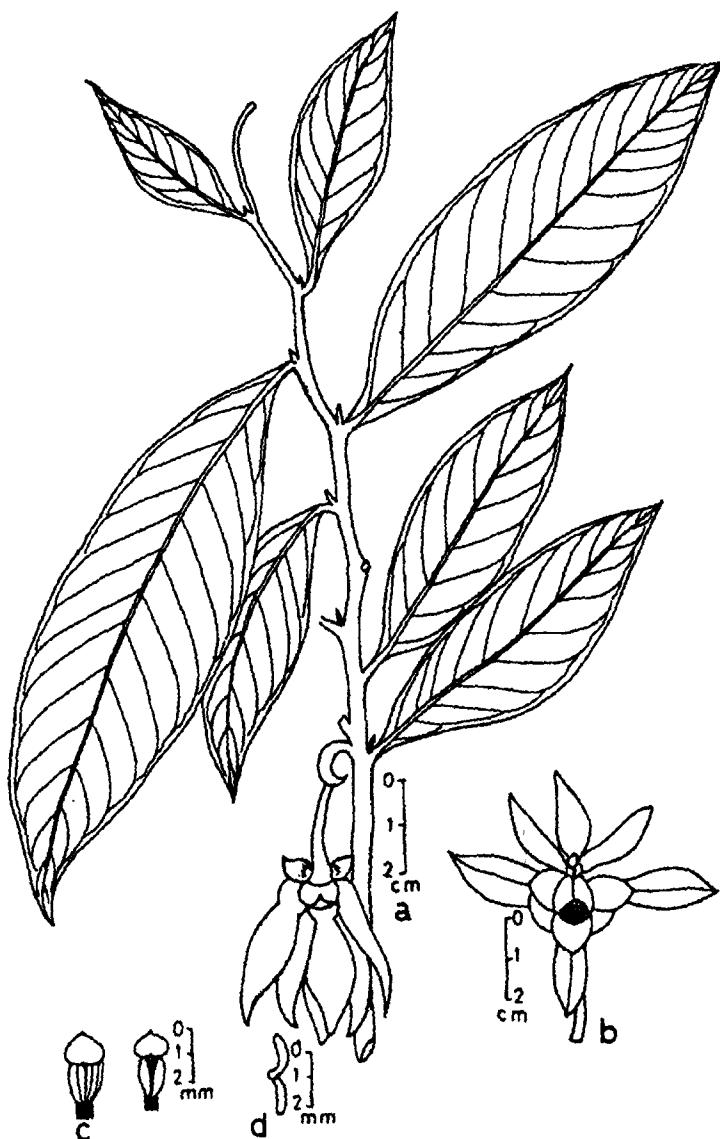


Fig. 40. *Artabotrys hexapetalus* (L. f.) Bhandari: a. flowering twig; b. flower; c. stamens, front and back views; d. carpel.

Beng.: *Kanthalichampa*; Hindi: *Madanmast*; Kan.: *Kandali-sampage*; Mal.: *Madana-kameswari*; Mar.: *Hira-champa*; Nep.: *Katar-champa*; Or.: *Kalomuro*; Tam.: *Manoranidam*; Tel.: *Manoranitamu*.

Shrubs with bushy habit, often scandent; young branches puberulous. Leaves oblong-lanceolate, acute at base, shortly acuminate at apex, 10 - 22 x 3.5 - 6 cm, thinly coriaceous, glabrous; lateral nerves 6 - 18 pairs; petioles ca 5 mm long. Flowers fragrant, ca 2 cm across, on hooked peduncles, solitary or in pairs, drooping, sweet-scented; pedicels 10 - 13 mm long. Sepals 3, ovate, connate at base, acute and reflexed at tip, 5 - 7 x 6 mm, puberulous. Petals 6 (3 + 3), sometimes up to 9, ovate-lanceolate, spreading from clawed saccate coherent base, greenish yellow to yellow at maturity; outer ones ca 2 - 2.5 x 0.5 - 1.3 cm; inner ones ca 1.5 x 0.7 cm; limb lanceolate, saccate-clawed at base. Stamens many, ca 1.5 mm long; connectives triangular, peltate. Carpels few, sickle-shaped, 1.5 - 2 mm long, pubescent or glabrous; ovules 2; style curved; stigma blunt. Ripe carpels 6 - 14 (-20), ovoid, narrowly obovoid, apiculate. 2.5 - 3.5 cm long, glabrous, yellow when mature; stalk very short. Seeds 1 - 2, oblong, deeply grooved on one side, brown.

Fl. April - July; *Fr.* Sept. - Feb.

Distrib. India: Said to be native of South India, cultivated as well as naturalised throughout the country.

Sri Lanka, Bhutan, Bangladesh, Myanmar to Malesia.

Notes. A decoction of the leaves is given for curing Cholera in Malaya. An essential oil is extracted from the flowers for use in perfumes.

4. *Artabotrys nicobarianus* D. Das in Bull. Bot. Surv. India 11: 194. 1969.

Scandent shrubs. Leaves elliptic, cuneate at base, caudate at apex, 10 - 13.5 x 4 - 5.5 cm, glabrous; petioles ca 5 mm long. Flowers many, on fasciculate branches of hooked peduncles; bracts minute, brown tomentose; pedicels slender, 7 - 12 mm long, pubescent. Sepals 3, ovate, acute, ca 4 mm long, tomentose outside. Petals 6 (3 + 3), dissimilar; outer ones clawed; limb linear-lanceolate with pointed apex, tomentose on both sides; inner ones united at clawed base, ca 1.5 cm long; limb free, subclavate or cylindric, grey tomentose. Stamens many, ca 1.5 mm long; connectives convex, beaked in front; anthers short. Carpels few, ovoid, ca 5 mm long, densely strigose; stigma sessile. Ripe carpels not seen.

Fl. March - April.

Distrib. India: Nicobar Islands.

Endemic.

5. *Artabotrys speciosus* Kurz ex Hook. f. & Thomson in Fl. Brit. India 1: 55. 1872.

Large climbers; young branches slender, sparsely appressed pilose, glabrous with age. Leaves oblong to oblong-lanceolate, acute at base, shortly and obtusely acuminate at apex, 10 - 20 x 4.5 - 6.5 cm, glabrous; petioles 7 - 10 mm long. Flowers few, fascicled on the hooked peduncle; pedicels ca 5 mm long, puberulous. Sepals 3, ovate, connate at base, abruptly acuminate at apex, 4 - 6 x 1.5 - 2 mm, pubescent outside, glabrous inside. Petals 6 (3 + 3), yellow; outer petals narrowly concave at base, linear upwards to obtuse apex, 2.5 - 4.5 cm, thickly coriaceous, appressed pubescent; inner ones connate at clawed base with free limbs, 1 - 2.5 cm long; connectives bluntly apiculate at apex, with brown dots. Carpels few, ca 1.5 mm long, mixed with straight hairs; styles articulated; stigma club-shaped. Ripe carpels not seen.

Fl. March - April.

Distrib. India: Andaman & Nicobar Islands.

Endemic.

6. *Artabotrys zeylanicus* Hook. f. & Thomson, Fl. Ind. 128. 1855 & in Fl. Brit. India 1: 54. 1872.

Woody straggling climbers, puberulous., glabrous with age. Leaves broadly lanceolate or oblanceolate, narrowed at base, subacute to slightly acuminate at apex, 12 - 17 x 5 - 8 cm, thickly coriaceous, glabrous; lateral nerves 8 - 12 pairs; petioles 7 - 10 mm long. Flowers 4 - 5 cm long, fragrant, 1 - 4 together on hooked peduncles; pedicels 7 - 12 mm long, rusty tomentose when young. Sepals 3, broadly ovate to triangular, connate at base, acute, 4 - 5 x 3 - 4 mm, rufous tomentose outside. Petals 6 (3 + 3), subequal or inner ones slightly shorter, connate at base, clawed, 3 - 3.5 x 0.5 - 0.5 cm; limb oblong-lanceolate, brown tomentose. Torus convex or flat, villous. Stamens many, ca 2 mm long; connectives broad, peltate. Carpels many, linear, ca 3 mm long, intermixed with strigose hairs; style linear and short; stigma flat, spatulate, sometimes curved. Ripe carpels many, sessile, broadly ovoid, mucronate, ca 2 cm across, ca 3 cm long, rugulose, harshly tomentose. Seeds 2, oblong-ovoid, ca 1 cm long, dark brown, finely wrinkled.

Fl. Oct. - Feb.; *Fr.* May - Aug.

Distrib. India: Tropical evergreen forests. Tamil Nadu, Karnataka and Kerala.

Sri Lanka.

11. *Cananga* (DC.) Hook. f. & Thomson, nom. cons.

Tall trees. Leaves large. Flowers bisexual, solitary or fascicled on short axillary peduncles. Sepals 3, ovate or triangular, valvate. Petals 6 (3 + 3), valvate, flat, strap-shaped, subequal or inner ones smaller, yellow, several-veined, fragrant. Stamens ca 3 mm long, many, linear; anther-thecae extrorse; connectives produced to an acute end. Carpels many, oblong; ovules numerous, 2-seriate; style slender; stigma subcapitate. Ripe carpels many, stalked or sessile, oblong, pulpy. Seeds many in 2 rows, pitted, sending spinous processes into the ruminant endosperm.

Sri Lanka, India, Myanmar, Indo-china, Thailand to Malesia, New Guinea, Australia and New Zealand; ca 2 species, one in India.

Cananga odorata (Lam.) Hook. f. & Thomson, Fl. Ind. 130. 1855 & in Fl. Brit. India 1: 56. 1872. *Uvaria odorata* Lam., Encycl. 1: 595. 1789.

Kan.: *Apurva-champak*; Mal.: *Kattuchempagam*; Tam.: *Kadi*; Tel.: *Apurva-champakama*.

Trees, 10 - 20 m tall; young branches minutely pubescent, branching at the top of the trunk. Leaves elliptic-ovate to oblong-lanceolate, sometimes broadly elliptic, rounded or subcuneate at base, shortly acuminate at apex, 9 - 18 x 4 - 7 cm, unequal-sided, glabrous; midrib and lateral nerves puberulous beneath; lateral nerves 8 - 10 pairs; petioles 1 - 1.5 cm long. Flowers bisexual, fragrant, few to several in shortly pedunculate racemes, pendulous; peduncles woody, up to 1.8 cm long, pubescent; pedicels 2.5 - 5 cm long, pubescent; bracts at the base and near middle, triangular, 1 - 2 mm long, pubescent, deciduous. Sepals valvate in bud, united at the base, ovate to triangular, acute, reflexed, 5 - 7 x 4 - 5 mm, pubescent. Petals linear-lanceolate, acute, 5 - 7 x 0.7 - 1 cm, subequal, green, yellow with age, several-veined, silky when young, minutely pubescent with age. Stamens numerous, closely packed, linear, ca 3 mm long; connectives produced into conical acute processes. Carpels many, linear-oblong, 3 - 4 mm long, puberulous; ovules many; styles curved; stigma peltate, pubescent. Ripe carpels 10 - 12, oblong-ovoid, or globose, blunt at top, 1 - 2.5 cm long, nearly black when ripe, pulpy; stalks 1 - 2 cm long. Seeds 6 - 12 in 2 rows, transversely flat, pale brown with pitted surface.

Fl. June - July; *Fr.* Oct. - Nov.

Distrib. India: Cultivated throughout the country, sometimes naturalised.

Myanmar, Indo-china, Thailand, Malesia to Australia and New Zealand.

Notes. Flowers yield an essential oil, commonly called *Cananga Oil*. Leaves also yield an oil which is used medicinally for headache, ophthalmia and gout. Decoction of bark used against rheumatism, ulcers and fevers.

12. *Cyathocalyx* Champion

Trees, medium-sized; branchlets striate, minutely puberulous when young. Leaves large, ovate-lanceolate, glabrous; lateral nerves forming intra-marginal loops. Flowers bisexual, solitary or few, in terminal, extra-axillary or leaf-opposed fascicles, fragrant. Sepals 3, valvate in bud, free or connate, sometimes forming a 3-lobed cup. Petals 6 (3 + 3), valvate in buds, clawed, subequal, concave at base, conniving, covering the stamens and carpels, spreading at upper portion; inner ones united as they fall together. Stamens numerous, closely packed, long-cuneate, truncate at apex; anther-thecae linear, dorsal. Carpels 1 - 3, on a concave torus, oblong to cylindrical; ovules many in 2 rows; style short; stigmas sometimes peltate, disk-shaped. Ripe carpels berries, globose or subglobose. Seeds transversely compressed.

India, Sri Lanka, Myanmar through Malesia to New Guinea; ca 38 species, 2 in India.

KEY TO THE SPECIES

- 1a. Calyx acutely and deeply 3-lobed; ripe carpels elliptic-oblong, transversely grooved 1. *C. martabanicus*
 b. Calyx a faintly 3-lobed cup; ripe carpels ovoid, not grooved 2. *C. zeylanicus*

1. *Cyathocalyx martabanicus* Hook. f. & Thomson in Fl. Brit. India 1: 53. 1872.

Trees, 10 - 12 (or more) m tall; young branches puberulous. Leaves elliptic, cuneate at base, abruptly shortly acuminate at apex, 20 - 29 x 7 - 11 cm, shiny glabrous on both surfaces; lateral nerves puberulous beneath when young; petioles 10 - 14 mm long. Flowers usually solitary, sometimes 2 - 3 together, extra-axillary; pedicels pubescent, ca 8 mm long, ebracteate. Sepals connate up to middle, then divided deeply into 3 oblong-lanceolate acute reflexed lobes, ca 7 x 5 mm, pubescent. Petals clawed, thick, yellowish pubescent; outer petals oblong, concave and conniving at base, spreading above, 25 - 30 x 5 - 7 mm; inner ones shorter and narrower than outer ones. Stamens numerous, cuneate, truncate at top of connectives, ca 2 mm long; anther-thecae linear. Carpels on concave torus, solitary or paired, oblong, 3 - 4 mm long, many-ovuled; stigma sessile, peltate. Ripe carpels solitary or in pairs, ellipsoid to oblongoid, blunt at top, ca 10 cm long, 5 - 6 cm across, torulose, transversely grooved, glabrous; pericarp thick, fleshy; stalk 1 - 1.3 cm long, stout. Seeds 8 - 10, in 2 rows, ca 4 x 1.5 cm.

Fl. April - May; Fr. Oct. - Nov.

Distrib. India: Assam, Nagaland and Meghalaya.

Myanmar.

2. *Cyathocalyx zeylanicus* Champ. in Hook. f. & Thomson, Fl. Ind. 127. 1855 & in Fl. Brit. India 1: 53. 1872.

Trees, evergreen, 20-30 m tall; branches glabrous; bark dark coloured; young branches drooping. Leaves elliptic-oblong or oblong-lanceolate, cuneate at base, shortly acuminate at apex, 20-27 x 5-9 cm, coriaceous, shiny above, glabrous; midrib and nerves beneath pubescent when young; petioles ca 1 cm long. Flowers pale green, extra-axillary, solitary or in pairs; pedicels 1-5 cm long, brown pubescent when young. Sepals united into a cup, faintly 3-lobed, 4-5 mm long, rufous pubescent outside. Petals thinly fleshy, clawed, oblong-lanceolate, subacute, golden pubescent outside, puberulous inside; outer petals 2.5-4 x 0.7-0.8 cm; inner ones shorter and narrower. Torus glabrous, flat with a cavity in the centre. Stamens numerous, long-cuneate at base, truncate at top, ca 2 mm long; anther-thecae linear. Carpel solitary on a concave torus, cylindrical, ca 4 mm long; ovules many; style short; stigma peltate, rotundate. Ripe carpels broadly ovoid, slightly constricted in the middle, obtuse, 5-7 cm in diam., fleshy, yellowish, turning black, glabrous; stalks ca 2 cm long. Seeds 8-10 in 2 rows, compressed; testa reddish brown, bony, smooth, transversely rugose on sides.

Fl. April - June; *Fr.* Oct. - Nov.

Distrib. India: Tropical evergreen forests at low elevations. Tamil Nadu and Kerala.

Sri Lanka.

13. *Desmos* Lour.

(*Unona* auct. non L., Hook. f. & Thomson)

Shrubs or scandent shrubs or small trees. Leaves often glaucous beneath, shiny above. Flowers bisexual, often solitary, extra-axillary or leaf-opposed, usually pendulous. Sepals 3, small, valvate in buds, free or connate at base. Petals 6 (3 + 3), sometimes the inner 3 absent, valvate, clawed at base. Stamens numerous; anther-thecae linear, extrorse; connectives subglobose or truncate at top. Carpels numerous, pubescent; style oblong or ovoid; stigma oblong, ovoid or clavate, opening U-shaped, grooved; ovules 2-8, 1-seriate. Ripe carpels many, moniliform, with 1-8 segments, sometimes torulose. Seed 1 in each segment.

India, Sri Lanka, Bangladesh, Myanmar, China, Indo-china, Thailand through Malesia to Australia, New Zealand and Pacific Islands; ca 30 species, 8 in India.

Literature. SAFFORD, W. E. (1912) *Desmos*, the proper generic name for the so-called *Unonas* of the Old World. *Bull. Torrey Bot. Club* 39: 501 - 508.

KEY TO THE SPECIES

- 1a. Petals 3 or 2, inner series absent 2
 b. Petals 6, in 2 series 3
- 2a. Flowers cream-coloured, usually 3-fringed; petals 3 - 4, acute to shortly acuminate
 3. *D. dasymaschalus*
 b. Flowers red, horn-shaped; petals 2 - 3, linear-lanceolate, long-acuminate 6. *D. longiflorus*
- 3a. Petals twice as long as broad 4
 b. Petals 4 times as long as broad or longer 5
- 4a. Flowering pedicels 10 - 15 cm long 2. *D. cochinchinensis*
 b. Flowering pedicels 1 - 3.5 cm long 4. *D. dumosus*
- 5a. Petals lanceolate 6
 b. Petals narrowly linear 7
- 6a. Leaves abruptly and bluntly acute, almost glabrous; bracts minute; petals glabrous 1. *D. chinensis*
 b. Leaves long-acuminate, pubescent beneath; bracts ca 1 cm long; petals pubescent to glabrous 8. *D. viridiflorus*
- 7a. Pedicels 4 - 7 cm long; petals silky pubescent; inner petals smaller 5. *D. lawii*
 b. Pedicels 2 - 3 cm long; petals glabrous; inner petals longer 7. *D. praecox*

1. *Desmos chinensis* Lour., Fl. Cochinch. 1: 352. 1790. *Unona discolor* Vahl, Symb. Bot. 2: 63, t. 36. 1791; Hook. f. & Thomson in Fl. Brit. Ind. 1: 59. 1872. *U. dunalii* Hook. f. & Thomson, Fl. Ind. 131. 1855. Fig. 41.

Tel.: *Chilukadudduga*.

Shrubs, spreading or sarmentose, up to 3 m tall; young branches subrugose, dark coloured, closely lenticellate, more or less pubescent. Leaves bifarious, oblong-elliptic or oblong-lanceolate, subcordate, rounded or subcuneate at base, bluntly acute to acuminate at apex, 7 - 18 x 3 - 6 cm, glabrous and shiny above, greyish-glaucous beneath; lateral nerves 7 - 12 pairs, faint above, prominent beneath; petioles 3 - 6 mm long. Flowers 8 - 12 cm long, pale yellowish green or cream-coloured, solitary, extra-axillary or leaf-opposed; pedicels slender, 3 - 5 cm long, puberulous or glabrous; bracts placed between the base and the middle of pedicels, linear, acute, 4 - 8 mm long. Sepals 3, free, elliptic-ovate to ovate-lanceolate, obtuse or acute, 5 - 10 x 3 - 4 cm, almost glabrous. Petals 6 (3 + 3), elliptic-lanceolate, narrowed and clawed at base, obtuse at apex, 3 - 5-nerved, glabrous or minutely silky pubescent, greenish yellow, odorous; outer ones 5 - 8 x 1.5 - 2.5 cm; inner ones narrowly lanceolate, 4 - 7 x 1 - 2 cm, glabrous or sparsely appressed pubescent, 5 - 8-veined. Stamens sessile, numerous, oblong, 1 - 1.5 mm long; connectives produced, flat-topped. Carpels sessile, numerous, oblong, 1.5 - 2 mm long, densely pubescent; stigma clavate with U-shaped groove. Ripe carpels many, moniliform with ovoid segments, 2 - 4 cm long, 4 - 5 mm thick, 2 - 6-jointed, with slightly apiculate terminal, fleshy, glabrous or pubescent, 7 - 10 mm long stalk; seeds 1 - 3, shiny, brownish.



Fig. 41. *Desmos chinensis* Lour.: a. branch with flower; b. flower with petals removed; c. stamens; d. carpel; e. fruit.

Fl. April - June; *Fr.* July - Oct.

Distrib. India: Tropical or subtropical forests, 300 - 800 m. West Bengal, Sikkim, Assam, Meghalaya, Mizoram, Orissa, Maharashtra, Andhra Pradesh, Tamil Nadu and Kerala (cultivated).

Bhutan, Bangladesh, Myanmar, Thailand to China and Malesia.

Notes. A species very variable in shape of leaves and pubescence. The 4 varieties described by Hook. f. & Thomson (l. c.) are difficult to demarcate.

The decoction of root is used for dysentery and vertigo.

2. *Desmos cochinchinensis* Lour., *Fl. Cochinch.* 1: 352. 1790. *Unona cochinchinensis* (Lour.) DC., *Prodr.* 1: 91. 1824. *Unona desmos* Raeusch., *Nomencl.* ed.3. 161. 1797; Hook. f. & Thomson in *Fl. Brit. India* 1: 59. 1872.

Climbers or scandent shrubs; young branches minutely rufous pubescent, glabrous with age. Leaves oblong to elliptic-oblong, rounded at base, acute to slightly obtuse at apex, 12 - 22 x 4 - 8 cm, thinly coriaceous, pubescent beneath and midrib above when young, glabrous with age; lateral nerves 12 - 14 pairs; petioles 6 - 10 mm long, pubescent when young. Flowers ca 5 mm long, fragrant, solitary, extra-axillary, pendulous; pedicels slender, 10 - 15 cm long, glabrous or minutely appressed pubescent; bracts 2, submedian, linear, ca 4 mm long. Sepals 3, free, ovate-lanceolate, acuminate, ca 7 x 3 mm, minutely appressed pubescent outside, glabrous inside. Petals 6 (3 + 3), obovate to ovate-lanceolate, longitudinally 3 - 6-nerved; outer ones 5 - 6 x 2.5 - 3 cm; inner ones shorter and narrower, greenish yellow to yellow, pink at base inside, broadly ovate, slightly appressed pubescent, thickly coriaceous. Stamens numerous, ca 2 mm long; connectives convex on the top. Carpels many, oblong, 2 - 3 mm long, brownish hirsute; stigma clavate with U-shaped groove. Ripe carpels numerous, glabrous, moniliform with 2 - 5 joints, terminal one apiculate; stalks 7 - 18 mm long.

Fl. June - July; *Fr.* Sept. - Oct.

Distrib. India: Evergreen forests. Assam and Manipur.

Myanmar, Cambodia, Thailand and Malaysia.

3. *Desmos dasymaschalus* (Blume) Safford in *Bull. Torrey Bot. Club* 39: 507. 1912. *Unona dasymaschala* Blume, *Fl. Java Anon.* 55, t. 27. 1828.

Erect or sarmentose shrubs; young branches usually softly rufous pubescent. Leaves elliptic-oblong to oblong-lanceolate, rounded or sometimes narrowed at base, acute to shortly acuminate at apex, 9 - 28 x 4 - 9.5 cm, glabrous above, puberulous on midrib

beneath; petioles 5 - 20 mm long. Flowers solitary, axillary or terminal, pendulous; pedicels 3.5 - 7 (-10) cm long; bracts minute, basal. Sepals 3, free, triangular, acuminate, 3 - 5 x 3 - 4 mm, silky, fleshy when young, minutely and sparsely pubescent. Petals 3 - 4, partly united when young, concave, clawed, ovate-acute to lanceolate-acuminate, broad at base, 4 - 13 x 1 - 2 cm, cream-coloured, thickly coriaceous; inner series absent. Stamens numerous, 2.5 - 3 mm long; anthers with oblique connectives, expanded at the apex. Carpels many, 3 - 4 mm long, densely villous; stigma clavate with U-shaped groove. Ripe carpels many, moniliform, 2 - 7-jointed, apiculate at apex, pubescent to glabrous; stalks 4 - 6 mm long.

Fl. & Fr. not known.

Distrib. India: Andaman and Nicobar Islands.

Myanmar, Thailand and Java.

4. *Desmos dumosus* (Roxb.) Safford in Bull. Torrey Bot. Club 39: 506. 1912. *Unona dumosa* Roxb., Fl. Ind. 2: 670. 1832; Hook. f. & Thomson in Fl. Brit. India 1: 59. 1872.

Nep.: *Male-lahara*.

Woody climbers; stems developing thickened loops and coils; young twigs brown tomentose, glabrous with age. Leaves ovate, oblong-ovate, elliptic-oblancoelate or obovate, subcuneate to rounded or subcordate at base, shortly acute or abruptly acuminate at apex, 8 - 15 x 4 - 7 cm, sparsely pubescent on the midribs and lateral nerves above, glabrous with age, rusty tomentose to pubescent below; petioles 4 - 10 mm long, rufous tomentose. Flowers solitary, terminal or leaf-opposed, pendulous; pedicels 1.5 - 3.5 cm long, tomentose; bracts ovate to linear, basal, subbasal or submedian. Sepals 3, ovate, acute, 7 - 10 x 5 - 6 mm, pubescent. Petals 6 (3 + 3); outer petals narrowed at base, 4 - 7 x 2 - 3.5 cm, yellowish; inner ones slightly smaller, broadly spatulate, slightly clawed at base, 4.5 - 5 x 0.8 - 1 cm, yellowish green, veined, coriaceous, densely pubescent to glabrous. Stamens numerous, oblong, ca 1.5 mm long; connectives flat-topped. Carpels many, ca 1.5 mm long, covered with brown hairs; stigma sessile, curved. Ripe carpels many, moniliform, up to 3 cm long, dark red at maturity, 1 - 4-seeded, pubescent; joints 2 - 3, terminal one apiculate; basal stalks 7 - 10 mm long.

Fl. May - July; *Fr.* Sep. - Jan.

Distrib. India: Tropical and subtropical forests, up to 800 m. West Bengal, Assam, Tripura and Mizoram.

Bhutan, Bangladesh, Myanmar, Thailand, Indochina and Malesia.

Notes. Sikdar (in Geobios 6: 90 - 91. 1979) records this from West Bengal.

5. *Desmos lawii* (Hook. f. & Thomson) Safford in Bull. Torrey Bot. Club 39: 506. 1912. *Unona lawii* Hook. f. & Thomson, Fl. Ind. 132. 1855 & in Fl. Brit. India 1: 59. 1872.

Climbing shrubs, up to 4 m long; young branches slender, pubescent. Leaves ovate-lanceolate, rounded at base, acute to slightly acuminate at apex, 6 - 10 x 2 - 4 cm, glabrescent and shiny above, sparsely to minutely strigose and subglaucous beneath; lateral nerves 7 - 9 pairs; petioles 2 - 3 mm long, pubescent. Flowers solitary, extra-axillary or leaf-opposed, odorous; pedicels 4 - 7 cm long, linear, pubescent; bracts ovate, acute, 4 - 7 x 2 - 3 mm, pubescent below the middle. Sepals ovate-lanceolate, acute, 5 - 7 x 2 - 3 mm, pubescent outside. Petals 6 (3 + 3); outer petals 5 - 6 x 0.5 - 0.7 cm; inner ones smaller, clawed; limb narrowly linear, acute, silky pubescent on both surfaces, thinly coriaceous; claw slightly expanded, granular villous. Stamens numerous, ca 2 mm long; connectives subglobose at top. Carpels many, oblong, ca 2 mm long, densely pubescent; ovules 2 - 3; stigma curved. Ripe carpels many, moniliform, 1 - 3-jointed, with mucronate terminal joint, shortly stalked.

Fl. Feb. - May; *Fr.* July - Nov.

Distrib. India: Maharashtra, Tamil Nadu, Karnataka and Kerala.

Sri Lanka.

6. *Desmos longiflorus* (Roxb.) Safford in Bull. Torrey Bot. Club 39: 507. 1912. *Unona longiflora* Roxb., Fl. Ind. 2: 668. 1832; Hook. f. & Thomson in Fl. Brit. India 1: 61. 1872.

Asm.: Jor-lewa; *Beng.:* Kulla.

Erect shrubs to small trees, 4 - 8 m tall; branches spreading; young branches puberulous; buds rusty tomentose. Leaves narrow-lanceolate or oblong-lanceolate, rounded or subcuneate at base, acute to acuminate at apex, 13 - 30 x 4 - 7.5 cm, glossy above, glaucous beneath, glabrous on both surfaces; lateral nerves 12 - 16 pairs, subparallel; petioles 1 - 2 cm long. Flowers solitary, axillary, pendulous, horn-shaped, 12 - 15 cm long, silky when young, reddish orange outside, yellow inside; pedicels 3 - 8 cm long; bracts few, subbasal, linear, minute. Sepals 3, broadly triangular, subacute, mucronate, 3 - 4 x 2 - 3 mm, minutely pubescent. Petals 3, usually 2 of them connate, linear-lanceolate, clawed at base, long-acuminate and twisted at apex, 8 - 18.5 x 1 - 1.5 cm, red, fleshy, pubescent when young, glabrous with age; inner series absent. Stamens numerous, spirally closely packed, ca 3 mm long; connectives concave at top. Carpels many, ovoid, 2 - 4 mm long; ovary elongate, densely hairy; stigma curved. Ripe carpels 15 - 50, moniliform, 2 - 4-jointed; segments 1.5 - 2 x 0.6 - 0.8 cm; terminal one apiculate; stalks 1 - 2.5 cm long.

Fl. March - June; *Fr.* July - Dec.

Distrib. India: Sikkim, Assam, Manipur, Meghalaya and Orissa.

Bhutan, Bangladesh and Myanmar.

7. *Desmos praecox* (Hook. f. & Thomson) Safford in Bull. Torrey Bot. Club 39: 507. 1912. *Unona praecox* Hook. f. & Thomson, Fl. Ind. 136. 1855 & Fl. Brit. India 1: 60. 1872.

Asm.: *Parteng-phang*.

Trees. Leaves narrowly ovate, elliptic to broadly lanceolate, cuneate at base, acuminate at apex, 8 - 15 x 3 - 5.5 cm, glabrous above, puberulous beneath; petioles 5 - 10 mm long. Flowers solitary, extra-axillary, precocious, appearing with young leaves from the base of the fallen leaves, pendulous, sweet-scented; pedicels 2 - 3 cm long, ebracteate. Sepals 3, linear-oblong to ovate-lanceolate, acute, 7 - 10 x ca 2 mm, reflexed, thin, slightly pubescent outside, glabrous inside. Petals 6 (3 + 3), pale green, narrowly elliptic to linear, thin, glabrous; inner petals larger, 5 - 9 x 0.4 - 0.7 cm; outer smaller. Stamens numerous, ca 1.5 mm long, truncate; connectives subglobose to flat at top. Carpels many, ca 1.5 mm long; style oblong, with flat stigma. Ripe carpels many, moniliform.

Fl. Feb. - May; *Fr.* Sep. - Dec.

Distrib. India: Subtropical forests, 500 - 1200 m. West Bengal, Sikkim and Assam.

Bhutan.

8. *Desmos viridiflorus* (Beddome) Safford in Bull. Torrey Bot. Club 39: 506. 1912. *Unona viridiflora* Beddome, Icon. Pl. Ind. Or. t. 34, 158. 1868 - 1874; Hook. f. & Thomson in Fl. Brit. India 1: 60. 1872. **Fig. 42.**

Gigantic climbers; young branches golden pubescent, older glabrate. Leaves ovate-lanceolate to oblong-lanceolate, rounded at base, long-attenuate to acuminate at apex, 7.5 - 14 x 2.5 - 4.5 cm, glabrous and shiny above, pubescent and whitish beneath; petioles 3 - 6 mm long, rufous pubescent. Flowers solitary, extra-axillary or leaf-opposed; pedicels slender, 2 - 2.5 cm long, rufous pubescent; bract solitary below the middle, cordate, acuminate, 6 - 10 mm long, rufous pubescent. Sepals 3, narrowly ovate, acute, 1.5 x 0.7 - 1 cm, pubescent on both surfaces. Petals 6 (3 + 3); outer ones 2.5 - 6.5 x 0.8 - 1.2 cm; inner ones smaller, lanceolate, acuminate, silky pubescent or glabrescent. Stamens numerous, ca 1.5 mm long, cuneate; anther-thecae linear; connectives subglobose at top. Carpels many, linear to oblong, ca 1.5 mm long, hairy; style short; stigma slightly curved. Ripe carpels not seen but young carpels show a tendency towards moniliform nature.

Fl. April; *Fr.* Oct.

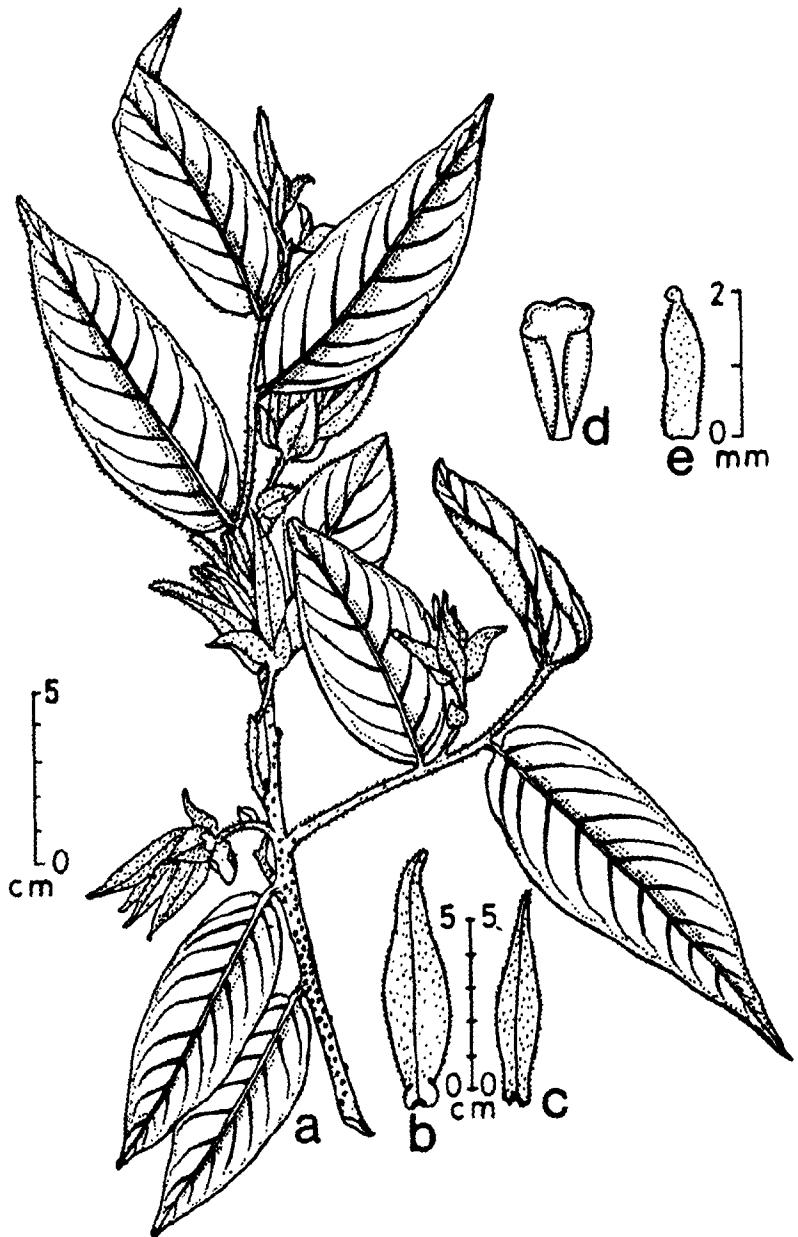


Fig. 42. *Desmos viridiflorus* (Beddome) Safford: a. flowering twig; b. outer petal; c. inner petal; d. stamen; e. carpel; (from A.N. Henry & V. Chitra in *Red Data Book of Indian Plants* 1: 25, 1987).

Distrib. India; Western Ghats of Tamil Nadu and Kerala.

Endemic and rare.

14. *Friesodielsia* van Steenis

[*Oxymitra* (Blume) Hook. f. & Thomson]

Climbers. Leaves parallel-nerved, forming broken or indistinct loops, reticulations scalariform. Flowers bisexual, leaf-opposed or extra-axillary. Sepals 3, valvate. Petals 6 (3 + 3), valvate; outer larger than inner, flat or triquetrous, narrow, leathery, more or less spreading; inner much smaller, ovate-lanceolate or oblong, conniving over stamens and carpels. Stamens many, linear-oblong or cuneate, truncate; anther-thecae dorsal, remote; connectives flat at the top or slightly convex. Carpels oblong or cylindrical, strigose; ovules 1 - 2, subbasal, ascending; style short, recurved; stigma subcapitate. Ripe carpels many, ovoid or oblong, stalked. Seed 1.

Africa, India, Bangladesh, Myanmar, Malaysia, Thailand, Indonesia, and Philippines; ca 55 species, 2 in India.

Literature. DAS, D. (1963) Studies on Indian and Burmese Annonaceae. Bull. Bot. Surv. India 5(1): 93. STEENIS, C.G.G.J. van (1948) Bull. Bot. Gard. Buitenz. 17: 457 - 464.

KEY TO THE SPECIES

- | | |
|--------------------------------------|------------------------|
| 1a. Pedicels of flowers ca 1 cm long | 1. <i>F. fornicata</i> |
| b. Pedicels of flowers 3 - 4 cm long | 2. <i>F. khoshool</i> |

1. *Friesodielsia fornicata* (Roxb.) D. Das in Bull. Bot. Surv. India 5: 43 & 93. 1963. *Uvaria fornicata* Roxb., Fl. Ind. 2: 662. 1832. *Oxymitra fornicata* (Roxb.) Hook. f. & Thomson in Fl. Brit. India 1: 71. 1872.

Asm.: *Meta-bolol-bill*.

Woody climbing shrubs; young branches brown tomentose. Leaves lanceolate or oblong-lanceolate, rounded at base, acuminate at apex, 10 - 18 x 3 - 7 cm, glabrous and glaucous above, hoary pubescent beneath; petioles 5 - 7 mm long. Flowers extra-axillary, solitary; pedicels 6 - 10 mm long, brown tomentose, bracteate at middle. Sepals connate at base, ovate-lanceolate, 5 - 10 x 4 - 5 mm, 5-nerved, densely pubescent on the midrib, reddish outside. Petals greenish to pale yellow; outer larger than the inner, oblong-lanceolate, 2 4 x 0.7 cm, tomentose, with prominent midrib; inner ones ovate, acute, connivent, connate at base, 6 - 8 x 3 - 4 mm, slightly pubescent outside. Stamens many, linear, ca 1 mm long, truncate; connectives round, flat. Carpels few, oblong, ca 1.5 mm

long, strigose; style glabrous, curved; stigmas subcapitate. Ripe carpels ca 10, oblong, apiculate, ca 2 cm long, verrucose, pubescent at base and apex, coppery puberulous; stalks very short, stout, pubescent. Seed 1.

Fl. May - July; *Fr.* Oct. - Dec.

Distrib. India: Arunachal Pradesh, Assam, Meghalaya and Andaman & Nicobar Islands.

Bangladesh, Myanmar and Indo-China.

2. *Friesodielsia khoshooi* Vasud. & T. Chakrab. in *J. Econ. Tax. Bot.* 6: 435. 1985.

Scandent shrubs; young branches densely tawny hirsute, becoming glabrescent. Leaves oblong-elliptic, subcordate at base, acute to acuminate at apex, 13 - 23 x 5 - 10 cm, glabrous above, thinly tawny tomentose beneath; petioles 4 - 8 mm long. Flowers extra-axillary, solitary, yellow or creamy yellow; pedicels 3 - 4 cm long, golden brown, hirsute outside. Outer petals 3, linear-lanceolate, triquetrous, 3.5 - 4.5 cm long, ca 8 mm broad, with prominent midrib, golden brown or tawnysericeous outside, glabrous inside; inner 3 ovate-lanceolate to triangular-lanceolate, long-acuminate at apex, sparsely puberulous to glabrous outside, glabrous inside. Stamens numerous, oblong, ca 2 mm long; connectives flat-topped, oblique. Carpels numerous, oblong, 1.5 - 2.5 mm long, densely golden brown or tawny hirsute; style geniculate or straight; stigma flat. Ripe carpels oblong-ellipsoid, apiculate at apex, 1.3 - 1.4 cm long, 8 - 9 mm in diam., appressed tawny hirsute; stalks 4 - 5 mm long.

Fl. April - May; *Fr.* Aug.

Distrib. India: Andaman & Nicobar Islands (Great Nicobar Island).

Endemic.

15. *Melogyne* Miq.

Small trees or shrubs. Leaves thin; nerves prominent on lower surface. Flowers axillary, sessile or subsessile, medium to large, densely tomentose. Sepals 3, valvate, connate at base. Petals 6 (3 + 3), valvate, tapering gradually from a broad base; inner series a little shorter than outer. Torus convex. Stamens numerous, cuneate; connectives projecting, flat, rhomboid at the top. Carpels 2 - 5, oblong, villous; ovules many, in 2 rows; stigma subcapitate, sessile. Ripe carpels few, oblong, sessile or subsessile. Seeds in 2 rows.

India, S. China, Thailand, Malaysia, Indonesia, Borneo, Philippines and New Guinea; ca 10 species, 2 in India.

KEY TO THE SPECIES

- 1a. Ripe carpels ovoid to globose, densely pubescent 1. *M. pannosa*
 b. Ripe carpels cylindrical to torulose, glabrescent 2. *M. ramarowii*

1. *Meiogyne pannosa* (Dalz.) Sinclair in Sarawak Mus. J. 5(3): 604. 1951; Hook. f. & Thomson in Fl. Brit. India 1: 58. 1872. *Unona pannosa* Dalz. in Hooker's J. Bot. Kew Gard. Misc. 3: 207. 1851.

Kan.: *Kadubondo*.

Trees, 5 - 9 m tall; young branches puberulous. Leaves lanceolate or ovate-lanceolate, rounded or acute at base, obtusely acuminate at apex, 4 - 16 x 1.5 - 4 cm, pellucid-dotted, glabrous and glossy above; midrib and nerves pubescent beneath; lateral nerves ca 8 pairs; petioles 5 - 9 mm long. Flowers yellowish green or dirty white, axillary or terminal, solitary, subsessile or pedicels ca 5 mm long, pubescent; bracts 2 - 3, pubescent. Sepals 3, connate at base, ovate, acute, 4 - 5 x 5 mm, green, tomentose outside, almost glabrous inside. Petals 6 (3 + 3), 2.5 - 5 x 0.5 - 1.4 cm; inner smaller, oblong-lanceolate, subacute, densely brown silky tomentose. Stamens numerous, cuneate, ca 3 mm long; anther-thecae extrorse; connectives broad, capitate. Carpels 10 - 12, oblong, 2 - 2.5 mm long, strigose; ovules 2 - 3; stigma capitate. Ripe carpels few together, ovoid, sometimes apiculate, 1 - 2.5 cm long, tomentose, subsessile. Seeds 1 - 3, shiny.

Fl. Jan. - May; *Fr.* Oct. - Dec.

Distrib. India: Evergreen forests of Western Ghats. Maharashtra, Karnataka, Tamil Nadu and Kerala.

Endemic.

2. *Meiogyne ramarowii* (Dunn) Gandhi in Saldanha & Nicolson, Fl. Hassan Dist. 38. 1976. *Unona ramarowii* Dunn in Bull. Misc. Inf. Kew 1914: 183. 1914. *Desmos ramarowii* (Dunn) D. Das in Bull. Bot. Surv. India 5: 42. 1963.

Large shrubs to small trees, 7 - 9 m tall; young parts pubescent. Leaves elliptic-oblong, obtusely cuneate at base, acuminate at apex. 10 - 20 x 3 - 5 cm, coriaceous, pellucid-punctate, glabrous above, sparsely appressed hirsute beneath; lateral nerves 5 - 6 pairs, impressed above, raised beneath; petioles 5 - 10 mm long. Flowers solitary, axillary, sessile or subsessile. Sepals 3, ovate, acute, ca 6 x 4 mm. Petals 6 (3 + 3), straw-coloured, lanceolate, all parts tomentose, except the tip inside; outer ones 3 - 5 cm long; inner ones shorter and broader. Stamens numerous, ca 1 mm long, cuneate; connectives truncate, much produced. Carpels 8 - 10, densely hirsute; ovules 2 - 4; stigma

capitate and depressed. Ripe carpels 3 - 5, cylindric to torulose, 1.5 - 2.5 cm long, abruptly apiculate, rounded at base to a short stalk, glabrescent. Seeds 1 - 3, ca 4 mm in diam.

Fl. Feb. - July; *Fr.* May - Oct.

Distrib. India: Evergreen forests of Western Ghats. Tamil Nadu, Karnataka and Kerala.

Endemic.

16. *Mezzettia* Beccari

Tall trees. Leaves with midrib broad and flat above, prominent beneath. Flowers small, fasciculate or umbellate. Sepals 3, small. Petals 6 (3 + 3), opening late; inner smaller than outer. Stamens 9 - 15; connectives truncated and concealing the anther-thecae from above. Carpel 1, flask-shaped; ovules 2. Ripe carpels elliptic or globose with hard walls. Seeds 2.

India, Malaysia and Borneo; ca 7 species, one in India.

Literature. HEIJDEN, E. van der & P.J.A. KEBLER (1990) Studies on the tribe Saccopetaleae (Annonaceae) - III. Revision of the genus *Mezzettia* Beccari. *Blumea* 35: 217 - 228.

Mezzettia parviflora Beccari in *Nuovo Giorn. Bot. Ital.* 3: 188. 1871. *M. curtisii* King, *Mat. Fl. Malay. Penins.* 1(4): 378. 1872 & in *Ann. R. Bot. Gard. Calc.* 4: 168, t. 217 B. 1893; Mathew & Mitra in *Indian For.* 117: 1077. 1991.

Trees. Leaves oblong-lanceolate, acuminate, 7.5 - 12 x 2.1 - 3.4 cm, glabrous; petioles 0.5 - 1 cm long. Flowers 4 - 10 in axillary fascicles; pedicels slender, pubescent. Sepals 3, semiorbicular, subacute and reflexed at apex, ca 2 mm long, silky tomentose. Petals 6 (3 + 3), silky tomentose; outer ones ligulate, ca 5 mm long; inner ones obtuse, shorter, ca 3 mm long. Stamens ca 14, ca 1 mm long; connectives flat-topped. Carpel 1, flask-shaped, ca 2 mm long. Ripe carpels sessile, subglobose, with a wavy bloom, 3.7 - 5 cm in diam. Seeds 2, oblong.

Fl. Jan. - Feb.; *Fr.* July - Aug.

Distrib. India: Andaman & Nicobar Islands. Known only from Mount Harriet - Shoal Bay in S. Andaman Island.

Thailand, Malaysia, Sumatra, Borneo and Molluccas.

Notes. Recorded for the first time from Indian territory by Mathew & Mitra (l. c.).

17. *Polyalthia* Blume

Trees or shrubs. Leaves glabrous or pubescent with simple hairs. Flowers bisexual, solitary or few together, axillary, pubescent, pedicellate. Sepals 3, valvate. Petals 6 (3 + 3), valvate, subequal, variously shaped, flat, spreading. Stamens numerous, cuneate; connectives produced. Carpels indefinite, oblong, cylindrical or angled, with 1 or 2 ovules, sometimes up to 5, basal or subbasal; styles almost absent. Ripe carpels few to many, berries, stalked, rarely sessile. Seeds 1 - 5.

Africa, India, Sri Lanka, Bangladesh, Myanmar, Indo-china, Malesia, Australia and New Zealand; 120 species, 14 species in India.

KEY TO THE SPECIES

- | | |
|---|-----------------------------|
| 1a. Petals up to 1.5 cm long | 2 |
| b. Petals more than 1.5 cm long | 8 |
| 2a. Petals equal in 2 series | 3 |
| b. Petals unequal in 2 series, outer shorter than the inner | 4 |
| 3a. Leaves oblong-lanceolate, pubescent beneath; flowers solitary or 2 - 3 together; petals oblong-ovate, acute | 2. <i>P. cerasoides</i> |
| b. Leaves oblong, glabrous and glaucous beneath; flowers many in dense fascicles on leafless branches; petals oblong, obtuse | 11. <i>P. parkinsonii</i> |
| 4a. Pedicels up to 1 cm long; petals thick, fleshy | 5 |
| b. Pedicels 1.5 - 3 cm long; petals thickly coriaceous | 6 |
| 5a. Bracts at the base of pedicels; all outer petals equal, ca 10 mm long, slightly smaller than inner ones; stigma capitate | 4. <i>P. crassa</i> |
| b. Bracts at the middle of pedicels; outer petals equal or unequal, ca 3 mm long or rarely one or two larger, ca 12 mm long; stigma discoid | 10. <i>P. meghalayensis</i> |
| 6a. Leaves obtuse; flowers extra-axillary | 14. <i>P. suberosa</i> |
| b. Leaves acute to acuminate; flowers axillary | 7 |
| 7a. Leaves elliptic-oblong, strongly reticulate-veined; petals oblong, pubescent outside | 7. <i>P. korintii</i> |
| b. Leaves oblong-lanceolate, faintly reticulate-veined; petals oblong-ovate, brown tomentose outside | 12. <i>P. rufescens</i> |
| 8a. Petals 1 - 2 cm wide | 9 |
| b. Petals less than 1 cm wide, rarely up to 1.2 cm wide | 10 |
| 9a. Leaves 10 - 20 cm long; flowers solitary or rarely in pairs; ripe carpels linear-oblong; ca 1.5 cm long | 6. <i>P. jenkinsii</i> |
| b. Leaves 25 - 40 cm long; flowers in fascicles; ripe carpels ovoid-ellipsoid, 2.5 - 3.5 cm long | 8. <i>P. lateriflora</i> |
| 10a. Trees with conical crown; branches and leaves pendulous; leaf-margins strongly undulate; sepals 1 - 2 mm long; petals up to 2 mm wide | 9. <i>P. longifolia</i> |

- b. Trees with subglobose crown; branches and leaves not pendulous; leaf-margins not or rarely slightly undulate; sepals 2 - 5 mm long; petals broader, 2 - 12 mm wide 11
- 11a. Petals strap-shaped, 10 - 12 mm wide; ripe carpels up to 1.2 cm long, often 2-seeded and constricted between seeds 1. *P. cauliflora*
- b. Petals linear to oblong-lanceolate, up to 8 mm wide; ripe carpels 1.5 - 5 cm long, 1-seeded 12
- 12a. Leaves slightly undulate along margins; petals oblong-lanceolate, 5 - 8 mm wide; ripe carpels 2 - 3 cm long with up to 1.5 cm long stalks 3. *P. coffeoides*
- b. Leaves not undulate along margins; petals linear-lanceolate, 2 - 4 mm wide; ripe carpels 2.5 - 5 cm long with 2 - 5 cm long stalks 13
- 13a. Flowers in peduncled or branched cymes; petals rufous-tomentose 5. *P. fragrans*
- b. Flowers in sessile fascicles; petals puberulous 13. *P. simlaurum*

1. *Polyalthia cauliflora* Hook. f. & Thomson var. *desmantha* (Hook. f. & Thomson) Sinclair in Gard. Bull. Sing. 15: 295. 1955; Sanjappa & Chatterjee in J. Econ. Tax. Bot. 7: 457, f.2. 1985. *Unona desmantha* Hook. f. & Thomson in Fl. Brit. India 1: 61. 1872; King in Ann. R. Bot. Gard. Calc. 4: 60, t. 83. 1893.

Small trees, 3 - 5 m tall; trunk 8 - 10 cm in diam., lenticellate; young twigs densely brown tomentose. Leaves elliptic-lanceolate, rounded at base, acutely acuminate at apex, 20 - 23 x 5.5 - 6.5 cm, coriaceous, glabrous, except for the midrib above and midrib and lateral nerves beneath; lateral nerves up to 12 pairs, curving and forming series of arches near margin, depressed above, prominent beneath; petioles ca 5 mm long, densely brown tomentose. Flowers arising from woody tubercles on the trunk and in axils of fallen leaves; pedicels 1.5 - 2 cm long, slender, appressed pubescent, becoming woody in fruits. Sepals 3, triangular or ovate-triangular, ca 5 mm long, slightly recurved, finely pubescent outside and on margins. Petals 6 (3 + 3), chocolate brown, strap-shaped; outer ones 4 - 5 x 1 - 1.2 cm; inner ones curving inwards, 4.5 - 5.5 x 0.5 - 0.6 cm, fleshy, minutely pubescent. Stamens many, ca 1.5 mm long; connectives angular, flat-topped. Carpels many, compact, angular, ca 1.5 mm long, pubescent; stigma sessile, subglobose, pubescent. Ripe carpels many, 1 - 1.2 cm long, 8 - 10 mm across, constricted between seeds, wrinkled when dry, dark brown, glabrous, 1 - 2-seeded.

Fl. May - July; *Fr.* July onwards.

Distrib. India: Tropical evergreen hill forests. Andaman & Nicobar Islands (Great Nicobar Island).

Thailand and Indonesia.

Notes. Reported from India for the first time by Sanjappa & Chatterjee (l. c.).

2. *Polyalthia cerasoides* (Roxb.) Beddome, Fl. Sylv. t. 1. 1869; Hook. f. & Thomson in Fl. Brit. India 1: 63. 1872. *Uvaria cerasoides* Roxb., Pl. Corom. 1: 30, t. 33. 1795 & Fl. Ind. 2: 666. 1832.

Hindi: *Kudumi*; Kan.: *Mabba*; Mal.: *Narela*; Or.: *Nobiniswaro*; Tam.: *Kodigilai*; Tel.: *Cihkadudduga*.

Shrubs or trees, 3 - 15 m tall; bark black or pale grey, lenticellate; young branches minutely rufous-tomentose, glabrous with age. Leaves oblong-lanceolate or lanceolate, acute or rounded at base, acute to acuminate at apex, 8 - 18 x 2.5 - 4 cm, thinly coriaceous, glabrous, dark green and shiny above, glabrescent, puberulous to pubescent beneath; lateral nerves 8 - 12 pairs; petioles 3 - 5 mm long, tomentose. Flowers axillary or extra-axillary, solitary or 2 - 3 fascicled, greenish white, 8 - 13 mm in diam.; pedicels stout, 1.5 - 3 cm long, tomentose; bracts 1 - 2, basal or submedian, leafy, oblong-ovate, acute, 2 - 5 mm long, tomentose. Sepals 3, free, ovate-lanceolate, 5 - 8 x 3 - 4 mm, membranous, appressed hairy outside, glabrous inside. Petals 6 (3 + 3), subequal, thickly coriaceous; outer petals ovate-oblong, acute, inflexed, 6 - 8 x 4 - 5 mm, puberulous, dirty green; inner ones slightly longer. Stamens numerous, cuneate, ca 1.5 mm long; anther-thecae extrorse, remote; connectives almost flat at top. Carpels many, oblong-linear, 1.5 - 2 mm long, covered with stiff hairs; ovule 1 (-2); stigma clavate, slightly curved. Ripe carpels many, ellipsoid to broadly ovoid, apiculate, ca 1 cm long, ca 5 mm across, glabrous, reddish brown when ripe; stalks slender, 1 - 1.5 cm long. Seed 1, globose.

Fl. April - July; *Fr.* Sept. - Dec.

Distrib. India: Bihar, West Bengal, Assam, Arunachal Pradesh, Orissa, Andhra Pradesh, Tamil Nadu and Kerala.

Myanmar, Thailand, Cambodia and Vietnam.

Notes. Timber used for carpentry and shipping purposes.

3. *Polyalthia coffeoides* (Hook. f. & Thomson) Thwaites, Enum. Pl. Zeyl. 398. 1864; Hook. f. & Thomson in Fl. Brit. India 1: 62. 1872. *Guatteria coffeoides* Hook. f. & Thomson, Fl. Ind. 141. 1855.

Mal.: *Villa*; Tam.: *Acevattai*, *Nedumarai*.

Trees, spreading, 18 - 25 m tall; crown subglobose; young branches tomentose when young, glabrous later. Leaves elliptic-lanceolate or oblong-lanceolate, rounded or slightly cuneate at base, long-acuminate at apex, slightly undulate along margins, 10 - 27 x 3.5 - 8.5 cm, glabrous, pellucid-dotted; lateral nerves 10 - 14 pairs, raised beneath; petioles ca 1 cm long, glabrous. Flowers solitary, extra-axillary or sometimes fascicled

on woody tubercles on trunk, greenish yellow; pedicels 1 - 4 cm long, slender, pubescent; bracts basal, ca 1 mm long, tomentose. Sepals 3, suborbicular, 2 - 3 mm across, tomentose. Petals 6 (3 + 3), greenish yellow; outer petals oblong-lanceolate, slightly clawed at base, acute, 2.5 - 5.5 x 0.5 - 0.8 cm, subequal, thickly coriaceous, glabrous; inner ones narrower. Stamens numerous, ca 1 mm long; connectives subglobose at top. Carpels oblong, broad at base, 3 - 4 mm long, densely pubescent; style short, linear, curved; stigma simple, capitate; ovule 1 in each locule. Ripe carpels many, ovoid, ellipsoid, obtuse, apiculate or slightly beaked, 2 - 3 x 1.5 cm, glabrous, dark purple; stalks 1 - 1.5 cm long, woody, stout. Seed 1, broadly ovoid, grooved.

Fl. March - Nov.; *Fr.* July - Aug., Jan. - Feb.

Distrib. India: Evergreen subtropical forests, 500 - 1500 m. Tamil Nadu, Karnataka and Kerala.

Sri Lanka.

Notes. Bark used for making ropes.

The fruiting periods given above are from herbarium specimens, probably there are two flushes of flowering. This needs further observations in the field.

4. *Polyalthia crassa* R. Parker in Indian For. 55: 375. 1929.

Trees, ca 4 m tall; branches glabrous. Leaves oblong, acute at base, acuminate at apex, 12 - 22 x 3 - 7 cm, glabrous, shiny above, pale beneath; petioles 3 - 5 mm long. Flowers solitary or few together on small tubercles on very short leafless extra-axillary branchlets; pedicels ca 1 cm long, stout, puberulous; bracts few, minute at the base of pedicels. Sepals 3, broadly ovate, obtuse at apex, ca 4 x 6 mm, puberulous. Petals 6 (3 + 3), ovate, acute, triangular at tip, green, fleshy, puberulous; outer ones 9 - 10 x 5 - 6 mm; inner ones slightly larger. Stamens numerous, spathulate, 1.5 - 2 mm long; filaments short; connectives suborbicular at top. Carpels many, ca 1 mm in diam., hairy; ovule 1, basal, erect; stigma sessile, capitate. Ripe carpels many, oblong-ellipsoid, ca 2 cm long, glabrous; stalk 1 - 1.5 cm long. Seed 1.

Fl. Feb. - April; *Fr.* Nov. - Dec.

Distrib. India: Andaman & Nicobar Islands.

Endemic.

5. *Polyalthia fragrans* (Dalz.) Beddome, Fl. Sylv. t. 74. 1871; Hook. f. & Thomson in Fl. Brit. India 1: 63. 1872. *Guatteria fragrans* Dalz. in Hooker's J. Bot. Gard. Misc. 3: 206. 1851.

Mal.: *Chella, Kodangi, Neduna, Pullarei*; Tam.: *Nedunar*.

Trees, 15 - 25 m tall; bark greenish grey, blotched with white; young branches densely minutely tawny tomentose. Leaves elliptic to oblong-lanceolate, acute or rounded at base, acute to shortly acuminate at apex, 9 - 27 x 3 - 12 cm, glabrous except midrib, pubescent on nerves when young; lateral nerves 16 - 20 pairs; petioles ca 1 cm long, glabrous. Flowers fragrant, greenish yellow, in many-flowered branched cymes from the axils of fallen leaves or on tubercles; peduncles ca 8 mm long; pedicels 1.5 - 2.5 cm long, rufous tomentose; bracts cup-shaped, suborbicular at middle of pedicels, rufous tomentose. Sepals 3, almost orbicular, obtuse, ca 4 x 3 mm, rufous tomentose. Petals 6 (3 + 3), subequal, linear-lanceolate, 1.5 - 2.5 x 0.2 - 0.3 cm, coriaceous, rufous tomentose; inner ones slightly longer. Stamens numerous, cuneate, ca 1 mm long; connectives globose at top. Carpels many, oblong-ovoid, ca 1.5 mm long, slightly curved, strigose; stigma broad, slightly bifid, blunt. Ripe carpels many, obliquely ellipsoid to broadly ovoid, blunt, 3 - 5 x 1.5 - 2 cm, hoary; stalks 2.5 - 5 cm long. Seed 1, orbicular, ovoid.

Fl. Nov. - Jan.; *Fr.* Mar. - May.

Distrib. India: Evergreen forests, from 500 to 1000 m. Maharashtra, Tamil Nadu and Kerala.

Endemic.

6. *Polyalthia jenkinsii* (Hook. f. & Thomson) Hook. f. & Thomson in *Fl. Brit. India* 1: 64. 1872. *Guatteria jenkinsii* Hook. f. & Thomson, *Fl. Ind.* 141. 1855.

Asm.: *Koliri, Kola-khamtou*; *Kh.*: *Dieng-ther*; *Nep.*: *Kalikath*.

Trees; young branches sparsely rufous pubescent, glabrous with age. Leaves elliptic, ovate to oblong-lanceolate, acute or rounded to subcuneate at base, acute to shortly and abruptly acuminate at apex, 10 - 20 x 4 - 6 cm, membranous or subchartaceous, glabrous; lateral nerves 6 - 8 pairs; petioles 6 - 8 mm long, puberulous. Flowers solitary, axillary, rarely in pairs, 6 - 8 mm long, white to pale yellow, sweet-scented; pedicels 1 - 2 cm long, expanding towards apex, appressed rusty tomentose; bracts at the base or submedian on pedicels, caducous. Sepals 3, suborbicular to ovate, acute, 3 - 5 x 2 - 4 mm, puberulous outside. Petals 6 (3 + 3), subequal, greenish yellow, broadly oblanceolate, narrowed at base, subacute at apex, 3.5 - 4 x 1.5 - 2 cm, subcoriaceous, puberulous to glabrous, faintly nerved. Stamens numerous, ca 1 mm long; connectives flat or convex. Carpels many, linear-oblong, ca 1.5 mm long, hairy; ovule 1; style short; stigma globose, slightly curved. Ripe carpels many, linear-oblong, slightly apiculate, ca 1.5 cm long, glabrous; stalks ca 1.5 cm long. Seed 1, smooth.

Fl. Aug. - Oct.; *Fr.* Dec. - June.

Distrib. India: Assam, Manipur and Andaman & Nicobar Islands.

Indo-china, Malaysia and Philippines.

Notes. Wood used for house posts.

7. *Polyalthia korintii* (Dunal) Thwaites, Enum. Pl. Zeyl. 398. 1864; Hook. f. & Thomson in Fl. Brit. India 1: 64. 1872. *Guatteria korintii* Dunal, Monogr. Fam. Anon. 133. 1817.

Mal.: *Karuvall*; Tel.: *Karinti*.

Shrubs or small trees, 3 - 5 m tall, spreading; young branches glabrous or subpilose. Leaves lanceolate, elliptic-oblong to ovate-oblong, acute to rounded at base, long acuminate at apex, 5 - 15 x 3 - 6 cm, glabrous, coriaceous, sometimes with pilose midrib beneath, strongly reticulate; petioles 3 - 5 mm long, glabrous. Flowers solitary, axillary or rarely 1 - 3 together from tubercles on old wood; pedicels slender, 2 - 3 cm long; bracts 1 - 3, minute, at base or submedian on pedicels. Sepals 3, ovate, subacute, ca 4 x 2 mm, appressed pubescent outside. Petals 6 (3 + 3), oblong, obtuse, 5 - 10 x 2 - 3 mm, thickly coriaceous, pubescent outside; inner ones longer and broader than outer ones. Stamens numerous, oblong, ca 1 mm long; connectives almost flat at top. Carpels 7 - 14, oblong, 1 - 1.5 mm long, strigose; ovules 1 - 3; stigma sessile, subglobose. Ripe carpels many, ellipsoid or subglobose, 5 - 7 mm long, bright crimson; stalks ca 7 mm long. Seed 1, smooth, shiny grey.

Fl. Jan. - Mar.; *Fr.* Aug. - Nov.

Distrib. India: Occasional in evergreen forests. Andhra Pradesh, Tamil Nadu and Kerala.

Sri Lanka.

8. *Polyalthia lateriflora* (Blume) Kurz in J. Asiat. Soc. Beng. 43(2): 52. 1874. *Guatteria lateriflora* Blume, Bijdr. 20. 1825. *Polyalthia simiarum* (Hook. f. & Thomson) Hook. f. & Thomson in Fl. Brit. India 1: 63. 1872, p. p.

Trees, 6 - 20 m tall, all parts except inflorescence glabrous. Leaves oblong to elliptic-oblong, narrowed to rounded or subcordate base, acute to shortly acuminate at apex, entire, 25 - 40 x 8 - 18 cm; petioles ca 7 mm long, stout, glabrous. Flowers in fascicles from tubercles on the stem or older branches; pedicels ca 5 mm long, pubescent; bracts submedian, amplexicaule. Sepals broadly ovate, acute, 4 - 5 x 2 - 3 mm, densely and minutely tomentose outside. Petals 6 (3 + 3), oblong-lanceolate, subacute, 4 - 5 x 1 - 1.4 cm, greenish yellow, reddish at base, coriaceous, minutely pubescent; inner petals slightly longer than outer. Stamens numerous, ca 1.5 mm long; connectives flat or convex

at top. Carpels many, linear, broad at base, 1 - 1.5 mm long, pubescent; ovule 1; stigma subglobose, slightly curved. Ripe carpels many, ovoid to ellipsoid, blunt at apex, 2.5 - 3.5 cm long, ca 6 cm in diam., glabrous, red when ripe; stalks 2 - 4.5 cm long, stout. Seed 1, oblong, longitudinally grooved.

Fl. June - July; *Fr.* Nov. - June.

Distrib. India: Andaman and Nicobar Islands.

Myanmar.

9. *Polyalthia longifolia* (Sonner.) Thwaites, Enum. Pl. Zeyl. 398. 1864; Hook. f. & Thomson in Fl. Brit. India 1: 62. 1872. *Uvaria longifolia* Sonner., Voy. aux Indes 2: 233, t. 131. 1782.

Asm.: Unboi; *Beng.:* Debdaru; *Hindi:* Ashoka; *Kan.:* Putranjiva; *Mal.:* Ashokam, Chorunna; *Or.:* Debdaru; *Tam.:* Asogam, Asothi; *Tel.:* Asokamu.

Trees with straight trunk and conical crown, 15 - 20 m tall; bark greyish brown; young branches spreading, pendulous, slender, glabrous or sparsely puberulous when young. Leaves oblong-lanceolate to narrow-lanceolate, rounded at base, gradually long-acuminate at apex, strongly undulate along margins, 15 - 23 x 2 - 4 cm, glabrous, shiny above, dull beneath; lateral nerves up to 30 pairs, faint; petioles 1 - 1.5 cm long. Flowers greenish yellow, 2.5 - 3 mm long, numerous, in subumbellate clusters on 3 - 10 mm long peduncle at axils of fallen leaves; pedicels slender, 2 - 3 cm long, slightly pubescent; bracts submedian. Sepals 3, connate at base, broadly ovate-triangular, acute at apex, 1 - 2 x 1 - 1.5 mm, pubescent. Petals 6 (3 + 3), subequal, linear, acuminate, broad at base, puberulous, membranous, greenish yellow; outer petals 6 - 7 x ca 2 mm; inner ones 10 - 15 x ca 2.5 mm. Stamens numerous, ca 1 mm long; connectives convex at top. Carpels many, linear, slightly broad at base, ca 1.5 mm long, puberulous. Ripe carpels numerous, ovoid to ellipsoid, obtuse at both ends, ca 2 cm long, ca 1 cm across, glabrous, yellowish, reddish to black later; stalks 1 - 1.5 cm long. Seed 1, almost ovoid, smooth or slightly longitudinally grooved, pale brown, shiny.

Fl. March - May; *Fr.* July - Sept.

Distrib. India: Cultivated throughout in gardens and as avenue trees, sometimes self regenerating.

Said to be native of South India and Sri Lanka, now introduced to many tropical countries.

Notes. The seed and fruit anatomy of this species has been studied by Mohana Rao (in Bot. Jahrb. 10: 83 - 89. 1979).

Polyalthia longifolia (Sonner.) Thwaites var. *pendula* is a well known ornamental plant cultivated in gardens and avenues in India.

The herbarium specimens of this variety are hardly distinguishable from those of the typical form. But the living specimens can be easily separated by the characters mentioned below.

Crown subcylindric to conical, tapering to apex. Stem slender, 10 m or more tall; branches slender, drooping; branchlets also drooping. Flowers in cymes, with fewer flowers than the typical variety, flowering irregular and fruits are rarely produced.

10. *Polyalthia meghalayensis* Prakash & Mehrotra in Nord. J. Bot. 10: 45 - 47, f. 1. 1990.

Shrubs, erect, unbranched or few-branched; stem black with numerous lenticels. Leaves elliptic-oblong, cuneate at base, acuminate at apex, 4 - 14 x 1.7 - 3.7 cm, glabrous, pubescent with simple hairs along midrib beneath; petioles 2 - 4 mm long, swollen with annular rings, glabrous or pubescent. Flowers 1.8 - 2.3 cm across, pinkish yellow, solitary, leaf-opposed; pedicels 5 - 8 mm long; bracts 2, above the base nearly at the middle, ovate, 1 - 1.5 mm long, hairy. Sepals 3, valvate, ovate, 2.5 - 3 mm long, pubescent. Petals 6 (3 + 3), ovate, thick, flat, spreading, hairy outside; outer petals valvate or imbricate, smaller, ca 3.5 mm long or 1 or 2 equal to inner ones; inner ones imbricate, larger, thicker, ca 12 x 9 mm. Stamens numerous; anthers sessile, 2-loculed, 2.3 - 2.5 mm long; connectives prominent, discoid-suborbicular at top. Carpels numerous, linear-oblong, ca 2 mm long, silky hairy; ovules 1 (-2); style absent; stigma discoid. Ripe carpels not seen.

Fl. & Fr. not known.

Distrib. India: Evergreen forests, ca 800 m. Meghalaya.

Endemic.

11. *Polyalthia parkinsonii* Hutch. in Bull. Misc. Inf. Kew 1917: 25. 1917.

Small trees; bark greyish. Leaves lanceolate, slightly oblique and obtuse at base, long-acuminate at apex, 10 - 20 x 3 - 6 cm, glabrous, shiny above, greyish glaucous beneath; petioles 7 - 10 mm long, minutely transversely rufous, glabrous. Flowers many in dense fascicles on leafless branches of previous year; pedicels slender, 1.5 - 2 cm long, glabrous; bract 1, minute, submedian. Sepals 3, triangular, obtuse, 1.5 - 2 x 1.5 mm, coriaceous, minutely pubescent. Petals 6 (3 + 3), sometimes 7, subequal, oblong to narrowly oblong, obtuse, ca 13 x 2 - 3 mm, white, densely tomentose outside, sparsely tomentose inside. Stamens numerous, triangular, less than 1 mm long; connectives truncate, almost flat at top. Carpels many, short, subglobose, glabrous; ovule 1, basal;

stigma sessile, truncate, thick. Ripe carpels many, subglobose, ca 1 cm in diam., more or less shiny, short-stipitate. Seed 1.

Fl. Nov. - Dec.; *Fr.* Feb. - Mar.

Distrib. India: Andaman & Nicobar Islands.

Endemic.

12. *Polyalthia rufescens* Hook. f. & Thomson in Fl. Brit. India 1: 66. 1872.

Trees; young branches densely tomentose. Leaves narrowly oblong-lanceolate, obliquely cordate at base, acuminate at apex, 9 - 10.5 x 2 - 3 cm, glabrous, except the midrib beneath; nerves faint; petioles 1 - 2 mm long, glabrous. Flowers solitary, axillary; pedicels ca 2 mm long, tomentose, minutely bracteate at base. Sepals 3, ovate, acute, 2 - 3 x ca 2 mm, pubescent. Petals 6 (3 + 3), oblong-ovate, subacute, 7 - 10 x 4 - 5 mm, thick, brown tomentose outside; inner ones larger than outer; connectives slightly convex, pubescent. Carpels many, linear, ca 1 mm long, covered with long straight brown hairs; ovules 2; styles minute; stigma capitate. Ripe carpels not seen.

Fl. Feb. - May.

Distrib. India: Kerala, Tamil Nadu and Andaman & Nicobar Islands.

Endemic.

13. *Polyalthia simiarum* (Hook. f. & Thomson) Hook. f. & Thomson in Fl. Brit. India 1 : 63. 1872, p. p. *Gutteria simiarum* Hook. f. & Thomson, Fl. Ind. 142. 1855.

Fig. 43.

Asm.: Boga-khamtoi, Borkoliori; *Kh.:* Dieng-ja-roi; *Or.:* Hajarh, Mongal, Ojher; *Sant.:* Dighi-bentia.

Trees, 15 - 25 m tall; bark light grey, smooth except horizontal wrinkles and vertical fissures; branches thin, glabrous; young shoots puberulous. Leaves bifarious, ovate-oblong to oblong-lanceolate, subcordate, rounded to subacute at base, acute to shortly acuminate at apex, entire, 15 - 30 x 5 - 11 cm, subcoriaceous, glabrous; lateral nerves 12 - 18 pairs, arcuate; petioles 5 - 9 mm long. Flowers yellowish green, 3.5 - 4 cm across, 3 - 5 fascicled in axils of fallen leaves or on tubercles on older branches; peduncles 3 - 6 mm long; pedicels 3 - 4 mm long, slender, minutely pubescent; bracts 1 - 2, submedian and basal, ca 1 mm across. Sepals 3, broadly ovate to triangular, reflexed, ca 3 x 2.5 mm, pubescent outside. Petals 6 (3 + 3), linear-lanceolate, acute to subacute, thickly coriaceous, puberulous outside, glabrous inside except the base, greenish yellow to purplish; outer petals 2 - 3 x 0.3 - 0.4 cm; inner ones 2.5 - 3 x 0.3 - 0.4 cm. Stamens numerous,

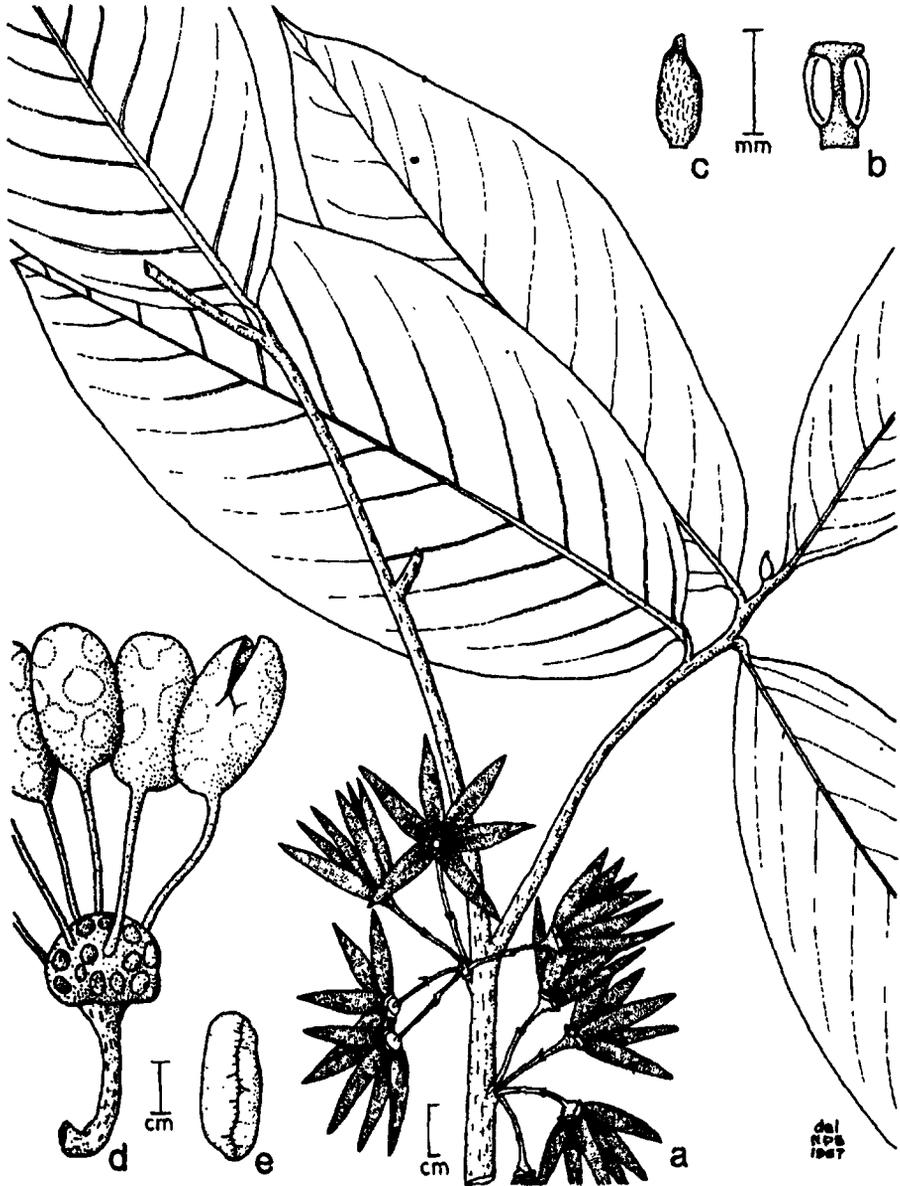


Fig. 43. *Polyalthia similarum* (Hook. f. & Thomson) Hook. f. & Thomson: a. branch with flowers; b. stamen; c. carpel; d. fruit; e. seed.

subglobose, less than 1 mm long; connectives flat to almost round at top. Carpels many, ca 1 mm long; ovule 1, basal, erect; style short; stigma spatulate. Ripe carpels ca 40, ovoid to ellipsoid, apiculate, 2.5 - 3.5 cm long, glabrous, orange red to bluish black when ripe; stalks 2 - 4 cm long. Seed 1, oblong-ovoid, grooved, transversely ribbed, 2.5 - 2.8 cm long, 1.2 - 1.5 cm thick.

Fl. April - Aug.; *Fr.* July - Nov.

Distrib. India: West Bengal, Sikkim, Assam and Orissa.

Bhutan, Bangladesh, Myanmar, Thailand, Cambodia, Vietnam and Laos.

Notes. The wood is useful for tea-chests. The bark fibres can be made into ropes.

14. *Polyalthia suberosa* (Roxb.) Thwaites, Enum. Pl. Zeyl. 398. 1864; Hook. f. & Thomson in Fl. Brit. India 1: 65. 1872. *Uvaria suberosa* Roxb., Pl. Corom. 1: t. 34. 1795.

Asm.: *Habida-cha, Makhameraphang*; *Beng.:* *Barachali, Kukuriam*; *Or.:* *Burhi-chamri, Lohania, Mossu*; *Sant.:* *Sandiome*; *Tel.:* *Buddadudduga*.

Shrubs or small trees, 4 - 6 m tall, branching from base; bark corky, rough, reddish inside; young branches rufous tomentose. Leaves oblong or oblong-lanceolate, slightly narrowed at base, obtuse at apex, 4 - 10.5 x 1.5 - 3.5 cm, glabrous and shiny above, pubescent and pale beneath; petioles 2 - 3 mm long, brown pubescent. Flowers 8 - 10 mm long, greenish yellow, extra-axillary, solitary, rarely in pairs; pedicels slender, 1.5 - 2.5 cm long; bracts 2, one basal and the other at middle of pedicel, ovate, acute, minute, pubescent. Sepals 3, spreading, ovate, acute, ca 2 x 1 mm, pubescent outside, glabrous inside. Petals 6 (3 + 3), reddish brown; outer petals ovate to oblong-lanceolate, acute, slightly reflexed, ca 6 x 4 - 5 cm, thickly coriaceous, silky pubescent outside, glabrous inside; inner ones slightly longer. Stamens numerous, ca 1 mm long; connectives slightly convex at top. Carpels many, ca 2 mm long, pubescent; ovule 1; stigma triangular, flat. Ripe carpels many, subglobose, ca 5 mm across, purple, puberulous; stalks slender, 0.5 - 1 cm long. Seeds 1 - 2, globose, smooth.

Fl. April - May; *Fr.* Oct. - Dec.

Distrib. India: West Bengal, Assam, Meghalaya, Orissa, Madhya Pradesh, Andhra Pradesh, Tamil Nadu and Kerala.

Sri Lanka, Myanmar, Thailand, China, Malaysia and Philippines.

Tribe 5. U V A R I E A E

Trees, shrubs or climbers. Flowers bisexual, rarely unisexual or polygamous, in few-flowered cymes or solitary, extra-axillary or leaf-opposed. Sepals 3, imbricate or valvate. Petals 6, imbricate. Stamens numerous, sometimes few (in *Sageraea*); anther-thecae concealed by the overlapping connectives. Carpels many, sometimes few (in *Sageraea*). Ripe carpels many, free, berries, few to many-seeded, sessile or stalked.

India, Sri Lanka, Bangladesh, Myanmar, China, Thailand to Malesia, Australia, New Zealand and Africa; 4 genera and 19 species in India.

18. *Cyathostemma* Griffith

Woody climbers, pubescent with simple or stellate hairs. Flowers bisexual or unisexual, in pendulous or clustered cymes from old branches or leaf-opposed or extra-axillary or sometimes terminal, globose. Sepals 3, valvate, connate, hairy. Petals 6 (3 + 3), clawed and valvate at the base, imbricate at top, coriaceous, clawed, convex outside. Stamens many, linear; anthers subintrorse; connectives obliquely incurved. Carpels many, pubescent; style cylindrical, glabrous, notched, sometimes absent; stigma U-shaped; ovules many in 2 rows. Torus flat, convex at margins. Ripe carpels oblong, ovoid with irregular bulges. Seeds many.

India, Bangladesh, Myanmar, Thailand, Malaysia, Borneo and New Guinea; ca 8 species, 2 in India.

KEY TO THE SPECIES

- | | |
|--|---------------------------|
| 1a. Leaves 7 - 12 cm long; flowers in simple cymes; bracts basal and median | 1. <i>C. micranthum</i> |
| b. Leaves 12 - 17 (-27) cm long; flowers in dichotomous cymes; bracts distichous giving zig-zag appearance | 2. <i>C. viridiflorum</i> |

1. *Cyathostemma micranthum* (DC.) Sinclair in Gard. Bull. Sing. 14: 225. 1955. *Guatteria micrantha* DC. in Mem. Soc. Phys. Geneve 5: 218. 1832. *Uvaria micrantha* (DC.) Hook. f. & Thomson in Fl. Brit. India 1: 51. 1872.

Climbers; young branches rusty tomentose, glabrous with age. Leaves oblong-lanceolate, rounded or slightly cuneate at base, long-acuminate at apex, 5 - 8 x 2 - 4 cm, glabrous, except the rufous pubescent midrib above, sometimes sparsely pubescent beneath; petioles 2 - 3 mm long, brown pubescent. Flowers bisexual, leaf-opposed or terminal, in 2 - 5-flowered cymes; pedicels 6 - 8 mm long, rusty brown tomentose; bracts 2, orbicular. Sepals subrotund, obtuse, connate at base, 2.4 - 2.5 mm long, pubescent outside, glabrous inside. Petals greenish yellow, tomentose; outer ones 4 - 5 x 3 - 4 mm, broadly clawed at base. Stamens ca 1 mm long; connectives round, flat. Carpels oblong,

ca 1 mm long; stigma sessile, bilobed. Ripe carpels many, globose or subglobose, with bulges, 5 - 7 mm in diam.; stalks slender, 2 - 2.5 cm long. Seeds in 2 rows, smooth, plano-convex, brown.

Fl. June - July; *Fr.* Sept. - Oct.

Distrib. India: Andaman & Nicobar Islands.

Endemic.

2. *Cyathostemma viridiflorum* Griffith, Notul. 4: 707. 1854 & in Icon. 4: t. 650. 1854; Hook. f. & Thomson in Fl. Brit. India 1: 57. 1872.

Climbers. Leaves oblong-lanceolate or oblong-elliptic, narrowed and faintly subcordate at base, acute at apex, 10 - 20 x 5 - 8 cm; petioles 5 - 7 mm long, pubescent. Flowers bisexual, greenish yellow; peduncles rusty tomentose, 1 - many, arising from the same point; bracts one basal at each bifurcation and one about the middle on each pedicel, tomentose, persistent. Sepals broadly ovate, connate at base, obtuse, reflexed, ca 3 x 5 mm, rusty tomentose. Petals broadly ovate, acute, ca 5 x 5 mm; outer ones with a thick and rudimentary claw; inner ones slightly narrowed with a thick and distinct claw. Stamens ca 2 mm long; connectives truncate, incurved. Carpels 4 - 5 mm long, tomentose; stigma sessile, U-shaped or horse-shoe shaped; ovules many, biseriate. Ripe carpels obtuse, irregularly bulged, 2.5 - 4 cm long, glabrous, thick-walled; stalks ca 2 cm long, stout. Seeds 5 - 6 in 2 rows.

Fl. June - July; *Fr.* Sept. - Dec.

Distrib. India: Andaman Islands.

Malayasia.

19. *Sageraea* Dalz.

Elegant trees. Leaves glabrous, glossy above. Flowers uni- or bisexual, small, globular in bud, solitary, axillary or fascicled, often on woody tubercles on old branches. Sepals 3, imbricate, orbicular or ovate, ciliate. Petals 6 (3 + 3), usually orbicular, subequal, concave, imbricate, free. Stamens 6 - 28 in 2 or more series, 1 - 2 mm thick; anther-thecae dorsal, oblong; connectives produced, not hiding the anthers. Torus flat or convex. Carpels 3 - 6; style short; stigma obtuse or capitate; ovules 1 or 6 - 14, biseriate on ventral suture. Ripe carpels solitary or few together, globose, thin-walled, nearly sessile or stalked.

Sri Lanka, India, Bangladesh, Myanmar, Thailand, Cambodia, Vietnam and Malasia; ca 9 species, 5 in India.

KEY TO THE SPECIES

- | | |
|--|---|
| 1a. Flowers unisexual | 2. <i>S. elliptica</i> |
| b. Flowers bisexual | 2 |
| 2a. Flowers sessile, usually solitary | 5. <i>S. listeri</i> var. <i>andamanica</i> |
| b. Flowers distinctly pedicelled; pedicels 1 - 3 cm long, usually fascicled | 3 |
| 3a. Leaves elliptic; inner petals smaller; stamens 25 - 28 | 1. <i>S. dalzellii</i> |
| b. Leaves oblong or lanceolate; inner petals larger or equalling the outer set; stamens 12 | 4 |
| 4a. Leaves 25 - 35 cm long; pedicels 2.5 - 3 cm long | 3. <i>S. grandiflora</i> |
| b. Leaves 10 - 20 cm long; pedicels 1 - 1.5 cm long | 4. <i>S. laurifolia</i> |

1. *Sageraea dalzellii* Beddome, Icon. Pl. Ind. Or. 9: t. 42. 1868 - 1874; King in Ann. R. Bot. Gard. Calc. 4: 8. 1893, p. p. *Bocagea dalzellii* (Beddome) Hook. f. & Thomson in Fl. Brit. India 1: 92. 1872, p. p.

Kan.: *Kaitha*; Mal.: *Kanakaita*, *Manja-nara*; Tam.: *Neduvattu*.

Evergreen trees, 15 - 18 m tall. Leaves elliptic to elliptic-oblong, rounded at base, subacute to obtuse at apex, 25 - 35 x 8 - 11 cm, glabrous; lateral nerves 10 - 12 pairs; petioles stout, 1 - 1.5 cm long, glabrous. Flowers ivory-yellow, axillary, in fascicles of 4 - 8 flowers on woody tubercles on older branches; pedicels 2 - 3 cm long, with many scaly bracts at base. Sepals connate at base, 1.5 - 2 mm across. Petals orbicular, concave, 5 - 6 mm across, bright yellow. Stamens 25 - 28, ca 2 mm long, all fertile; anther-thecae dorsal and distinct; connectives thin and flat in outer series and thick and quadrate in inner ones. Carpels 3 - 5, oblong, hairy; ovules ca 12, in 2 series; style short; stigma capitate, slightly curved. Ripe carpels subsessile, subglobose, ca 4 cm across, glabrous. Seeds many, ca 2 cm long, biseriate, transversely striate.

Fl. March - May; Fr. Aug. - Sept.

Distrib. India: Evergreen forests, 750 - 1000 m. Tamil Nadu and Kerala.

Endemic to southern Western Ghats.

Notes. Leaves used for the treatment of rheumatism; wood valued for building work.

2. *Sageraea elliptica* (DC.) Hook. f. & Thomson, Fl. Ind. 93. 1855; C.E. Parkinson, For. Fl. Andaman Isl. 77. 1923. *Uvaria elliptica* DC. in Mem. Soc. Phys. Geneve 5: 23. 1832. *Bocagea elliptica* (DC.) Hook. f. & Thomson in Fl. Brit. India 1: 92. 1872.

Large trees, glabrous. Leaves narrowly oblong, usually rounded and rarely cordate at base, acute at apex, 20 - 35 x 4.5 cm; petioles thick, ca 4 mm long. Flowers reddish; pedicels ca 6 mm long, with several bracts near the base. Sepals semi-circular, ca 4 x 5 mm, ciliate along margins, thick; inner ones smaller. Stamens 12 - 18; anthers extrorse. Carpels 3, ca 2 mm long; stigma sessile, capitate; ovules about 8. Ripe carpels 2 - 3, subglobose, ca 2.5 cm across, glabrous. Seeds 4 - 5 in 2 rows.

Fl. Feb. - March; *Fr.* April - May.

Distrib. India: Andaman Islands (based on Parkinson, l. c., no specimen seen in CAL, DD or PBL).

Notes. Wood heavy, straight, grained and elastic, used in Andamans for making boats and bows.

3. *Sageraea grandiflora* Dunn in Bull. Misc. Inf. Kew 1914: 182. 1914 & in Gamble, Fl. Pres. Madras 12. 1915.

Trees, ca 20 m tall, all parts except flowers glabrous. Leaves oblong, rounded at base, short-acuminate at apex, 25 - 35 x 7 - 8 cm, glabrous; petioles 8 - 9 cm long. Flowers clustered below the leaf scars. Sepals 2 - 3 mm long, connate at base. Petals orbicular, ciliate along margins; outer ones ca 1.5 cm long; inner ones slightly larger. Stamens 12, obovate; anther-thecae distant. Carpels 3 - 5, strigose; stigma almost sessile, entire; ovules 12 - 14. Ripe carpels not known.

Fl. Nov. - Dec.

Distrib. India: Evergreen forests. Kerala (Konni in Pathanamthitta Dist.).

Endemic.

Notes. This highly endangered species has not been relocated since the type collection by Bourdillon (469 in K and MH).

4. *Sageraea laurifolia* (Graham) Blatter in J. Bombay Nat. Hist. Soc. 34: 294. 1931. *Guatteria laurifolia* Graham, Cat. Bombay Pl. 4. 1839. *Bocagea dalzellii* (Beddome) Hook. f. & Thomson in Fl. Brit. India 1: 92. 1872, p. p. *Sageraea laurina* Dalz. in Hooker's J. Bot. Gard. Misc. Kew 3: 207. 1851. Fig. 44.

Kan.: *Sarare*; Mar.: *Sageri*.

Trees, medium-sized. Leaves oblong-lanceolate, cuneate or sometimes rounded at base, acute at apex, glabrous; petioles ca 1 cm long. Flowers solitary or in small fascicles on short tubercles below the leaves, sometimes axillary with a few scaly bracts at the base

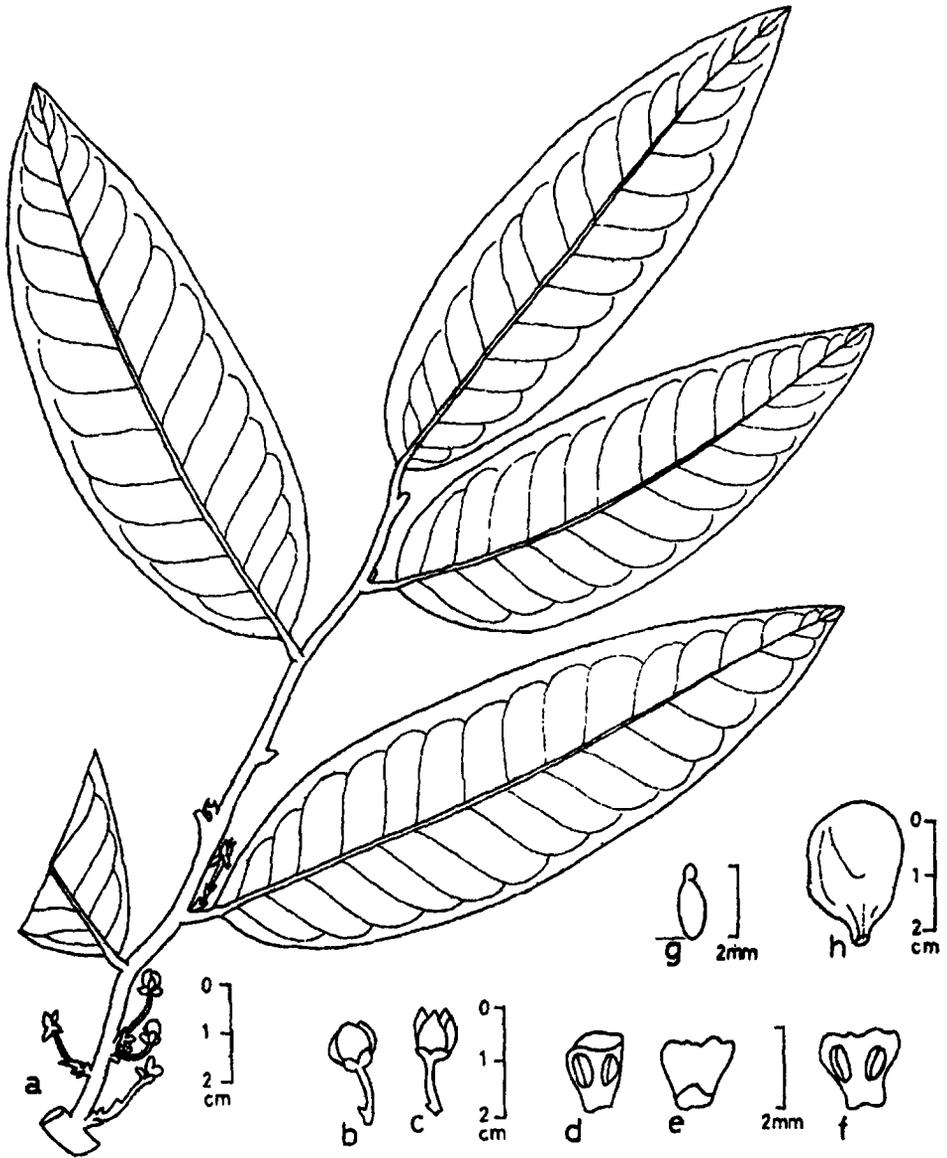


Fig. 44. *Sageraea laurifolia* (Graham) Blatter : a. flowering twig; b. bud; c. flower; d, e. & f. stamens (e. sterile); g. carpel; h. ripe carpel.

of the pedicels. Sepals slightly connate at base, ca 1.5 mm across, minutely ciliate along margins. Petals concave, 5 - 8 mm across, glabrous, except the ciliate margin, white. Stamens in 2 rows, outer sometimes sterile and flattened, variable in size and shape; connectives broad. Carpels 3 - 5, elliptic-ovate, ca 2 mm long, glabrous; stigma sessile, capitate; ovules 8 - 10. Ripe carpels 1 - 2, glabrous, ca 2.5 cm across, wrinkled when dry. Seed 1.

Fl. Oct. - Nov.; *Fr.* Jan. - Feb.

Distrib. India: Maharashtra, Karnataka and Tamil Nadu.

Endemic to Western Ghats.

5. *Sageraea listeri* King in Ann. R. Bot. Gard. Calc. 4: 7, t. 35A. 1893.

Notes. The typical variety is known only from Chittagong in Bangladesh. However, var. *andamanica* occurs in India and is distinguished as follows:

KEY TO THE VARIETIES

- | | |
|--|------------------------|
| 1a. Main lateral nerves 6 - 18 pairs; bracts 1 - 3; stamens 9 | var. <i>listeri</i> |
| b. Main lateral nerves 8 - 12 pairs; bracts about 10; stamens 15 | var. <i>andamanica</i> |

var. *andamanica* Chatterjee & Mukerjee in Proc. Linn. Soc. 154: 268. 1941 - 42.

And.: *Chooi*.

Flowers solitary, rarely in pairs; bracts at the base of the sessile flowers, semi-circular or reniform. Petals 6, equal, strap-shaped. Stamens ca 2 mm long.

Fl. March - April; *Fr.* Oct. - Nov.

Distrib. India: Andaman Islands.

Myanmar.

Notes. It yields a good timber suitable for making planks.

20. *Trivalvaria* Miq.

Shrubs or small trees. Leaves large, usually glabrous; midrib prominent below; lateral nerves decurrent at the midrib. Flowers polygamous, extra-axillary, solitary or 2 - 3 together, sessile or shortly pedicelled. Sepals 3, free, imbricate. Petals 6, in 2 series, imbricate, free or adhering by edges, concave or vaulted, tomentose. Torus convex. Stamens numerous, short; connectives usually rhomboid at top. Carpels many, villous, uniovulate; style oblong; stigma usually capitate. Ripe carpels many, ellipsoid, shortly stalked. Seed 1.

India, Bangladesh, Myanmar, Thailand, Malaysia, Borneo and Indonesia; ca 7 species, 3 in India.

KEY TO THE SPECIES

- 1a. Leaves lanceolate, 12 - 15 cm long; pedicels 3 - 5 mm long with lanceolate bracts; outer petals valvate, inner imbricate 3. *T. karjilalli*
- b. Leaves oblong-lanceolate, 15 - 24 cm long; pedicels minute with ovate bracts; petals of both series imbricate 2
- 2a. Flowers in fascicles on woody tubercles; sepals densely gland-dotted outside; petals unequal, outer larger 1. *T. argentea*
- b. Flowers solitary or in pairs; sepals silky tomentose outside; petals equal 2. *T. dubia*

1. *Trivalvaria argentea* (Hook. f. & Thomson) Sinclair in Sarawak Mus. J. 5: 603. 1951. *Polyalthia argentea* Hook. f. & Thomson in Fl. Brit. India 1: 67. 1872. *Popowia hookeri* King in J. Asiat. Soc. Beng. 61(2): 97. 1892.

Shrubs, wholly glabrous; branches dark brown. Leaves oblong or oblanceolate, acute to rounded at base, abruptly acuminate at apex, 15 - 21 x 3.5 - 9 cm, thinly chartaceous, glabrous, glaucous beneath; lateral nerves 8 - 10 pairs, slender, arcuate; petioles 5 - 7 mm long. Flowers very small, solitary or in fascicles or 2 - 3 from extra-axillary tubercles, polygamous. Sepals ovate, acuminate, ca 3 x 2 mm. Petals of outer series ca 2.5 x 1.5 mm, pubescent outside; inner ones with a rudimentary claw at base, ca 2 x 1 mm, pubescent on midrib. Male flowers: Stamens sessile on a central column; connectives capitate at top. Female flowers: Carpels numerous, inserted on a cylindrical torus with abortive stamens at the base, oblong, densely silky; stigma sessile, capitate. Ripe carpels numerous, oblong, minutely apiculate, 1.5 - 2 cm long, granulate, longitudinally grooved, pale pinkish; stalks 3 - 5 mm long. Seed 1.

Fl. June - July; *Fr.* Sept. - Feb.

Distrib. India: Assam, Arunachal Pradesh, Meghalaya and Nagaland.

Bangladesh.

2. *Trivalvaria dubia* (Kurz) Sinclair in Gard. Bull. Singapore 14: 47. 1955. *Polyalthia dubia* Kurz, For. Fl. Brit. Burma 1: 38. 1877. *Popowia kurzii* King in Ann. R. Bot. Gard. Calc. 4: 122, t. 163 B. 1893.

Shrubs or small trees, 2 - 3 m tall; branches glabrous, furrowed; young shoots pubescent. Leaves broadly oblong-lanceolate or elliptic-obovate, cuneate at base, bluntly acuminate at apex, 15 - 24 x 5 - 8 cm, glabrous above, slightly pubescent on midrib beneath; lateral nerves 8 - 12 pairs; petioles pubescent, 5 - 7 mm long. Flowers white, polygamous, extra-axillary, solitary or in pairs, sessile or on very short and tomentose pedicels; bracts ovate, brown tomentose. Sepals orbicular, 2 - 4 mm across, tomentose outside. Petals concave, 4 - 7 mm across, silky tomentose outside, glabrous inside; outer ones valvate; inner ones imbricate, slightly smaller. Stamens numerous, ca 2 mm long; anthers linear; connectives convex or rhomboid at top. Carpels ca 10, linear, pubescent, sometimes abortive; stigma clavate. Ripe carpels ca 2 x 1 cm, rugose. Seed with 2 longitudinal channels.

Fl. April - July; *Fr.* Sept. - Dec.

Distrib. India: Assam and Andaman & Nicobar Islands.

Myanmar.

3. *Trivalvaria kanjilalii* D. Das in Bull. Bot. Surv. India 10: 263. 1968. **Fig. 45.**

Small trees or shrubs, 2 - 4 m tall; young branches brown tomentose, glabrous with age. Leaves lanceolate, subacute or rounded at base, long-acuminate at apex, 12 - 15 x 3.5 - 4 cm, thinly coriaceous, glabrous; lateral nerves 8 - 9 pairs, faint above, distinct beneath; petioles 2 - 3 mm long, glabrous. Flowers terminal or axillary, solitary, bisexual; pedicels 3 - 5 mm long, brown-tomentose; bracts median, lanceolate, acuminate, 2 - 3 mm long, brown tomentose. Sepals 3, imbricate, free, broadly ovate or orbicular, 3 - 4 x 4 mm, densely brown tomentose outside, puberulous inside. Petals 6 (3 + 3), brown tomentose outside, puberulous inside; outer petals valvate, ovate, acute, 2.5 - 3 x 2.5 mm; inner ones imbricate, shortly clawed, more or less rhomboid, obtuse and incurved at tip, 3 - 4 x 2.5 - 3 mm. Stamens numerous, ca 1 mm long; connectives flat or slightly convex at top. Carpels numerous, oblong, ca 1 mm long, strigose; style curved; stigma capitate, pubescent. Ripe carpels few, subglobose, obtuse at both ends, ca 1 cm in diam., juicy, glabrous, reddish with a distinct transverse groove around the middle, thin-walled; stalk 5 - 7 mm long. Seed 1.

Fl. June - July; *Fr.* Oct. - Dec.

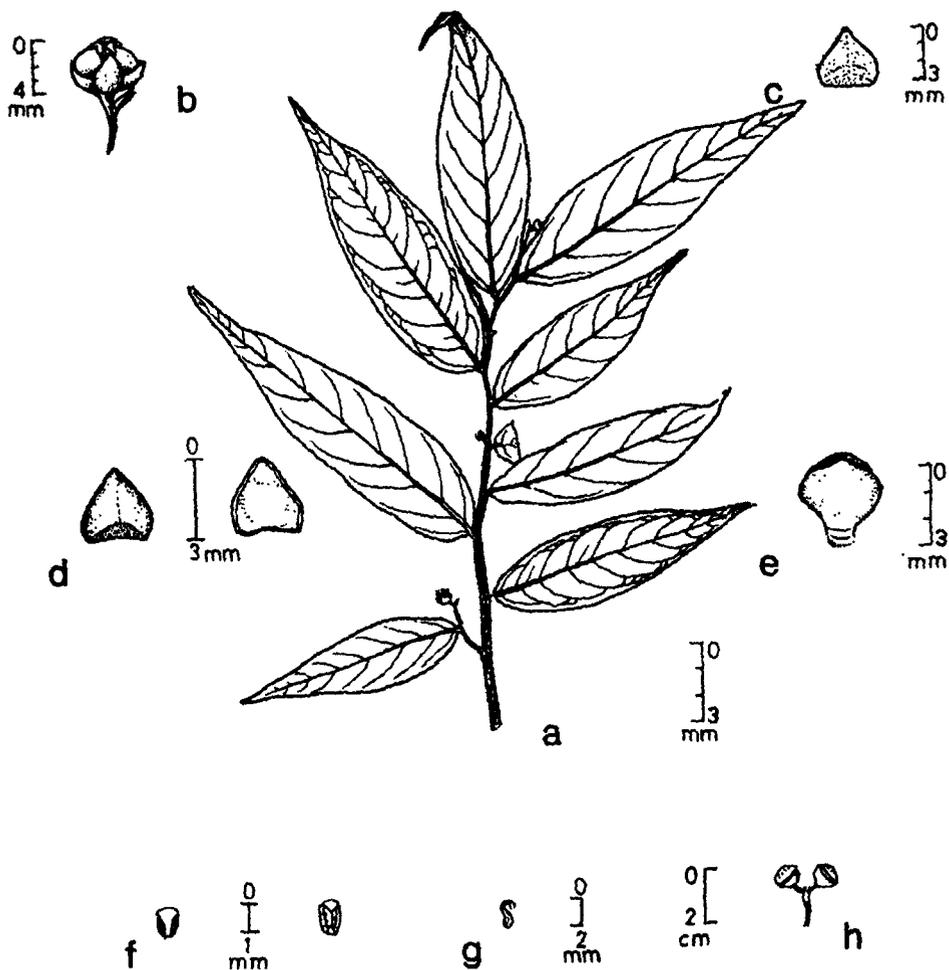


Fig. 45. *Trivalvaria kanjilalii* D. Das: a. flowering twig; b. flower; c. sepal; d. outer petals showing outer and inner surfaces; e. inner petal; f. stamens showing back and front views; g. carpel; h. ripe carpels.

Distrib. India: Subtropical evergreen forests, up to 1500 m. Meghalaya.

Endemic.

21. *Uvaria* L.

Scandent or sarmentose shrubs, usually stellate pubescent. Flowers bisexual, rarely unisexual, terminal or leaf-opposed, in few-flowered cymes, sometimes solitary, yellow, purple or reddish brown. Sepals 3, often connate below. Petals 6 (3 + 3), free, sometimes connate at the base. Stamens numerous, outer sometimes sterile, ovoid or oblong, truncate or subfoliaceous; connectives produced at top. Carpels many, linear-oblong; styles short, thick; ovules many, 2-seriate, rarely few and 1-seriate. Torus depressed, pubescent or tomentose. Ripe carpels many, dry or berries, often sweet and edible. Seeds few to many, 1 - 2-seriate.

Sri Lanka, India, Bangladesh, Myanmar, China, Indo-china, Thailand, Malaysia, Sumatra, Philippines to New Guinea, Australia, New Zealand and Africa; ca 150 species, 10 in India.

KEY TO THE SPECIES

- | | |
|--|-------------------------|
| 1a. Flowers unisexual or polygamous | 2 |
| b. Flowers bisexual | 3 |
| 2a. Flowers usually in cymes; sepals partly connate, not splitting irregularly, stellate tomentose outside | 1. <i>U. andamanica</i> |
| b. Flowers solitary; sepals connate, splitting irregularly, tuberculate outside | 3. <i>U. eucineta</i> |
| 3a. Leaves densely hairy beneath | 4 |
| b. Leaves glabrous, sometimes pubescent when young | 6 |
| 4a. Petals less than 1.5 cm long | 9. <i>U. rufa</i> |
| b. Petals more than 1.5 cm long | 5 |
| 5a. Petioles ca 1 cm long; pedicels 7 - 10 mm long; ripe carpels oblong; stalks 1 - 1.3 cm long | 2. <i>U. cordata</i> |
| b. Petioles ca 6 mm long; pedicels 2.5 - 4 cm long; ripe carpels ovoid to subglobose; stalks 2.5 - 5.5 cm long | 4. <i>U. hamiltonii</i> |
| 6a. Ripe carpels oblong-cylindric | 7 |
| b. Ripe carpels ovoid to oblong | 8 |
| 7a. Stalk of ripe carpels 4 - 15 cm long | 6. <i>U. lurida</i> |
| b. Stalk of ripe carpels 1 - 2 cm long | 8. <i>U. nicobarica</i> |
| 8a. Leaves not more than 10 cm long, reddish beneath when dry; pedicels ca 7 mm long | 10. <i>U. zeylanica</i> |
| b. Leaves more than 10 cm long, brown beneath when dry; pedicels 1 - 3 cm long | 9 |

- 9a. Pedicels 1 - 1.5 cm long; petals ovate; ripe carpels biseriate, ca 3 cm long; stalk ca 4 cm long
5. *U. hookeri*
- b. Pedicels 2 - 3 cm long; petals rotund-ovate; ripe carpels uniseriate, ca 5 cm long; stalk 5 - 8 cm long
7. *U. narum*

1. *Uvaria andamanica* King in J. Asiat. Soc. Beng. 61(2): 21. 1892 & in Ann. R. Bot. Gard. Calc. 4: 29, t. 25. 1893; Srivastava & Ramesh Kumar in J. Bombay Nat. Hist. Soc. 89: 389 - 391, ff. 1 - 5. 1992.

Scandent shrubs. Leaves oblong to oblanceolate, narrowed at base, shortly acuminate at apex, 17 - 22 x 5.5 - 7.5 cm, glabrous above except the puberulous midrib and lateral nerves; stellate pubescent on the midrib and lateral nerves on lower surface; petioles ca 7 mm long, stellate pubescent. Flowers in terminal or axillary cymes, rarely solitary, stellate rusty tomentose; pedicels ca 4 mm long in bud; bracts solitary, orbicular. Sepals 3, ca 4 mm long in bud, orbicular, glabrous inside. Petals 6 (3 + 3); outer ones ca 5 mm diam. in bud; inner ones smaller, orbicular, fleshy, puberulous outside. Stamens numerous, narrowly elongate, ca 1.5 mm long; connectives rounded and flat on top. Ripe carpels many, ca 3 cm long, oblong, slightly tuberculate, stellately rusty tomentose, constricted between seeds. Seeds ca 8, in 2 rows, plano-convex.

Fl. Dec. - Jan.; *Fr.* April onwards.

Distrib. India: Andaman & Nicobar Islands.

Endemic.

2. *Uvaria cordata* (Dunal) Alston, Handb. Fl. Ceylon, Suppl. 6: 4. 1931. *Guatteria cordata* Dunal, Monogr. Fam. Anon. 129, t. 30. 1817. *U. macrophylla* Roxb., Fl. Ind. 2: 663. 1832; Hook. f. & Thomson, Fl. Brit. India 1: 49. 1872.

Beng.: *Gagh-ranga*.

Large scandent shrubs. Leaves elliptic-oblong to ovate-oblong, cordate at base, abruptly acuminate at apex, 13 - 28 x 6.5 - 13.5 cm, glabrous, except midrib and lateral nerves, densely stellate-pubescent below. Flowers ca 4, clustered in extra-axillary cymes; bracts 2, broadly ovate, the larger one ca 5 x 7 mm. Sepals 1.5 - 2 cm in diam., united. Petals 6, subequal, broadly ovate, splitting at margins with age, 1.2 - 1.5 x 0.8 - 1 cm, reddish brown. Stamens many, 5 - 7 mm long; outer ones staminodes, larger; inner ones fertile, shorter; connectives obliquely truncate at apex. Carpels many, linear, narrow, compressed, ca 5 mm long, tomentose. Ripe carpels many, 2 - 4 cm long, scarlet, glabrous. Seeds many, in 2 rows, ovoid, compressed, shiny dark brown.

Fl. June - July; *Fr.* Aug. - Sept.

Distrib. India: West Bengal and Andaman & Nicobar Islands.

Sri Lanka, Bangladesh, Myanmar, Thailand, Laos, Vietnam, Malaysia, Java, Philippines and New Guinea.

3. *Uvaria eucineta* Beddome ex Dunn in Bull. Misc. Inf. Kew 1914: 182. 1914.

Scandent shrubs. Leaves oblong, rounded at base, shortly acuminate, 15 - 25 x 4.5 - 6 cm, glabrous, rusty pubescent beneath when young; petioles 6 - 10 mm long. Flowers leaf-opposed; peduncles ca 1 cm long, thick, tuberculate. Sepals 3, globose in bud, rounded at apex, ca 1.2 cm across, scabrid with rusty tubercles, hairy. Petals 6 (3 + 3), ovate, united at base, free and rounded at apex, 1.5 - 2 x ca 1 cm, slightly tomentose. Stamens numerous in male flowers, ca 2 mm long; connectives truncate, subglobose at apex, fleshy. Carpels many in bisexual flowers, multiovulate. Ripe carpels oblong, ca 2 cm long; stalks ca 4.5 cm long. Seeds many, biseriate.

Fl. not known.

Distrib. India: Orissa.

Endemic and rare.

4. *Uvaria hamiltonii* Hook. f. & Thomson, Fl. Ind. 96. 1855 & in Fl. Brit. India 1: 48. 1872.

Beng.: *Latkean*; Or.: *Lakantinli*.

Scandent shrubs. Leaves elliptic-oblong or obovate, rounded or slightly cordate at base, acuminate at apex, 15 - 25 x 7 - 11 cm, densely rufous stellate-tomentose below. Flowers solitary or 2 - 3 together, extra-axillary, brown tomentose; bract solitary, suborbicular, 0.5 - 1 cm long. Sepals 3, connate at base, broadly ovate, ultimately reflexed, thin, brown tomentose outside, pubescent inside. Petals 6 (3 + 3), obovate, incurved at tips, 2 - 3 x 1.2 - 1.5 cm, coriaceous, brick red, brown tomentose on both sides. Stamens many, ca 4 mm long; anthers linear; connectives oblong at top, pubescent. Carpels many, ca 4 mm long, pubescent; stigma sessile, glabrous. Ripe carpels ca 10, 1.5 - 2.5 cm long, orange-coloured, tomentose. Seeds many, flat, shiny.

KEY TO THE VARIETIES

1a. Main lateral nerves 20 - 25; pedicels 2.5 - 4 cm long; petals 2 - 3 cm long, brick-red

4.1. var. *hamiltonii*

b. Main lateral nerves 12 - 16 pairs; pedicels 1.5 - 2 cm long; petals 1 - 1.5 cm long, reddish yellow

4.2. var. *kurzii*

4.1. var. *hamiltonii*

Fl. May - July; *Fr.* Aug. - Sept.

Distrib. India: Uttar Pradesh, Bihar, West Bengal, Sikkim, Assam, Meghalaya, Tripura, Orissa and Andhra Pradesh.

Nepal, Myanmar and Thailand.

4.2. var. *kurzii* King in Ann. R. Bot. Gard. Calc. 4: 17. 1893.

Leaves wider at base, often minutely cordate. Flowers on shorter pedicels. Petals ovate to oblong-ovate.

Fl. July.

Distrib. India: Andaman & Nicobar Islands.

Endemic.

5. *Uvaria hookeri* King in Ann. R. Bot. Gard. Calc. 4: 28, t. 22. 1893. *U. narum* Wallich ex Hook. f. & Thomson var. *macrophylla* Hook. f. & Thomson in Fl. Brit. India 1: 50. 1872.

Mal.: *Kurilvalli*.

Climbers, all parts, except the inflorescences, glabrous. Leaves oblong or oblong-lanceolate, almost rounded at base, slightly acuminate at apex, 11 - 16 x 2.6 - 5.5 cm, coriaceous, glabrous, brown beneath when dry; petioles ca 5 mm long. Flowers solitary, terminal or leaf-opposed; pedicels 1 - 1.5 cm long, pubescent. Sepals 3, broadly ovate, connate at base, tuberculate, ca 1 cm across, pubescent. Petals 6 (3 + 3), connate at base, ovate, reflexed at tips, 1.5 x ca 0.9 cm, tomentose outside, pubescent inside. Stamens numerous, linear, ca 2.5 mm long; connectives almost flat. Carpels many, linear-oblong, ca 1.5 mm long; styles short, thick; ovules many. Ripe carpels many, ovoid or oblong-ovoid, tapering to apex, 1.7 - 3 cm long, glabrous; stalks stout, 3.2 - 4.5 cm long. Seeds many, biseriate, shiny reddish brown.

Fl. May - July; *Fr.* Sept. - Jan.

Distrib. India: Evergreen forests. Karnataka, Kerala and Tamil Nadu.

6. *Uvaria lurida* Hook. f. & Thomson, Fl. Ind. 101. 1855 & in Fl. Brit. India 1: 50. 1872.

Or.: *Gaichiria*.

Large woody climbers; young parts stellate hairy, rusty. Leaves oblong or oblong-lanceolate, rounded or subcuneate at base, acute to shortly acuminate at apex, 16 - 29 x 3.5 - 6.5 cm, glabrous with age; petioles 1 - 1.5 cm long. Flowers terminal or leaf-opposed, 1 - 2-flowered; pedicels 1 - 1.5 cm long, stout, ebracteate. Sepals 3, broadly ovate, connate at base, 1.5 - 2 cm long, pubescent inside. Petals 6 (3 + 3), outer ones broadly ovate with inflexed tips, 2 - 2.5 x ca 2 cm, brick red, densely pubescent inside. Stamens many, cuneate with truncate ribs, 2 - 3 mm long. Carpels numerous, oblong, ca 4 mm long; stigma sessile, subcapitate. Ripe carpels many, 2 - 4 cm long, constricted, glabrous. Seeds 3 - 6 in a single row, compressed, globose.

KEY TO THE VARIETIES

- | | |
|---|-------------------------------------|
| 1a. Ripe carpels cylindrical; stalks 4 - 6 cm long | 6.1. var. <i>lurida</i> |
| b. Ripe carpels strongly triquetrous; stalk 12 - 15 cm long | 6.2. var. <i>sikkimensis</i> |

6.1. var. *lurida*

Fl. Jan. - May; *Fr.* Aug. - Oct.

Distrib. India: Bihar, Orissa, Assam, Meghalaya and Andaman & Nicobar Islands.

6.2. var. *sikkimensis* King in Ann. R. Bot. Gard. Calc. 4: 29, t. 23. 1893.

Fl. Oct.; *Fr.* Aug.

Distrib. India: Sikkim.

Endemic.

7. *Uvaria narum* (Dunal) Blume, Fl. Java 5. 1828; Hook. f. & Thomson in Fl. Brit. India 1: 50. 1872, p. p. *Unona narum* Dunal, Monogr. Fam. Anon. 99. 1817, p. p.

Kan.: *Kariballi*; Mal.: *Narumpannal*; Tam.: *Puliccan*.

Large woody climbers, all parts except young branchlets and inflorescence glabrous. Leaves elliptic to oblong-lanceolate, subobtusate to subcuneate at base, acuminate at apex, 10 - 15 x 2.5 - 5.7 cm, glabrous, brownish beneath when dry, coriaceous; lateral nerves 9 - 19 pairs; petioles 3 - 5 mm long. Flowers ca 3 cm long, extra-axillary, leaf-opposed or terminal, solitary; pedicels ca 1 cm long; bracts oblong, 1 - 3 mm long, glabrous, caducous. Sepals 3, rotund-ovate, connate at base, obtuse and reflexed at apex, ca 5 mm

in diam., minutely tomentose. Petals 6 (3 + 3), rotund-ovate, connate at base, inflexed at apex, 1 - 2 x 0.8 - 1.4 cm, flesh-coloured, minutely tomentose. Torus raised, ca 8 mm across. Stamens numerous, all fertile, ca 1.5 mm long; connectives of anthers broad, truncate. Carpels many, oblong, ca 5 mm long, tomentose; ovules many; stigma broad. Ripe carpels numerous, ovoid to oblong, obtuse at both ends, 2 - 5 cm long, glabrous, scarlet; stalks 5 - 8 cm long. Seeds 4 - 6, in a single row, ovate, smooth, plano-convex, chestnut-brown.

Fl. Dec. - April; *Fr.* Nov. - Dec.

Distrib. India: Frequent along rivers and streams from coastal areas to deciduous forests of low hills. Karnataka, Kerala and Tamil Nadu.

Sri Lanka.

Notes. A decoction of the root bark is used against rheumatism, bowel complaints and fits during delivery. A decoction of leaves is used in rheumatic swellings and jaundice.

8. *Uvaria nicobarica* Raizada & Sahni in Indian For. 87: 101. 1961.

Large woody climbers; young twigs dark brown, stellate pubescent, glabrous with age. Leaves broadly elliptic to oblanceolate, sometimes obovate, somewhat rounded to slightly cuneate at base, acuminate at apex, 15 - 17 x 9 - 9.5 cm, glabrous; midrib stellately pubescent; petioles ca 5 mm long, stellately pubescent. Flowers not known. Torus ca 2 cm in diam, subglobose. Ripe carpels several, 2.5 - 3 cm long; pericarp yellow. Seeds about 8, uniseriate, ca 5 mm long, shiny, chocolate-brown.

Fr. Oct.

Distrib. India: Andaman & Nicobar Islands (Great Nicobar Island).

Endemic and rare.

9. *Uvaria rufa* Blume, Fl. Java 19, t. 4 & 13c. 1828.

Fig. 46.

Climbers; young branches rusty stellate-tomentose. Leaves elliptic-lanceolate to oblong, slightly cordate at base, acuminate at apex, 10 - 13 x 4 - 6 cm, scabrid above, stellate-tomentose beneath; petioles 4 - 5 mm long, brown pubescent. Flowers in cymes of 1 - 4 flowers, sometimes solitary, extra-axillary, rusty stellate-tomentose; pedicels 7 - 10 mm long, tomentose; bracts submedian. Sepals 3, suborbicular, connate at base, ca 3 x

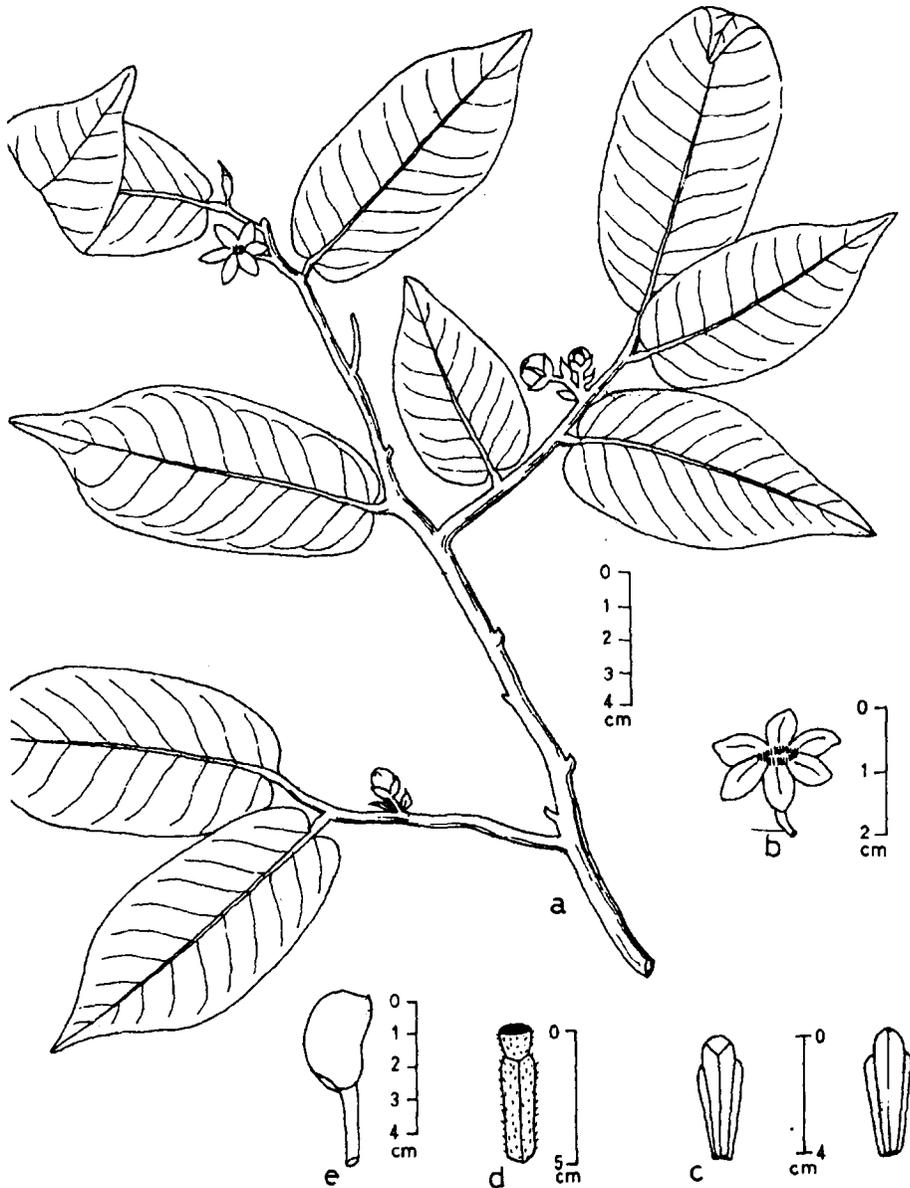


Fig. 46. *Uvaria rufa* Blume : a. flowering twig; b. flower; c. stamens; d. carpel; e. ripe carpel.

4 mm, rusty stellate-tomentose. Petals 6 (3 + 3), free, broadly oblong, obtuse, 7 - 10 x 4 - 5 mm, bright red to dull reddish-purple, minutely pubescent on both surfaces. Stamens numerous, 3 - 4 mm long; outer ones staminodes; connective broad and flat. Carpels many, quadrate, 4 - 5 mm long, pubescent; stigma sessile, mucronulate, stellate pubescent. Seeds many in 2 rows, reddish brown, smooth, shiny.

Fl. May - June; *Fr.* Sept. Dec.

Distrib. India: Andaman & Nicobar Islands.

Cambodia, Laos, Vietnam, Thailand, Malaysia, Indonesia, Philippines to New Guinea.

10. *Uvaria zeylanica* L., Sp. Pl. 536. 1753; Hook. f. & Thomson in Fl. Brit. India 1: 51. 1872.

Large slender climbers; young branches ferruginous tomentose. Leaves elliptic, lanceolate or oblong-lanceolate, cuneate at base, bluntly acuminate or acute at apex, 5 - 9.5 x 2 - 3 cm, thinly coriaceous, glabrous; lateral nerves 7 - 15 pairs; petioles 3 - 4 mm long. Flowers solitary or paired, terminal or leaf-opposed; pedicels 3 - 7 mm long, rufous pubescent; bracts few, elliptic, 1.5 - 2.5 mm long, pubescent, caducous. Sepals 3, rotund-ovate, subretuse and reflexed at apex, 4 - 5 x 5 - 6 mm, pubescent. Petals 6 (3 + 3), ovate to oblong-ovate, slightly reflexed at apex, 7 - 10 x 4 - 5 mm, dull red or purple, pubescent outside, glabrous inside except the margins. Carpels many, obovate to oblong, ca 1 mm long, pubescent; stigma sessile, subcapitate. Ripe carpels 4 - 12, ovoid, ca 1 cm long, sometimes constricted, pubescent; stalks 1 - 2 mm long. Seeds 3 - 6 in a single row, compressed, 6 - 7 x 4 - 5 mm, smooth.

Fl. Oct. - Dec.; *Fr.* July - Aug.

Distrib. India: Karnataka, Kerala and Tamil Nadu.

Sri Lanka.

Tribe 6. XYLOPIEAE

Shrubs, trees or climbers. Flowers triquetrous or cylindrical. Sepals and petals valvate. Petals thick, spreading; inner ones erect, touching by their sides. Stamens with slightly produced connectives; anthers with large pollen grains, sometimes visible and appearing septate (in *Xylopia*). Carpels dehiscent (follicle in *Anaxagorea*) or indehiscent.

22. *Anaxagorea* St. Hill.

Trees or shrubs. Flowers bisexual, leaf-opposed or terminal and extra-axillary, solitary, small. Sepals 3, valvate, connate at the base. Petals 6 (3 + 3), valvate, thin, flat, subequal. Torus convex. Stamens many; connectives with a terminal process; anthers extrorse or sublateral. Carpels few to many; ovules 2, subbasal, collateral; styles variable in length. Ripe carpels follicular, clavate, dehiscent by 2 valves, stalked. Seeds 1 - 2, exarillate, shiny.

India, Sri Lanka, Myanmar, Cambodia, Laos, Thailand, Malaysia, Indonesia, Philippines to Central America and West Indies; ca 30 species, 1 in India.

Literature. MAAS, P. J. M. (1984 - 85) Studies in Annonaceae II. A monograph of the genus *Anaxagorea* A. St. Hill. Bull. Jahrb. Syst. 105(1): 73 - 134 105 (2): 145 - 204.

Anaxagorea luzonensis A. Gray, Bot. Wilkes. U. S. Explor. Exped. 27. 1854; Hook. f. & Thomson in Fl. Brit. India 1: 68. 1872.

Shrubs, ca 1 m high; branches glabrous. Leaves oblong or elliptic, cuneate at base, acuminate at apex, 12 - 19 x 4 - 8 cm, glabrous; petioles 1 - 1.5 cm long, glabrous. Flowers solitary, leaf-opposed, small; pedicels 2 - 3 mm long, slightly puberulous; bracts 1 - 2, amplexicaul, basal. Sepals 3, ovate, connate at base, obtuse, 2 - 3 x 2 mm, glabrous. Petals 6 (3 + 3), subequal, valvate, ovate to elliptic, obtuse, 4 - 7 x 3 - 4 mm (inner smaller), white, thin, glabrous. Stamens many, ca 2 mm long, broadly elliptic; connectives blunt at top. Carpels about 4, flask-shaped, slightly pubescent ca 3 mm long; styles prominent; stigma blunt. Ripe carpels few together, follicular, 2 - 4 cm long (with stalk), cuneate-clavate, sharply apiculate, slightly compressed, narrowed into a long stalk. Seeds 1 - 2, obovoid, shiny black.

Fl. July - Aug.; *Fr.* Sept. - Nov.

Distrib. India: Andaman & Nicobar Islands.

Sri Lanka, Myanmar, Cambodia, Laos, Thailand to Malesia and South America.

23. *Fissistigma* Griffith

Climbing or scrambling shrubs. Leaves with strong parallel nerves, pubescent to tomentose. Flowers bisexual, terminal, leaf-opposed or axillary, solitary or in fascicled cymes or branched panicles; buds triquetrous. Sepals 3, small, valvate, connate at base, persistent. Petals 6 (3 + 3), valvate, thick, leathery, pubescent to tomentose; outer flat, plano-convex or trigonous; inner ones smaller, triquetrous above, flat or concave at base, shorter than outer. Stamens many; connectives ovoid, quadrate or apiculate at top.

Carpels many; ovules 2 or more; style oblong to narrow clavate; stigma short. Ripe carpels ovoid or globose, berries, usually stalked. Seeds many.

N.E. India, Bhutan, Bangladesh, Myanmar, Indo-china, Thailand, Malesia to Australia, New Zealand and Africa; ca 70 species, 8 species in India.

KEY TO THE SPECIES

- | | |
|--|--------------------------|
| 1a. Outer petals up to 1.5 cm long | 2 |
| b. Outer petals more than 2 cm long | 6 |
| 2a. Leaves broad, elliptic, obtuse or subacute at apex | 3 |
| b. Leaves oblong or oblong-lanceolate, acuminate at apex | 4 |
| 3a. Main lateral nerves 22 - 27 pairs; pedicels ca 1 cm long | 2. <i>F. ellipticum</i> |
| b. Main lateral nerves ca 12 pairs; pedicels very short or absent | 5. <i>F. rufinerve</i> |
| 4a. Petals densely rufous tomentose outside, ca 1.5 cm long | 8. <i>F. wallichii</i> |
| b. Petals pubescent outside, ca 1 cm or shorter | 5 |
| 5a. Leaves 12 - 17 cm long; pedicels 4 - 5 mm long; petals deltoid, 6 - 7 mm long, greyish pubescent | 3. <i>F. polyanthum</i> |
| b. Leaves 16 - 22 cm long; pedicels ca 15 mm long; petals oblong, ca 1 cm long, brown pubescent | 6. <i>F. santapauli</i> |
| 6a. Leaves broadly elliptic; petals acuminate at apex, 2.5 - 3 cm long | 4. <i>F. rubiginosum</i> |
| b. Leaves narrowly oblong or oblong-lanceolate; petals obtuse or subacute at apex, ca 2 cm long | 7 |
| 7a. Pedicels 2 - 3 cm long; ripe carpels verrucose | 7. <i>F. verrucosum</i> |
| b. Pedicels 1 - 1.5 cm long; ripe carpels smooth | 1. <i>F. bicolor</i> |

1. *Fissistigma bicolor* (Roxb.) Merr. in Philip. J. Sci. (Bot.) 15: 131. 1919. *Uvaria bicolor* Roxb., Fl. Ind. 2: 662. 1832 (non Wallich). *Melodonum bicolor* (Roxb.) Hook. f. & Thomson, Fl. Ind. 119. 1855 & in Fl. Brit. India 1: 80. 1872.

Asm.: *Hed-bheduli*.

Large woody climbers; young branches brownish tomentose. Leaves oblong or elliptic-oblong, almost rounded at base, obtuse or shortly acuminate at apex, 10 - 18 x 4 - 8 cm, glabrous above except the midrib, appressed pubescent beneath; petioles 6 - 13 mm long, pubescent. Flowers solitary or 2 - 3 together, leaf-opposed, velvety tomentose; pedicels 1 - 1.3 cm long, brown tomentose; bracts basal, ca 7 mm long, tomentose outside, glabrous inside. Sepals 3, ovate, acute, 5 - 8 x 5 - 6 mm, tomentose outside. Petals 6 (3 + 3), ovate-lanceolate, acute, 18 - 20 x 6 mm, villous outside, glabrous inside; inner ones shorter and narrower, glabrous, red. Stamens numerous, ca 2 mm long; connectives ovoid at top. Carpels many, ca 3 mm long, densely tan-silky; style shortly curved; stigma bifid. Ripe carpels many, globose or subglobose, mucronate, 2 - 3 cm long, tomentose; stalk less than 1 cm long, stout, tomentose. Seeds 4 - 8, oblong, brown.

Fl. March - April; *Fr.* Aug. - Oct.

Distrib. India: Subtropical forests. West Bengal, Sikkim, Arunachal Pradesh, Assam, Nagaland, Manipur and Meghalaya.

Myanmar.

Notes. Sikdar (in *Geobios* 6: 90 - 91. 1979) records this from West Bengal.

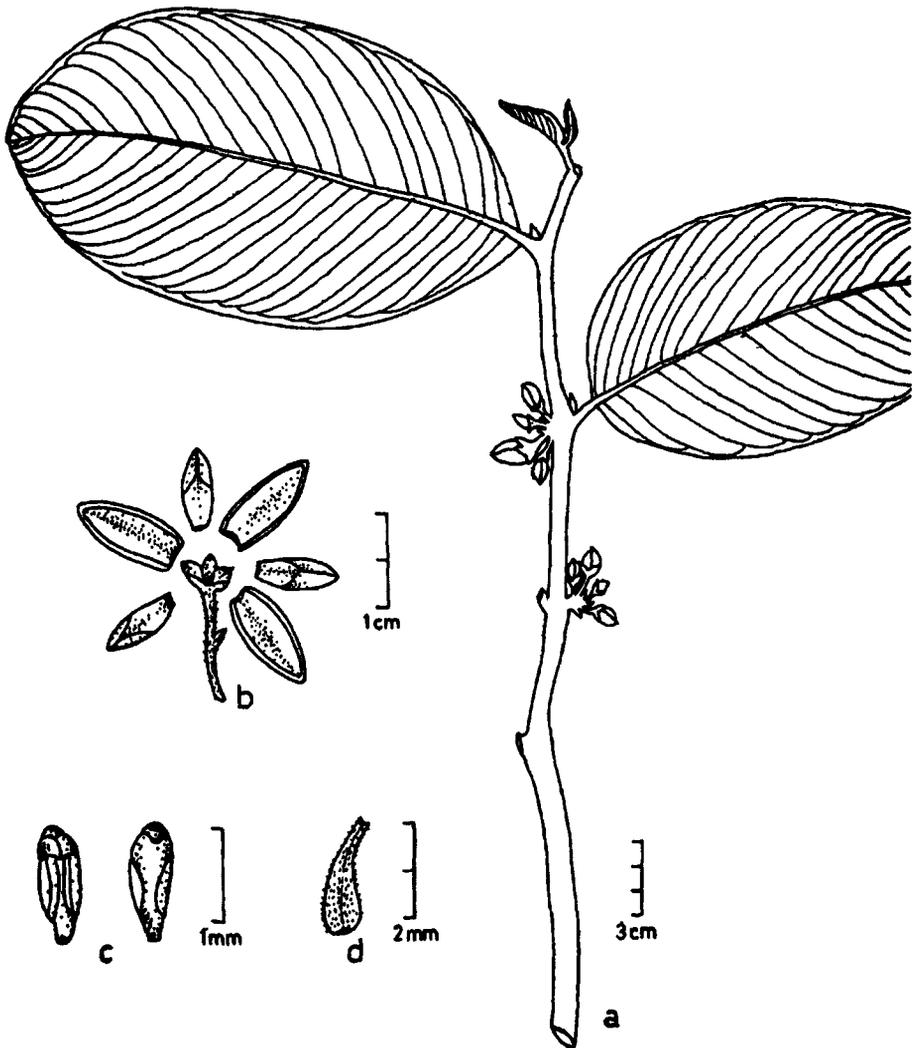


Fig. 47. *Fissistigma ellipticum* (King) D. Mitra : a. flowering twig; b. flower with dissected sepals and petals; c. stamens, front and back views; d. carpel.

2. *Fissistigma ellipticum* (King) D. Mitra in Bull. Bot. Surv. India (ined.)
Melodorum polyanthum Hook. f. & Thomson var. *ellipticum* King in Ann. R. Bot. Gard.
 Calc. 4: 131. 1893. *Fissistigma polyanthum* (Hook. f. & Thomson) Merr. var. *ellipticum*
 (King) Sinclair in Bull. Bot. Soc. Beng. 9(2): 86. 1955. **Fig. 47.**

Climbers; young branches rufous tomentose. Leaves broadly elliptic, slightly cordate at base, obtuse or abruptly short acuminate at apex, 17 - 28 x 9 - 14 cm, sparsely appressed pubescent above, more or less rufous tomentose beneath, glabrescent with age; main lateral nerves 22 - 27 pairs; petioles 1 - 1.5 cm long, rufous pubescent to glabrescent. Flowers bisexual, in extra-axillary leaf-opposed few-flowered cymes; peduncles minute or absent; pedicels ca 1 cm long, rufous pubescent; bract at the middle of the pedicel, ovate, obtuse, ca 2 mm long, pubescent. Sepals 3, connate at base, broadly ovate, subacute, ca 2.5 x 2 mm, densely pubescent outside, glabrous inside. Petals 6 (3 + 3); outer ones oblong-ovate, subacute, 7 - 10 x ca 5 mm, fleshy, rufous pubescent outside, glabrous inside; inner ones 4 - 5 x ca 2 mm, pubescent at the ridge and tip outside, glabrous inside. Stamens numerous, ca 1 mm long; connectives broad, recurved at top; filaments short. Carpels few, linear, ca 2 mm long; ovules ca 8 in 2 rows; style prominent; stigma bilobed. Ripe carpels not seen.

Fl. March.

Distrib. India: Assam.

Notes. This species is closely allied to *Fissistigma polyanthum* (Hook. f. & Thomson) Merr. but differs from the latter by its larger, broadly elliptic leaves, very short extra-axillary peduncle with longer pedicels, smaller sepals connate at the base and the larger oblong-ovate petals.

3. *Fissistigma polyanthum* (Hook. f. & Thomson) Merr. in Philipp. J. Sci. (Bot.) 15: 135. 1919. *Melodorum polyanthum* Hook. f. & Thomson, Fl. Ind. 121. 1855 & in Fl. Brit. India 1: 81. 1872.

Asm.: Karle-phingnu.

Large woody climbers; branches dark brown, glabrous. Leaves oblong-elliptic or lanceolate, rounded or cuneate at base, shortly acuminate at apex, 10 - 17 x 3.5 - 6.5 cm, coriaceous, minutely pubescent or glaucous beneath, glabrous and shiny above; petioles 8 - 10 mm long, pubescent when young, glabrous with age. Flowers 3 - 7 together in leaf-opposed subumbellate cymes, pale orange, sweet-scented; peduncles ca 5 mm long, woody, hoary, glabrate; pedicels 4 - 8 mm long; bracts ovate, ca 2 mm long, pubescent, basal and median. Sepals 3, ovate, acute, 3 - 4 x ca 3 mm, hoary, greyish tomentose, persistent after the falling of petals. Petals 6 (3 + 3), orange-red; outer ones ovate-deltoid, broadened and concave at base, acute, 6 - 7 x 5 - 6 mm, thick, greyish pubescent outside, glabrous inside; inner ones shorter, concave at base. Stamens numerous, ca 1

mm long; connectives almost quadrate at top. Carpels many, oblong, ca 3 mm long, silky hairy; style linear; stigma entire. Ripe carpels many, berries, spherical, apiculate, 1 - 2.5 cm in diam., silky hairy; stalks 6 - 8 mm long, pubescent. Seeds several, in 2 rows, smooth, shiny.

Fl. Nov. - Mar.; *Fr.* June - Aug.

Distrib. India: Tropical and subtropical forests. Assam, Nagaland and Manipur.

Bhutan and Bangladesh.

4. *Fissistigma rubiginosum* (DC.) Merr. in Philipp. J. Sci. (Bot.) 15: 135. 1919. *Uvaria rubiginosa* DC. in Mem. Soc. Phys. Geneve 5: 202. 1832. *Melodorum rubiginosum* Hook. f. & Thomson in Fl. Brit. India 1: 79. 1872.

Kh.: *Thir-kalwang*.

Large climbers; young branchlets brown tomentose, glabrous at maturity. Leaves broadly elliptic, almost rounded at the base, obtuse or abruptly and shortly acuminate at apex, 18 - 22 x 6 - 11 cm, glabrous above, except the tomentose sunken midrib; petioles 1 - 1.5 cm long, stout, tomentose. Flowers solitary or 3 - 5 together in leaf-opposed or terminal cymes; peduncles ca 5 mm long; pedicels 1.5 - 2 cm long, brown pubescent; bracts basal, median, minute, ovate, pubescent. Sepals 3, broadly triangular, slightly united at base, acute, 2 - 3 x 3 - 4 mm, pubescent outside, glabrous inside. Petals 6 (3 + 3); outer ones narrowly oblong to lanceolate, acuminate, 2.5 - 3 x ca 1 cm, brown tomentose outside, pale pink and hoary inside; inner ones shorter and narrower, with triquetrous limb, pubescent outside, glabrous and yellowish inside. Stamens many, ca 2.5 mm long, pink; connectives slightly oblique and apiculate at top. Carpels many, ca 2 mm long, strigose; style stout; stigma obtuse, grooved. Ripe carpels many, globose or oblong, obtuse or slightly apiculate at apex, ca 1.5 cm in diam., pubescent, thin-walled; stalks 1.5 - 2 cm long, pubescent. Seeds several in 2 rows, dark shiny brown .

Fl. Nov. - Jan.; *Fr.* July - Aug.

Distrib. India: Assam.

Bangladesh, Myanmar, Thailand, Cambodia, Malaysia and Indonesia.

5. *Fissistigma rufinerve* (Hook. f. & Thomson) Merr. in Philip. J. Sci. (Bot.) 15: 136. 1919. *Melodorum rufinerve* Hook. f. & Thomson, Fl. Ind. 121. 1855 & in Fl. Brit. India 1: 81. 1872.

Large woody climbers; branches slender, dark coloured; branchlets glabrous; buds golden pubescent. Leaves narrow-elliptic, rounded or retuse at base, tapering to an

obtuse or slightly acute apex, 16 - 26 x 5 - 6.5 cm, glabrous above, glaucous and minutely pubescent beneath; main lateral nerves about 12 - 14 pairs, slender, arching; petioles ca 1 cm long, glabrous. Flowers minute, in few-flowered leaf-opposed pubescent cymes; pedicels absent or very short, golden pubescent; bracts minute, scale-like, submedian. Sepals 3, connate at base, broadly ovate, pubescent outside. Petals 6 (3 + 3), fleshy. Stamens numerous; connectives apiculate. Carpels multiovulate. Ripe carpels not seen.

Fl. not known.

Distrib. India: Assam.

Bangladesh.

Notes. An imperfectly known species, very rare and not collected recently.

6. *Fissistigma santapaui* D. Das in Bull. Bot. Surv. India 10: 263 - 266. 1969.

Fig. 48.

Trees, ca 13 m tall. Leaves broadly oblong, rounded at base, shortly acuminate at apex, 16 - 22 x 6 - 9 cm, glabrous; petioles ca 1.5 cm long, puberulous. Flowers bisexual in 8 - 10-flowered leaf-opposed cymes; peduncles ca 5 mm long; pedicels ca 1.5 cm long, hoary whitish pubescent; bracts minute, median and basal. Sepals 3, connate at base, ovate, acuminate, ca 2 x 1.5 mm, pubescent outside and at base inside. Petals 6 (3 + 3), subequal, oblong, obtuse at apex, ca 1 x 0.5 cm, fleshy; outer petals brown pubescent outside, whitish hoary pubescent inside; inner ones reddish, concave at base inside, narrower than outer ones, pubescent on both surfaces. Stamens numerous, ca 2 cm long, with the connectives broad and recurved at top; anther-thecae linear; filaments short. Carpels ca 2.5 mm long, pubescent; ovules many in 2 rows; style linear; stigma curved. Ripe carpels not seen.

Fl. March.

Distrib. India: Assam.

Endemic.



Fig. 48. *Fissistigma santapauli* D. Das: a. flowering twig; b. dissected flower; c. stamens showing front and back views; d. carpel.

7. *Fissistigma verrucosum* (Hook. f. & Thomson) Merr. in Philip. J. Sci. (Bot.) 15: 137. 1919. *Melodorum verrucosum* Hook. f. & Thomson, Fl. Ind. 119. 1855 & in Fl. Brit. India 1: 80. 1872.

Kh.: *Jyrmī-soh-ram-khlow*.

Large woody climbers; young branches and shoots brown tomentose. Leaves oblong or oblong-lanceolate, rounded or slightly cuneate at base, acute or acuminate and almost bristly at apex, 9 - 13 x 2.5 - 4 cm, thinly coriaceous, glabrous above except the puberulous midrib, softly rusty-pubescent beneath; lateral nerves 15 - 18 pairs, oblique; tertiaries subparallel; petioles 7 - 12 mm long, rusty-pubescent. Flowers pale yellow, sweet-scented, ca 1.5 cm long, solitary or fascicled in few-flowered cymes, leaf-opposed or terminal, tomentose; pedicels 2 - 3 cm long, minutely pubescent; bracts 2, pubescent, basal and median. Sepals 3, broadly ovate, acute, 5 - 6 x 4 - 6 mm, spreading, tomentose outside, glabrous inside. Petals 6 (3 + 3), ovate-lanceolate, subacute, 1.5 - 2 x ca 1 cm, tomentose outside; inner petals shorter, triangular to oblong, acute, concave at base, triquetrous at tip, puberulous. Stamens numerous, ca 2 mm long; connectives broadly and obliquely triangular, apiculate at apex. Carpels many, oblong-ovoid, curved, ca 2 mm long, strigose; style prominent, glabrous; stigma entire. Ripe carpels subglobose, 2 - 4 cm in diam., often with a sharp ventral ridge, densely warted, puberulous; young carpels club-shaped; stalks 2.5 - 15 cm long, stout, thickened upwards; pulp aromatic, edible. Seeds in 2 rows of 3 - 5 each, closely packed, elliptic-oblong, flat, ca 2.5 x 1 cm, dark shiny brown.

Fl. April - July; Fr. Oct. - Jan.

Distrib. India: Subtropical evergreen forests, 1000 - 2000 m. Assam, Mizoram and Meghalaya.

Bangladesh and Myanmar.

Notes. Ripe berries are eaten by tribals with much relish.

8. *Fissistigma wallichii* (Hook. f. & Thomson) Merr. in Philip. J. Sci. (Bot.) 15: 137. 1919. *Melodorum wallichii* Hook. f. & Thomson, Fl. Ind. 118. 1855 & in Fl. Brit. India 1: 81. 1872. Fig. 49.

Large woody climbers; branchlets often cirrhiform; young parts slightly golden pubescent. Leaves oblong-lanceolate, slightly rounded or subcuneate at base, acute to acuminate at apex, 10 - 18 x 3 - 4.5 cm, thinly coriaceous, glabrous and shiny above, sparsely appressed pubescent and pale beneath; lateral nerves 10 - 12 pairs, slightly arched; petioles 5 - 7 mm long, pubescent. Flowers solitary, terminal or 3 - 4 in terminal or leaf-opposed fascicles; pedicels pubescent, 7 - 9 mm long; bracts 1 - 2, connate at



Fig. 49. *Fissistigma wallichii* (Hook. f. & Thomson) Merr. : a. flowering twig; b. sepal; c. & d. petals, outer and inner views; e. stamens, back and front views; f. carpel

base, ovate, acute, ca 3 mm long, pubescent. Sepals 3, connate at base, ovate, acute, 5 - 7 x ca 6 mm, pubescent outside, glabrous inside. Petals 6 (3 + 3); outer petals ca 1.5 x 0.7 cm, densely rufous-tomentose outside, glabrous inside, fleshy; inner ones shorter, brown purple, hoary. Stamens numerous, ca 2 mm long; filaments short; connectives ovate, acute, convex at top. Carpels many, subglobose, ca 3 mm long, strigose; style hairy; stigma furrowed. Ripe carpels many, berries, subglobose to oblong-ovoid, ca 2.5 cm long, ca 2 cm in diam., yellowish brown, slightly warty, mucronate; stalks 2 - 3 cm long. Seeds 1 - 2 per carpel, oblong-ellipsoid, ca 12 mm long, ca 9 mm wide, glossy brown.

Fl. Nov. - Feb.; *Fr.* July - Aug.

Distrib. India: Lowland evergreen forests. Assam, Mizoram and Meghalaya.

Bangladesh.

24. *Xylopia* L.

Shrubs or trees. Leaves coriaceous. Flowers bisexual, axillary, solitary, fascicled or cymose; buds triquetrous or conical; bracts many, ovate, uppermost the largest. Sepals 3, valvate in buds, connate at base or free. Petals 6 (3 + 3), valvate in buds, free, thick, linear, sometimes ovate, flat, concave at the base; inner triquetrous, as long as the outer, shorter. Torus flat or hollow, enclosing the carpels. Stamens numerous, closely arranged, linear or oblong; connectives obtusely or acutely produced; anther-locules remote or contiguous, usually transversely septate with large macroscopic pollen grains in tetrads. Carpels 1 or more; style filiform; stigma clavate; ovules 2 - 6 or more, 1 - 2 seriate. Ripe carpels solitary or few, cylindrical or ovoid, sometimes moniliform, semidehiscent. Seeds several, 1 - 2-seriate.

India, Sri Lanka, Indo-china, Malaysia, Philippines, New Guinea, Tropical Africa, Central America and West Indies; about 160 species, one in India.

Xylopia parvifolia (Wight) Hook. f. & Thomson, *Fl. Ind.* 125. 1855 & in *Fl. Brit. India* 1: 84. 1872. *Patonia parvifolia* Wight, *Illus.* 1: 19. 1838. **Fig. 50.**

Kan.: *Ulli*; Mal.: *Kallupottan*; Tam.: *Karboruttal*.

Trees, 15 - 25 m tall with buttresses; young branches brown pubescent. Leaves ovate to oblong-lanceolate, acute at base, acuminate at apex, 8 - 9.5 x 2.5 - 3.5 cm, coriaceous, glabrous above, sparsely puberulous beneath; petioles 6 - 8 mm long, glabrous. Flowers yellow, 2 - 5 together in axillary fascicles; pedicels very short, pubescent, covered with bracts and bracteoles; bracts many, orbicular, pubescent, the uppermost close to the sepals. Sepals 3, connate up to middle, ovate, acute, 1.5 x 2.5 - 3 mm, pubescent outside, glabrous inside. Petals 6 (3 + 3); outer petals linear, slightly clawed and dilated at base, 10 - 13 x 1.5 - 2 mm, brown-pubescent outside, hoary inside; inner ones a little

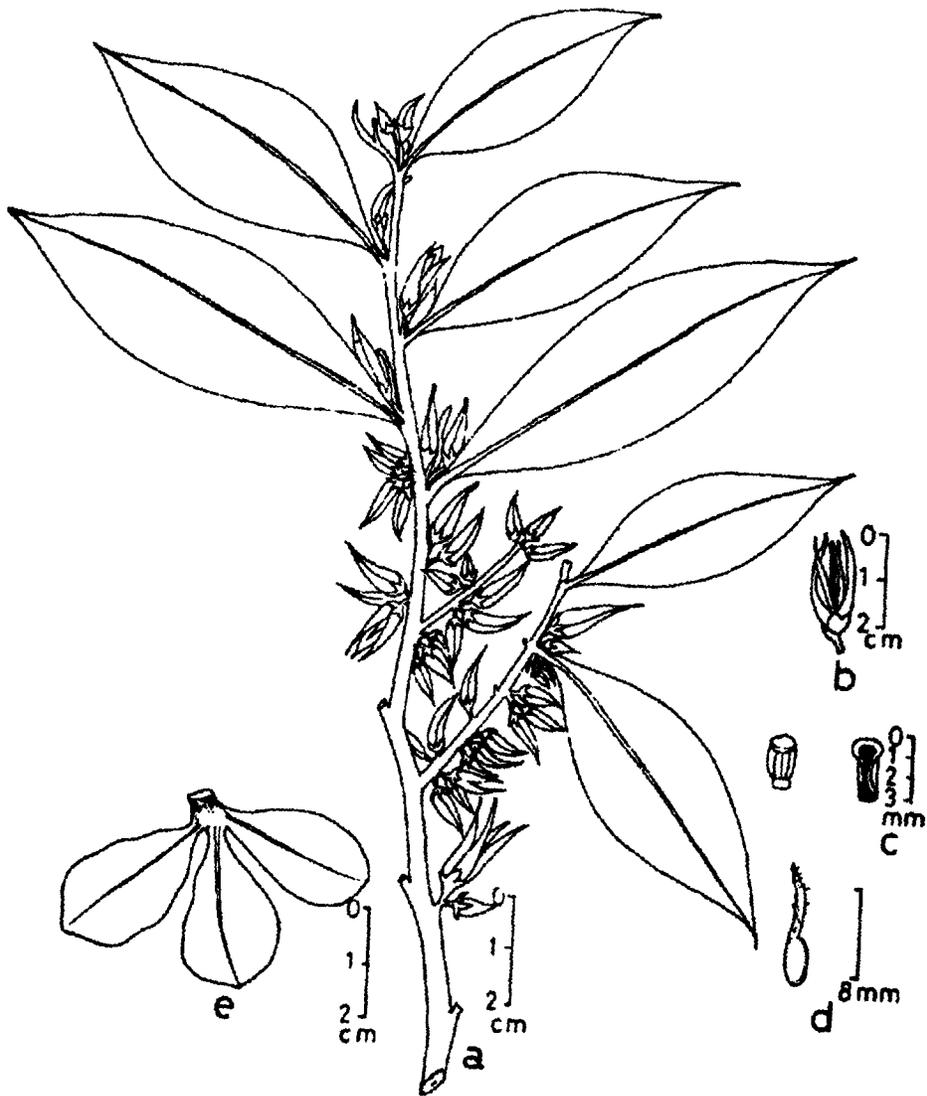


Fig. 50. *Xylopia parvifolia* (Wight) Hook. f. & Thomson : a. flowering twig; b. flower; c. stamens front and back views; d. carpel; e. ripe carpels.

shorter and narrower, linear, expanded, concave and spoon-shaped at base, ca 10 x 0.7 mm, densely tomentose. Stamens numerous, ca 2 mm long; connectives flat, round; anthers transversely septate with larger pollen. Carpels 5, linear, ca 4 mm long, slightly hairy; style linear; stigma fusciform, acute. Ripe carpels 1 - 4 together, subsessile, obovoid, blunt at apex, tapering to base, 2.5 - 3.8 cm long, pubescent; stalks 1 - 2 mm long, woody. Seeds 4 - 6, oblong.

Fl. Aug. - Nov.; *Fr.*: Dec.- Feb.

Distrib. India: Evergreen forests at low elevations. Kerala. Rare.

Sri Lanka.

Notes. Timber used for house constructions.

EXCLUDED TAXA

***Milusa mollis* Pierre var. *sparsior* Craib, Fl. Siam. Enum. 1: 59. 1931; Goel et al. in Higher Plants of Indian Subcont. in Add. Series Indian J. For. 5: 1 - 4, ff. A-L. 1991.**

Goel et al. (l.c.) reports this variety from coastal forests around Chiriatapu in South Andaman Island, earlier known from Thailand only. Based on the descriptions it comes near to *M. mukerjeeana* but differs in leaves being 2.5 - 12 x 1 - 4 cm eith bilobed or sometimes amplexicaul base. More collections are required to conform its identity.

MENISPERMACEAE

(A. Pramanik and M. Gangopadhyay)

Herbs, shrubs, climbers or lianas, erect or creeping, rarely trees, dioecious or rarely monoecious. Leaves spiral, exstipulate, simple or occasionally compound, entire or palmately lobed, peltate or not, palmately nerved; petioles often swollen at base and/or at apex. Inflorescences usually axillary or on old woods, racemes, fascicles, panicles or cymes; bracts small, often leafy; bracteoles short. Flowers unisexual, actinomorphic or zygomorphic, 2-3-merous, small. Perianth free or connate, 2-many-seriate, often differentiated into calyx and corolla; sepals 6 (1-12), in 2-4 series each of 3 or sometimes 4-5 sepals, imbricate; petals 3-6 in 1 or 2 whorls, usually smaller than innermost sepals or absent. Male flowers: Stamens 2-many; filaments free or variously connate, often forming peltate synandrium on androphore; anthers 2 or 4-loculed, transversely or vertically dehiscent; pistillode small or absent. Female flowers: Staminalodes 6, usually subulate or absent; carpels 1-6, free, superior; styles terminal or basal, simple or deeply lobed; stigmas terminal, capitate or discoid, entire or lobed; ovules 1 or 2, ventral, amphitropous. Fruits sessile or stalked, drupes or a few drupelets, often compressed, with subbasal or terminal style-scar; exocarp membranous to coriaceous; mesocarp fleshy; endocarp straight or strongly curved, horseshoe-shaped, usually bony, rarely crustaceous, variously ornamented. Seeds globose, reniform or curved, rarely straight; endosperm ruminant; embryo elongate or ellipsoid; cotyledons foliaceous, rarely folded.

Mainly tropical, extending to N. America and temperate Asia; 8 tribes with about 73 genera and ca 350 species, 5 tribes with 20 genera and 43 species in India.

Literature. DIELS, L. (1910) Menispermaceae. In: Engler, Pflanzenr. IV. 94 (Heft 46): 1 - 345. FORMAN, L. L. (1986) Menispermaceae. In: Fl. Males. I, 10(2): 157 - 253. MIERS, J. (1871) Menispermaceae. Contrib. Bot. 3: 1 - 402. THANIKAIMONI, G. (1968) Morphologie des Pollens des Menispermaceae. Trav. Sect. Sci. Techn. Inst. Franc. Pondicherry 5: 1 - 56. THANIKAIMONI, G. (1986) Evolution of Menispermaceae. Canad. J. Bot. 64: 3130 - 3133. WILKINSON, H. P. (1989) Leaf anatomy of the Menispermaceae, tribe Tiliaceae Miers. Bot. J. Linn. Soc. 99: 125 - 174.

KEY TO THE TRIBES

- | | |
|---|------------------------|
| 1a. Perianth scarcely differentiated into sepals and petals | 2 |
| b. Perianth very frequently differentiated into sepals and petals | 3 |
| 2a. Endocarp curved, smooth or fibrous, less ornamented | 1. <i>Coscinleae</i> |
| b. Endocarp straight, smooth, sometimes strongly rugose | 2. <i>Fibraureae</i> |
| 3a. Cotyledons not foliaceous; endosperm non-ruminate | 3. <i>Menispermeae</i> |
| b. Cotyledons divaricate, foliaceous; endosperm ruminate | 4 |
| 4a. Drupes shortly horeshoe-shaped | 4. <i>Tillacoreae</i> |
| b. Drupes straight or subrotund to subelliptic | 5. <i>Tinosporeae</i> |

KEY TO THE GENERA IN TRIBES

Tribe 1. COSCINIEAE

- | | |
|--|---------------------|
| 1a. Inflorescence paniculate; flowers pedicellate; sepals glabrous; stamens connate into a syndrium with 9 - 35 anthers; gynophore columnar (continuous with panicles) | 1. <i>Anamirta</i> |
| b. Inflorescence a raceme of peduncled capitulae; flowers sessile or subsessile; sepals externally sericeous; stamens 6, outer 3 free; gynophore globose | 2. <i>Coscinium</i> |

Tribe 2. FIBRAUREAE

- | | |
|---|-----------------------|
| 1a. Leaves subpeltate; lamina-base 3 (- 5)-nerved; main basal lateral nerves running along with the midrib for 4 - 15 mm before diverging outwards; inflorescences lax panicle, glabrous; petals absent; endocarp ellipsoid, smooth, rounded at apex | 3. <i>Fibraurea</i> |
| b. Leaves not peltate; lamina-base 3 - 5-nerved; all nerves diverging directly from lamina base; inflorescence a raceme, several from protruberances on old stems, ferruginous pubescent; petals 6, with-in-volute margins; endocarps compressed, rugose or rugulose, acute at apex | 4. <i>Tinomiscium</i> |

Tribe 3. MENISPERMEAE

- | | |
|--|----------------------|
| 1a. Leaves pinnately 3 - 5-nerved | 10. <i>Pachygone</i> |
| b. Leaves palmately 3 - 12-nerved | 2 |
| 2a. Leaves oblong or oblong-lanceolate, acute or rounded at base; style simple | 3 |
| b. Leaves ovate, orbicular or triangular; styles 2 - 8-partite | 4 |
| 3a. Leaves glabrous; anthers longitudinally dehiscent; style compressed | 9. <i>Hypserpa</i> |
| b. Leaves villous beneath; anthers transversely dehiscent; styles cylindrical | 6. <i>Cocculus</i> |

- 4a. Stamens free; synandrium absent; carpels 3 5
 b. Stamens connate, forming synandrium; carpel 1 6
 5a. Leaves both peltate and non-peltate, glabrous; petioles glabrous; sepals 6 8. *Diploclisia*
 b. Leaves not peltate, tomentose beneath; petioles pubescent; sepals 9 11. *Pericampylus*
 6a. Inflorescence umbellate or condensed disc-like capitula; sepals and petals free; stigma 3 - 8-cleft 12. *Stephania*
 b. Inflorescence paniculate, cymose or racemiform; sepals free or connate; petals connate; stigma 3-cleft 7
 7a. Sepals free; drupes ridged in 2 rows; bracts and bracteoles broadly ovate-orbicular 5. *Cissampelos*
 b. Sepals connate; drupes tuberculate in 3 - 6 rows; bracts and bracteoles linear-lanceolate or absent 7. *Cyclea*

Tribe 4. TILIACOREAE

- 1a. Leaves triplinerved at base; sepals marked with red streaks 15. *Haematocarpus*
 b. Leaves pinnately nerved, sometimes subpalmately nerved at base; sepals without markings 2
 2a. Innermost whorl of sepals connate or valvate; drupes with style-scars near base 3
 b. Innermost whorl of sepals imbricate; drupes with style-scars remote from base 4
 3a. Innermost whorl of sepals connate; stamens 18 - 24; female flowers with 6 staminodes; gynophore unbranched 13. *Albertisia*
 b. Innermost whorl of sepals valvate; stamens 3 - 9; female flowers without staminodes; gynophore branched 17. *Tiliacora*
 4a. Stamens 5 - 18, almost connate in a tight cluster; drupes up to 3 cm in diam. 16. *Pycnarrhena*
 b. Stamens 6, free; drupes 3.2 - 5 cm in diam. 14. *Eleutharrhena*

Tribe 5. TINOSPOREAE

- 1a. Leaves slightly peltate; endocarp flat with thin broad lateral wings, without any ventral cavity or hollow chamber 18. *Apaldecarya*
 b. Leaves not peltate; endocarp almost subellipsoid to subglobose, usually spiny or tuberculate, with a ventral cavity or hollow chamber 2
 2a. Stamens united into a peltate synandrium; ventral side of endocarp either with a cavity bordered by usually incurved teeth or spines or with a closed inflated chamber 19. *Parabaena*
 b. Stamens free; ventral side of endocarp with a well defined central or median groove with a smooth margin 20. *Tinospora*

Tribe 1. COSCINEAE Hook. f. & Thomson

(A. Pramanik)

Leaves peltate or not peltate, usually ovate, palmately nerved. Perianth not differentiated into sepals and petals; inner segments usually larger than the outer ones. Stamens connate (outer ones free in *Coscinium*). Carpels 3 - 6. Drupes almost globose; style-scar sublateral towards base or lateral; endocarp smooth or fibrous, less ornamented; condyle obsolete or sub-hemispherical, deeply intrusive, 2-locular. Endosperm present, sometimes ruminant; cotyledons thin, foliaceous, divaricate, often much folded.

India to Indo-china and Malesia; 3 genera, 2 in India.

Literature. FERGUSON, I. K. (1978) Pollen morphology of the tribe Coscineae of the Menispermaceae in relation to its taxonomy. *Kew Bull.* 32: 339 - 346, tt. 18 - 26. FORMAN, L. L. (1978) A revision of the tribe Coscineae Hook. f. & Thoms. (Menispermaceae). *Kew Bull.* 32: 323 - 338. WILKINSON, H. P. (1978) Leaf anatomy of the tribe Coscineae Hook. f. & Thoms. (Menispermaceae). *Kew Bull.* 32: 347 - 360.

1. *Anamirta* Colebr.

Large lianas, glabrous. Leaves not peltate, palmately nerved at base with hairy domatia in axils of nerves. Inflorescence usually cauliflorous (staminate ones sometimes axillary), paniculate. Male flowers: pedicellate; sepals 6, concave, imbricate; outer 2 minute; inner ones 6 (3 + 3), imbricate, concave, larger, reflexed; petals absent; synandrium shortly peduncled, globular, with clusters of 30 - 35 transversely dehiscing anthers. Female flowers: sepals as in male; staminodes 6 - 9, in one whorl, minute, clavate; carpels 3 (-4); gynophore central, conical, elongating in fruit; stigma recurved. Drupes subreniform, globose, somewhat compressed, dorsally gibbous, on terminal divergent 3-fid gynophore, with thin pericarp; endocarp woody, reticulate on surface, with 2 small sublateral perforations on the ventral (concave) side, deeply intrusive; condyle bilobed. Seed globose, embracing a subglobose hollow intrusion of endocarp; endosperm copious, of horny granules; cotyledons divaricate, much larger than radicle, narrowly oblong, thin, spreading.

India, Sri Lanka, Indo-china to Malesia; monotypic.

Anamirta cocculus (L.) Wight & Arn., *Prodr.* 1: 446. 1834; Hook. f. & Thomson in *Fl. Brit. India* 1: 98. 1872. *Menispermum cocculus* L., *Sp. Pl.* 340. 1753. *A. paniculata* Colebr. in *Trans. Linn. Soc.* 13: 66. 1822.

Beng.: *Kakmari*; Sans.: *Kakmari*; Tam.: *Kakka-kolyivirai*.

Climbers or lianas, up to 12 m long with drooping branches and panicles; young

stems and petioles pale greyish straw-coloured on drying, striate; bark thick, corky. Leaves ovate to broadly ovate, cordate to truncate (or broadly obtuse) at base, bluntly subacute to acuminate at apex, 11 - 28 x 8 - 24 cm, thinly coriaceous, glabrous; basal nerves 3 - 5 (-7), palmate; lateral nerves 4 - 5 pairs, with hairy axils, linked to each other with scalariform cross-veins; nervules reticulate, slightly raised beneath; petioles 6 - 18 (-25) cm long, swollen at nodes, geniculate at base. Inflorescences on old branches, paniculate, drooping, 16 - 40 cm long, with 2 - 5 cm long lateral branches, glabrous; bracteoles ca 0.5 mm long; flowers green, scented, ca 4 mm across. Male flowers: pedicels 2 - 3 mm long; sepals white, yellow or pale green; outer 2 scarcely 1 mm long; inner ones broadly elliptic, 2.5 - 3 x ca 2 mm, glabrous; synandrium globular, 1.5 - 2 mm across, transversely dehiscent. Female flowers: pedicels 2 - 3 mm long; staminodes 6, club-shaped, scarcely 0.25 mm long; stamens numerous, with 2-loculed anthers around the top of central column; carpels 3 (-4), curved-ellipsoid, 1.5 - 2 mm long; style lateral; stigma thick, subcapitate, recurved; gynophore 6 - 16 mm long, thick, columnar, continuous with pedicel. Drupes ca 1 x 0.8 cm, white, becoming dark blue; style-scar basal; endocarp subreniform, globose, reticulate-rugulose with fine dorsal groove; cotyledons narrowly elliptic, 5 - 7 mm long, ca 2 mm broad.

Fl. & Fr. Aug. - Dec.

Distrib. India: Lowland and hill forests, banks of rivers or streams, coastal forests, on limestone and sandy soil, up to 500 m. Uttar Pradesh, Maharashtra, Karnataka, Tamil Nadu, Kerala and Andaman & Nicobar Islands.

Sri Lanka, Bangladesh, Myanmar, Indo-china, Thailand to Malesia.

Notes. The fruits are used as fish poison and also to kill lice on the scalp. Effective in treatment of schizophrenia, used as an antidote for barbiturate and morphine poisoning. Fresh fruit juice is a good application to scabies and foul ulcers (Forman in Kew Bull. 32: 331. 1978).

The stem produces bast fibres.

2. *Coscinium* Colebr.

Large lianas. Leaves often peltate, palmately nerved, white tomentose beneath. Inflorescences supra-axillary or ramiflorous peduncled racemes bearing more or less globose heads of flowers. Male flowers: sepals 9, imbricate, in 3 whorls, sericeous outside; petals absent; stamens 6, outer 3 free, with 1-locular anthers; inner 3 connate with 2-locular latrorse anthers. Female flowers: tepals as in male flowers; staminodes 6; carpels 3, densely pilose; style filiform, recurved. Drupes subglobose, on globose gynophore, finely tomentose or tomentellous; style-scar sublateral; endocarp with anastomosing, fibrous ridges; condyle thickly clavate, intrusive. Seeds subglobose, peltate, enclosing the condyle; cotyledons folded, divaricate, surrounded by endosperm.

India, Sri Lanka, Thailand, Vietnam to W. Malesia; 2 species, one in India.

Coscinium fenestratum (Gaertn.) Colebr. in Trans. Linn. Soc. Lond. 13: 65. 1822; Hook. f. & Thomson in Fl. Brit. India 1: 99. 1872. *Menispermum fenestratum* Gaertn., Fruct. 1: 219, t. 45, f.5. 1788.

Tam.: *Maramanjal*.

Lianas with yellow wood and sap; branchlets terete, brownish tomentose, later glabrescent with disciform petiole-scars. Leaves broadly ovate, rounded, truncate or shallowly cordate at base, acuminate at apex, 10 - 32 x 8 - 22 cm, glabrescent above, white tomentellous beneath, thinly coriaceous; main nerves 5 - 7, palmate, with 2 pairs of distal lateral nerves; midrib and other main nerves sunken, whitish tomentose beneath; petioles 3 - 16 cm long, conspicuously swollen at both ends, geniculate at base, inserted up to 0.8 (-2.7) cm above basal margin on the lamina of leaf. Inflorescences supra-axillary or on old leafless stems; heads on 1 - 3 cm long peduncles, of 5 - 11 cm long racemes, 6 - 7 mm across; bracts subulate, 4 - 5 mm long. Male flowers: sessile or shortly ca 1 mm long pedicellate; sepals broadly elliptic to obovate, 1.5 - 2 mm long, densely sericeous outside, glabrous inside, yellow; outer ones 3 - 6, broadly elliptic, 1 - 1.5 mm long; inner ones 3 - 6, spreading, 1.5 - 2 mm long, yellow. Stamens 6; filaments ca 1 mm long. Female flowers: sepals as in male; staminodes ca 1 mm long; carpels curved, ellipsoid, ca 2 mm long; styles filiform, recurved. Drupes 1 - 3, on globose, 7 - 8 mm in diam. gynophore, subglobose, 2.6 - 3 cm across, brown, orange or yellow, tomentellous; pericarp woody when dry, ca 1 mm thick; endocarp bony, 2.2 - 2.5 cm in diam. Seeds whitish, subglobose, peltate, enclosing condyle.

Fr. & Fr. Aug. - Oct.

Distrib. India: In primary lowland forests where soil bears granitic sand and sandstone. Tamil Nadu and Karnataka.

Sri Lanka, Cambodia, Vietnam and West Malesia.

Notes. Decoction of stems and leaves has antiseptic properties, used to dress wounds.

Tribe 2. FIBRAUREAE Diels

(A. Pramanik)

Petals and sepals scarcely distinct; petals sometimes with involute margins, erect and connivent at anthesis, sometimes absent; sepals reflexed at anthesis. Endocarp smooth, sometimes strongly rugose; condyle broad oval intrusion, often obsolete; style-scar at apex of drupe. Seeds with endosperm; embryo with thin flat cotyledons.

S. E. Asia and Madagascar; 3 genera, 2 in India.

Literature. FORMAN, L. L. (1985) A revision of tribe Fibraureae (Menispermaceae) in Asia. *Kew Bull.* 40: 539 - 551.

3. *Fibraurea* Lour.

Climbers or lianas, dioecious; stems woody, with yellow wood. Leaves ovate or oblong, long-petiolate, 3 (-5)-nerved at base, with main basal lateral nerves running shortly alongside or midrib before curving outwards; distal lateral nerves 2 - 4 pairs. Inflorescences lax panicles, often ramiflorous. Male flowers: sepals 6 - 9, outer ones minute; petals absent; stamens 3 - 6; filaments thick, with a collar around anther-base; anthers longitudinally or obliquely dehiscent. Female flowers: staminodes 6, subulate; carpels 3, ovoid, 2-ovuled; stigma sessile, cleft. Drupes on knob-like carpophore, oblong, terete, with subterminal styler scar, coarsely wrinkled when dry, ventrally flat and channelled. Seeds oblong, subellipsoid, dorsally convex, ventrally narrow-grooved lengthwise, reniform in cross section; endosperm abundant, horny; cotyledons thinly foliaceous, longitudinally curved; radicle short, cylindrical.

N.E. India, Nicobar Islands, Myanmar, Indo-china, S. China and Malesia; 2 species, one in India.

Fibraurea tinctoria Lour., *Fl. Cochinch.* 626. 1790; Hook. f. & Thomson in *Fl. Brit. India* 1: 98. 1872. *Cocculus fibraurea* DC., *Prodr.* 1: 99. 1824. *F. chloroleuca* Miers., *Contr. Bot.* 3: 42, t.93. 1871. *Tinomiscium nicobaricum* Balakr. in *New Botanist* 7: 7 - 9. f. 1. 1980, p. p.

Large woody climbers, up to 40 m long; stems up to 5 cm thick, with white latex; branches striate. Leaves elliptic-ovate or oblong, sometimes subpeltate or usually rounded or obtuse at base, acuminate at apex, 10 - 26 x 5 - 14 cm, smooth above, obscurely reticulate, thinly coriaceous, drying greyish; petioles slender, swollen at base, 4 - 13 cm long. Inflorescences axillary or ramiflorous, 10 - 35 cm long; lateral branches up to 12 cm long. Male flowers: pedicels 1.5 - 5 mm long; sepals broadly elliptic, concave, 2 - 4 x 1 mm, white or yellow; stamens 6, 2 - 2.5 mm long; filaments thick, columnar, ca 1 mm long; anthers elongate, longitudinally dehiscent. Female flowers: staminodes subulate,

ca 2 mm long; carpels ellipsoid, ca 1.5 mm long. Drupes on 6 - 15 mm long pedicels, yellow to orange; endocarps 2 - 3 mm long, hard, rigid.

Fl. & Fr. Jan. - Dec.

Distrib. India: Lowland forests, in shaded places on clayey or stoney soil, up to 1000 m. Manipur and Andaman & Nicobar Islands.

Myanmar, Thailand, Vietnam, Malaysia, Sumatra, Java and Celebes.

Notes. The stems are medicinally important for stomach ailments.

4. *Tinomiscium* Hook. f. & Thomson

Woody climbers, with white latex; stems ferruginous pubescent when young. Leaves ovate or ovate-elliptic, entire, basally 3 - 5-nerved; nervules very fine, parallel, ridged above; petioles usually long, bent and swollen at base and often at apex. Inflorescence racemose, arising from old leafless stems, usually ferruginous tomentose. Male flowers: sepals 9, in 3 whorls, outer ones smaller; petals 6, with involute edges; stamens 6, free, opposite to petals; filaments flat; anthers longitudinally or transversely dehiscent; rudimentary carpels 3. Female flowers: sepals and petals as in male; staminodes 6, narrow; carpels 3; stigma lobed. Drupes 3 on discoid carpophores; style-scar terminal; endocarp dorsally compressed, ventrally flat or slightly concave, rugose or rugulose, elliptic to ovate or subobovate, acute at apex. Seed oblong, flat, endospermous; cotyledons thin, flat; radicle short, cylindrical.

Native of S.E. Asia, from Assam to Malesia; monotypic.

Tinomiscium petiolare Hook. f. & Thomson, Fl. Ind. 205. 1855 & in Fl. Brit. India 1:97. 1872. *T. micranthum* Diels in Engler, Pflanzenr. 46: 119. 1910. *T. nicobaricum* Balakr. in New Botanist 7: 7 - 9, ff. 2 - 7, 1980, p. p.

Woody climbers, up to 30 m long; stems woody with milky latex; branches coarsely striate; young twigs densely hairy. Leaves alternate, ovate to broadly ovate or elliptic, truncate or rounded at base, acute or sometimes shortly caudate-acuminate at apex, 11 - 19.5 x 4.5 - 13 cm, coriaceous, glabrous on both sides; basal nerves 3 - 5, palmate; lateral nerves distal, 2 - 4 pairs; petioles slender, slightly swollen and geniculate at base, 6 - 7.5 cm long. Inflorescences racemose, 8 - 25 cm long, several together on old stems, ferruginous tomentose, rarely glabrous; pedicels 2.5 - 5 mm long, puberulous. Male flowers: Outer sepals 3, triangular-ovate to narrowly triangular, 1 - 2 mm long, glabrous; inner ones 6, elliptic, reflexed at anthesis, 4 - 5 mm long, white to yellow, puberulous; petals broadly elliptic, concave with incurved edges, 2.5 - 3.5 mm long, glabrous; stamens 2 - 2.5 mm long; anthers immersed in the thickened connective or prominent, longitudinally or transversely dehiscent. Female flowers: staminodes linear-oblong, acute, ca 3

mm long; carpels ca 2 mm long, curved-ellipsoid; stigma shortly multilobed. Drupes 3 or 1 or 2 aborted, on discoid carpophore, compressed, ellipsoid, narrowed at base into a short stipe, green, with white spots when young, later white to yellow or orange, with white latex, glabrous; endocarp compressed, narrowly to broadly elliptic to subovate in outline, rounded to obtuse at base, obtuse to sharply acute at apex, 2 - 3.5 x 1 - 2 cm, obscurely to strongly rugose or rugulose.

Fl. & Fr. Aug. - April.

Distrib. India: Mixed inland forests, up to 500 m. Assam and Nicobar Islands.

China, Myanmar, Vietnam, Thailand, Malaysia, Indonesia, Philippines to New Guinea.

Notes. Milky exudates are medicinally important. Fruits used as fish poison. Seeds edible and sweet.

This species is very variable in morphological features like leaf-shape, ornamentations, shape of endocarps etc. *T. nicobaricum* Balakr. is an incompletely described species as the female inflorescences and fruits were not reported. On a comparative study with the microfiche of syntype of *T. petiolare* (Wallich Cat. 4964 in CAL) and the specimens of *T. nicobaricum*, it appears that the male inflorescences belong to *T. petiolare* and the leaves to *Fibraurea tinctoria* Lour.

Tribe 3. MENISPERMEAE DC.

Leaves sometimes peltate; endocarps variously ornamented with processes or ridges; seed-cavity usually horse-shoe shaped, curved around a well developed condyle; condyle obovate or orbicular in outline; endosperm present, non-ruminate; cotyledons not foliaceous.

Tropics and subtropics of North and South America, Africa and S.E. Asia to Australia; 8 genera in India.

5. *Cissampelos* L.

(M. Gangopadhyay)

Scandent shrubs or lianas. Leaves peltate or not. Male flowers in axillary, peduncled, corymbose cymes, solitary or fascicled; sepals 4, obovate; petals connate into a cup or nearly free; stamens connate into a peltate synandrium. Female flowers in elongate thyrsoid cymes or fascicled; bracts orbicular; sepal 1; petal 1 or 2 - 3; staminodes absent; carpel 1. Drupes curved, hairy; style-scar basal; endocarp with dorsal ridges in 2 rows. Seeds bent like horse-shoe; embryo elongate, terete; cotyledons flattened.

Pantropical; ca 25 species, one in India.

Cissampelos pareira L. var. *hirsuta* (Buch.-Ham. ex DC.) Forman in Kew Bull. 22: 356. 1968. *C. hirsuta* Buch.-Ham. ex DC., Syst. Nat. 1: 535. 1817. *C. pareira* L., Sp. Pl. 1031. 1753, p. p., quoad B; Hook. f., Fl. Brit. India 1: 103. 1872.

Asm.: *Tubaki-lata*; Beng.: *Akanadi*, *Memuka*; Hindi: *Akanabindi*, *Bharat-buti*, *Harjuri*, *Parhe*; Kh.: *Jyrmisalla*; Kon.: *Parayel*; Mal.: *Kattuvalli*; Mar.: *Kuruphad*, *Pahadmul*, *Pahadvel*; Nep.: *Bara-panrhe*; Sans.: *Patha*; Tam.: *Appatta*; Tel.: *Semayeru*.

Climbers, compact, thicket-forming; branchlets hairy or glabrous. Leaves ovate, reniform or orbicular, peltate, truncate or cordate at base, acuminate, obtuse or mucronate at apex, 3 - 12 x 3.5 - 11 cm, chartaceous, tomentose, palmately 5 - 7-nerved; nervules inconspicuous; petioles 2 - 10 cm long, pubescent or puberulous. Inflorescences pendulous, subcorymbose cymes, up to 6 cm long, pubescent. Male flowers green to yellow; bracts obovate to orbicular; bracteoles linear; sepals 4, free, pilose above; petals 4, 0.5 - 1 mm long, greenish, puberulous inside; stamens 4; synandrium peltate, ca 1 mm long, transversely dehiscent. Female flowers 1 - 1.5 mm across; bracts ovate-orbicular, foliaceous, persistent; sepal 1, obovate; petal 1, obovate, cuneate at base; ovary pilose; style glabrous; stigma 3-fid. Drupes obovoid, 5 - 7 x 2.5 - 4 mm, red; style-scar subbasal; endocarp curved, with 9 - 11 transverse ridges; embryo ca 1 mm long; radicle mucronate at base.

Fl. & Fr. July - May.

Distrib. India: Throughout in primary and secondary forests from plains to 1500 m. Himachal Pradesh, Punjab, Haryana, Rajasthan, Uttar Pradesh, Bihar, West Bengal, Sikkim, Assam, Arunachal Pradesh, Nagaland, Manipur, Mizoram, Tripura, Meghalaya, Orissa, Madhya Pradesh, Gujarat, Maharashtra, Andhra Pradesh, Karnataka, Tamil Nadu and Kerala.

Pakistan, Nepal, Bhutan, Bangladesh to Malesia.

Notes. Leaves and roots are used as an antidote for snake-bite and scorpion stings and for curing cough, dyspepsia, dropsy and diarrhoea. Stem fibres are used for manufacturing ropes.

6. *Cocculus* DC., nom. cons.

Climbing or erect herbs or shrubs or small trees. Leaves non-peltate, entire or lobed. Inflorescences cymose or thyrsoid. Male flowers: sepals 6 or 9 in 2 or 3 series, imbricate, the outer ones smaller; petals 6, usually bifid at apex, auricled below; stamens 6 or 9, free. Female flowers: sepals and petals as in male; staminodes 6 or absent; carpels 3 or

6; styles cylindrical, subulate, reflexed. Drupes curved, obovoid, or rotund in outline, slightly compressed laterally; style-scar near base; endocarp bony, often perforate on both sides, transversely ridged on dorsal sides. Seed curved almost into a ring, broad, dorsoventrally flattened; endosperm very thin; cotyledons liguliform.

N. & C. America, Africa, to S. China and Malesia; ca 8 species, 5 in India.

Notes. Ferguson (in Kew Bull. 29: 483-492, tt. 16-21, 1974) has studied the epidermal characters in this genus.

KEY TO THE SPECIES

- | | |
|--|--------------------------|
| 1a. Leaves strongly 5-nerved | 2 |
| b. Leaves strongly 3-nerved, sometimes with 2 obscure lateral nerves | 3 |
| 2a. Leaves densely greyish tomentose to puberulous; flowers pale yellow; sepals pubescent; female inflorescences 0.5 - 2.5 cm long | 1. <i>C. hirsutus</i> |
| b. Leaves thinly puberulous to glabrous; flowers white; sepals glabrous; female inflorescences up to 5 cm long | 3. <i>C. orbiculatus</i> |
| 3a. Scandent herbs or climbing or straggling shrubs; leaves 1.5 - 5 x 0.5 - 3 cm | 4 |
| b. Erect shrubs or small trees; leaves 7 - 11 (-15) x 3.9 - 5.5 cm. | 2. <i>C. laurifolius</i> |
| 4a. Petioles 2 - 10 mm long; leaves linear-oblong or narrow-elliptic; female inflorescences 0.7 - 1.3 cm long | 4. <i>C. pendulus</i> |
| b. Petioles 15 - 25 mm long; leaves broadly ovate or elliptic; female inflorescences 1 - 5 cm long | 5. <i>C. prainianus</i> |

1. *Cocculus hirsutus* (L.) Diels in Engler, Pflanzent. 46: 236. 1910. *Menispermum hirsutum* L., Sp. Pl. 341. 1753. *Cocculus villosus* (Lam.) DC., Syst. Nat. 1: 525. 1817; Hook. f. & Thomson in Fl. Brit. India 1: 101. 1872. *Menispermum villosum* Lam., Encycl. 4: 97. 1797.

Hindi (Bih.): *Jaljamani*; Tam.: *Kattukodi*, *Sirungarukodi*.

Straggling or climbing hirsute evergreen shrubs, up to 6 m long; branches densely tomentose. Leaves ovate-cordate, 3 - 6 x 2 - 3.5 cm (basal leaves larger), yellowish tomentose, chartaceous, 5-nerved, various in shape; lower ones of main branches 3-5-lobed; upper ones usually entire, narrowly to broadly ovate, ovate-oblong or obovate, cuneate, rounded or rarely cordate at base, obtuse, mucronate at apex, 3 - 8 x 2 - 4 cm; petioles 5 - 20 mm long. Male flowers in up to 5 cm long axillary panicles; peduncles 1.5 - 2.5 cm long; pedicels 0.5 - 1 mm long; sepals 3 + 3, free, long pubescent; outer ones oblong to lanceolate, 1.5 x 2 x 0.5 - 2 mm; inner ones broadly ovate or obovate, 1.5 - 2.5 x 1.7 - 2 mm; petals 6, free, oblong-ovate, auricled at base, 2-fid at apex, 0.5 - 1.5 x 0.3 - 0.6 mm, greenish, thin, sparsely pubescent to glabrescent; stamens 6, free, 0.7 - 1 mm long, enclosed by petals; anthers vertically dehiscent. Female flowers in axillary

fascicles or racemes, 0.5 - 2.5 cm long; sepals and petals as in male; staminodes ca 0.5 cm long; carpels 3, 0.7 - 1 mm long; styles terete. Drupes laterally compressed, 4 - 8 x 3 - 4 mm; style-scar basal; endocarp transversely ridged; condyle-septum perforated.

Fl. & Fr. Aug. - May.

Distrib. India: In bushland and semi-desert scrubs, from plains to 1100 m. Uttar Pradesh, Bihar, West Bengal, Orissa, Rajasthan, Gujarat, Karnataka and Tamil Nadu.

Tropical Africa and Asia.

2. *Cocculus laurifolius* DC., Syst. Nat. 1: 530. 1817; Hook. f. & Thomson in Fl. Brit. India 1: 101. 1872.

Erect evergreen shrubs or small trees, up to 6 m high; main stem up to 12 cm thick; branchlets glabrous. Leaves elliptic or elliptic-oblongate, acute to occasionally cuneate at base, acute at apex, 7 - 11 (-15) x 3 - 5.5 cm, glabrous, stiffly chartaceous; basal nerves 3, strong, almost parallel to the margin beyond the middle of lamina; petioles 3 - 6 mm long. Male flowers yellow in axillary, single or thyrsoid up to 4 cm long glabrous cymes; bracts subulate, ca 1 mm long, frequently puberulous; pedicels ca 1 mm long; outer sepals 0.5 - 0.75 mm long; inner sepals ca 1 mm long; petals cuneate, emarginate at apex, clasping the stamens, ca 0.5 mm long; stamens ca 0.75 mm long. Female flowers: pedicels up to 5 mm long; staminodes 6, minute; carpels 3; styles slender, reflexed. Drupes rotund, ca 4 mm in diam., glabrous; endocarp with small curved aperture on both sides, finely ridged on dorsal surface.

Fl. & Fr. Oct. - July.

Distrib. India: Open forests, grasslands, river banks and plantations, up to 1500 m. Himachal Pradesh, Punjab, Uttar Pradesh, Karnataka and Tamil Nadu.

Nepal, Myanmar, Thailand, Indo-china, S. China, Taiwan and Japan to Malesia.

3. *Cocculus orbiculatus* (L.) DC., Syst. Nat. 1: 523. 1817. *Menispermum orbiculatum* L., Sp. Pl. 341. 1753. *C. mollis* Wallich ex Hook. f. & Thomson, Fl. Ind. 193. 1855 & in Fl. Brit. India 1: 102. 1872.

Climbing shrubs; stems herbaceous or slightly woody, 1 - 1.5 cm thick, grooved, slender, pubescent, blackish. Leaves elliptic to ovate-elliptic or ovate, cordate, truncate or abruptly cuneate at base, acute, apiculate or rounded and sometimes emarginate at apex, 3 - 10 x 1 - 5.5 cm, bright green and glabrous above, pale green and villous beneath, subcoriaceous; basal nerves 3 - 5, palmate; lateral nerves 2 - 3 pairs; petioles slender, 5 - 10 mm long, puberulous. Inflorescences axillary, extra-axillary or terminal, narrowly thyrsoid racemes, up to 7 cm long, often shorter than leaves, yellowish puberulous; male

inflorescences fewer-flowered, shorter; bracts filiform; pedicels ca 5 mm long. Male flowers white, glabrous; sepals in 3 whorls of 3 each; outermost minute, middle ones up to 1 mm long, inner ones obovate to rotund, 1 - 2.5 mm long; petals 6, oblong, obovate, 2-auricled at base clasping filaments of opposite stamens, divided at apex into 2 acute lobes, 1 - 1.5 mm long; stamens 6, ca 1 mm long. Female flowers: sepals and petals as in male; staminodes 6, minute, linear, ca 0.3 mm long, glabrous; carpels 6, ca 0.75 mm long, glabrous; style slender, recurved. Drupes dark green to dark blue, compressed, pisiform, rotund in outline, 4 - 6 mm in diam., sculptured outside with 4 lateral rows of tubercles, glabrous; style-scar subbasal; endocarp dorsally keeled with branched ridges; style-scar subbasal.

Fl. & Fr. May - Aug.

Distr. India: Assam, Nagaland, Tripura and Meghalaya.

Myanmar and S. China to Malesia.

4. *Cocculus pendulus* (J. R. & G. Forst.) Diels in Engler, Pflanzenr. 46: 237. 1910. *Epibatium pendulum* J. R. & G. Forst., Char. Gen. Pl. 108, t. 54. 1776. *Cocculus laeaba* DC., Syst. Nat. 1: 529. 1817; Hook. f. & Thomson in Fl. Brit. India 1: 102. 1872.

Raj. : *Pitwan*

Twining shrubs, much branched; stems up to 15 cm thick; branches slender, puberulous, 5 - 6 m long. Leaves oblong-lanceolate to oblong-ovate, truncate, cuneate, rounded or trilobed-hastate at base, obtuse, mucronate or emarginate at apex, 1.6 - 5 x 0.5 - 3 cm, generally glabrous or slightly puberulous; basal nerves 3 - 5. Male flowers minute, sessile or subsessile in axillary 5 - 20 mm long fascicles on ca 1.5 cm long peduncles; sepals ovate-elliptic, fleshy or membranous; outer 3 smaller, 1 - 1.5 x 0.4 - 0.7 mm, sparsely puberulous; inner 3 larger, puberulous to glabrous, shiny; petals ovate to obovate, 0.8 - 2 x 0.5 - 1 mm; stamens 0.8 - 1.5 mm long. Female flowers axillary, solitary or rarely in pairs, on 0.7 - 1.3 cm long peduncles; sepals and petals as in male; carpels ca 1 mm long. Drupes ovoid to obovoid or reniform, compressed, 4 - 7 x 4 - 5 mm, reddish, black on drying; endocarp ribbed on lateral faces, without crest, not perforated at centre.

Fl. & Fr. Oct. - Jan. (often throughout the year).

Distrib. India: In semi-desert scrubs and deciduous bushland and wastelands, up to 700 m. Jammu & Kashmir, Punjab, Haryana, Uttar Pradesh, Madhya Pradesh, Rajasthan, Gujarat and Tamil Nadu.

Pakistan to tropical and subtropical Africa.

Notes. Diluted leaf-juice with sugar is a good tonic; roots and leaves are used in

rheumatic pains.

5. *Cocculus prainianus* (Diels) Pramanik & Thoth. in Kew Bull. 42(3): 706. 1986.
Pericampylus prainianus Diels in Engler, Pflanzenr. 46: 221. 1910.

Scandent herbs; branches densely pilose hairy. Leaves broadly ovate to elliptic, acuminate, 4 - 7 x 2.5 - 4 cm, pilose above, pallid beneath, palmately 3-nerved, at times obscurely 5-nerved. Inflorescences axillary, paniculate corymbs, lax-flowered; branches spreading, pubescent; pedicels 5 - 7 mm long, slender. Male flowers: sepals 6; the outer 3 obovate, spatulate, ca 2 x 1 mm; the inner 3 narrowly obovate, ca 1.8 mm long; petals spatulate, inflexed along margins, ca 1 mm long; stamens 6, united at upper part.

Fl. & Fr. June - Sept.

Distrib. India: Nagaland and Great Nicobar Island.

Notes. The plant shows characters different from *Pericampylus* in having palmately 3-nerved leaves, acute leaf-bases and 6 sepals.

7. *Cyclea* Arn. ex Wight

(M. Gangopadhyay)

Climbing shrubs. Leaves peltate or not, palmately nerved. Inflorescences axillary or often cauliflorous, racemose or thyrsoid-paniculate. Male flowers: sepals 4 or 5, free or connate, 4- to 5-lobed; petals 4, free or connate into a cup or rarely 0; stamens 4 or 5, connate into a peltate synandrium; anthers dehiscing transversely. Female flowers: sepals 1 or 2; petals 1 or 2, rarely 0. Carpel 1; style short; stigma 3-fid. Drupes obovoid, curved, with 6 rows of tubercles. Seeds curved; embryo narrow, terete, embedded in endosperm.

India, Central and South China, Indo-china, Thailand to Malesia; ca 29 species, 8 species in India.

KEY TO THE SPECIES

- | | |
|--|------------------------|
| 1a. Flowers without bracts and bracteoles | 2 |
| b. Flowers with bracts and bracteoles | 3 |
| 2a. Petioles 3 - 6 cm long; male inflorescence up to 18 cm long; calyx in male flowers tubular, 4-toothed; petals subcampanulate, 4-lobed | 7. <i>C. pendulina</i> |
| b. Petioles 5 - 10 cm long; male inflorescence ca 8 cm long; calyx in male flowers campanulate, 4-lobed with narrow ovate lobes; petals free | 5. <i>C. meeboldii</i> |
| 3a. Leaves ciliate or hispid along margins | 4 |

- b. Leaves glabrous along margins 5
- 4a. Sepals in male flowers puberulous inside; synandrium 1.5 - 2 mm long; petals 2 in female flower; ovary ellipsoid; drupes obliquely ovoid or rounded, puberulous 1. *C. barbata*
- b. Sepals in male flowers pilose inside; synandrium 1 - 1.5 mm long; petal one in female flowers; ovary oblongoid; drupes ovoid, pilose 4. *C. fissicalyx*
- 5a. Petals absent 2. *C. bicristata*
- b. Petals present 6
- 6a. Bracts foliaceous; sepals free 8. *C. wattii*
- b. Bracts linear to lanceolate; sepals connate 7
- 7a. Petioles 1 - 2.5 cm long; cymes subsessile; calyx glabrous in male flowers; synandrium exerted 3. *C. debilliflora*
- b. Petioles 2 - 5 cm long; cymes peduncled; calyx pilose in male flowers; synandrium included 6. *C. peltata*

1. *Cyclea barbata* Miers (in Ann. Mag. Nat. Hist. ser. 3, 18: 19. 1866, nom. nud.)
Contrib. Bot. 3: 237. 1871; Forman in Kew Bull. 14: 76. 1960. *C. wallichii* Diels in Engler,
Pflanzenr. 46: 314. 1910; Calder in Rec. Bot. Surv. India 11(1): 39. 1926.

Slender climbers, up to 5 m long; branches hispid when young; roots tuberous. Leaves ovate to deltoid-ovate, truncate or rounded at base, acuminate and mucronate at apex, 6 - 18 x 4 - 13 cm, hispid along margins, palmately 9 - 12-nerved at base; petioles 3 - 6 cm long, placed 6 - 25 mm above basal margin. Inflorescence axillary or cauliflorous, 7 - 30 cm long, 1 - 2 cm wide, puberulous; bracteoles linear, puberulous; petioles 3 - 6.5 cm long, hispid. Male inflorescences axillary, solitary or fascicled, branched corymbose dense-flowered 5 - 8 mm wide cymes; sepals 4, slightly connate at base, triangular, glabrous; corolla cyathiform, turbinate, 0.6 - 0.8 mm long; synandrium 4 - 6-loculed, exerted. Female inflorescences paniced, branched; cymes subglobose, pedunculate; flowers sessile in dense heads; sepals 2, ovate to obovate, subrhomboid, 0.6 - 0.8 mm long, pilose outside; petals 2, reniform, ca 0.5 x 1 mm, glabrous; ovary ellipsoid, curved, ca 1 mm long, pilose; stigma 3-fid. Drupes obliquely obovoid to rotund, compressed, 5 - 7 x 1 - 6 mm, puberulous; endocarp with papilliform tubercles in 3 rows; seeds curved.

Fl. & Fr. July - May.

Distrib. India: Sikkim, Assam and Andaman & Nicobar Islands.

Bangladesh, Myanmar and Indo-china to Malesia.

Notes. The leaves and roots are regarded medicinal.

2. *Cyclea bicristata* (Griffith) Diels in Engler, Pflanzenr. 46: 317. 1910. *Lophophyllum bicristatum* Griffith, Notul. 4: 313. 1854 & Ic. Pl. Asiat. 491. 1854; Hook. f. & Thomson in Fl. Brit. India 1: 105. 1872. *C. populifolia* Hook. f. & Thomson, Fl. Ind. 202. 1855. Fig. 51.

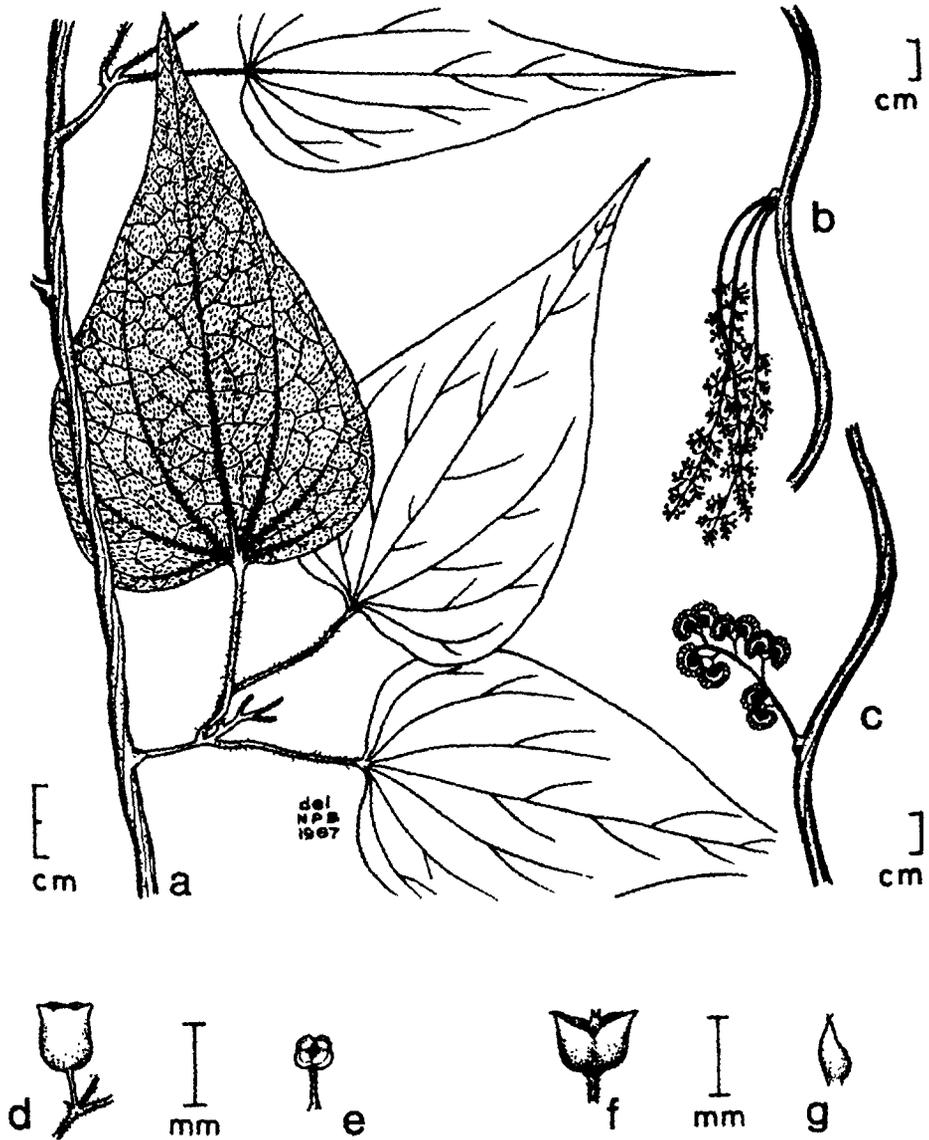


Fig. 51. *Cyclea bicristata* (Griffith) Diels: a, b. & c. twigs, vegetative, flowering and b fruiting; d. male flower; e. stamen; f. female flower; g. pistil.

Tall climbing shrubs; branches striated; bark white; branchlets pubescent. Leaves subpeltate, ovate to elongate-deltoid, broadly cordate at base, long acuminate at apex. 10 - 15 x 5 - 8 cm, coriaceous, glabrous above, pilose beneath, 5 - 9-nerved; petioles 4 - 8 cm long, thickened at both ends, pilose. Inflorescence a slender compound panicle of corymbose cymes, 5 - 8 cm long, fascicled, axillary or on old leafless stems, pilose; bracts linear-lanceolate, 1.5 - 2 mm long, sericeo-pilose. Male flowers: pedicels 1 - 1.5 mm long; sepals 4 - 8, connate into an inflated globose cup, campanulate, 4-lobed at apex, ca 1.5 mm long, glabrous; petals absent; synandrium peltate, 4 - 5-loculed. Female flowers: sepals 2 or 4, ovate-orbicular; petals absent; carpel 1, subglobose, glabrous; style short; stigma 2 - 3-fid. Drupes orbicular, compressed, subovoid, 4 - 7 mm in diam., pilose; endocarp subovoid, with 3 series of hooked tubercles on each edge; style-scar subbasal. Seed horse-shoe-shaped, curved; radicle obtuse at base; cotyledons ovate-oblong.

Fl. & Fr. Aug. - May.

Distrib. India: Subtropical evergreen forests, up to 1500 m. Sikkim, Arunachal Pradesh, Meghalaya and Manipur.

Bhutan and Myanmar.

3. *Cyclea debilliflora* Miers [in Ann. Mag. Nat. Hist. ser.3, 18: 20. 1866, nom. nud.] in Contrib. Bot. 3: 242. 1871. *C. peltata* auct. non (Lam.) Hook. f. & Thomson; Hook. f. & Thomson in Fl. Brit. India 1: 104. 1872, p. p.

Branches grooved and striated, sparsely pilose or glabrous. Leaves deltoid-ovate, truncate or orbicular and subpeltate at base, mucronate at apex, 8 - 15 x 5 - 8 cm, papery, glabrous and dark green above, pilose and glaucous green beneath, palmately 5 - 7-nerved at base; petioles 2 - 4.5 cm long, inserted at 1 - 1.5 cm inside the base of lamina, glabrous or pilose. Male flowers in panicles of corymbose cymes; branches filiform, pilose; pedicels 1 - 1.5 mm long; bracts long ciliate; calyx campanulate, ca 2 mm long, membranous, glabrous; petals 1 - 1.5 mm long, cyathiform; synandrium ca 2.5 mm long, exerted. Infrutescences up to 12 cm long, loosely pilose. Drupes obovoid, compressed, truncate at base, pilose; endocarp with tubercles in 3 rows on both sides. Seed curved.

Fl. & Fr. May - Aug.

Distrib. India: Between 600 to 1200 m. Meghalaya.

Endemic.

4. *Cyclea fissicalyx* Dunn in Gamble Fl. Pres. Madras 1: 31. 1915 & in Kew Bull. 1916(3): 60. 1916. *C. peltata* Miers, Contrib. Bot. 3: 236. 1871, non Hook. f. & Thomson 1855.

Branches striated. Leaves deltoid or ovate, truncate, sinuate or acute at base, mucronate at apex, 4 - 12 x 5 - 11 cm, ciliate along margins; petioles 3 - 6 cm long. Male flowers subsessile and congested in much-branched panicles; calyx campanulate, divided almost to base into 4 sepals, pilose; petals connate, glabrous; synandrium 1 - 1.5 mm long. Female flowers in racemes; sepals 2, obovate or oblong; petal 1, oblong to orbicular; ovary ovoid-oblong, pilose; style short. Drupes sessile, ovoid, ca 4 x 4 mm, pilose; endocarp with elevated tubercles in 3 rows. Seeds curved; embryo ca 3 mm long; radicle terete; cotyledons oblong, obtuse at apex.

Fl. & Fr. Feb. - March.

Distrib. India: Evergreen forests, 150 - 1000 m. Kerala.

Endemic.

5. *Cyclea meeboldii* Diels in Engler, *Pflanzenr.* 46: 315. 1910.

Shrubs, ca 3 m tall; branches striate, hispid to pilose. Leaves broadly cordate, long-acuminate at apex, 10 - 18 x 8 - 15 cm, membranous, hispid beneath; primary nerves 5 - 7, palmate, distinct beneath; petioles 5 - 10 cm long, geniculate at base, striate, hispid. Male inflorescences paniculate, ca 8 cm long, hispid or pilose with 1 - 1.5 cm long lateral branches; cymules capitate, with congested flowers; pedicels ca 1.5 cm long; calyx 1 - 1.2 mm long, 4-lobed, pubescent outside; lobes narrowly ovate; petals 4, free, broadly ovate, ca 0.8 x 0.3 mm, glabrous; synandrium ca 1 mm long. Infructescences subsessile, ca 5 cm long, ca 2.5 cm wide at base, hispid or pubescent. Drupes ca 4 x 4 mm, hispid; endocarp with seriate tubercles, ca 4 mm across.

Fl. & Fr. Dec. - March.

Distrib. India: Evergreen subtropical forests, ca 1500 m. Nagaland and Mizoram.

Myanmar.

6. *Cyclea peltata* (Lam.) Hook. f. & Thomson, *Fl. Ind.* 201. 1855 & in *Fl. Brit. India* 1: 104. 1872, p. p. *Menispermum peltatum* Lam., *Encycl. Meth.* 4: 96. 1797. *Cyclea burmannii* (Wight & Arn.) Hook. f. & Thomson, *Fl. Ind.* 201. 1855 & *Fl. Brit. India* 1: 104. 1872. *Clypea burmannii* Wight & Arn., *Prodr.* 1: 14. 1834. *Cyclea amottii* Miers in *Contrib. Bot.* 3: 240. 1871; Gamble, *Fl. Pres. Madras* 1: 31. 1915 (repr. ed. 1: 22. 1957).

Guj.: *Kanipet, Kalepat*; Tam.: *Para*.

Twining, branches grooved. Leaves triangular-ovate, deltoid, ~~elongate-ovate~~ or ovate-oblong, truncate, obtuse or subcordate at base, obtuse, acute, acuminate or apiculate at apex, 5 - 15 x 4 - 8 cm, pilose beneath, 5-nerved; petioles 2 - 5 cm long. Male

inflorescence a panicle of congested cymes, 20 - 30 cm long, puberulous, peduncled; flowers pedicellate, green; calyx campanulate, lobed for 1/4 of the tube into 4 - 6 sepals, pilose inside, puberulous outside; petals cyathiform, glabrous; stamens 4; synandrium peltate, included, 6 - 8-loculed. Female inflorescence a panicle, 2.5 - 5 cm long, pilose; bracteoles ovate-lanceolate or linear, pilose; flowers sessile; sepal 1, orbicular, pilose; petal 1, orbicular, glabrous; staminodes 6; carpels 3, ovoid, pilose; style short. Drupes obovoid, 3 - 4 x 3 - 4 mm, pilose; endocarp with tubercles in 3 rows. Seeds curved; embryo curved; radicle terete.

Fl. & Fr. April - May.

Distrib. India: Gujarat, Maharashtra, Tamil Nadu and Kerala.

Sri Lanka.

7. *Cyclea pendulina* Miers [in *Ann. Mag. Nat. Hist. ser. 3*, 18: 19. 1866, nom. nud.] in *Contrib. Bot.* 3: 243. 1871.

Branches striate, ferruginous pubescent. Leaves subovate, rounded or emarginate at base, mucronate at apex, 10 - 12 x 7 - 8 cm, glabrous above, pubescent or pilose beneath; basal nerves 5, palmate; petioles inserted peltately on lamina, 3 - 6 cm long, densely pubescent. Male inflorescence a panicle of pedunculate cymes, slender, up to 18 cm long; peduncles 5 - 7 mm long; calyx tubular, 4-toothed, ca 2.5 mm long, pilose outside; corolla subcampanulate, 4-lobed, glabrous; synandrium exerted, 4-loculed. Female inflorescence up to 20 cm long, branched with subglobose cymules, pubescent or tomentose; sepals short, pilose; petals cuneate-orbicular, retuse at apex, glabrous; ovary pilose; stigma 3-fid, divaricate, subulate. Fruit not seen.

Fl. Feb.

Distrib. India: Nicobar Islands.

Endemic.

8. *Cyclea wattii* Diels in *Engler, Pflanzenr.* 46: 320. 1910.

Branches slender, striate, glabrous. Leaves broad-ovate or lanceolate, truncate at base, acuminate at apex, 6 - 9 x 3 - 5 cm, glabrous above, pilose beneath; basal nerves 3 - 5, palmate, distinct beneath; petioles slender, 3 - 5 cm long, glabrous. Male inflorescences subaxillary, slender, 4 - 6 cm long, pseudo-racemose with 1 - 3-flowered cymes, pilose; bracts foliaceous, 1.5 - 2 mm long, pilose at apex; bracteoles ovate, acute; pedicels 1 - 1.5 cm long, glabrous. Male flowers glabrous; sepals 5 - 8, free, oblong or elliptic, 1.2 - 1.5 mm long, 0.5 - 0.7 mm wide; petals 4 - 6, free, unequal, obovate or linguiform, ca 0.3 mm long; synandrium irregular, 0.5 - 1 mm long. Female flowers and fruits not

seen.

Fl. May - June.

Distrib. India: Nagaland.

Endemic.

8. *Diploclisia* Miers

(A. Pramanik)

Woody climbers; branches pendulous. Leaves peltate or non-peltate. Inflorescences supra-axillary or cauliflorous, composed of racemose cymes. Male flowers: sepals 6, outer 3 narrower than inner ones; petals 6, marginally involute around opposite stamens; stamens 6; filaments free, thickened upwards; anthers subglobose, 4-lobed, dehiscing by transverse slit. Female flowers: sepals and petals as in male; staminodes 6, filamentose; carpels 3; styles short, stout; stigma recurved, flattened, dentate at margins. Drupes laterally compressed, curved; endocarp obovate to narrowly obovate-curved, transversely ridged, with an elongated depression on each side. Seeds curved; embryo narrow; radicle much shorter than flat cotyledons; endosperm scanty.

Tropical S. E. Asia; 2 species, one species with 2 varieties in India.

Diploclisia glaucescens (Blume) Diels in Engler, Pflanzenr. 46: 225, f. 77 A - L. 1910. *Cocculus glaucescens* Blume, Bijdr. 25. 1825. *Cocculus macrocarpus* Wight & Arn., Prodr. 13. 1834; Hook. f. & Thomson in Fl. Brit. India 1: 101. 1872.

Tam.: *Korraiya-chachi*, *Morasankodi*.

Deciduous woody climbers, up to 30 m long; stems glabrous, ca 5 cm thick, finely striate when young. Leaves peltate or not, broadly ovate to suborbicular, rounded to cordate at base, acuminate to rounded at apex, slightly crenate along margins, 6 - 11 cm across, chartaceous, glaucous beneath with fine reticulations; petioles 5 - 12 cm long, inserted up to 2.8 cm inside the lamina base. Inflorescences cauliflorous, up to 50 cm long, ca 8 cm wide. Male flowers pale yellow; pedicels 2 - 4 cm long; sepals 6, free; outer 3 elliptic, ca 2.5 cm long; inner ones 3, broadly elliptic, ca 2.5 mm long; petals 6, ovate-rhombic, auriculate at base, acute or emarginate at apex, ca 1 mm long, yellowish; stamens 6, free, ca 2 mm long; anthers dehiscing by transverse slits. Female flowers: sepals 6, in 2 whorls of 3 each; petals 6; staminodes 6, filamentose; carpels 3, ca 2 mm long. Drupes obovoid, ca 2.5 x 1.5 cm, yellow to orange; style-scar basal; endocarp elongate, narrowly obovate, 15 - 20 x 8 - 12 mm, transversely ridged, dorsally ornamented with transverse and longitudinal ridges.

KEY TO THE VARIETIES

- 1a. Leaves non-peltate; panicles lax, spreading; pedicels 4 - 5 mm long; outer sepals obovate-oblong, 2 - 2.5 x 1 - 1.2 mm; drupes 1.5 - 2.5 cm long, 4 - 6 mm thick. 1. var. *glaucescens*
- b. Leaves distinctly peltate; panicles dense, fasciculate; pedicels 3 - 4 mm long; outer sepals elliptic, 2 x 0.7 mm, drupes robust, ca 3 cm long, 7 - 10 mm thick 2. var. *kuntleri*

1. var. *glaucescens*

Fl. & Fr. March - Aug.

Distrib. India: In sheltered forests, up to 1500 m. Arunachal Pradesh, Maharashtra, Karnataka, Tamil Nadu, Kerala and Andaman islands.

Sri Lanka, Myanmar, S. China, Thailand, Indo-china and Malesia.

2. var. *kuntleri* (King) Pramanik & Thoth. in Kew Bull. 42: 705. 1986. *Cocculus kuntleri* King in J. Asiat. Soc. Beng. 58(2): 384. 1889. *Diploclisia kuntleri* (King) Diels in Engler, Pflanzenr. 46: 227, f. 77 M - N. 1910.

Fl. & Fr. March - Nov.

Distrib. India: Hill jungles of S. Andaman Island (east coast of Port Blair, 14.3.1891, *King's Coll.* s. n. in CAL). Extremely rare, no other collection.

Malaya and Borneo.

9. *Hypserpa* Miers

(A. Pramanik)

Scandent shrubs or woody climbers; young growing tips sometimes tendrilliform. Leaves ovate to elliptic, 3 - 7-nerved at base, sparsely or densely pubescent. Inflorescence axillary or supra-axillary, cymose or paniculate. Male flowers: sepals 7 - 12, glabrous or subglabrous; outer ones minute; inner ones larger, imbricate; petals 5 - 9, fleshy; stamens 9 - 40, free or connate. Female flowers: sepals and petals as in male; carpels 2 - 3; styles solitary, reflexed; stigma entire, reflexed. Drupes subcompressed, curved, obovoid to globose; style-scar basal; endocarp perforate or imperforate, rugose to rugulose on dorsal side. Seed curved, narrow, endospermous.

India, China to Malesia; ca 9 species, one in India.

Hypserpa nitida Miers in Hook. Kew J. Bot. 3: 258. 1851. *Limacia cuspidata* Hook. f. & Thomson, Fl. Ind. 189. 1855 & Fl. Brit. India 1; 100. 1872.

Scandent shrubs; branchlets sparsely to densely pubescent with yellowish hairs when young, later glabrescent. Leaves variable in shape, lanceolate to elliptic or broadly ovate to oblong-elliptic, obtuse to rounded or truncate at base, acuminate to obtuse and mucronate at apex, 4 - 12 x 1.5 - 7 cm, glabrous; basal nerves 3; main lateral nerves about 2 pairs, often indistinct; petioles 8 - 20 mm long, pubescent. Inflorescence cymose to paniculate, 1 - 4 (-12) cm long, up to 2 cm broad, yellowish pubescent. Male flowers yellow; pedicels 1 - 2 mm long, pubescent; sepals 7 - 11; outer ones subtriangular, scarcely 1 mm long, puberulous outside; inner ones 4 - 5, ovate to rotund, ca 2.5 x 1.5 mm, puberulous outside; petals 5, obovate, ca 1 mm long; stamens 9 - 10, connate at base, free above, 1 - 1.75 mm long. Female flowers: sepals and petals as in male; carpels 2, ellipsoid, ca 1 mm long. Drupes subglobose, on 1 - 4 mm long pedicels, (5-) 6 - 8 mm in diam., yellow to red; endocarp rugulose, sometimes perforate.

Fl. & Fr. March - Oct.

Distrib. India: From sea level to 2000 m. Assam, Meghalaya, Andhra Pradesh and Andaman & Nicobar Islands.

Sri Lanka, Myanmar, Thailand, Indo-china to Malesia.

10. *Pachygone* Miers

(M. Gangopadhyay)

Woody climbers. Leaves petiolate, ovate, 3 or 5-nerved. Inflorescence axillary, pseudoracemose. Male flowers: sepals 6 - 12, inner ones larger, imbricate; petals 6, auriculate at base; stamens 6. Female flowers: sepals and petals as in male; staminodes 6; carpels 3, glabrous. Drupes obovoid, subcompressed with basal style-scar; endocarp smooth, depressed laterally, with a dorsal median groove. Seeds strongly curved, non-endospermous; embryo enclosed in membranous integuments; cotyledons large, thick.

India, China to Malesia, Australia and Polynesia; ca 10 species, one in India.

Pachygone ovata (Poiret) Hook. f. & Thomson, Fl. Ind. 203. 1855 & in Fl. Brit. India 1: 105. 1872. *Cissampelos ovata* Poiret in Lam., Encycl. Meth. Bot. 5: 10. 1804.

Tam.: *Kadukkodi*.

Woody climbers or stragglers, up to 15 m high; branchlets yellowish pubescent or

puberulous when young, later glabrous. Leaves ovate-lanceolate or ovate, truncate or rounded at base, acuminate-mucronate or rarely obtuse at apex, 5-12 x 3-8 cm, chartaceous, softly pubescent to glabrous; basal nerves 3-5; lateral nerves 1-2 pairs; petioles 2-5 cm long, yellowish pubescent or glabrous. Inflorescences racemose, axillary, solitary or 2-3-fascicled, 5-20 cm long, puberulous; flowers minute, sweet-scented, in clusters of 3-5; bracts 4-5 mm long, puberulous or glabrous. Male flowers yellow; pedicels 1-3 mm long; sepals 6-12; outer 3-6 bracteiform, elliptic to rounded, 1-2 mm long; inner 3-6, elliptic, rotund, 1.5-2.5 mm long, puberulous outside; petals 6, oblong, auriculate at base, emarginate at apex, 1-1.5 mm long, glabrous; stamens 6, free, clasped by petals; filaments ca 1.5 mm long; anthers dehiscing by transverse slits; pistillodes 3. Female flowers: sepals and petals as in male; staminodes 6, minute; carpels 3, subovoid; style flattened; stigma minute. Drupes obovoid, subcompressed, reniform, 7-8 x 5-6 mm, glabrous, on 3-5 mm long stalks; style-scar subbasal; endocarp smooth. Seeds 5-7 mm long; embryo ca 5 mm long; cotyledons oblong, obtuse at apex.

Fl. & Fr. Jan. - Sept.

Distrib. India: Scrub jungles, hill forests along slopes, often in secondary forests, up to 900 m altitude. Andhra Pradesh, Karnataka and Tamil Nadu.

Sri Lanka, Malesia and N.E. Australia.

Notes. The dried fruits are used for killing worms and stupefying fish.

11. *Pericampylus* Miers

(A. Pramanik)

Woody climbers. Leaves not peltate, palmately 5-nerved. Inflorescence axillary, cymose and subumbellate, pedunculate; cymes solitary or fasciculate. Sepals 9; outermost 3 narrow, minute; inner 6 imbricate, concave; innermost 3 broader than others. Petals 6, cuneate. Male flowers: stamens 6, free; anthers dehiscing longitudinally. Female flowers: staminodes 6, filamentose; carpels 3; stigma deeply bifid with dorsal and lateral processes, recurved, laterally concave. Drupes curved, with basal style-scar; endocarp rotund in outline, laterally concave; condyle septiform, imperforate. Seeds curved; embryo enclosed in endosperm, elongate, narrow, terete; radicle much longer than subterete cotyledons.

Tropical and subtropical Asia; ca 3 species, one in India.

Pericampylus glaucus (Lam.) Merr., Interpr. Rumph. Herb. Amboin. 219. 1917. *Menispermum glaucum* Lam., Encycl. Meth. 4: 100. 1797. *Cocculus incanus* Colebr. in Trans. Linn. Soc. Lond. 13: 57. 1822. *Pericampylus incanus* (Colebr.) Miers in Ann. Nat. Hist. ser. 7, 2: 40. 1851; Hook. f. & Thomson in Fl. Brit. India 1: 102. 1872. **Fig. 52.**

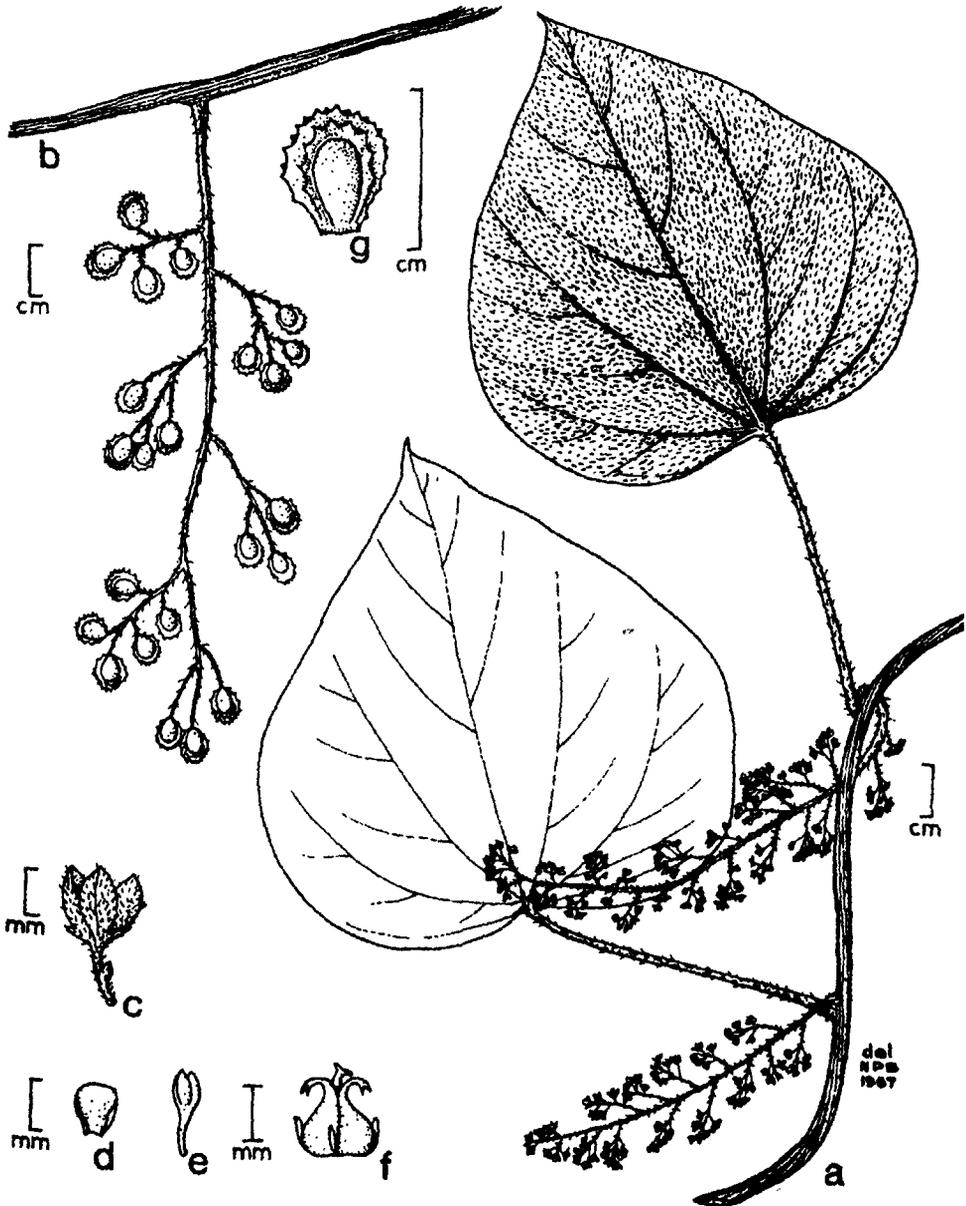


Fig. 52. *Pericampylus glaucus* (Lam.) Merr. : a. branch with flower; b. branch with fruits; c. flower; d. petal; e. stamen; f. pistil; g. fruit.

Climbing woody shrubs; stems striate; young stems yellowish tomentose, later glabrescent. Leaves broadly triangular-ovate, subpeltate, cordate, truncate or obtuse at base, rounded or obtuse, sometimes acute and apiculate at apex, shallowly crenate along margins, 5 - 10 x 2 - 8 cm, chartaceous, tomentose or softly pubescent beneath, sparsely pubescent above; basal nerves 5, palmate; lateral nerves fine, minutely reticulate; petioles 3 - 7 cm long, yellowish tomentose. Inflorescences fascicled or in paniculate cymes, 2 - 4 cm long, yellowish tomentose. Male flowers white or yellow; pedicels ca 1 mm long; sepals 9 in 3 whorls, hairy outside; outer 3 narrow, ca 0.5 mm long; middle 3 oblanceolate, ca 1 mm long; inner 3 obovate, ca 1 mm long; petals 6, obcuneate, ca 0.5 mm long, glabrous; stamens 6, free, ca 0.75 mm long. Female flowers: sepals and petals as in male; staminodes 6, filamentose; carpels 3, ca 0.5 mm long; style bipartite with subulate stigmatic arms. Drupes subglobose, echinate, red-purple to black, glabrous; style scar subbasal; endocarp rotund, 5 - 6 mm across, bearing 2 dorsal rows of 15 pointed projections, linked by projections in 2 lateral rows.

Fl. April - May; *Fr.* June - Aug.

Distrib. India: Primary and secondary forests, up to 1600 m. Uttar Pradesh, West Bengal, Sikkim, Arunachal Pradesh, Assam, Nagaland, Mizoram, Tripura, Meghalaya and Andaman & Nicobar Islands.

Myanmar, S. China, Indo-china, Thailand to Malesia.

Notes. Stems used for basketry and as ropes. Sap of stems used as eye medicine.

12. *Stephania* Lour.

(M. Gangopadhyay)

Slender climbers, stems woody or herbaceous; roots sometimes tuberous. Leaves peltate, ovate to suborbicular or deltoid, palmately 8 - 13-nerved, glabrous or hairy; petioles usually geniculate at base. Inflorescences axillary or arising from old leafless stems; flowers in umbelliform cymes or disciform capitula, 1 many-peduncled. Male flowers symmetrical; sepals 6 or 8, in whorls, free, imbricate; petals 3 or 4, free, broadly obovate; stamens 2 - 6, connate, forming a peltate synandrium. Female flowers symmetrical or asymmetrical; sepals 1 - 8; petals 2 - 4, similar to as in male; carpel 1; style short, 3 - 6-partite or absent; stigma short or divaricately laciniate. Drupes obovoid or ovoid; style-scar distinct near base; pericarp thin, glabrous; mesocarp fleshy; endocarp bony, horseshoe-shaped; tubercles in 2 - 4 longitudinal rows or transversely ribbed on dorsal side; condyle perforate. Seeds curved.

Tropical Africa, Indian subcontinent, Malesia to Australia; ca 35 species, 8 species

and 2 varieties in India.

KEY TO THE SPECIES

- | | |
|---|---------------------------|
| 1a. Inflorescences from main stem or leafless branches, large, compound, spreading; branches ending in corymbs with congested flowers | 1. <i>S. andamanica</i> |
| b. Inflorescences from leafy branches; flowers in simple or compound pseudumbels | 2 |
| 2a. Cymes ultimately congested into a head; flowers sessile to subsessile; leaves 9 - 11-nerved | 3 |
| b. Cymes ultimately lax; flowers pedicellate; leaves 5-nerved | 4 |
| 3a. Leaves entire; heads in panicles; flowers sessile to subsessile; peduncles 2 - 8 cm long; endocarp with erect tubercles | 6. <i>S. japonica</i> |
| b. Leaves lobed; heads solitary; flowers sessile; peduncles 1.5 - 2.5 cm long; endocarp ribbed or grooved | 8. <i>S. wightii</i> |
| 4a. Sepals glabrous; endocarp ribbed and grooved | 5 |
| b. Sepals papillose; endocarp with erect tubercles | 6 |
| 5a. Petioles 5 - 15 cm long; sepals linear-oblong, internally glandular; synandrium 1.5 - 2 mm long; drupes ovoid | 3. <i>S. glabra</i> |
| b. Petioles 2 - 6 cm long; sepals ovate-oblong to obovate, glandless; synandrium ca 0.5 mm long; drupes obovoid | 7 |
| 6a. Leaves entire, glaucous beneath; petals orbicular; drupes obovoid | 4. <i>S. glandulifera</i> |
| b. Leaves lobed, papillose beneath; petals obovate; drupes ovoid | 7. <i>S. venosa</i> |
| 7a. Leaves long-triangular; petioles 2 - 4 cm long; bracts 1 - 1.5 mm long | 2. <i>S. elegans</i> |
| b. Leaves broadly triangular, ovate or orbicular; petioles 5 - 6 cm long; bracts 3 - 4 mm long | 5. <i>S. gracilentia</i> |

1. *Stephania andamanica* Diels in Engler, Pflanzenr. 46: 266. 1910.

Leaves ovate, rounded at base, acute or acuminate at apex, 6 - 8 x 3 - 5.5 cm, puberulous beneath, 7 - 9-nerved; petioles 2 - 5 cm long, slender. Male inflorescence a panicle of corymbose cymes, pendulous, 40 - 60 cm long, with slender branches. Male flowers: pedicels 1 - 7 mm long; sepals ovate-elliptic, ribbed or not; petals 3, auriculate, thick, inflexed; synandrium 1 - 1.5 mm long; antheriferous disc ca 1 mm across. Female flowers and fruits not seen.

Fl. June.

Distrib. India: S. Andaman Island.

China (?).

2. *Stephania elegans* Hook. f. & Thomson, Fl. Ind. 195. 1855 & Fl. Brit. India 1: 103. 1872.

Kh.: *Mi-soh-iong-rit*.

Leaves elongate-triangular, truncate at base, acute to obtuse at apex, 5 - 10 x 4 - 6 cm, glabrous, glossy, 5-nerved; petioles 2 - 4 cm long. Inflorescence cymose umbels; peduncles 4 - 7 cm long, filiform; branches short, glabrous; bracts 1 - 1.5 mm long, linear. Male flowers green or purple; pedicels 1 - 2 mm long; sepals obovate, glabrous; petals obovate or ovate, glabrous; synandrium ca 0.5 mm long. Female flowers: sepals 3 - 6, obovate, glabrous; petals obovate; ovary oblong; style short; stigmas 3 or 4, minute. Drupes obovoid, 6 - 8 x 6 - 7 mm, glabrous, red when ripe; endocarp transversely ribbed and grooved, tubercled on periphery.

Fl. & Fr. June - May.

Distrib. India: ca 1800 m. Uttar Pradesh, West Bengal, Sikkim, Assam, Nagaland and Meghalaya.

Nepal, Bhutan and Bangladesh.

3. *Stephania glabra* (Roxb.) Miers, Contrib. Bot. 3: 217. 1817. *Cissampelos glabra* Roxb., Fl. Ind. 3: 840. 1832.

Asm.: Paer-gruj; Garh.: Gindaru; Hindi: Purha.

Leaves ovate or orbicular, obtuse at apex, 4 - 15 x 4 - 12 cm, glabrous, 5-nerved; petioles 5 - 14 cm long, thickened at base. Male flowers in axillary umbellate cymes; peduncles 4 - 8 cm long, glabrous; bracts and bracteoles linear or linear-lanceolate, glabrous; sepals 6; outer ones narrow-oblong; inner ones obovate; petals 3, 1.5 - 2 mm long. Female flowers: ovary oblong-ovoid; style short; stigma 4 - 5-cleft. Inflorescence up to 15 cm long. Drupes stalked, ovoid, ca 5 x 6 mm; endocarp transversely ribbed and grooved; embryo ca 4 mm long; cotyledons oblong, obtuse at apex.

Fl. & Fr. May - April.

Distrib. India: Uttar Pradesh, Assam and Meghalaya.

Notes. The roots have medicinal properties.

4. *Stephania glandulifera* Miers, Contrib. Bot. 220. 1871. *S. rotunda* auct. non Lour.; Hook. f. & Thomson, Fl. Ind. 197. 1855 & Fl. Brit. India 1: 103. 1872, p. p.

Kh.: Soh-pung-um-lang-sang; Nep.: Gana-grjo.

Large climbers with tuberous roots; branches warty; tubers globose, deep yellow inside. Leaves suborbicular, rounded or truncate at base, obtuse or mucronate at apex, 7 - 11 cm across, glabrous and glaucous beneath; basal nerves 5 (-9); petioles 7 - 15 cm long. Inflorescence a peduncled umbellate cyme. Male flowers: sepals 6 - 8, ovate-

spathulate or obovate, glandular, papillose above; petals 3 - 4, orbicular, cuneate at base; synandrium ca 1 mm long. Female flowers: ovary ovoid, glabrous; style short; stigma 5-fid. Drupes sessile, obovoid, 7 - 10 x 6 - 7 mm; endocarp with erect tubercles, 5 - 6 mm long; cotyledons oblong, obtuse at apex.

Fl. & Fr. Feb. - Jan.

Distrib. India: E. Himalayas and N.E. India, 450 - 1740 m. Sikkim, Assam, Nagaland, Manipur and Meghalaya.

5. *Stephania gracilentia* Miers, Contrib. Bot. 3: 223. 1817.

Branches striate. Leaves orbicular or subtriangular, truncate at base, mucronate at apex, 5 6 x 6 8 cm, 5-nerved; petioles 5 - 6 cm long. Male inflorescences axillary, peduncled, umbellate cymes; peduncles 3 - 4 cm long; bracts oblanceolate, 3 - 4 mm long, glabrous; bracteoles oblong, ca 2 mm long; pedicels up to 1 mm long; flowers purple; sepals 3 + 3, obovate to oblong, inflexed; petals 3 or 4, obovate or obcordate; synandrium ca 0.5 mm long. Female flowers not seen. Drupes obovoid, truncate at base, ca 7 x 8 mm, glabrous; endocarp transversely ribbed and grooved; embryo 5 - 7 mm long; cotyledons oblong, obtuse at apex.

Fl. & Fr. Aug. - Nov.

Distrib. India: C. Himalayas, 1800 - 2500 m. Uttar Pradesh.

Nepal.

6. *Stephania japonica* (Thunb.) Miers, Contrib. Bot. 3: 213. 1871, p. p. excl. Cuming. 1160. *Menispermum japonicum* Thunb., Fl. Jap. 193. 1784. *Cissampelos hermandifolia* Willd., Sp. Pl. 4: 861. 1806. *Stephania hermandifolia* (Willd.) Walp., Rep. Bot. Syst. 1: 96. 1842; Hook. f. & Thomson in Fl. Brit. India 1: 103. 1872.

Large slender climbers, winding clockwise around supports, 2 10 m long; roots tuberous; stems striate, glabrous or puberulous; branchlets striate, glabrous. Leaves ovate-triangular to ovate or deltoid, peltate, truncate, rounded or rarely cordate at base, acute, acuminate or obtusely mucronate at apex, 4 17 x 4 15 cm, membranous, to papyraceous, shiny glabrous above, glabrous or thinly puberulous beneath; basal nerves 8 - 10, others finely reticulate; petioles 3 - 12 cm long, puberulous. Inflorescences axillary, capitate umbellate cymes with sessile flowers; main peduncles 2 - 8 cm long; rays 8 - 12 with subulate bracts. Male flowers green, yellow or white, sessile or subsessile; sepals 6 - 8, oblanceolate or spathulate, 1 - 1.5 mm long; petals 3 - 5, free, obdeltoid or orbicular, 0.7 - 0.8 mm long, glabrous, fleshy; stamens 6 or 8 in peltate 0.5 - 1 mm long synandrium; anthers transversely dehiscent. Female flowers yellow; sepals 3 - 5; petals 3 - 5; carpels solitary, ovoid, ca 1 mm long; style 3 - 5-lobed. Drupes sessile to shortly stalked, obovoid

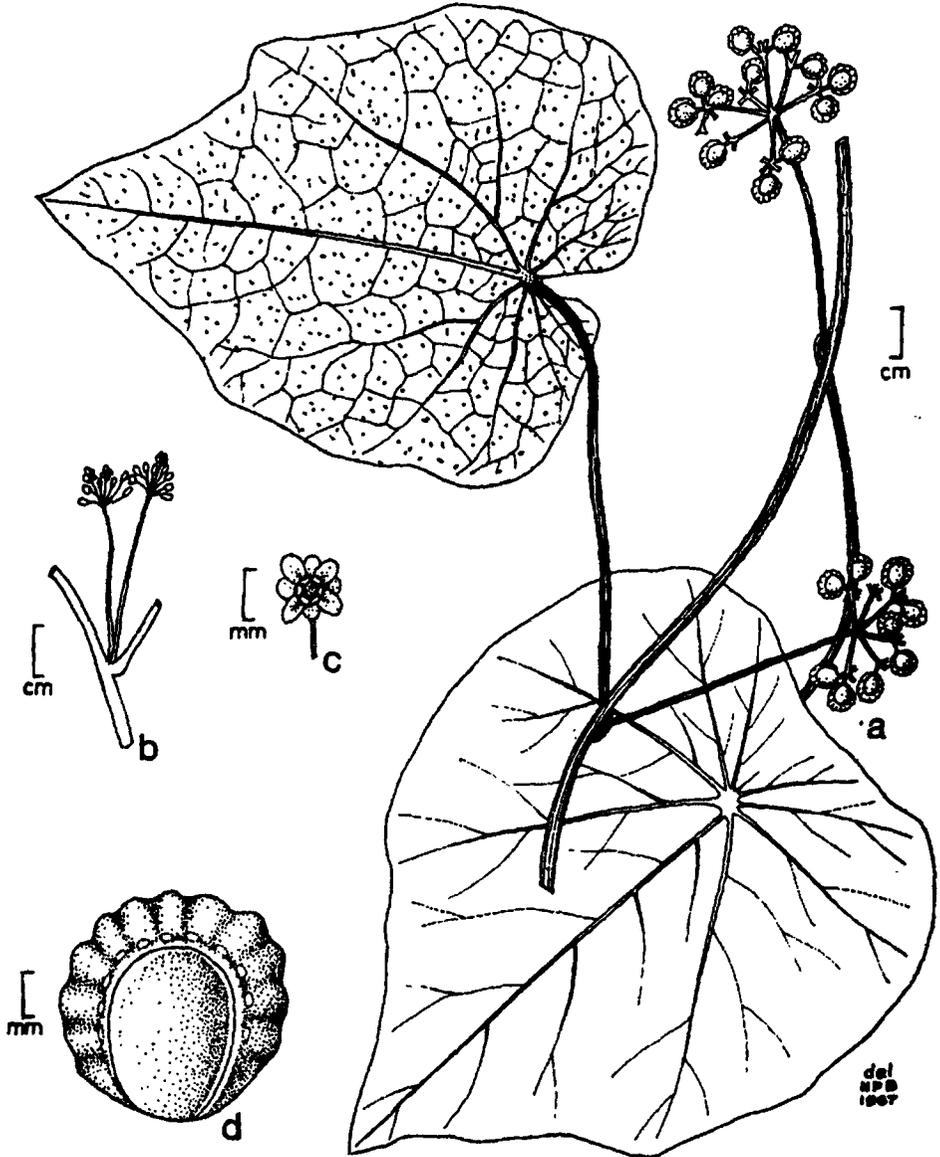


Fig. 53. *Stephania japonica* (Thunb.) Miers var. *discolor* (Blume) Forman: a. branch with fruits; b. flowering branch; c. flower; d. fruit.

or subglobose, 4 - 8 x 4 - 7 mm, glabrous, red; endocarp compressed, transversely ridged and grooved; ridges often 2-lobed, forming distinct tubercles, both hooked and papilliform; style-scar basal. Seeds 5 - 6 mm long; embryo 4 - 5.5 mm long; cotyledons oblong, obtuse at apex, fleshy.

KEY TO THE VARIETIES

- 1a. Leaves puberulous beneath 6.1. var. **discolor**
 b. Leaves glabrous beneath 6.2. var. **japonica**

6.1. var. discolor (Blume) Forman in Kew Bull. 11: 56. 1956. *Clypea discolor* Blume, Bijdr. 26. 1825. *S. hernandifolia* (Willd.) Walp. var. *discolor* (Blume) Miq., Ann. Mus. Lugd.-Bat. 4: 85. 1868. *Cissampelos hexandra* Roxb., Fl. Ind. 3: 841. 1832. **Fig. 53.**

Asm.: *Galuda, Tubuki-lot*; Beng.: *Agnadnemuka, Akanadi, Nimukha*; Garo: *Kharkha*; Or.: *Musakani, Nimukha*; Sans.: *Ambastha, Vanatiktika*.

Leaves puberulous beneath; inflorescences puberulous.

Fl. & Fr. March - Dec.

Distrib. India: Sikkim, Arunachal Pradesh, Assam, Meghalaya and Nicobar-Islands.

Myanmar, Thailand, Indo-china to Malesia and E. Australia.

Notes. Roots used in medicines. Crushed leaves applied to boils, inflammations and breast infections.

6.2. var. japonica

Mal.: *Putakilammu, Patavalli*.

Plants quite glabrous; bracts, bracteoles and sepals rarely papillose above.

Fl. & Fr. March - Sept.

Distrib. India: Wayside thickets, slopes of hills up to 900 m. Karnataka and Tamil Nadu.

Sri Lanka, E. China, Taiwan, Korea, Japan and Malesia.

7. *Stephania venosa* (Blume) Spreng., Syst. Veg. 4: 316. 1827. *Clypea venosa* Blume, Bijdr. 27. 1825.

Leaves broadly triangular or ovate, cordate at base, mucronate at apex, lobed along margins, 6 - 20 cm across, membranous, papillose beneath; petioles 6 - 20 cm long. Inflorescences axillary, peduncled, umbellate cymes, 5 - 12 cm long. Male flowers yellow to orange; pedicels 1 - 2 mm long; sepals 3 + 3, oblanceolate or obovate, papillose; petals 3, obovate; synandrium 1 - 2 mm long. Female flowers pedicellate; sepal 1, obovate; petals 2, orbicular, glabrous; ovary ellipsoid. Drupes stalked, ovoid, 6 - 9 x 5 - 7 mm, red; stalks 4 - 6 mm long; endocarp with papilliform tubercles in 4 rows.

Fl. & Fr. not known.

Distrib. India: Andaman Islands.

S. China, Vietnam, Thailand and Malesia.

8. *Stephania wightii* (Arn.) Dunn in Gamble, Fl. Pres. Madras 30. 1915 & in Kew Bull. 1916(3): 59. 1916. *Clypea wightii* Arn. in Wight, Illus. Bot. 1: 22. 1840. *S. rotunda* sensu Hook. f. & Thomson in Fl. Brit. India 1: 103, 1872, p. p., non Lour. 1790.

Leaves ovate, truncate at base, acute to acuminate at apex, lobed, 4 - 10 x 3.5 - 9 cm, glabrous, 9 - 10-nerved; petioles slender, 3 - 13 cm long. Inflorescences axillary, capitate cymes, 4 - 8 mm across; peduncles slender, 1.5 - 2.5 cm long, glabrous. Male flowers sessile, greenish to yellow; sepals 3 + 3, obovate, inflexed; petals oblong or obovate, ca 0.5 mm long; synandrium ca 0.5 mm long. Female flowers: ovary ovoid; style short; stigma 6 - 8-cleft. Infructescence up to 4 cm long, glabrous. Drupes obovoid, 6 - 7 x 3 - 4 mm, glabrous; endocarp ribbed.

Fl. & Fr. April - June.

Distrib. India: Southern W. Ghats, 500 - 1000 m. Tamil Nadu and Kerala.

Endemic.

Tribe 4. TILIA COREAE Miers

Leaves peltate, sometimes subpeltate, triplinerved or pinnately nerved, often subpalmately nerved at base, varied in shape, cordate, entire. Sepals many, imbricate or inner whorl valvate, often connate. Petals 6, often scarcely distinct. Stamens free or variously united. Staminodes usually absent. Drupes excentrically smaller on one side and bent to the shape of horse-shoe; style scar somewhat subapical or nearly basal; condyle small and rudimentary; endocarp smooth, irregularly ridged or rugose. Seeds ellipsoid, non-endospermous (or with copious ruminant endosperm in *Tiliacora*).

Tropical and subtropical humid regions of Asia, Africa, N. America and Australia; ca 14 genera, 5 genera in India.

13. *Albertisia* Becc.

(M. Gangopadhyay)

Woody climbers. Leaves elliptic, penninerved; subbasal nerves 1 - 2 pairs; petioles swollen at both ends; petiole scars prominent, discoid. Male flowers in axillary or ramiflorous cymes or fascicles; sepals 6, in 2 whorls; outer 3 minute, triangular; inner 3 connate, tubular, fleshy, corolliform; petals 3 or 6, fleshy, minute; stamens 18 - 24, connate; anthers 2-loculed, transversely dehiscent. Female flowers: sepals and petals as in male; carpels 4 - 6, elongate-ovoid; style subulate. Drupes ellipsoid; style-scar near the base. Seed straight or slightly curved, ellipsoid; embryo straight, ellipsoid; endosperm absent.

Tropical and subtropical Africa and India; ca 12 species, one in India.

Albertisia mecistophylla (Miers) Forman in Kew Bull. 30: 84. 1975. *Pycnarhena mecistophylla* Miers in Ann. Mag. Nat. Hist. ser.3, 20: 12. 1867; Hook. f. & Thomson in Fl. Brit. India 1: 106. 1872, in adnot.

Branches ferruginous tomentose when young. Leaves rounded at base, acuminate at apex, 17 - 22 x 4 - 7 cm, pubescent or tomentose beneath; lateral nerves 7 pairs, ascending; petioles 3 - 5 cm long, tomentellous. Male inflorescences axillary, tomentose, fasciculate; sepals tomentose above. Female flowers and fruits not seen.

Fl. & Fr. not known.

Distrib. India: Assam and Meghalaya.

Endemic.

14. *Eleutharrhena* Forman

(M. Gangopadhyay)

Branches with petiole scars. Leaves subpeltate, penninerved; petioles swollen and geniculate at apex. Male inflorescences axillary or ramiflorous, fasciculate; sepals 12 in 3 whorls, imbricate; petals 6; stamens 6, free; anthers introrse. Female flowers not seen. Infrutescences thick, peduncled; gynophore swollen; carpels 6. Drupes short-stalked; style-scar near base; endocarp slightly woody; endosperm absent or scanty. Seeds ellipsoid; cotyledons thick.

China and N. E. India; monotypic.

Eleutharrhena macrocarpa (Diels) Forman in Kew Bull. 30: 99. 1975. *Pycnarrhena macrocarpa* Diels in Engler, Pflanzenr. 46: 52. 1910.

Branches puberulous when young. Leaves oblong-ovate, rounded or obtuse at base, acuminate at apex, 9.5 - 22 x 4 - 13 cm; lateral nerves 5 - 6 pairs; petioles 2.5 - 8 cm long, slender. Male inflorescences fasciculate, peduncled, 1 - 13-flowered; sepals of outer whorls ovate, puberulous, middle whorl triangular, ovate; inner whorl subrotundate, glabrous; stamens ca 1.5 mm long. Drupes ellipsoid, 2.5 - 3 x 1.5 - 2.5 cm, red, glabrous; stalks ca 1.5 cm long. Seeds ellipsoid, 1.5 - 1.7 cm long.

Fl. & Fr. not known.

Distrib. India: Meghalaya.

China.

15. **Haematocarpus** Miers

(M. Gangopadhyay)

Lianas. Leaves slightly or not peltate, elliptic, 3-nerved. Inflorescence axillary, terminal or cauliflorous panicle or raceme. Male flowers: sepals 12 - 15 in 3 whorls, imbricate, much smaller in outer whorls; petals 6, inner 3 auriculate at base, clasping the stamen; stamens 6, free; connectives enlarged, projecting inwards. Female flowers: sepals and petals as in male flowers; staminodes 6, minute; carpels 6, style reflexed. Drupes oblong-ellipsoid, narrowed at base into a stalk; style-scar near base; endocarp smooth. Seeds curved; endosperm absent; radicle short; cotyledons long, thick.

N.E. India, Bangladesh to Malesia; ca 3 species, one in India.

Haematocarpus validus (Miers) Bakh. f. ex Forman in Kew Bull. 26: 420. 1972. *Baterium validum* Miers in Ann. Mag. Nat. Hist. ser. 3, 13: 124. 1864. *H. comptus* Miers in Ann. Mag. Nat. Hist. ser. 3, 19: 197. 1867, nom. illeg. & Contrib. Bot. 3: 326, t.134. 1871. *H. thomsonii* Miers, l. c. 1867; Hook. f. & Thomson in Fl. Brit. India 1: 106. 1872.

Asm.: Inramji-dulela.

Branches puberulous or glabrous. Leaves elliptic, obovate-elliptic or ovate-elliptic, obtuse at base, acuminate or obtuse at apex, 7 - 18 x 4 - 8 cm; nerves and nervules conspicuous beneath; petioles 1.2 - 3.5 cm long. Inflorescences axillary, panicles or subracemes, up to 40 cm long, puberulous or glabrous; branches slender, up to 9 cm long. Male flowers: pedicels 1.5 - 3.5 mm long; sepals and petals with dark red lines and

spots; outer sepals of outer whorls ovate, ciliate or not; inner ones larger, elliptic or elliptic-ovate, glabrous; petals ovate or broadly elliptic-oblong, 1.5 - 2.5 mm long; stamens ca 1 mm long; connectives swollen. Female flowers: sepals and petals as in male; staminodes less than 1 mm long, rod-like. Carpels ovoid-ellipsoid, 1 - 1.5 mm long; styles sharply reflexed, ca 0.5 mm long. Drupes ovoid-ellipsoid, 4 - 5 x 2 - 2.5 cm, glabrous, red; embryo 3 - 3.5 mm long.

Fl. & Fr. Throughout the year.

Distrib. India: From plains to hills, up to 650 m. Assam, Meghalaya and Andaman & Nicobar Islands.

Bangladesh, Sumatra, Java and Borneo.

16. *Pycnarrhena* Hook. f. & Thomson

(M. Gangopadhyay)

Twining. Leaves elliptic or oblanceolate, penninerved or subpalmately nerved at base; petioles swollen at both ends. Inflorescences axillary or ramiflorous, usually cymose, rarely 1-flowered or fasciculate. Male flowers: sepals 6 - 15, imbricate, in 3 whorls; outer ones minute; inner ones larger and concave; petals 0 - 5, minute; stamens 5 - 18, clustered; filaments partially connate; anthers densely clustered. Female flowers: sepals and petals as in male; carpels 3 - 6, with recurved styles and stigma. Drupes ellipsoid to subglobose; endocarp thin, smooth, non-endospermous; cotyledons large, slightly curved.

S. China, Indo-malesia to N. Australia; ca 9 species, 2 in India.

KEY TO THE SPECIES

- 1a. Male flowers laxly fascicled; pedicels 3 - 5 mm long; petals 3 in male flowers; stamens 12, stalked
1. *P. lucida*
- b. Male flowers densely clustered; pedicels up to 2 mm long; petals 4 - 5 in male flowers; stamens 6 - 10, sessile
2. *P. pleniflora*

1. *Pycnarrhena lucida* (Teijsm. & Binn.) Miq. in Ann. Mus. Bot. Lugd.-Bat. 4: 87. 1868. *Cocculus lucidus* Teijsm. & Binn., Nat. Tijd. 4: 397. 1853. *Antitaxis fasciculata* Miers, Contrib. Bot. 3: 356. 1871; Hook. f. & Thomson in Fl. Brit. India 1: 108. 1872. *P. fasciculata* (Miers) Diels in Engler, Pflanzenr. 46: 50. 1910.

Leaves elliptic, acute or obtuse at base, acuminate at apex, 6 - 12 x 2.5 - 5.5 cm,

puberulous at first, later glabrescent; main nerves 6; petioles slender, 1 - 2 cm long, puberulous or glabrous. Male inflorescences axillary or ramiflorous, fasciculate, 1 few-flowered; sepals 9 - 12; outer one puberulous, small; inner 3 - 6 larger, rotundate, glabrous; petals 3, obovate, cuneiform; stamens 6 - 12, shortly connate, ca 0.5 mm long. Female flowers unknown. Infrutescences unbranched. Drupes globose, 8 - 15 mm across, glabrous, red.

Fl. & Fr. Throughout the year.

Distrib. India: Andaman & Nicobar Islands.

Thailand, Cambodia, Malaya, Sumatra and W. Java.

2. *Pycnarrhena pleniflora* Hook. f. & Thomson, Fl. Ind. 206. 1855 (as '*planiflora*') & in Fl. Brit. India 1: 106. 1872.

Asm.: *Holok-lota*.

Leaves elliptic, obovate or ovate-elliptic, rounded or obtuse at base, shortly and bluntly acuminate at apex, 10 - 18 x 4 - 7 cm, glabrous or puberulous beneath; lateral nerves impressed above; petioles 1 - 2.5 cm long, puberulous or glabrescent. Male inflorescences axillary, glomerulate or rarely congested, many-flowered; pedicels 2 - 3 mm long, puberulous or glabrous; sepals of outer whorls puberulous; inner whorls obovate, ca 2 mm long, glabrous; petals 4 - 5, deltoid, ca 1 mm long; stamens 6 - 10 in a sessile cluster. Female flowers not seen. Drupes up to 1 cm long, wrinkled, glabrous; stalks 2 - 4 mm long. Seeds ellipsoid, ca 8 mm long.

Fl. & Fr. March - May.

Distrib. India: Subtropical forests, up to 1000 m. West Bengal, Arunachal Pradesh, Assam, Mizoram, Tripura and Meghalaya.

Bhutan, Bangladesh, Myanmar and China.

17. *Tiliacora* Colebr.

(A. Pramanik)

Evergreen woody climbers; branches with distinct discoid petiole-scars. Leaves alternate, coriaceous, pinnately 3 - 5-nerved with steeply ascending basal nerves; petioles flattened, twisted at base, curved at apex, slightly longer in male plants than in female plants; stipules occasionally present. Inflorescences axillary or cauliflorous or mixed panicles or pseudoracemes composed of few-flowered peduncled cymes, mostly reduced to solitary flowers in female inflorescences. Flowers sessile; sepals 6 - 12, free in

3 rows, ovate-acute, fleshy; outer ones smallest; inner ones largest, valvate; petals 3 or 6, free, much shorter than inner sepals. Male flowers: stamens 3 - 9, usually free; filaments stout; anthers 2-loculed, introrse, dehiscent obliquely by longitudinal slits; pistillode absent or seen occasionally. Female flowers: staminodes absent or occasionally present; carpels (3-) 6 - 12 (-15), apocarpous or inserted on gynophore; ovule 1, on basal placentation; style recurved; stigma simple. Drupes subobovoid, shortly stipitate (borne on branches of gynophore); condyle linear, deeply intruding, forming a septum; endocarp hard, often deeply ruminant. Seed horse-shoe-shaped; cotyledons compressed, incumbent, fleshy, flattened, much longer than radicle.

Tropical Africa and S.E. Asia; ca 19 species, 2 species in India.

KEY TO THE SPECIES

- 1a. Petioles and midrib on lower surface of lamina not verruculose; lateral nerves free at margin; inner whorls of male flowers ca 4 mm long; stamens 6, 2 - 3.5 mm long; drupes 10 - 12 mm long; endocarp obscurely reticulate 1. *T. acuminata*
- b. Petioles and basal part of midrib on lower surface of lamina verruculose; lateral nerves united at margin; inner sepals of male flowers ca 2 mm long; stamens 3, 1.5 - 2 mm long; drupes 7 - 18 mm long; endocarp transversely and irregularly ridged 2. *T. triandra*

1. *Tiliacora acuminata* (Lam.) Hook. f. & Thomson, Fl. Ind. 187. 1855; Dunal in Gamble, Fl. Pres. Madras 28. 1915, repr. ed. 1: 20. 1957. *Menispermum acuminatum* Lam., Encycl. 4: 101. 1797. *T. racemosa* Colebr. in Trans. Linn. soc. Lond. 13: 67. 1822; Hook. f. & Thomson in Fl. Brit. India 1: 99. 1872.

Beng.: *Tiliacord*; Or.: *Kalajati-noi*.

Large woody climbers, 5 - 8 m tall; stems from a woody base, sparsely puberulous to glabrous, striate. Leaves ovate, sometimes lanceolate, obtusely rounded or truncate to subcordate at base, acute to acuminate at apex, 4.5 - 22 x 4 - 14 cm, slightly larger in male plants than in female plants, glabrous; basal nerves 3 - 5, subpalmate; lateral nerves 2 - 3 pairs; petioles 1.5 - 5 cm long, glabrous, striate-sulcate. Inflorescences axillary, 1 - many-flowered peduncled racemose cymes, pubescent, 2 - 21 cm long; peduncles ca 1 cm long. Male flowers yellow; sepals usually 9, 3 in each whorl, broadly elliptic, glabrous; inner ones 1 - 1.5 x 0.9 - 1.5 mm; petals 6, obovate, concave, 1 - 1.5 mm long, bright yellow, glabrous; stamens 6, free, 3 - 3.5 mm long; anthers dehiscent by longitudinal slits. Female flowers: sepals and petals as in male; carpels (3-) 8 - 12, ca 1 mm long, glabrous. Drupes oblong-ovoid to obovoid, subcompressed, 10 - 12 x 6 - 7 mm, glabrous; style-scar subbasal; endocarp thin, obscurely reticulate on surface.

Fl. & Fr. April - Dec.

Distrib. India: Along river banks in forests, up to 2000 m. Uttar Pradesh, Bihar, West Bengal, Orissa, Tamil Nadu and Kerala; often introduced in gardens for its foliage and fragrant flowers.

Sri Lanka and S.E. Asia.

Notes. Roots mixed with water given as a drink for cure in snake-bite.

2. *Tiliacora triandra* (Colebr.) Diels in Engler, *Pflanzenr.* 46: 62. 1910. *Cocculus triandrus* Colebr. in *Trans. Linn. Soc.* 13: 64. 1821. *Limacia triandra* (Colebr.) Hook. f. & Thomson, *Fl. Ind.* 188. 1855 & in *Fl. Brit. India* 1: 100. 1872.

Stems puberulous to glabrous, striate. Leaves elliptic, lanceolate or subovate, cuneate or rounded or often subcordate at base, acute to obtuse or acuminate at apex, 6 - 12 (-17) x 2 - 5 (-8) cm, puberulous or glabrous; basal nerves 3 - 5, subpalmate; lateral nerves 2 - 6 pairs; main nerves tending to link up towards margins; midrib verrucose near base beneath, glabrous; petioles 0.5 - 2 cm long, verrucose at apex. Inflorescences axillary or cauliflorous, on 1 - few-flowered cymes, 2 - 8 (-17) cm long; peduncles ca 5 mm long. Male flowers yellow; inner sepals broadly elliptic, ca 2 mm long, glabrous; petals 3 or 6, cuneate, emarginate, ca 1 mm long; stamens 3, clavate, 1.5 - 2 mm long. Female flowers: inner sepals orbicular, ca 2 mm long, puberulous outside; petals 6, oblong-elliptic, ca 1 mm long; carpels 8 or 9, less than 0.5 mm long. Drupes subcompressed, obovoid, 7 - 10 x 6 - 7 mm, glabrous, red; endocarp transversely irregularly ridged.

Fl. & Fr. not known.

Distrib. India: On rocky and clayey soils or limestone hills, evergreen forests, 200 - 1300 m. Meghalaya.

Myanmar, Thailand, Cambodia, Laos, Vietnam to Malaya.

Notes. Leafy shoots are used in preparation of medicine for dysentery in Cambodia.

Tribe 5. TINOSPORA E Hook. f. & Thomson

(A. Pramanik)

Sepals many; stamens often 6, free or united into a peltate synandrium. Drupes with style-scar terminal (at times opposite and from base); condyle usually crescent-shaped (absent in *Aspidocarya*); endosperm present. Seeds usually straight; embryo with thin divaricate foliaceous cotyledons.

Tropical Africa, S.E. Asia, Australia to Pacific; 17 genera and ca 78 species, 3 genera and 6 species in India.

18. *Aspidocarya* Hook. f. & Thomson

Slender woody climbers. Leaves slightly peltate, ovate, entire, palmately nerved at base. Inflorescences axillary, pseudopaniculate. Male flowers: sepals 6 - 12 in 2 - 4 whorls of 3 each; petals 6, with inrolled lateral edges; stamens connate into a peltate synandrium; anthers 6, dehiscing transversely. Female flowers: sepals and petals as in male flowers; staminodes 6, linear; carpels 3; stigma reflexed, lobed. Drupes with flattened, scutiform endocarp, having a medium dorsal ridge and thin lateral wings; coadyle absent. Seed straight, flat; endosperm fleshy; cotyledons oblong, thin, flat, foliaceous, divaricate at base; radicle short.

India (E. Himalayas), Bhutan and S.W. China (Yunnan); monotypic.

Aspidocarya uvifera Hook. f. & Thomson, Fl. Ind. 180. 1855 & in Fl. Brit. India 1: 95. 1872.

Lep.: *Myungarerrick*.

Large evergreen twiners; young stems tomentose, otherwise pubescent, straight; branches slender, terete, longitudinally ribbed. Leaves broadly ovate, subpeltate, cordate, subsagittate to truncate at base, caudately tapering to an obtuse or fine point at apex, 9 - 17 x 6 - 14 cm, dark green and glabrous above, sparsely pilose along nerves beneath; basal nerves 5 (-7); lateral nerves 2 (-3) pairs; petioles 7 - 15 cm long, attached to base or 1 - 2 mm inside the margin of lamina, glabrescent or pubescent. Inflorescences slender panicles, from axils of fallen leaves, up to 25 cm long; lateral branches of panicles 1 - 2 (-5) cm long, pubescent. Male flowers: pedicels 1 - 3 mm long, pubescent; sepals 6 - 12, greenish, ciliate; outer ones 3 - 6, green, narrow-elliptic, 2 - 2.5 mm long, puberulous; inner ones 3 - 6, obovate to broadly elliptic, ca 3 mm long, yellow, glabrous; petals cuneate-obovate, concave with laterally inrolled edges and truncate apex, 2 - 2.5 x 1 mm, yellow; synandrium ca 2 mm long, on thick column. Female flowers: petals narrower; staminodes linear, club-shaped, ca 1.5 mm long. Infructescences 12 - 20 cm long. Drupes oblong-ovoid, flattened with longitudinal ridges when dry, glabrous; endocarps sparsely spinulose, ca 17 x 10 mm, with dorsal ridges forming an apical crest; ventral surface with 2 lateral irregular ridges; marginal wings notched along edges. Seeds oblong, flat.

Fl. Feb. - April; Fr. May - Aug.

Distrib. India: Subtropical warm forests, 500 - 1500 m. West Bengal, Sikkim, Arunachal Pradesh, Assam, Nagaland and Meghalaya.

Bhutan, Myanmar and S.W. China.

Notes. The fruits are edible.

19. *Parabaena* Miers

Slender woody climbers. Leaves ovate or oblong, cordiform or hastate at base, rarely 3-5-lobed, entire or repand-dentate along margins, palmately nerved at base, papyraceous; petioles swollen and geniculate at base. Inflorescences axillary, dichotomously cymose or thyrsoid. Male flowers: sepals 6, free, equal; petals 6, sometimes with projecting lobes on basal inner surface; synandrium usually peltate; anthers around the margin, dehiscing transversely. Female flowers: sepals and petals as in male flowers; staminodes 6, minute; carpels 3; stigma reflexed, lobed or lacinate. Drupes 3, borne on subglobose carpophore, subglobose; endocarp bony, variously ridged or spiny on dorsal and lateral surfaces; condyle ventrally placed, bordered by incurved spines or developed into inflated ventral chamber, with flattened seed cavity; cotyledons very thin, divaricate, broad; radicle prominent.

S.E. Asia, from India up to Solomon Islands; ca 6 species, one in India.

Parabaena sagittata Miers ex Hook. f. & Thomson, Fl. Ind. 181. 1855 & in Fl. Brit. India 1: 96. 1872.

Slender climbers with milky juice; branches finely striate, pubescent. Leaves ovate or oblong, sagittate, cordate or hastate at base, with acute basal lobes, acuminate at apex, entire or distantly toothed, 11 - 24 x 6 - 15 cm, thinly coriaceous, usually glabrous above, densely pubescent to subglabrous beneath; basal nerves 3 - 5; lateral nerves 3 - 5 pairs; petioles 4 - 12 cm long, pubescent. Inflorescences axillary or slightly supra-axillary, dichotomously branched cymes, occasionally thyrsoid, 3 - 10 cm long; flowers few to many, often solitary or paired. Male flowers: pedicels 1 - 2 mm long; sepals yellow, equal, elliptic, 1.5 - 2 cm long, externally pubescent or glabrous; petals narrowly obovate, 1 - 1.5 mm long; staminal column ca 1 mm long; anthers 6, free, with transverse slits. Female flowers: sepals and petals as in male flowers; staminodes 6, oblong; carpels 3, erect; style recurved. Drupes ovoid, rostrate, ca 7 x 5 mm, orange, glabrous; endocarp rotund in outline (excluding apical keel), with 2 rows of spines, mixed with scattered spines on the dorsal surface, 5 - 6 x 4.5 - 5.5 mm.

Fl. April - July; *Fr.* June - Dec.

Distrib. India: In subtropical evergreen scrubs or mixed forests on steep slopes in shaded ravines, close to streams on calcareous rocks, up to 1500 m. West Bengal, Sikkim, Assam, Tripura, Meghalaya, Orissa, Andhra Pradesh and Andaman & Nicobar Islands.

Bhutan, Bangladesh and S.W. China (Yunnan).

20. *Tinospora* Miers

Woody climbers; bark exfoliating on drying. Leaves ovate, subcordate, entire, sometimes dentate, rarely 3-lobed;; basal nerves 3 - 5(-7), palmate; lateral nerves distal, 1 - 3 pairs, sometimes with domatia or glandular patches; petioles swollen and geniculate at base. Inflorescences thyrsoid, psuedo-paniculate, pseudo-racemose or pseudo- spicate. Male flowers: sepals free, rarely connate at base, 6, in 2 whorls; outer 3 smaller, subelliptic; petals 3 - 6, obovate, cuneate, with inrolled lateral edges, usually fleshy, glandular papillose; stamens 6, free. Female flowers: sepals and petals as in male ones; staminodes 6, subulate; carpels 3, curved-ellipsoid; style short; stigma peltate, reflexed, with short pointed lobes. Drupes 3, ovoid or ellipsoid; carpophore columnar; endocarp bony, dorsally convex, often verrucose or tuberculate, ventrally with central aperture; condyle present; endosperm usually ruminant, deeply intrusive.

Tropical Africa, Madagascar, Asia to Australia and Pacific Islands; ca 32 species, 4 species in India.

KEY TO THE SPECIES

- | | |
|---|--------------------------------|
| 1a. Stems strongly tuberculate; petals usually 3; endocarp 11 - 13 mm long | 2. <i>T. crispa</i> |
| b. Stems not tuberculate; petals 6; endocarp 6 - 9 mm long | 2 |
| 2a. Male flowers on 8 - 12 mm long pedicels; drupes radiating from unbranched short columnar carpophore | 3. <i>T. glabra</i> |
| b. Male flowers on 2 - 5 mm long pedicels; drupes radiating from shortly 3-branched or 3-cornered carpophore | 3 |
| 3a. Leaves glabrous, with glandular papillose patches (domatia) on lower surface; peduncles 4 - 7 mm long; endocarp very thinly bony, rounded at both ends | 1. <i>T. cordifolia</i> |
| b. Leaves hairy, usually lacking glandular patches; peduncles 8 - 11(-15) mm long; endocarp strongly bony, obtusely pointed at base, broadly keeled at apex | 4. <i>T. sinensis</i> |

1. *Tinospora cordifolia* (Willd.) Hook. f. & Thomson, Fl. Ind. 184. 1855 & in Fl. Brit. India 1: 97. 1872. *Menispermum cordifolium* Willd., Sp. Pl. 4: 826. 1806. *Cocculus cordifolius* (Willd.) DC., Syst. 1: 517. 1818.

Asm.: *Hoguni-lot*; Beng.: *Gulanca*; Mal.: *Chittamruth, Siddamirth*; Mar.: *Gulval*; Nep.: *Gurjo*; Tam.: *Chintil, Senthil-kodi*; Tel.: *Tippa-tiga*.

Deciduous woody climbers, up to 10 m high, entirely glabrous; stems striate when young, often with scattered lenticels, sometimes with aerial roots; bark corky, flaking off with age. Leaves broadly ovate-cordate, sinuate at base, abruptly cuspidate-acuminate at apex, 4 - 15 x 4.5 - 13 cm, glabrous; basal nerves 5 - 7, palmate; domatia usually present on lower surface in nerve-axils; petioles pulvinate, 2 - 7 cm long. Inflorescences pseudo-

racemose, axillary or on leafless branches, usually solitary, 5 - 15 cm long, slender. Male flowers fascicled, yellow; pedicels 3 - 4 mm long, slender; outer 3 sepals ovate, 1 - 1.5 mm long; inner 3 elliptic, concave, 3 - 4 mm long; petals 6, rhombic-unguiculate, papillose outside at base, with incurved lateral edges, 2 - 2.5 mm long, green; stamens 6, free; filaments clavate, ca 3 mm long; anthers longitudinally dehiscent. Female flowers solitary; pedicels ca 5 mm long; petals spatulate, ca 2.5 mm long; staminodes 6, ca 1.5 mm long; carpels 3, ellipsoid, ca 1.75 mm long; stigma capitate. Drupes globose, red, radiating from a ca 2 mm long carpophore; peduncles 4 - 7 mm long; pericarp drying very thin; style scar subterminal; endocarp very thinly bony, broadly elliptic or subrotund in outline, 6 - 7 mm long, rounded at both ends, ventrally flattened with a weak dorsal ridge, slightly papillose on surface.

Fl. Jan. - April; *Fr.* Jan. - May.

Distrib. India: Along hedges and in moist deciduous subtropical forests and scrubs, from plains to 1400 m. Delhi, Uttar Pradesh, Bihar, West Bengal, Sikkim, Arunachal Pradesh, Assam, Orissa, Gujarat, Maharashtra, Karnataka, Tamil Nadu and Kerala.

Sri Lanka, Bangladesh and Myanmar.

Notes. An ingredient in several Ayurvedic preparations; used for general debility, dyspepsia, fevers and urinary diseases and to heal fractures (in Bihar). Antiviral properties against Ranikhet disease in poultry have been reported. Elephants are fond of aerial roots. Dried stem powder, washed with water, mixed with honey is used to treat coughs.

2. *Tinospora crispa* (L.) Hook. f. & Thomson, Fl. Ind. 183. 1855 & Fl. Brit. India 1: 96. 1872. *Menispermum crispum* L., Sp. Pl. ed. 2. 1488. 1763. *T. mastersii* Diels in Engler, Pflanzenr. 46: 140. 1910.

Asm.: *Hoguni-lot.*

Shrubs, climbing, up to 15 m, glabrous; stems prominently striate, tuberculate, often bearing aerial roots, with bitter milky sap. Leaves broadly ovate to oblong-orbicular, shortly or deeply cordate at base, acuminate at apex, palmately 5 - 7-nerved at base, thinly papyraceous; domatia absent; petioles 5 - 15 cm long. Inflorescences on old leafless stems, pseudo-racemose, 1 - 3-flowered fascicles, slender, 9 - 25 cm long; flowers yellowish green; bracts subulate, 2 - 3 mm long, fleshy. Male flowers: pedicels 2 - 4 mm long; sepals pale green; outer 3 subovate, thickened at base, 1 - 1.5 mm long; inner 3 obovate, unguiculate or acute at base, 3 - 4 mm long; petals 3, usually only outer whorl developed; inner 3 petals reduced and minute, rarely up to 1.5 mm long; stamens 6, ca 2 mm long. Female flowers: staminodes 6, subulate, ca 1 mm long; carpels 3, ellipsoid, ca 2 mm long; stigma very shortly lobed. Drupes ellipsoid, ca 2 cm long, orange-coloured; endocarp 11 - 13 x 7 - 9 mm, obscurely rugulose or smooth, with prominent dorsal ridge and small elliptic ventral aperture; condyle deeply intrusive into seed cavity.

Fl. & Fr. Feb. - June.

Distrib. India: Mixed deciduous forests, up to 900 m. West Bengal, Arunachal Pradesh and Assam.

China, Cambodia, Thailand, Malaya, Java to Philippines.

Notes. Used for treatment of fevers and jaundice. Stem is cut into small pieces, scraped, then infused in boiling water and after cooling is used as quinine for malaria. The stem powder with fodder is fed to cattle and horses for stimulating appetite.

3. *Tinospora glabra* (Burm. f.) Merr. in J. Arn. Arb. 19: 340. 1938. *Menispermum glabrum* Burm. f., Fl. Ind. 216. 1768. *T. uliginosa* Miers in Ann. Mag. Nat. ser.3, 13: 321. 1864 & Contr. Bot. 3: 35. 1871; Hook. f. & Thomson in Fl. Brit. India 1: 97. 1872. *T. andamanica* Diels in Engler, Pflanzenr. 46: 141. 1910.

Large woody climbers; young branches striate, becoming warty with raised lenticels; bark smooth, thin, papery, detached on drying. Leaves oblong-ovate or narrowly to broadly ovate, cordate to truncate at base, acuminate at apex, 7 - 12 x 5 - 9 cm; domatia present beneath with glandular patches; petioles 4 - 8 cm long. Inflorescences axillary, pseudoracemose, slender, 1 - 20 cm long, lax-flowered; bracts subulate, ca 1 mm long. Male flowers: pedicels 6 - 12 mm long, slender; sepals yellow or greenish yellow; outer 3 narrowly ovate, ca 1 mm long; inner 3 broadly elliptic, concave, 4 - 5 mm long; petals 6, broadly cuneate-obovate, incurved along lateral edges, 2 - 3 mm long, papillose outside at base; stamens 6, clavate, 3 - 5 mm long. Female flowers: sepals and petals as in male; staminodes 6, subulate, 0.5 - 1 mm long; carpels 3, ellipsoid, ca 1.5 mm long, gynophore subglobose, 1 - 1.5 mm across; stigma lobed. Drupes 10 - 12 x 5 - 6 mm, red, radiating from unbranched columnar 2 - 4 mm long carpophore; stalks 4 - 10 mm long; pericarp drying thin and close to endocarp; endocarp subrotund, elliptic in outline, pointed at base, keeled at apex, 6 - 8 x 3 - 5 mm, dorsally convex with a median ridge, irregularly tuberculate, ventrally flattened.

Fl. & Fr. Throughout the year.

Distrib. India: Prefers various habitats like beach, open woods, shrubberies, limestone hill, scrub forests, riverine dense forests, semi-moist forests and littoral rain forests, etc., up to 500 m. S. Andaman Islands.

China (Hainan), Malaysia, Sumatra, Java, Lesser Sunda Islands, Borneo, Philippines, New Guinea to Solomon Islands.

4. *Tinospora sinensis* (Lour.) Merr. in Sunyatsenia 1: 193. 1934. *Campylus sinensis* Lour., Fl. Cochinch. 113. 1790. *Menispermum malabaricum* Lam., Encycl. Meth. 4: 96. 1797. *Cocculus tomentosa* Colebr. in Trans. Linn. Soc. Lond. 13: 56. 1872. *T. tomentosa*

(Colebr.) Hook. f. & Thomson, Fl. Ind. 183. 1855 & in Fl. Brit. India 1: 96. 1872. *T. malabarica* (Lam.) Hook. f. & Thomson in Fl. Brit. India 1: 96. 1872.

Asm.: *Hoguni-lot*; Beng.: *Padma-gulanchara*; Mal.: *Kattamirthu*.

Large fleshy climbers; stems puberulous when young, striate, with scattered lentils; leaf-scars distinct. Leaves ovate to suborbicular, abruptly truncate or cuneate or subcordate at base, acutely acuminate at apex, 7-15 x 4.5-12 cm, membranous, sparingly pubescent above, pilose beneath with glandular patches in basal nerve axils; basal nerves 5-7; lateral nerves 1 or 2 on either side of midrib; petioles 4-10 cm long, puberulous. Inflorescences pseudo-racemose, 3-12 cm long, slender. Male flowers: pedicels 2-5 mm long; sepals yellowish green, glabrous; outer 3 ovate, 1-1.5 mm long; inner 3 broadly elliptic, 3-5 x 2-5 mm; petals 6, obliquely rhomboid-ovate, 3-4 x 1-3 mm; stamens ca 3 mm long. Female flowers: pedicels 3-10 mm long; staminodes ca 1 mm long; carpels 1.5-2 mm long; stigma flat, lobed; gynophore ca 1 mm long. Drupes globose, 1-3, 10-13 mm across, red, scarlet or orange red; carpophores 2-3 mm long on 8-10 mm long peduncles; pericarp drying thin; endocarp broadly elliptic to subrotund in outline, 7-9 x 5-6 mm, tuberculate; aperture small, elliptic, ca 1 mm long on ventral face; condyle intrusive.

Fl. & Fr. Feb. - June.

Distrib. India: Along streams in subtropical evergreen or mixed deciduous forests, scrub jungles and disturbed forests, on sandy loam, hedges and occasionally in rocky valleys, up to 800 m. Bihar, Assam, Orissa, Maharashtra and Kerala.

Sri Lanka, Nepal, Bangladesh, Myanmar, China, Thailand, Vietnam and Cambodia.

Notes. Used for treatment of piles and ulcerated wounds, liver complaints, chronic rheumatism and also as muscle relaxant.

BERBERIDACEAE

Shrubs, often spiny, perennial or sometimes herbs, glabrous. Leaves alternate or tufted, simple or 1-pinnate, sometimes ternately compound or sometimes deeply lobed, coriaceous, usually spiny, exstipulate, rarely stipulate (in *Epimedium*); buds scaly. Flowers actinomorphic, bisexual, solitary or several to many in fascicles, umbels, racemose-umbels, spikes, cymes or panicles, usually yellow, sometimes greenish or white, rarely tinged with red. Sepals generally in 2 series or whorls of 3 each, imbricate, free, petal-like. Petals 6, hypogynous, caducous, 2 many-seriate, imbricate, with 2 oblong glands near base. Stamens 4 - 6 (-15), opposite to the petals, free or sometimes slightly adnate to petals; anthers basifixed, 2-loculed, opening by valves. Ovary consisting of one carpel, superior; ovules few to many, basal or superposed along ventral suture, bitegmic, crassinucellar, anatropous; style terminal, short or absent; stigma dilated or conic or oblong, large. Fruit a berry, rarely a capsule dehiscing by a transverse slit, very rarely a nutlet, usually ellipsoid, oblong, ovoid or obovoid; pericarp sometimes disappearing before the seeds ripen. Seeds sometimes arillate, dark red, reddish purple, black or pale yellow, yellowish brown; embryo minute, roundish, linear or spatulate, straight; endosperm copious, fleshy or horny; cotyledons undifferentiated, sometimes thin, as broad or broader than radicle.

Sri Lanka, Pakistan, India, China, S.E. Asia to Borneo, West and Central Asia, Europe, North Africa, Central America to South America and Pacific Islands; 13 genera and ca 575 species, 3 genera and 68 species in India.

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Notes. Bentham & Hooker treats the family Berberidaceae sensu lato including Nandinaceae, Lardizabalaceae and Podophyllaceae in the order Ranales. Nandinaceae do not occur in India, though *Nandina domestica* Thunb. a native of China and Japan is often cultivated in Assam gardens and elsewhere for its bright red berries. Lardizabalaceae and Podophyllaceae are treated as separate families in this work.

KEY TO THE GENERA

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|--|-----------------------|
| 1a. Herbs; flowers usually white; ovules superposed along the ventral suture | 2. <i>Epilimedium</i> |
| b. Shrubs; flowers usually yellow; ovules erect, basal | 2 |
| 2a. Stems usually spiny; leaves simple; sepals usually in two series or whorls | 1. <i>Berberis</i> |
| b. Stems unarmed; leaves imparipinnate; sepals usually in three series | 3. <i>Mahonia</i> |

1. *Berberis* L.

Spiny shrubs; wood yellow; stems terete, angled or sulcate, usually spiny; spines 3 - 5-fid (modified leaves); shoots long and short. Leaves simple, but usually with a joint at the junction of blade and petiole, in fascicles or whorls, each of which is attached at a node and protected by spines, the long shoots have their leaves metamorphosed into spines, with the transitions often conspicuous; the short shoots in the axils of spines bear clusters of green leaves. Flowers yellow, bisexual, fascicled, racemed or solitary. Sepals 6 - 12, imbricate in 2 - 4 whorls, with 2 - 3 appressed bracts. Petals 6, imbricate in 2 series, usually with 2 basal glands inside. Stamens 6 or 3; anther-locules opening by recurved valves. Ovary simple; stigma peltate, sessile or on a short style; ovules few, basal, erect. Berry few-seeded.

India, Pakistan, W. & C. Asia, China, Japan, S.E. Asia and E. Africa; ca 450 species, 54 species in India.

Literature. AHRENDT, L. W. A. (1941 - 45) A survey of the genus *Berberis* L. in Asia - New and old species from Bhutan, Assam, southern Tibet, Upper Burma and N. W. Yunnan in their relationship to the analytical framework of the genus. *J. Bot. suppl.* 79: 1 - 116. CHATTERJEE, R. (1949) *The Rasanjana of the Hindus.* *Lloydia* 12: 178 - 182 (The medicinal uses of *Berberis*). SCHNEIDER, C. K. (1905) *Die Gattung Berberis (Euberberis).* *Mitt. Deutsch. Dendr. Ges.* 14: 111 - 124. SCHNEIDER, C. K. (1942) *Die Berberis der Section Wallichianae.* *Mitt. Deutsch. Dendr. Ges.* 55: 1 - 60.

KEY TO THE SECTIONS

(Modified from Ahrendt, l. c. 1961)

- | | |
|--|------------------------------|
| 1a. Evergreen shrubs | 2 |
| b. Usually deciduous shrubs | 4 |
| 2a. Fruits red or red purple | sect. 5. <i>TINCTORIAE</i> |
| b. Fruits black, often pruinose | 3 |
| 3a. Flowers racemose-umbellate, rarely paniced | sect. 2. <i>ASIATICAE</i> |
| b. Flowers fascicled | sect. 8. <i>WALLICHIANAE</i> |
| 4a. Flowers large, 14 - 20 mm in diam. | sect. 1. <i>ANGULOSAE</i> |
| b. Flowers usually 4 - 12 mm in diam. | 5 |
| 5a. Inflorescence 15 - 30-flowered | sect. 7. <i>VULGARES</i> |

- | | |
|---|----------------------|
| b. Inflorescence 2 - 10-flowered | 6 |
| 6a. Berries usually pink or red | sect. 4. POLYANTHAE |
| b. Berries usually black, sometimes blue or white | 7 |
| 7a. Leaves fairly broad, usually entire | sect. 3. HETEROPODAE |
| b. Leaves linear with 1 - 5 spinules at margins | sect. 6. ULICINAE |

Section 1. ANGULOSAE Schneider

Leaves usually deciduous. Inflorescence usually 2 - 8-flowered, solitary, fascicled, umbellate, subumbellate or sometimes pseudo-umbellate or subracemose. Flowers up to 2 cm across. Petals always shorter than inner sepals. Ovules usually 4 - 12. Berries mostly red, occasionally dark red, mostly epruinose.

India, Afghanistan, Nepal, Bhutan, China (Yunnan), Taiwan and Siberia.

KEY TO THE SUBSECTIONS

- | | |
|---------------------------|--------------------------|
| 1a. Ovules usually 6 - 12 | subject. 1. DIAPHANAE |
| | subject. 2. EUANGULOSAE |
| b. Ovules usually 3 - 5 | subject. 3. JAESCHKEANAE |
| | subject. 4. SUBANGULOSAE |

Notes. As there are overlapping characters, a complete key for all subsections could not be provided.

Subsection 1. DIAPHANAE Ahrendt

(D. N. Guha Bakshi)

Stems glabrous, terete; spines 1 - 5 cm long. Leaves deciduous, grey, pruinose below. Inflorescences 4 - 8-flowered, umbellate-racemose; pedicels 8 - 12, slender. Flowers pale yellowish green. Sepals ca 7.5 x 5 mm. Petals 6, obovate, entire, 3 - 5 mm. Ovules 4 - 5. Berries ovoid, curved attenuate at apex, stylose or with very short thick style, epruinose, purple.

India, Bhutan, China and Taiwan; only one species in India.

1. *Berberis virescens* Hook. f. in Bot. Mag. 116, t. 7116. 1880. *B. vulgaris* L. var. *brachybotrys* (Edgew.) Hook. f. & Thomson in Fl. Brit. India 1: 109. 1872. *B. brachybotrys* Edgew. in Trans. Linn. Soc. 20: 29. 1846. *B. paravirescens* Ahrendt in J. Asiat. Soc. Beng. (Sci.) 11: 4. 1945.

Shrubs 2 - 3 m high; stems subterete, purplish to dark red, lustrous, glabrous; spines colorous. subsulcate, 3-fid, 0.6 - 2 cm long. Leaves oblong-obovate, spathulate, cuneate to decurrent to petiole at base, obtuse at apex, entire, 1 - 5 x 0.5 - 1.5 mm, open-veined, not reticulate; petioles 3 - 8 mm long. Inflorescence 4 - 8-flowered, umbellate-racemose, 1.5 - 5 cm long, including 5 - 10 mm long peduncle; pedicels slender, 4 - 12 mm long. Flowers 6 - 8 mm across, pale yellowish green. Prophylls concolorous, oblong-lanceolate; outer sepals ovate to obovate, subobtuse, ca 3 - 6 x 1.5 - 4 mm; inner sepals ca 7.25 x 5 mm. Petals 6, obovate, clawed at base, entire, often notched at apex, ca 3 - 5 x ca 2.5 mm, lateral and middle veins branched; glands situated above the claw, ca 0.6 x 0.3 mm, greenish. Stamens 3 - 5 mm long, produced, conico-apiculate at apex. Style 0.5 - 0.75 mm long; ovules 4 - 5. Berries oblong, ellipsoid, 8 - 10 x 3.5 - 5 mm, red, turning to blue-black or black, pruinose, estylose.

Fl. April - June; *Fr.* July - Aug.

Distrib. India: Temperate and subtropical hill slopes, 2000 - 3800 m. Sikkim.

Bhutan, Nepal and China (S.E. Tibet).

Subsect. 2. EUANGULOSAE Schneider

(P. B. Sur)

Stems markedly sulcate. Leaves deciduous or semi-evergreen. Flowers large, usually 14 - 20 mm across, solitary or few, fascicled. Outer sepals often as long as inner. Inner sepals usually 8 - 12 mm long. Petals usually 5 - 8 mm long, always much shorter than inner sepals. Stamens more or less truncate or apiculate. Ovules usually 6 - 12. Berries bright red, usually globose, ellipsoid or narrowly oblong.

KEY TO THE SPECIES

- | | |
|--|--------------------------|
| 1a. Pedicels and stems pubescent; fruits globose to ellipsoid | 2 |
| b. Pedicels and stems usually glabrous; stems sometimes pubescent; fruits narrower | 3 |
| 2a. Pedicels 12 - 18 mm long; outer sepals narrower than inner sepals; petals entire; ovules 6 - 10; fruits estylose | 2. <i>B. angulosa</i> |
| b. Pedicels 5 - 12 mm long; outer sepals as broad as inner sepals; petals emarginate; ovules 4 - 5; fruits shortly stylose | 6. <i>B. parispala</i> |
| 3a. Leaves white pruinose and densely finely papillose beneath | 3. <i>B. concinna</i> |
| b. Leaves grey pruinose beneath, not papillose | 4 |
| 4a. Leaf margins usually with one spinous serration | 4. <i>B. kumaonensis</i> |
| b. Leaf margins usually with 4 - 8 spinous serrations | 5. <i>B. macrosepala</i> |

2. *Berberis angulosa* Wallich ex Hook. f. & Thomson, Fl. Ind. 227. 1855 & in Fl. Brit. India 1: 111. 1872.

Nep.: *Chutro*.

Shrubs, rigid, stout-stemmed, ca 1 - 1.5 m high, deciduous; stems strongly grooved-angled, conspicuously hairy; spines 1 - 2.5 cm long, slender, 1 - 5-fid, generally puberulous below; internodes 1.5 - 2 cm long. Leaves elliptic, obovate, cuneate at base, acute to rounded at apex, entire or sometimes spinose-toothed, 10 - 25 x 6 - 15 mm, herbaceous. Flowers yellow, 1 - 1.5 cm across, solitary or in fascicles of 2 - 3; pedicels 10 - 25 mm long. Outer sepals ovate, 8 - 10 x 4 - 5 mm; inner ones broader, up to 7 mm wide. Petals obovate, entire, rounded at apex, 7 - 8 x 5 - 6 mm. Berries ellipsoid to subglobose, 10 - 12 x 7 - 12 mm, firm, red; styles absent or scarcely distinct.

There are 2 varieties in Sikkim.

KEY TO THE VARIETIES

- 1a. Flowers solitary
b. Flowers fascicled

- 2.1. var. *angulosa*
2.2. var. *fasciculata*

2.1. var. *angulosa*

Fl. & Fr. July - Aug.; *Fr.* Sept. - Nov.

Distrib. India: 3500 - 4000 m. West Bengal and Sikkim.

Nepal and China (S.E. Tibet).

2.2. var. *fasciculata* Ahrendt in J. Bot. Lond. 79 (suppl.): 42. 1941.

Fl. May - July; *Fr.* Sept. - Nov.

Distrib. India: Open rocky hillslopes, 3500 - 4000 m. Sikkim.

China (S.E. Tibet).

Notes. Valued for its large shiny vermillion-coloured berries.

3. *Berberis concinna* Hook. f. & Thomson in Bot. Mag. 79, t. 4744. 1853 & in Fl. Brit. India 1: 111. 1872.

Shrubs, bushy, short, up to 2 m high; stems glabrous, stout, very sulcate; internodes 1 - 2.8 cm long, pubescent; spines sulcate, 3 - 4-fid, 1.2 - 2.5 cm long. Leaves oblong, obovate or suborbicular, cuneate or decurrent to 1 - 5 mm long petioles, strongly 3 - 7 spinose-serrate along margins, 10 - 20 x 5 - 15 mm, subcoriaceous, greyish glaucous beneath. Flowers 1 - 1.5 cm across, yellowish; pedicels 0.5 - 3 cm long. Prophylls oblong-triangular, acuminate, 2 - 2.5 x 1.5 - 2 mm. Outer sepals oblong-ovate, subacute, 4 - 6 x 3 - 4 mm. Median and inner sepals obovate, equal, 9 - 10 x 6 - 7 mm. Petals obovate, acutely emarginate with 2 rounded lobes at apex, 6.5 x 4 - 5 mm. Stamens truncate, 4 - 4.5 mm. Ovules 6 - 8. Berries oblong or ellipsoid, 13 - 16 x 6 - 8 mm, dull red.

KEY TO THE VARIETIES

- | | |
|--|---------------------------|
| 1a. Pedicels 5 - 10 mm long; fruits 10 - 11 x 7 - 8 mm | 3.1. var. <i>brevior</i> |
| b. Pedicels 15 - 20 mm long; fruits 13 - 16 x 6 - 8 mm | 3.2. var. <i>concinna</i> |

3.1. var. *brevior* Ahrendt in J. Asiat. Soc. Beng. (Sci.) 11: 3. 1945.

Fl. June - July; *Fr.* Aug. - Oct.

Distrib. India: 3000 - 4500 m. Sikkim and Uttar Pradesh.

Nepal.

3.2. var. *concinna*

Fl. June - July; *Fr.* Aug. - Nov.

Distrib. India: Rocky hillslopes, 3400 - 4200 m. Sikkim.

Nepal.

4. *Berberis kumaonensis* Schneider in Bull. Herb. Boiss. ser. 2, 5: 397. 1905.

Suberect or prostrate shrubs; stems glabrous; internodes 5 - 20 mm long; spines 3-fid, finely sulcate, 15 - 25 mm long. Leaves subsessile, obovate, cuneate at base, 1 - 2-spinose serrate along margins, 8 - 20 x 4 - 9 mm, semievergreen. Flowers solitary; pedicels 5 - 9 mm long; prophylls concolorous, triangular, acuminate, 2 x 1.5 mm. Outer sepals ovate, acute, 7 - 7.5 x 3.5 - 4 mm; median sepals oblong-obovate, obtuse, 8 - 10 x 5 - 6 mm; inner sepals obovate, 11 - 12 x 7 - 7.5 mm. Petals 8, obovate, scarcely clawed at base, acutely emarginate with subobtusate lobes, ca 5.5 mm long. Stamens ca 4.5 mm long. Ovules 6 - 8. Berries ovoid, attenuate and bent with short thick styles at apex, 8 - 10 x 5 - 6 mm, red.

Fl. & Fr. Aug. -Nov.

Distrib. India: Garhwal Himalayas., 3000 - 4500 m. Uttar Pradesh.

Endemic. Nepal.

5. *Berberis macrosepala* Hook. f. & Thomson, Fl. Ind. 228. 1855 & in Fl. Brit. India 1: 111. 1872.

Spreading shrubs, up to 1.8 m tall; stems puberulous, subangled and often somewhat sulcate, subterete when old; internodes 1 - 3.5 cm long; spines 3-fid, 1 - 2 cm long. Leaves obovate, contracted to decurrent petiole at base, 2 - 14-spinose along margins, 2 - 4.5 x 1 - 2 cm; petioles 2 - 7 mm long. Flowers solitary, 1 - 1.5 cm across, bright yellow; pedicels 2 - 3 cm long. Outer and inner sepals 8.5 - 10 x 5 - 6 mm. Petals obovate, emarginate with two acute lobes at apex, 6 - 7 x 3.5 - 4.5 mm. Stamens 4 - 4.5 mm long, produced, rounded, truncate. Berries oblong to ellipsoid, 12 - 16 x 7 - 10 mm, red.

KEY TO THE VARIETIES

- | | |
|--|-------------------------------------|
| 1a. Stems subangled or terete; leaf apices rounded | 5.1. var. <i>macrosepala</i> |
| b. Stems sulcate; leaf-apices acute | 2 |
| 2a. Leaves with 2 - 7 spinules along each margin; pedicels 0.8 - 1.5 cm long | 5.2. var. <i>sakdenensis</i> |
| b. Leaves with 8 - 14 spinules along each margin; pedicels 2.5 - 3 cm long | 5.3. var. <i>setifolia</i> |

5.1. var. *macrosepala*

Fl. June - July; *Fr.* Aug. - Oct.

Distrib. India: Rocky alpine and subalpine regions, 3500 - 4300 m. Sikkim and Arunachal Pradesh.

Bhutan and China (S.E. Tibet).

5.2. var. *sakdenensis* (Ahrendt) Ahrendt in J. Linn. Soc. Lond. (Bot.) 57: 116. 1961.
B. ludlowii var. *sakdenensis* Ahrendt in J. Bot. Lond. 79 (suppl.): 44. 1941.

Fl. June - July; *Fr.* Aug. - Sept.

Distrib. India: Open rocky hillsides, ca 4000 m. Sikkim.

Bhutan.

5.3. var. *setifolia* Ahrendt in J. Bot. Lond. 79 (suppl.): 46. 1941.

Fl. July - Aug.; *Fr.* Sept. - Oct.

Distrib. India: E. Himalayas, ca 4500m. Sikkim.

Bhutan.

6. *Berberis parisejala* Ahrendt in Gard. Chron. (3)109: 100. 1941 & J. Bot. Lond. 79 (Suppl.): 42. 1941.

Shrubs, 2 - 3.5 m tall; stems stout, hairy, dark reddish brown; spines stout, 3 (-5)-fid, often puberulous at base, 4 - 16 mm long. Leaves obovate, cuneate at base, rounded at apex, entire, 1 - 4 x 0.6 - 1.5 cm, shiny deep yellow-green, epapillose beneath. Flowers solitary; pedicels 5 - 9 (-12) mm long; prophylls ovate, acute, ca 1.25 x 0.75 mm, yellow. Sepals in 3 series, all similar, 8 - 9 x 6.5 - 7.5 mm. Petals acutely emarginate, ca 7.5 x 4 mm. Ovules 4 - 5. Berries oblong, subglobose, ca 10 x 8 mm, with a distinct short style.

Fl. & Fr. May - Oct.

Distrib. India: E. Himalayas in steep hill sides on rocky slopes, 3500 - 4500 m. Arunachal Pradesh (Mishmi hills).

Nepal, Bhutan and China (S.E. Tibet).

Extremely rare, no other collection (S.E. Tibet).

Subsect. 3. JAESCHKEANAE Ahrendt

(Syamali Das Gupta)

Stems yellow. Leaves deciduous, with a few spinules along margin or entire. Inflorescence 1 - 10-flowered, in fascicles or subumbels or pseudoracemose. Flowers 6 - 12 mm in diam. Petals always smaller than inner sepals. Ovules (3-) 4 - 5 (-6). Style absent.

India, Nepal, Bhutan and China (S.E. Tibet).

KEY TO THE SPECIES

- | | |
|--|--------------------------|
| 1a. Leaves narrowly elliptic | 2 |
| b. Leaves obovate or spatulate | 3 |
| 2a. Inflorescence 4 - 7-flowered; berries oblong, estylose | 11. <i>B. lambertii</i> |
| b. Inflorescence 1 or rarely 2-flowered; berries stylose | 12. <i>B. osmastonii</i> |
| 3a. Leaves entire or rarely spiny | 4 |
| b. Leaves spinulose | 5 |

- 4a. Leaves up to 5 x 1.5 mm; peduncles very short, up to 2 mm long or absent; pedicels 2 - 2.5 cm long in fruit
9. *B. himalaica*
- b. Leaves 2 - 3.5 x 0.6 - 1.3 cm; peduncles longer, 3 - 20 mm long; pedicels 0.5 - 1 cm long in fruit
8. *B. hamiltoniana*
10. *B. jacschkeana*
- 5a. Leaves 3 - 5; flowers 3 - 5
7. *B. apiculata*

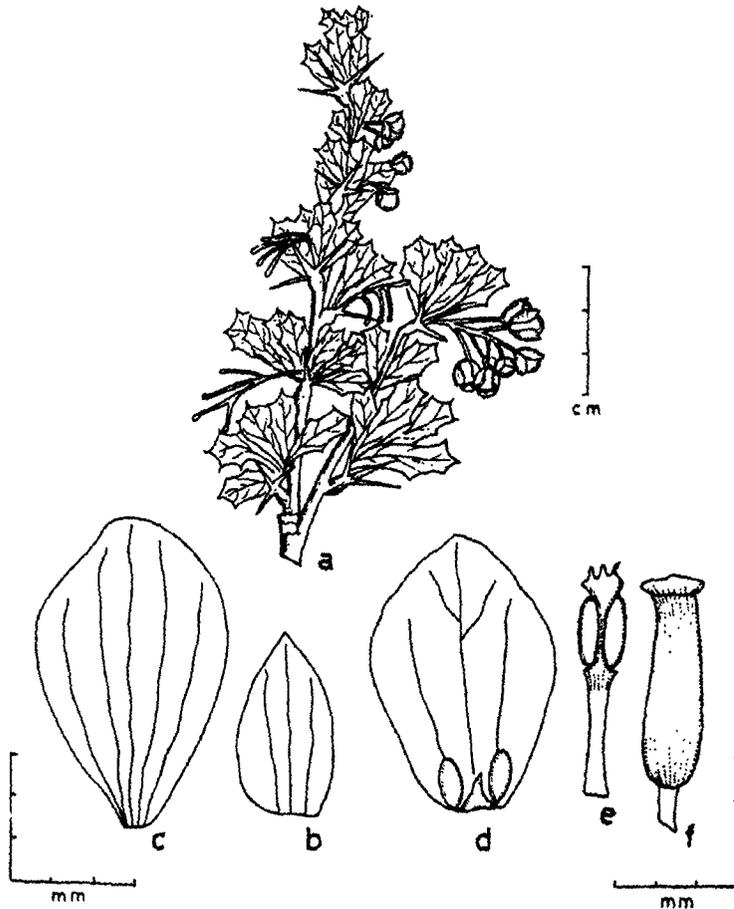


Fig. 54. *Berberis apiculata* Ahrendt : a. twig; b. outer sepal; c. inner sepal; d. petal with glands; e. stamen; f. pistil.

7. *Berberis apiculata* Ahrendt in J. Linn. Soc. Lond. (Bot.) 57: 135. 1961. *B. usteriana* var. *apiculata* Ahrendt in J. Asiat. Soc. Beng. (Sci.) 11: 3. 1945. **Fig. 54.**

Shrubs, 1.5 - 1.7 m high; stems subterete, gland-dotted, glabrous, densely leafy; internodes very short, up to 1 cm long; spines 8 - 15 mm long, often very short. Leaves up to 10 from a node, narrowly obovate, attenuate at base, rounded-mucronate at apex, entire at lower half, with 2 - 3, ca 1 mm long spinules 2 - 4 mm apart on either margins of upper half, 2.3 x 0.6 - 0.7 cm, lustrous above, paler beneath, openly veined. Inflorescence 2.5 - 4 cm long, 5 - 10-flowered, subumbellate or subracemose; peduncles very short or absent. Flowers ca 7 x 10 mm; pedicels 3 - 10 mm long; bracts ovate or lanceolate, acute, ca 2.2 x 1 mm, puberulous along margins. Prophyll 1, ovate, obtuse, 3 - 4 x 1 - 1.5 mm, 3-veined. Outer sepals 3, obovate or elliptic, obtuse, 5 - 6 x 2.5 - 3 mm, 5-veined, entire; inner sepals 4, obovate, clawed at base, obtuse, 7 - 8 x 4 - 5.5 mm, 5-veined, entire; nectar-glands 0.5 - 1 cm above the base, oblanceolate or oblong, ca 1 x 0.3 mm long; anthers ca 2 x 1.2 mm; filaments ca 2.5 x 7 mm; connectives produced, dentate. Ovary oblong, ca 5 x 1.2 mm, estylose; ovules 5 - 7, stipitate; stigma ca 1.5 mm broad.

Fl. June - July; *Fr.* July - Sept.

Distrib. India: On the banks of streams, ca 3600 - 3700 m. Himachal Pradesh and West Bengal.

Bhutan.

8. *Berberis hamiltoniana* Ahrendt in Gard. Illus. 64: 426. 1944. **Fig. 55.**

Shrubs, 1.5 - 2 m high, profusely branched, densely leafy; stems glabrous, gland-dotted, angled towards the apex or terete; internodes 1 - 2 cm long; spines 6 - 18 mm long; middle one longer, often not divided. Leaves 4 - 9 of different maturities from a single node, obovate, obtuse or subacute and often spiny at apex, entire or spiny along margins, 2 - 3.5 x 6 - 1.3 cm, sublustrous, yellowish green on dorsal surface, grey pruinose beneath, a little revolute along margins, prominently reticulate. Inflorescences 4 - 7-flowered, pseudoumbellate or subracemose, 2 - 3 cm long; peduncles 0.3 - 2 cm long; pedicels 5 - 10 mm long; bracts lanceolate, acuminate, 1.5 - 2.5 mm long. Flowers ca 1 cm across. Sepals 6 or 5, elliptic, revolute along margins, concave, ca 6.5 x 3.4 mm, 5-veined. Petals 6, obovate, emarginate, cuneate at base, ca 5 x 4 mm; nectar-glands non-marginal, separate, suboblong, 7 - 10 x 4 - 5 mm. Stamens 4 - 5 mm long, sometimes produced and subtruncate or obtuse at apex. Ovary oblong, 4 - 5 x 1.3 - 2 mm, estylose; ovules 3 - 5. Berries oblong or obovoid, bright red, estylose, wrinkled.

Fl. June - July; *Fr.* Aug. - Oct.

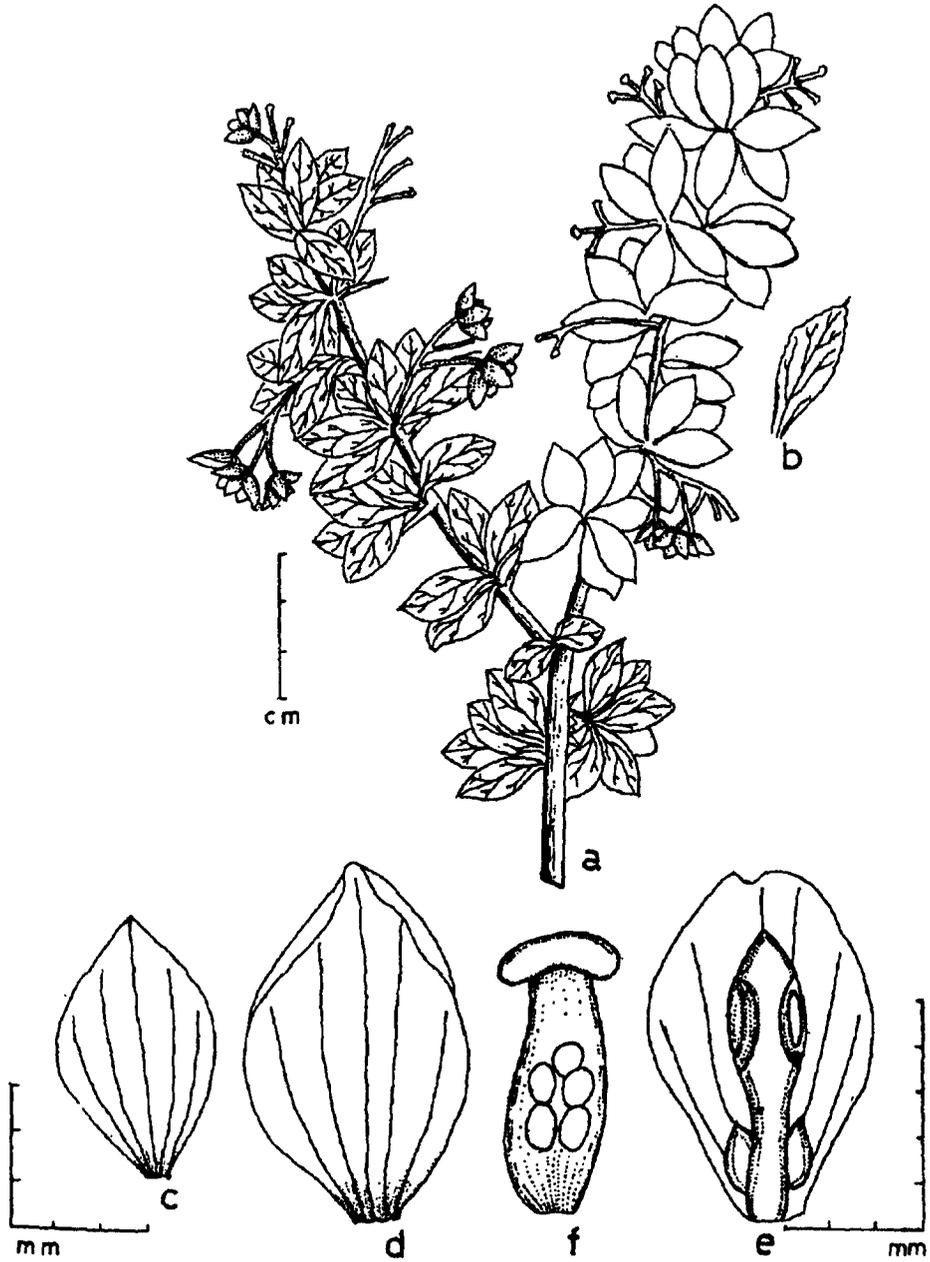


Fig. 55. *Berberis hamiltoniana* Ahrendt : a. twig; b. leaf; c. outer sepal; d. inner sepal; e. petal with glands and stamen; f. pistil with ovules.

Distrib. India: Stony hillsides, dry slopes and among boulders on river banks, 3500 - 4500 m. Himachal Pradesh.

Nepal and China (Tibet).

9. *Berberis himalaica* Ahrendt in J. Bot. Lond. 79 (suppl.): 68. 1942.

Stems subterete, gland-dotted, glabrous; internodes 2 - 4 cm long; spines 1 - 2 cm long. Leaves 5 - 6, variable at maturity, obovate or spatulate, long-attenuate at base to decurrent petiole, obtuse, up to ca 5 x 1.5 cm, entire or rarely spinulose, pruinose or not; venation finely reticulate; petioles up to 1.5 cm long. Inflorescences 3 - 4-flowered, fascicled or subumbellate, 2.5 - 3 cm long; peduncles very short; pedicels 1 - 2.5 cm long in fruits; bracts ca 2 x 1 mm. Prophylls 2, ovate, ca 2.5 x 1 mm. Outer sepals ovate, oblong-elliptic to rounded, ca 2.75 x 1.5 mm; inner sepals obovate, rounded, ca 4 x 3 mm. Petals obovate, cuneate, entire, ca 3 x 2.7 mm; nectar-glands contiguous. Stamens ca 2.7 mm long, scarcely produced. Berries ovoid, oblong, ca 8 - 13 x 4 - 7 mm, estylose.

Fl. May; *Fr.* Sept. - Oct.

Distrib. India: Open scrub jungles and in Pine forests, 2500 - 3500 m. Sikkim.

Bhutan and China (Tibet).

10. *Berberis jaeschkeana* Schneider in Bull. Herb. Boiss. ser.2, 5: 399. 1905; R. Parker, For. Fl. Punjab, Hazara & Delhi 14. 1918.

Shrubs, stunted, up to 2 m high; stems stout, angled, branched profusely; internodes up to 2 cm long; spines 5 - 15 mm long. Leaves 3 - 5, often deciduous, leaving the spines only, narrowly obovoid-oblong, attenuate at base, obtuse-mucronate at apex, 1 - 2.5 x 0.4 - 1 cm, slightly revolute along margins, slightly lustrous above, pale and pruinose beneath. Inflorescences 3 - 8-flowered, umbellate or subumbellate, 0.5 - 4 cm long including peduncle, glabrous. Prophylls ovate. Sepals obovate or elliptic, obtuse, concave, entire. Petals obovate, obtusely emarginate. Ovary oblong; style inconspicuous, ca 0.5 mm long; stigma ca 1.5 mm broad. Berries oblong, obscurely stylose, red.

KEY TO THE VARIETIES

- 1a. Stems puberulous; leaves with 3 or more serrations on either side
 b. Stems glabrous; leaves entire or with 1 - 2 serrations on either side

- 10.1. var. *jaeschkeana*
 10.2. var. *usteriiana*

10.1. var. *jaeschkeana*

Fig. 56.

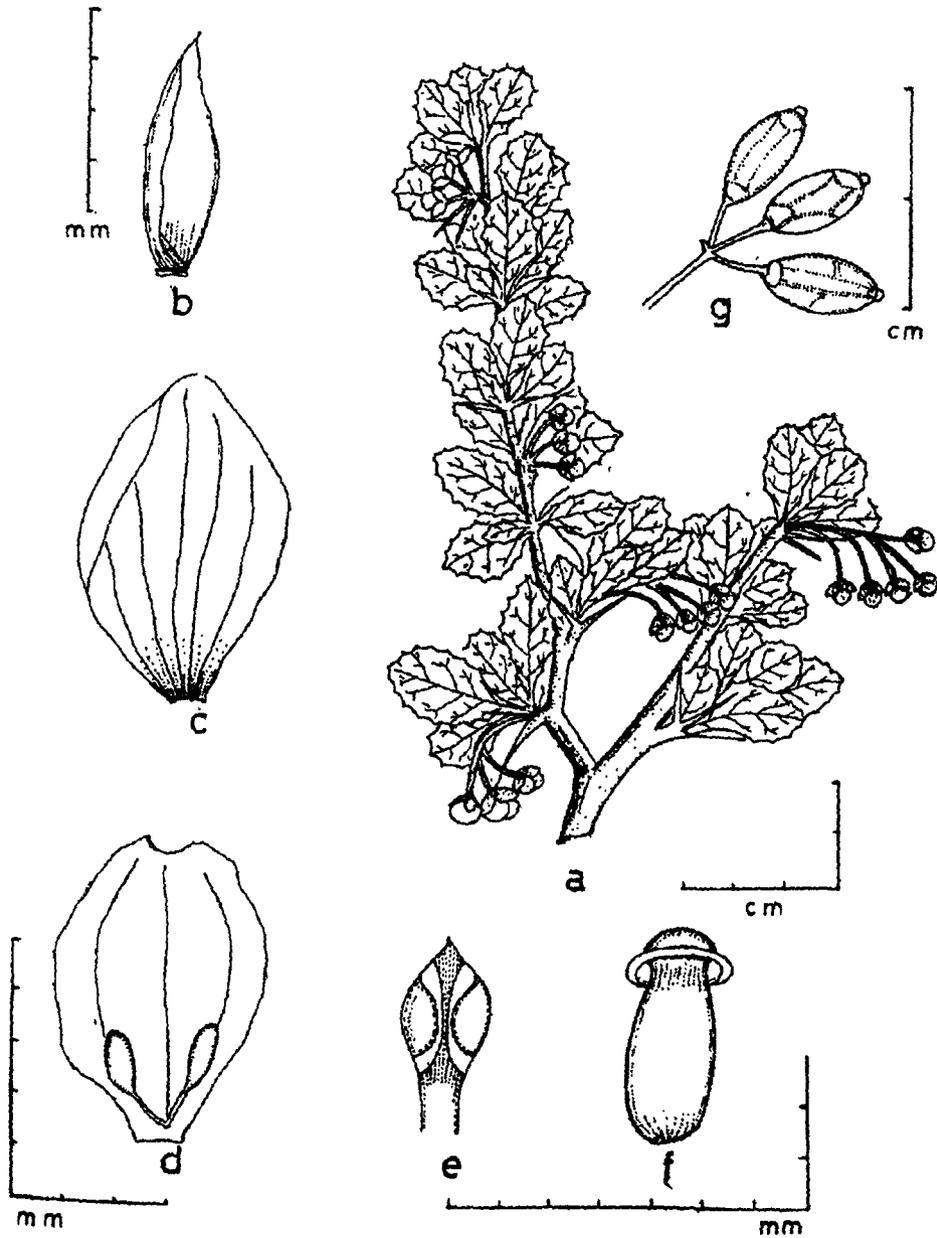


Fig. 56. *Berberis jaeschkeana* Schneider var. *jaeschkeana*: a. twig; b. prophyll; c. sepal; d. petal with glands; e. stamen; f. pistil; g. berries

Spines 1 - 1.5 cm long; stems puberulous. Leaf-margins prominently serrulate, with 2 or more serrations 1 - 3 mm apart on either side; venations prominently reticulate. Peduncles 5 - 10 mm long; pedicels 3 - 8 mm long. Prophylls elongated, ovate, acute, concave, thickened at base, ca 4 x 2 mm. Sepals 7, 4 - 7 x 4 - 5 mm. Petals 6, slightly clawed at base, 4 - 6.5 x 3 - 5 mm, 3-veined. Glands separate, oblong to irregularly broad, ca 1 x 0.5 - 1 mm. Stamens 3.5 - 4 mm long, apiculate or truncate. Ovary ca 4 x 1.5 mm; ovules 5. Berries ca 1 x 0.5 cm, red, shortly stylose. Seeds dark purple.

Fl. May - July; *Fr.* July - Aug.

Distrib. India: Forming dense patches on rocky or sandy slopes among boulders, at 3000 - 5200 m. Jammu and Kashmir, Himachal Pradesh, Uttar Pradesh and Sikkim.

Pakistan and Nepal.

102. var. *usteriana* Schneider in Bull. Herb. Boiss. ser.2, 5: 399. 1905. *B. usteriana* (Schneider) R. Parker in Indian For. 50: 399. 1924.

Stems glabrous; spines 5 - 10 mm long. Leaves with 0 - 2 spinules on margins; midvein prominent; reticulations not prominent. Peduncles 1 - 2 cm long; pedicels 2 - 8 mm long. Prophylls lanceolate or ovate, acute, ca 2 x 1.5 mm, entire. Outer sepals elliptic, ca 4.5 x 3 mm. Inner sepals 5 - 6 x 4 - 4.5 mm. Petals obovate, slightly cuneate at base, 3.5 - 4.5 x 3 mm; nectar-glands separate, oblong, ca 0.5 x 0.2 mm. Stamens ca 2.5 mm long, truncate at apex. Ovary ca 3 x 0.7 mm at base. Berries ca 8 x 4 mm.

Fl. June - July; *Fr.* Aug. - Sept.

Distrib. India: 2800 - 4500 m. Jammu & Kashmir, Himachal Pradesh and Uttar Pradesh.

Nepal.

11. *Berberis lambertii* R. Parker in Bull. Misc. Inf. Kew 1921: 367. 1921.

Small shrub, up to 1 m tall; stems stout, angular, finely sulcate, glabrous; internodes up to 1.5 cm long; spines slender, up to 1.5 cm long. Leaves 4 - 6 from the nodes, oblanceolate, near-elliptic, attenuate at base, spiny-mucronate at apex, 12 - 25 x 2 - 7 mm, thickened and revolute along margins, entire, shiny above; venations inconspicuous above, prominent beneath. Inflorescences each of 4 - 7 flowers, subracemose or umbels and racemes mixed, 5 - 6 cm long; pedicels 5 - 10 mm long in fruits, glabrous. Ovules 3 - 6. Berries ovoid, oblong, 1 - 1.2 x 0.5 - 0.7 cm, red, estylose.

Fr. Oct.

Distrib. India: ca 3000 m. Uttar Pradesh.

Endemic.

12. *Berberis osmastonii* Dunn in Kew Bull. 1920: 335. 1920.

Fig. 57.

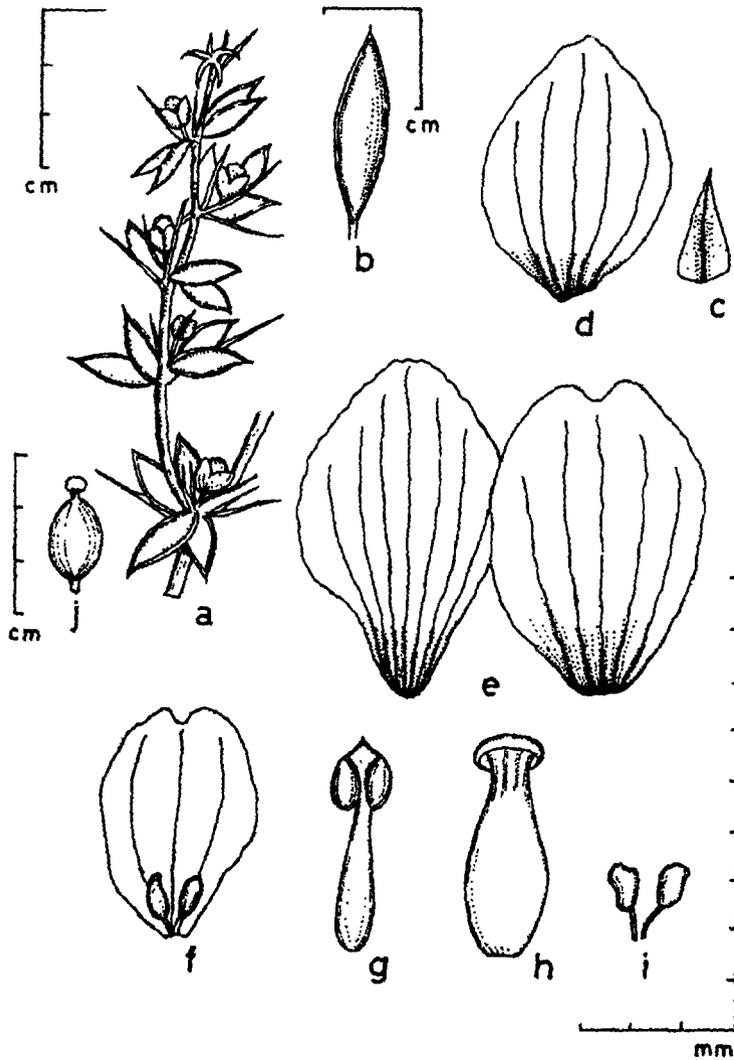


Fig. 57. *Berberis osmastonii* Dunn: a. twig; b. leaf; c. bract; d. outer sepal; e. inner sepals; f. petal with glands; g. stamen; h. pistil; i. nectary glands; j. berry.

Dwarf shrubs, erect or subprostrate, 10 - 50 cm high; stems terete or subterete, glabrous or puberulous, yellow, lustrous; internodes 5 - 10 mm long; spines 3-fid, 1 - 2 cm long, longer than leaves. Leaves 2 - 5 from each node, narrowly oblong or narrowly elliptic, entire, thickened and revolute along margins, 1 - 2.5 x 0.2 - 0.3 cm, thick, leathery, with hypoderm, lustrous above, pruinose beneath. Flowers solitary; pedicels 2 - 4 mm long; bracts ca 1 mm long. Prophylls 3, linear-lanceolate, acute, concave, 2.5 - 3 x 1 - 1.5 mm, thick, particularly along midvein at base. Sepals 6; outer sepals elliptic to oblong-lanceolate, ca 3.5 x 1 mm; inner sepals often clawed at base, narrowly obovate, concave, obtuse, 6 - 7 x 3.5 - 4.5 mm; veins 5 - 7, thickened at base. Petals 3, obovate, concave, entire, slightly clawed at base, obtusely emarginate at apex, 5 - 6 x 3 - 4 mm; veins 3 - 5, thickened at base; nectar-glands on two lateral nerves, 0.7 - 1 x 0.5 - 1 mm. Stamens broader below, apiculate at tips; anthers ca 1 mm across. Ovary ellipsoid, narrowed above, ca 5 x 1.7 mm; ovules 6 - 8; stigma ca 1 mm broad. Berries broadly ovoid-oblongoid, 12 - 13 x ca 7 mm, stylose, bluish black, glabrous; styles 1.5 - 2 mm long, including stigma. Seeds concave-convex, ca 4 x 2 mm, smooth, shiny. Berries ovoid, ca 10 x 6 mm, excluding ca 1.5 mm long style.

Fl. Jan. - May; *Fr.* Oct. - Jan.

Distrib. India: Bare rocky slopes, at ca 3000 m. Uttar Pradesh (Garhwal).

Endemic.

Subsect. 3. SUBANGULOSAE Ahrendt

(R. R. Rao and S. Kumar)

Stems glabrous, red or purple. Leaves deciduous, spinose along margins. Inflorescences umbellate or pseudo-umbellate subracemes. Petals always shorter than inner sepals. Ovules 3 - 5. Berries red.

India, Afghanistan, Pakistan, Nepal, Bhutan and China (S.E. Tibet and W. Yunnan); only one species in India.

13. *Berberis orthobotrys* Bienert ex Aitch. in J. Linn. Soc. Lond. 19: 150. 1882.

Stems glabrous, dark red. Leaves 1 - 3.5 cm long, spinose. Inflorescences racemose, umbellate-racemose or racemose-subfascicled with 5 - 10 flowers. Pedicels 4 - 15 mm long. Ovules 3 - 5. Berries 7 - 11 x 5 - 6 mm, estylose, red.

Notes. This is a very variable species with an assemblage of at least 4 distinct varieties occurring in India, differing mainly in leaf-size, serration, fruit size and colour (Ahrendt, l. c.). Jafri (in Fl. W. Pakistan 87: 18. 1975) recognises two subspecies under this species, as follows:

KEY TO THE SUBSPECIES

- 1a. Leaves usually 1 - 2 cm long; inflorescence short, congested, sometimes compound, somewhat capitate; pedicels 5 - 10 mm long; berries subobovoid to subellipsoid **13.1. subsp. capitata**
- b. Leaves usually 2 - 3.5 cm long; inflorescence somewhat lax, simple; pedicels 10 - 12 mm long; berries oblong, rarely ellipsoid **13.2. subsp. orthobotrys**

13.1. subsp. capitata Jafri in Fl. W. Pakistan 87: 20, f. 60D. 1975.

Erect, rigid, glabrous shrubs; stems sulcate, red-brown to pale whitish, verrucose or not. Leaves sessile to obscurely petiolate, elliptic-obovate, acute or obtuse, 10 - 20 (-25) x 5 - 15 (-18) mm, with 5 - 15 spinose-serrations along margins, greenish on both surfaces, reticulately veined with open to somewhat close venations. Inflorescences short, simple, compound or paniced, (5-) 10 - 20-flowered, subumbellate or subfascicled, 1.5 - 3 cm long in fruit with somewhat compact umbellate appearance. Berries oblong-subobovoid or subellipsoid, 7 - 8 (-10) x 5 - 6 mm, estylose, pale reddish when dried; pedicels 5 - 10 mm long, divergent, sometimes reflexed; ovules 4, sessile. Seeds 2 - 3, oblong-ellipsoid, ca 5 x 2 mm, brown.

Fl. April - May; *Fr.* June - July.

Distrib. India: Jammu and Kashmir.

Pakistan.

13.2. subsp. orthobotrys

Shrubs, up to 2 m high, compact; stems glabrous, dark red or pale beneath, sulcate; internodes 1 - 3.5 cm long; spines usually 3-fid, 1 - 2.5 cm long, orange-yellow. Leaves subsessile, deciduous, obovate, 1 - 3.5 x 0.5 cm, spinulose along margins, rarely subentire; veins reticulate. Inflorescences 1.5 - 4 cm long, racemose, subumbellate or subfascicled, rarely compound, 5 - 15-flowered; pedicels 4 - 15 mm long. Flowers yellow. Sepals in 3 whorls; outer small, 3.5 - 4 x 1.3 mm; median sepals ca 6 x 3.5 mm; inner ones ca 7 x 5 mm. Petals ca 6 x 4 mm, subequal, emarginate. Ovules 3 - 5. Berries oblong, subovoid, 6 - 10 x 4 - 6 mm, dull red, subpruinose, estylose.

This subspecies occurring in Afghanistan, Pakistan and Kashmir to Nepal exhibits 4 varieties as follows:

KEY TO THE VARIETIES

- | | |
|---|-----------------------------------|
| 1a. Leaves grey pruinose beneath | 13.2.1. var. <i>canescens</i> |
| b. Leaves green and epruinose beneath | 2 |
| 2a. Pedicels 4 - 8 mm long | 13.2.4. var. <i>sindhaniensis</i> |
| b. Pedicels 8 - 15 mm long | 3 |
| 3a. Stamens slightly exceeding the petals; berries 9 - 10 mm long | 13.2.2. var. <i>conwayi</i> |
| b. Stamens shorter than petals; berries up to 7 mm long | 13.2.3. var. <i>orthobotrys</i> |

13.2.1. var. *canescens* Ahrendt in J. Linn. Soc. Lond. (Bot.) 57: 144. 1961.

Spines concolorous, sulcate, 1 - 2.5 cm long. Leaves 10 - 25 x 3 - 8 mm, dull grey green above, grey-pruinose beneath. Inflorescences 5 - 10-flowered, umbellate-racemose. Pedicels 6 - 12 mm long. Sepals in 3 whorls. Petals with lanceolate glands. Stamens much produced. Berries red.

Fl. May - July; *Fr.* Aug. - Nov.

Distrib. India: 3000 - 3500 m. Kashmir.

Nepal.

Notes. A valuable cultivated garden shrub.

13.2.2. var. *conwayi* Ahrendt in J. Linn. Soc. Lond. (Bot.) 57: 143. 1961.

Leaves ca 3.5 x 2 cm. Inflorescences 4 - 8-flowered. Sepals in 2 series. Petals convolute. Stamens scarcely produced at apex, ca 5 mm long, protruding beyond the petals. Berries ca 7 x 5 mm.

Distrib. India: ca 5000 m. Kashmir.

Afghanistan.

13.2.3. var. *orthobotrys*

Fl. May - June; *Fr.* July - Aug.

Distrib. India: 2000 - 3000 m. Himachal Pradesh and Jammu & Kashmir.

Afghanistan, Pakistan, Nepal, Bhutan and China (Tibet).

13.2.4. var. *sinthanensis* Ahrendt in J. Linn. Soc. Lond. (Bot.) 57: 143. 1961.

Leaves deciduous, spinulose along margins. Inflorescences 5 - 25-flowered. Pedicels 4 - 8 mm long. Petals subequal. Ovules 3 - 5. Berries oblong, subovoid, dull red, estylose.

Distrib. India: ca 3500 m. Kashmir.

Endemic.

Section 2. ASIATICAE Schneider

(B. P. Uniyal and R. R. Rao)

Shrubs; stems terete, rarely sulcate, pale yellow; spines solitary or 3-fid. Leaves deciduous or evergreen, entire or spinulose. Inflorescence racemose, umbellate or fascicled, rarely paniculate, 5 - 25-flowered. Ovules 3 - 7. Berries 8 - 12 mm long, usually pruinose and stylose, rarely estylose.

KEY TO THE SPECIES

- | | |
|---|---------------------------|
| 1a. Leaves rigidly coriaceous | 15. <i>B. asiatica</i> |
| b. Leaves thinly subcoriaceous | 2 |
| 2a. Stems terete, if subsulcate then-sepals in 3 whorls | 3 |
| b. Stems sulcate; sepals in 2 whorls | 6 |
| 3a. Young leaves with truncate base; petioles up to 4 cm long | 17. <i>B. hainessii</i> |
| b. Young leaves without truncate base; petioles up to 6 mm long | 4 |
| 4a. Petals longer than the inner sepals | 16. <i>B. glaucocarpa</i> |
| b. Petals shorter than the inner sepals | 5 |
| 5a. Flowers 12 - 14 mm across; petals entire, truncate | 14. <i>B. ahrendtii</i> |
| b. Flowers 7 - 8 mm across; petals emarginate with acute lobes | 19. <i>B. lycium</i> |
| 6a. Leaves sessile, 1.5 - 2 cm long; spines smooth | 18. <i>B. khasiana</i> |
| b. Leaves shortly petioled, 2 - 6 cm long; spines sulcate | 20. <i>B. parkeriana</i> |

14. *Berberis ahrendtii* R. R. Rao & Uniyal in Indian J. For. 8(4): 334. 1985. *B. lycioides* Stapf in Bot. Mag. 151, t.9102. 1926; Ahrendt in J. Linn. Soc. Lond. 57: 89. 1961, non Lowe, 1856, Linden & Planch. 1863.

Shrubs, up to 3.5 m tall; stems pale yellow, glabrous, terete; internodes 3 - 5 cm long; spines solitary, 1 - 2 cm long. Leaves sessile, narrowly obovate, subacute, mucronate, entire or slightly spinulose, 1.5 - 7 x 0.5 - 1.8 cm, finely reticulate, epappillose. Inflorescences dense drooping racemes, 10 - 20-flowered, sometimes compound below; peduncles 1 - 2 cm long; flowered 12 - 14 mm across, fragrant; pedicels ca 10 mm long.

Sepals in 3 whorls; outer ones ovate, acute, ca 2.5 x 1.5 mm; median ones ca 5 x 2.5 mm; inner ones longer, ca 7.5 x 4.5 mm. Petals shorter than the inner sepals, obovate-elliptic, entire, with marginal glands, ca 6.5 x 4 mm. Stamens produced, apiculate. Berries oblong-ovoid, estylose, ca 11 x 6 mm, black, pruinose; style ca 1 cm long.

Fl. & Fr. : April - Oct.

Distrib. India: N. W. Himalaya (Jaunsar).

Endemic.

15. *Berberis asiatica* Roxb. ex DC., Syst. Nat. 2: 13. 1821, non Griffith, 1847; Hook. f. & Thomson in Fl. Brit. India 1: 110. 1872.

Hindi: *Kilmoru* (Kumaon).

Shrubs, up to 3 m high; stems pale yellowish, terete; internodes up to 4 cm long; spines 1 - 3 cm long, 3-fid, rarely solitary towards tip. Leaves shortly petioled, broadly obovate-elliptic, acute or obtuse and mucronate at apex, entire or distantly 2 - 6-spinose along margins, 1.5 - 7 x 0.8 - 3.5 cm, thickly coriaceous, finely reticulate. Inflorescences racemose or fascicled, 15 - 25-flowered, 1 - 2.5 cm long, short when in flower, elongating to 4 cm in fruits; pedicels 1 - 1.5 cm long, glabrous, red; bracts ca 2.5 x 2.5 mm. Outer sepals broadly ovate, ca 5 x 4 mm; inner sepals longer and broader. Petals obovate, emarginate, 7 - 8 x 5.5 - 6 mm; glands obovate. Stamens 5 - 5.5 mm long, truncate, not produced. Ovary ellipsoid; ovules 2 - 5. Berries oblong-ovoid to ellipsoid, ca 8 mm across, pruinose, stylose, red, becoming black; style 0.5 - 1 cm long.

KEY TO THE VARIETIES

- | | |
|---|-----------------------------|
| 1a. Leaves usually with 2 - 5 spinulose margins; flowers umbellate-racemose | 15.1. var. <i>asiatica</i> |
| b. Leaves usually with entire margins; flowers in fascicles | 15.2. var. <i>clarkiana</i> |

15.1. var. *asiatica*

Leaves usually with 2 - 5 spinose margins, rarely entire. Inflorescence umbellate-racemose.

Fl. April - May.

Distrib. India: Sub-himalayan ranges, hillsides and valleys, 1000 to 2000 m. Himachal Pradesh, Uttar Pradesh, West Bengal, Sikkim and Arunachal Pradesh.

Afghanistan, Nepal, Bhutan and China.

15.2. var. *clarkeana* Schneider in Bull. Herb. Boiss. ser.2, 5: 457. 1905.

Differs from variety *asiatica* in having entire leaves and fascicled flowers. The leaves are highly variable and both spinulose and entire margined leaves can be found in one and the same specimen. Hence this character is not dependable.

Fl. & Fr. : April - Aug.

Distrib. India: Open hill sides, 1000 - 2000 m. Madhya Pradesh, Bihar and Arunachal Pradesh.

Nepal and Bhutan.

16. *Berberis glaucocarpa* Stapf in Bot. Mag. 151, sub. t. 9102. 1926, in obs.; Ahrendt in J. Bot. Lond. 80 (suppl.): 101. 1943. *B. coriacea* auct. non Royle; Brandis ex Gamble, Man. Indian Timb. ed.1, 14. 1881; Collett, Fl. Siml. 22. 1902.

Shrubs, ca 3.5 m high; stems pale yellow, terete, glabrous; internodes ca 4 cm long; spines ca 1 cm long, usually solitary, rarely 3-fid. Leaves shortly petioled, elliptic-obovate, acute, 4 - 5 spinulose or entire along margins, 3 - 8 x 1 - 2.5 cm, shiny green on both sides. Inflorescences racemose, 2 - 4 cm long, 15 - 25-flowered; pedicels ca 8 mm long. Prophylls ca 1 mm long. Sepals in 3 whorls; outer ovate, ca 2 mm long; median ones longer; inner ones obovate, ca 6 x 5 mm. Petals obovate, clawed at base, retuse, ca 7 x 4.5 mm; glands 2, marginal. Stamens ca 5.5 mm long, produced. Ovules 4, stipitate. Berries oblong-globose, ca 8 mm long, black, pruinose, minutely stylose.

Fl. April - June; *Fr.* July - Aug.

Distrib. India: Jammu & Kashmir, Himachal Pradesh and Uttar Pradesh.

Pakistan and Nepal.

17. *Berberis hainesii* Ahrendt in J. Bot. Lond. 80 (suppl.): 105. 1944 & in J. Linn. Soc. Lond. 57: 90. 1961.

Erect shrubs, 1 - 2 m high; stems pale yellow, terete; internodes 1.5 - 6 cm long; spines 6 - 12 mm long, sulcate. Leaves petioled, broadly oblong-elliptic, entire or few-spinulose, 4 - 6 x 2 - 3 cm, papillose beneath; young leaves thinner, with up to 4 cm long petioles, truncate at base. Inflorescence umbellate-racemose or subfascicled, 3 - 6-flowered; flowers 8 - 10 mm across. Petals narrowly obovate, ca 6 mm long. Berries oblong-ellipsoid, estylose or shortly stylose, pruinose.

Ahrendt (l. c.) recognises 2 varieties as separated below:

KEY TO THE VARIETIES

- 1a. Pedicels up to 9 mm long; berries shortly stylose 17.1. var. *brevifilipes*
 b. Pedicels 1 - 2 cm long; berries estylose 17.2. var. *hainesii*

17.1. var. *brevifilipes* Ahrendt in J. Bot. Lond. 80 (suppl.): 105. 1944 & in J. Linn. Soc. Lond. (Bot.) 57: 91. 1961.

Fl. & Fr. : Feb. - June

Distrib. India: Madhya Pradesh.

Endemic.

17.2. var. *hainesii*

Stems pale yellow, turning ashy on maturity; internodes ca 4 cm long; spines ca 1.5 cm long, sulcate.

Fl. June.

Distrib. India: On sandstones, ca 700 m. Madhya Pradesh.

Endemic.

18. *Berberis khasiana* Ahrendt in J. Bot. Lond. 80 (suppl.): 100. 1943 & in J. Linn. Soc. Lond. (Bot.) 57: 89. 1961.

Stems yellow at maturity, sulcate, pubescent; internodes 1.5 - 2.5 cm long; spines 1 - 1.5 cm long, 3-fid. Leaves sessile, obovate, acute, mucronate, entire, 15 - 20 x 0.5 - 7 cm. Inflorescences umbellate-fascicled, 7 - 20-flowered. Pedicels ca 8 mm long. Berries ellipsoid to oblong-ovoid, white pruinose, shortly stylose.

Distrib. India: Meghalaya.

Nepal.

19. *Berberis lycium* Royle in Trans. Linn. Soc. Lond. 17: 94. 1834; Hook. f. Thomson in Fl. Brit. India 1: 110. 1872.

Shrubs, up to 4 m high; stems pale, terete or subsulcate, glabrous or pubescent; internodes 1.5 - 3.5 cm long; spines 6 - 20 mm long, subterete, 3-fid; lateral ones 7 - 12

mm long. Leaves sessile, oblanceolate to obovate, attenuate at base, acute-mucronate at apex, entire or 2-4 spinulose along margins, 2-7 x 0.6-1.2 cm, papillose, greyish or whitish below. Inflorescences racemose or subfascicled; flowers 7-8 mm across; pedicels slender, up to 2 cm long. Prophylls ovate, 1 x 0.5 mm. Sepals in 3 whorls; outer ones ovate, obtuse, ca 2 x 1 mm, yellow; median ones ovate, obtuse, ca 3.5 x 2 mm; inner ones obovate, ca 5 x 3 mm. Petals obovate, emarginate with acute lobes, ca 4 x 2 mm; glands separate, lanceolate, ca 1.2 x 0.3 mm. Stamens produced, apiculate, ca 3.25 mm long. Ovules 4, shortly stipitate. Berries ellipsoid to ovoid, ca 9 x 5 mm, blue or black, pruinose, minutely stylose.

One of the commonest species of *Berberis* in India. Very variable and the following varieties have been recognised by Ahrendt (l. c.).

KEY TO THE VARIETIES

- | | |
|--|-----------------------------------|
| 1a. Stems slightly sulcate; leaves becoming dull green below | 19.4. var. <i>subvirescens</i> |
| b. Stems terete; leaves whitish and conspicuously papillose below | 2 |
| 2a. Stems pubescent; inflorescences racemose, 2-5 cm long | 19.2. var. <i>simlensis</i> |
| b. Stems glabrescent; inflorescences subfascicled or racemose; racemes more than 5 cm long | 3 |
| 3a. Inflorescences subfascicled, 2-2.5 cm long | 19.3. var. <i>subfascicularis</i> |
| b. Inflorescences 5-15 cm long racemes, 5-9 cm long | 19.1. var. <i>lycium</i> |

19.1. var. *lycium*

Shrubs; stems terete; internodes up to 3.5 cm long. Inflorescences 5-9 cm long, racemose, 6-25-flowered.

Fl. March - April; *Fr.* May - July.

Distrib. India: Open hillsides, 1500-2500 m. Jammu & Kashmir, Himachal Pradesh, Uttar Pradesh, Madhya Pradesh and Tamil Nadu (Nilgiris).

Pakistan and Nepal.

19.2. var. *simlensis* Ahrendt in J. Asiat. Soc. Beng. (Sci.) 11: 1. 1945 & in J. Linn. Soc. Lond. (Bot.) 57: 88. 1961.

Distinguished from all other varieties mainly by the pubescent nature of the stem. But this appears to be a variable character particularly in mature stems.

Fl. March - April; *Fr.* May - July.

Distrib. India: 1500-2500 m. Himachal Pradesh and Uttar Pradesh.

19.3. var. *subfascicularis* Ahrendt in J. Linn. Soc. Lond. (Bot.) 57: 88. 1961.

Racemes much smaller, subfascicled.

Distrib. India: Forest clearings, ca 2200 m. Jammu & Kashmir, Himachal Pradesh and Uttar Pradesh.

19.4. var. *subvirescens* Ahrendt in J. Linn. Soc. Lond. (Bot.) 57: 88. 1961.

Stems slightly sulcate; leaves dull green below.

Distrib. India: On banks of streams, ca 1700 m. Jammu & Kashmir.

Endemic.

20. *Berberis parkeriana* Schneider in Fedde, Repert. Spec. Nov. 11: 162. 1912.

Shrubs, up to 2.5 m high; stems sulcate; internodes up to 3 cm long; spines 1 - 2 cm long, 3-fid, slender, sulcate. Leaves lanceolate to oblanceolate or narrowly obovate, acute-mucronulate at apex, entire, 2 - 6 x 0.5 - 1.3 cm, epapillose; petioles very short. Inflorescences subfascicled, racemose, 4 - 18-flowered; pedicels 8 - 14 mm long; prophylls ca 1 x 0.5 mm. Outer sepals oblong-elliptic, ca 2.5 x 1.5 mm, reddish; inner sepals obovate-elliptic, ca 5 x 4 mm. Petals narrowly oblong-elliptic, cuneate, subentire, 4.5 - 5 x 2 - 3 mm; glands separate, ca 0.8 x 0.2 mm. Stamens ca 4 mm long, produced, shortly apiculate. Ovules 4. Berries ca 9 x 7 mm, bright blue, pruinose, stylose.

Fl. April - May; *Fr.* June - July.

Distrib. India: 1000 - 1500 m. Jammu & Kashmir and Himachal Pradesh.

Pakistan and Iran.

Notes. Used in malarial fever, also as a blood purifier.

Section 3. HETEROPODAE Schneider

(R. R. Rao and S. Kumar)

Leaves deciduous, mostly entire. Inflorescences 2 - 10-flowered. Flowers 5 - 8 mm across. Ovules 1 - 6. Berries black or blue, often pruinose.

KEY TO THE SUBSECTIONS

- 1a. Style conspicuous subsect. 1. CRETICAE
 b. Style absent subsect. 2. PSEUDOUMBELLATAE

Subsection 1. CRETICAE Schneiderf

Stems glabrous, dark red or purple. Leaves 1 - 4.5 cm long, deciduous, *entire*. Inflorescences 3 - 8-flowered, fascicled, racemose-subfascicled, umbellate or pseudo-umbellate, 1 - 3 cm long; pedicels 2 - 12 mm long. Flowers 4 - 8 mm in diam. Berries ellipsoid to obovoid, black, sometimes pruinose.

KEY TO THE SPECIES

- 1a. Leaves up to 35 mm long; inflorescences 20 - 30 mm long, subfascicled-racemose; pedicels 5 - 12 mm long; berries globose to obovoid, conspicuously pruinose 21. *B. calliobotrys*
 b. Leaves up to 17 mm long; inflorescences 6 - 10 mm long, fascicled; pedicels 2 - 5 mm long; berries ellipsoid, epruinose or very slightly pruinose 22. *B. cretica*

21. *Berberis calliobotrys* Aitch. ex Koehne, Deutsche Dendr. 168. 1898. *B. vulgaris* auct. non L.; Aitch. in J. Linn. Soc. Lond. 19: 151. 1882. *B. wazirastanica* Ahrendt in J. Asiat. Soc. Beng. (Sci.) 11: 3. 1945.

Shrubs, 1 - 2 m high; stems glabrous, red brown to pale brown, sulcate; internodes 1 - 2.5 cm long; spines 3-fid, 1 - 2 cm long. Leaves oblong-obovate, attenuate at base, *entire*, rarely 1 - 4 spinose-serrulate, acute and minutely spine-tipped at apex, 8 - 35 x 4 - 12 mm, green, epapillose, reticulate. Inflorescences 2 - 3 cm long, subfascicled; racemes 2 - 10-flowered. Flowers 6 - 8 mm across, yellow; pedicels 5 - 10 mm long, glabrous. Sepals in 2 whorls, outer ones obovate, ca 4 x 2.5 mm; inner ones ca 6 x 4.5 mm. Petals obovate, ca 5.5 x 3 mm. Stamens 3 - 4 mm long, not produced, truncate. Ovules 2. Berries globose to obovoid, ca 5 x 2 mm, black, conspicuously pruinose, stylose; styles ca 1 mm long; seeds ca 5 x 2 - 2.5 mm.

Fl. April - May; *Fr.* June - July.

Distrib. India: ca 2100 m. Jammu & Kashmir.

Pakistan and Afghanistan.

Notes. Cultivated in Kashmir. Leaves are said to cure jaundice.

22. *Berberis cretica* L., Sp. Pl. 331. 1753. *B. vulgaris* var. *cretica* (L.) Hook. f. & Thomson in Fl. Brit. India 1: 109. 1872.

Shrubs, 1 - 2 m high; stems glabrous, stout, sulcate, lustrous when mature; spines yellow to orange. Leaves sessile, obovate, cuneate at base, acute to subacute at apex, entire, 10 - 17 x 4 - 7 mm, openly reticulate with distinct lateral veins on both surfaces. Inflorescences 6 - 10 mm long, 3 - 6-flowered, fascicled; pedicels 2 - 5 mm long. Sepals in 2 whorls; outer ones elliptic, ca 4 x 2.5 mm; inner ones obovate, 4 - 4.5 x 3 mm. Petals obovate, entire, 4 - 4.7 x ca 3 mm; glands 3, oblanceolate, submarginal, orange-coloured. Stamens 3.5 - 4.5 mm long. Ovules 2. Berries ellipsoid, 6 - 7 x 4 - 5 mm, red, turning to black at maturity, epruinose or very slightly pruinose, shortly stylose.

Fl. April - May; *Fr.* June - July.

Distrib. India: Himachal Pradesh (Garhwal to Balti, 3300m.).

Cyprus, Crete and Greece.

Notes. Chromosome no. $2n = 28$ (Darlington & Wylie, Chromosome Atlas of Flowering Plants 28. 1955).

Subsection 2. PSEUDOUNBELLATAE Ahrendt

Stems glabrous, dark red; internodes up to 4 cm long; spines 1 - 2.5 cm long. Leaves deciduous, entire, rarely with a few conspicuous spinules. Inflorescences 3 - 15-flowered, fasciculate, racemose-subfascicled, umbellate or subumbellate; pedicels 4 - 16 mm long. Flowers 5 - 8 mm across. Ovules 1 - 3. Berries black, pruinose, stylose.

India, Pakistan and Afghanistan.

KEY TO THE SPECIES

- | | |
|--|-------------------------------|
| 1a. Inflorescences umbellate or subumbellate; berries subglobose, obovoid to ellipsoid | 23. <i>B. pseudoumbellata</i> |
| b. Inflorescences subfascicled to racemose; berries oblong | 24. <i>B. royleana</i> |

23. *Berberis pseudoumbellata* R. Parker in Bull. Misc. Inf. Kew 1921: 118. 1921. *B. umbellata* auct. non G. Don; R. Parker, For. Fl. Punjab, Hazara, Delhi 15. 1918.

Shrubs, 2 - 3 m high; stems finely sulcate to subterete, red brown; internodes up to 2.5 cm long; spines 1 - 3-fid, up to 1.5 cm long. Leaves oblong-obovate, entire or inconspicuously 1 - 5-spinose along margins, rounded-mucronate at apex, ca 4 x 1.5 cm, dull grey-green above, grey pruinose beneath; petioles 4 - 5 mm long. Inflorescence umbellate to subumbellate, 3 - 15-flowered; pedicels stout, up to 15 mm long. Prophylls oblong-ovate, ca 1.5 x 1 mm. Outer sepals ovate, ca 2.75 x 1.75 mm; inner sepals obovate,

ca 5 x 3 mm. Petals ca 5.5 x 3 mm; glands submarginal. Stamens ca 4 mm long, truncate. Ovules 3. Berries obovoid-subglobose, 8 - 10 x 6 - 9 mm, black to purple, pruinose, estylose. Seeds ca 6 mm long.

KEY TO THE SUBSPECIES

- 1a. Inflorescences racemose-subumbellate, 10 - 15-flowered, simple to panicled below; berries scarcely pruinose 23.1. subsp. *gilgitica*
 b. Inflorescences umbellate to subumbellate, 3 - 7-flowered, simple; berries conspicuously pruinose 23.2. subsp. *pseudumbellata*

23.1. subsp. *gilgitica* Jafri in Fl. W. Pakistan 87: 26, f.8A. 1975.

Racemes 2.5 - 5 cm long, 10 - 15-flowered, simple or rarely paniculate; pedicels thin, 10 - 15 mm long. Berries ellipsoid-obovoid, 10 - 12 mm long, 6 - 7 mm wide, dark red, epruinose; style short and indistinct; seeds 3, stipitate.

Fl. May - June; *Fr.* July - Aug.

Distrib. India: Jammu & Kashmir (Gilgit region).

Endemic.

23.2. subsp. *pseudumbellata*

Fl. May - June; *Fr.* July - Sept.

Distrib. India: 2100 - 3000 m. Jammu & Kashmir, Himachal Pradesh and Uttar Pradesh.

Pakistan.

24. *Berberis royleana* Ahrendt in J. Asiat. Soc. Beng. (Sci.) 11: 5. 1945; Chatterjee in Rec. Bot. Surv. India 16(2): 31. 1953.

Shrubs 2 - 3 m high; stems glabrous, more or less sulcate; young twigs red brown, sulcate; internodes ca 2 mm long; spines 1 - 3-fid, stout, up to 1.5 cm long, red. Leaves broadly oblong-obovate, contracted at base, entire, rounded at apex, ca 2 x 1 cm, grey pruinose beneath, with distinct branched venation on both surfaces; petioles 1 - 2 mm long. Inflorescences 3 - 8-flowered, fascicled or subumbellate- subfascicled; pedicels stout, 6 - 10 mm long. Berries oblong, estylose, 8 - 10 x 3.5 - 5 mm, blue-black, greyish pruinose.

Fl. May - June; *Fr.* July - Aug.

Distrib. India: Jammu & Kashmir (Srinagar).

Pakistan.

Section 4. POLYANTHEAE Schneider

(B. P. Uniyal and R. R. Rao)

Stems mostly sulcate; internodes 1.4 - 3.5 cm long; spines usually 3-flowered. Leaves mostly deciduous, rarely semi-evergreen. Inflorescences usually 12 - 100-flowered. Flowers 6 - 8 mm across. Ovules 1 - 5. Berries red.

India, Pakistan, Nepal, Bhutan and China.

KEY TO THE SPECIES

- | | |
|---|----------------------------|
| 1a. Leaves pruinose beneath; panicles 8 - 17 cm long; pedicels 4 - 15 mm long | 25. <i>B. koehneana</i> |
| b. Leaves epruinose beneath; panicles up to 4 cm long; pedicels 1 - 4 mm long | 26. <i>B. kunawarensis</i> |

25. *Berberis koehneana* Schneider in Bull. Herb. Boiss. ser. 2, 5: 814. 1905.

Shrubs, up to 2.5 m high; stems and branches glabrous, red-brown or yellow, subsulcate; internodes 1.5 - 3 cm long; spines 1 - 3-fid, 1 - 2 cm long, terete, yellow brown. Leaves sessile, deciduous, obovate to oblong-oblong-ovate, cuneate at base, entire or few-spinulose on margins, mucronate at apex, 1 - 4 x 0.4 - 1.8 cm, greyish beneath, papillose. Inflorescences paniculate, 8 - 17 cm long; branches up to 8 cm long, many-flowered; pedicels 2 - 8 mm long; bracts ca 1.5 mm long. Sepals in 3 whorls; outer ones ovate, ca 3 x 2 mm; median ones oblong-ovate, ca 4.5 x 4 mm; inner ones obovate, ca 7 x 4.5 mm. Petals shorter than the inner sepals, incised at apex; glands obovate. Stamens ca 3 mm long, produced. Berries oblong, 7 - 8 x 4 - 4.5 mm, bright red, epruinose, estylose.

Fl. May - Aug.; *Fr.* Sept. - Nov.

Distrib. India: 2700 - 3500 m. Himachal Pradesh and Uttar Pradesh.

Nepal.

Notes. The yellow-stemmed plants have been described as var. *auramea* from Nepal. Its occurrence in India is doubtful.

26. *Berberis kunawurensis* Royle, *Illus. Bot. Himal.* 64. 1834. *B. vulgaris* L. vars. *aetnensis* & *brachybotrys* Hook. f. & Thomson in *Fl. Brit. India* 1: 109. 1872. *B. edgeworthiana* Schneider in *Bull. Herb. Boiss.* ser. 2, 8: 263. 1908.

Shrubs, ca 1.5 m high; stems subterete to sulcate, glabrous to puberulous, pale ashy or red-brown, subangled; internodes up to 3 cm long; spines 0.5 - 2 cm long, mostly 3-fid. Leaves subsessile, lanceolate, obovate or narrowly elliptic, cuneate at base, acute to subacuminate and mucronate at apex, serrulate and 3 - 8-spinose along margins, epapillose and epruinose. Inflorescences paniculate, 10 - 40-flowered; peduncles 5 - 14 mm long; secondary peduncles 4 - 7 mm long. Flowers red-brown, 5 - 6 mm across; pedicels 1.5 - 4 mm long; bracts 1 - 2 mm long. Sepals in 2 whorls; outer ones oblong, 3 - 4 x 2 - 2.5 mm; inner ones obovate, 4 - 5 x 3.5 - 4 mm. Petals elliptic-obovate, 4 - 5 x 3 mm. Stamens produced. Ovules 2. Berries oblong-elliptic, 7 - 8 x 4 - 4.5 mm, bright orange-red, estylose or very shortly stylose, 1 - 2-seeded.

Fl. May - June.

Distrib. India: 2300 - 3500m. Jammu & Kashmir, Himachal Pradesh and Uttar Pradesh.

Pakistan.

Section 5. TINCTORIAE Schneider

Evergreen shrubs. Inflorescences racemose, umbellate, pseudoumbellate or fascicled or occasionally corymbose paniculate. Ovules 1 - 5. Stamens edentate. Fruits pale, bright or dark red, often epruinose.

India, E. Africa, Arabia, Afghanistan, Nepal, Bhutan, China (Tibet) and Sri Lanka.

KEY TO THE SUBSECTIONS

- | | |
|--|--------------------------|
| 1a. Ovules usually 1 - 2 | subject. 2. EUTINCTORIAE |
| b. Ovules usually 4 - 5 | 2 |
| 2a. Styles conspicuous, 0.5 - 1.5 mm long | subject. 1. CHITRIAE |
| b. Styles absent | 3 |
| 3a. Inflorescences 2 - 10-flowered, subumbellate or subfascicled | subject. 4. UMBELLATAE |
| b. Inflorescences 10 - 25-flowered, racemose | subject. 3. LINDLEYANAE |

Subsection 1. CHITRIAE Schneider

(R. N. Banerjee)

Leaves more or less evergreen, subcoriaceous, entire or with 1 - 9 spinules. Inflorescences 3 - 25-flowered, racemose, umbellate, subracemose-pseudumbellate, rarely corymbose paniculate. Stamens produced at apex. Ovules usually 4 - 5. Fruits bright or dark red, stylose.

India, E. Africa, Nepal, Bhutan and China (W. Yunnan).

KEY TO THE SPECIES

- | | |
|---|---------------------------|
| 1a. Stems pubescent or puberulous | 2 |
| b. Stems always glabrous | 4 |
| 2a. Stems yellow, very sulcate; leaves many spinescent along margins | 33. <i>B. sikkimensis</i> |
| b. Stems dark red, terete or subangled; leaves entire or 2 - 4 spinulose along margins | 3 |
| 3a. Stems pubescent, terete; internodes up to 2.5 cm long; leaves up to 4 x 1.5 cm, closely reticulate; inflorescences ca 4 cm long | 32. <i>B. micrantha</i> |
| b. Stems puberulous, angled; internodes up to 5 cm long; leaves 8 x 2 cm, openly veined; inflorescences 9 - 11 cm long | 29. <i>B. chitria</i> |
| 4a. Petals emarginate; inner sepals 8 - 10 mm long; fruits 12 - 13 mm long | 30. <i>B. coriaria</i> |
| b. Petals entire; inner sepals 4.5 - 5 mm long; fruits 9 - 11 mm long | 5 |
| 5a. Leaves narrow; spines 4 - 6 mm long | 27. <i>B. affinis</i> |
| b. Leaves broad; spines 5 - 50 mm long | 6 |
| 6a. Spines 3-fid, 1 - 5 cm long; inner sepals 7 - 8 mm long; fruits ovoid | 28. <i>B. aristata</i> |
| b. Spines solitary, 5 - 10 mm long; inner sepals 5 - 6 mm long; fruits oblong | 31. <i>B. floribunda</i> |

* 27. *Berberis affinis* G. Don, Gen. Syst. 1: 115. 1831. *B. floribunda* var. *affinis* Ahrendt in J. Bot. Lond. 80 (suppl.): 89. 1942.

Stems glabrous, terete to subangled, pale yellow; internodes up to 5 cm long; spines absent or very weak, 1 - 3, up to 5 mm long. Leaves sessile, oblanceolate, attenuate and shortly petioled at base, narrowly acuminate at apex, entire, soft spinulose at apex, 4 - 7 x 1 - 2 cm. Inflorescences up to 25-flowered, up to 7.5 cm long, on dwarf shoots; peduncles ca 2 cm long; pedicels 6 - 10 mm long; bracts linear, 2 - 25 mm long. Flowers 6 - 7 mm across. Berries linear, ovoid, 9 - 11 mm in diam.

Fl. May - June.

Distrib. India: W. Himalayas at ca 2500 m in Kumaon. Uttar Pradesh.

Endemic.

28. *Berberis aristata* DC., Syst. Nat. 2: 8. 1821; Hook. f. & Thomson in Fl. Brit. India 1 : 110. 1872, p. p.

Shrubs, 1 - 3 m tall; stems glabrous, pale brownish yellow, terete; internodes ca 4 cm long; spines solitary towards apex, 2 - 3-fid at base, 1.5 - 3 cm long. Leaves obovate to elliptic-obovate, subsessile and cuneate at base, subacute to acute and mucronate at apex, entire or few-spinose along margins, 4 - 8 x 2 - 3 cm, prominently veined; petioles 4 - 8 mm long. Flowers 11 - 14 mm across, in 5 - 6 cm long 8 - 25-flowered racemes; pedicels 5 - 10 mm long; bracts lanceolate, ca 3 x 1 mm, greenish. Outer sepals 3, ovate-lanceolate, ca 2 x 1 mm; inner ones obovate, 5 - 7 x 3 - 4 mm. Petals obovate to oblong-obovate, cuneate at base with 2 glands, entire, 6 - 7 x 4 mm. Stamens shorter than petals; connectives apiculate. Ovules 3 - 5. Berries ovoid to oblong-ovoid, 9 - 11 x 6 - 7 mm, bright red, slightly pruinose blue; style ca 1 mm long.

Fl. May - June.

Distrib. India: Uttar Pradesh (Garhwal Himalayas).

Nepal and Bhutan.

29. *Berberis chitria* Edwards in Bot. Reg. 9: t. 729. 1823. *B. aristata* auct. non DC.; sensu Hook. f. & Thomson in Fl. Brit. India 1: 110. 1872. *B. chitria* var. *occidentalis* Ahrendt in J. Bot. Lond. 80 (suppl.): 85. 1942.

Stems terete, dark red when young, pubescent; internodes 3 - 5 cm long; spines 1 - 3-fid, 1 - 1.9 cm long. Leaves 4 in each whorl, obovate, oblanceolate, elliptic, entire or 3 - 9 spinose-serrate along margins, 4 - 8 x 2 - 3 cm, finely reticulate on both surfaces, dull green above, pale yellow green beneath, sparsely papillose. Inflorescences 10 - 22 cm long, emerging from the axils of spines, 10 - 20-flowered, dwarf shoots negligible or very short. Flowers 1.5 - 2 cm across, normally in groups of 3 - 5 on elongated glabrous rachis; rachis 9 - 11 cm long, including 4 - 5 cm long peduncle; pedicels 10 - 18 mm long, each bearing 3 flowers, glabrous; bracts 2 - 4 mm long; prophylls ca 1.5 x 1 mm. Outer sepals 3, unequal, oblong (lateral ones) or ovate (median one), 2 - 4 mm long; inner sepals ca 7 mm long. Petals oblong, clawed, ca 6 mm long. Stamens 6; connectives capitate; anther linear. Ovary ca 5 mm long; stigma capitate. Berries dark reddish brown, narrowly ovoid or oblong-ellipsoid, ca 12 x 4 - 6 mm, dark reddish brown.

Fl. May - June; *Fr.* July - Aug.

Distrib. India: W. Himalayas at 2000 - 3000 m. Jammu & Kashmir, Himachal Pradesh and Uttar Pradesh.

Nepal.

30. *Berberis coriaria* Royle ex Lindley, Bot. Reg. 27: t. 46. 1841.

Stems glabrous, angled, sometimes terete, pale yellow; internodes 20 - 50 mm long; spines fairly stout, 3-fid, up to 2 cm long, unequal. Leaves up to 6 at each node, sessile to subsessile, lanceolate, cuneate at base, acute at apex, entire, 25 - 45 x 7 - 13 mm; young leaves spinulose along margins, with midrib and reticulations prominent beneath. Racemes peduncled, many-flowered; peduncles 1 - 2 cm long, drooping; pedicels 4 - 5 cm in flowers and ca 6 cm in fruits; bracteoles 1.5 - 2 mm long. Flowers ca 1.7 cm across. Outer sepals ovate, 4 - 5 mm long; inner sepals elliptic-oblong, concave, obtuse, ca 6 mm long in bud, 8 - 10 mm long in flowers. Petals oblong-elliptic, broadly clawed with separate oblong glands at base, emarginate at apex with obtuse lobes, ca 5 mm long. Stamens ca 5 mm long, apiculate. Style persistent, ca 3 mm long. Berries oblong.

KEY TO THE VARIETIES

- | | |
|---|----------------------------|
| 1a. Racemes dense, rigid, 4 - 5 cm long; pedicels 3 - 5 mm long | 30.1. var. <i>coriaria</i> |
| b. Racemes lax, 5 - 8 cm long; pedicels 6 - 12 mm long | 30.2. var. <i>patula</i> |

30.1. var. *coriaria*

Fl. May - June.

Distrib. India: Himalayas, 2600 - 3000 m. Uttar Pradesh.

Nepal.

30.2. var. *patula* Ahrendt in J. Bot. Lond. 80 (suppl.): 91. 1942.

Distrib. India: Himalayas, ca 2500 m. Uttar Pradesh.

Endemic.

31. *Berberis floribunda* Wallich ex G. Don, Gen. Syst. 1: 115. 1831. *B. umbellata* Lindley in Bot. Reg. 30: t. 44. 1844, (non Wallich ex G. Don, 1831); Hook. f. & Thomson in Fl. Brit. India 1: 110 1872.

Shrubs; stems glabrous, pale yellow, terete or subterete, sparsely and distinctly verruculose; nodes swollen; internodes 2.5 - 4 cm long; spines absent or solitary, rarely up to 2 at the base, 4 - 10 mm long. Leaves 5 at each node, unequal, obovate, lanceolate to elliptic, attenuate at base, entire or rarely with a few spinules along margins, subacute to obtuse at apex, up to 5.2 x 2.3 cm, distinctly reticulate on both surfaces; stiff hairy on both surfaces; petioles 1 - 3 mm long. Racemes up to 25-flowered; pedicels ca 6 mm long; bracts 1 - 2 mm long. Outer sepals oblong-ovate, subacute, ca 2.5 x 1.5 mm; median sepals

elliptic, ca 4 x 3 mm; inner sepals obovate, oblong-elliptic, ca 6 x 4.5 mm. Petals entire, clawed at base, glandular. Stamens 3 - 4 mm long, not or scarcely produced, truncate or rounded. Ovules 4 - 5. Berries broadly oblong-ellipsoid, dark red, finally purple to pruinose blue; style ca 0.5 mm long.

Fl. & Fr. May - Sept.

Distrib. India: Himalayas, 3000 - 3600 m. Himachal Pradesh and Uttar Pradesh.

Nepal.

32. *Berberis micrantha* (Hook. f. & Thomson) Ahrendt in Gard. Illus. 64: 426. 1944.
B. aristata var. *micrantha* Hook. f. & Thomson in Fl. Brit. India 1: 117. 1872, p. p.

Stems faintly angled or ridged and furrowed, zig-zag, puberulous; internodes 1 - 2.5 cm long; spines 3-fid, ca 2 cm long. Leaves sessile, 3 - 5 at the nodes, unequal, obovate, elliptic, cuneate at base, acute-mucronate at apex, 2 - 4 spinulose and subserrate along margins, 1 - 2 x 0.5 - 1 cm, coriaceous, glossy above, pale beneath, papillose on both surfaces; nerves one on either side of the midrib, finely reticulate beneath. Racemes ca 4 cm long, 6 - 15-flowered; peduncles 1 - 5 cm long; pedicels ca 3 mm long, glabrous. Prophylls ca 2 x 1 mm, acute, red. Outer sepals 5, ovate-rotundate, 3 - 4 x 2 - 2.5 mm, hyaline along margins; median sepals ovate-elliptic, obtuse, 5 - 6 x 3.5 - 4.5 mm; inner sepals rounded, ca 5 mm across. Petals obovate, cuneate with oblong glands at base, rounded-emarginate at apex, ca 4 x 3 mm, caducous at maturity. Stamens 4 - 4.5 mm long, apiculate. Berries oblong, 8 - 10 x 5 - 6 mm, dark red, epruinose; style ca 1 mm long.

Fl. June - July; *Fr.* July - Nov.

Distrib. India: Himachal Pradesh and Uttar Pradesh.

Nepal and Bhutan.

33. *Berberis sikkimensis* (Schneider) Ahrendt in J. Bot. Lond. 80 (suppl.): 85. 1942.
B. chitria var. *sikkimensis* Schneider in Fedde, Repert. Spec. Nov. 46: 248. 1939. *B. aristata* var. *micrantha* Hook. f. & Thomson in Fl. Brit. India 1: 110. 1872, p. p.

Stems ridged and furrowed, pubescent when young, pale yellowish grey, verruculose on maturity; internodes 10 - 25 mm long; spines 2, unequal, the longer one up to 1.8 cm long. Leaves 6 in a whorl, sessile, unequal, obovate, cuneate at base, acute-mucronate at apex, subrevolute and serrate along margins, 9 - 27 x 4 - 10 mm, coriaceous, bright green and lustrous above. Inflorescences 3 - 12-flowered, umbellate, rarely racemose, 3 - 4 cm long; peduncles 1 - 2 cm long, red; flowers bright yellow; pedicels ca 8 mm long, glabrous; bracts ovate, attenuate, ca 1.5 x 0.9 mm, red. Prophylls subamplexicaul,

concave, acute, ca 1 mm long, glabrous. Outer sepals 3, broadly ovate, ca 3 x 3 mm; inner ones oblong, ca 7 x 3 mm. Petals 6, broadly obovate with oblong submarginal glands, rounded at apex, ca 7 x 4 mm. Stamens ca 6 mm long, with 2 spurs on the connectives. Ovules 4. Berries narrowly ovoid, often curved, up to 15 x 14 mm, dark red, epruinose, stylose.

Fl. & Fr. May - Aug.

Distrib. India: Sikkim.

Nepal and Bhutan.

Subsection 2. EUTINCTORIAE Schneider

(R. R. Rao and B. D. Naithani)

Branches pale yellowish grey or reddish. Leaves more or less evergreen, slightly coriaceous, venation not conspicuous. Inflorescences umbellate, racemose or rarely paniculate. Flowers very small. Ovules 1 - 2. Berries red or purple.

KEY TO THE SPECIES

- | | |
|--|-----------------------------|
| 1a. Stems dark red, terete; leaves green, epruinose beneath | 36. <i>B. petiolaris</i> |
| b. Stems pale yellow, sulcate or angled; leaves pruinose, grey white | 2 |
| 2a. Petals shorter than inner sepals | 3 |
| b. Petals longer than or as long as inner sepals | 4 |
| 3a. Stems glabrous; berries pruinose | 37. <i>B. tinctoria</i> |
| b. Stems puberulous; berries epruinose | 38. <i>B. wightiana</i> |
| 4a. Petals entire; stems puberulous | 34. <i>B. huegeliana</i> |
| b. Petals emarginate; stems glabrous | 35. <i>B. nilghiriensis</i> |

34. *Berberis huegeliana* Schneider in Bull. Herb. Boiss. ser.2, 5: 451. 1905.

Shrubs; stems puberulous, glabrous or subglabrous at maturity, angled, terete or subterete; internodes ca 2 cm long; spines slender, 1 - 2 cm long. Leaves sessile or shortly petioled, oblong-obovate, cuneate to decurrent at base, subacute at apex, 1 - 4 spinulose along margins, occasionally entire, 3 - 4.5 x 1.2 - 1.7 cm, subcoriaceous, greyish beneath. Inflorescence racemose, sometimes compound below, 10 - 18-flowered; peduncles ca 1 cm long. Flowers ca 1 cm across; pedicels 5 - 10 mm long; bracts ca 2 mm long. Prophylls ca 2 mm long. Inner sepals ca 6 mm long. Petals entire, ca 6 mm long. Style distinct. Berries not seen.

Fl. April - May.

Distrib. India: Kashmir (Srinagar, 1700 - 2000 m).

Endemic.

35. *Berberis nilghiriensis* Ahrendt in *J. Asiat. Soc. Beng. (Sci.)* 11: 1. 1945 & in *J. Linn. Soc. Lond. (Bot.)* 57: 94. 1961.

Shrubs; stems and branches glabrous; internodes 1.5 - 3 cm long; spines 1.5 - 2.5 cm long. Leaves oblong, obovate, entire, 3 - 4 x 1 - 1.5 cm, reticulate, greyish white beneath. Inflorescence including peduncles 5 - 8 cm long, racemose, 10 - 15-flowered; pedicels 5 - 10 mm long. Prophylls ovate, obtuse, ca 3 x 1.75 mm, red. Sepals in 2 whorls; outer sepals elliptic, ca 4.25 x 2.5 mm, yellow, flushed red; inner ones obovate, ca 6 x 4 mm. Petals obovate, ca 7 x 4 mm, acutely emarginate with rounded lobes, clawed at base with linear-lanceolate 2 - 3 x 0.5 mm glands. Stamens edentate, truncate and not produced at apex.

Fl. & Fr. March - June.

Distrib. India: Tamil Nadu (Nigiris, above 2000 m.).

Endemic.

Notes. This species differs from other South Indian species, namely *B. tinctoria* and *B. wightiana* in having petals conspicuously longer than the inner sepals.

36. *Berberis petiolaris* Wallich ex G. Don, *Gen. Syst.* 1: 116. 1831; Ahrendt in *J. Linn. Soc. Lond. (Bot.)* 57: 94. 1961.

Shrubs, up to 6.5 m tall; stems glabrous, terete, sublustrous, mature ones deep red to red brown; internodes 3 - 4 cm long; spines often absent, occasionally solitary or 3-fid, 3 - 7 mm long. Leaves entire or 1 - 2 spinulose or irregularly toothed, 4 - 8 x 1.4 - 3 cm, loosely reticulate, epruinose and green on both sides; petioles 1 - 2 cm long. Inflorescences 4 - 6 cm long, consisting of racemes or umbels; racemes 8 - 15 mm long; pedicels 7 - 15 mm long, glabrous. Outer sepals ovate, ca 3 x 2 mm; inner sepals obovate, ca 6.5 x 5 mm. Petals obovate, entire, clawed at base, ca 6.5 x 5 mm; glands lanceolate, acuminate, discrete, ca 1.2 x 0.3 mm. Stamens ca 5.5 mm long, not produced. Style 1 - 1.5 mm long, very short. Ovules 2, subsessile. Berries ellipsoid or oblong, ca 7 x 3.5 cm; style 0.5 - 1.5 mm long.

Notes. This species is often confused with W. Himalayan *B. pachyacantha* Koehne, which have 10 - 30 spinose or subserrulate epruinose leaves and epappillose, estylose and epruinose berries.

A very variable species with at least two distinct varieties, which probably deserve specific ranks; but as the types are not available to authors, these are treated as varieties only, following Ahrendt (l. c.).

KEY TO THE VARIETIES

- | | |
|--|------------------------------|
| 1a. Leaves spinose; umbels 3 - 7-flowered, 2 - 3 cm long; styles ca 0.5 mm long | 36.1. var. <i>garhwalana</i> |
| b. Leaves entire; racemes 8 - 15-flowered, 3 - 6 cm long; styles 1 - 1.5 mm long | 36.2. var. <i>petiolaris</i> |

36.1. var. *garhwalana* Ahrendt in J. Bot. Lond. 80 (suppl.): 82. 1941 & in J. Linn. Soc. Lond. (Bot.) 57: 94. 1961.

Differs from the type variety in having distinctly serrulate leaves and inflorescences with 3 - 7 flowers, all in short umbels and in the much shorter styles.

Fl. & Fr. May - June.

Distrib. India: Uttar Pradesh.

Endemic.

36.2. var. *petiolaris*

Fl. & Fr. not known.

Distrib. India: no specimen nor any record from India seen, probably can be expected in Garhwal Himalayas.

Nepal.

37. *Berberis tinctoria* Leschen. in Mem. Mus. Paris 9: 306. 1822; Fyson, Fl. South Indian Hill St. 2: t. 10. 1932.

Shrubs, 3 - 5 m tall; stems glabrous, very sulcate, yellow; internodes up to 4 cm long, spines 3-fid, 1.5 - 3 cm long, concolorous. Leaves obovate, obtuse, mucronate, entire, rarely with 1 - 2 spinules, 1.5 - 3.5 x 0.7 - 1.3 cm, thick, dull above, pruinose, papillose, white or greyish beneath; venation branched, reticulate; petioles 3 - 4 (-6) mm long. Inflorescences 10 - 20-flowered, racemose, drooping, sometimes branched, 3.5 - 5 cm long; pedicels slender, 5 - 10 mm long. Prophylls ca 1 x 0.5 mm long. Sepals in 3 whorls; outer sepals ovate, acute, ca 2.5 x 1 mm; median ones ovate, obtuse, ca 2.5 mm long; inner ones obovate, ca 7 x 5 mm. Petals obovate, clawed, ca 6 x 4.5 mm; glands ca 1 x 0.4 mm, at the base of the claw. Stamens ca 5 mm long, shortly apiculate. Ovules 2, stipitate.

Berries oblong, 9 - 10 x 5 mm, excluding 1 - 1.5 mm long style, slightly pruinose, blue or red.

Fl. & Fr. Feb. - June.

Distrib. India: Tamil Nadu (Nilgiri hills).

Notes. Chromosome no. $n = 5$ (Shobha & Ramachandran in *Taxon* 29: 165. 1980).

Berberis tinctoria Leschen. is often confused with *B. aristata*, but can be distinguished by the slender drooping pedicels and in the shape of the berries, which are eventually top-shaped, purplish and turning dark blue with glaucous bloom and with conspicuous style and stigma.

Fyson (l. c.) states, "Schneider in *Bull. de L'Herbier Boiss. ser.2, 5: 432. 1905* divides the Nilgiri specimens into three species, *B. tinctoria*, *B. wightiana* and *B. ceylanica*, by the colour and surface of the underside of the leaves, the hairiness of the twigs and the inflorescences. I am not, however, able to distinguish these."

Alkaloids like Berberine and Jatrorhizine have been reported in this species (Chatterjee, l. c. 1953).

38. *Berberis wightiana* Schneider in *Bull. Herb. Boiss. ser.2, 5: 452. 1905.*

Shrubs; stems very sulcate, puberulous, yellow; internodes 1.5 - 2.5 cm long; spines 1.5 - 3 cm long, concolorous, slightly sulcate, Leaves sessile, oblong-obovate, obtuse, entire, rarely with 1 - 2 marginal spinules, ca 2.4 x 1.4 cm, thick, pruinose grey with raised veins beneath. Inflorescences 7 - 12-flowered, racemose to subumbellate-racemose, 2 - 4 cm long; pedicels 8 - 18 mm long. Prophylls acuminate, ca 1.5 x 0.5 mm. Outer sepals oblong-ovate, ca 3 x 1.25 mm; inner ones obovate, ca 5 x 3.75 mm. Petals narrowly obovoid, ca 4 x 2.5 mm. Stamens ca 3 mm long, shortly apiculate. Berries obovoid, ca 9 x 4 mm, pruinose; style ca 1 mm long.

Fl. & Fr. : Feb. - July

Distrib. India: Tamil Nadu (Nilgiri hills). Very rare.

Sri Lanka.

Subsection 3. LINDLEYANAE Ahrendt

(R. R. Rao and S. Kumar)

Stems yellow to purple. Leaves green or grey. Inflorescences 8-25-flowered, elongate, racemose. Berries estylose.

India (Kashmir), Nepal and S.E. Tibet; one species in India.

39. *Berberis kashmiriana* Ahrendt in J. Bot. Lond. 80 (suppl.): 97. 1943 & in J. Linn. Soc. Lond. (Bot.) 57: 107. 1961.

Shrubs, 1 - 2 m high; stems terete to subsulcate, pale yellow; branches glabrous; internodes 2 - 3 cm long; spines 3-fid, 1 - 1.5 cm long. Leaves subsessile or very shortly petioled, narrowly obovate to oblong, 15 - 25 spinose along margins, 3 - 6 x 1 - 1.8 cm, elevated reticulate on both sides, dull green above, epruinose. Inflorescences racemose, 8 - 10-flowered, 3 - 5 cm long; pedicels 8 - 17 mm long, glabrous; flowers 10 - 12 mm across. Sepals in 2 whorls; outer ones ovate, acute, ca 5.5 x 3.5 mm long; inner ones obovate, 6 - 7 x 5.5 - 6 mm. Petals broadly elliptic, subentire, ca 4.5 x 4 mm; glands elliptic. Stamens ca 4 mm long, truncate at apex. Ovules 4 - 5, shortly stipitate. Berries oblong-ellipsoid, 9 - 10 x 4 - 5 mm, dark red, epruinose, estylose or very shortly stylose.

Fl. May - June; *Fr.* July - Aug.

Distrib. India: 3500 - 4000 m. Kashmir.

Endemic.

Subsection 4. UMBELLATAE Schneider

(P. B. Sur)

Stems various; internodes usually 2.5 - 3.5 cm long; spines usually 1 - 2 cm long. Leaves usually subcoriaceous. Inflorescences mostly 2 - 10-flowered, subumbellate or subfascicled, occasionally 10 - 25-flowered and racemose. Inner sepals longer than petals. Ovules 4 - 5. Berries dark red or reddish brown.

India, Nepal and Bhutan.

KEY TO THE SPECIES

1a. Stems puberulous
Stems glabrous

41. *B. thomsoniana*

2

- 2a. Leaves open-reticulate, entire; petioles 8 - 20 mm long 40. *B. brandisiana*
 b. Leaves closely reticulate, spinulose along margins; petioles 5 - 8 mm long 42. *B. umbellata*

40. *Berberis brandisiana* Ahrendt in J. Asiat. Soc. Beng. (Sci.) 11: 2. 1945.

Stems finely subsulcate to subterete, dark red; internodes 1.5 - 2.5 cm long; spines absent or solitary, 3 - 10 mm long. Leaves cuneate at base, entire or rarely 8 - 15-spinulose along margins, obtuse-mucronate at apex, 2 - 4 x 1.2 - 2 cm, green pruinose beneath; petioles 0.5 - 2 cm long. Inflorescences 3 - 6-flowered, umbellate-racemose, 2.5 - 4 cm long; pedicels 1 - 1.5 mm long. Berries obovoid, ca 9 x 6 mm, firm, red; style absent or rarely extremely short and indistinct.

Fl. April - May; *Fr.* June - July.

Distrib. India: Himachal Pradesh.

Pakistan and Nepal.

41. *Berberis thomsoniana* Schneider in Bull. Herb. Boiss. ser.2, 5: 8. 1905.

Stems glabrous, very sulcate, yellowish and strongly grooved; internodes 1.5 - 4 cm long; spines 3-fid, 6 - 13 mm long. Leaves narrowly oblong-obovate, cuneate to decurrent at base, obtuse-mucronate at apex, usually entire, sometimes spinose-dentate, 2 - 5 x 1 - 1.75 cm, with branched venation on both sides, paler and papillose beneath. Inflorescence 5 - 12-flowered, umbellate-racemose, 3 - 5 cm long including 1 - 1.5 cm long peduncles; pedicels 1 - 2 cm long. Outer sepals ovate or narrowly elliptic, acute, 3 - 5 x 1.5 - 2 mm; median ones ovate-elliptic, obtuse, ca 4.5 x 2.5 mm; inner ones obovate, 5 - 6 x 3 - 4 mm. Petals obovate, 4 - 5 x 3 - 4 mm. Ovules sessile. Berries oblong-ellipsoid, 8 - 9 x 5 - 6 mm.

Fl. June - July; *Fr.* Aug. - Sept.

Distrib. India: Open hillsides, 3000 - 4000 m. West Bengal and Sikkim.

Nepal.

42. *Berberis umbellata* Wallich ex G. Don, Gen. Syst. 1: 116. 1831; Hook. f. & Thomson in Fl. Brit. India 1: 110. 1872.

Stems with young shoots deep red and sulcate, mature ones reddish brown and smooth; spines sometimes absent, 3-fid, sometimes 1, sulcate, 7 - 17 mm long. Leaves subacute to mucronate, shortly cuneate to decurrent at base, 5 - 20 spinulose and subserrulate along margins, 2 - 5.5 x 0.7 - 2.5 cm, densely papillose. Inflorescences 3 - 6-flowered, rarely 10-flowered, subumbellate or fascicled, 1.5 - 3.5 cm long, including

1 - 1.5 cm long peduncles; pedicels 0.5 - 2 cm long; bracts ovate, acute, ca 2 x 1.8 mm; prophylls triangular, ca 2.5 x 1.75 mm. Flowers yellow. Sepals 6, in 2 series. Outer sepals ovate, acute, 3.5 - 4.5 x 2.5 - 3 mm; inner sepals obovate, 5.5 - 6.5 x 4 - 5 mm. Petals 6, in 2 series, obovate, cuneate, entire. Stamens 6, free; anthers opening by two recurved valves. Ovary simple; ovules stipitate; stigma flat, subsessile. Berries bright red, oblong-ellipsoid, 10 - 12 x 4.5 - 6 mm, bright red, pruinose. Seeds dark brown.

KEY TO THE VARIETIES

- | | |
|--|------------------------------------|
| 1a. Internodes 1 - 2 cm long; stems distinctly stoloniferous | 42.1. var. <i>branii</i> |
| b. Internodes 2 - 2.5 cm long; stems not stoloniferous | 42.2. var. <i>umbellata</i> |

42.1. var. *branii* Ahrendt in J. Bot. Lond. 80 (suppl.): 94. 1942.

Stems densely coarsely concolorous and verruculose. Leaves smaller than the type variety, less toothed, less veined, bright green and lustrous.

Fl. May - June; *Fr.* July - Aug.

Distrib. India: Sikkim (2000 - 3500 m).

Endemic.

42.2. var. *umbellata*

Fl. May - June; *Fr.* July - Aug.

Distrib. India: Uttar Pradesh (Garhwal Himalayas, 3000 - 4000 m).

Nepal and Bhutan.

Section 6. ULICINAE Schneider

(R. R. Rao and S. Kumar)

Shrubs, up to 1 m high; stems glabrous, dark purple; internodes 5 - 10 mm long; spines 1 - 2 cm long, subsulcate, yellow. Leaves deciduous, narrow, concolorous green, pruinose below. Inflorescences 2 - 7-flowered; pedicels ca 2.5 mm long. Berries 4 - 5 mm across, black, pruinose, estylose.

India and China (W. Tibet).

43. *Berberis ulicina* Hook. f. & Thomson, Fl. Ind. 227. 1855 & in Fl. Brit. India 1: 111. 1872.

Shrubs 0.5 - 1 m tall; branches compact, densely spiny; stems glabrous, dark red, sulcate; internodes 5 - 8 mm long; spines 1 - 2 cm long, yellow, 3-fid. Leaves linear-lanceolate with 1 - 2 spinules along margins, 7 - 15 x 1 - 2.5 mm. Inflorescences 3 - 6-flowered, fascicled or fasciculate umbels, 4 - 8 mm long; pedicels 3 - 5 mm long. Flowers yellow, 4 - 5 mm long. Sepals in 2 whorls; inner ones ca 5 x 3.5 mm. Petals emarginate, ca 4 x 2 mm. Stamens ca 3 mm long. Ovules 3 - 5. Berries globose, 5 - 6 mm in diam., epruinose, purplish or black.

Fl. June - July; *Fr.* Aug. - Sept.

Distrib. India: Alpine Himalayas, 4200 - 4500 m. Jammu & Kashmir (Ladakh).

Notes. This species is used in preparing eye-drops in Ladakh, where it is called by the name 'Kerapa.'

Section 7. V U L G A R I S Schneider

(B. P. Uniyal and R. R. Rao)

Stems glabrous, mostly yellow when mature. Leaves deciduous, petioled, usually closely spinulose on the margins. Racemes up to 10 cm long, 10 - 30-flowered. Stamens not or scarcely produced, truncate or rounded. Ovules 1 - 2. Berries oblong, 8 - 12 mm long.

India, Europe, Japan, China, Korea and Iran.

44. *Berberis pachyacantha* Koehne, Deutsche Dendr. 170. 1892; R. Parker in For. Fl. Punjab, Hazara & Delhi 12. 1918.

Deciduous shrubs, up to 3 m high; stems dark red or pale yellowish, subterete; internodes ca 3.5 cm long; spines solitary or 3-fid or absent. Leaves distinctly petioled, obovate-elliptic or oblanceolate, many-spinulose along margins, 5 - 10 x 1.5 - 3.5 cm. Inflorescence racemose, 15 - 20-flowered; peduncles ca 1.5 cm long; pedicels up to 1.5 cm long. Sepals in 2 whorls; outer ones ovate-obtuse, ca 3 x 2 mm; inner ones obovate, ca 5.5 x 3.5 mm. Petals acutely emarginate. Berries oblong-ovoid, ca 8 mm long, estylose, epruinose, red. Seeds ca 6 x 2.5 mm, black.

KEY TO THE SUBSPECIES

- 1a. Stems dark red to pale brownish; flowers 7 - 9 mm across; pedicels 10 - 15 mm long. 44.1. subsp. *pachyacantha*
 b. Stems pale; flowers 5 - 6 mm across; pedicels 4 - 8 mm long 44.2. subsp. *zabelliana*

44.1. subsp. *pachyacantha*

Stems dark red or pale brownish, subterete. Leaves closely spinulose along margins.

Fl. July - Aug.; *Fr.* Aug. - Oct.

Distrib. India: Jammu & Kashmir, Himachal Pradesh and Uttar Pradesh.

Pakistan and Iran.

44.2. subsp. *zabelliana* (Schneider) Jafri in *Fl. W. Pakistan* 87: 21, f. 5 B, 1975. *B. zabelliana* Schneider in *Bull. Herb. Boiss.* 2, 5: 667. 1905.

Shrubs. Stems pale yellowish. Flowers 5 - 6 mm across on 4 - 8 mm long pedicels.

Fl. May - July; *Fr.* July - Nov.

Distrib. India: Jammu & Kashmir, Himachal Pradesh and Uttar Pradesh.

Pakistan.

Notes. Kornik & Kornik (in Rechinger, *Fl. Iranica* 111: 8. 1975) treat both the above taxa under *B. pachyacantha*

Section 8. WALLICHIANA E Schneider

Leaves evergreen, usually coriaceous, spinose along margins. Flowers solitary or 2 - 25 together in fascicles. Ovules usually 1 - 5. Fruits black, pruinose or epruinose.

India, Nepal, Bhutan, Myanmar, China, Taiwan, Java, Sumatra and Philippines.

KEY TO THE SUBSECTIONS

(Modified from Ahrendt, 1965)

- 1a. Stems always without spines subsect. 3. **INSIGNES**
 b. Stems always with spines **2**

- | | | |
|---|----------------------------|---|
| 2a. Ovules 6 - 15 | subject. 2. HOOKERIANAE | |
| b. Ovules 1 - 5 | | 3 |
| 3a. Leaves thick, rigid or stiff | | 4 |
| b. Leaves thin, flexible | | 5 |
| 4a. Internodes 2 - 8 cm long; spines 3 - 6 cm long; leaves scarcely revolute | subject. 1. EUWALLICHIANAE | |
| b. Internodes 1.5 - 2.5 cm long; spines up to 2 cm long; leaves very revolute | subject. 6. REPLICATAE | |
| 5a. Ovules (2-) 4 - 5 | subject. 4. MANIPURANAE | |
| b. Ovule solitary (rarely 2) | subject. 5. SUBLEVES | |

Subsection 1. EUWALLICHIANAE Schneider

(D.N. Guha Bakshi)

Stems yellow; internodes 2 - 8 cm long; spines 3-fid, 3 - 6 cm long. Leaves thick, often rigid; venations nearly always distinct and mostly reticulate. Flowers 7 - 15 mm in diam. Stamens scarcely produced, truncate. Ovules 1 - 2, scarcely 3, generally sessile or subsessile. Fruits 7 - 10 mm long, mostly stylose.

India, Nepal, Bhutan and China.

KEY TO THE SPECIES

- | | |
|--|---------------------------|
| 1a. Pedicels 3 - 4 mm long; petals shorter than outer sepals | 45. <i>B. micropetala</i> |
| b. Pedicels 6 - 10 mm long; petals longer than outer sepals | 46. <i>B. wallichiana</i> |

45. *Berberis micropetala* Schneider in Fedde, Repert. Spec. Nov. 46: 266. 1939.

Internodes 2.5 - 3.5 cm long; spines 1 - 2 cm long, sulcate. Leaves oblong-elliptic, acute, 1 - 4 spinulose-toothed on either side, openly veined, greyish, pruinose below. Flowers 4 - 5, fascicled; pedicels 3 - 4 mm long. Sepals in 3 series; outer ones ovate, acuminate, ca 5 x 3 mm long; median ones oblong-obovate, 7 - 8 x 5 mm; inner ones 8 - 9 x 5 mm. Petals white, emarginate, ca 4 - 2.5 mm. Stamens apiculate. Ovules 2, sessile. Berries estylose.

Fl. March - April; *Fr.* May - June.

Distrib. India: ca 3000 m. Nagaland.

Endemic.

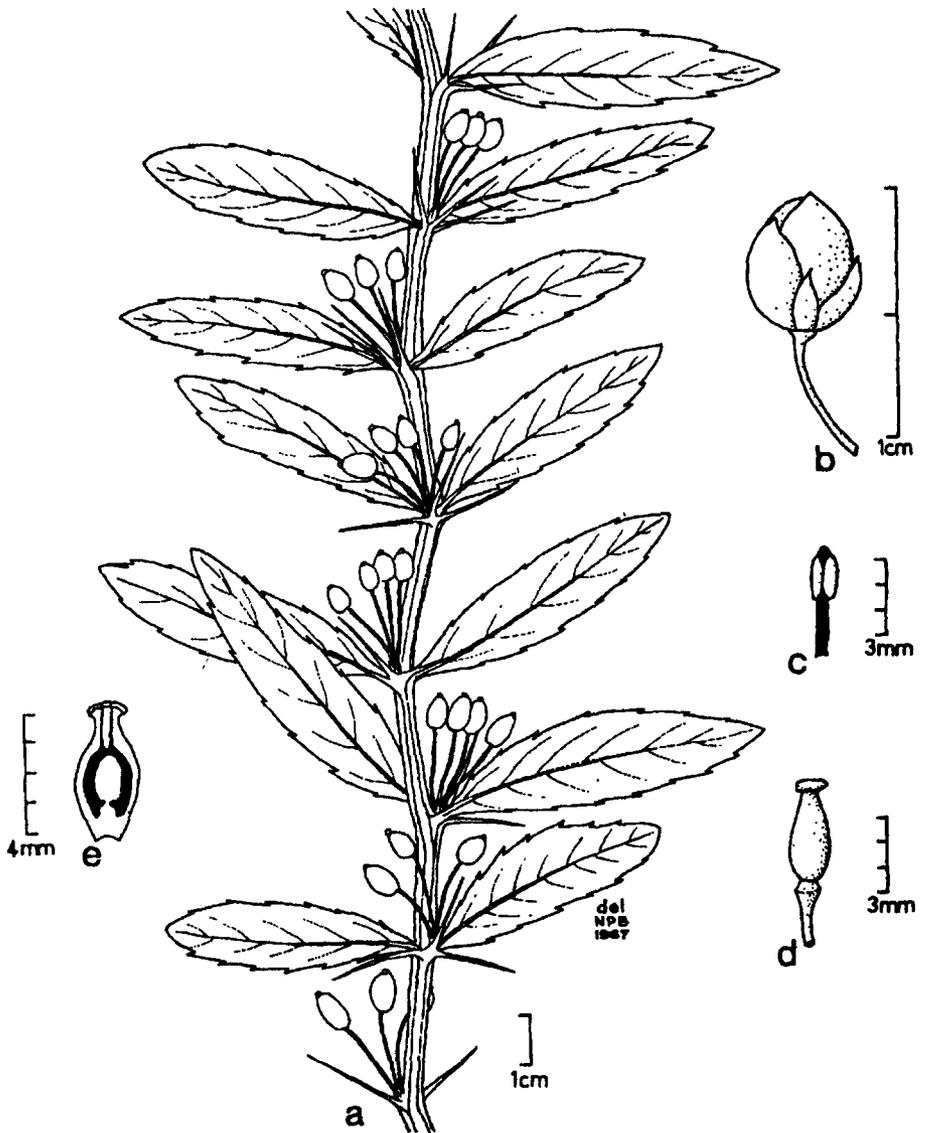


Fig. 58. *Berberis wallichiana* DC. a. branch; b. flower; c. stamen; d. pistil; e. l.s. of pistil.

46. *Berberis wallichiana* DC., Prodr. 1: 107. 1824; Wallich, Pl. Asiat. Rar. 3. 23, t. 243. 1832. **Fig. 58.**

Erect shrubs, 2 - 3.5 m tall; stems glabrous, subangled; spines slender, slightly sulcate, ca 2 cm long. Leaves sessile, oblong-lanceolate, acute to subacute or obtuse at apex, with 12 - 25 spinules along margins, 4 - 12 x 1.2 - 2.8 cm, sublustrous above with 5 - 9 lateral veins, indistinctly reticulate. Flowers 7 - 8 mm across, 10 - 20 fascicled; pedicels stout, 6 - 10 mm long. Prophylls acuminate, ca 1 x 1 mm. Sepals in 2 series, outer ones oblong-obovate, ca 3 x 1.5 mm; inner ones ca 4.5 x 3 mm. Petals obovate, entire, ca 5 x 2.5 mm; basal glands separate, lanceolate. Ovules solitary, shortly stipitate. Stamens 3.5 - 4 mm long. Berries 8 - 9 x 4 - 5 mm, excluding 0.5 - 0.75 mm long style, ovoid, epruinose, black.

Fl. & Fr. not known.

Distrib. India: Meghalaya.

Nepal and Bhutan.

Subsection 2. HOOKERIANA E Ahrendt

(Syamali Dasgupta)

Stems glabrous, mostly angled; spines present. Leaves evergreen, lustrous above, pruinose white beneath. Flowers 1 - 6 fascicled, 1.5 - 2.5 cm in diam. Anthers flattened, broadly truncate at apex. Ovules 6 - 15. Berries black, with white bloom, estylose.

India, Bhutan and China (S.E. Tibet).

47. *Berberis hookeri* Lemaire in Illus. Hort. 6: 207. 1859. *B. wallichiana* sensu Hook. f. & Thomson in Bot. Reg. 76, t. 4656. 1852, non DC. *B. hookeri* var. *viridis* Schneider in Bull. Herb. Boiss. 8: 197. 1908. *B. hookeri* vars *microcarpa* & var. *platyphylla* Ahrendt in J. Linn. Soc. Long. (Bot.) 57: 40. 1961. **Fig. 59.**

Erect shrubs, ca 1 m high; stems terete, angled, glabrous, gland-dotted, profusely branching; internodes 2 - 6 cm long; spines up to 2.5 cm long. Leaves 5 - 9, oblong or broadly elliptic-lanceolate, attenuate at base to a short petiole, revolute and 5 - 19 spinose-dentate along margins, acute or obtuse at apex, 3 - 8 x 0.8 - 3 cm, lustrous dark green above, white-pruinose beneath; veins prominently reticulate. Flowers 3 - 8 in fascicle; pedicels 1.5 - 3 cm long. Prophylls ovate, concave, acute, thickened at middle, 2.5 - 3.5 x 1.5 - 2 mm. Sepals 6; outer sepals ovate or obovate, concave, hooded, acute or obtuse, entire, 6 - 7 x 5 - 6 mm; innermost ones elliptic, ca 8 x 5 mm. Petals 6, obovate,

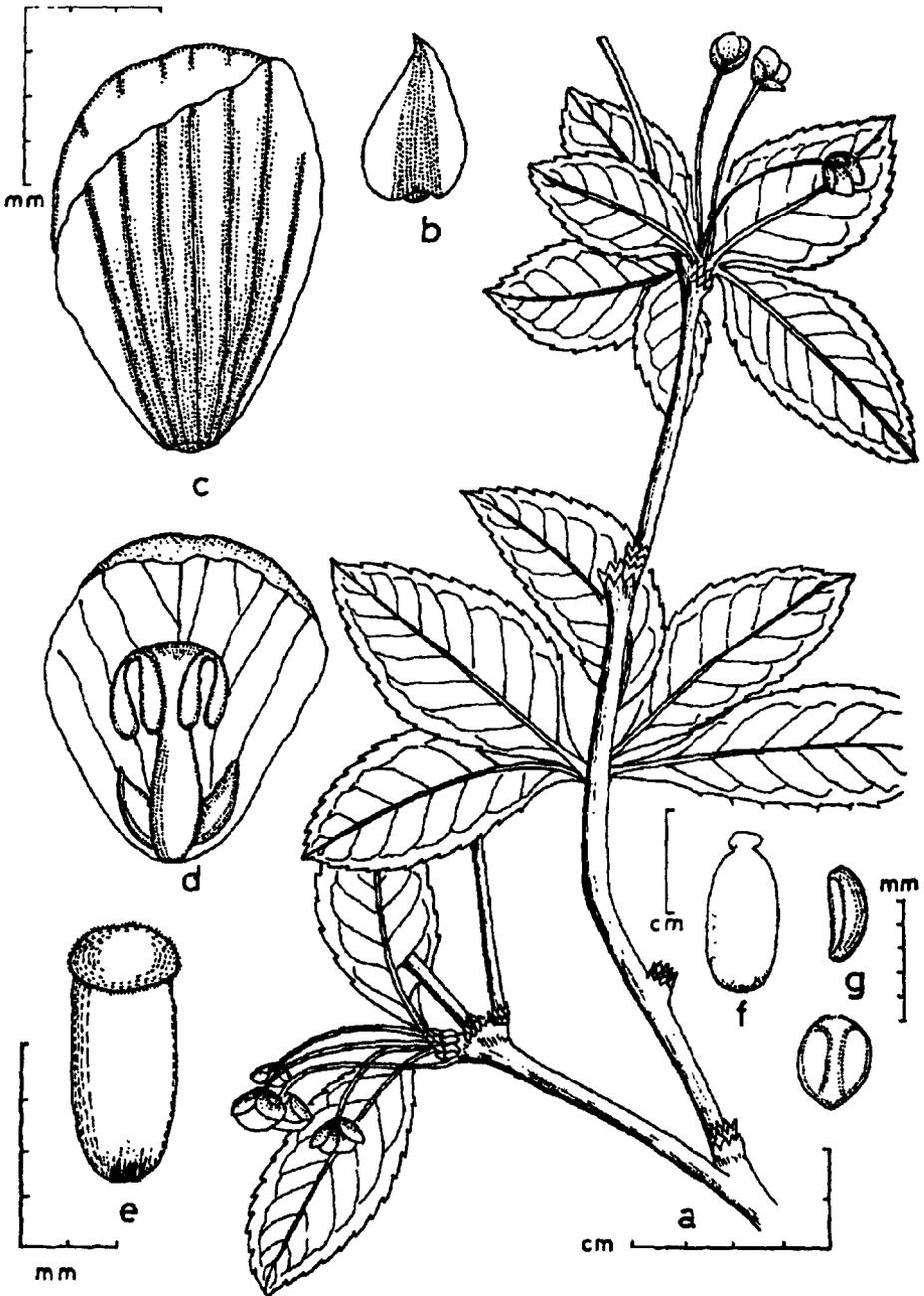


Fig. 59. *Berberis hookeri* Lemaire : a. twig; b. prophyll; c. sepal; d. petal with glands; e. pistil; f. berry; g. seeds, dorsal and lateral views.

entire, cuneate at base, obtuse at apex, 6 - 7 x 5 - 6 mm. Stamens 3 - 4 mm long; filaments ca 2.2 mm long; connectives truncate at top; anthers 1.2 - 1.7 mm across. Ovary oblong, estylose, 3 - 4.5 x 1 - 2 mm; ovules 6 - 8; stigma 1.2 - 2 mm broad. Berries oblong, 1 - 1.5 x 0.4 - 0.7 cm, purplish black, estylose. Seeds 3, obovoid to oblong, plano-convex.

Fl. March - June; *Fr.* May - Oct.(- Nov.).

Distrib. India: Rocky moss-covered slopes in *Tsuga* forests, at 2400 - 3400 m. West Bengal, Sikkim and Arunachal Pradesh.

Nepal and Bhutan.

Subsection 3. *INSIGNIS* Schneider

(Syamali Dasgupta)

Stems terete; spines absent, particularly in the upper part. Leaves evergreen, 6 - 22 x 1 - 5 cm. Flowers in fascicles, 10 - 14 mm across. Petals shorter than inner sepals. Anthers oblong or ovoid, not flattened, edentate. Ovules 3 - 7. Berries black, shortly stylose, rarely pruinose.

India, Bhutan, China (S.E. Tibet) and N. Myanmar.

KEY TO THE SPECIES

- | | |
|--------------------------------------|-------------------------|
| 1a. Stem pubescent; stamen apiculate | 48. <i>B. dasyclada</i> |
| b. Stem glabrous; stamen obtuse | 49. <i>B. insignis</i> |

48. *Berberis dasyclada* Ahrendt in J. Bot. Lond. 79 (suppl.): 12. 1941 & in J. Linn. Soc. Lond. (Bot.) 57: 36. 1961. *B. insignis* Hook. f. & Thomson var. *zelaica* Ahrendt in J. Bot. Lond. 79(suppl.): 9. 1942. Fig. 60.

Low growing gregarious shrubs, forming dense thickets, up to 60 cm high; stems terete, pubescent, dark red; internodes 1.5 - 4 cm long, short. Leaves 2 - 4 from each node, narrowly elliptic or lanceolate, attenuate at base to form a 2 mm long petiole, with 10 - 18, 2 - 3 mm long serrations along margins, acute at apex, 4 - 12 x 1.2 - 3.5 cm, coriaceous, thick with hypoderm, sublustrous, dark green above, paler beneath. Flowers 3 - 12, in fascicles, golden yellow, fragrant; pedicels 1 - 1.5 cm long, slender; bracts lanceolate, acuminate, 3 - 5 x 1 mm. Prophylls 3, deltoid or lanceolate, acuminate, thickened in the middle, 3.5 - 5 x 1.2 - 2.5 mm. Outer sepals 3, elliptic, concave, obtuse, ca 5 x 3 mm; inner ones 4, obovate, obtuse, entire, 7 - 8 x 5 - 6 mm. Petals 6, obovate, clawed at base, hooded and emarginate at tip, 4.5 - 5 x 4 mm; nectary glands lanceolate, ca 1 mm above the base of petals, ca 1 x 0.5 mm. Stamens ca 4 mm long; filaments ca 2.5

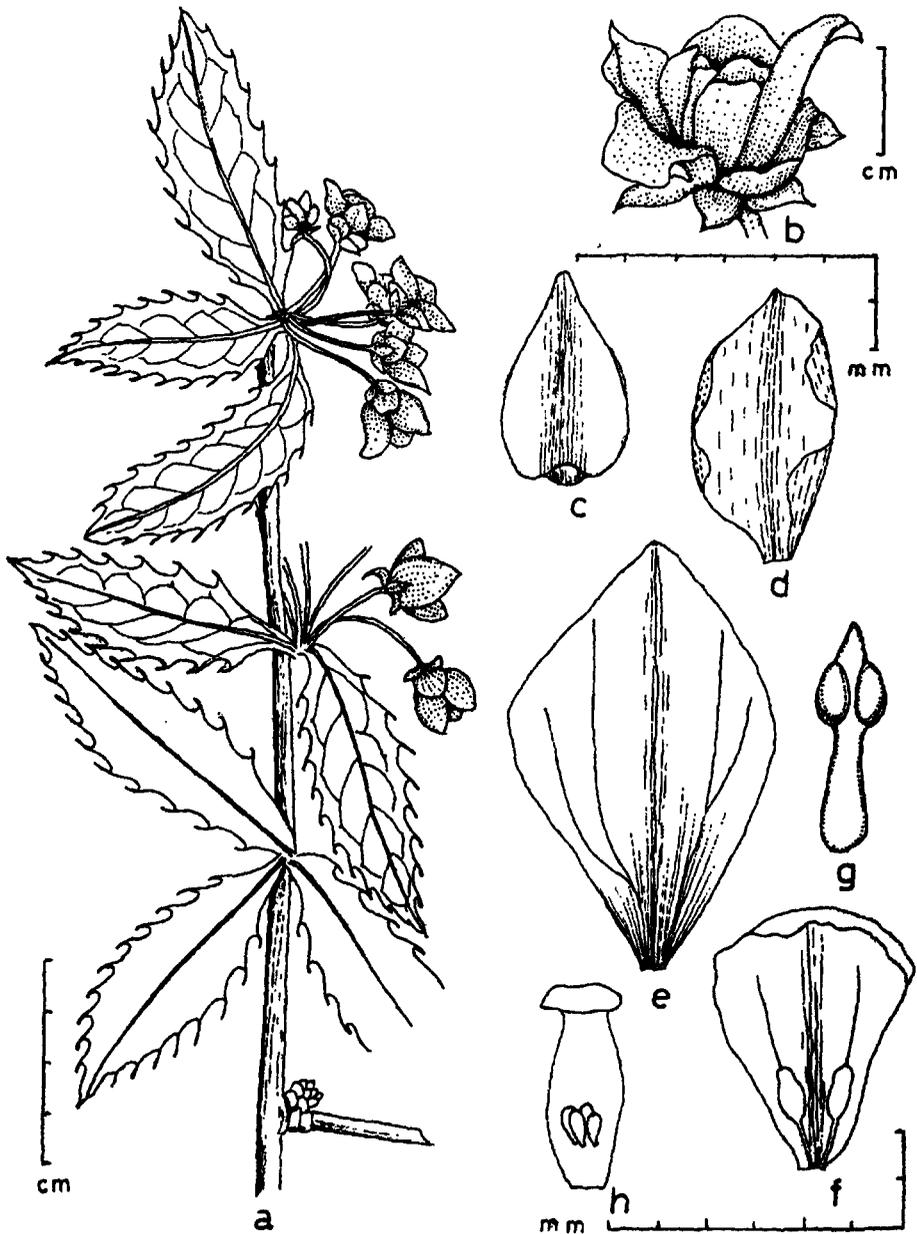


Fig. 60. *Berris dasyclada* Ahrendt: a. twig; b. flower; c. prophyll; d. outer sepal; e. inner sepal; f. petal with nectary glands; g. stamen; h. pistil with ovules inside.

mm long; anthers ca 1 mm long; connectives apiculate. Ovary oblong, ca 4 x 1.5 mm, estylose; stigma ca 1.7 mm broad; ovules 3 - 4. Berries not known.

Fl. May - June.

Distrib. India: At about 3000 - 3500 m. Arunachal Pradesh.

Endemic.

49. *Berberis insignis* Hook. f. & Thomson, Fl. Ind. 226. 1855 & in Fl. Brit. India 1: 111. 1872. *B. insignis* var. *elegantifolia* Ahrendt in J. Linn. Soc. Lond. (Bot.) 57: 37. 1961. *B. insignis* var. *gouldii* Ahrendt, l. c. 38. *B. insignis* var. *shergaonensis* Ahrendt, l. c. 37.

Fig. 61.

Shrubs, 1 - 2 m high; stems terete, yellowish or purplish to dark red, glabrous, not spiny or spines form only on lower nodes; internodes 1 - 7 cm long. Leaves 1 - 5 at each node, elliptic-lanceolate, attenuate and subpetiolate at base, acute to acuminate at apex, spiny with 2 - 4 mm long spines along margins, 4 - 16 x 2 - 4 cm, coriaceous, with hypoderm; midvein prominent, depressed above, raised beneath; lateral veins anastomosing. Flowers 5 - 14 in fascicles on 2 - 5 mm long axillary shoots; pedicels thick, 0.7 - 1.5 cm long. Prophylls 3 - 4, deltoid, 1.5 - 3 x 1 - 2 mm. Sepals 6, broadly oblong, entire and wavy along margins, 5 - 7 x 3 - 5 mm, gradually increasing in size inwards, with a few parallel veins. Petals 6, broadly oblong or obovate, emarginate, with a few parallel veins; nectary glands elongate, ovoid, ca 1 x 0.5 mm. Filaments oblong, 1 - 2 x 0.5 - 1 mm; anthers ovoid, 1 - 1.2 mm across; connective obtuse. Ovary oblong, 1.5 - 2 x 0.7 - 1 mm; style inconspicuous; stigma umbrella-like, ca 1 x 1.5 mm. Berries obovoid, oblong, 6 - 8 x 3 - 4 mm, black, uneven and irregularly reticulate on surface; style short, placed like a small cap at the top of the berry, ca 0.5 mm long. Seeds 3, obovoid, plano-convex or concave-convex, 4 - 5 x 2 - 4 mm, brownish black, not shiny, often one smaller than the other.

Fl. May - Aug.; *Fr.* Aug. - Oct.

Distrib. India: E. Himalayas, edges of forests, 2000 - 3350 m. West Bengal, Sikkim and Arunachal Pradesh.

Nepal, Bhutan and China (Tibet).

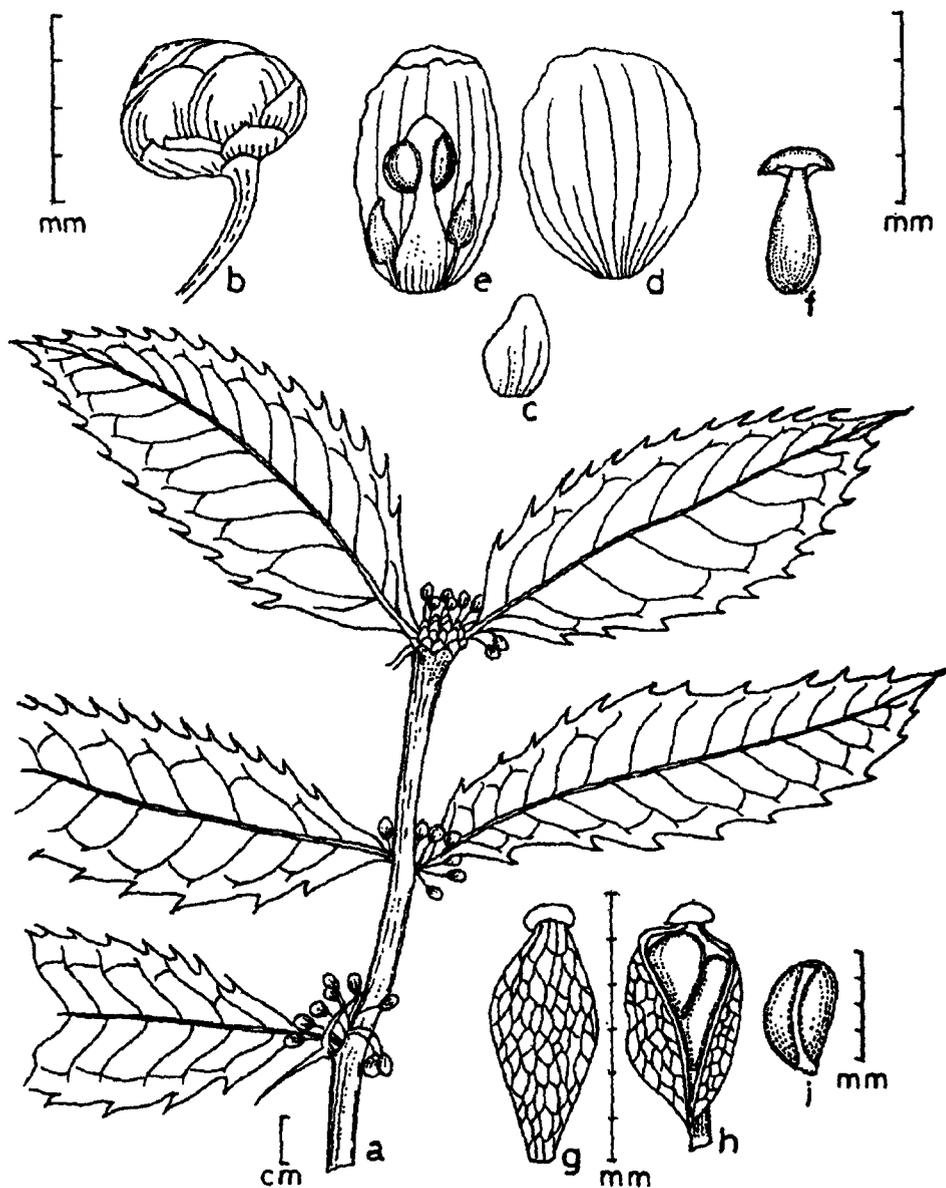


Fig. 61. *Berberis insignis* Hook. f. & Thomson : a. twig with flowers; b. flower; c. prophyll; d. sepal; e. petal with glands and stamen; f. pistil; g. berry; h. berry with seeds inside; i. seed

Subsection 4. M A N I P U R A N A E Ahrendt

(Syamali Dasgupta)

Stems glabrous; internodes 1.5 - 5 cm long. Leaves evergreen, fairly thin, without hypoderm, mostly reticulate. Ovules 2 - 5. Berries often pruinose, estylose.

India, Myanmar, China and Taiwan.

KEY TO THE SPECIES

- | | |
|---|--------------------------|
| 1a. Leaves 4.5 - 8.5 x 1 - 3 cm, greenish epruinose beneath | 50. <i>B. manipurana</i> |
| b. Leaves 2.3 x 1 - 1.5 cm, whitish pruinose beneath | 51. <i>B. wardii</i> |

50. *Berberis manipurana* Ahrendt in Kew Bull. 1939: 262. 1939 & in J. Linn. Soc. Bot.Lond.(Bot.)57:47.1961. Fig. 62.

Shrubs ca 3 m high; stems angled, sparsely branching, glabrous, upper verrucose, lower terete; internodes 2 - 6 cm long; spines 2 - 6 from a node, concolorous, sulcate, 5 - 30 mm long; middle ones longer. Leaves oblong to ovate-elliptic, attenuate at base to form 2 - 4 mm long petiole, acute-mucronate at apex, spinulose along margins, 4.5 - 8.5 x 1 - 3 cm, lustrous above, sublustrous beneath, epruinose; hypoderm absent. Flowers 6 - 15, fascicled; pedicels 15 - 20 mm long, slender, glabrous. Prophylls 2, ovate, acute, thickened in the middle, concave. Outer sepals 3, ovate or oblong-ovate, acute, thickened in the middle, concave, obtuse. Petals 6, obovate, emarginate, 4.5 - 8.5 x 2.5 - 7.5 mm, glandular. Stamens 3 - 5.5 mm long; anthers ovoid, 1.5 mm long; connective tip 2-dentate. Ovary oblong, 3.5 x 1.2 mm, estylose; stigma ca 1.5 mm broad; ovules 2 - 5. Berries oblong, 7 - 10 x 4 - 6 mm, not shiny, pruinose blue.

Fl. March - May; *Fr.* June - Oct.

Distrib. India: In Oak-Magnolia forests, 1500 - 2500 m. Manipur and Meghalaya.

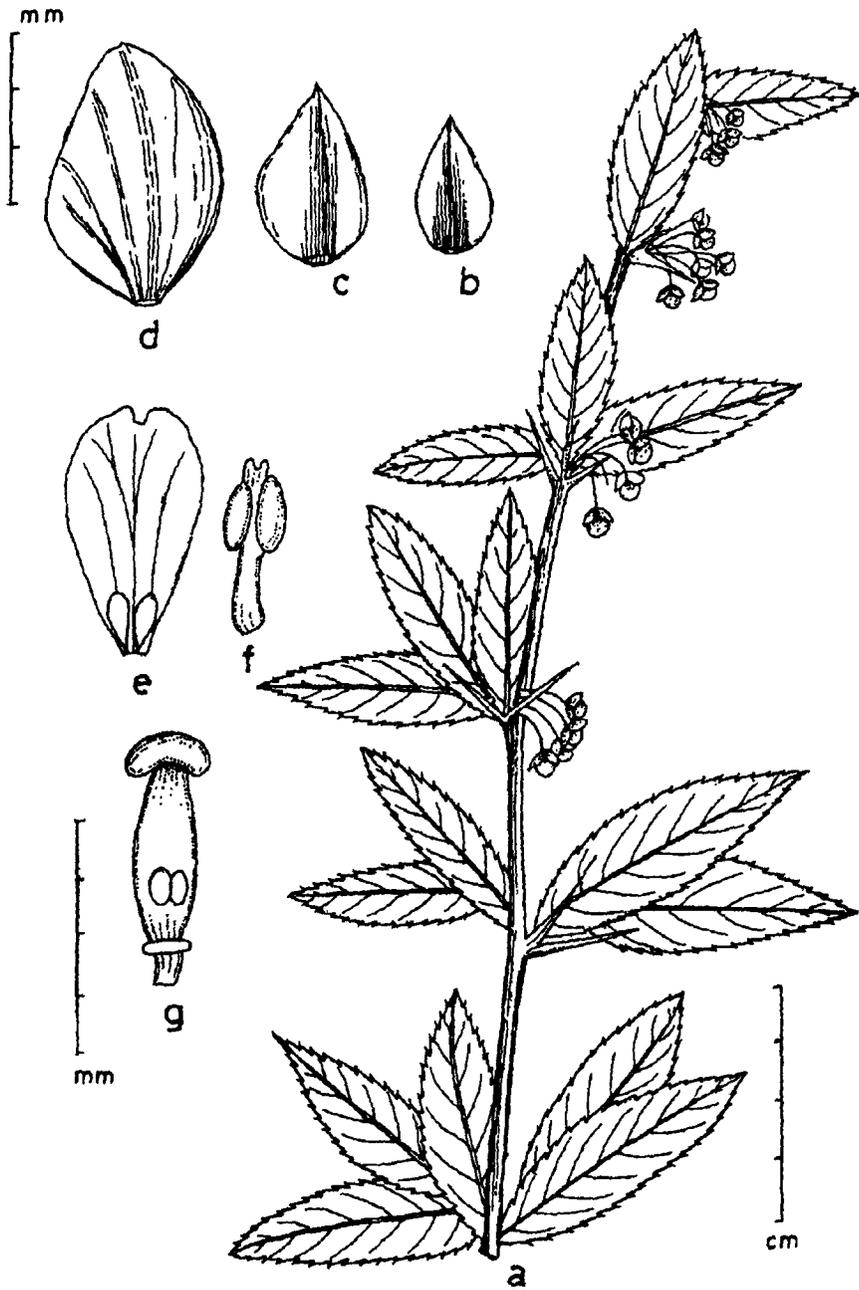


Fig. 62. *Berberis manipurana* Ahrendt : a. twig; b. prophyll; c. outer sepal; d. inner sepal; e. petal with glands; f. stamen; g. pistil.

51. *Berberis wardii* Schneider in Fedde, Repert. Spec. Nov. 46: 262. 1959.

Profusely leafy thickly bushy shrubs; stems angled; shoots purple, finally yellow; internodes ca 1 cm long; spines ca 1 cm long. Leaves 6 - 8 from each node, elliptic to ovate-elliptic, 5 - 9 spinulose along margins, 2 - 3 x 1 - 1.5 cm, deep greyish green, pruinose or waxy white beneath; lateral and marginal veins and a few veinlets elevated. Flowers 2 - 5, fascicled; pedicels 1.5 - 2.5 cm long, red. Prophylls small. Outer sepals ovate, obtuse, ca 4 x 3 mm; inner sepals oblong-elliptic to oblong-ovate, subentire. Petals obovate, oblong, clawed at base, emarginate, ca 8 mm long; nectarial glands oblong. Stamens slightly produced, crenulate with shortly apiculate centre. Ovary ellipsoid; stigma sessile; ovules sessile. Berries shortly stylose, blue black.

Fl. Aug. - Oct.; *Fr.* Nov. - Dec.

Distrib. India: Open grassy places, 3000 - 3200 m. Nagaland.

Endemic.

Notes. Chamberlain & Hu (in Notes R. Bot. Gard. Edinb. 42: 529 - 557. 1985) treated the above 2 species under the section *Wallichianae*.

Subsection 5. R E P L I C A T A E Ahrendt

(R. N. Banerjee)

Stems either terete or subterete or conspicuously sulcate, yellow when mature, always glabrous; internodes 1.5 - 2.5 cm long. Leaves enervate or sub-enervate, very revolute along margins. Flowers 3 - 12 (-25), fascicled. Ovules 1 - 4.

India, Bhutan, Myanmar and China (S.E. Tibet and W. Yunnan).

KEY TO THE SPECIES

- 1a. Leaves dull; flowers 4 - 8 fascicled; pedicels 16 to 20 mm long; petals emarginate at apex; ovules 3 - 4
52. *B. griffithiana*
- b. Leaves shiny; flowers 6 - 15 fascicled; pedicels up to 15 mm long; petals rounded at apex; ovules 1(-2)
53. *B. praecipua*

52. *Berberis griffithiana* Schneider in Bull. Herb. Boiss. ser. 2, 5: 403. 1905. *B. bhutanensis* Ahrendt in J. Bot. Lond. 79(suppl.): 17. 1941.

Evergreen shrubs, 1 - 3 m tall; stems subterete, yellowish; young ones grooved; spines up to 2 cm long, smaller above. Leaves sessile, linear-lanceolate to elliptic-lanceolate, attenuate or cuneate at base, spinulose at apex and margins, thickened with up to 15, ca

1.5 mm long spines, 4 - 8 mm apart along margins, ca 7.5 x 1.3 cm, glabrous, glandular; midrib projecting beneath, impressed above. Flowers in axillary fascicles of 3 - 7; pedicels 16 - 20 mm long; bracts in two whorls, concave, linear, spinulose. Prophylls ca 2 x 1 mm. Sepals 10; outermost 4, 2 - 3 mm long; middle ones ca 5 mm long; innermost ones obovate-elliptic, 7 - 9 x 4 - 6 mm. Petals 6, obovate to oblanceolate, invaginated at apex, 5 - 6 x 3 - 4 mm. Stamens 6, 2 free and 4 adnate to the petals 2 - 3 mm long; filaments thick, produced beyond the two anther lobes. Ovary cylindrical; ovules 2 - 4; style ca 3 mm long; stigma peltate. Berries obovoid, 8 - 10 x 3 - 4 mm, reddish.

Fl. April - May.

Distrib. India: Above 1700 m. Meghalaya.

Bhutan and China (S.E. Tibet).

53. *Berberis praecipua* Schneider in Fedde, Repert. Spec. Nov. 46: 248. 1939. *B. subpteroclada* Ahrendt var. *minoripes* Ahrendt in J. Linn. Soc. Lond. (Bot.) 57: 73. 1961.

Bushy shrubs, 1 - 1.5 m high; stems rusty, scabrous, terete, swollen at the nodes. Leaves oblong-elliptic to elliptic-lanceolate, mucronate, spinulose-serrate with up to 1 mm long, 3 - 4 mm distant, 11 - 30 spinules along margins, 15 - 45 x 5 - 10 mm; lateral nerves 8 - 10, transverse, prominent beneath. Flowers ca 30 in fascicles of 5 - 15; pedicels 10 - 15 mm long. Outer sepals 4, 2 - 3 mm long; inner sepals 3, imbricate, 5 - 5.5 x 2 - 3.5 mm. Petals 7, ca 4 mm long. Stamens 6, 3 - 4 mm long; filaments thick, adnate to petals. Ovary oblong; stigma capitate; ovules 1 - 2. Seeds oblong, black.

Fl. April - June; *Fr.* July - Oct.

Distrib. India: ca 2500 m. Arunachal Pradesh.

Nepal and Bhutan.

Subsection 6. S U B L E V I S Ahrendt

(D. N. Guha Bakshi)

Stems very sulcate, yellow on maturity; internodes ca 2 cm long; spines 3-fid. Leaves evergreen, subcoriaceous. Flowers small, 6 - 9 mm in diam., fascicled. Petals emarginate. Stamens distinctly produced. Ovules solitary. Berries black, epruinose.

India and China (W. Yunnan).

54. *Berberis sublevis* W. Smith in Notes R. Bot. Gard. Edinb. 9: 83. 1916.

Stems more or less verruculose; spines ca 1.5 cm long; internodes ca 2.5 cm long. Leaves evergreen, lanceolate acuminate, with 10 - 18 subappressed spinules along margins or subtire, 2.5 - 8 x 0.5 - 4 cm, subcoriaceous; petioles 1 - 4 mm long. Prophylls ovate, acute, red. Outer sepals ovate, subacute, ca 2.5 x 2 mm, reddish; inner sepals obovate to oblong-elliptic, ca 5 x 3 mm. Petals clawed, ca 5.5 x 3 mm; glands 1.5 x 0.5 mm. Stamens obtuse, ca 3.5 mm. Berries 6 - 7 x 3 - 3.5 mm, black, estylose.

KEY TO THE VARIETIES

- | | |
|--|------------------------------|
| 1a. Leaves with 15 - 30 marginal spinules; fascicles 3 - 10-flowered | 54.1. var. microcarpa |
| b. Leaves entire; fascicles 10 - 50-flowered | 54.2. var. sublevis |

54.1. var. microcarpa (Hook. f. & Thomson) Ahrendt in J. Linn. Soc. Lond. (Bot.) 57: 58. 1961. *B. sublevis* var. *prainiana* Schneider in Bot. Mag. 157, sub t. 9153. 1928. *B. wallichinana* var. *microcarpa* Hook. f. & Thomson, Fl. Ind. 226. 1855 & in Fl. Brit. India 1: 111. 1872.

Fl. Feb. - May; *Fr.* June - Aug.

Distrib. India: 1500 - 2500 m. Manipur, Meghalaya.

China (W. Yunnan).

54.2. var. sublevis

Fl. May - June; *Fr.* July - Dec.

Distrib. India: Manipur (ca 2600 m).

Endemic.

2. *Epimedium* L.

(R. R. Rao and P. K. Hajra)

Perennial herbs; rootstocks creeping. Leaves ternately compound; stipules short. Flowers usually white or sometimes yellowish white, in racemes or panicles, 2-merous, pendulous, sometimes with glandular hairs on stalk. Sepals 8, petaloid, in 2 opposite series; outer smaller. Petals 4, opposite to the sepals, hooded or spurred. Stamens 4, opposite to petals; anther-thecae opening by recurved valves. Ovary 1; style subulate; stigma dilated; ovules few to many, 2-seriate on the ventral suture. Capsules elongate, unequally 2-valved. Seeds few, smooth, almost black.

India, N. Africa, Italy, N. E. Asia and Japan; ca 21 species, one in India.

Epimedium elatum Merr. & Decsne in Ann. Soc. Nat. ser. 2, 2: 356. 1834.

Herbs, 50 - 140 cm high, slender, glabrous; rhizomes 3 - 5 mm thick. Leaves 2 - 3-ternate, 15 - 30 cm across; leaflets ovate-cordate, spinous-toothed, laterally oblique, 1.5 - 6.5 x 1.2 - 3.5 cm. Panicle glabrous or glandular, up to 30 cm long; bracts minute; pedicels filiform, 5 - 20 mm long. Sepals ovate-lanceolate, acute, 1 - 2 mm long; inner ones 1.5 - 2.5 mm long. Petals 2 - 3 mm long. Stamens ca 5 mm long; anthers linear, ca 1.5 mm long; filaments equal to the ovary. Ovary linear; style slender, persistent. Capsules short, stout. Seeds 2 - 3, black.

Fl. June - July; *Fr.* Aug.

Distrib. India: W. Himalayas, 2000 - 3000 m. Jammu & Kashmir.

Notes. The plant is a strong mosquito repellent.

3. *Mahonia* Nuttall

(D. N. Guha Bakshi)

Erect or climbing shrubs, unarmed or sometimes spiny. Leaves alternate, simple or 1-pinnate, herbaceous or coriaceous, exstipulate; rachis articulated at each leaflet node. Flowers solitary or several to many in fascicled racemes, bisexual, actinomorphic. Sepals usually in 3 series of 3 each, yellow. Petals similar, usually 6 in 2 series of 3 each, free, yellow or greenish, sometimes tinged red, each with 2 oblong glands near the base. Stamens 6, slightly adnate to the base of the petals; anthers opening by valves. Ovary consisting of a single carpel, superior; ovules few, basal; style short or absent; stigma rounded. Fruit a berry. Seeds with conspicuous endosperm.

Himalayas, China to Japan, Taiwan, Thailand, Philippines and N. & C. America; ca 70 species, 13 in India.

Literature. AHRENDT, L. W. A. (1961) Berberis & Mahonia - a taxonomic revision. *J. Linn. Soc. Lond. (Bot.)* 57: 296 - 398.

KEY TO THE SPECIES

- 1a. Stamens dentate
- b. Stamens edentate
- 2a. Racemes 15 - 33 cm long; pedicels 7 - 10 mm long; ovules 5 - 6
- b. Racemes 5 - 9 cm long; pedicels 3 - 4 mm long; ovules 4

6. *M. leschenaultii*
12. *M. sikkimensis*

- | | |
|---|----------------------------|
| 3a. Bracts longer than pedicels | 4 |
| b. Bracts shorter than pedicels or subequal or equal | 6 |
| 4a. Petals and inner sepals equal inside; style absent or very short | 3. <i>M. calamianensis</i> |
| b. Petals smaller than inner sepals; styles 1 - 2 mm long | 5 |
| 5a. Pedicels 1 - 2 mm long; inner sepals ca 6 x 3 mm; style ca 1 mm long | 4. <i>M. feddei</i> |
| b. Pedicels 1 - 2 mm long; inner sepals 8 - 8.5 x 3 - 3.5 mm; style 1 - 2 mm long | 2. <i>M. borealis</i> |
| 6a. Leaflets broader 1: 1 - 2.8, with 2 - 6 marginal teeth | 7 |
| b. Leaflets narrow, 1: 3 - 4, with 7 - 11 marginal spinules (rarely up to 18) | 11 |
| 7a. Racemes 14 - 22 cm long | 8 |
| b. Racemes 4 - 12 cm long | 9 |
| 8a. Inflorescence of 3 - 4 fascicles; bracts 2.5 - 3 x 1.2 - 1.5 cm; ovules 3 - 4. | 1. <i>M. acanthifolia</i> |
| b. Inflorescence of ca 10 fascicles; bracts ca 1.2 x 7 mm; ovules 2 | 10. <i>M. pycnophylla</i> |
| 9a. Style 8 - 10 mm long | 5. <i>M. jaunsarensis</i> |
| b. Style 3 - 4 mm long | 10 |
| 10a. Leaflets 4 - 5 paired, mostly separate; stamens not produced, truncate | 11. <i>M. roxburghii</i> |
| b. Leaflets 7 - 9 paired, mostly overlapping; stamens produced, obtusely subapiculate | 8. <i>M. manipurensis</i> |
| 11a. Pedicels 6 - 8 mm long; floral bracts 4 - 6 mm long | 9. <i>M. napaulensis</i> |
| b. Pedicels 2 - 4 mm long; floral bracts 1 - 2.5 mm long | 12 |
| 12a. Margins of leaflets 7 - 11 spinose; style very short | 13. <i>M. simonsii</i> |
| b. Margins of leaflets 10 - 18 spinose; style 1 - 1.5 mm or longer | 7. <i>M. magnifica</i> |

1. Mahonia acanthifolia G. Don, Gen. Syst. 1: 118. 1831.

Leaves oblong-lanceolate up to 48 x 12 cm; stipules filiform, 5 - 7 mm long; leaflets 8 - 11 pairs, lowermost pair smaller, semicircular, fairly thick and rigid; lateral leaflets broadly to narrowly oblong-ovate, truncated at base, 2 - 4 spinulose along margins, 4.5 - 6.5 cm long; terminal leaflet large, 6.5 - 7.5 x 3.5 - 4.4 cm, with ca 1.5 cm long petiole. Racemes 15 - 23 cm long, in fascicles of 3 - 4; rachis 2.5 - 4 mm thick; bracts 2.5 - 3 x 1.2 - 1.5 cm; pedicels filiform, more or less drooping near the apex. Sepals in 3 series; outer broadly ovate, acute, ca 2 mm long, 5 - 7-nerved; median sepals ovate, obtuse, 4 - 5 mm long, ca 3 mm broad, 5-nerved; inner ones oblong-elliptic, 7 - 8 x ca 3 mm, 2-lobed at apex, edentate. Stamens ca 3.5 mm long, distinctly conical-apiculate at apex. Ovules 2 - 4; style ca 1 mm long. Berries ovoid, 8 - 10 mm long, blue-black, pruinose; style distinctly coronate.

Fl. & Fr. Oct. - March.

Distrib. India: 2000 - 3000 m. Sikkim, West Bengal and Nagaland

Nepal.

2. Mahonia borealis Takeda in Notes R. Bot. Gard. Edinb. 6: 221. 1917.

Shrubs. Leaves oblong-oblongate, with 5 - 9 pairs of usually separate leaflets; the lowermost pair very small, truncate or rotundate-cuneate and oblique at base, spinose dentate along margins, 5 - 10 x 1.5 - 2 cm, chartaceous to subcoriaceous, smooth above, dull beneath, 5-nerved; veins conspicuously raised on both surfaces. Racemes 5 - 20, fascicled, densely flowered; rachis thick, 5 - 10 cm long; pedicels thick, 3 - 4 mm long; floral bracts 3 - 5 mm long. Outer sepals ovate, acute, ca 5 x 2.5 mm; median sepals oblong-ovate, subacute, ca 7 x 2.5 - 3 mm; inner ones oblong-obovate, 8 - 8.5 x 3 - 3.5 mm. Petals oblong, acutely emarginate at apex, 5 - 6 x 3 - 3.5 mm; glands distinct. Stamens slightly swollen below the anthers, apiculate. Ovules 3 - 4. Berries subglobose, ovoid, 5 - 8 x 5 mm, pruinose, blue-black.

KEY TO THE VARIETIES

- | | |
|--|---------------------------|
| 1a. Racemes 5 - 12 cm long; fruits ovoid | 2.1. var. borealis |
| b. Racemes 12 - 20 cm long; fruits globose | 2.2. var. parryii |

2.1. var. borealis

Distrib. India: W. Himalayas, 2000 - 2500 m. Jammu & Kashmir, Himachal Pradesh and Uttar Pradesh.

Endemic.

2.2. var. parryii Ahrendt in J. Linn. Soc. Lond. (Bot.) 57: 308. 1961.

Lus. : Puallang.

Fl. & Fr. Feb. - April.

Distrib. India: ca 2000 m. Mizoram.

Endemic.

Notes. A yellow dye is made from the sap.

3. Mahonia calamicaulis Sparre & Fisch. in Bull. Misc. Inf. Kew 1929: 249. 1929.

Undershrubs, 60 - 90 cm high, glabrous; stems yellowish brown, shiny, marked with scars of fallen leaves. Leaves 15 - 30 cm long; leaflets 4 - 7 pairs, with the lowest pair only 5 mm from the base, sessile, ovate to lanceolate, cuneate at base, 7.4 - 11.4 x 1.5 - 3.0 cm long; pseudo-petiole 5 - 10 cm long. Racemes 6 - 12 cm long, fascicled; peduncles up to

2 cm long; bracts of the inflorescence ca 1.7 cm long; pedicels 3 - 5 mm long, with 6 - 10 mm long floral bracts. Outer sepals small, ovate to suborbicular; median and inner sepals equal, oblong, ca 5 mm long. Petals narrowly obovate, emarginate with obtuse lobes, ca 5 mm long. Stamens 6, 3 - 4 mm long. Ovules 4; stigma sessile, depressed, capitate.

Fl. & Fr. April - May.

Distrib. India: E. Himalayas, 2500 - 3000 m. Arunachal Pradesh.

China (S.E. Tibet.)

4. *Mahonia feddei* Ahrendt in J. Linn. Soc. Lond. (Bot.) 57: 303. 1961.

Shrubs, 1 - 2 m high. Leaflets 4 - 6 pairs, 7.5 - 9 x 5 - 6 cm; the basal pair at 1 - 1.5 cm above base; terminal one oblong-elliptic, 3 - 6-spinose along margins, with indistinct cusp, ca 11 x 8 cm, openly and loosely veined, yellowish-green below. Racemes 6 - 11 cm long; flowers golden yellow; pedicels ca 1.5 mm; bracts 3 - 4 mm long. Outer sepals oblong, 2.5 - 1.5 mm long; median sepals elliptic-obovate, ca 4 x 2.75 mm; inner sepals elliptic, ca 6 x 3 mm. Petals elliptic-obovate, shortly acutely emarginate with two acute lobes at apex, ca 4.5 x 2.25 mm; basal glands distinct. Stamens ca 4 mm long. Ovules solitary. Style 1 mm or longer.

Fl. & Fr. April - July.

Distrib. India: Manipur (2500 m).

Endemic.

5. *Mahonia jaunsarensis* Ahrendt in J. Linn. Soc. Lond. (Bot.) 57: 310. 1961.

Shrubs. Leaves obovate, up to 28 x 13 cm; leaflets 5 - 7 pairs, broadly ovate to lanceolate, broadly cuneate at base, rounded or subtruncate at apex, 3 - 5 spinose-dentate along margins, 3.5 - 7 x ca 3.5 cm, slightly lustrous above, with subelevated and subreticulate veins on both sides; terminal leaflet ca 9 x 4 cm with 1.5 - 2 cm long petiole. Racemes 7 - 14 cm long, in 5 fascicles; bracts 1.5 cm long; pedicels 5 - 7 mm long; floral bracts 2 - 3.5 mm. Berries ovoid, 8 x 5 mm, pruinose, blue.

Fl. & Fr. April - July.

Distrib. India: Common in moist places in Oak forests near Chakrata, ca 2000 m. Uttar Pradesh.

Endemic.

6. *Mahonia leschenaultii* (Wight & Arn.) Takeda in Notes R. Bot. Gard. Edinb. 6: 223. 1917. *Berberis leschenaultii* Wight & Arn., Prodr. 1: 16. 1834. *B. nepalensis* var. *leschenaultii* Hook. f. & Thomson in Fl. Brit. India 1: 109. 1872.

Large shrubs or small trees; bark corky. Leaves oblong to oblanceolate, up to 48 x 13 cm; leaflets 7-10 pairs, broadly oblong, rotundate-subtruncate or truncate at base, 4 - 8 spinulose dentate along margins, 3 - 9 x 2 - 5 cm (the lowermost pair ca 1 cm long), thick, rigid, coriaceous, shiny above, pale beneath; secondary veins prominent. Racemes generally fascicled, often robust, ca 30 cm long, dense-flowered; pedicels ca 10 mm long, erect, thin; floral bracts 2-3 mm long. Outer sepals broadly ovate, obtuse, ca 3 x 3 mm; median sepals oblong-ovate, 4 - 5 x 3 - 4 mm; inner sepals oblong-ovate, 6 - 7 x ca 4 mm. Petals 5 - 6, acutely emarginate with rounded lobes at apex, ca 4 mm long; basal glands distinct. Stamens scarcely produced, truncate. Ovules 5 - 6. Berries subglobose, ca 7 - 8 mm long, excluding ca 1 mm long style, pruinose, blue.

Fl. & Fr. June - Dec.

Distrib. India: ca 2500 m. Tamil Nadu (Nilgiris).

Endemic.

7. *Mahonia magnifica* Ahrendt in J. Linn. Soc. Lond. (Bot.) 57: 309. 1961.

Small trees, branching repeatedly. Leaves up to 50 x 25 cm; the basal pair 5 - 20 mm above the base; lateral leaflets 10 - 11 pairs, lanceolate, broadly cuneate to subrounded at base, 10 - 18 spinose-serrate along margins, 10 - 14 x 1.8 - 3.5 cm, dull above, indistinctly openly reticulate. Racemes 10 - 20 cm, erect, fascicled; flowers ca 12, brilliant yellow; bracts 12 - 15 x 6 - 8 mm; pedicels 2 - 5 mm, slender. Outer sepals oblong-ovate, 2 - 3 x 6 - 8 mm; median sepals elliptic, ca 5 x 2.5 - 3 mm; inner sepals oblong-elliptic, ca 6.5 x 3 mm. Petals ca 4.5 x 2.5 mm. Stamens 3.5 - 4 mm, scarcely produced, truncate. Styles 1 - 1.5 mm or longer.

Distrib. India: Manipur.

Endemic.

8. *Mahonia manipurensis* Takeda in Notes R. Bot. Gard. Edinb. 6: 222. 1917.

Leaves oblong, close to the stipules, ca 30 - 40 x 8 - 10 cm; leaflets 7 - 9 pairs, overlapping, ovate to broadly ovate, with inconspicuous apical cusp, coriaceous, glabrous above, dull beneath; lower leaflets oblong-quadrate. Racemes 4 - 8 cm long, in 3 - 5 fascicles; bracts 10 - 15 mm long; pedicels slender, ca 3 mm long; bracts 2.5 - 3.5 mm long. Outer sepals ovate, ca 4 x 2 mm; median sepals oblong-ovate, obtuse, ca 7 x 4 mm; inner ones elliptic or oblong-obovate, 8 - 9 x 4 - 5 mm. Petals oblong, ovate, bilobed

at apex, ca 7 x 5 mm. Stamens produced, obtusely subapiculate; connectives depressed, triangular; anthers shorter than filaments. Ovules 1 - 2. Style short.

Fl. & Fr. Jan. - April.

Distrib. India: Manipur.

Myanmar.

9. *Mahonia napaulensis* DC., Syst. Nat. 2: 21. 1821 & Prodr. 1: 109. 1824. *Berberis nepalensis* (DC.) Spreng., Syst. Veg. 2: 120. 1825; Hook. f. & Thomson in Fl. Brit. India 1: 109. 1872, p. p.

Kh.: *Dieng-niang-mat, Dieng-la-ranong*; Nep.: *Chutro, Kesari, Lek-chutra*.

Shrubs, 1 - 3 m tall; stems leafy at the ends of branches; bark soft, corky. Leaves sheathed at base with a pair of subulate stipules, 30 - 45 x 12 cm long, coriaceous; leaflets opposite, 6 - 12 pairs, basal pair ca 2 x 1.5 cm at ca 1 cm above base; lateral pairs oblong-ovate to lanceolate, rarely suborbicular, rounded or truncate at base, acute at apex, coarsely 3 - 7 spinose-dentate along margins, 3 - 8 x 2 - 4 cm, glabrous, shiny above, pale beneath, strongly 3 - 5 nerved from base; terminal leaflet lanceolate, ca 9 x 4 cm. Racemes erect, 10 - 25 cm long, pendulous in fascicles of 6 - 10, each from axil of a bract; bracts oblong-ovate, concave, 3 - 6 x 1.5 - 3 mm, hyaline, caducous; bracteoles small, broadly ovate to oblong, concave, caducous; pedicels 5 - 10 mm long. Sepals 6 in 2 series, imbricate, oblong-ovate to obovate, emarginate with rounded lobes at apex, 2 - 8 x 2 - 4 mm, petaloid. Petals 6 in 2 series, obovate, 4.5 - 6 x 2.5 - 4 mm, glandular at base. Stamens 6, sensitive; anthers dehiscent by ascending valves. Ovules 4 - 5. Berries ellipsoid to subglobose, 9 - 12 x 5 - 7 mm, purple to blue-black, glaucous; style up to 2 mm long.

Fl. Nov. - Dec.; *Fr.* Dec. - Feb.

Distrib. India: Edges of Oak and Rhododendron forests, 1500 - 3000 m. Sikkim and Meghalaya

Nepal and Bhutan.

10. *Mahonia pycnophylla* (Fedde) Takeda in Notes R. Bot. Gard. Edinb. 6: 210. 1917. *Berberis nepalensis* (DC.) Spreng. var. *pycnophylla* Fedde in Bot. Jahrb. 31: 124. 1901.

Leaves oblong, ca 30 x 15 cm; leaflets 5 - 6 pairs, mostly contiguous, lowermost pair equalling stipules, rotundate at base, 3 - 5 spinose along margins, without a distinct apical cusp, coriaceous, rigid, glabrous above, pale beneath; petioles dilated at base; stipules

filiform, ca 10 mm long. Racemes 10 - 12 cm long, fascicled; bracts of inflorescence ca 12 x 7 mm; pedicels slender, 5 - 7 mm long; bracts ca 2 mm long. Sepals ovate, 5 - 6 x ca 3 mm; outer sepals ovate-obtuse, 2 - 2.5 x 2 mm; inner sepals elliptic, ca 7 x 3.5 mm. Petals elliptic-lanceolate, 2-lobed at apex, ca 5 mm long. Stamens ca 3.5 mm long, conical, apiculate, ca 3.5 mm long. Ovules 2. Style minute.

Fl. & Fr. May.

Distrib. India: ca 1500 m. Meghalaya.

Endemic.

11. *Mahonia roxburghii* (DC.) Takeda in Notes R. Bot. Gard. Edinb. 6: 218. 1917. *M. napaulensis* var. *roxburghii* DC., Prodr. 1: 109. 1824. *Berberis pinnata* Roxb., Fl. Ind. 2: 184. 1832.

Slender shrubs, 2 - 3 m tall; leaflets 4 - 5 pairs; lowermost pair about 2 cm above base; lateral leaflets oblong, rotundate or cuneate at base, 3 - 5-toothed along margins, 6 - 8 x 3 - 4 cm, coriaceous, dull above, pale beneath, 5-nerved at base. Racemes 8 - 12 cm long with slender rachis; pedicels slender, ca 4.5 mm long; floral bracts 2 - 2.5 mm long. Outer sepals ovate, ca 4 x 3 mm; median sepals oblong-ovate, ca 7 x 4 mm; inner sepals elliptic, 8 x 3 mm. Petals oblong-elliptic with obtuse lobes, ca 7 x 3 mm. Stamens not produced, truncate. Ovules 2. Style short.

Distrib. India: Manipur.

Endemic.

Notes: Takeda (l. c.) observes that among the known Indian species, this is very distinct in having the stamens with truncate connectives. The leaves and flowers are very different from those of *M. napaulensis*.

12. *Mahonia sikkimensis* Takeda in Notes R. Bot. Gard. Edinb. 6: 220. 1917.

Leaves large; leaflets 8 - 12 pairs, mostly over-lapping or contiguous, the lowest pair at 8 - 15 mm above base, ca 2.5 x 1.5 cm; lateral leaflets ovate or oblong-ovate, truncate or subtruncate at base, more or less dentate, 4 - 8 x 2 - 3.5 cm coriaceous; lower leaflets 3 - 6 toothed; nerves prominent beneath. Racemes densely fascicled, 5 - 9 cm long; bracts ovate-oblong, obtuse, 3 - 4 x ca 2 mm; pedicels ca 4 mm long. Outer sepals ovate-acute, 3.5 - 4 x 1.5 - 2 mm; median sepals oblong-ovate, acute, ca 6 x 3 mm; inner sepals similar, ca 7 x 3.5 mm. Petals oblong-elliptic, acutely emarginate with rounded lobes at apex, ca 6 x 3 mm; basal glands conspicuous. Stamens apiculate. Ovules 4. Style short.

Distrib. India: Sikkim (ca 2500 m).

Endemic.

13. *Mahonia simonsii* Takeda in Notes R. Bot. Gard. Edinb. 6: 222. 1917.

Leaves with 6 - 9 pairs of contiguous leaflets; petioles short, dilated at base; stipules slender; leaflets 6 - 9 pairs, the lowermost pair smallest and near to the stipule, second pair at a good distance from the lowest pair, lanceolate, rotundate-subcuneate at base, acuminate at apex, serrate-dentate along margins, with 6 - 10 teeth in lower leaflets and 5 - 8 in upper ones, 7 - 11 x 2 - 3 cm, subcoriaceous, shiny yellowish. Racemes 10 - 15 cm long with 8 flowers in fascicles; rachis rather thick, loosely flowered at base; bracts minute, ca 2 mm long, triangular. Sepals in 3 series; outer smallest, elliptic-ovate, 3-nerved, ca 2 x 1.5 mm; median sepals elliptic-oblong, ca 5 x 2 mm; inner ones oblong-obovate, 3-nerved, ca 7 x 3 mm. Petals oblong, bilobed, ca 5 x 2 mm. Stamens slightly shorter than petals; filaments edentate, slightly longer than anther. Ovary short-styled; ovules 2 - 3.

Fl. Nov.

Distrib. India: Meghalaya.

Endemic.

PODOPHYLLACEAE

(R. R. Rao and P. K. Hajra)

Herbs, perennial, with fleshy roots, rhizomatous; stems erect, unbranched. Leaves 2 (-3), alternate or subopposite at apex of stem, simple, rarely 3-foliolate, deeply palmately lobed and serrate, or sometimes bipartite, exstipulate, palmately veined. Inflorescence terminal cymes, fascicles, subumbels, racemes, spikes, panicles or flowers solitary. Flowers actinomorphic, bisexual, erect or pendulous. Perianth parts 9 (-18), imbricate, in 2 - 3 series; outer 3 sepaloid, fugaceous; inner 6 petaloid. Stamens (3-) 6' (-18); anthers basifixed, extrorse, opening by longitudinal slits; connective shortly produced. Ovary a solitary carpel, superior, 1-locular; ovules one to numerous, marginal; stigma peltate. Fruit a fleshy berry or dehiscent follicles; seeds many.

Himalayas to E. Asia and eastern N. America; 6 genera and ca 20 species, one genus and 2 species in India.

Literature. CHATTERJEE, R. (1953) Studies in Indian Berberidaceae from botanical, chemical and pharmaceutical aspects. *Rec. Bot. Surv. India* 16(2): 1 - 86. 1953. JAFRI, S. M. H. (1974) Podophyllaceae. In: *Fl. W. Pakistan* 57: 1 - 4.

Podophyllum L.

Herbs, scapigerous; rootstock creeping, scaly at base. Leaves 2 (rarely 3), alternate, at the apex of stem, peltate, palmately lobed. Flowers 1 - 3, on petioles of upper leaf, large, pendulous, white, rose-cloured. Perianth parts 9 in 3 series, outer 3, sepaloid, fugaceous, inner 6 petaloid. Stamens as many as or twice as many as the petals; anther locules opening by longitudinal slits. Ovary solitary, simple, 1-carpeled, 1-locular; ovules many on a broad ventral marginal placenta; stigma large, sessile, peltate. Fruit a berry, fleshy, many - seeded, irregularly dehiscent. Seeds ovoid, embedded in pulp.

Afghanistan, Pakistan, India (Himalayas), Nepal, Bhutan, China to E. Asia and one in N. America; ca 6 species, 2 in India.

Literature. CHATTERJEE, R. (1952) Indian Podophyllum. *Econ. Bot.* 6: 342 - 354, ff. 1 - 12. SELIVA-NOVA-GORODKOVA, E.A. (1975) Morphology and biology peculiarities of shoots of *Podophyllum hexandrum* Royle and *P. peltatum* L. *Bot. Zhurn.* 58a(2): 273 - 284. WALLIS, T. E. & S. GOLDBERG (1937) The history of Indian Podophyllum. *Quart. J. Pharm.* 10: 311 - 318.

KEY TO THE SPECIES

- 1a. Scales of rootstock membranous; pedicels erect; flowers usually solitary 1. *P. hexandrum*
 b. Scales of rootstock chartaceous; pedicels drooping; flowers 2 2. *P. sikkimensis*

1. *Podophyllum hexandrum* Royle, *Illus. Bot. Himal.* 64. 1834; Cambess. in Jacquem., *Voy. Ind.* 2: 10, t.9. 1844. *P. emodi* Wallich ex Honigberger, *Thirtyfive years in the East* 329, t.20. 1852; Hook. f. & Thomson in *Fl. Brit. India* 1: 112. 1872, nom. illeg. *P. emodi* var. *hexandrum* (Royle) Chatterjee & Mukerjee in *Rec. Bot. Surv. India* 16(2): 45. 1953.

Hindi: *Bankakdi* (H.P.).

Herbs, erect, 15 - 30 (-45) cm high, glabrous, succulent; scales of rootstock ovate-lanceolate, up to 5 x 1 - 2 cm; stems 15 - 50 cm high, leafy at top. Leaves 2, alternate, deflexed at first, peltate, orbicular-reniform in outline, 6 - 15 x 3.5 - 10 cm, plaited at venation, palmately divided almost to base into 3 broadly elliptic or obovate segments, cuneate at base, acute at apex, serrate along margins, pubescent beneath; segments undivided or 2 - 3-lobed to middle; petioles up to 20 cm long. Flowers solitary, erect, rarely 2, cup-shaped, ca 3.5 cm across, pinkish white; peduncle erect, elongating to 2 - 3 cm in fruit, thickened. Sepals 3, broadly oblong, petaloid, caducous. Petals 6, obovate-oblong, 1 - 3 x 1 - 1.5 cm, white or pink. Stamens 6; filaments slightly flattened; anthers ca 3 mm long. Style short; stigma crest-like, ridged. Berry oblong-ovoid, 2.5 - 5(-6) x 2 - 3 cm, reddish scarlet, borne on 2 - 5 cm long pedicel. Seeds many, enveloped in pulp, obovoid or suborbicular, 2 - 3 mm across.

Fl. & Fr. April - June.

**Distrib.* India: Alpine Himalayas, 3000 - 4000 m. Jammu & Kashmir, Himachal Pradesh, Uttar Pradesh, Sikkim and Arunachal Pradesh.

Nepal, Bhutan and China.

Notes. The shape of leaves is variable. Recently this species has been placed under a separate monotypic genus, *Sinopodophyllum* Ying. See Soejarto et al. (in *Taxon* 28: 549 - 551. 1979) for discussions on the nomenclature of this species. Fruits are edible. Rhizomes are medicinal. Decoction of roots is used in diarrhoea and liver troubles. It is also used to promote conception (Kapahi in *J. Econ. Tax. Bot.* 14: 53. 1990) See Krishnamurty et al. (in *Indian For.* 91: 470 - 475. 1965) for details on the cultivation and exploitation of *Podophyllum* in India.

2. *Podophyllum sikkimensis* Chatterjee & Mukerjee in *Rec. Bot. Surv. India* 16(2): 48. 1953; Greirson & Long, *Fl. Bhutan* 1(2): 329. 1984. *P. sikkimensis* var. *emodi* Chatterjee & Mukerjee in *Rec. Bot. Surv. India* 16(2): 48. 1953.

Erect glabrous herbs, 15 - 40 cm high; rhizome stout, 2.3 - 3 cm long, 2 - 4 cm across; roots long, numerous; stems sometimes grooved, scaly near the base; scales chartaceous, short and loose-fitting. Leaves alternate, peltate, orbicular in outline, up to 25 cm across, reniform, palmately 6 - 8-partite, serrate with short teeth; lamina slightly cupped at base; petioles 2 - 10 cm long. Flowers 2 - 3, sometimes pendulous, on up to 3 - 7 cm long pedicels, cup-shaped. Petals 6, oblong, 1.5 - 2 cm long, pink or white; styles short. Berry elliptic.

Fl. & Fr. April - May.

Distrib. India: E. Himalayas, damp scrubs or forests, ca 3300 m. Sikkim.

Bhutan.

Notes. According to Grierson & Long (l.c.) further studies are necessary on the generic limits within Podophyllaceae. *P. sikkimensis* may belong to the genus *Dysosma* Woodson as it is closely related to *D. aurantiocaula* (Hand.-Mazz.) Hu.

EXCLUDED TAXA

Podophyllum emodi Wallich ex Honigberger var. **axillaris** Chatterjee & Mukerjee in *Rec. Bot. Surv. India* 16(2): 46. 1953.

Distrib. Sikkim.

Podophyllum emodi Wallich ex Honigberger var. **jaeschkei** Chatterjee & Mukerjee, l. c. 47.

Distrib. Labul.

Notes. The above two varieties are based on minor characters of no adaptive value and hence excluded from the main treatment.

Podophyllum aurantiocaula Hand.-Mazz.

Distrib. Arunachal Pradesh and China (Yunnan).

Notes. This species was reported by Fischer (in *Kew Bull.* 1937: 474. 1937) on the basis of F. Kingdon Ward's collection from Delei Valley in Arunachal Pradesh. As the authors could not examine any specimen, this species has not been dealt in the main treatment.

Podophyllum versipelle Hance

Notes. Naithani (Fl. Pl. India, Nepal & Bhutan 29. 1990) listed this species as occurring in India. But Fischer (in Kew Bull. 1929: 249. 1929) states that the species was erroneously quoted as *P. versipelle* Hance and that it actually is *P. aurantiocaulis* Hand.-Mazz.

LARDIZABALACEAE

(M.P. Nayar and T.K. Paul)

Lianas or erect shrubs, monoecious or dioecious. Leaves alternate or opposite, usually digitately compound, rarely 2 - 3-ternate, digitate or palmate or rarely pinnately compound, exstipulate; petioles swollen at base. Inflorescences axillary racemes or flowers solitary or fascicled. Flowers small to moderate-sized, unisexual or polygamous, actinomorphic, trimerous. Sepals 3 or 6 in one or two series, imbricate or the outer ones valvate, inner ones often petaloid. Petals 6 or absent, smaller than sepals, sometimes in 2 whorls of 3 nectariform honey-scales. Male flowers: Stamens 6; filaments short, free or connate into a tube or column; anthers free, extrorse, basifixed, dehiscing longitudinally, with connectives often protruding; pistillodes present or absent. Female flowers: Staminodes 6 or absent; carpels 3 or 6 or more, in 1 2(-5) whorls, superior, free, erect, but soon divergent, 1-locular; ovules many in 2 or more rows, parietal or ventral, sometimes solitary and basal, bitegmic, crassinucellar, anatropous, campylotropous or orthotropous; stigma oblique, subsessile. Fruitlets fleshy follicles or berries, indehiscent or opening by dorsal longitudinal sutures at maturity, often flesh-coloured. Seeds ovoid or subreniform with fleshy copious endosperm and small embryo.

Himalayas, N. E. India to China, Japan and S. America (Chile); 7 genera and ca 30 species, 3 genera and 5 species in India.

Notes. Though this family is included under the family Berberidaceae by Bentham & Hook. f. (Gen. Pl. 1: 40. 1862) and Hook. f. & Thomson (in Fl. Brit. India 1: 108. 1872), it differs by its climbing habit, unisexual flowers, extrorse anthers and gynoecia of 3 or more free carpels. It differs from Menispermaceae in being primarily monoecious, in the presence of more than one ovule in each carpel and by the absence of bony endocarp.

Literature. DECAISNE, J. (1839) Memoire sur la famille des Lardizabalees. Arch. Mus. Hist. Nat. (Paris) 1: 143 - 213, tt. 10 - 13. GAGNEPAIN, F. (1908) Revision des Lardizabalees asiatiques de l'herbier du Muséum. Bull. Mus. Hist. Nat. (Paris) 14: 64 - 70. HEMSLEY, W. B. (1908) Asiatic Lardizabalaceae. Kew Bull. 1908: 459 - 461. JAFRI, S. M. H. (1974) Lardizabalaceae. In: Fl. W. Pakistan 60: 1 - 4, f. 1. KUMAZAWA, M. (1937) Pollen morphology in Ranunculaceae, Lardizabalaceae and Berberidaceae. J. Jap. Bot. 8: 19 - 46. NAYAR, M. P. & T. K. PAUL (1988) Lardizabalaceae. In: Fasc. Fl. India 19: 29 - 38, ff. 5 - 8.

KEY TO THE GENERA

- | | |
|--|----------------------|
| 1a. Erect shrubs; leaves pinnate with several pairs of opposite leaflets | 1. <i>Decaisnea</i> |
| b. Climbing shrubs; leaves trifoliolate or digitately compound | 2 |
| 2a. Filaments of stamens free | 2. <i>Holboellia</i> |
| b. Filaments of stamens united into a column | 3. <i>Parvattia</i> |

1. *Decaisnea* Hook. f. & Thomson, nom. cons.

Erect shrubs; stems with large scars of fallen leaves. Leaves pinnately compound, with petioles jointed at base. Inflorescences racemose. Flowers unisexual; pedicels slender. Sepals 6, subimbricate, in 2 rows, lanceolate, long acuminate, petaloid. Petals absent. Male flowers: Stamens 6, connate into a column; anthers oblong, with subulate connectives. Female flowers: Staminodes 6, small, free; carpels 3, subsessile, oblong, one or all maturing into fruits; stigma sessile; ovules many, 2-seriate. Fruits follicular, fleshy, each with numerous seeds in 2 rows embedded in fleshy pulp.

N. E. India, E. Himalayas and W. China; 2 species, one in India.

Literature. BALAKRISHNAN, N.P. (1966) Proposal to conserve the generic name 2551 *Decaisnea* Hook. f. & Thoms. (Lardizabalaceae). *Taxon* 15: 334. SWAMY, B. G. L. (1953) Some observations on the embryology of *Decaisnea insignis* Hook. f. & Thoms. *Proc. Natl. Inst. Sci. India* 19: 307 - 310.

Decaisnea insignis (Griffith) Hook. f. & Thomson in *Proc. Linn. Soc.* 2: 350. 1854 & in *Fl. Brit. India* 1: 107. 1872. *Stakia insignis* Griffith, *Itin. Notes* 187. 1848.

Shrubs, 3 - 5 m tall; stems erect, simple or forked. Leaves pinnately compound with 5 - 10 pairs of opposite leaflets; petioles 10 - 24 cm long; leaflets ovate-oblong, acute at base, acuminate at apex, entire, 5 - 10 x 2 - 4 cm, glabrous, glaucous beneath; petiolules 2 - 8 mm long, somewhat swollen at base. Inflorescences racemose, 10 - 25 cm long; pedicels 1 - 2 cm long; bracts subulate, caducous. Flowers 1 - 2 cm across, pendulous, pale yellowish green with slight purple tinge towards apex. Sepals linear-lanceolate, 10 - 20 x 2 - 4 mm. Petals absent. Male flowers: Stamens 6, connate basally into a column, 1.5 - 2 cm long; pistillodes minute. Female flowers: Staminodes minute, ca 3 mm long; carpels 3, free, about half as long as the sepals, oblong, glabrous; stigma oblong; each carpel maturing into a separate diverging fruit. Fruits oblong, cylindrical, somewhat rounded at base and apex, recurved, 3 - 5 x 1 - 1.5 cm, fleshy. Seeds numerous in 2 rows, ovate to rounded, ca 10 x 6 mm, glabrous, brownish black.

Fl. May - June; *Fr.* July - Aug.

Distrib. India: Sikkim and Arunachal Pradesh.

Bhutan and China.

Notes. Fruits edible and used by Lepchas of Sikkim.

2. *Holboellia* Wallich

Climbing or twining monoecious evergreen shrubs. Leaves trifoliolate or digitate with up to 9 leaflets, coriaceous. Inflorescences racemose, axillary, solitary or fasciculate, often in axils of fallen leaves. Flowers unisexual, bracteate, fragrant. Sepals 6, biseriate, oblong, elliptic or ovate, obtuse. Petals 6, reduced, orbicular, nectariform. Male flowers: Stamens 6, free; pistillodes rudimentary, minute or absent. Female flowers: Staminodes 6, minute; Carpels 3, oblong-ellipsoid, 1-locular with numerous ovules on parietal placenta. Fruiting carpels 1 - 3, berries, glabrous. Seeds many, small, blackish, embedded in pulp.

E. Himalayas and China; 6 species, 2 in India.

KEY TO THE SPECIES

- 1a. Leaflets 7 - 9, linear-lanceolate, with acuminate apices, becoming spinescent during maturity; petioles 1.5 - 4 cm long; racemes much longer than petiole; anthers sessile **1. *H. khasiana***
- b. Leaflets 3 - 5, ovate-oblong, with acute or short acuminate apices; petioles 4 - 8 cm long; racemes much shorter than petioles; anthers with distinct filament **2. *H. latifolia***

1. *Holboellia khasiana* T. K. Paul & Nayar in Bull. Bot. Surv. India 27: 105. 1986 & in Fasc. Fl. India 19: 32, f. 6. 1988. **Fig. 63.**

Climbing shrubs, monoecious; bark of mature stems and branches striated; apical portions of stems glabrous, often twining. Leaves alternate, digitately 4 - 5-foliolate; petioles 1.5 - 4 cm long; petiolules 4 - 8 mm long; leaflets ovate-elliptic, long acuminate at apex, becoming spinulose in dried leaves, entire and slightly revolute along margins, 3 - 6.5 x 1 - 3 cm, coriaceous, glabrous. Inflorescences axillary, fasciculate racemes, longer than petioles. Flowers unisexual, actinomorphic, bracteate; pedicels 3 - 5 mm long. Sepals 6, biseriate, 5 - 8 x 1 - 3 mm; outer 3 sepals ovate-lanceolate; inner 3 linear, glabrous. Petals 6, minute or indistinct, nectariferous. Male flowers: Stamens 6, free, sessile; anthers ca 2 mm long; pistillodes minute. Female flowers: Staminodes minute; carpels 3, free, about as long as the sepals, oblong, glabrous. Fruits not seen.

Distrib. India: Meghalaya (Khasi hills).

Endemic and rare.

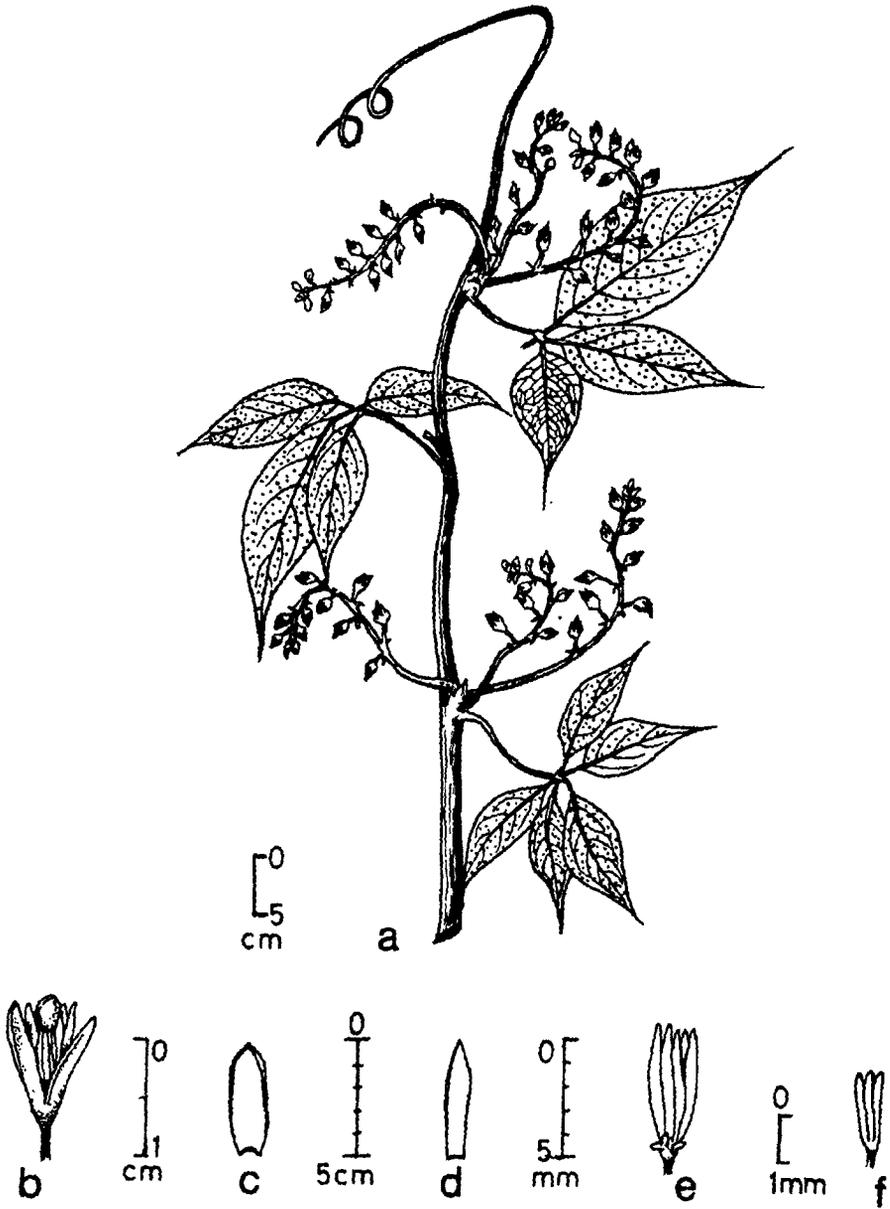


Fig. 63. *Holboellia khasiana* T.K. Paul & Nayar : a. flowering twig; b. flower; c. outer sepal; d. inner sepal; e. stamens; f. carpels.

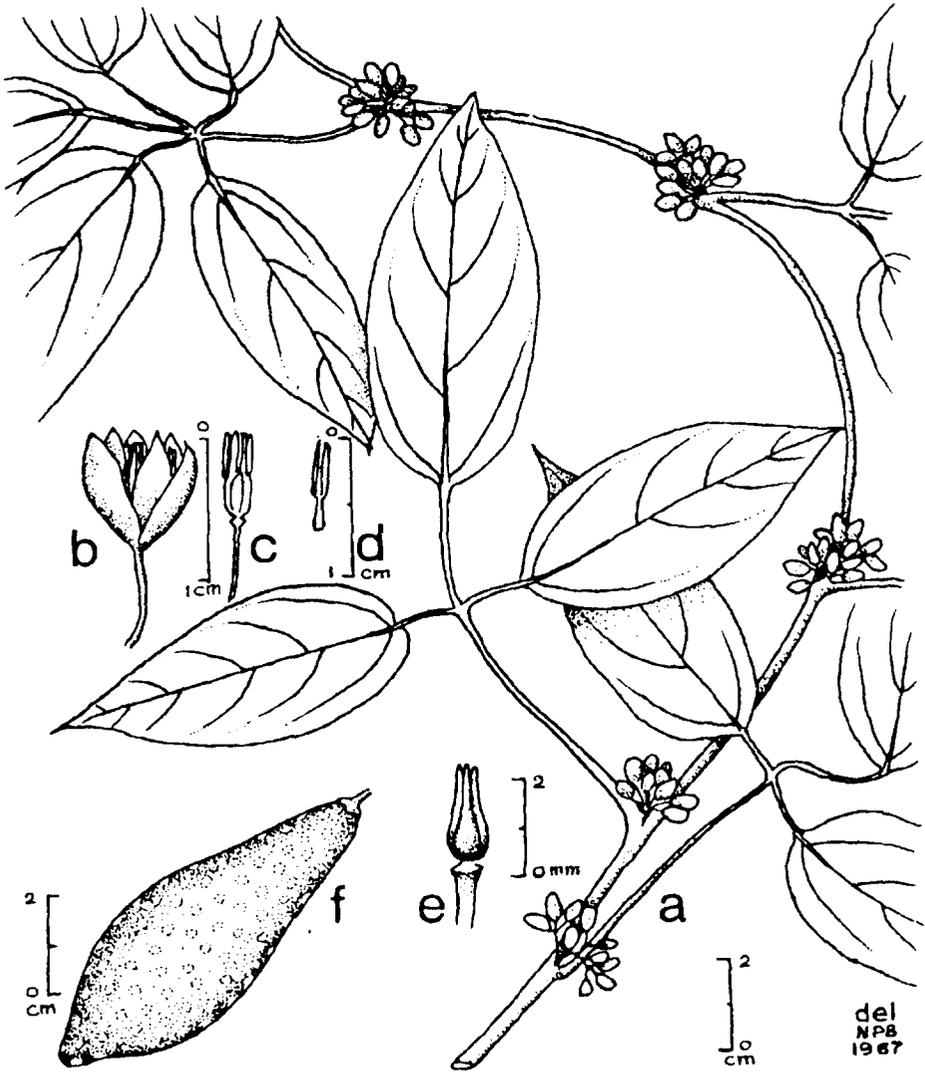


Fig. 64. *Holboellia latifolia* Wallich var. *latifolia* : a. branch; b. flower; c. flower with perianth removed; d. stamen; e. pistil; f. fruit.

2. *Holboellia latifolia* Wallich, Tent. Fl. Nep. 24, t.16. 1824; Hook. f. & Thomson in Fl. Brit. India 1: 108. 1872. Fig. 64.

Jain.: *Soh-tymbro*; Kh.: *Mi-rang-ksa, Soh-lygn-kait*; Nep.: *Gulfa*.

Climbing shrubs, 3 - 5 m high; stems up to 12 cm thick at base, with corky bark; branches and twigs glabrous, often twining at apical portion. Leaves alternate, digitately 3 - 9-foliolate; petioles 4 - 8 cm long; petiolules 0.5 - 4 cm long; leaflets variable in size and shape, oblong-ovate, elliptic-ovate or narrow-lanceolate, rounded or cuneate at base, acute to slightly acuminate at apex, entire, 4 - 13 x 1 - 5 cm, glabrous, somewhat shiny above, pale beneath, usually 3-nerved at base. Racemes 3 - 12 cm long, 3 - 7-flowered, in axillary fascicles; peduncles shorter than petioles, as long as the petiolules; pedicels filiform, 4 - 12 mm long, purplish. Flowers 1 - 2 cm across, green or purplish green, sweet-scented. Sepals 6 in 2 series, the outer 3 valvate, the inner 3 imbricate, oblong or oblong-elliptic, 10 - 15 x 2 - 5 mm, green or purplish. Petals 6, orbicular, nectariform, minute. Male flowers: Stamens 6, free; filaments 2 - 4 mm long, dark brownish red; anthers 3 - 5 mm long, apiculate; pistillodes linear, ca 1.5 mm long. Female flowers: Staminodes minute; carpels free, linear-ellipsoid or oblong, 2 - 3 mm long; stigma sessile, simple, entire. Fruit usually of one carpel, pear-shaped, ellipsoid or oblong-ovate, 5 - 10 x 2 - 6 cm, red. Seeds orbicular, obovoid, compressed or slightly curved, embedded in yellow pulp, 6 - 10 x 3 - 4 cm, blackish, glossy.

KEY TO THE VARIETIES

1a . Leaflets narrow-lanceolate

2 .1. var. *angustifolia*

b. Leaflets oblong-ovate

2.2. var. *latifolia*

2.1. var. *angustifolia* (Wallich) Hook. f. & Thomson in Fl. Brit. India 1: 108. 1872.
H. angustifolia Wallich, Tent. Fl. Nep. 24, t. 17. 1824.

Fl. April - May; *Fr.* June - July.

Distrib. India: Temperate Himalayas, 2000 - 2600 m. Uttar Pradesh, Sikkim, Arunachal Pradesh and Meghalaya.

Nepal, Bhutan and Myanmar.

2.2. var. *latifolia*

Fl. Feb. - June; *Fr.* June - Oct.

Distrib. India: Subtropical and temperate Himalayas, in broad-leaved forests, 1200 - 2500 m. Uttar Pradesh, West Bengal, Sikkim, Arunachal Pradesh, Manipur, Assam and Meghalaya.

Nepal, Bhutan, Bangladesh, Myanmar and W. China.

Notes. Pulp of the fruits are edible.

3. *Parvatia* Decaisne

Large evergreen climbing monoecious shrubs. Leaves alternate, pinnately trifoliate, coriaceous. Inflorescences racemose in axillary fascicles. Flowers unisexual, actinomorphic, bracteate. Sepals 6, biseriata, outer 3 valvate, inner 3 imbricate. Petals 6, smaller than sepals, lanceolate. Male flowers: Stamens 6; filaments united into a column; anthers oblong, apiculate; pistillodes minute, linear-lanceolate. Female flowers: Staminodes 6, minute, free; carpels 3; stigma sessile, oblong, acute; ovules many, covering the walls of each carpel, mixed with long hairs. Fruitlets 3, berries, indehiscent. Seeds numerous, embedded in pulp.

E. Himalayas, N. E. India, Bangladesh and S. China; 3 species, 2 in India.

Notes. *Parvatia* Decaisne differs from *Stauntonia* DC. in the presence of petals, the latter bearing no petals and is confined to China and do not occur in India.

KEY TO THE SPECIES

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|--|-------------------------|
| 1a. Leaves ovate-lanceolate, acuminate at apex; racemes solitary or few together; staminal column ca 1.5 mm long | 1. <i>P. brunoniana</i> |
| b. Leaves ovate-elliptic, acute or rounded at apex; racemes numerous, fascicled; staminal column ca 5 mm long | 2. <i>P. elliptica</i> |

1. *Parvatia brunoniana* Decaisne in Arch. Mus. Hist. Nat. Paris 1: 190, t.12A. 1839; Hook. f. & Thomson in Fl. Brit. India 1: 108. 1872. *Stauntonia brunoniana* Wallich [Cat. 4952. 1824, nom. nud.] ex Hemsley in Hook. Ic. Pl. t.2843. 1907.

Large evergreen climbing shrubs; bark of young branches smooth, of old branches corky. Leaves alternate, pinnately compound, 3-foliolate; petioles 3 - 12 cm long; leaflets ovate or ovate-lanceolate, acuminate or rarely obtuse at apex, entire and slightly revolute along margins, 5 - 12 x 2 - 4 cm, glabrous, shiny above, pale and often glaucous beneath; lateral nerves 6 - 8 pairs; petiolule of middle leaflet longer, 1 - 3 cm long. Racemes axillary, solitary or 2 - 4 fascicled together on scaly tubercles; peduncles rigid, slender, 5 - 10 cm long; bracteoles basal, minute, linear; pedicels ca 2 mm long. Flowers 5 - 10 mm across, greenish-yellow. Sepals oblong-lanceolate, 10 - 12 x 2 - 3 mm. Petals lanceolate, much smaller than sepals, ca 2 x 0.5 - 1 mm. Male flowers: Stamens 6, monadelphous; staminal column ca 1.5 mm long; anthers 2 - 2.5 mm long, oblong, apiculate; pistillodes 3, minute. Female flowers: Staminodes 6, ca 1 mm long; carpels 3, free, oblong, 2.5 - 3 mm long, granulate, glabrous, with sessile stigma, one or all maturing into separate diverging fruitlets. Fruitlets oblong or oblong-ovoid. Seeds numerous,

trigonus, embedded in yellow pulp, black.

Fl. Aug. - Oct.; *Fr.* Feb. - June.

Distrib. India: Arunachal Pradesh, Assam and Meghalaya.

Bangladesh.

2. *Parvatia elliptica* (Hemsley) Nayar & T. K. Paul in Fasc. Fl. India 19: 36. 1988. *Stauntonia elliptica* Hemsley in Hook. Icon. Pl. t. 2844. 1907; Kanjilal et al., Fl. Assam 1(1): 60. 1934.

Large climbing shrubs; stems and branches striated. Leaves pinnately 3-foliolate; petioles 4 - 8 cm long, swollen at base; leaflets ovate or elliptic, rounded at base, acute or rounded at apex, entire and slightly recurved along margins, 4 - 10 x 2 - 5 cm, glabrous, paler beneath; lateral nerves 6 - 8 pairs; petiolule of the middle leaflet longer, 1 - 2.5 cm long. Inflorescences of many subcorymbose racemes in fascicles from imbricately bracteate axillary tubercles, 7 - 12 cm long; pedicels filiform, 3 - 5 mm long. Sepals 6, ovate or elliptic, irregularly ribbed, 5 - 10 x 2 - 4 mm. Petals 6, ca 1 mm long, much smaller than sepals, greenish yellow. Male flowers: Stamens 6, monadelphous, ca 5 mm long; anthers oblong; pistillodes minute. Female flowers: Staminodes minute; carpels 3, oblong, glabrous. Fruits when young of 4 distinct carpels, when mature solitary, oblong, ca 5 cm long and ca 2.5 cm across. Seeds numerous, embedded in yellow pulp, irregularly faceted, with thin grey papery arillus (or exocarp ?), shiny dark brown to almost black.

Fl. Aug. - Nov.; *Fr.* June - Nov.

Distrib. India: Arunachal Pradesh, Assam and Meghalaya.

Notes. Kanjilal et al. (l. c.) state that the fruit takes 12 months to mature.

EXCLUDED SPECIES

Parvatia filamentosa (Griffith) Gagnepain in Bull. Mus. Nat. Paris 14: 66. 1908. *Stauntonia filamentosa* Griffith, Notul. 4: 334. 1854 & Ic. Pl. Asiat. t. 495, f. 1. 1954; Kanjilal et al., Fl. Assam 1(1): 60. 1934.

No specimen of this species is seen. The original description and illustrations of Griffith (ll. cc.) do not depict female flowers or fruits. Even Kanjilal (l. c.) has not been able to see flowers or fruits. Though the leaves are said to be digitately 3 - 7-foliolate, instead of pinnately 3-foliolate in the other two species and the leaflets are stated to be with ca 10 pairs of lateral nerves, instead of 6 - 8 pairs in the other species, its taxonomic position is doubtful and can be decided only by studying more collections with flowers.

NYMPHAEACEAE

(R. L. Mitra)

Aquatic, acaulescent, rhizomatous, laticiferous herbs, usually stoloniferous with air-canals and scattered vascular bundles devoid of cambium. Roots adventitious in groups at base of petioles. Leaves simple, stipulate, usually long petiolate, heterophyllous, submerged (usually juvenile ones) and floating, spirally arranged on rhizome; venation palmate, all but one, the pinnately branched midrib, dichotomously branched; vernation involute; foliar sclereids present. Flowers solitary in leafsite or anodic side of leaf-axil, usually long-pedunculate, bisexual, with spirally arranged floral appendages. Sepals 4, free, hypogynous or epigynous. Petals usually numerous, subequal, free, innermost ones staminodal, hypogynous to epigynous. Stamens usually numerous, free, hypogynous to epigynous, with or without sterile appendages, dorsiventrally flattened, with paired microsporangia arranged adaxially; dehiscence longitudinal; pollen uniaperturate. Carpels 5 - many, partially or fully coherent and fused peripherally with receptacular tissue forming a multilocular ovary. Ovules 2 - many in each carpel, anatropous, bitegmic, crassinucellate; placentation laminar. Fruit ripening under water, an irregularly dehiscent, many-seeded berry. Seeds arillate, operculate, with minute embryo, scanty endosperm and copious perisperm.

Tropical and temperate regions of the world; 5 genera and ca 70 species, 2 genera and 7 species in India.

Literature. MITRA, R.L. (1990) *Nymphaeaceae*. In: *Fasc. Fl. India* 20: 11-25, ff. 1-2. SALAR KHAN, MD. (1979) *Nymphaeaceae*. In: *Fl. Bangladesh* 9: 1-12, tt. 1-4.

Notes. *Nymphaeaceae (sensu lato)* are often considered as a heterogeneous assemblage primarily on the basis of gynoecial characters. The three subfamilies originally recognised by Caspary (in Engler & Prantl, *Pflanzenfam.* 3, 2: 4. 1888) have been accorded distinct familial status by Bessey (*Ann. Missouri Bot. Gard.* 2: 130 & 137. 1915), but segregated further into 5 families by Li (*Am. Midl. Nat.* 54: 33-41. 1955), Hutchinson (*Fam. Fl. Pl. ed. 3, 1: 497 & 501. 1973*), however, recognised only Cabombaceae and retained the other two subfamilies in the *Nymphaeaceae*, while Takhtajan (*Bot. Rev.* 46: 225-359. 1980) in partial modification of his earlier views (*Fl. Pl. Origin & Disp.* 207. 1969) accepted only three families like Bessey (l.c.). Cronquist on the other hand, though originally (*Evol. Class. Fl. Pl.* 147-150. 1968) maintained only *Nelumbonac*

ceae and regrouped the remaining two subfamilies into Nymphaeaceae, he likewise changed his previous opinion (An Integrated Syst. Class. Fl. Pl. 105-106, 1981) and maintained four families, a view favoured by Takhtajan (l.c. 1969) earlier. These segregated families have been placed in different orders or given new ordinal ranks.

In view of the conflicting morphological evidences, some of which are fragmentary, many authors still follow Wood (J. Arnold Arb. 40: 94-112, 1959) in retaining Nymphaeaceae *sensu lato* as a single family, while considering a few genera, particularly *Nelumbo* as the most specialised in the whole family. Though there are growing evidences in recent times in favour of the familial concept proposed by Bessey (l.c.), in the present work families have been delimited following Cronquist (l.c. 1981).

KEY TO THE GENERA

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|---|--------------------|
| 1a. Plants densely prickly; sepals, petals and stamens epigynous | 1. <i>Euryale</i> |
| b. Plants without prickles; sepals, petals and stamens hypogynous to perigynous | 2. <i>Nymphaea</i> |

1. *Euryale* Salisb.

Annual or short-lived perennial herbs with submerged and floating juvenile leaves, and densely prickly and strongly venose adult floating leaves. Rhizomes short, thick, erect, with leaves and flowers arranged in distinct spirals; vegetative buds absent. Flowers on densely prickly peduncles, partially submerged; sepals, petals and stamens epigynous, arranged on a broad rim along distal outer margin of cup-like depression of ovary. Sepals 4. Petals ca 25, innermost few transitional to stamens. Stamens numerous in fascicles, inflexed, dorsiventrally flattened; outer ones spatulate with broader filaments and reduced anthers; inner ones spatulate with narrower filaments and longer anthers; anther-sacs partially sunken in outer stamens. Ovary 7-12-loculate, with a cup-like depression above formed by radiating curvate stigmas; stigmatic appendages absent. Ovules 2-3 in each locule, at length usually one by abortion; placentation parietal. Berry 8-20-seeded.

Monotypic; in fresh water tanks, lakes and swamps in India, Bangladesh, Japan, Taiwan, China and Ussuri in Russia. Also reported from Pleiocene and later deposits in Europe.

Euryale ferox Salisb. in König & Sims (ed.), Ann. Bot. 2: 74, 1805; Hook. f. & Thomson in Fl. Brit. India 1: 115, 1872.

Asm., Beng. & Hindi: *Makhana*, *Makhna*; Kh.: *Shriew-u-puban*; Or.: *Kuntapadma*.

Leaves centrally peltate, orbicular, acute at one side, terminating in a pinnately branched vein, shallowly notched at opposite side, 30-120 x 25-110 cm, coriaceous,

green, bullate (also corrugated along margins when young) and prickly along veins above, violet, strongly venose (with interlacing nerves) and prickly along veins beneath. Sepals 2 - 3 x 1.2 - 1.8 cm, fleshy, triangular-ovate, concave, obtuse and cucullate at apex, violet or pinkish-violet inside, green and armed with scattered recurved prickles outside. Outer petals 1.8 - 2.5 x 0.8 - 1.2 cm, concave, oblong, obtuse and cucullate at apex, dark-violet (fading near to base), gradually smaller in size and fading to white towards centre. Outer stamens 8 - 10 mm long; inner stamens 4 - 6 mm long. Berry 4 - 10 cm across, globular-ovoid, tuberculate and densely prickly, with a conical crown of persistent floral appendages. Seeds 7 - 12 mm across, with thick and hard testa, subglobose, wrinkled, dark brown, enclosed in pulpy white aril marked with scattered reddish streaks.

Fl. & Fr. May - Dec.

Distrib. India: Rajasthan, Kashmir, Uttar Pradesh, Bihar, West Bengal, Assam, Meghalaya, Manipur and Tripura; also cultivated for its starchy edible seeds.

Notes. Seeds puffed by roasting in sand are commonly sold in the markets in India.

In *Euryale ferox*, the floating leaves are highly polymorphic. The early floating leaves, which are sometimes preserved in the herbaria, are quite different in appearance from adult leaves. These are membranous, broadly elliptic to elliptic-orbicular, at first non-peltate with a deep sinus up to petiole base, deep violet on both surfaces with a few or no prickles, afterwards peltate with a shallow sinus, green above, deep violet beneath, with prickles on both surfaces and petioles.

2. *Nymphaea* L., nom. cons.

Perennial herbs. Rhizomes usually stoloniferous, erect or creeping, sometimes branched, hairy in interfoliar region, with leaves, vegetative buds and flowers arranged in spirals. Leaves polymorphic, long-petiolate; juvenile leaves membranous, at first subulate, hastate, sagittate, deltoid or cordate-ovate and submerged, afterwards elliptic and cleft up to petiole-base and floating; adult leaves coriaceous, prominently venose beneath, broadly elliptic to orbicular and deeply cleft near or up to petiole-base, floating or rarely emersed. Flowers on long peduncles, floating or emersed, showy. Sepals 4, free, hypogynous. Petals numerous, hypogynous to perigynous, a few outermost ones sometimes sepaloid, innermost ones often transitional to stamens. Stamens numerous, inflexed, perigynous, dorsiventrally flattened with or without distal sterile appendages, outer stamens with broad, petaloid filaments and reduced anthers, the inner with narrower filaments and longer anthers; anther-sacs partially sunken. Carpels 5 - 35, partially (septa double) or fully (septa single) coherent, fused peripherally, arranged radially around and adnate below to central core of receptacular tissue to about half their length, with a cup-shaped depression above formed by radiating, curvate, bilobed stigmas with or without an appendage. Ovules numerous, arising all over septa. Berry

globose, often crowned with persistent, green filaments, retracted to and ripening under water. Seeds enclosed in bell-shaped aril, indurate.

Tropical and temperate regions inhabiting stagnant freshwater ponds, lakes and swamps; ca 50 species, 6 species in India. Besides, a few exotics are cultivated in ponds and lakes.

Literature. CONARD, H.S. (1905). The waterlilies: a monograph of the genus *Nymphaea*. Carnegie Inst. Wash. Publ. 4: 1 - 279, tt. 1-30.

KEY TO THE SPECIES

- 1a. Leaves distinctly subpeltate; primary veins prominently raised beneath 2
- b. Leaves cleft to petiole-base, non-peltate; primary veins impressed beneath 4
- 2a. Leaves glabrous; sepals obscurely veined, persistent in fruit; stamens with distal sterile appendage 3. *N. nouchall*
- b. Leaves velutinous pubescent beneath; sepals conspicuously veined, decaying after flowering; stamens without sterile appendages 3
- 3a. Flowers white or a few sepals and outer petals with a tinge of purple towards apex outside; anthers yellow; filaments of inner stamens without purplish band outside 4. *N. pubescens*
- b. Flowers crimson red; anthers red; filaments of inner stamens with a purplish band outside 5. *N. rubra*
- 4a. Rhizomes 2.5 - 7 cm long, erect, densely clothed with black hairs; leaves 3 - 7 cm across; petioles ca 1.5 mm across, filiform; sepals accrescent in fruit 6. *N. tetragona*
- b. Rhizomes much longer than 7 cm, horizontally creeping; interfoliar hairs not black; leaves 10 - 28 cm across; petioles 3 - 10 mm across; sepals not accrescent in fruit 5
- 5a. Flower buds obtuse at apex; receptacle cylindrical; sepals as long as or shorter than petals; filaments of innermost stamens filiform, narrower than anthers; stigma almost flat 1. *N. alba*
- b. Flower buds acute at apex; receptacle weakly tetragonous; sepals longer than petals; filaments of innermost stamens lanceolate, never narrower than anthers; stigma strongly concave 2. *N. candida*

1. *Nymphaea alba* L., Sp. Pl. 510. 1753; Hook. f. & Thomson in Fl. Brit. India 1: 114. 1872.

Kash.: *Brimposh*.

Leaves suborbicular, rounded or retuse at apex, 10 - 28 x 9.5 - 26 cm, with lowest pair of veins straight and divergently produced into basal lobes, at least in the first one-third; basal lobes unequal, nearly straight along inner margin and obtuse at apex.

Flowers 10 - 15 cm across, white. Sepals ovate-oblong, obtusely cucullate at apex, 5.5 - 8 x 1.5 - 1.8 cm, green outside. Petals ca 20; outer ones as long as or longer than

sepals, oblong-lanceolate, obtusely cucullate at apex, attenuate at base. Stamens numerous, distributed up to summit of ovary; outer ones 2.5 - 3.4 cm long with lanceolate filament. Ovary 14 - 20-loculate; stigma flat with a hemispheric central projection, yellow; stigmatic appendages incurved, triangular-ovate, 3 - 4 mm long, sulcate inside. Berry 3 - 4 cm across. Seeds ellipsoid, 2 - 3 x 1.7 mm.

Fl. & Fr. April - Oct.

Distrib. India: Kashmir.

Africa, Asia minor and Europe.

2. *Nymphaea candida* C. Presl in J. & C. Presl, Del. Prag. 224. 1822. *N. alba* var. *cachmeriana* Hook. f. & Thomson in Fl. Brit. India 1: 114. 1872, as "*kashmiriana*".

Leaves elliptic-suborbicular, rounded or retuse at apex, 10 - 20 x 9 - 19 cm, with lowest pair of veins arcuately converging into basal lobes; basal lobes subequal, usually concave along inner margin and acute at apex. Flowers 6 - 8 cm across, white. Sepals ovate-lanceolate to ovate-oblong, obtusely cucullate at apex, 3.5 - 4.5 x 1.3 - 1.5 cm, green outside. Petals ca 12, outer ones oblong-lanceolate, obtuse at apex, 3 - 4.2 x 1 - 1.3 cm. Stamens ca 40, absent from summit of ovary, outer ones 1.8 - 2.2 cm long with lanceolate filaments. Ovary 6 - 10-loculate. Stigmas strongly concave with a conical central projection, purple; stigmatic appendages 2 - 3 mm long, incurved, flattened, oblong. Berry 3 - 3.5 cm across. Seeds ellipsoid-oblong, 3 - 4 x 2 mm.

Fl. & Fr. April - Dec.

Distrib. India: Kashmir (1200 - 1800 m).

Scandinavia, Central Europe, Russia (Siberia) and Central Asia.

Notes. The small form usually referred to as *N. candida* var. *minor* Wainio in Acta Soc. Fauna & Pl. Fenn. 8: 58. 1891 is also recorded from Kashmir.

3. *Nymphaea nouchali* Burm. f., Fl. Ind. 120. 1768. *N. stellata* Willd., Sp. Pl. 2: 1153. 1799; Hook. f. & Thomson in Fl. Brit. India 1: 114. 1872, incl. var. 1, 2 & 3.

Beng.: *Sundi*, *Nil-sapla*; Hindi: *Bhenght*; Mal.: *Sitambal*; Or.: *Subdi-kain*; Tam.: *Nilotpalam*.

Leaves elliptic-orbicular to subrotund, repand to irregularly sinuate-dentate with broad obtuse teeth, or subentire, 6 - 45 x 5 - 41 cm, glabrous and often punctulate on both surfaces, green and sometimes also blotched purple above, reddish purple beneath.

Flowers 4-17 cm across, bluish-purple, blue, or pale bluish-white, fragrant. Sepals triangular-ovate and obtusely cucullate at apex, 2.5-9 x 7-2.6 cm, green, often with dark purplish streaks outside. Petals 8-15, outer ones lanceolate to oblong-lanceolate, subacute at apex, 2.5-7.5 x 0.8-1.7 cm. Stamens 25-40, outer ones 1.5-3 cm long, yellow with blue appendage. Ovary 8-16-loculate. Stigmatic appendages 1-3.5 mm long, incurved. Berry 1.5-4 cm across. Seeds ellipsoid, ca 1.5 mm long, reticulate, longitudinally ribbed, conspicuously ciliate along ribs when immature, becoming glabrate with growth of aril.

Fl. & Fr. All round the year; profusely during Aug.-Jan.

Distrib. India: Throughout the plains.

Sri Lanka, Myanmar, Taiwan, Thailand, Laos, Cambodia, Vietnam, Malaysia, Indonesia, Philippines and New Guinea.

Notes. The tuberous rhizome and peduncles are eaten as vegetable; seeds on frying are eaten as puffed grain.

Reports of *N. nouchali* Burm.f. from other than plains usually belong to *N. caerulea* Savigny.

4. *Nymphaea pubescens* Willd., Sp. Pl. 2: 1154. 1798. *N. lotus* auct. non L. (1753); Hook. f. & Thomson in Fl. Brit. India 1: 114. 1872, uterque p.p. *N. lotus* var. *pubescens* (Willd.) Hook. f. & Thomson in Fl. Brit. India 1: 114. 1872.

Asm.: *Mokuwa, Nal*; Beng.: *Shaluk, Shapla*; Hindi: *Koka*; Or.: *Dhabala-kain*; Sans.: *Kumuda*; Mal.: *Ambal*; Tam.: *Allitamarai, Vellambal*.

Leaves broadly ovate-elliptic, or reniform to orbicular, 15-50 x 12-45 cm, repand to sinuately spinous-dentate and somewhat crispate along margin, dark-green, glabrous and often pustulate above, green or dull purplish-green and velutinous pubescent beneath. Flowers 4-15 cm across, slightly fragrant. Sepals usually ovate-lanceolate, elliptic-oblong and obovate-oblong, subacute or obtuse at apex, 2.5-8 x 1-3.2 cm, puberulous and green with 5-9 prominent white veins outside, white inside. Petals 10-25; outer ones 2-7 x 1-2.8 cm, linear-oblong-lanceolate, obtuse or subacute at apex. Stamens 25-70; outer ones 1.5-3.5 cm long, yellow. Ovary 13-22-loculate; stigmatic appendages 0.5-1 cm long, oblong, inflexed, yellow. Berry 2.5-4 cm across. Seeds ca 1.5 x 1 mm, ellipsoid, longitudinally marked with rows of irregular papillae.

Fl. & Fr. All round the year; profusely during Aug.-Jan.

Distrib. India: Throughout the plain regions.

Sri Lanka, Thailand, Laos, Cambodia, Vietnam, Malaysia, Indonesia, New Guinea and Philippines.

Notes. Similar to *N. nouchali* Burm.f.

5. *Nymphaea rubra* Roxb. ex Andrews, Bot. Rep. 8(104): t. 503. 1808. *N. lotus* auct. non L. (1753); Hook. f. & Thomson in Fl. Brit. India 1: 114. 1872, uterque p.p. quoad syn. *N. rubra*.

Beng.: *Lal-shapla*; Or.: *Rang-kai*.

Very similar to *N. pubescens* Willd. but differs chiefly in colour of leaves, flowers, and in being completely sterile. Leaves at first dark red both above and beneath, turning greenish above with age. Flowers usually 5 - 15 cm across, crimson red. Petals 16 - 25. Stamens 55 - 80; filaments of nearly inner two-third stamens with a dark purplish band near base. Ovary 17 - 27, usually 19 - 21-loculate.

Fl. All round the year; profusely during Aug.-Jan.

Distrib. India: Throughout in plains.

Sri Lanka, Myanmar, Thailand, Laos, Cambodia, Vietnam, Malaysia, Indonesia and Philippines.

Notes. *N. rubra* Roxb. ex Andrews, originally claimed to be a native of Bengal, never sets fruit in nature and appears to be an obligate apomictic species. It propagates mainly through stolons and vegetative buds and, in exceptional cases by proliferation of flowers. Unlike the two common species of Indian plains, viz. *N. nouchali* Burm. f. and *N. pubescens* Willd., the uncommon *N. rubra* is not met with in temporary habitats like seasonally inundated fields, rice swamps, shallow ditches along roadsides and railway tracks, but is restricted only to the permanent ponds, lakes, etc. (Mitra & Subramanyam in Bull. Bot. Surv. India 24: 83-86. 1983).

In cultivation there is a rose-coloured variety known as *N. omrana*, Hort. ex Gard. Tr. 8: 96. 1895; Conard l.c. Pl. 30 t. *N. rubra* var. *rosea* Sims in Curtis, Bot. Mag. t. 1364. 1811) with leaves bronze-green and blotched brown above and yellowish-brown beneath. Stamens are yellow with reddish-brown tips and without any purplish bands on their filaments. It is claimed to be a third generation hybrid between *N. lotus* L. and *N. rubra* Roxb. ex Andrews, or their derivatives, and occasionally sets fruits. The chromosome number report $2n = 56$ (Langlet & Soderberg in Acta Hort. Berg. 9: 85. 1927; Janaki Ammal in Bull. Bot. Surv. India 1: 35. 1959) probably belongs to this cultivated variety.

6. *Nymphaea tetragona* Georgi in Reise Russ. Reich. 1: 220. 1775. *N. pygmaea* Aiton, Hort. Kew. ed. 2, 3: 293. 1811; Hook. f. & Thomson in Fl. Brit. India 1: 115. 1872.
Fig. 65.

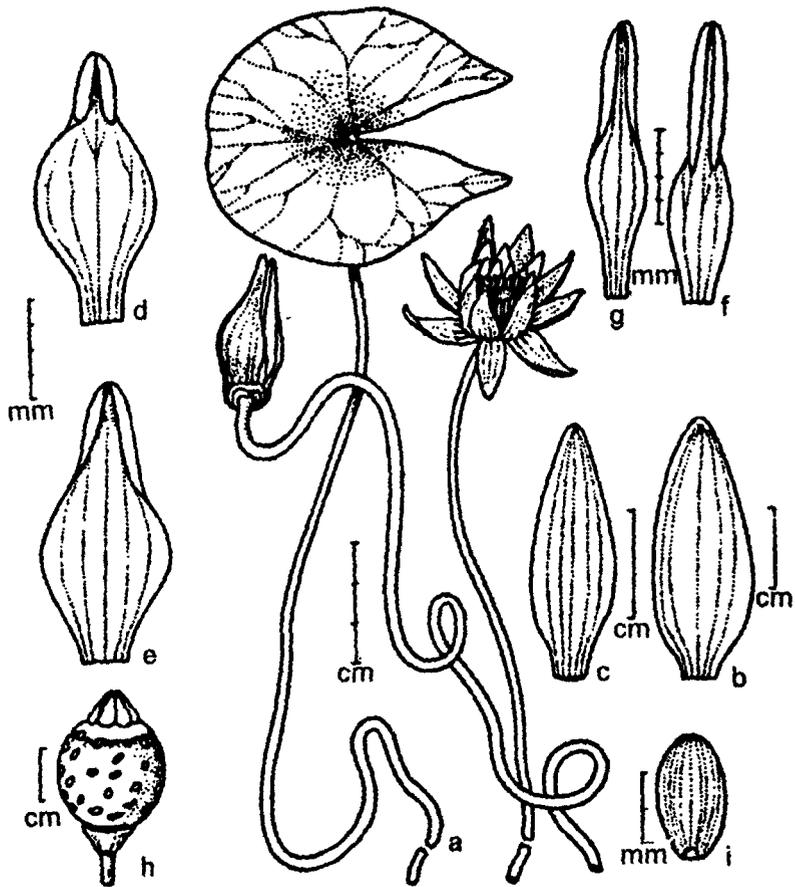


Fig. 65. *Nymphaea tetragona* Georgi: a. habit; b. sepal; c. petal; d-g. outer and inner stamens, dorsal and ventral views; h. berry; i. seed.

Eng.: *Pigmy Water Lily*; Kh.: *Sohpyllain-phulieh*.

Leaves orbicular-obovate or horse-shoe shaped, rounded or retuse at apex, 3 - 7 x 2.2 - 5.8 cm, reddish-brown with patches of green above (green above and pale purplish beneath when submerged), turning scarlet with age, green with a tinge of purple along margins beneath; basal lobes subequal, acuminate, more or less straight and divergent. Flowers 2.5 - 5 cm across, white; receptacle sharply tetragonus; peduncles ca 2 mm across, spirally twisted in fruit. Sepals ovate-lanceolate to oblong-lanceolate, obtusely cucullate at apex, 1.4 - 3.2 x 0.5 - 1.2 cm. Petals ca 12; outer ones obovate-oblong or oblong-lanceolate, 1.3 - 2.5 x 0.5 - 0.8 cm, innermost ones abruptly much reduced and transitional to stamens. Stamens ca 50; outer ones 7 - 12 mm long with spatulate or obovate-oblong filaments. Stigmas raised, convex; stigmatic appendages 2 - 3 mm long, ovate-lanceolate with involute sulcate margin. Berry 1.5 - 2 cm across. Seeds 3 - 4 x 2 mm, oblong, black.

Fl. & Fr. July - Sept.

Distrib. India: Kashmir and Meghalaya (1200 - 1800 m).

Finland, Eastern Siberia, China, Japan and N. America.

CULTIVATED TAXA

A. Flowers blue or bluish-purple; stamens 50 - 80, appendaged:

1. *Nymphaea caerulea* Savigny in Dec. Egypt. 3: 74. 1793; Conard, l.c. 141, pl. 8.

Leaves green beneath with dark purple spots and pale purplish along margin. The Blue Lotus of Egypt, grown in Ward Lake, Shillong, and elsewhere; often indistinguishable from *N. nouchali* Burm.f. in herbarium.

2. *Nymphaea micrantha* Guill. & Perr., Fl. Seneg. Tent. 1: 16. 1830; Conard, l.c. 146, pl. 16.

Leaves reddish beneath with dark violet spots, green above with a woolly umbo at the summit of petiole when young, becoming characteristically bulbiferous afterwards. A native of Africa, introduced in ponds and lakes in Tripura, Manipur, and elsewhere. The viviparous habit is reported to develop only during second year of plant's growth; till then the plant is liable to be mistaken for *N. caerulea* Savigny and *N. nouchali* Burm.f.

B. Flowers yellow; stamens ca 75, without appendages:

3. *Nymphaea alba* x *N. mexicana* = *Nymphaea marliacea* Latour-Marliac in Gard. Chron. 1: 564. 1888; Conard, l.c. 230.

Leaves floating, raised well above water when crowded and become somewhat cupped and dark green above, paler beneath with reddish-brown blotches towards margin; petioles and peduncles inconspicuously ribbed and slightly flattened. Contrary to the claim by Marliac (l.c.) often believed to be a hybrid between *N. tuberosa* and *N. mexicana*.

C. Flowers carmine red; stamens ca 75, without appendages:

4. *Nymphaea alba* var. *rubra* Loennroth in Bot. Notis. 124. 1856; Conard, l.c. 179, pl. 15.

Leaves reddish both above and beneath when young, turning dark green above and pale green beneath except along margin with age, and rise well above water level when crowded. Flowers deep red in the centre, paler towards periphery.

Grown in Ward Lake, Shillong and elsewhere; often misidentified as *N. alba* L.

D. Flowers creamy white to dull crimson; stamens numerous, without appendages:

1. *Victoria amazonica* (Poepp.) Sowerby in Ann. & Mag. Nat. Hist. ser. 2, 6: 310. 1850; Bailey, Man. Cult. Pl. 384. 1958. *Euryale amazonica* Poepp. in Foriep., Notiz. 35: 131. 1832. *V. regia* Lindley, Monogr. Victoria Regia 3. 1837.

The Giant Water Lily of Amazon, occasionally grown in water gardens for its enormous, orbicular floating leaves, upturned at margins. Grown in ponds of Indian Botanic Garden, Howrah.

2. *Victoria cruziana* Orbigny in Ann. Sci. Nat. ser. 2. 13. 57. 1840; Bailey, l.c.

Similar to *V. amazonica*, sometimes considered a variety of it, is also sometimes grown in gardens. Easily recognised by its green upturned leaf-margins which are purplish in *V. amazonica*. Also grown in Indian Botanic Garden, Howrah.

CABOMBACEAE

(R. L. Mitra)

Aquatic, caulescent, rhizomatous, laticiferous, mucilaginous herbs, usually stoloniferous with air-canals and scattered vascular bundles devoid of cambium; rhizomes sympodial, erect; roots adventitious in groups at the base of rhizomes and nodes of stolons. Leaves alternate, simple, exstipulate, usually long-petiolate, heterophyllous, submerged and floating, spirally arranged on rhizome, on one side of stolons and distichous or tristichous, or even opposite or ternate on floating shoots; foliar sclereids absent. Flowers small, solitary at nodes on floating shoots, usually long-pedunculate, bisexual, hypogynous, trimerous, with floral appendages arranged in low spirals. Sepals (2-) 3 (-4), free or slightly connate at base. Petals (2-) 3 (-4), free or slightly connate at base. Stamens 3 - 36, free, more or less flattened with paired microsporangia arranged laterally or abaxially, dehiscent longitudinally; pollen uniaperturate; staminodes absent. Carpels (1-) 2 - 18, free; ovules 1 - 4 in each carpel, anatropous or orthotropous, bitegmic, crassinucellate; placentation laminar to submarginal. Fruits ripening under water, indehiscent, 1 - 4-seeded follicles. Seeds exarillate, operculate, with minute embryo, scanty endosperm and copious perisperm.

Tropical and temperate regions of the world, except Europe; 2 genera and 8 species, 2 genera and 2 species (one introduced) in India.

Notes. Cabombaceae and Nymphaeaceae have much in common with monocots (Dahlgren, 1983).

Literature. DAHLGREN, R. (1983) General aspects of angiosperm evolution and macrosystematics. Nord. J. Bot. 3: 119 -149. MITRA, R. L. (1990) Cabombaceae. In: Fasc. Fl. India 20: 3 - 7. OSBORN, J. M, T.N. TAYLOR & E.L. SCHNEIDER (1991) Pollen morphology and ultrastructure of the Cabombaceae : correlations with pollination biology. Amer. J. Bot. 78: 1367 - 1378.

KEY TO THE GENERA

- | | |
|--|--------------------|
| 1a. Adult leaves monomorphic, floating, entire; stamens 12 - 18 | 1. <i>Brasenia</i> |
| b. Adult leaves dimorphic, submerged and floating submerged leaves deeply and finely palmately dissected stamens 3 - 6 | 2. <i>Cabomba</i> |

1. *Brasenia* Schreb.

Slender, perennial herbs; rhizomes small, erect with submerged and floating leaves and floating shoots; submerged parts covered by mucilaginous jelly. Leaves mostly crowded near the summit, long-petioled; juvenile leaves subulate to eccentrically peltate, submerged; adult leaves centrally peltate, floating. Flowers reddish, inconspicuous, on peduncles of unequal length, emerged above water at anthesis. Sepals (2-)3(-4), somewhat petaloid. Petals (2-)3(-4). Stamens (12-)18-36, with or without short apiculate sterile appendages; thecae (microsporangia) lateral; pollen 1-sulcate. Carpels (4-)7-18, each with (1-)2(-4) pendulous ovules in laminar or dorsal position. Ovules atropous, anatropous at maturity. Pods coriaceous, 1-4-seeded.

Sporadically distributed in all the continents, except Europe; but seeds reported from pleistocene and interglacial deposits in Europe; monotypic.

Notes. The floating shoots bear floating leaves and flowers at nodes which are the products of axillary buds of runners. Though it appears as a continuous axis, it represents a sympodial branch system (Richardson in Univ. Calif. Publ. Bot. 47: 4. 1969). In gregarious populations, the floating shoots form a dense interwoven mass.

Brasenia schreberi J. F. Gmel., Syst. Nat. 2: 853. 1791; Balakr., Fl. Jowai 1: 72. 1981. *B. peltata* Pursh, Fl. Amer. Sept. 2: 389. 1814, nom. illeg.; Hook. f. & Thomson in Fl. Brit. India 1: 113. 1872. Fig. 66.

Stems up to 2 m long, branched; floating shoots rising almost to water surface, ca 1 m or more long, with floating leaves and flowers at nodes; young submerged parts including petioles, peduncles and undersurface of leaves coated with thick transparent mucilage. Floating leaves 4-10(-13.5) x 2.5-6(-8) cm, distichous or tristichous (when flowers are absent), suborbicular or broadly elliptic, entire, green above, dull purplish beneath; petioles usually 0.5-1 m long. Sepals lanceolate, obtuse at apex, 1-1.5 x 0.3-0.5 cm, reddish inside puberulous, persistent. Petals lanceolate, cucullate at apex, 1.5-1.8 x 0.3-0.6 cm, puberulous, persistent. Anthers ca 3 mm long; filaments 8-12 mm long, puberulous. Ovary 5-6 mm long, ca 1 cm in fruit, fusiform, appressed puberulous; styles 3-4 mm long, with densely papillose-hairy stigmatic region along adaxial face, persistent and incurved in fruit. Seeds ellipsoid, minutely beaked at hilum, 3-4 x 2.5-3 mm, sparsely papillate, dark brown.

Fl. & Fr. Aug. - Nov.

Distrib. India: Stagnant pools and tanks, 1200-1800 m. Meghalaya (Nongkreem in Khasia hills and Nartiang - Jowai in Jaintia hills).

Bhutan, China, Japan, Asiatic Russia, N. America, Central America, trop. E. Africa and Australia.

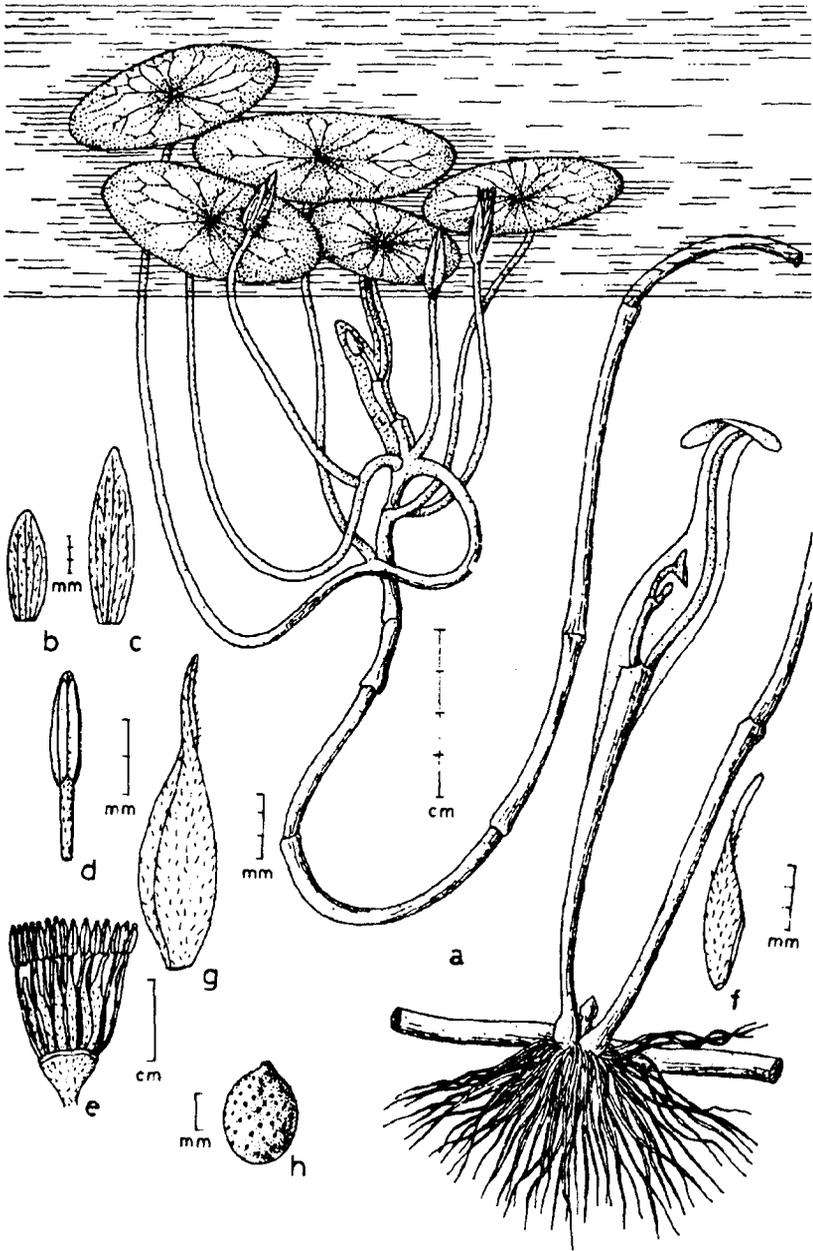


Fig. 66. *Brasenia schreberi* J.F. Gmel. : a. habit; b. sepal; c. petal; d. stamen; e. flower with petals and sepals removed; f. carpel; g. fruit; h. seed.

Notes. A thick coat of transparent mucilage on young plant parts is secreted by densely packed glandular trichomes, which swell, rupture and disintegrate with age, leaving the older parts free from mucilage (Richardson, op. cit. p. 7). Specimens, unless pressed between wax-paper, stick to drying sheets (Wood in J. Arn. Arb. 40: 104. 1959).

2. *Cabomba* Aubl.

Herbs, perennial, slender, completely submerged, except during flowering; roots adventitious in groups at lower nodes of stems trailing through mud. Leaves dimorphic, petiolate; principal leaves opposite, some small, alternate; submerged leaves opposite or ternate, palmately divided at the summit of petiole into 3 - 9 parts; each part dividing 2 - 3-chotomously several times into many long, narrow segments forming a dissected blade, flabellate in outline; floating leaves when present alternate, peltate. Flowers white to yellow or purple, emerged above water, on peduncles of unequal length. Sepals 3, slightly connate at base. Petals 3, clawed and often auriculate, slightly connate at base. Stamens 3 - 6, without distal sterile appendages; microsporangia lateral to abaxial; pollen anasulcate. Carpels 1 - 4, each with 3 pendulous ovules in laminar position. Pods coriaceous, usually 3-seeded; seeds covered with hygroscopic hairs.

Tropical and temperate regions of America; ca 7 species, one introduced in India.

Literature. FASSETT, N. C. (1953) A monograph of *Cabomba*. *Castanea* 18: 116 - 128. MITRA, R. L. (1990) Cabombaceae. In: *Fasc. Fl. India* 20: 3 - 7. ORGAARD, M. (1991) The genus *Cabomba* (Cabombaceae) - a taxonomic study. *Nord. J. Bot.* 11: 179 - 203, ff. 1 - 10. SCHNEIDER, E. L. & J. M. JETER (1982) Morphological studies on the Nymphaeaceae XII. The floral biology of *Cabomba caroliniana*. *Amer. J. Bot.* 69: 1410 - 1419.

Cabomba caroliniana Gray in *Ann. Lyc. N. Y.* 4: 46. 1837; Orgaard in *Nord. J. Bot.* 11: 199, f. 2D. 1991. *C. aquatica* auct. non Aubl. 1775; Aleykutty & Inamdar in *Curr. Sci.* 47: 136, ff. 1 - 5. 1978.

Stems up to 2 m long, branched, thinly mucilaginous; shoots green, sometimes reddish brown. Petioles 1 - 3 cm long, pubescent. Submerged leaves finely dissected, flabellate in outline, 2 - 5 cm wide; terminal segments slightly spatulate, 0.3 - 0.8 mm broad, with an obscure midrib. Floating leaves peltate, linear-oblong to linear-elliptic, 5 - 20 x 1.5 - 3 mm, often emarginate at one end, usually pubescent beneath, green. Flowers 1 - 1.5 cm across, 0.6 - 1.2 cm long, creamy white with a pair of yellow spots at base of each petal, rising above water on peduncles from upper axils; peduncles 1.5 - 8 cm long, pubescent. Sepals and petals 3 each, the former elliptic, the latter obovate, rounded at apex and auriculate near base, 6 - 12 mm long. Stamens 3 - 6. Carpels 2 - 4, elongate, divergent at maturity, puberulous. Seeds ovoid, 1.5 - 3 x 1 - 5 mm, covered with hygroscopic hairs.

Fl. & Fr. May - Aug.

Distrib. India: Fresh water ponds and ditches around Kochi in Kerala - introduced.

Native of N. America.

Notes. Aleykuty & Inamdar (l. c.) reported this plant from fresh water ponds and ditches around Kochi in Kerala as *C. aquatica* Aubl. Except for the creamy white colour of the flower and the emarginate nature of the linear-oblong floating peltate leaves, as seen in their drawings, all other characters mentioned by them are generalised in nature and both these two characters are applicable only to *C. caroliniana* Gray (Gardner in Hook. Ic. Pl. 7: t. 642 & Fassett, op. cit. p. 120). On the other hand, in *C. aquatica* Aubl. the flowers are yellow and the floating peltate leaves are broadly elliptic to orbicular and entire in outline.

The plant is commonly grown in fresh water aquaria for their decorative dark green fan-shaped submerged leaves. It probably got introduced into Kerala from discarded aquarium plantlings. Under indoor conditions, this plant never produce floating leaves and flowers and always remain completely submerged and thus are often mistaken for *Limnophila* species. The plant, however, can be easily recognised by its submerged leaves being long-petiolate and leaf-segments 2-3-chotomously branched, while in *Limnophila* they are sessile and pinnately divided.

NELUMBONACEAE

(R. L. Mitra)

Large perennial, rhizomatous, laticiferous, acaulescent, aquatic herbs with air canals and scattered vascular bundles devoid of cambium. Rhizomes stoloniferous, branched, creeping, slender or tuberous, producing at nodes adventitious roots, solitary leaf, flower and axillary bud. Leaves simple, stipulate, long-petiolate, orbicular with radiating veins branched dichotomously except the midrib; juvenile ones eccentrically peltate, floating; adult ones centrally peltate, floating or submerged; foliar sclereids absent. Flower solitary on long peduncles, raised well above water, large, showy, rose-pink, white or yellow, bisexual, hypogynous with spirally arranged floral appendages. Sepals 4 - 5, free, intermediate ones larger, caducous; innermost ones sometimes transitional to stamens. Stamens numerous, free, long and linear, each differentiated into a subterete filament, an anther with adaxial to sublateral microsporangia and a distal, clavate, incurved sterile appendage; pollen tricolpate. Carpels (9-)12 28(-39), distinct, embedded singly in cavities or turbinate, accrescent receptacles; ovules solitary in each carpel, pendulous, orthotropous, anatropous at maturity, bitegmic, crassinucellate; placentation laminar. Nuts ripening above water; pericarp smooth, bony. Seed filling the carpel, exarillate, inoperculate; cotyledons large, fleshy; plumule folded, enclosed in a stipule-like sheath.

Tropical and subtropical regions of West Indies, Columbia, Central America. S.E. United States, Asia to N.E. Australia; one genus and 2 species, one species in India.

Literature. MITRA, R. L. (1990) Nelumbonaceae. In: Fasc. Fl. India 20: 8 - 10. SIMON, J. P. (1971) Comparative serology of the order Nymphaeales 2. Relationships of Nymphaeaceae and Nelumbonaceae. *Aliso* 7: 325 - 350.

Nelumbo Adans.

Description and distribution same as for family.

Nelumbo nucifera Gaertn., *Fruct.* 1: 73, t.19., f.2. 1788. *Nelumbium speciosum* Willd., *Sp. Pl.* 2: 1258. 1799; Hook. f. & Thomson in *Fl. Brit. India* 1: 116. 1872.

Asm.: *Podam*; Beng.: *Podma*; Hindi: *Kanwal, Kamal*; Kan.: *Kamala, Tavaregadde*; Kash.: *Pampos*; Kh.: *Soh-lapudong*; Mal.: *Chentamara, Tamara*; Mar.: *Kamal*; Or.: *Padma*; Punj.: *Pampos*; Sans.: *Padma*; Tam.: *Tamarai*; Tel.: *Erra-tamara, Kalung*.

Leaves flat when floating, somewhat cupped when emersed, suborbicular, 20 - 80 cm across, shallowly notched and apiculate at one side, terminating in a simple vein, with minute apicula at opposite side, glabrous and glaucous on both surfaces, dark green above, paler beneath, coriaceous, membranous when dry; petioles up to 2 m long, beset with scattered hard minute papillae. Flowers 8 - 25 cm across, rose-pink or white, fragrant; peduncles up to 2 m long, beset with scattered hard minute papillae. Sepals ovate or elliptic, 1.5 - 5 x 0.8 - 3.5 cm, concave, green (in white flowers) or pinkish green (in rose-pink flowers). Petals ca 20 (single form) or ca 110 (double form), each elliptic, obtuse or subacute, concave, 4 - 15 x 2 - 8 cm, gradually becoming obovate to spatulate. Stamens up to 225, each 2.2 - 4.5 cm long; outermost ones in double form staminodial. Receptacles 2 - 4 cm across, spongy, yellow during anthesis, turning green and finally becoming dark brown and 5 - 10 cm across in fruit. Carpels 8 - 10 x 2 - 3 mm, becoming ca 2 x 1 cm in fruit, each differentiated into an oblong-cylindric ovary and a short exerted stylopodium with peltate, centrally depressed and papillose stigma.

Fl. & Fr. March - Dec. (- Jan.).

Distrib. India: Throughout in fresh water ponds and lakes, also grown as an ornamental plant.

S. and E. Asia to far eastern Russia and to N. Australia.

Notes. The sacred lotus of Hindus, used for religious and decorative purposes, and also in indigenous systems of medicine. Tuberous rhizomes and ripe carpels are edible and are sold in market; cultivated in a small scale in Punjab and extensively in China and Japan.

The seeds of *Nelumbo nucifera* are perhaps the longest viable; seeds recovered from moist peat of a drained lake in southern Manchuria, variously claimed between 100 and 1000 years old, germinated consistently (Sculthcope, Biol. Aquatic Vasc. Pl. 325. 1967).

BARCLAYACEAE

(R. L. Mitra)

Slender, perennial, rhizomatous, laticiferous, acaulescent aquatic herbs, with air canals and scattered vascular bundles. Rhizomes short, erect, villous-pubescent, bearing flowers, leaves, vegetative buds and axillary runners. Leaves simple, stipulate, long-, petiolate, heterophyllous, submerged and erect, or floating, oblong to suborbicular, cordate or subsagittate at base. Flowers small, solitary, usually long-pedunculate, bisexual, with spirally arranged floral appendages. Sepals 5, free, hypogynous, persistent. Petals numerous, unequal, epigynous, free above, connate into a tube and adnate to the ovary below, persistent; innermost ones transitional to stamens. Stamens numerous, free, arranged on corolla tube, pendulous, each differentiated into a short constricted filament (oval in cross section) and a dorsiventrally flattened broad anther with microsporangia arranged laterally or sublaterally. Ovary 6-14-loculate with a cup-like depression above, formed by radiating curved stigmas; stigmatic appendages incurved, conniving into a cone; ovules numerous in each locule, orthotropous, bitegmic, crassinucellate; placentation laminar. Fruit ripening under water into an irregularly dehiscent many-seeded berry, enclosed by and crowned with persistent calyx and corolla. Seeds spinulate, exarillate, operculate, with minute embryo, scanty endosperm and copious perisperm.

S.E. Asia, one genus and 4 species; one species in India.

Barclaya Wallich, nom. cons.

Charaters and distribution of the family.

Notes. The name *Hydrostemma* Wallich (in Phil. Mag. n. s. 1: 454. June 1827) originally proposed for this genus predates *Barclaya* Wallich (in Trans. Linn. Soc. 15: 442. Dec. 1827) by six months. However, *Barclaya* Wallich has been conserved against *Hydrostemma* Wallich (see Taxon 36: 737. 1987 & 37: 440. 1988).

Literature. HU, S. Y. (1968) Studies in the flora of Thailand. 48. The genus *Barclaya* (Nymphaeaceae). Dansk. Bot. Ark. 23: 533 - 540.

Barclaya longifolia Wallich in Trans. Linn. Soc. Lond. 15: 443, t. 18. 1827; Hook. f. & Thomson in Fl. Brit. India 1: 115. 1872.

Leaves linear-oblong, cordate-sagittate at base, obtuse at apex, undulate-crispate along margins, 12 - 28 x 2 - 6 cm, puberulous or glabrate beneath; petioles 6 - 25 cm long, puberulous or glabrescent. Flowers 1.5 - 2.5 cm long, purplish, hardly expanding and emerging above water; peduncles 10 - 35 cm long. Sepals linear-elliptic, concave, obtuse, 1.5 - 2.5 x 0.5 - 0.6 cm, with midrib distinct near the apex and produced into a 3 - 5 cm long tail, greenish purple outside, purplish inside. Corolla shorter than sepals, green outside, purplish inside; lobes broadly or narrowly oblong. Inner stamens 2 - 2.5 mm long, fertile, incurved. Berry 1 - 1.5 cm across. Seeds globose, ca 1 mm across, brown, spinulose; spines radiating, tufted at micropylar region.

Fl. & Fr. July - Dec.

Distrib. India: In pools and slow streams, South Andaman Islands.

Myanmar, Thailand, Indo-china and Malaysia.

Notes. Prain (in *J. Asiat. Soc. Beng.* 59: 252. 1890) considers the plant doubtfully indigenous to Andaman flora. It appears to be very rare and localised in distribution, for the plant was collected only thrice (from Caddelgunj Jungle, *King's coll.* s. n. in 1893; Anikhet valley, *Rogers* 369, in 1904 and from Poona-nallah, on way to Poochang forest post, *Mehrotra* 136 on 6 Sept. 1982) since its first record (*King* in *J. Asiat. Soc. Beng.* 58: 390. 1889) from a ditch near Haddo in Port Blair (*King's Coll.* s. n.) in 1884.

Popularly grown in aquaria in continental Europe and N. America (*Taxon* 33: 517. 1984).

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