A revision of the species described under *Arundinaria (Gramineae)* in Southeast Asia and Africa

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Summary. 42 species originally described under *Arundinaria* by Munro, Gamble, A. Camus and others in Asia and Africa have been revised by the authors. Only two species are considered to be true *Arundinaria*, the rest have been, or are here, transferred into seven other genera *(Sinarundinaria, Thamnocalamus, Racemobambos, Chimonobambusa, Indosasa, Sinobambusa* and *Acidosasa)*. A key to the related genera, based on the flowering and vegetative state is given separately, and the differences between *Arundinaria* and related genera are discussed in detail.

The genus *Arundinaria* was published by Michaux in 1803 and is the earliest name in the group of bamboos characterised by monopodial rhizomes. The type species, *Arundinaria gigantea* (Walt.) Muhl. (*Arundinaria macrosperma* Michaux), is native to the United States of America. Since 1803, many bamboo species have been placed in this genus. The binomials under the name *Arundinaria* now total about 380; they include American, Asian and African species, but represent a taxonomically heterogeneous group of bamboos.

With the increasing interest in bamboo systematics, this genus, which was the biggest in the *Bambusoideae* at one time, has been interpreted by different authors in various ways. Some Japanese and Chinese botanists have recognized that certain species in Asia, originally included *Arundinaria*, differed in various ways, and they therefore published new genera to accommodate these divergent species, e.g. *Sinobambusa* Makino ex Nakai, *Chimonobambusa* Makino, *Indocalamus* Nakai, *Pleioblastus* Nakai, *Sinarundinaria* Nakai, *Oreocalamus* Keng, *Chimonocalamus* Hsueh & Yi, *Yushania* Keng f., *Drepanostachyum* Keng f., *Himalayacalamus* Keng f., *Oligostachyum* Wang & Ye, *Bashania* Keng f. & Yi. In some cases these segregates from *Arundinaria* are justified, i.e. *Sinobambusa, Chimonobambusa, Indocalamus* and *Sinarundinaria*; but in others they lead to more confusion and have subsequently been reduced to synonymy, i.e. *Pleioblastus, Oligostachyum* and *Bashania* = *Arundinaria; Oreocalamus* = *Chimonobambusa; Chimonocalamus, Yushania* and *Drepanostachyum* = *Sinarundinaria* and *Himalayacalamus* = *Thamnocalamus*.

The famous bamboo specialist F. A. McClure did remarkable research on bamboo classification, much of which was published in his book 'Genera of bamboos, Native to the New World' (1973). He dealt exhaustively with the type species of the genus *Arundinaria* and indicated what he regarded as the essential characters of the genus, from which he excluded many American species formerly included in it. He transferred these excluded species to other genera or to new genera, comprehensively revising the American species

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originally described under *Arundinaria*. Unfortunately he did not extend this revision to the Asian and African species included in *Arundinaria*, although he knew them well. He only mentioned some genera named by Japanese and Chinese botanists and did not indicate where the Asiatic species belonged and what Asiatic bamboos were true *Arundinaria* species.

The bamboo species in South Asia and Africa had been taxonomically studied by Munro (1866), Gamble (1896) and A. Camus (in several publications), whose work received much acclaim in their time. There were 29 species of *Arundinaria* in the world in Munro's monograph, 28 species in the Himalayan region in Gamble's monograph and 14 species collected from Indo-China and Madagascar named by A. Camus and P. Balansa. In the course of our study, we have examined most of the type specimens of these species and have come to the conclusion that only two species are true *Arundinaria*, and that the rest should be transferred to seven other genera.

All material cited has been seen and is at K, unless otherwise stated.

KEY TO ARUNDINARIA AND RELATED GENERA

(based on the inflorescence and flower)

1. Inflorescence determinate (semelauctant), composed of panicles or racemes, sometimes reduced to single spikelet; spikelet pedicelled; basal bract absent or very small; glumes usually 2:
   2. Stamens 6 ..... **1. Acidosasa**
   2. Stamens 3:
      3. Inflorescence exserted, an open panicle or raceme, supported by small narrow sheaths:
         4. Rhizome monopodial ..... **2. Arundinaria**
         4. Rhizome sympodial with short or long necks ..... **3. Sinarundinaria**
      3. Inflorescence shortened, enclosed by large spathulate sheaths; rhizome sympodial ..... **4. Thamnocalamus**
1. Inflorescence indeterminate (iterauctant); spikelet sessile with a subtending bract at the base; glumes usually more than 2:
   5. Stamens 6:
      6. Spikelets racemose; culms climbing from a sympodial rhizome, branch complement many ..... **5. Racemobambos**
      6. Spikelets congested; culms erect from a monopodial rhizome, branch complement usually 3 ..... **6. Indosasa**
   5. Stamens 3:
      7. Stigmas 2; culms usually with thorns at the nodes ..... **7. Chimonobambusa**
      7. Stigmas usually 3; culms without thorns at the nodes ..... **8. Sinobambusa**

(based principally on the vegetative state)

1. Rhizome sympodial, with short or long necks lacking buds and roots:
   2. Culms erect, branch complement without a conspicuous dominant branch:

3. Inflorescence exserted, an open panicle or raceme, supported by small narrow sheaths ..... **3. Sinarundinaria**
3. Inflorescence shortened, enclosed by large spathulate sheaths .... **4. Thamnocalamus**

2. Culms climbing or scrambling, branch complement usually with 1 dominant branch ..... **5. Racemobambos**

1. Rhizome monopodial, with buds and roots at the nodes:
4. Culm nodes usually with thorns; sheaths persistent, the blades very small, inconspicuous ..... **7. Chimonobambusa**
4. Culm nodes without thorns; sheaths persistent or deciduous, the blades conspicuous:
5. Internodes terete without grooves or only slightly grooved just above the branch complement:
6. Culm sheaths deciduous; stamens 6 ..... **1. Acidosasa**
6. Culm sheaths persistent or late falling; stamens 3 .... **2. Arundinaria**
5. Internodes conspicuously grooved on one side of branch complement; culm sheaths deciduous:
7. Culm nodes usually swollen, geniculate; stamens 6 .... **6. Indosasa**
7. Culm nodes a little prominent, not geniculate; stamens 3 .... **8. Sinobambusa**

1. **Acidosasa** *Chu & Chao*

in Nanj. Tech. Coll. For. Prod. 1–2: 142 (1979) & in Bamb. Res. 1: 31 (1981).

This genus differs from *Arundinaria* in the structure of the floret. In *Acidosasa*, each floret has 6 stamens while in *Arundinaria* the floret has 3 stamens. The genus *Acidosasa* is similar to the genus *Sasa* in the inflorescence type and the structure of the spikelet and the floret, but from *Sasa* it is distinguished by its taller stature and branch complement with 3 branches.

Six species, mostly native to South China, one species in Indo-China.

Acidosasa brilletii *(A. Camus) Chao & Renv.* comb. nov.

Arundinaria brilletii A. Camus in Bull. Soc. Bot. France 74: 620 (1927). Type: Viet-Nam, Tonkin, Yen-lap, reserve 90, *Brillet* (holotype P).

This species is very similar to *Acidosasa chinensis*, the type species of this genus, in its inflorescence appearance and large spikelets. It is distinguished from *A. chinensis* by its mucronate lemmas and its small narrow leaves.

2. **Arundinaria** *Michaux*

Fl. Bor. Am. 1: 73 (1803); McCl. in Smiths. Contr. Bot. 9: 21 (1973).

Pleioblastus Nakai in Journ. Arn. Arb. 6: 145 (1925).
Nipponocalamus Nakai in Journ. Jap. Bot. 18: 350 (1942).
Oligostachyum Wang & Ye in Nanj. Univ. Journ. Nat. Sci. 1982: 95 (1982).
Bashania Keng f. & Yi in Journ. Bamb. Res. 1(2): 37 (1982).
Omeiocalamus Keng f. op. cit. 2(1): 20 (1983).
Clavinodum Wen in Journ. Bamb. Res. 3(1): 23 (1984).

The essential characters of this genus are: rhizome monopodial; culms usually terete with (1–)3–7 branches at each node; inflorescence determinate, usually a raceme, sometimes a panicle or reduced to a single spikelet; spikelet with a pedicel and 2 glumes; stamens 3 in each flower; stigmas (2–)3.

About 50 species, chiefly in Asia, especially in China and Japan, 1 species in North America, 2 species in South Asia.

1. Arundinaria racemosa *Munro* in Trans. Linn. Soc. 26: 17 (1866) excl. the *Hooker* specimen; Gamble in Ann. Roy. Bot. Gard. Calc. 7: 9, pl. 8 (1896) & in Fl. Brit. Ind. 7: 379 (1897). Type: NE Himalaya [E Nepal, Sikkim and Darjeeling] Birch Hill, 6000 ft [1800 m], Aug. 1857, *Thomson* (lectotype K, chosen here).

Fargesia racemosa (Munro) Yi in Journ. Bamb. Res. 2(1): 39 (1983).

INDIA. Sikkim, 11000 ft [3300 m], 1857, *Thomson*; 10000 ft [3000 m], June 1887, *King's collector*, 10000 ft [3000 m], May 1890, *King's collector*; 12000 ft [3600 m], July 1897, *Phul Sing*; 11500 ft [3450 m], May 1892, *Gammie*. West Bengal, Darjeeling Distr. 10000 ft [3000 m], March 1889, *Gammie*.

BHUTAN. Thimphu, Bari Song [Barshong], 3700 m, *Bedi* 1134.

King's collector's specimens clearly show a monopodial rhizome. This is therefore a true species of *Arundinaria*.

2. Arundinaria baviensis *Balansa* in Journ. de Bot. 4: 27 (1890). Type: Viet-Nam, Tonkin, Mont-Bavi, 1300 m, *Balansa* 1585 (isotype K).

This species is easily distinguished from the Indian species, *Arundinaria racemosa*, by its densely pubescent peduncles and pedicels, its blunt lemmas, and its swollen culm nodes with usually 3 branches.

3. Sinarundinaria *Nakai*
in Journ. Jap. Bot. 11: 1 (1935); Chao *et al.* in Acta Phytotax. Sin. 18(1): 20 (1980).

Yushania Keng f. in Acta Phytotax. Sin. 6: 355 (1957).
Chimonocalamus Hsueh & Yi in Acta Bot. Yunnan. 1: 75 (1979).
Otatea (McCl. & Smith) Cald. & Soderstrom in Smiths. Contr. Bot. 44: 21 (1980).
Burmabambus Keng f. in Journ. Bamb. Res. 1(2): 39 (1982).
Butania Keng f. op. cit.: 41 (1982).
Drepanostachyum Keng f. op. cit. 2(1): 15 (1983).

The genus *Sinarundinaria* is similar to *Arundinaria* in the inflorescence type, which is determinate (semelauctant) and the structure of the spikelet and floret, but quite different from it in the midculm prophyllum and branch primordium, which is triple as opposed to single and in the rhizome type, which is sympodial with a short neck producing a clump habit or with a long neck resulting in scattered culms. In the vegetative state *Sinarundinaria* resembles *Thamnocalamus*, from which it is distinguished by the exserted panicle or raceme without spathulate sheaths; in *Thamnocalamus* the raceme is shortened and has large spathulate sheaths.

Hsueh & Yi published a new genus, *Chimonocalamus*, in 1979, which is like *Sinarundinaria* in the inflorescence type, the structure of the spikelet and floret and rhizome type; it differs only in the culm nodes, which have root thorns. We propose that *Chimonocalamus* is best regarded as a section of *Sinarundinaria*.

In addition, Munro (1866) divided the genus *Arundinaria* into two sections designated I & II, but he did not name them. Gamble (1896) adopted Munro's sections in his monograph but did not name them either. Keng decided to recognize Munro's section II at generic level and gave it the name *Drepanostachyum*. The characters of this group were: inflorescence congested at the nodes of leafless culms or branches and the leaves borne on separate culms. After examining a large number of specimens, it seems that the above-mentioned characters are variable and do not justify recognition of a separate genus or section.

The New World representatives of *Sinarundinaria* were formerly distinguished as the genus *Otatea*. However, although *Otatea* is remarkable for its shortly awned lemmas and obtuse paleas, we are of the opinion that these features are insufficient to justify generic segregation.

Sinarundinaria, occurring in Asia, America, Africa and Madagascar, are very important bamboos in the mountains, especially at high altitudes. In the Himalayan region the species are usually the dominant plants under the coniferous or broad-leaved forests of high mountains, forming their own extensive understorey bamboo forests.

A genus of approximately 50 species, 2 in Central America, 3 in Africa and Madagascar, the rest in Asia.

Sect. I Chimonocalamus *(Hsueh & Yi) Chao & Renv.* stat. nov.

Chimonocalamus Hsueh & Yi in Acta Bot. Yunnan. 1: 75 (1979). Type: *C. delicata* Hsueh & Yi.

Culm nodes with root thorns.

1. Sinarundinaria griffithiana *(Munro) Chao & Renv.* comb. nov.

Arundinaria griffithiana Munro in Trans. Linn. Soc. 26: 20 (1866); Gamble in Ann. Roy. Bot. Gard. Calc. 7: 10, pl. 9 (1896) & in Fl. Brit. Ind. 7: 379 (1897). Type: India, Khasi and Jaintia Hills of Assam, 1835, *Griffith* (holotype K).

Chimonobambusa griffithiana (Munro) Nakai in Journ. Arn. Arb. 6: 151 (1925).

Chimonocalamus griffithiana (Munro) Hsueh & Yi in Acta Bot. Yunnan, 1: 83 (1979).

INDIA. West Bengal, Darjeeling Distr. 10000 ft [3000 m], *Pantling* s.n. Meghalaya, *Soderstrom* 2601; Jaintia Hills, 3500 ft [1050 m], *Mann* s.n.; Khasia Hills, 3000 ft [900 m], *Mann* s.n.

BURMA. Thaton Distr., 4000–5000 ft [1200–1500 m], *Lace* 4613.

This species is very distinctive; it is easily recognized by its culm and branch nodes bearing a circle of spines and around the sheath scars a ring of yellow hairs; the culm-sheaths are covered with densely bulbous-based hairs and are furnished with auricles at the apex.

Soderstrom 2601 records the rhizome of this species as sympodial.

2. Sinarundinaria gallatlyi *(Gamble) Chao & Renv.* comb. nov.

Arundinaria gallatlyi Gamble in Ann. Roy. Bot. Gard. Calc. 7: 23, pl. 21 (1896) & in Fl. Brit. Ind. 7: 384 (1897). Type: Burma, Tenasserim, Moolyet Hill, 6000 ft [2000 m], *Gallatly* 276 (holotype K).
Chimonobambusa gallatlyi (Gamble) Rhind, Grass. Burma 2: 10 (1945).
Chimonocalamus gallatlyi (Gamble) Hsueh & Yi in Journ. Bamb. Res. 2(1): 38 (1983).

BURMA. Amherst Dist., 5500 ft [1650 m], *Parkinson* 5126.

This thorny Burmese species is distinguished from *S. griffithiana* by the glabrous culm nodes, the glabrous culm-sheaths without auricles, and by its larger leaf-blades.

Sect. II Sinarundinaria

Culm nodes without root thorns.

3. Sinarundinaria microphylla *(Munro) Chao & Renv.* comb. nov.

Arundinaria microphylla Munro in Trans. Linn. Soc. 26: 32 (1866); Gamble in Ann. Roy. Bot. Gard. Calc. 7: 22 (1896) & in Fl. Brit. Ind. 7: 383 (1897). Type: Bhutan, Sana, Tashigang Distr., 7000 ft [2100 m], *Griffith* 623 (holotype K).

BHUTAN. Tongsa Distr., 7500–11000 ft [2350–3300 m], *Gould* 704.

This small alpine bamboo is easily distinguished by its very small leaves which have 2 secondary nerves, and by its leaf-sheaths which bear auricles and oral setae at the apex.

4. Sinarundinaria densifolia (*Munro*) *Chao & Renv.* comb. nov.

Arundinaria densifolia Munro in Trans. Linn. Soc. 26: 32 (1866); Gamble in Ann. Roy. Bot. Gard. Calc. 7: 8, pl. 7 (1896) & in Fl. Brit. Ind. 7: 379 (1897). Type: Sri Lanka, *Watson* 25 (lectotype chosen by Soderstrom & Ellis 1988).
Chimonobambusa densifolia (Munro) Nakai in Journ. Arn. Arb. 6: 151 (1925).

INDIA. Kerala, 8500 ft [2550 m], 1873, *Beddome*.
SRI LANKA. 7299 ft [2190 m], 1890, *Trimen*; 1892, *Gamble*; 6500 ft [1950 m], 1899, *Gamble*; *Soderstrom* 2556; *Soderstrom & Kulatunge* 1656; *Schmer & Sumithraarachchi* 10051; 2300 m, *Gould & Cooray* 13780; 2175 m, *Comanor* 451; 2300 m, *Clayton* 5486.

This species is close to *Sinarundinaria microphylla*, but is easily distinguished from that species by its leaf-sheaths without auricles and oral setae; the secondary nerves on the leaf-blades are absent.

5. Sinarundinaria walkeriana (*Munro*) *Chao & Renv.* comb. nov.

Arundinaria walkeriana Munro in Trans. Linn. Soc. 26: 21 (1866); Gamble in Ann. Roy. Bot. Gard. Calc. 7: 3, pl. 1 (1896) & in Fl. Brit. Ind. 7: 377 (1897). Type: Sri Lanka, *Walker* 96 (lectotype K, chosen by Soderstrom & Ellis (1988)).
Indocalamus walkerianus (Munro) Nakai in Journ. Arn. Arb. 6: 149 (1925).

SRI LANKA 6000 ft [2000 m], *Thwaites* 429; 5000 ft [1500 m], 1888, *Trimen*; 2330 m, *Soderstrom & Kulatunge* 1772; 7000–8281 ft [2100–2480 m], *Meijer* 1939.

INDIA. Travancore, 8800 ft [2640 m], *Barnes* 1591, 1592, 1593.

This species is characterized by the large panicle and thick leaf-blades with rounded or truncate bases and pungent tips.

6. Sinarundinaria hirsuta (*Munro*) *Chao & Renv.* comb. nov.

Arundinaria hirsuta Munro in Trans. Linn. Soc. 26: 30 (1866); Gamble in Ann. Roy. Bot. Gard. Calc. 7: 22, pl. 20 (1896) & in Fl. Brit. Ind. 7: 384 (1897). Type: India, Khasi Hills, among rocks, 5600 ft [1680 m], Nov. 1835, *Griffith* 6726 (lectotype K, chosen here).

INDIA. Meghalaya, Kasi Hills, 5725 ft [1710 m], *Hooker & Thomson*; 5600 ft [1680 m], *Clarke* 38980; 5500 ft [1650 m], *Clarke* 44651; 5000 ft [1500 m], *Mann* 22661. Manipur, 8900 ft [2670 m], *Meebold* 6470.

It is easy to recognize this species by the conspicuous auricles and oral setae of the culm- and leaf-sheaths; the culm-sheaths and young culms also have retrorse hairs.

7. Sinarundinaria rolloana (*Gamble*) *Chao & Renv.* comb. nov.

Arundinaria rolloana Gamble in Ann. Roy. Bot. Gard. Calc. 7: 24, pl. 23 (1896) & in Fl. Brit. Ind. 7: 384 (1897). Type: India, Assam, Naga Hills, Zullah Valley, 5500 ft [1650 m], 1889, *Rollo* (holotype K) loc. name 'Jipvo'.
Yushania rolloana (Gamble) Yi in Journ. Bamb. Res. 2(1): 39 (1983).

INDIA. Nagaland, Naga Hills, 5000 ft [1500 m], 1889, *Banerjee*.

This species is similar to *Sinarundinaria hirsuta*, but it is not difficult to recognize for it has very short oral setae on the leaf-sheaths, only 2–5 mm long, and culm-sheaths with antrorse hairs and internodes glabrous when young; *Sinarundinaria hirsuta* has quite long oral setae on the leaf-sheaths, 5–8 mm long and culm-sheaths and young culms with densely retrorse hairs.

8. Sinarundinaria debilis (*Thwaites*) *Chao & Renv.* comb. nov.

Arundinaria debilis Thwaites, Enum. Plant. Zeyl.: 375 (1864); Munro in Trans. Linn. Soc. 26: 24 (1866); Gamble in Ann. Roy. Bot. Gard. Calc. 7: 7, pl. 6 (1896) & in Fl. Brit. Ind. 7: 378 (1897). Type: Sri Lanka, Central Prov. 6000–8000 ft [1800–2400 m], *Thwaites* C.P.I. (lectotype PDA, chosen by Soderstrom & Ellis 1988).
Indocalamus debilis (Thwaites) Alston, Suppl. Fl. Ceylon 6: 342 (1931).

SRI LANKA. Central Prov., *Maxwell* s.n.; Nuwara Eliya, 6500 ft [1950 m], 1899, *Gamble*; 1830 m, *Soderstrom* 2550, 2557 & 2553; Northern slopes of Pidurutalagala mountain, *Schmer & Sumithraarachchi* 10163; 2000 m, *Gould* 13518; 1890 m, *Soderstrom & Kulatunge* 1606, 1612; 2200 m, *Jayasurija* 2385, 2388; 7000–8281 ft [2100–2490 m], *Meijer* 1959; Kandy Dist., Rangala Hill, 2000 m, *Soderstrom & Kulatunge* 1771.

This is a very common bamboo species at 1800–2500 m in the Central Province of Sri Lanka. It is characterized by the small leaf-blades with

inconspicuously transverse veinlets usually having sparse bristles on the upper surface, culms which are scabrous when young and short inflorescences and spikelets.

9. Sinarundinaria floribunda (*Thwaites*) *Chao & Renv.* comb. nov.

Arundinaria floribunda Thwaites Enum. Plant. Zeyl.: 375 (1864); Munro in Trans. Linn. Soc. 26: 20 (1866); Gamble in Ann. Roy. Bot. Gard. Calc. 7: 5, pl. 3 (1896) & in Fl. Brit. Ind. 7: 377 (1897). Type: Sri Lanka, 5000 ft [1500 m], *Thwaites* 2624 (isotype K).
Indocalamus floribundus (Thwaites) Nakai in Journ. Arn. Arb. 6: 148 (1925).

SRI LANKA. Nuwara Eliya Dist., Haputale range, 1780 m, *Soderstrom* 2555. Badulla Dist., 1890 m, *Soderstrom & Kulatunge* 1658.

S. floribunda is similar to *S. wightiana* in the inflorescence, but it has very prominent nodes, purplish-black speckled culms, 5–8-flowered spikelets and densely pubescent lemmas.

10. Sinarundinaria wightiana (*Nees*) *Chao & Renv.* comb. nov.

Arundinaria wightiana Nees in Linnaea 9: 182 (1834); Rupr., Bamb. 26, pl. III f. 10 (1839); Munro in Trans. Linn. Soc. 26: 19 (1866); Gamble in Ann. Roy. Bot. Gard. Calc. 7: 4, pl. 2 (1896) & in Fl. Brit. Ind. 7: 377 (1897). Type: India, Nilgiris Dist., *Wight* 1797 (isotype K).
Arundinaria hispida Steud. Syn. Pl. Glum. 1: 335 (1854); **synon. nov.** Type: India, Nilgiris, *Herb. Hohenacker* 1282 (isotype K).
A. wightiana var. *hispida* (Steud.) Gamble in Ann. Roy. Bot. Gard. Calc. 7: 5 (1896).
Indocalamus wightiana (Nees) Nakai in Journ. Arn. Arb. 6: 149 (1925).
I. wightianus var. *hispida* (Steud.) Nakai l.c. (1925).

INDIA. Tamil Nadu, Nilgiri Hills, 6000 ft [1800 m], *Gamble* 11607; 7500 ft [2250 m], *Gamble* 20332; 8000 ft [2400 m], *Gamble* 20733. Pulney [Palni] Hills, 6000 ft [1800 m], *Sauliere* 397.

This species is characterized by a large open panicle with 2–4-flowered spikelets, scabrous culms and glabrous to hispid leaf-sheaths. After examination of several specimens, we have come to the conclusion that it is most difficult to distinguish the variety 'hispida' from the typical form of the species, and does not justify recognition as a separate taxon.

11. Sinarundinaria maling (*Gamble*) *Chao & Renv.* comb. nov.

Arundinaria maling Gamble in Kew Bull. 1912: 139 (1912). Type: India, Darjeeling Dist., Mount Tonglo [Tanglu], 9000 ft [3000 m], May 1904, *Osmaston* (lectotype K, chosen here).

NEPAL. Barun Khola, 8000 ft [2400 m], *Emery* 20; 21; 102; 146 & 147 (BM); 183 & 191. Tamur Valley, 7500 ft [2250 m], *Stainton* 1222 (BM). Tudam-Chyamtang, 10500 ft [3150 m], *Beer* 10730 (BM).
INDIA. Sikkim. 12000 ft [3600 m], *Phul Sing* 10346. West Bengal, Darjeeling Distr., 10000 ft [3000 m], *Gammie*; 7000 ft [2100 m], *Gamble* 3171A; 10000 ft [3000 m], *Gamble* 7447; 6000 ft [1800 m], *Gamble* 7542.

This species is common at 2400–3040 m in Nepal and Sikkim. In Gamble's description, he wrote '*Arundinaria maling* undoubtedly comes very near to *A. pantlingii*'. In fact it is not too difficult to distinguish these two species. In *S. maling* the culm-sheaths are densely hirsute and without auricles, and the leaf-sheaths have radiate oral setae; while in *S. pantlingii* the culm-sheaths are glabrous except at the base, the auricles are conspicuous and the leaf-sheaths have straight oral setae.

12. Sinarundinaria elegans (*Kurz*) *Chao & Renv.* comb. nov.

Arundinaria elegans Kurz in Journ. As. Soc. Beng. 42: 249 (1873); Gamble in Ann. Roy. Bot. Gard. Calc. 7: 6, pl. 4 (1896) & in Fl. Brit. Ind. 7: 378 (1897). Type: Burma, Nattaung Hills in Martaban, 5000–7000 ft [1600–2300 m], *Kurz* 114 (isotype K).
Sinobambusa elegans (Kurz) Nakai in Journ. Arn. Arb. 6: 152 (1925).
Burmabambus elegans (Kurz) Keng f. in Journ. Bamb. Res. 1(2): 40 (1982).

INDIA. Nagaland, Naga Hills, 5500 ft [1650 m], *Rollo* 21852.

This species is similar to *Sinarundinaria maling* in vegetative characters, but has glabrous, smooth young culms, the leaf-sheaths have a few oral setae and the inflorescence is racemose.

13. Sinarundinaria intermedia (*Munro*) *Chao & Renv.* comb. nov.

Arundinaria intermedia Munro in Trans. Linn. Soc. 26: 28 (1866); Gamble in Ann. Roy. Bot. Gard. Calc. 7: 15, pl. 14 (1896) & in Fl. Brit. Ind. 7: 381 (1897). Type: Sikkim, 7000 ft [2100 m], 1848, *Hooker* (holotype K).
Arundinaria suberecta Munro op. cit.: 32 (1866); Gamble op. cit.: 25 (1896); **synon. nov.**; exclud., 1889, *Mann*. Type: India, Moosmai Falls, Khasi Hills, 4000 ft [1200 m], *Griffith* 558 (holotype K).
Chimonobambusa intermedia (Munro) Nakai in Journ. Arn. Arb. 6: 151 (1925).
Drepanostachyum intermedium (Munro) Keng f. in Journ. Bamb. Res. 2(1): 18 (1983).

NEPAL. Wang Khola, 5000 ft [1500 m], *Emery* 159, 160 & 161; 5500 ft [1650 m], *Emery* 164 & 165. Sankhuwa Sabha, 1830 m, *Emery* 29.
BHUTAN. Tongsa Distr., 1850 m, *Grierson & Long* 4199. Mangde Chu Valley, 1300 m, *Grierson & Long* 1714.
INDIA. West Bengal, Darjeeling Distr., 4000 ft [1200 m], *Kurz* s.n., 3500 ft [1050 m], *Gamble* 3099B; 3000 ft [900 m], *Gamble* 6948; 4500 ft [1350 m], *Gamble* 7549.

This species has auricles and oral setae on the leaf-sheaths, which are excellent characters to separate it from the related species *Sinarundinaria falcata* and *S. hookeriana*, but it is most difficult to distinguish it from *Arundinaria suberecta*. We have carefully examined the types and the other specimens of *Arundinaria suberecta* and *A. intermedia*, and have found them to be conspecific, although their leaf-blades vary in size.

14. Sinarundinaria falcata (*Nees*) *Chao & Renv.* comb. nov.

Arundinaria falcata Nees in Linnaea 9: 478 (1834); Munro in Trans. Linn. Soc. 26: 26 (1866); Gamble in Ann. Roy. Bot. Gard. Calc. 7: 12, pl. 11 (1896) &

in Fl. Brit. Ind. 7: 381 (1897). Type: NW India, *Royle* (lectotype K, chosen here).

A. interrupta Trin. in Mem. Acad. St. Petersb. VI. Sci. Nat. 1: 620 (1835). Type Nepal, 1819, *Wallich* (isotype K).

A. khasiana Munro in Trans. Linn. Soc. 26: 28 (1866); Gamble in Ann. Roy. Bot. Gard. Calc. 7: 14, pl. 13 (1896) & in Fl. Brit. Ind. 7: 381 (1897); **synon. nov.** Type: India, Khasia, Shillong, 5800 ft [1740 m], *Griffith* 1058 (holotype K).

A. falcata var. *glomerata* Gamble in Ann. Roy. Bot. Gard. Calc. 7: 13, pl. 12 (1896); **synon. nov.** Type: NW India, Jaunsar, *Bagshawe* 6608 (holotype K).

Chimonobambusa falcata (Nees) Nakai in Journ. Arn. Arb. 6: 151 (1925).

C. khasiana (Munro) Nakai l.c. (1925).

Drepanostachyum falcatum (Nees) Keng f. in Journ. Bamb. Res. 2(1): 17 (1983).

D. khasianum (Munro) Keng f. op. cit.: 18 (1983).

Arundinaria suberecta auct. non Munro: Gamble in Ann. Roy. Bot. Gard. Calc. 7: 25, pl. 24 (1896) quoad 1889, Mann.

PAKISTAN. Kotli Dist., Azad Kashmir, 5000 ft [1500 m], *Stewart* 27359 (BM).

NEPAL. Sankhuwa Sabha Distr., Wang Khola, 1830 m., *Emery* 17; Mai Pokhari [Pokhara], 7000 ft [2100 m], *Williams* 433.

INDIA. Punjab, *Parker* 3245. Himachal Pradesh, 5000 ft [1500 m], *Collett* 546; 2100 m, *Parker* 3426. Uttar Pradesh, Jaunsar, 7500 ft [2250 m], *Gamble* 23477; 4000 ft [1200 m], *Gamble* 24340; 6000 ft [1800 m], *Gamble* 27256. Mussoorie, 1950 m, *Soderstrom* 2605; *Falconer* 1244. Meghalaya, Khasi Hills, 5000 ft [1500 m], *Mann* s.n.; *Griffith* s.n.; *Hooker & Thomson* 1407 & 1466. Jaintia Hills, 3500 ft [1050 m], *Mann* s.n. Darjeeling, cult. 1898, *Kennedy* s.n. Tamil Nadu, Nilgiri Hills, 6000 ft [1800 m], *Gamble* 11318; *Gamble* 11722.

This is a very common bamboo species of the Himalayan region and always found in the undergrowth of the broad-leaved forests. It is characterized by 2-flowered spikelets, culm-sheaths with longer ligules and sparse hairs at the back, and leaf-blades without transverse veinlets and oral setae.

It is most difficult to distinguish *Arundinaria khasiana* and *A. falcata* var. *glomerata* from this species. The culms, culm-sheaths and leaf-blades are very similar. After examining a large number of specimens, we have come to the conclusion that the characters mentioned by Munro and Gamble (contracted or loose racemens) are variable, and we consider *A. khasiana* and *A. falcata* var. *glomerata* to be conspecific.

15. **Sinarundinaria hookeriana** (*Munro*) *Chao & Renv.* comb. nov.

Arundinaria hookeriana Munro in Trans. Linn. Soc. 26: 29 (1866); Gamble in Ann. Roy. Bot. Gard. Calc. 7: 16, pl. 15 (1896) & in Fl. Brit. Ind. 7: 382 (1897). Type: Sikkim, Yoksun, 4000–6800 ft, 1848, *Hooker* (holotype K) loc. name 'Praong'.

Chimonobambusa hookeriana (Monro) Nakai in Journ. Arn. Arb. 6: 151 (1925).

Drepanostachyum hookerianum (Munro) Keng. f. in Journ. Bamb. Res. 2(1): 17 (1983).

BHUTAN. N of Samdrup Tongkhar, 2200 m, *Grierson & Long* 2259.

INDIA. Sikkim, *Pantling* 46439. West Bengal, Darjeeling Distr., 6000 ft

[1800 m], *Rogers* s.n.; *Gamble* 7524; 7624 & 8053; 6000 ft [1800 m], *Gammie* s.n.; 4000 ft [1200 m], *Haines* 2026.

This species closely resembles *S. falcata*, but is easily distinguished by its entirely glabrous culm-sheaths and one-flowered spikelets.

16. Sinarundinaria polystachya (*Gamble*) *Chao & Renv.* comb. nov.

Arundinaria polystachya Kurz ex Gamble in Ann. Roy. Bot. Gard. Calc. 7: 7, pl. 5 (1896) & in Fl. Brit. Ind. 7: 378 (1897). Type: Sikkim, E Himalaya, 4000–5000 ft [1200–1650 m], 1868, *Kurz & Anderson* (lectotype K, chosen here).
Chimonobambusa polystachya (Kurz) Nakai in Journ. Arn. Arb. 6: 151 (1925).

INDIA. Darjeeling. 3000 ft [900 m], May 1898, *Gammie* (BM). Meghalaya, Khasi Hills, 3000–4000 ft [900–1200 m], *Mann* 254. Uttar Pradesh, Dehra Dun, cult. Sept. 1893, *Gamble*.

This species is characterized by its large panicle with 3–6-flowered spikelets, broader leaf-blades and long ligule.

17. Sinarundinaria pantlingii (*Gamble*) *Chao & Renv.* comb. nov.

Arundinaria pantlingii Gamble in Ann. Roy. Bot. Gard. Calc. 7: 129, pl. 118 (1896) & in Fl. Brit. Ind. 7: 384 (1897). Type: Darjeeling Distr. 'Bhutan', Rechi-La, 11000 ft [3390 m], Sept. 1895, *Pantling* (holotype K).
Semiarundinaria pantlingii (Gamble) Nakai in Journ. Arn. Arb. 6: 151 (1925).

NEPAL. Sankhuwa Sabha Distr., 3750 m, *Emery* 54. Milke Danda Distr., 11000 ft [3300 m], *Emery* 111. Kasua Khola Distr., 3172 m, *Emery* 203.
BHUTAN. 3800 m, *Bedi* 32.
INDIA. West Bengal, Darjeeling Distr., 3000 m, *Sharma* 29; 2100 m, *Sharma* 30. Sikkim, 12000 ft [3600 m], *Phul Sing* 10344; 10000 ft [3000 m], *Phul Sing* 10347.

This species is easily recognized by its smooth culms, sheath scars covered with a ring of hairs and the culm-sheaths glabrous except for the base and bearing auricles and oral setae.

18. Sinarundinaria anceps (*Mitf.*) *Chao & Renv.* comb. nov.

Arundinaria anceps Mitf., Bamb. Gard.: 181 (1896). Type: a specimen from a plant cultivated at Batsford Park; no longer in existence.
A. jaunsarensis Gamble in Ann. Roy. Bot. Gard. Calc. 7: 23, pl. 22 (1896) & in Fl. Brit. Ind. 7: 384 (1897). Type: India, Uttar Pradesh, Jaunsar Hills, Mundali, 7500 ft [2250 m], May 1892, *Gamble* 23752 (isotype K).
Chimonobambusa jaunsarensis (Gamble) Bahadur & Naithani in Indian Journ. Forestry 1: 41 (1978).
Yushania jaunsarensis (Gamble) Yi in Journ. Bamb. Res 2(1): 39 (1983).

INDIA. Uttar Pradesh, Jaunsar, 8000 ft [2400 m], May 1893, *Gamble* 24088; 7500 ft [2250 m], Nov. 1894, *Gamble* 25045; 7000 ft [2100 m], May 1891, *Gamble* 23134; 8000–9000 ft [2400–2700 m], *Duthie* 12976 (BM).
ENGLAND. (cult.) Warwickshire, Batsford park, *Hubbard & Souster* 6, 13, 16. Devon: Teignmouth, June 1957, *Gilbert-Carter*. Dorset, Uplyme, Feb. 1965,

Mutch. Cornwall, Probus Demonstration garden, *Blake* 4, 5, 14, 15. Surrey, Kew bamboo garden, April 1980, *Renvoize* s.n.; June 1950, *Souster* s.n.; Feb. 1897, *Gamble*. Ramster garden, June 1976, *Hubbard*. E Hants, July 1911, *Gamble* s.n. Essex, Great Warley Place, *Clement* 13. Oxford Bot. Gard., Feb. 1945, *Hubbard* s.n. Somerset, Wootton Courtenay, Ranscombe Lodge, Oct. 1971, *Meikle* s.n.

GUERNSEY. (cult.) Caledonia Nursery, Oct. 1967, *McClintock* s.n.

IRELAND. (cult.) Glasnevin, National Botanic Gardens, July 1970, *Morley* s.n.

On the basis of 3 different dates appearing in small print in Gamble's Bamboos of British India, Bahadur & Naithani claim that this book was published in three parts on the dates shown and that since *A. jaunsarensis* is included in the fascicle dated 1894 this name has priority over *A. anceps* Mitf., published in 1896. This claim is open to question. The dates in small print are probably printers' dates and not dates of publication. An advertising leaflet in vol. 1 of Ann. Cal. Bot. Gard. clearly indicates that this book was offered for sale as a single volume in 1896. Thus both names were published in the same year (1896) and the problem remains, which was published first.

Mitford's book was published between 24 February 1896, the date of the preface, and 25 April 1896, when it was noticed in Gardeners Chronicle no. 487. Gamble's book was published between 7 March 1896, the last printers' date and August 1896, when it was noticed in the Kew Bulletin of Miscellaneous Information 1896: 234 (1896) and reported therein as 'just been issued'. The Bulletin at that time was published monthly and although the part in which the review was entered is dated December 1896, it was in fact published in August 1896. This was due to problems of publishing in that period and is explained more fully in Journal of Botany 35: 451 (1897). The Linnean Society received their copy on 1 September 1896.

From this evidence it seems likely that Mitford's name should take priority.

Numata in Reports of the Fuji Bamboo Gds. 12: 66 (1967) discusses the cultivation and flowering of *Arundinaria anceps* in England. He mentions the problem of identifying the correct name for the species, which arises following the assessment by Blatter in Indian Forester 55: 548–549 (1929) that *A. anceps* and *A. jaunsarensis* were conspecific. According to Numata, C. E. Hubbard asserted that *A. anceps* was published in the spring of 1896 whereas *A. jaunsarensis* was published in July 1896, but no indication is given as to where Hubbard got this information.

Chimonobambusa is identified, in part, by its monopodial (running) rhizomes and indeterminate inflorescence; *Arundinaria anceps* has sympodial rhizomes with long necks and a determinate inflorescence and should therefore be transferred to *Sinarundinaria*. *Arundinaria* although having a similarly determinate inflorescence to *Sinarundinaria* differs in having monopodial rhizomes.

This species is distinguished by its sympodial rhizome with long necks resulting in some scattered culms, and by the glabrous culm-sheaths with conspicuous auricles.

19. Sinarundinaria schmidiana (*A. Camus*) *Chao & Renv.* comb. nov.

Arundinaria schmidiana A. Camus in Mus. Nat. Hist. Nat. (Paris) 14: 253 (1952). Type: Viet-Nam, Lang-bian, 2000 m, *Schmid* 570 (holotype P).

VIET-NAM. Lang-bian, 2200 m, *Schmid* 1249 (P); Chu Yang Sink 2200 m, *Schmid* 1819 (P).

This species is similar to *S. maling* and *S. anceps*, but differs in its open panicles with short 4–5-flowered spikelets and its pubescent leaf-blades and leaf-sheaths without oral setae.

The specimen *Schmid* 1819 shows the sympodial rhizome character.

20. Sinarundinaria alpina (*K. Schum.*) *Chao & Renv.* comb. nov.

Arundinaria alpina K. Schum. in Engler, Pflanzenw. Ost-Afr. 5: 116 (1895). Type: Kenya, Kikuyu, *Fischer* 672 (holotype B, not seen, destroyed?).

A. tolange K. Schum. in Bot. Jahrb. Engler 28: 351 (1900). Type: Tanganyika, Uluguru Mts, Lukwangule Plateau, *Goetze* 254 (holotype B, not seen, destroyed?).

A. fischeri K. Schum. op. cit. 351 (1900). Type: Kenya, Laikipia Plateau, *Fischer* (holotype B, not seen, destroyed?).

Oxytenanthera ruwensorensis Chiov. in Ann. Bot. (Roma) 6: 148 (1907). Type: Uganda, Ruwensori, between Nibitawa and Kuchuchu, Mubuku valley, *Duke of Abruzzi* (holotype TO).

W. CAMEROONS. Bamenda, 7800 ft [2340 m], *Brunt* 795.

ZAIRE. Kivu, 2200–2400 m, *Humbert* 7470; 2400 m, *Léonard* 479; 2300 m, *van der Veken* 8765; 2300 m, *Hendrick* 5773; 3300 m, *Pierlot* 209; Mt Muhende, *Scaetta* 101M.

SUDAN. Kippia, Imatong Mts, 9000 ft [2700 m], *Thomas* 1884; 8744 ft [2600 m], *Chipp* 94.

ETHIOPIA. Sidamo Prov. 8000–9000 ft [2400–2700 m], *Mooney* 5660; 8500 ft [2550 m], *Burger* 3424; 1575 m, *Meyer* 8770; Gojam Prov., 8000 ft [2400 m], *Meyer* 8629; Kaffa Prov., 1780 m, *Meyer* 7875, 1800 m, *Meyer* 7750 & 9077; 2460 m, *Meyer* 7950; Bale Prov. 2250 m, *Mooney* 8491; Gamu Gofa Prov., 13000 ft [3900 m], *Mulvany* 4.

UGANDA. E Prov. Mt Elgon, 8000–10000 ft [2400–3000 m], *Dummer* 3508; 9100 ft [2730 m], *Eggeling* 2427; W Prov., Kigezi, 8000–10000 ft [2400–3000 m], *Snowden* 1495 & 1610; Nyamugasani, 2200 m, *Osmaston* 2307.

KENYA. Masai Prov., 8900 ft [2700 m], *Greenway & Kanuri* 13638; 8500 ft [2550 m], *Gwynne & Samuel* 1396; 8400 ft [2520 m], *Gwynne & Samuel* 1187; Nyanza Prov., 2280 m, *Rhind* 13079; 2800 m, *Geesteranus* 5568; Central Prov., 3030 m, *Kimani* 31; Rift Valley Prov., 8500 ft [2550 m], *Davidse* 9223; 8500 ft [2550 m], *Polhill* 354; 2700 m, *Mwangangi* 1018; 9100 ft [2730 m], *Rogers & Gardner* 765.

TANZANIA. Eastern Prov., *Greenway & Eggeling* 8665; 1850–2100 m, *Thulin & Mhoro* 2788; Southern Highlands Prov., *Renvoize* 2060; Northern Prov., 9500–10450 ft [2850–3140 m], *Burtt* 4223; 2700 m, *Greenway* 7803.

This species is characterized by large panicles with many spikelets, densely pubescent culm-sheaths, long caudate leaf-blades and leaf-sheaths with conspicuously prominant auricles.

It is a very important bamboo on many mountains of East Africa and forms extensive bamboo forests. Some of the largest areas are on the Aberdare Range (250 sq. miles), Mau Range (200 sq. miles) and Mt Kenya (150 sq. miles).

This bamboo apparently varies greatly in size from 2–19·5 m in height and from 2–12·5 cm in diameter depending on altitude and soil condition; c.f. Hubbard in Fl. Trop. East Afr. *Gramineae* (1): 111 (1970).

21. Sinarundinaria madagascariensis (*A. Camus*) *Chao & Renv.* comb. nov.

Arundinaria madagascariensis A. Camus in Bull. Mus. Nat. Hist. Nat. (Paris) 30: 394 (1924). Type: Madagascar, Mt Tsaratanana, 2000–2800 m, *Perrier de la Bâthie* 10778 (holotype P; isotype K).
A. perrieri A. Camus op. cit. 295 (1924); **synon. nov.** Type: Madagascar, Mt Manongarivo, 1000 m *Perrier de la Bâthie* 11269 (holotype P).
A. marojejyensis A. Camus in Bull. Soc. Bot. France 97: 84 (1950); **synon. nov.** Type: Madagascar, Massif de Marojejy, 1850–2137 m, *Humbert* 23734 (holotype P).

MADAGASCAR. Mt Manongarivo, 1000 m, *Perrier de la Bâthie* 192.

The species is similar to *S. alpina* (Schum.) Chao & Renv., but is distinguished by its slender spikelets with long rachillas, pilose leaf-blades and leaf-sheaths without prominent auricles.

We have examined the type specimens of *Arundinaria perrieri* and *Arundinaria marojejyensis* and found them to be the same as *Sinarundinaria madagascariensis* (A. Camus) Chao & Renv.

22. Sinarundinaria humbertii (*A. Camus*) *Chao & Renv.* comb. nov.

Arundinaria humbertii A. Camus in Bull. Soc. Bot. France 73: 624 [1926] (1927). Type: Madagascar, Massif de L'Andringitra (Iratsy) 2000 m, *Humbert* 3750 (holotype P; isotype K).
A. ambositrensis A. Camus op. cit. 78: 8 (1931); **synon. nov.** Type Madagascar, near Ambositra, forest of Ranomena, 1300–1400 m, *Humbert* 4868 bis (holotype P; isotype K).

This species closely resembles *Sinarundinaria madagascariensis* (A. Camus) Chao & Renv., but it differs from that species in the larger leaf-blades, 9–15 × 1–1·2 cm, glabrous, except at the base, and in the leaf-sheaths which have denser and longer oral setae 4–8 mm long.

4. Thamnocalamus *Munro*

in Trans. Linn. Soc. 26: 33 (1866); Bentham in Benth. & Hook. f. Gen. Pl. 3(2): 1028 (1886); Soderstrom in Brittonia 3(4): 495 (1979); Chao *et. al.* in Acta Phytotax. Sin. 18(1): 22 (1980).

Arundinaria sect. *Thamnocalamus* Hackel in Engler & Prantl, Nat. Pflanzenfam. II, 2: 93 (1887); Gamble in Ann. Roy. Bot. Gard. Calc. 7: 17 (1896).
Fargesia Franch. in Bull. Linn. Soc. Paris 2: 1067 (1893).
Himalayacalamus Keng f. in Journ. Bamb. Res. 2(1): 23 (1983).

This genus is distinguished from *Arundinaria* by its sympodial rhizome, clumped habit and its shortened inflorescence with large spathulate sheaths. It is most difficult to separate from *Sinarundinaria* on vegetative structure, but the genus *Sinarundinaria* has an open panicle or raceme without spathulate sheaths.

6 species, 2 in China, 1 in Africa, 3 in the Himalaya.

1. Thamnocalamus falconeri *Hook. f.* ex *Munro* in Trans. Linn. Soc. 26: 34 (1866); E. G. Camus, Bamb. Monog. 53, pl. 29, f. C (1913). Type: Nepal, 8000 ft [2400 m], *Wallich* 5040 (holotype K).

Arundinaria falconeri (Munro) Benth. et Hook. f., Gen. Pl. 3: 1208 (1883); Gamble in Ann. Roy. Bot. Gard. Calc. 7: 20 (1896) & in Fl. Brit. Ind. 7: 383 (1897).

Himalayacalamus falconeri (Hook. f.) Keng f. in Journ. Bamb. Res. 2(1): 24 (1983).

NEPAL. 2200 m, *Emery* 12 (BM); 1980 m, *Emery* 40; 7200 ft [2160 m], *Emery* 205; 8500 ft [2550 m], *Schilling* 781. 2000 m, *Dobremez* 2338 (BM). 2900 m, *Dobremez* 2814 (BM).

INDIA. Uttar Pradesh, *Strachey & Winterbottom* 1. Sikkim, 10000 ft [3000 m], *Cave* s.n., 9500 ft [2850 m], *Bowes Lyon* 3009 (BM), 9000 ft [2700 m], *Clarke* 27760. W Bengal, Darjeeling Distr., 7000 ft [2100 m], *Rogers* s.n. 6000 ft [1800 m], *Phul Singh* 10135, 6000 ft [1800 m], *Rogers* s.n.

This species approaches the simple condition in its inflorescence, which has 1-flowered spikelets and smaller spathulate sheaths. The leaf-blades are without transverse veinlets.

2. Thamnocalamus spathiflorus (*Trin.*) *Munro* in Trans. Linn. Soc. 26: 34 (1866); E. G. Camus, Bamb. Monog. 55, pl. 30, f. A (1913). Type: Nepal, Mts of NW Himalaya, 7000 ft [2300 m], *Wallich* 5041 (lectotype K chosen here).

Arundinaria spathiflora Trin. in Mem. Acad. St. Petersb. VI. Sci. nat. 1: 617 (1835); Gamble in Ann. Roy. Bot. Gard. Calc. 7: 17, pl. 16 (1896) & in Fl. Brit. Ind. 7: 382 (1897).

NEPAL. *Wallich* 5041.

INDIA. Himachal Pradesh, 9500 ft [2850 m], *Gamble* 6075A. Uttar Pradesh, 8000 ft [2400 m], *Gamble* 23470; 7000 ft [2100 m], *Gamble* 23497; 9000 ft [2700 m], *Gamble* 24341.

This is the common species at higher altitudes of the northwest Himalaya, especially in the undergrowth of the *Cedrus* and *Abies* forests. It is readily distinguished by its prominent veinlets and conspicuous auricles and oral setae on the leaf-sheaths, its many-flowered spikelets and large spathaceous sheaths.

3. Thamnocalamus aristatus (*Gamble*) *E. G. Camus*, Bamb. Monog. 54, pl. 37, f. E (1913). Type: India, Sikkim, Phalut, 10000 ft [3000 m], May 1890, *Gammie* (lectotype K, chosen here).

Arundinaria aristata Gamble in Ann. Roy. Bot. Gard. Calc. 7: 18, pl. 17 (1896) & in Fl. Brit. Ind. 7: 382 (1897).

Arundinaria racemosa sensu Munro in Trans. Linn. Soc. 26: 17 (1866) quoad *Hooker* specimen called 'Pat-hioo'.

NEPAL. Balutar, 2450 m, *Emery* 45.

INDIA. Sikkim, 10000 ft [3000 m], *Dr King's Collector*; 11000 ft [3300 m],

Clarke 10057. W Bengal, Darjeeling, Distr. 10000 ft [3000 m], *Phul Sing* 10131; 11000 ft [3300 m], *Gammie* s.n.; 11000 ft [3300 m], *Rogers* s.n.; 10000 ft [3000 m], *Rogers* s.n.; 10000 ft [3000 m], *Gamble* 7436.

This species is similar to *T. spathiflorus*, but usually has broader bracts enclosing 3–6 sessile spikelets and culm-sheaths covered with sparse bristles while *T. spathiflorus* has narrower bracts, enclosing 2–3 pedicellate spikelets and glabrous culm-sheaths.

4. Thamnocalamus tessellatus (*Nees*) *Soderstrom & Ellis* in Bothalia 14(1): 53 (1982). Type: South Africa, Cape, Katberg, 4000–5000 ft [1200–1500 m], *Drège* s.n. (lectotype PRE, chosen by Soderstrom & Ellis).

Nastus tessellatus Nees, Fl. Afr. Austr. 1: 463 (1841).
Arundinaria tessellata (Nees) Munro in Trans. Linn. Soc. 26: 31 (1866).
A. ibityensis A. Camus in Bull. Soc. Bot. France 107: 211 (1960); **synon. nov.** Type: Madagascar, Vakinankaratra Prov., Antsirabe Dist., Mt Ibity, 2000–2250 m, *Viguier & Humbert* 1471 & 1800–2300 m, *Perrier de la Bâthie* 10761 (syntypes P).

South Africa. Cape Prov., Wittebergen, 5000–6000 ft [1500–1800 m], *Drège* s.n.; Victoria, April 1964, *Morton* s.n.; Gxulu Kop, Keiskammahoek, *Story* 3515. Lesotho, mountain side near Buffalo River waterfall, *Galpin* 6931. Natal, Drakensberg National Park, 6500 ft [1950 m], *Codd & Dyer* 2778; *Hutchinson* 4532. Orange Free State, Drakensberg, 5000–7000 ft [1500–2100 m], July 1908, *Putterill* in Herb. Medley Wood No. 11336; SE of Visierskerf, *Scheepers* 1853; Van Reenen, 8000 ft [2650 m], *Schlechter* 6997.

This species is characterized by the inflorescence with narrowly spathulate sheaths and spikelets with four florets, and by its stiff leaf-blades with a hard point and conspicuous tessellation.

A. Camus published *Arundinaria ibityensis*, collected from Mt. Ibity in Madagascar but the syntypes of the species are sterile. After examining a large number of specimens, *Arundinaria ibityensis* is considered to be the same species as *Thamnocalamus tessellatus*.

5. Racemobambos *Holttum*

in Gard. Bull. Singapore 15: 268 (1956); S. Dransfield in Kew Bull. 37: 661 (1983).

Microcalamus Gamble in Journ. As. Soc. Beng. 59: 207 (1980), non Franch. (1889).
Neomicrocalamus Keng f. in Journ. Bamb. Res. 2(2): 10 (1983).

This genus is quite different from *Arundinaria* in essential characters. It has a sympodial rhizome with long necks, climbing or scrambling habit, indeterminate inflorescence, as indicated by the presence of very small bracts subtending the sessile spikelets and 6 stamens in each floret.

18 species in S Asia.

1. Racemobambos prainii *(Gamble) Keng f. & Wen* in Journ. Bamb. Res. 5(2): 13 (1986). Type: India, Assam, Naga Hills, 7870 ft [2600 m], 1886, *Prain* (holotype K).

Microcalamus prainii Gamble in Journ. As. Soc. Beng. 59: 207 (1980).
Neomicrocalamus prainii (Gamble) Keng f. in Journ. Bamb. Res. 2(2): 10 (1983).

INDIA. Khasia & Jaintia Hills, 3500 ft [1150 m], April 1889, *Mann;* Naga Hills, 5400 ft [1800 m], March 1891, *Rollo.*

2. Racemobambos ciliata *(A. Camus) Chao & Renv.* comb. nov.

Arundinaria ciliata A. Camus in Bull. Mus. Hist. Nat. (Paris) 25: 672 (1919). Type: Cambodia, Compong-thom, *Pierre* 6659 (holotype P).
A. pusilla A. Chevalier & A. Camus in op. cit. 27: 450 (1921); **synon. nov.** Type: Viet-Nam, Long bian, Dran, 1000–1200 m, *A. Chevalier* 40330, 40506, 40600 (syntypes P).

THAILAND. Muang Petchabum, 50 m, *Kerr* 5680.

This species is similar to *R. prainii*, but distinguished from that species by the many-nerved lemmas, shorter rachillas, longer leaf-blades with a contracted base and the leaf-sheaths with conspicuously falcate auricles.

In the literature the inflorescence of *Racemobambos* is interpreted as determinate i.e. its branches are without subtending bracts enclosing axillary buds—see S. Dransfield in Kew Bull. 37: 663 (1983). Clayton & Renvoize in Genera Graminum: 49 (1986) also interpret the inflorescence as determinate but draw attention to the tiny empty bracts which are often present, subtending the spikelet pedicels. In this paper we have accepted the bracts subtending the spikelets as sufficient evidence to interpret the inflorescence of *Racemobambos* as indeterminate and therefore we include *R. prainii* and *R. ciliata*, in which these bracts are particularly prominent.

6. Indosasa *McClure*

in Lingnan Univ. Sci. Bull. 9: 28 (1940); Chao & Chu in Acta Phytotax. Sin. 21: 60 (1983).

The genus *Indosasa* differs from *Arundinaria* in the inflorescence, which is indeterminate and forms a tight cluster of spikelets; the spikelets are sessile and contain 6 stamens in each floret. It closely resembles *Sinobambusa* in vegetative structure, but in *Sinobambusa* there are 3 stamens in each floret.

12 species, native to Asia.

Indosasa laotica *(A. Camus) Chao & Renv.* comb. nov.

Arundinaria laotica A. Camus in Bull. Mus. Hist. Nat. (Paris) II, 3: 760 (1931). Type: Laos, Nape, *Delacour* 1928 (holotype P).

7. Chimonobambusa *Makino*

in Bot. Mag. Tokyo 28: 153 (1914); Nakai in Journ. Arn. Arb. 6: 151 (1925).

Oreocalamus Keng in Sunyatsenia 4: 146 (1940); Keng f. in Journ. Bamb. Res. 3(1): 22 (1984).

The genus *Chimonobambusa* was published by the Japanese botanist T. Makino. It has monopodial rhizomes, root thorns at the nodes, branches 3 or 3-dominant at the mid-culm, culm-sheaths with very small blades and inde-

terminate inflorescences, as indicated by the bracts which subtend the sessile spikelets, and 3 stamens in each floret. These characters easily distinguish it from *Arundinaria* and the other genera. Nakai (1925) transferred 7 Himalayan species of *Arundinaria* into this genus; in our opinion only the transfer of *A. callosa* is correct, *A. falcata, A. griffithiana, A. hookeriana, A. intermedia, A. khasiana* and *A. polystachya* are in our opinion referable to *Sinarundinaria*.

About 10 species, native in Asia, 2 species in the Himalaya.

1. Chimonobambusa callosa (Munro) Nakai in Journ. Arn. Arb. 6: 151 (1925).

Arundinaria callosa Munro in Trans. Linn. Soc. 26: 30 (1866); Gamble in Ann. Roy. Bot. Gard. Calc. 7: 11, pl. 10 (1896) & in Fl. Brit. Ind. 7: 380 (1897). Type: India, Meghalaya, Khasia Hills, 6000 ft [1800 m], 1850, *Hooker* (lectotype K chosen here).

Chimonocalamus callosus (Munro) Hsueh & Hi in Acta Bot. Yunnan. 1(2): 84 (1979).

BHUTAN. 2200 m, *Grierson & Long* 2258.

INDIA. Meghalaya, 6500 ft [1950 m], *Clarke* 14453; 6300 ft [1890 m], *Clarke* 37434; 5000–6000 ft [1500–1800 m], *Mann* s.n. Manipur, *Meebold* 6577. Mizoram, 5000 ft [1500 m], *Parry* 501.

The flower was unknown to Munro when he published this species; *Clarke* 37434 shows the characters of the flower and inflorescence well.

2. Chimonobambusa armata *(Gamble) Hsueh & Yi* in Journ. Bamb. Res. 2(1): 38 (1983).

Arundinaria armata Gamble in Ann. Roy. Bot. Gard. Calc. 7: 130, pl. 119 (1896) & in Fl. Brit. Ind. 7: 385 (1897). Type: N Burma, 5500 ft [1650 m], Feb. 1894, *Oliver* (holotype K).

This species is easily distinguished from *C. callosa* by its scabrous culms and very small blades to the culm-sheaths.

8. Sinobambusa *Makino* ex *Nakai*

in Journ. Arn. Arb. 6: 152 (1925).

Neobambus Keng f. in Techn. Bull. Nat. For. Res. Bur. China 8: 15 (1948) nom. nud.

Sinobambusa differs from the genus *Arundinaria* in its indeterminate inflorescence, forming a tight cluster of spikelets, the many-flowered sessile spikelets and the culms with grooved internodes. It closely resembles *Indosasa* but has 3 stamens in each floret.

17 species, native to Asia.

Sinobambusa sat *(Balansa) Chao & Renv.* **comb. nov.**

Arundinaria sat Balansa in Journ. de Bot. 4: 28 (1890). Type: Viet-Nam, Tonkin, Oronbi, Mt Bavi, *Balansa* 1576 (isotype K).

Doubtful species

The three species *Arundinaria mannii* Gamble, *A. kurzii* Gamble and *A. petelotii* A. Camus could not be identified because we have not seen the types or the types are sterile and no other useful specimens can be found. But it seems that they are not members of the genus *Arundinaria* on account of their morphological characters. We only list them as follows:

1. Arundinaria mannii *Gamble* in Ann. Roy. Bot. Gard. Calc. 7: 26, pl. 26 (1896) & in Fl. Brit. Ind. 7: 385 (1897). Type: India, Assam, Jaintia Hills, 2500–3000 ft [750–900 m], April 1889, *Mann* (holotype K).

This is a very curious species having a sympodial rhizome, climbing habit and very long internodes up to 1 m. On this account, Gamble thought it was similar to *Arundinaria prainii (Racemobambos prainii)*. It could belong to the genus *Racemobambos*, but it cannot be accurately identified until flowering material has been collected.

2. Arundinaria kurzii *Gamble* in Ann. Roy. Bot. Gard. Calc. 7: 25, pl. 25 (1896) & in Fl. Brit. Ind. 7: 385 (1897). Type: Burma, southern coasts, 1878, *Kurz* (holotype K).

This species is characterized by long internodes, very thin walls of the culms and numerous very long, filiform branches.

3. Arundinaria petelotii *A. Camus* in Mus. Nat. Hist. Nat. 14: 252 (1952).

We have not seen the type specimens, *Pételot* 8356, from Mts Phan-si-pan, Cha-pa, Tonkin of Viet-Nam. According to Camus' description, it seems to be a member of the genus *Indocalamus*.

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