



DRAFT

# FLORA OF BHUTAN

INCLUDING A RECORD OF PLANTS FROM  
SIKKIM AND DARJEELING

VOLUME 3 PART 2



THE GRASSES OF BHUTAN

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ཨ་མཉུ་ག་པ་ལྷ་ཤིང་ལྷ་མོ་ག་ལ།

ROYAL BOTANIC GARDEN, EDINBURGH  
ROYAL GOVERNMENT OF BHUTAN  
2000



**TRIBE 1. BAMBUSEAE** Kunth ex Nees (Woody bamboos)

C.M.A. Stapleton

Perennial grasses. *Rhizomes* well developed, either leptomorph (long, thin, with monopodial branching, Fig. 4a) or pachymorph (thick with sympodial branching, rootless neck section sometimes elongated, Fig. 4d). *Culms* woody, erect (Fig. 3a) to pendulous (Fig. 3k), either arising singly and well separated (habit diffuse, Fig. 8c), or arising in a single dense clump (habit unicaespitose, Fig. 1a), or arising in a series of clumps of tillering culms connected by long rhizomes (habit pluricaespitose). Internodes often with single, wide groove above branches (sulcate). *Buds* at culm nodes enclosed by a single broad prophyll with margins free (Fig. 3l) or fused (Fig. 3b), or by a narrow prophyll and matching sheath (Fig. 8d), or by narrow prophyll and sheath fused together at back and/or front (Fig. 7c). *Branches* at culm nodes 1–many, similar in size (Fig. 5b) or with smaller branches around larger central ones (Fig. 1b,f). Sheaths subtending minor branches either all present, or some absent so that multiple initials or distinct ranks of initials are visible (Fig. 5d). *Leaf sheaths* with inner and outer ligules,  $\pm$  auricles and oral setae (Fig. 6g–s). Leaf blades broad, eventually deciduous, articulating from leaf sheath on a pseudopetiole, venation all parallel, or with additional cross-veins (tessellation). Culm leaves (culm sheaths) well differentiated from foliage leaves, thickened with progressively reduced blades (Fig. 1i–q). *Inflorescence* a simple or complex branching system, with spikes of sessile flowers (florets), a short peduncle and basal glumes together forming spikelets (pseudospikelets if glumes subtend buds). Inflorescence branches (paraclades) subtended by sheaths (bracteate), or with sheaths much reduced or absent (ebracteate). Young inflorescence bud enclosed by a single broad prophyll (Fig. 1d), or by a narrow prophyll and matching sheath (Fig. 1h). Branching of inflorescences simple (racemose) or compound (paniculate). Branches (paraclades) separate or clustered together (fasciculated), often divergent with small axillary swellings (pulvini). *Spikelets* sessile or borne on a stalk or promontory (incorrectly called a pedicel in grasses), the first sheath a prophyll inserted at or distant from the point of branching, often constituting the lower glume. Prophyll and glumes basal to spikelet with or without subtended buds. Those spikelets (pseudospikelets) with developing buds capable of repeated ramification (flowering iterant) often developing into dense capitate clusters (Fig. 1g). Spikelets with basal buds absent or vestigial incapable of further development (flowering semelauctant, Fig. 5c,g). Stamens 3 or 6(–c. 120). Lodicules(0–)3(–12 or more). Flowering cyclical, usually at intervals of 15 to 150 years. Flowering synchronised over districts or regions (gregarious), or sporadic.

## 1. BAMBUSEAE

The bamboos are extensively used in the area for a wide variety of purposes. The larger species occur naturally or are cultivated up to 1600m, and are widely used for poles, edible shoots and animal fodder. Smaller species occurring naturally as forest understorey up to 3,400m, or cultivated around settlements, or forming extensive areas of pure bamboo pastureland, are used for basketry, house roofs, walls and floors, edible shoots and fodder.

**Taxonomic key**

1. Inflorescence fully bracteate; all axes within the inflorescence subtended by a sheath and bearing a prophyll close to the point of branching ..... 2
- + Inflorescence partially or wholly ebracteate; inflorescence axes with some to all of the subtending sheaths and prophylls reduced, modified or absent ..... 9
2. Rhizomes leptomorph (all internodes longer than wide, culms well differentiated from rhizomes); culm nodes prominently swollen, often bearing thorns; stamens 3 ..... **15. [Chimonobambusa](#)**
- + Rhizomes pachymorph (root-bearing internodes wider than long, rhizomes normally developing directly into culms); culm nodes not prominently swollen; stamens 6 ..... 3
3. Culm sheath blade needle-like; florets separated on long, sinuous rhachilla ..... **14. [Neomicrocalamus](#)**
- + Culm sheath blade triangular or lanceolate; florets usually overlapping on straight rhachilla ..... 4
4. Style short, solid; central branch large or dormant; mainly giant bamboos 12–30m tall ..... 5
- + Style elongate, hollow; branches subequal; mainly bamboos of medium height, 8–16(–20)m tall ..... 6
5. Inflorescence bud enclosed within a single, broad, 2-keeled prophyll; new culms usually covered with light, waxy deposits ..... **1. [Bambusa](#)**
- + Inflorescence bud enclosed within two, narrow, single-keeled bracts; new culms covered with thick, dark, waxy deposits ..... **2. [Dendrocalamus](#)**
6. Rhizome neck over 50cm long; culms diffuse or pluricaespitose ..... 7
- + Rhizome neck under 50cm long; culms unicaespitose ..... 8
7. Culm thick-walled, diameter under 7cm; culm sheath blade lanceolate, reflexed, persistent; fruit more than 5cm ..... **3. [Melocanna](#)**

- + Culm thin-walled, diameter under 4cm, culm sheath blade triangular, erect, deciduous; fruit less than 1cm ..... 6. [Pseudostachyum](#)
- 8. Inflorescence globular ..... 4. [Cephalostachyum](#)
- + Inflorescence spicate ..... 5. [Teinostachyum](#)
- 9. Rhizomes leptomorph (all internodes longer than wide, culms well differentiated from rhizomes) ..... 7. [Arundinaria](#)
- + Rhizomes pachymorph (root-bearing internodes wider than long, rhizomes normally developing into culms) ..... 10
- 10. Mid-culm branch prophylls broad, 2-keeled; lateral branches initially 4, subtended by sheaths ..... 8. [Thamnocalamus](#)
- + Mid-culm branch prophylls narrow, single-keeled; lateral branches initially 6 or more, without subtending sheaths ..... 11
- 11. Culms pendulous to semi-scandent; nodes with wide, corky ring; front of mid-culm bud-scale initially closed; glumes 1-2 ..... 13. [Ampelocalamus](#)
- + Culms erect to pendulous; nodes without corky ring; front of mid-culm bud-scale always open, with free margins; glumes 2 ..... 12
- 12. Mid-culm buds tall; fewer than 10 branches in the first year ..... 13
- + Mid-culm buds short; more than 10 branches in the first year ..... 14
- 13. Rhizomes to 30cm long; culms unicaespitose ..... 9. [Borinda](#)
- + Rhizomes to 300cm long; culms diffuse or pluricaespitose ..... 10. [Yushania](#)
- 14. Spikelets with more than 1 floret; interior of culm sheath distally rough ..... 11. [Drepanostachyum](#)
- + Spikelets usually with 1 floret; interior of culm sheath smooth ..... 12. [Himalayacalamus](#)

**Field key to genera** (from Stapleton 1994a)

- 1. Clump-forming bamboos; culms growing in clumps of more than 10 ..... 2
- + Spreading bamboos; culms growing separately, or in groups of up to 10..... 10
- 2. Maximum culm diameter more than 7cm ..... 3
- + Maximum culm diameter less than 7cm ..... 4

## 1. BAMBUSEAE

3. Culm with light covering of pale wax; central branches fairly uniform, usually quite small ..... **1. [Bambusa](#)**
  - + Culm covered with dark or thick, furry wax; central branches varied, often very large ..... **2. [Dendrocalamus](#)**
4. Maximum internode length more than 40cm ..... 5
  - + Maximum internode length less than 40cm ..... 7
5. Leaves with cross-veins linking long veins ..... **9. [Borinda](#)**
  - + Leaves with no cross-veins between long veins..... 6
6. Culm nodes with no collar, or with thick, flat, even collar . **4. [Cephalostachyum](#)**
  - + Culm nodes with thin, projecting, wavy collar ..... **13. [Ampelocalamus](#)**
7. Buds tall, chilli-shaped ..... **8. [Thamnocalamus](#)**
  - + Buds short, onion-shaped ..... 8
8. Culm sheath blade more than 2cm wide ..... **1. [Bambusa](#)**
  - + Culm sheath blade less than 1cm wide ..... 9
9. Culm sheath rough inside at top ..... **11. [Drepanostachyum](#)**
  - + Culm sheath smooth inside at top ..... **12. [Himalayacalamus](#)**
10. Culms with rings of thorns around the nodes ..... **15. [Chimonobambusa](#)**
  - + Culms with no thorns ..... 11
11. Leaves with no cross veins between long veins ..... 12
  - + Leaves with distinct cross veins between long veins ..... 13
12. Culm diameter over 4cm ..... **3. [Melocanna](#)**
  - + Culm diameter 2-4cm ..... **6. [Pseudostachyum](#)**
  - + Culm diameter under 2cm ..... **14. [Neomicrocalamus](#)**
13. Rhizome rooting at all nodes ..... **7. [Arundinaria](#)**
  - + Long lengths of rhizome without roots ..... **10. [Yushania](#)**

## 1. BAMBUSA Schreber

Tropical and subtropical bamboos, 2–25m in height. Rhizomes pachymorph, without extended necks. Culms usually glabrous, or lightly waxy. Branches small and uniform, or large and variable. Culm sheaths usually with large auricles and long, dense oral setae. Leaf blades under 25cm. Inflorescence fully bracteate, spicate to globular, enclosed within a 2-keeled prophyll. Spikelets with basal buds (flowering iterant), terminating in an incomplete, or rudimentary, floret. Florets usually separated by clearly distinguishable, disarticulating rhachilla internodes. Palea keeled, acute, never deeply bifid. Stamens 6, filaments free. Lodicules 3.

- |  |  |
|--|--|
| 1. Culm diameter over 5cm .....                          | 2                                      |
| + Culm diameter under 4cm .....                          | 5                                      |
| 2. Culm sheaths without auricles .....                   | 2. <a href="#"><u>B. balcooa</u></a>   |
| + Culm sheath with auricles .....                        | 3                                      |
| 3. Culm sheath auricles over 10mm wide .....             | 4                                      |
| + Culm sheath auricles 2–10mm wide .....                 | 3. <a href="#"><u>B. clavata</u></a>   |
| 4. Leaf sheath auricles small, oral setae erect .....    | 5. <a href="#"><u>B. nutans</u></a>    |
| + Leaf sheath auricles large, oral setae spreading ..... | 6. <a href="#"><u>B. tulda</u></a>     |
| 5. Culm sheath auricles large, dissimilar .....          | 1. <a href="#"><u>B. alamii</u></a>    |
| + Culm sheath auricles absent or small, similar .....    | 4. <a href="#"><u>B. multiplex</u></a> |

**1. B. alamii** Stapleton; Nep: *mugi bans*. Figs. 1i; 2a, l.

Culms to 10m, to 4cm in diameter, erect to drooping, internodes waxy, branches many. Culm sheaths persistent, completely glabrous; blades broad, erect; auricles strongly dissimilar, one rounded, one very large and elongated down sheath margin; oral setae to 1cm, dense, wavy; ligule 1–2mm wide, entire. Leaf sheaths glabrous; auricles large, spreading; oral setae long, erect or spreading; blades to 25×2.5cm, glabrous; ligule short. Inflorescence spicate; spikelets 2–3cm; lemmas glabrous; paleas truncate, keels distally ciliate; anthers slightly apiculate.

**Bhutan:** S—Gaylephug district. Cultivated, 200–300m.

Note: culms used for weaving, and the foliage for animal fodder.

Note: *B. alamii* has been considered to be a synonym of *B. jaintiana* R. B. Majumdar (Alam & Hassan, 1994). *B. jaintiana* was minimally diagnosed on the basis of a type collection from the Khasia Hills of Meghalaya. It was stated, in the diagnosis, to have

## 1. BAMBUSEAE

smaller auricles than *B. tulda*, whereas *B. alamii* has larger auricles. The isoparatype of *B. jaintiana* at K seems identical to *B. tulda*, and the holotypes need to be compared.

**2. *B. balcooa*** Roxb.; Nep: *dhanu bans*. Figs. 1j; 2b.

Culms to 25m, to 16cm in diameter, erect to drooping; internodes with dense, brown, furry wax at first, becoming glossy; nodes with aerial roots; bearing branches to the base of the culm; central branches very large, ultimate branchlets thorn-like. Culm sheaths with dense, dark brown hairs; auricles and oral setae absent; blade edges basally corrugated; ligule 3–5mm wide, wavy, finely serrate. Leaf sheaths with dense, deciduous, brown hairs; ligule short; auricles absent; oral setae few, short, erect. Inflorescence spicate to globular. Mature spikelets disarticulating reluctantly, c. 10×8mm, strongly flattened, with prominent, long, white cilia on lemma margins and palea keels; lemmas green with purple edges, apex sharp. Anthers yellow; tips apiculate, glabrous, ± purple.

**Bhutan:** S—Sarbhong district (Sarbhong). Cultivated, 200–300m.

Note: culms used for heavy-duty construction purposes such as beams, pillars, and ox-carts; the foliage is used as animal fodder.

**3. *B. clavata*** Stapleton; Dz: *pagshing*; Nep: *chile bans*. Figs. 1k; 2c, j.

Culms to 18m, to 9cm in diameter, erect to drooping; internodes largely without wax; nodes with dense rings of white wax above and below, aerial roots lacking; branches medium-sized, absent from lower nodes. Culm sheaths with dark brown hairs; auricles small; oral setae short; blades broad, appressed, deciduous; ligules broad, fimbriate, often with a single, deep erosion or cleavage. Leaf sheaths glabrous; ligule short, ciliate; auricles absent; oral setae few, erect, short. Inflorescence initially club-shaped with a single spikelet, or spicate, becoming globular. Spikelets large, basally constricted, to 3cm, disarticulating reluctantly; lemmas green with purple, apiculate tips, margins glabrous. Anthers yellow; tips purple, initially penicillate.

**Bhutan:** C—Punakha (Tinlegang) and Tongsa (Shemgang) districts; S—Sarbhong and Gaylephug districts. Cultivated 300–1600m.

Note: used for construction and roofing, and also for animal fodder.

**4. *B. multiplex*** (Loureiro) Raeuschel ex J.A. & J.H. Schultes; *B. glaucescens* (Willdenow) Merrill; *B. nana* Roxb.; Eng: *Chinese bamboo*. Figs. 1l; 2d.

Culms short, erect, 6–10m (though under 2m in some cultivated varieties); internodes waxy or sparsely brown-setose, often variously striped; branches small, the central one dominant. Culm sheaths persistent, glabrous, with erect, narrowly triangular blades; auricles small or absent; oral setae short; ligule 1–2mm wide,

entire. Leaf sheaths distally pubescent; auricles large, spreading; oral setae long, erect or spreading; ligule short; blades to 10cm, or only 3cm,  $\pm$  striped in some cultivated varieties, abaxial surface glaucous or pubescent. Inflorescence spicate; spikelets cylindric; rhachilla segments elongate, disarticulating readily; florets completely glabrous, except for the distally, minutely ciliate palea keels.

**Bhutan:** S—Phuntsholing district (Phuntsholing town). Cultivated as low, ornamental hedging.

**5. *B. nutans*** Wall. ex Munro subsp. ***cupulata*** Stapleton; *B. teres* Munro; Dz: *jhushing*; Nep: *mal bans*. Figs. 1m; 2e.

Culms to 23m, to 10cm in diameter, erect or drooping; nodes scarcely raised; branching uniform, branch diameter to 2cm. Culm sheath with appressed, jet-black hairs; auricles large, broad; oral setae many, wavy, copper-coloured; blade prominently cupped, readily deciduous, the interior pubescent in centre. Leaf sheath glabrous; auricles small; oral setae few, erect, deciduous; ligule short, truncate, blade to 30 cm. Inflorescence spicate; spikelets to 5cm, cylindric, often curving, rarely flattened; rhachilla segments elongate, disarticulating very readily, usually before the spikelets become flattened; lemma margins glabrous, interior distally tomentose; palea keels shortly ciliate. Flowering gregarious.

**Bhutan:** S—Phuntsholing to Deothang districts, **C**—Punakha district (Wangdi Phodrang); **Sikkim** (Mallee Lines, Rungbee, Teesta). Cultivated , 300–1500m.

Note: widely cultivated for general purpose construction, archery bows, and for animal fodder.

**6. *B. tulda*** Roxb.; Dz: *jhushing*; Nep: *singhane bans*. Figs. 1n; 2f.

Culms to 15m, to 7cm in diameter, usually erect, slightly crooked; walls thick; nodes raised; branching strong, uniform to base, with central branch to 3cm in diameter. Culm sheath with dense, dark brown hairs; auricles large, one taller than broad; blade not cupped, persistent, interior with few hairs. Leaf sheath pubescent or glabrous; auricles large; oral setae persistent, upright or spreading; ligule short, truncate; blade to 25cm. Inflorescence spicate; spikelets to 35mm, cylindric, becoming flattened; rhachilla segments elongate, disarticulating readily but usually after the spikelets become flattened; lemma margins distally short-ciliate, interior distally tomentose; palea keels with long, white cilia.

**Bhutan:** S—Sarbhong district (Chirang). Cultivated for construction and fodder.



## 1. BAMBUSEAE

## 2. DENDROCALAMUS Nees

Tropical and subtropical bamboos 6–30m in height. Rhizomes pachymorph, without extended necks. Branches dissimilar, often large. Culms with dense, furry wax. Culm sheaths usually with small auricles; oral setae absent to many. Leaf blades to 50cm. Inflorescence fully bracteate, globular, enclosed between two separate, 1-keeled bracts. Spikelets with basal buds (flowering iterant), terminating in an incomplete or rudimentary floret. Florets dense, on short, non-disarticulating, rachilla internodes. Paleas keeled and acute, never deeply bifid. Stamens 6, filaments free. Lodicules scarce–3.

1. Culm sheath auricles always absent ..... see *Bambusa balcooa*  
+ Culm sheaths with auricles ..... 2
2. Culm sheath auricles very small, triangular, naked ..... **1. [D. hamiltonii](#)**  
+ Culm sheath auricles small, rounded, with oral setae ..... 3
3. Culm sheath auricle 2–10mm wide ..... see *Bambusa clavata*  
+ Culm sheath auricle 7–40mm wide ..... 4
4. Culm sheath auricle to 2cm wide; leaf sheaths with few, deciduous oral setae to 3mm in length ..... **2. [D. hookeri](#)**  
+ Culm sheath auricle over 2cm wide; leaf sheaths with many, persistent oral setae over 5mm in length ..... **3. [D. sikkimensis](#)**

**1. *D. hamiltonii*** Munro var. ***hamiltonii***; *Bambusa monogynia* Griff.; Dz: *pagshi*; Nep: *tama bans*. Figs. 1o; 2g,k.

Culms to 25m, to 9cm in diameter, apex strongly pendulous, densely covered in persistent, brown and white, furry wax; walls thin; branches fewer towards base, central branch to 5cm in diameter, smallest branches recurving from culm; nodes with dense, long aerial roots. Culm sheaths persistent, often decaying on culm, triangular, with patches of dark brown, appressed hairs; auricles small, triangular, naked; ligule centrally acute, broad and serrate, laterally erose. Leaf sheaths with white hairs; shoulders rising, slightly hooked; auricles and oral setae absent; ligule very long; blade to 40cm. Sporadic flowering common. Inflorescence very dense, globular, protogynous; spikelets soft, bell-shaped, 6mm long, initially purple; stigmas and anthers reddish–purple; grain spherical. Flowering both gregarious and sporadic, sporadic flowering very common.

**Bhutan:** S—Phuntsholing to Deothang districts; **Sikkim** (Teesta, Yoksum, Malee lines, Rungbee, Pemionghi). Both naturally occurring and cultivated, 300–1500m.

Note: common in deciduous forest and widely cultivated for weaving, light construction, edible shoots and animal fodder.

var. **edulis** Munro; Nep: *guliyo tama bans*; Keng: *su*; Lep: *rugvi*.

Differs from var. *hamiltonii* as follows: spikelets soft, yellowish-brown, to 15mm; anthers yellow; leaf sheath ligules shorter; with fewer recurving branchlets.

Note: this variety becomes more common, and replaces var. *hamiltonii*, towards E Bhutan and has particularly palatable new shoots. Flowering both gregarious and sporadic, sporadic flowering very common.

**2. D. hookeri** Munro; Dz: *pagshi*; Lep: *patu*. Figs. 1p; 2h.

Culms to 18m, to 9cm in diameter, nodding to drooping, initially densely covered in brown, furry wax, becoming glossy, dark green; walls thin; nodes with dense, short aerial roots; branches absent near base, central branch to 5cm wide. Culm sheaths deciduous, broad, with V-shaped lines of dense, dark brown, erect hairs; auricles 1–2cm, rounded; oral setae curving; ligule broad, serrate. Leaf sheaths glabrous; ligule very short, truncate; auricles absent; oral setae few, erect; blade to 40cm long. Inflorescence dense, globular; spikelets to 8mm, hard, ovate, initially olive-green; palea keels ciliate; anthers yellow, penicillate. Flowering gregarious.

**Bhutan:** C—Tongsa, Bumthang, Mongar and Tashigang districts; **Sikkim** (Pemiongchi, Rinchinpong; Mamring). Cultivated, 900–1500m.

Note: occasionally cultivated for light construction and animal fodder.

**3. D. sikkimensis** Oliver. Dz: *Zhang*; Shar: *Demtshar*; Lep: *Pugriang*. Figs. 1q; 2i,m.

Culms to 25m, to 15cm in diameter, erect to nodding, initially densely covered in brown, furry wax, becoming glossy orange; walls thin, internodal cavities very large; nodes with few aerial roots; branches absent near base, central branch to 5cm in diameter. Culm sheaths deciduous, broad, with thick, velvet-like, dark brown, erect hairs; auricles 2–5cm, wavy; oral setae long, curving; ligule broad, rolled, fimbriate. Leaf sheaths glabrous; ligule very short, truncate; auricles absent; oral setae many, erect and spreading; blade to 40cm. Inflorescence dense, globular, large; spikelets to 12mm, hard, ovate, initially olive-green with purple tips; palea keels densely shaggy; anthers yellow, long-apiculate.

**Bhutan:** C—Tongsa (Shemgang), Bumthang, Mongar and Tashigang districts, S—Deothang district; **Sikkim** (Rangeet Valley, ‘Sikkim superior’). On ridges in dry deciduous forest; also cultivated, 500–1200m.

Note: culms used to make containers and the foliage for animal fodder.

## 1. BAMBUSEAE

## 3. MELOCANNA Trinius

Tropical and subtropical bamboos. Culms 3–20m, erect or nodding. Rhizomes pachymorph, necks to 2m; clumps very open. Culm sheaths apically corrugated, external ligule present; blades long and narrow. Branches many, sub-equal. Leaf blades without obvious cross-veins. Inflorescences fully bracteate, , initially terminal to a leafy branch, tall and narrowly triangular; branches (paraclades) unilateral, subtending bracts long, narrow, projecting, with a short awn from midrib or keel. Spikelets with basal buds (flowering iterant). Fertile lemma 1, terminating in rachilla extension or rudimentary floret. Palea unkeeled. Stamens 6, filaments free or irregularly connate. Style long, hollow. Fruit to 12cm, with thick, fleshy pericarp.

**1. *M. baccifera* (Roxb.) Kurz; *M. bambusoides* Trinius; Nep: *philim bans*. Fig. 3a–d.**

Culms to 12m, to 5cm in diameter; internodes to 30cm, smooth, dull; nodes level, white-pruinose below. Culm sheath deciduous, with scarce, white, deciduous hairs; distally with deep, transverse corrugation; blade to 50cm, narrow, recurved; exterior ligule pronounced. Leaf sheaths glabrous; ligule short; auricles small or narrow and laterally spreading; oral setae long, erect, white; blades to 30×5cm, glabrous. Fruit to 13cm, acuminate, the size and shape of a pear. Flowering gregarious.

**Sikkim** (Singtam (Biswas *et al.*, 1991)). Cultivated.

## 4. CEPHALOSTACHYUM Munro

Subtropical bamboos. Culms 6–12m, pendulous; internodes long. Rhizomes pachymorph, without extended necks; clumps dense. Branches subequal; buds short, 2-keeled, closed. Leaf blades without obvious cross-veins, abruptly acuminate. Inflorescence fully bracteate, initially terminal to a leafy branch, sub-globular or globular at maturity; branches (paraclades) unilateral, subtending bracts long, narrow, projecting, with a long awn from midrib or keel; prophylls with 2 keels, one weak, the other strong and awned. Spikelets with basal buds (flowering iterant), one fertile lemma, terminating in a rachilla extension or rudimentary floret. Palea delicate, with cross-venation (tessellate), keels close. Stamens 6, filaments free. Lodicules large, papery, papillate. Style long, hollow. Flowering gregarious.

**1. *C. capitatum* Munro; *Schizostachyum capitatum* (Munro) R.B. Majumdar illeg. hom.; *S. munroi* S. Kumar & P. Singh, incl. var. *decompositum* Gamble; Dz: *jhi*; Keng: *pishima*; Nep: *dulloo bans*; Lep: *payong*. Fig. 3h,j.**

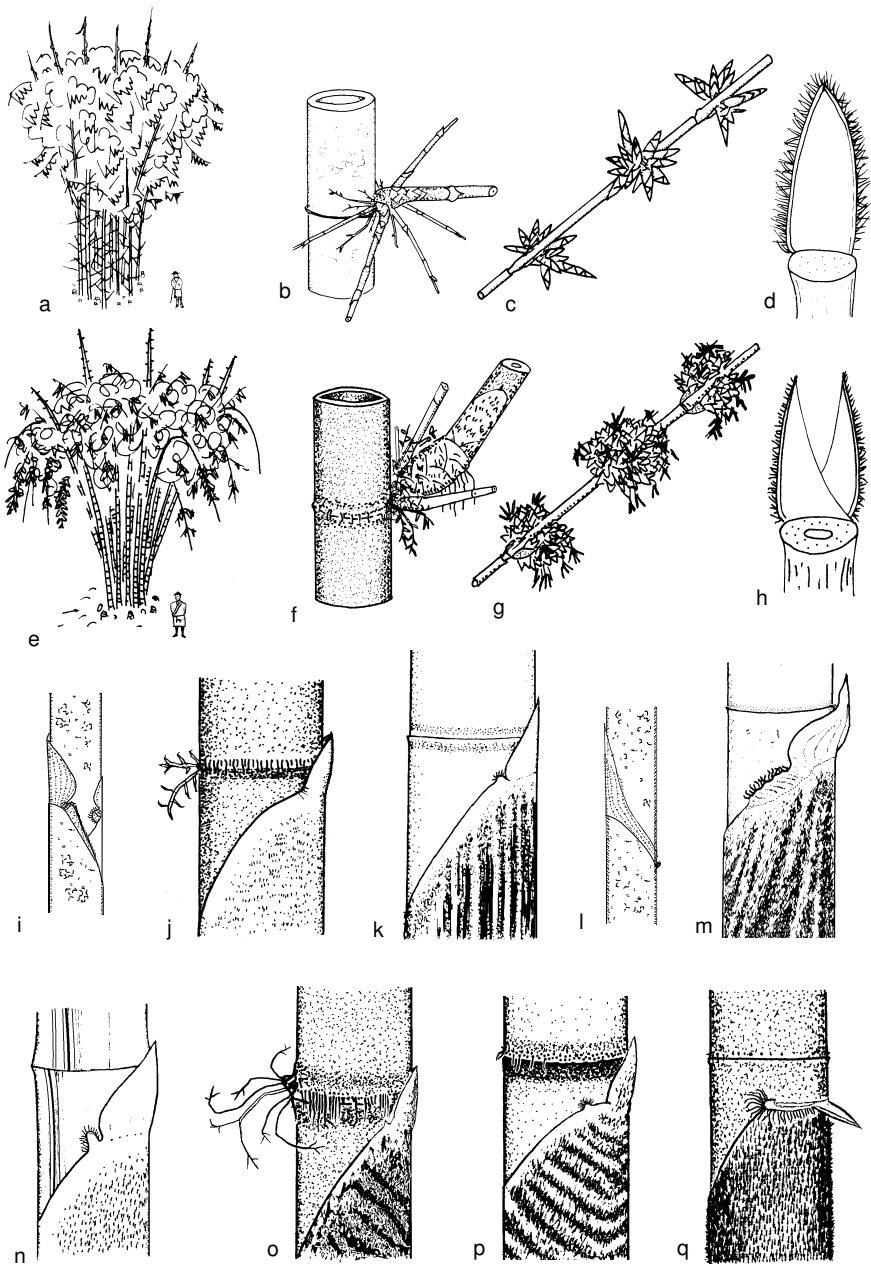


FIG. 1. a-d, *Bambusa*. e-h, *Dendrocalamus*. a,e, clump habit; b,f, mid-culm branching; c,g, 3 synflorescences on flowering branch; d,h, bracts subtending synflorescences. i-q, lower culm sheaths: i, *Bambusa alamii*; j, *B. balcooa*; k, *B. clavata*; l, *B. multiplex*; m, *B. nutans* subsp. *cupulata*; n, *B. tulda*; o, *Dendrocalamus hamiltonii*; p, *D. hookeri*; q, *D. sikkimensis*. Drawn by C. Stapleton, from Stapleton 1994.

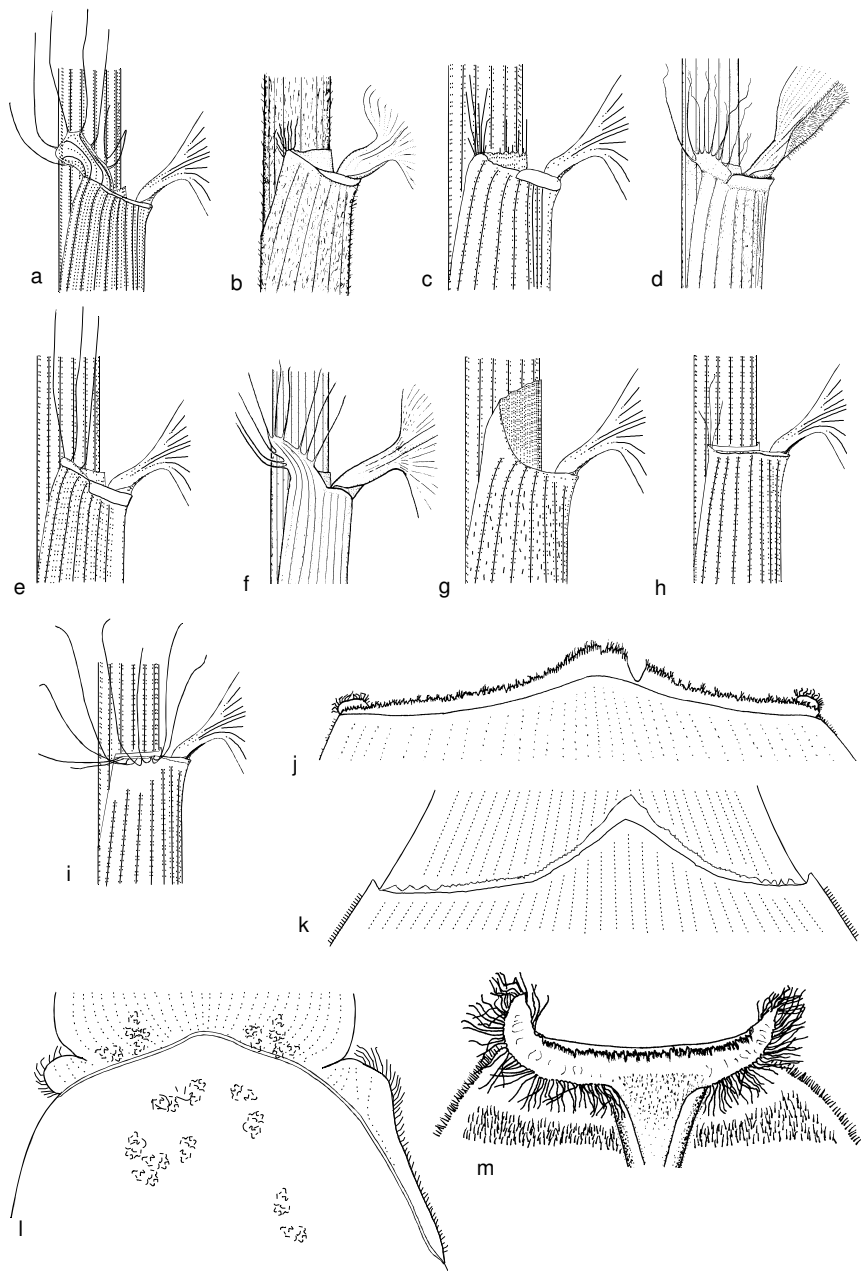


FIG. 2. *Bambusa* & *Dendrocalamus*. a-i, leaf sheaths: a, *Bambusa alamii*; b, *B. balcooa*; c, *B. clavata*; d, *B. multiplex*; e, *B. nutans* subsp. *cupulata*; f, *B. tulda*; g, *Dendrocalamus hamiltonii*; h, *D. hookeri*; i, *D. sikkimensis*. j-m, culm sheath ligule and auricles: j, *Bambusa clavata*; k, *Dendrocalamus hamiltonii*; l, *Bambusa alamii*; m, *Dendrocalamus sikkimensis*. Drawn by C. Stapleton, from Stapleton 1994.

Culms to 10m, to 4cm in diameter; internodes to 70cm, smooth, apically white-pruinose; nodes level, glabrous. Culm sheaths to 30cm, smooth; margins tough; shoulders level; oral setae long, erect, red, cylindric; blades rolled, often longer than the sheath. Leaf sheath shoulders level; oral setae erect or spreading, cylindric; ligule very short, densely tomentose; blades to 4×25cm. Inflorescence compound, unilateral, becoming sub-globular. Spikelets orange-yellow, cylindric; empty glume c. 1cm with strong, c. 3mm awn; fertile lemma c.1cm, with scabrid, c. 2mm awn, exterior glabrous, interior distally tomentose; palea shortly bifid, scabrous between minutely scabrous keels; anthers bifid.

**Bhutan:** C—Punakha district (Tashitang); S—Deothang district; **Darjeeling** (Songchunglu); **Sikkim** Habitat not recorded, 1200-1800m.

Note: widely collected from forest areas for weaving into mats; inflorescences used as paint brushes.

Note: developmental changes lead to alteration in appearance of inflorescences as flowering progresses. Older inflorescences may be less globular, lateral rather than terminal, and lacking leaves. Such material was described as var. *decompositum* Gamble, but it does not seem to differ substantially from the type variety.

Note: because of its local name, this species was previously enumerated as *Teinostachyum dullooa* (Stapleton 1994a, 1994b). Although Gamble (1896) included Assamese collections of *dullooa bans* in *T. dullooa*, and adopted that vernacular name as an epithet, the type of *T. dullooa* is from a different species.

**2. C. latifolium** Munro; *C. fuchsianum* Gamble; *Schizostachyum latifolium* (Munro) R.B. Majumdar; Dz: *jhi*; Keng: *pishima*; Nep: *ghopi bans*. Fig. 3g,i.

Culms to 15m, to 5cm in diameter; internodes to 1m, striate, rough, apically white-pruinose; nodes thickened, with a corky collar and fringe of hairs. Culm sheaths to 50cm, ridged; edges membranous; shoulders raised, tessellate, delicate; oral setae long and erect, white, flattened, quickly deciduous; blade to 30cm, flat, shorter than the sheath. Leaf sheath shoulders raised; oral setae long, erect, white, flattened, quickly deciduous; ligule long, glabrous; blades broad, to 7×35cm. Inflorescence compound, unilateral, becoming sub-globular. Spikelets orange-yellow, cylindric; empty glume c. 1cm, with c. 6mm awn; fertile lemma c. 2cm, with c. 2mm, scabrid awn, exterior papillose, interior distally tomentose in centre; palea shortly bifid, scabrous between the minutely scabrous keels; anthers blunt or apiculate.

**Bhutan:** S—Phuntsholing and Gaylephug districts; **Darjeeling** (Songchunglu). Subtropical forest, 1500–2000m.

## 1. BAMBUSEAE

Note: widely collected from forest areas for weaving into roofing mats; flowers used as paint brushes. The prominent, but quickly deciduous, oral setae of the leaf sheaths, not noticed when *C. latifolium* was described, led to the, unnecessary, later description of *C. fuchsianum*.

## 5. TEINOSTACHYUM Munro

Subtropical bamboos. Culms 6–12m, pendulous; internodes long. Rhizomes pachymorph, without extended necks; clumps dense. Branches subequal; buds short, 2-keeled, open. Leaf blades without obvious cross-veins. Inflorescence fully bracteate, spicate, divaricating, initially terminal, later lateral, never globular nor unilateral; bracts subtending branches (paraclades) short, not projecting, with awn absent or short; prophylls with 2 equal keels. Spikelets with basal buds (flowering iterant), several fertile lemmas, terminating in a rachilla extension or rudimentary floret. Stamens 6, filaments free or connate. Style long, hollow.

**1. *T. dullooa*** Gamble; *Neohouzeaua dullooa* (Gamble) Camus; *Schizostachyum dullooa* (Gamble) R.B. Majumdar; Nep: *tokhre bans*; Lep: *paksalu*.

Culms to 15m, to 5cm in diameter; internodes to 1m, smooth, apically white-pruinose; nodes level, glabrous. Culm sheaths to 30cm, ridged; edges thick; shoulders level; oral setae dense, long, erect, white, cylindric; blades slightly rolled, sometimes longer than the sheath, interior with dense, thick, opaque, short, scabrous bristles; ligule margin long-ciliate or fimbriate. Leaf sheath shoulders level; oral setae erect or spreading, cylindric; ligule long, densely tomentose, margin long-ciliate or fimbriate; blade to 6×25cm. Inflorescence compound, unilateral, becoming sub-globular. Spikelets very narrow, cylindric; empty glume and fertile lemmas c. 4mm, exterior lightly pubescent; filaments connate, anthers blunt, minutely penicillate.

**Darjeeling** (Rani Tal, Ramti). Habitat not recorded, 700m.

Note: collections from Bhutan known as *dulloo bans* (Stapleton 1994a, 1994b) are now identified as *Cephalostachyum capitatum* (see above).

## 6. PSEUDOSTACHYUM Munro

Tropical and subtropical bamboo. Rhizomes pachymorph, extended necks to 3m. Culms 6–16m, pendulous or semi-scandent, in many separate clumps from the same plant (pluricaespitose); walls very thin; internodes short; buds open. Leaf blades with cross-veins visible (tessellate). Inflorescence bracteate, all bracts short, not projecting, with awn absent or short, prophylls with 2 equal keels; panicles with curving, wiry

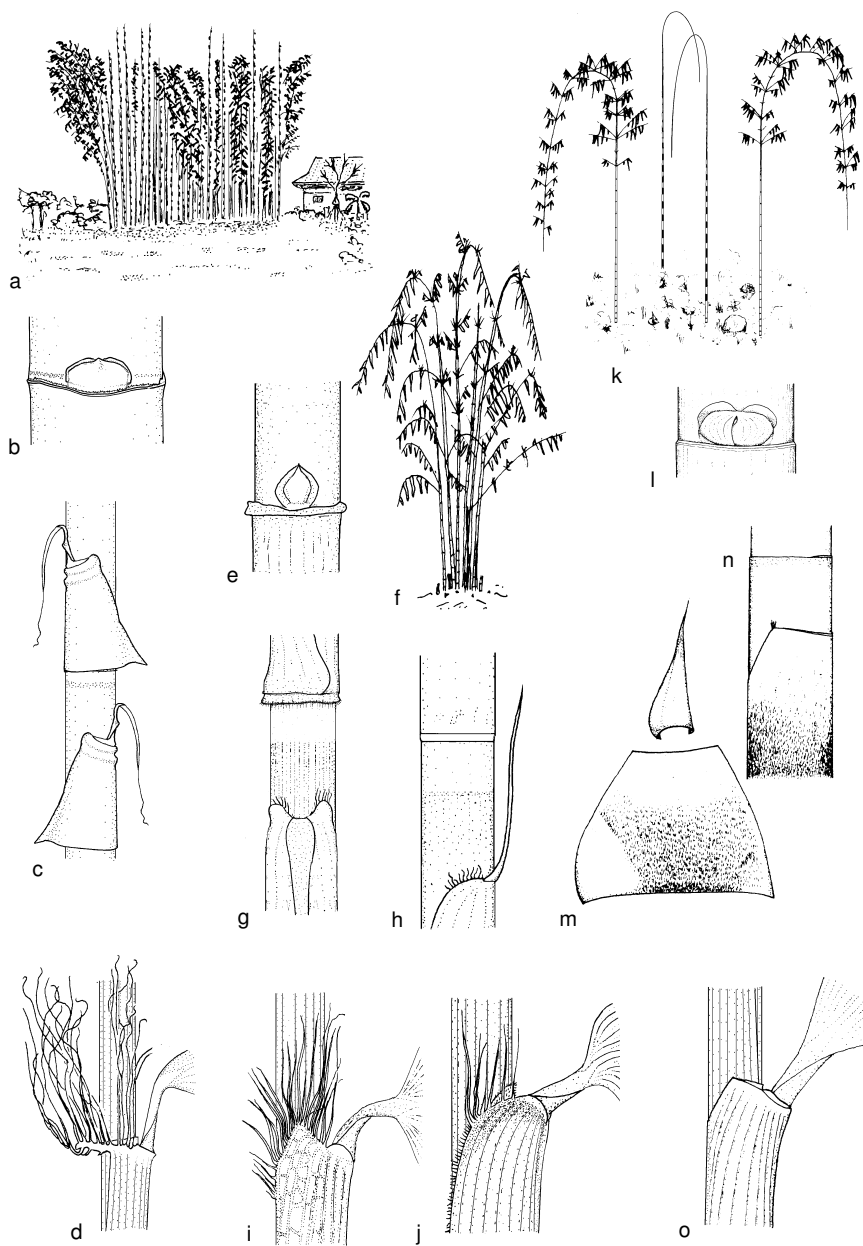


FIG. 3. a-d, *Melocanna baccifera*. e-j, *Cephalostachyum*: g,i, *C. latifolium*; h,j, *C. capitatum*. k-o, *Pseudostachyum polymorphum*. a,f,k, clump habit; b,e,l, mid-culm buds; c,g,h,m,n, culm sheaths and culm; d,i,j,o, leaf sheaths. Drawn by C. Stapleton, from Stapleton 1994.



## 1. BAMBUSEAE

branches and pedicels; spikelets with basal buds (flowering iterant), initially narrow, often becoming swollen, curved and hispid. Stamens 6, filaments free. Style hollow. Grain spherical, c. 5mm. Flowering gregarious.

**1. P. polymorphum** Munro; *Schizostachyum polymorphum* (Gamble) R.B. Majumdar; Keng: *dai*; Nep: *philim*. Fig. 3k–o.

Culms to 16m, to 4cm in diameter; internodes to 20cm, apically lightly waxy, smooth; wall less than 3mm thick; nodes level and glabrous. Culm sheaths very broad, basally brown-pubescent, distally waxy; blade triangular, erect, quickly deciduous. Leaf sheaths pruinose; ligule short; auricles and oral setae absent; blade to 5×35cm, with weak cross-veins (lightly tessellate).

**Bhutan:** S—Sarbhag district; C—Tongsa district (Tingtibi); **Sikkim** (Rungbi Jhora). Subtropical forest, 1000–1200m.



## 7. ARUNDINARIA Michaux

Temperate bamboos. Rhizomes leptomorph. Culms tillering, in many separate clumps from the same plant (pluricaespitose), erect to drooping; internodes smooth. Branch buds tall, enclosed within single, 2-keeled prophylls, always open at the front. Branches erect, central branch without compressed basal nodes, branching away from culm, complement becoming fan-shaped. Lateral branch axes always subtended by sheaths. Leaf blades with prominent cross-veins (tessellate). Inflorescence branching erect, racemose or paniculate, subtended by very small remnants of sheaths, or rings of hairs, branching often with small pulvini and rarely clustered together (fasciculated); glumes without subtended buds (flowering semelauctant); rhachilla sinuous, strongly flattened; palea curved. Stamens 3. Flowering gregarious.

**1. Racemosa** Munro; *Fargesia racemosa* (Munro) T.P. Yi; *Yushania racemosa* (Munro) R.B. Majumdar; Keng: *maxilla*; Lep: *miknu*. Figs. 4a–c; 6g.

Culms to 2m, nodding; internodes always smooth. Culm sheaths glabrous; auricles small; oral setae spreading; blade erect. Leaf sheath nearly glabrous, without tessellation; ligule short; auricles small, narrow, erect; oral setae erect, nearly glabrous, stout, persistent; blade to 10cm, margins similarly thickened, abaxial surface sparsely long-pilose, adaxial glabrous, cross-veins very prominent (venation tessellate). Spikelets with up to 10 florets; rhachilla sections scabrous with pubescent edges, distally pubescent; fertile lemma scabrous, margins pubescent; palea scabrous, keels ciliate; anthers shortly bifid.

**Bhutan:** C—Thimphu, Punakha, Bumthang and Tongsa districts; N—Upper Mo Chu and Upper Kuru Chu districts; **Sikkim** (Singalila range). Coniferous forest and pasture, 2900–3500m.

## 8. THAMNOCALAMUS Munro

Temperate bamboos. Rhizomes pachymorph, necks to 30cm; culms loose to dense, in a single clump (unicaespitose). Culms drooping to pendulous; internodes to 25cm, smooth, waxy. Mid-culm buds tall, enclosed within single, 2-keeled prophylls, the front of all culm buds open, with lateral branch axes always subtended by sheaths. First-year branches usually 5 at mid-culm, from compressed basal nodes on central branch, strongly flattened on one side. Culm sheaths usually with upright, persistent blades. Cross-veins of leaf blades prominent (venation tessellate). Inflorescence partially ebracteate, dense, with racemose or paniculate branching, never unilateral, shortly exserted from broad, persistent subtending sheath; branches occasionally clustered together (fasciculated) with no pulvini, usually subtended by substantial sheaths, or occasionally by rings of hairs; lower glumes often with vestigial buds (flowering semelauctant). Stamens 3. Flowering gregarious.

**1. *T. spathiflorus*** (Trinius) Munro subsp. ***spathiflorus***; *T. aristatus* (Gamble) E.G. Camus; *T. spathiflorus* subsp. *aristatus* (Gamble) McClintock *Arundinaria spathiflora* Trinius; *A. aristata* Gamble; Dz: *hum*; Lepcha: *pumoon*; Nep: *rato nigalo*. Figs. 4n–p; 6n.

Clumps loose. Culms to 5m, slightly crooked; internodes to 20cm, initially lightly grey-waxy, becoming red or yellow; nodes slightly raised. Branches dissimilar, angular, flattened on one side; branchlets becoming multi-noded, pendulous. Culm sheaths tough, symmetrical, densely pubescent with stiff, erect, deciduous hairs; blade distinct; auricles similar; ligule flat. Leaf sheaths glabrous; auricle small; oral setae spreading, red, scabrous; exterior ligule prominently ciliate; petiole waxy, red; blade linear-lanceolate, to 12cm. Pedicels 1–7mm. Spikelets 2–4cm; fertile lemmas 5–15mm, with 5mm, scabrous awn; palea distinctly bifid.

**Bhutan:** **C**—Thimphu, Punakha districts; **N**—Upper Mo Chu district. Common in mixed temperate forest, 2800–3500m.

var. ***bhutanensis*** Stapleton; Dz: *hum*.

Differs from subsp. *spathiflorus* as follows: clumps tighter; culms with denser wax; culm sheath apex strongly asymmetrical, with one shoulder horizontal, often with a larger, triangular auricle and an oblique ligule; leaf blades broader, more ovate.

**Bhutan:** **N**—Upper Kuru Chu district, **C**—Bumthang district. Mixed temperate forest, 2800–3500m.

## 1. BAMBUSEAE

## 9. BORINDA Stapleton

Subtropical to temperate bamboos. Rhizomes pachymorph, necks to 30cm. Culms in a single dense to loose clump (unicaespitose), erect or curving at base, nodding to drooping above; internodes to 50cm, usually striate, lightly waxy; nodes scarcely raised. Mid-culm branch buds very tall, enclosed between 2, single-keeled bracts, open at front, lateral branch axes lacking subtending sheaths. Basal culm buds closed at front by fusion of margins. First year branches usually 7 at mid-culm, from compressed basal nodes on central branch. Culm sheaths usually delicate, blades long, reflexed, deciduous. Leaf blades persistent or deciduous in winter, cross-veins strong (venation tessellate). Inflorescence ebracteate, contracted, with erect branches (paraclades); branching paniculate, never unilateral, mostly exerted from narrow subtending sheath, without fasciculation or pulvini, subtended by greatly reduced sheath remnants or hairs; glumes basally loose with space for buds, and frequently subtending buds of limited viability (flowering semelauctant). Stamens 3.

**1. B. grossa** (T.P. Yi) Stapleton; *Fargesia grossa* T.P. Yi; Dz: *rhui, baa*. Figs. 4k–m; 6m.

Clumps dense; culms to 10m, to 4.5cm in diameter, basally erect, drooping above; internodes to 50cm, prominently striate, lightly waxy; nodes densely waxy below, level, shortly pubescent. Culm sheaths triangular, to 25cm, distally with dense, deciduous, erect brown bristles, basally pilose; blade slender, to 7cm, decurrent; auricles absent or small; oral setae thick, erect, 8mm, straight, brown, glabrous, striate; ligule shortly fimbriate, pubescent. Leaf sheaths glabrous; auricles absent; oral setae 5mm, erect, wavy; ligule pubescent, truncate; blade to 25cm, persistent in winter. Pedicels to 25mm. Spikelets 2–5cm; fertile lemmas 10–15mm, with 3–5mm awn, edges pubescent; palea blunt or very shortly bifid.

**Bhutan:** C—Punakha, Tongsa, and Bumthang districts. Wet, temperate, mixed forest, often in association with *Tsuga dumosa*; also cultivated, 2600–3200m.

Note: an economically important, naturally occurring, forest product, and widely cultivated around houses near the Pele La. Culms extensively and systematically harvested for weaving into fencing lattices and roofing mats.

10. YUSHANIA Keng f.; *Butania* Keng f.; *Burmabambus* Keng f.

Temperate bamboos. Rhizomes pachymorph, necks to 3m. Culms in many separate clumps from the same plant (pluricaespitose), forming extensive thickets, basally erect, nodding to drooping above; internodes to 50cm, lightly waxy, usually

rough. Mid-culm branch buds very tall, enclosed between 2, single-keeled bracts, open at front, lateral branch axes lacking subtending sheaths. Basal culm buds closed at front and back by fusion of margins. First year mid-culm branches usually 7, from compressed basal nodes on central branch. Central branch often dominant, especially at lower nodes. Culm sheaths basally thickened, usually with reflexed blades. Cross-veins of leaf blades strong (venation tessellate). Inflorescence ebracteate open, branches (paraclades) spreading widely; branching paniculate, never unilateral, completely exerted from narrow subtending sheath, without fasciculation, pulvini frequent, subtended by hairs; glumes basally tight, without any subtended buds or space for buds (flowering semelauctant). Stamens 3. Flowering gregarious.

Note: *Yushania* species have invasive rhizomes. Larger species form dense thickets that restrict tree regeneration and are difficult to control; they provide, however, winter grazing for livestock and wildlife, and the culms are harvested for fencing and *eccra* walling.

- |  |  |
|--|--|
| 1. Rhizome neck hollow .....   | 2  |
| + Rhizome neck solid.....  | 3  |
| 2. Leaf sheath auricles small; oral setae spreading .....                  | 3. <a href="#"><u>Y. microphylla</u></a> |
| + Leaf sheath auricles absent; oral setae erect .....                      | 5. <a href="#"><u>Y. yadongensis</u></a> |
| 3. Leaf sheath auricles large, persistent; oral setae spreading widely ... | 1. <a href="#"><u>Y. hirsuta</u></a>     |
| + Leaf sheath auricles small or absent, oral setae few, erect .....        | 4  |
| 4. Base of new culm sheath glabrous, or with small, deciduous hair ring    | 2. <a href="#"><u>Y. maling</u></a>      |
| + Base of new culm sheath with prominent, persistent frill of hairs        | 4. <a href="#"><u>Y. pantlingii</u></a>  |

**1. *Y. hirsuta*** (Munro) R.B. Majumdar; *Sinarundinaria hirsuta* (Munro) Chao & Renvoize; Dz: *hima*. Figs. 4f; 6h.

Rhizome necks solid. Culms to 8m; internodes to 40cm, densely scabrous. Culm sheaths very tough, dark brown, glabrous with broad, dense basal ring of dark brown hairs; auricles large, spreading, antler-like; oral setae long, spreading, persistent. Leaf sheaths long-pilose, hairs deciduous; auricles large, sickle-shaped, spreading; oral setae long, spreading, persistent; ligule long, pubescent; exterior ligule shortly ciliate. Flowers unknown.

**Bhutan:** S—Chukka district; C—Thimphu and Tongsa districts; N—Upper Mo Chu district. Conifer and broad-leaved forest, 1800-2800m.

Note: type material from Meghalaya has denser, more persistent leaf sheath hairs, broader, less sickle-shaped auricles, and mainly pubescent culm sheaths that are glabrous at the base. Bhutanese material differs in having the culm sheath

## 1. BAMBUSEAE

pubescence closer to that of *Y. pantlingii* from Sikkim. Flowers are not known from either Meghalaya or Bhutan.

**2. *Y. maling*** (Gamble) R.B. Majumdar; *Sinarundinaria maling* (Gamble) Chao & Renvoize; Nep: *maling*; Lep: *pheung*. Figs. 4g; 6i.

Rhizome necks solid. Culms to 5m; internodes to 30cm, initially densely scabrous below nodes. Culm sheaths papery, with scattered, appressed or erect, brown hairs, and variable ring of upward-pointing hairs around base; auricles absent or small; oral setae few, erect or spreading. Leaf sheath glabrous; ligule long, rounded; auricles absent; oral setae few, tall, erect, glabrous. Spikelets long, narrow; rachilla densely pubescent with white tuft below lemmas; fertile lemmas scabrous, mucronate, with pronounced midrib; palea pubescent between scabrous or ciliate keels.

**Bhutan:** S—Chukka district; N—Upper Mo Chu district; **Sikkim** (Jongri). Mixed temperate forest, 1800–3100m.

**3. *Y. microphylla*** (Munro) R.B. Majumdar; *Sinarundinaria microphylla* (Munro) Chao & Renvoize; Dz; *mingma*; Keng: *meg*. Figs. 4h; 6j.

Rhizome necks hollow. Culms to 3m; internodes smooth, persistent, blackening, waxy ring present below nodes. Culm sheaths tough,  $\pm$  striped, with light, matted, white hairs towards base; auricles absent; oral setae scarce. Leaf sheaths pubescent at margins; ligule short, truncate; auricles pronounced; oral setae spreading, tough, scabrous; blade with one margin strongly thickened and long-scabrous, abaxial surface persistently pilose. Flowers unknown.

**Bhutan:** C—Tongsa, Bumthang and Tashigang districts. Cool-temperate areas, forming extensive stands in subalpine pastures, 2300–3500m.

**4. *Y. pantlingii*** (Gamble) R.B. Majumdar; *Semiarundinaria pantlingii* (Gamble) Nakai; *Butania pantlingii* (Gamble) Keng f.; *Sinarundinaria pantlingii* (Gamble) Chao & Renvoize; Keng: *zing*. Figs. 4i; 6k.

Rhizome necks solid. Culms to 8m; internodes finely striate and lightly scabrous. Culm sheaths quite tough, distally appressed brown-setose or basally pilose in the centre, one margin long-ciliate, with prominent basal fringe of reflexed, light brown hairs; auricles absent or small; oral setae few, erect; ligule quite tall, rounded, shortly pubescent, shortly fimbriate. Leaf sheath glabrous, tough, one margin initially long-ciliate; ligule very short; auricles absent; oral setae tall, erect, basally scabrous; exterior ligule long-ciliate on one side or short-ciliate on both sides. Spikelets long, narrow; rachilla densely pubescent, with white tuft below the glabrous fertile lemmas; palea tomentose between scabrous keels.

**Bhutan:** C—Tongsa and Tashigang districts. Common in coniferous and broad-leaved forest, 1700–2600m.

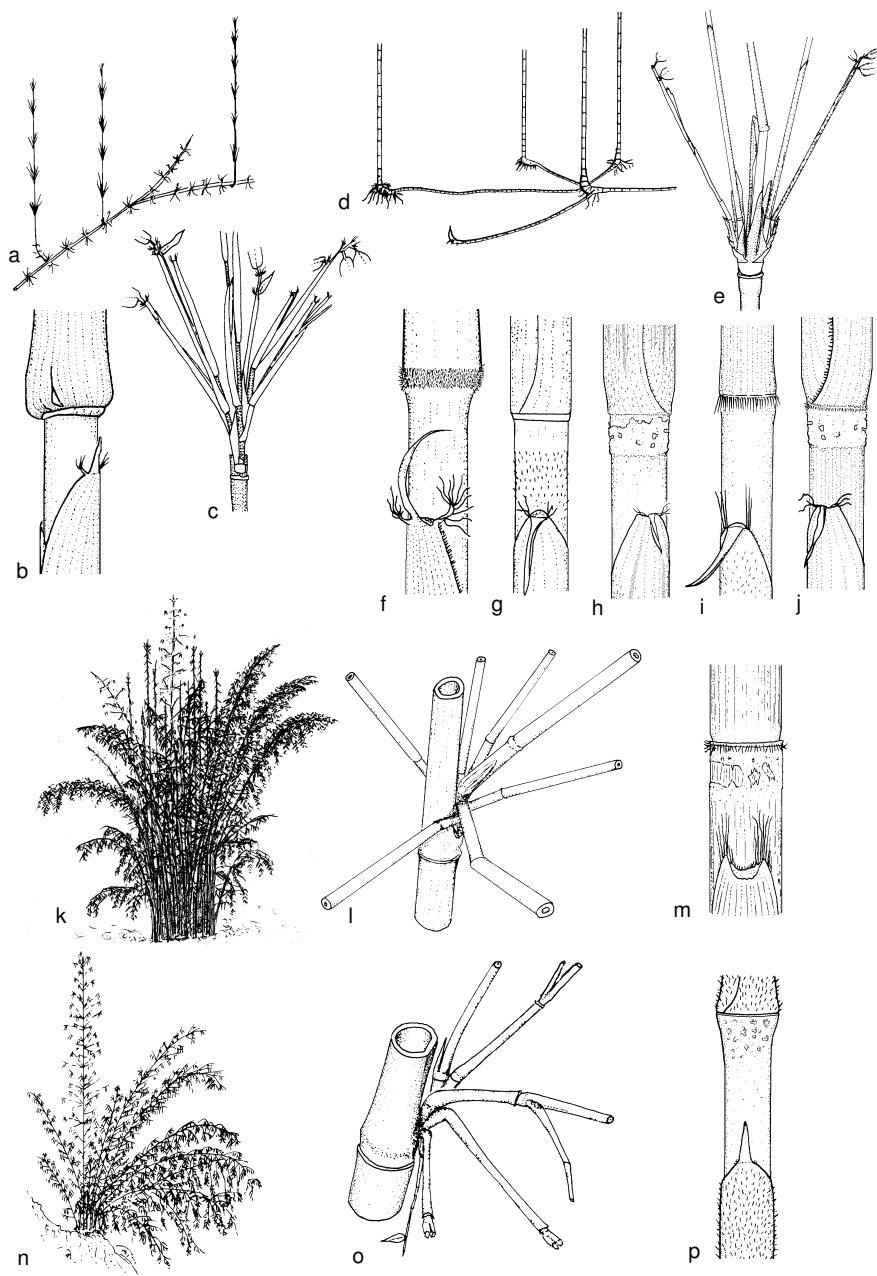


FIG. 4. a-c, *Arundinaria racemosa*. d-j, *Yushania*: f, *Y. hirsuta*; g, *Y. maling*; h, *Y. microphylla*; i, *Y. panlingii*; j, *Y. yadongensis*. k-m, *Borinda grossa*; n-p, *Thamnocalamus pathiflorus*. Drawn by Chris Stapleton, from Stapleton 1994a.

## 1. BAMBUSEAE

Note: the culms are considered very tough and used for flooring. The prominent frill of hairs below the nodes unites central and eastern collections, which are tentatively included in *Y. pantlingii* on the basis of their similar leaf sheath characteristics and the hairs on the culm sheath bases. Eastern collections, however, are quite similar to *Y. elegans* (Kurz) R.B. Majumdar from Nagaland and further collections and study are required.

**5. *Y. yadongensis*** T.P. Yi. Figs. 4j; 6l.

Rhizome necks hollow. Culms to 3m; internodes lightly scabrous, striate; persistent, blackening, waxy ring present below nodes; nodes with a light ring of hairs. Culm sheaths tough, with scarce white hairs; auricles small; oral setae few, densely scabrous. Leaf sheaths glabrous or margins pubescent; ligule rounded; auricles absent; oral setae erect, tough, scabrous; blade abaxially lightly pilose. Flowers unknown.

**Bhutan:** C—Thimphu district; N—Upper Mo Chu district; **Sikkim** (Jongri). Mixed temperate forest; along streams in blue pine forest, 2300–3700m.

Note: this was included under *Y. microphylla* in Stapleton (1994a).

**11. DREPANOSTACHYUM** Keng f.

Subtropical bamboos. Rhizomes pachymorph, necks to 25cm. Culms in a single dense clump (unicaespitose), to 5m, usually smooth, basally erect, pendulous above; internodes to 25cm; nodes raised. Mid-culm branch buds ovate, enclosed between 2, single-keeled bracts, open at front; lateral branches many, visibly 2-ranked, lacking subtending sheaths. Mid-culm branches c. 25 in first year, later to 80, subequal, from compressed basal nodes on central branch. Culm sheaths apically scabrous or pubescent on interior, distally acuminate. Cross-veins of leaf blades not visible. Inflorescence ebracteate, open, with erect or spreading, sickle-shaped branches (paraclades), strongly clustered together (fasciculated); branching paniculate, never unilateral, completely exserted from short subtending sheaths, without pulvini, subtended by hairs or reduced sheaths; glumes delicate, always 2, without subtended buds (flowering semelauctant); spikelets mainly with more than 1 floret. Stamens 3. Flowering gregarious.

Note: *Drepanostachyum* species are widely browsed by livestock and sometimes planted to provide fodder, and culms for weaving.

1. Culm sheaths with basal ring of dense, brown hairs ..... 1. ***D. annulatum***
- + Culm sheaths without basal ring of dense, brown hairs ..... 2

2. Leaf sheath ligules more than 2mm long ..... 4. [D. polystachyum](#)  
 + Leaf sheath ligules less than 2mm long ..... 3
3. Leaf sheath auricles over 2mm wide..... 2. [D. intermedium](#)  
 + Leaf sheath auricles 0–2mm wide ..... 3. [D. khasianum](#)

**1. D. annulatum** Stapleton; Dz: *him*; Nep: *ban nigalo*. Figs. 5i,n,o; 6o.

Culms to 3m; internodes to 20cm, dark green, initially with uniform, dense, deciduous wax; nodes raised, with ring of deciduous, brown hairs. Culm sheaths blotched above, glabrous or sparsely pilose, with basal ring of dense, brown hairs; interior densely pubescent below ligule; ligule long; auricles and oral setae absent. Leaf sheath glabrous; auricles and oral setae absent or scarce; ligule rounded, long; blade mainly glabrous. Fertile florets 2–3; lemma distally scabrous, margins distally shortly ciliate at first; palea and keels scabrous, apex shortly bifid or truncate.

**Bhutan:** S—Chukka district (Chhukha). Deciduous forest, 1000–2000m.

**2. D. intermedium** (Munro) Keng f.; *Chimonobambusa intermedia* (Munro) Nakai; *Sinarundinaria intermedia* (Munro) Chao & Renvoize; Nep: *tite nigalo*; Lep: *parmiok*. Figs. 5j; 6a,b,p.

Culms to 4m; internodes to 20cm, dark green, wax scarce; nodes raised. Culm sheaths glabrous; interior densely scabrous below ligule; ligule very long; auricles and oral setae absent. Leaf sheath variably pilose; auricles large; oral setae long, spreading; ligule long, rounded or truncate; blade abaxially pubescent. Spikelets with 2–3 fertile florets; lemma mainly glabrous, distally shortly ciliate at first; palea keels distally scabrous, apex shortly bifid.

**Bhutan:** S—Sarbhang district, **C**—Tongsa district; **Darjeeling** (above Sivoke, Goke); **Sikkim**. Evergreen oak and chestnut forest; also cultivated, 1000–2100m.

Note: the Sikkim material (collected by Kennedy) was initially misidentified as *D. suberectum*, which is treated here as a synonym of *D. khasianum*.

**3. D. khasianum** (Munro) Keng f.; *Chimonobambusa khasiana* (Munro) Nakai; *Drepanostachyum suberectum* (Munro) R.B. Majumdar; Dz: *daphe*; Nep: *ban nigalo*. Figs. 5k; 6q.

Culms to 3m; internodes to 20cm, dark green, wax scarce; nodes raised. Culm sheaths glabrous; interior lightly scabrous below ligule; ligule short; auricles and oral setae absent. Leaf sheath glabrous; auricles absent; oral setae absent or scarce; ligule rounded, long, densely pubescent; blade mainly glabrous. Spikelets with 1–2 fertile florets; lemma mainly glabrous, distally shortly ciliate at first; palea keels distally scabrous, apex shortly bifid.



## 1. BAMBUSEAE

**Bhutan:** C—Punakha (Tinlegang) and Tongsa districts, N—Upper Mo Chu district. Deciduous, subtropical forest and roadsides, 1000-1600m.

**4. D. polystachyum** (Gamble) R.B. Majumdar.

Rhizome, culms and culm sheaths not known. Leaf sheaths glabrous; auricles and oral setae absent; shoulders rising steeply, very shortly ciliate; ligule very long, striate, basally shortly pubescent, lacerate; blade abaxially lightly pubescent with glandular hairs; cross veins (tessellation) faint. Spikelets with 3-5 fertile florets; palea longer than lemma; lemma margins lightly pubescent; palea keels scabrous.

?**Darjeeling** (Hoom). Habitat not recorded, 1200-1500m.

Note: further work is required - the Mann syntype from Meghalaya is rather different and previous lectotypification (Chao & Renvoize, 1989) was inadequate.

## 12. HIMALAYACALAMUS Keng f.

Subtropical to temperate bamboos. Rhizomes pachymorph, necks to 25cm. Culms in a single dense clump (unicaespitose), to 12m, basally erect; internodes to 50cm; nodes slightly raised. Mid-culm branch buds ovate, enclosed between 2, single-keeled bracts, open at front, few lateral branch axes visible, lacking subtending sheaths. Mid-culm branches c. 15 in first year, later to 40, from compressed basal nodes on central branch; central branch large or dormant, sometimes with aerial roots. Culm sheaths glabrous below ligule on interior, distally usually acute or obtuse rather than acuminate. Leaf blades usually lacking cross-veins. Inflorescence ebracteate, open, with short or erect branches (paraclades) clustered together (fasciculated); branching paniculate with basal branches absent, never unilateral, completely exerted from short subtending sheaths, without pulvini, subtended by hairs or reduced sheaths; glumes delicate, always 2, without subtended buds (flowering semelauctant); spikelets mainly with 1 fertile floret. Stamens 3. Flowering gregarious.

1. Culm sheaths short, broad at the top, asymmetrical; new culms with thin white wax ..... 1. [H. falconeri](#)
- + Culm sheaths tall, narrow at the top; new culms with thick blue wax ..... 2. [H. hookerianus](#)

**1. H. falconeri** (Munro) Keng f.; *Thamnocalamus falconeri* Munro; Nep: *singhane*. Figs. 5l; 6r.

Culms to 6m; new shoots with thick glutinous exudate, drying to thin white wax; internodes to 30cm, smooth; nodes slightly raised, red above and below. Culm sheath glabrous, apex broad, asymmetrical, distally obtuse; auricles and oral setae absent;

ligule broad, short. Leaf sheath glabrous; auricles and oral setae absent; ligule rounded, short; blade glabrous. Spikelets 1, rarely 2; pedicels to 3mm; lemma glabrous, prominently mucronate, margins distally short-ciliate; palea glabrous, keels glabrous or slightly scabrous, with distal tuft of hairs.

**Bhutan:** S—Chukka district (Gedu); **Sikkim** (Laghep, Tendong, Karponang). Cool, broad-leaved forest, 2000–3100m.

Note: harvested from the forest and used for weaving, fodder and edible shoots.

**2. *H. hookerianus*** (Munro) Stapleton; *Sinarundinaria hookeriana* (Munro) Chao & Renvoize; *Chimonobambusa hookeriana* (Munro) Nakai; *Drepanostachyum hookerianum* (Munro) Keng f; Nep & Lep: *padang*, *parang*. Figs. 5m, 6s.

Culms to 8m; internodes to 40cm, smooth, uniformly blue-green to purple or yellow; nodes level. Culm sheaths glabrous, very long, distally long-acuminate; auricles and oral setae absent; ligule narrow, long. Leaf sheath glabrous; auricles and oral setae absent; ligule rounded, long; blade glabrous. Spikelets 1–(2); pedicels to 20mm; lemma pubescent, prominently mucronate, margins distally long-ciliate; palea pubescent, keels scabrous.

**Bhutan:** S—Sarbhag district (Chirang, Lamidanda). **Sikkim** (Yoksum Chungthang). Native in forest in Sikkim; cultivated in Bhutan, 1000-2000m.

Note: used for weaving and fodder.

### 13. AMPELOCALAMUS S.L. Chen, T.H. Wen & G.Y. Sheng

Subtropical bamboos. Rhizomes pachymorph with necks to 25cm long. Culms in a single dense clump (unicaespitose), to 12m, basally erect, pendulous to semi-scandent above; internodes to 50cm; nodes often with prominent corky ring. Mid-culm branch buds ovate, enclosed within a 2-keeled, fused budscale, initially closed at front; lateral branches without subtending sheaths. Mid-culm branches c. 25 in first year, from compressed basal nodes on central branch, subequal, strongly geniculate, aerial roots present or absent. Culm sheaths distally acuminate with broad apex, margins often prominently ciliate or fimbriate. Leaf blades lacking cross-veins. Inflorescence partially bracteate, open, with pendulous branches (paraclades) clustered together (fasciculated), completely exserted from short subtending sheaths; branching racemose to panicle, never unilateral, without pulvini, subtended by hairs, or reduced, but often substantial, sheaths. Spikelets large; pedicels thin, wiry, scabrous or pubescent; glumes 1-2, delicate, the lower lacking in terminal spikelet, the upper often subtending a rudimentary axis (flowering semelauctant). Stamens 3. Flowering gregarious.

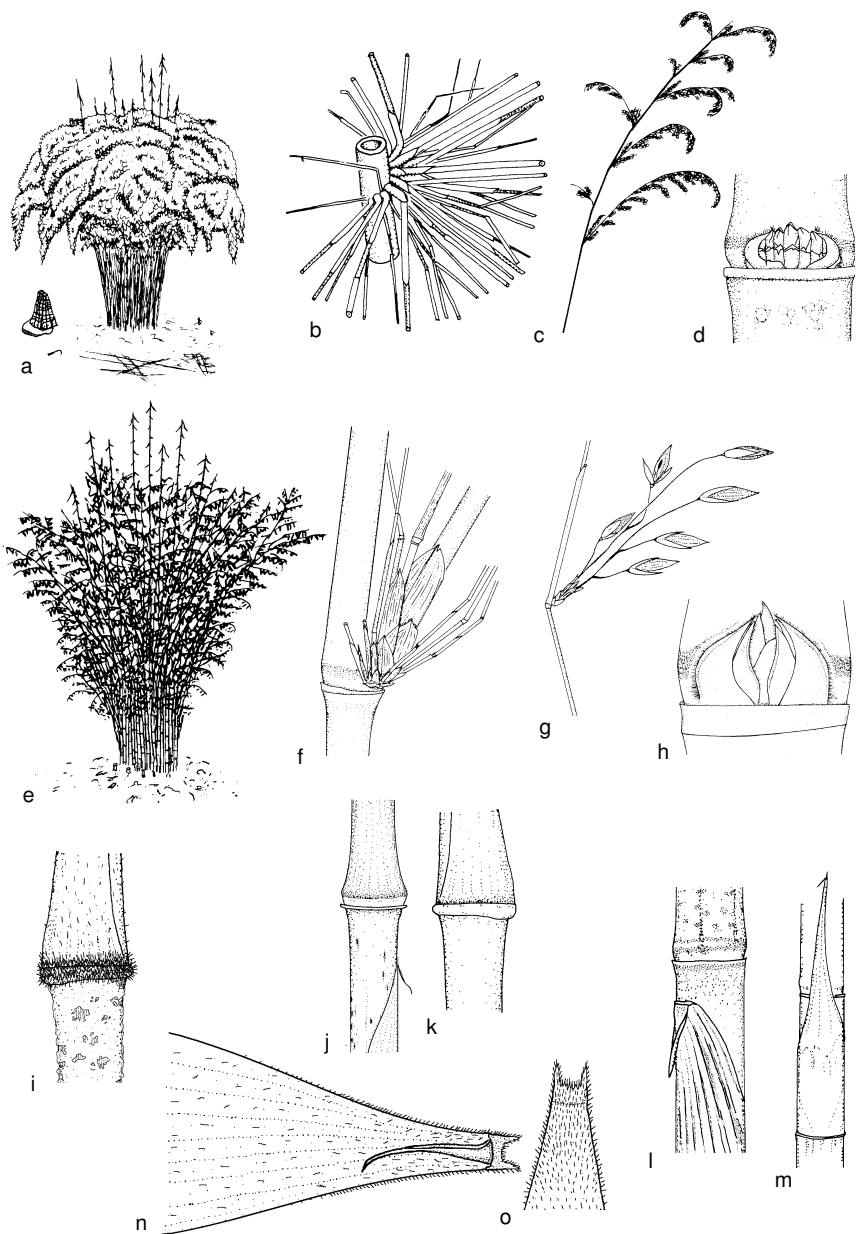


FIG. 5. a-d, *Drepanostachyum*; e-h, *Himalayacalamus*: a,e, clump habit; b,f, mid-culm branching; c,g, synflorescences; d,h, mid-culm buds. i-m, culm nodes with sheaths: i, *Drepanostachyum annulatum*; j, *D. intermedium*; k, *D. khasianum*; l, *Himalayacalamus falconeri*; m, *H. hookerianus*. n,o, *Drepanostachyum annulatum* n, culm sheath apex exterior; o, culm sheath apex interior. Drawn by Chris Stapleton, from Stapleton 1994a.

**1. A. patellaris** (Gamble) Stapleton; *Dendrocalamus patellaris* Gamble; *Patellocalamus patellaris* (Gamble) W.T. Lin; *Sinocalamus patellaris* (Gamble) T. Q. Nguyen; *Chimonobambusa jainiana* C.R. Das & D.C. Pal; *Drepanostachyum jainianum* (C.R. Das & D.C. Pal) R.B. Majumdar; *Sinarundinaria jainiana* (C.R. Das & D.C. Pal) H.B. Naithani; Nep: *nibha*, *ghopi bans*; Lep: *pajiok*. Figs. 7a–c; g–h.

Culms to 12m, to 5cm in diameter, strongly pendulous or semi-scandent above; internodes to 50cm, strongly striate, sparsely black-setose; nodes with prominent, wavy, corky collar. Culm sheath with long-feathered margins; blade broad, reflexed. Leaf sheath glabrous; shoulders rising, with long, erect oral setae; auricles absent; ligule short, fimbriate. Spikelets 2-3cm; florets 4-7; pedicels to 35mm; glumes pale; lemmas darker, deeply furrowed, lightly scabrous, margins long-pubescent; palea nearly glabrous, keels scabrous; apex blunt, shortly ciliate.

**Sikkim** (Jungat); **Darjeeling** (Kalimpong). Cultivated, 1220m.

Note: cultivated for weaving and fodder.

#### 14. NEOMICROCALAMUS Keng f.

Rhizomes pachymorph, necks long. Culms in many separate dense clumps from the same plant (pluricaespitose), to 12m, solid or hollow, narrow, semi-scandent; internodes to 50cm, smooth or scabrous; nodes level. Mid-culm buds tall, enclosed within a 2-keeled prophyll, open at front; lateral branches subtended by sheaths. First year branches c. 15 at mid-culm, from compressed basal nodes on large, dominant, scandent central branch, strongly geniculate. Culm sheaths tough, smooth or scabrous, apex narrow; blade needle-shaped. Leaf sheaths glabrous; auricles and oral setae absent; blade thin, acuminate, lacking cross-veins; foliage forming dense curtains over tree branches. Inflorescence bracteate, open, with paniculate branching; branches (paraclades) subtended by sheaths, with prophylls at the point of branching; spikelets sessile; florets broad, not overlapping; glumes 1-2, glumes and prophylls lacking subtended buds (flowering semelauctant); rhachilla long, sinuate. Stamens 6.

**1. N. andropogonifolius** (Griff.) Stapleton; *Bambusa andropogonifolia* Griff.; Sha: *ringshu*; Keng: *ula*; Nep: *langma*. Figs. 7d–f, i, j; 8a–b.

Rhizome necks to ?1m long, clumps pluricaespitose, dense. Culms to 12m, very smooth, narrow, hollow, semi-scandent; internodes to 50cm, glossy green; nodes level. Culm sheaths tough, smooth, glabrous, blotched, apex narrow, blade needle-shaped. Leaf sheaths glabrous; auricles and oral setae absent; blade thin, broad, long-acuminate, glabrous; ligule triangular, glabrous. Inflorescence not known.

**Bhutan:** S—Manas and Deothang districts. Subtropical forest, 300–1800m.

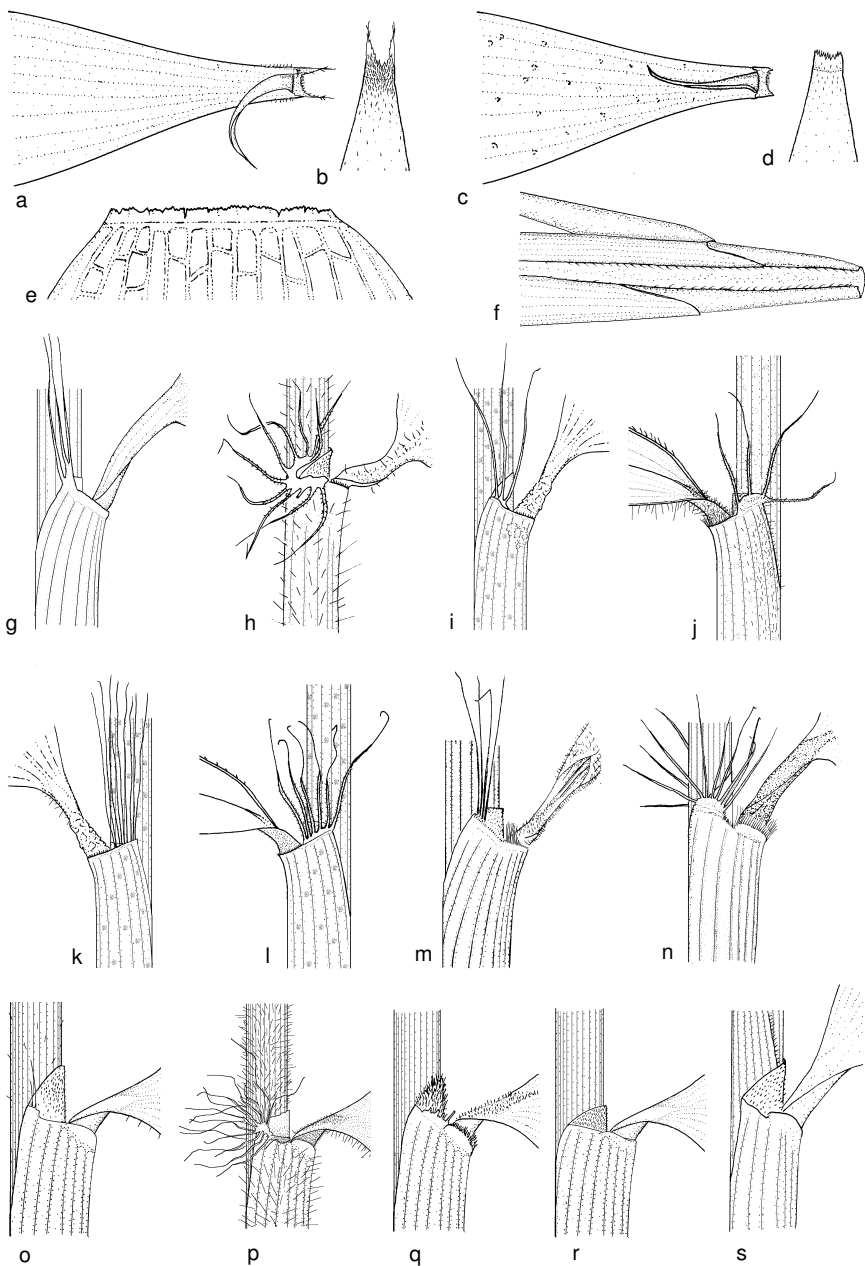


FIG. 6. a–f, culm sheath apices: a,b, *Drepanostachyum intermedium*; c,d, *D. khasianum*; e, *Himalayacalamus falconeri* (interior); f, *H. hookerianus*. g–s, leaf sheaths: g, *Arundinaria racemosa*; h, *Yushania hirsuta*; i, *Y. maling*; j, *Y. microphylla*; k, *Y. pantlingii*; l, *Y. yadongensis*; m, *Borinda grossa*; n, *Thamnocalamus spathiflorus*; o, *Drepanostachyum annulatum*; p, *D. intermedium*; q, *D. khasianum*; r, *Himalayacalamus falconeri*; s, *H. hookerianus*. Drawn by Chris Stapleton, from Stapleton 1994a.

Note: harvested from natural forest. Culm strips are dyed and woven into hats, arrow quivers and ornamental food containers (Dz: *bangchung*).

### 15. CHIMONOBAMBUSA Makino

Rhizomes leptomorph; culms arising singly. Culms to 8m, erect; nodes swollen, often with ring of thorns; internodes smooth or scabrous, ridged above branches, often slightly quadrangular. Mid-culm branch buds ovate, enclosed between 2, single-keeled bracts, open at front; lateral branches 2, from compressed basal nodes on dominant central branch, with subtending sheaths. Branches usually 3. Leaf blades with strong cross-veins (venation tessellated). Inflorescence bracteate, mainly exerted from broad, persistent sheaths, often bladed; branches (paraclades) erect, dense, clustered together (fasciculated), subtended by sheaths; branching racemose to paniculate, never unilateral, pulvini absent; branching always prophyllate, prophyll of lateral spikelets a lower glume; terminal spikelet with 1–2 glumes; prophyll and glumes without buds with buds that may develop (flowering iterant) or may not develop (flowering semelant). Spikelets narrow, cylindric. Florets just overlapping; rachilla long. Stamens 3. Flowering gregarious.

**1. C. callosa** (Munro) Nakai; Dz: *u*; Keng: *rawa*; Nep: *khare bans*. Fig. 8c–i.

Culms to 6m; nodes pubescent, with ring of thorns; internodes smooth, mottled brown, terete. Culm sheaths lightly pubescent; blades small, erect; auricles absent; oral setae few, erect. Leaf sheaths glabrous with ciliate edges; auricles small, spreading laterally; oral setae long and erect. Inflorescence axes pubescent. Terminal spikelet rudimentary. Lateral spikelets long; glumes with small vestigial buds; florets fewer than 10; rachilla glabrous; lemma glabrous; palea keels ciliate.

**Bhutan:** **S**—Phuntsholing and Chukka districts, **C**—Tongsa (Shemgang) and Tashigang districts. 1400–2000m.

Note: Gamble (1896) reported that Pantling had found a thorny bamboo in Sikkim (Paong gong) in 1895. This collection was cited by Chao & Revoize (1989) under *Sinarundinaria griffithiana* (Munro) Chao & Renvoize (*Chimonocalamus griffithianus* (Munro) Hsueh & Yi); however it shows no thorns whatsoever, and seems to represent an as yet unidentified species of *Yushania*, rather than either *Chimonobambusa callosa* or *Chimonocalamus griffithianus*. There is no evidence that the thorny, clump-forming genus *Chimonocalamus* is found in the Himalaya.

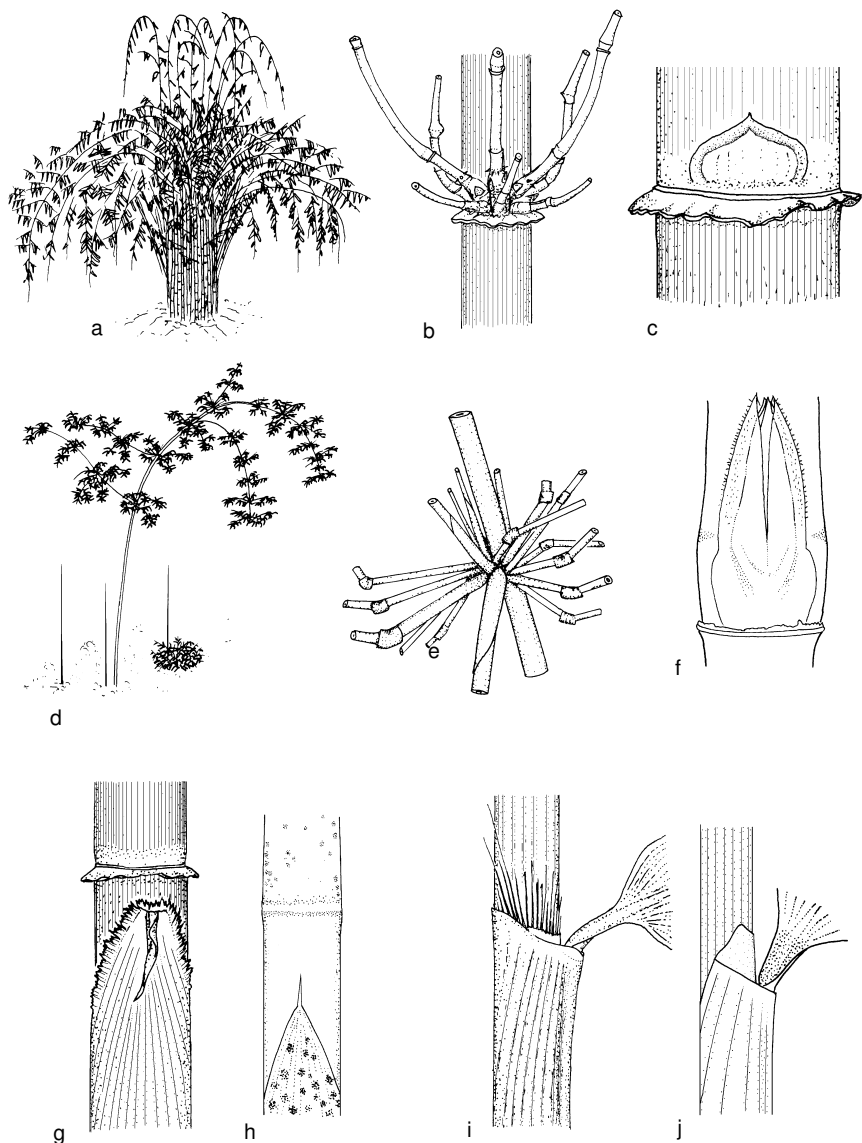


FIG. 7. a–c, *Ampelocalamus patellaris*: a, clump form; b, mid-culm branching; c, mid-culm buds. d–f, *Neomicrocalamus andropogonifolius*: d, clump form; e, mid-culm branching; f, mid-culm buds. g–h, culm nodes and sheath apex: g, *Ampelocalamus patellaris*; h, *Neomicrocalamus andropogonifolius*. i–j, leaf sheaths: i, *Ampelocalamus patellaris*; j, *Neomicrocalamus andropogonifolius*. Drawn by Chris Stapleton, from Stapleton 1994a.

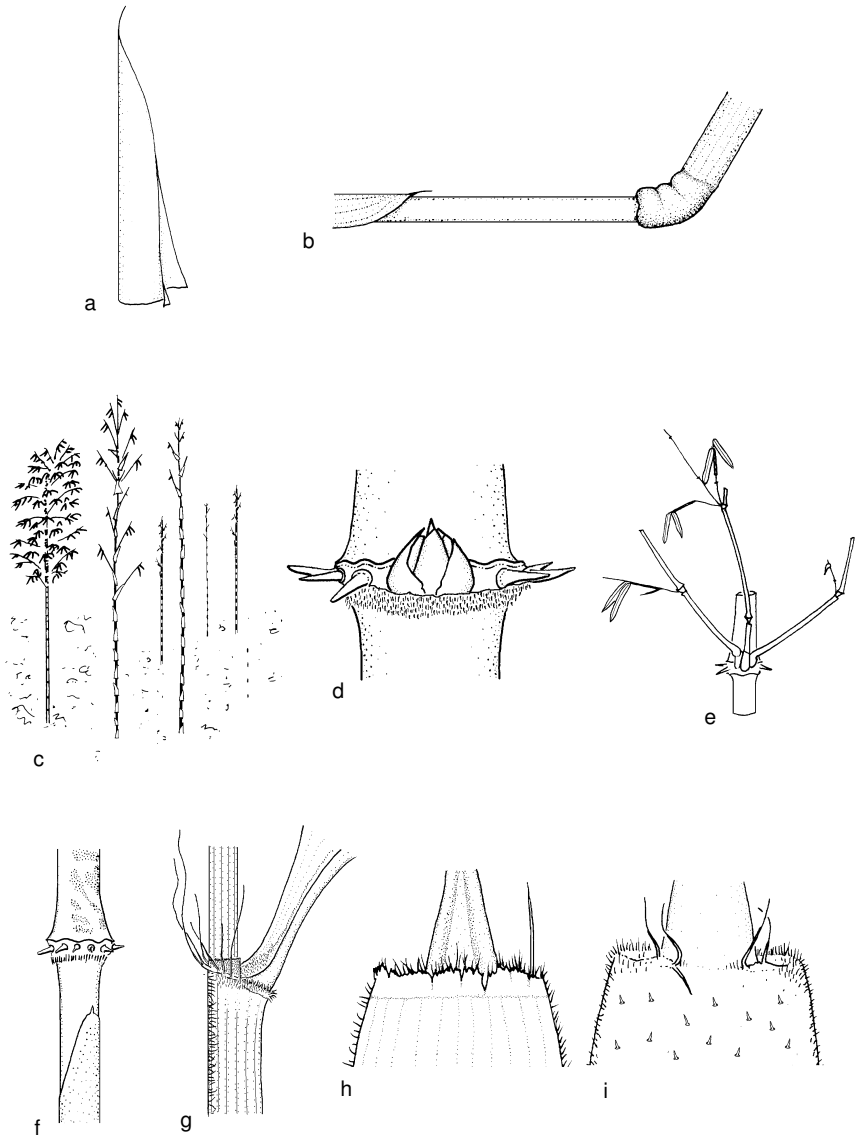


Fig. 8. a–b, *Neomicrocalamus andropogonifolius*: a, culm sheath; b, swollen nodes on branchlets. c–i, *Chimonobambusa callosa*: c, clump form; d, mid-culm buds; e, mid-culm branching; f, culm node and sheath apex; g, leaf sheath; h,i, culm sheath apex, interior & exterior. Drawn by Chris Stapleton, from Stapleton 1994a.