

and England since the early twentieth century, with usually only a few canes in a stand bearing flowers. Because it is not invasive, it is "... a good plant for any position in the garden where it can be allowed to display its beautiful foliage to its full advantage ... ideal for growing in the ornamental border, or in a sunny position in a rockery. The golden-yellow variegated foliage is outstanding, making this species instantly recognizable from the other yellow variegated species by its sheer brilliance ... The golden striping varies in both width and number from leaf to leaf."¹⁰

Arundinaria callosa: 12–20 feet by ½–1 inch. Native to India, in the Himalayas and Khasia Hills, and Assam to 6,500 feet. Used for construction, tying thatch, crafts. Local names include *uskong*, *uspar*, *spa* (Khasia).¹¹

Arundinaria elegans: 12–20 feet by 1 inch; *jilli* (Naga). From the Naga Hills in India, it grows at 5,000–7,000 feet. Used for interior walls and room dividers, walls of native huts.¹²

Arundinaria falcata: 15–20 feet by ½–¾ inch; Himalayan bamboo, *ringal*, *nirgal*, *nagre*, *narri*, *gari*, *gorwa*, *spikso*, *ningalo*, *kewi*, *tham*, *utham*, *kutino*. Native to India (Ravi), Nepal, Vietnam; used for construction and as a lining for roofs.¹³

**Arundinaria fastuosa*: 25 feet by 1¾ inches, –4°F

(*Arundinaria narihira*, *Bambusa fastuosa*, *Semiarundinaria fastuosa*). Native to the Honshu, Shikaku, and Kyushu districts of Japan, where this elegant species is called *narihira* for an eleventh century mythical hero of romance, it was introduced into France in 1892. *Fastuosa*—stately—the name then given the species in Europe, suits it well: The culms are noble and erect, straight as honor, thin walled, and a deep green with a hint of purple maturing to a yellow brown. The culm sheaths are not persistent: purple outside, a quite distinctive claret on the inner surface, soon weathering to a nondescript dull light brown. "The smooth straw-colored culm sheaths often hang on in a semidetached state for a number of weeks after the new culms have completed their growth and are quite characteristic during that period."¹⁴

Nodes, uninflated, as much as 1 inch apart, bear two to three short stiff branches on the lower cane, more above. Leaves, four to six to a branch, are up to 10 inches by 1 inch on young canes, smaller as the culms mature. They are clearly tessellated and edged with bristles, a bright green above, dull grey green below. *A. fastuosa* flowered in England in 1935–36, in Japan in 1951, and Lawson (1968) reports several clumps sporadically in flower for many years at the bamboo gardens under his care at Pitt White

in East Devon (England). The flowering canes of the species are bizarre in showing above the perfectly cylindrical lower culm typical of *Arundinarias* the peculiar features of *Phyllostachys* species. Beginning above the lowest branches, the internodes are grooved and zigzag from node to node. The species has a very slow moving rhizome and "makes a magnificent solo specimen plant."¹⁵ A beautiful sample of *A. fastuosa* grows next to the giant Buddha in the Japanese Tea Garden in San Francisco's Golden Gate Park. "This splendid bamboo ... is the stateliest, if not the handsomest, of the hardy bamboos."¹⁶

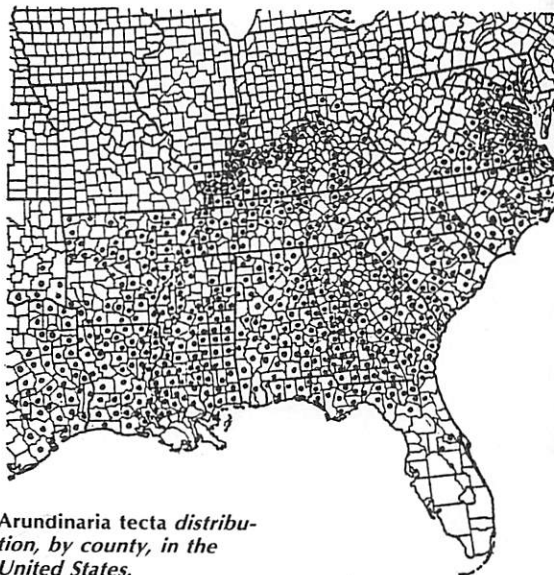
Arundinaria fortunei: 4½ feet by ½ inch (*Bambusa fortunei variegata*, *Pleioblastus variegatus*).

A hardy ornamental from Japan, "the best of the white variegated bamboos,"¹⁷ introduced into Belgium in 1863; it is an excellent specimen for a rock garden and an attractive potted plant. New shoots are white with green tips, culms a pale green with uninflated nodes, 6 inches apart, bearing persistent sheaths, thick and straw colored. Branches are thin and long, borne singly, sometimes paired. The clearly tessellated leaves, 8 inches by 1 inch, are covered with fine white hairs, more densely below than above, with prominent midribs. Leaves are dark green striped with white above, fading to a paler green; below, a duller green with less white striation. *Fortunei* is fairly invasive in warm climates; quite hardy but may lose leaves in a harsh winter.¹⁸

**Arundinaria gigantea*: 30 feet by 1¼ inch, –10°F

(*Arundinaria macrosperma*).

One of two bamboos native to the continental United States, its "canebrakes" once covered large areas from Virginia to Texas and provided



Arundinaria tecta distribution, by county, in the United States.

an effective exit from the South for runaway slaves headed north for freedom before the Civil War. It also provided valued forage for early settlers, who found the cane an excellent indicator of fertile soils. Tests in North Carolina show that cane may be the highest yielding native range in the United States.¹⁹ In the North Carolina coastal plain, it provided 46 percent of forest grazing in the forage types among farms surveyed in the early 1940s. Canebrakes are being drastically reduced in area by fire, uncontrolled grazing, and clearing for cultivated crops. Once killed out, cane comes back quite slowly, requiring several generations for it to naturally reestablish itself.

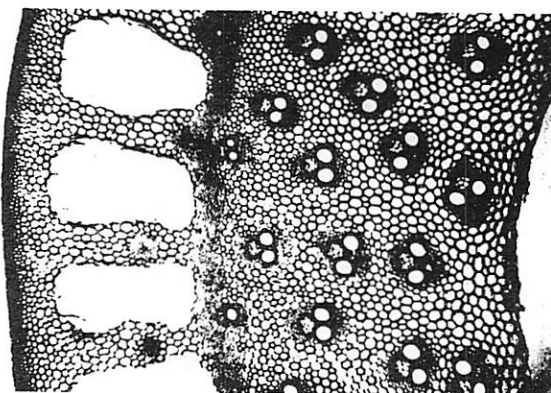
As with other bamboos, flowering of *A. gigantea* can mean a marked decrease in vitality or the death of a grove. "Fox Island was full of game from my earliest recollections up to 1850, when the cane which covered it went to seed and then all died. The seed grew in clusters and resembled oats, and all the animals and fowl got rolling fat from eating it. The squirrels were so fat that their kidneys were covered. This food imparted a delicious flavor to the flesh and we feasted that summer and fall. But this was the end of the cane on Fox Island, as it all died the following winter and was either carried off by high water or rotted on the ground"²⁰; from a nineteenth century autobiography written in Indiana. The seed is not only eaten by squirrels; an unidentified larva bores into the seed near the base and devours the starchy endosperm, retarding prompt recovery of flowering groves.

Canebrakes were a favorite hunting ground of the Indians, as they abounded in bears, deer, panthers, wildcats, turkeys, and much small game. Canebrakes were also a good place to hide from whites, who often arrived in new territory along the rivers where canebrakes grew most abundantly. The new settlers not only pastured their livestock on cane, but also drove them into the canebreaks during winter for protection from the cold.

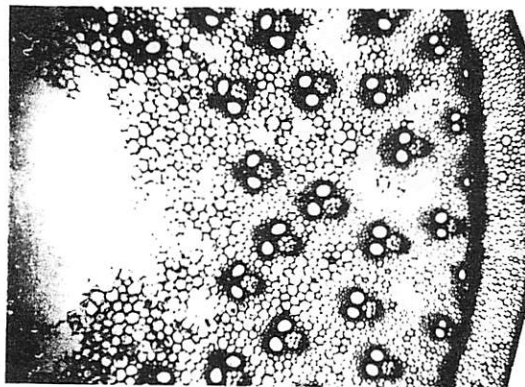
Canes owe their wide distribution to broad tolerance in weather and soil. They grow from sea level to 2,000 feet in the Appalachians, on all types of soil from sandy, rock cliffs and mountain slopes to muck lands (*pocosins*) and rich alluvial areas of the coastal plain—withstanding extremes of temperature from -10° to 105° F.

A smaller cane, *A. tecta*, reaches a height of about 8 feet. Some authors regard it as a separate species; others, as a form of *A. gigantea*.²¹ Neither are highly regarded as ornamental plants. "There may well be situations in which a small patch would be of interest and not seriously disfiguring," is the best that Young can say for it,²² while Lawson regretfully finds it "rather second rate . . . always sad and tattered during winter months."²³

McClure has this to say about the confusion of species: "Small plants of *A. gigantea* are often confused with switch cane, *A. tecta*, but the two



Cross section of young rhizome of Arundinaria tecta, showing air canals that distinguish it from A. gigantea (times 25).



Cross section of young rhizome of A. gigantea (times 25). The absence of air canals distinguishes it from A. tecta.

can be distinguished by the branching habit alone: culms 25–30 feet by 2–3 inches, branches short (usually much less than 1 foot) and stiffish, initiated *before* culms reach full height: *A. gigantea*. Culms 12–15 feet by $\frac{1}{4}$ – $\frac{1}{2}$ inch, branches long and withy, initiated in the spring, several months *after* culms reach full height: *A. tecta*.²⁴ McClure also reports discovering, with a 9x hand lens, air canals in the rhizomes of *A. tecta* that are absent in *A. gigantea*, further indicating they are indeed distinct species.²⁵

Arundinaria graminea: 10–16 feet by $\frac{3}{4}$ inch (*Arundinaria hindsii*, var. *graminea*, *Bambusa graminea*, *Pleioblastus gramineus*). From the Ryuku Islands of Japan, *A. graminea* was introduced into England in 1877 and into the United States "from a European source, as have been most of our other oriental bamboos of small and medium size."²⁶ Distinguished by its narrow leaves, "grasslike," as the specific name signifies, it is one of the few hardy bamboos that love the shade. The culms, though thin walled, make very useful garden stakes. Pale green when new, they

most common and popular ornamental bamboos in a number of Western countries. "For hedging and screening purposes, this species is without equal, and the mature canes, when ripened properly, are eminently suitable for garden purposes, even though they are fairly thin walled. It also makes a fine tub plant."⁹⁷

Large groves can be found at least as far north as Washington, D.C., on the East Coast, where the Benedictine monks of Saint Anselm's Abbey (Brookland, D.C.) are happy to share their abundance. Hardy on the Pacific Coast to the Columbia River or more.⁹⁸

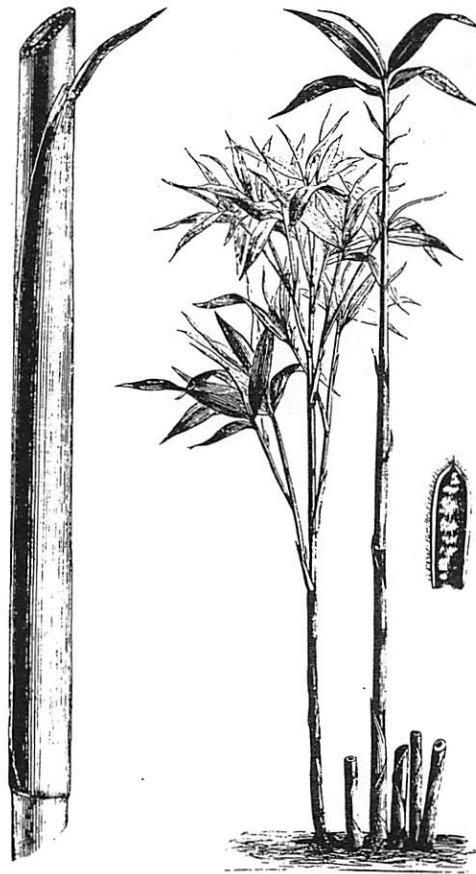
"When planted on the west and north of a peasant's cottage, this bamboo grows thick and bushy and forms an excellent shelter against the wind. Its stems are an indispensable household article, used for raising well buckets and for fences. For catching shell fish (*Pinna japonica* and *Mya arenaria*) the tallest specimens are selected, cut in late autumn and stored during the winter in a smoky place. In early spring they are bent over a fire and an iron hook affixed to the end. With this instrument the bottom of the sea is dredged. Cut into lengths of 6 or 7 feet, it is plaited together to form a fish stew, which floating in the sea serves to keep cray fish and so forth alive.

"It bears the cold well, is very easy to cultivate, grows in soil half earth, half stone, and flourishes exposed to the violence of seashore waves. Plants growing on hillsides or river embankments expose their rootstocks, and they hang in the water without suffering any loss of strength or luxuriance. These qualities render it of great use in the construction of *kase* (groins) as a protection against floods. The flow of a side current is obstructed by planting bamboos on the banks of a large river or at the waterline of a dike where it is feared the water may break through. When they begin to grow thick and close, the inner face is stopped up with straw, earth and stones, vegetation, or the bark of trees. Such *kase* are absolutely necessary as a protection against floods.

"Smaller canes are used by the common people plaited together as ceilings, for the framework of mud walls of houses, for the frames of round fans, for all sorts of baskets, the ribs of umbrellas, and many other purposes."⁹⁹

Sasa disticha: 2–5 feet by $\frac{3}{4}$ inch, 10°F.
(*Arundinaria disticha*, *Bambusa disticha*,
Bambusa nana).

Native to Japan, from where it was introduced into Europe in the late 1860s, "dwarf fernleaf bamboo" is named for its distinctive foliage that is fernlike in sunlight but more open in shade. *Disticha*, "arranged in two rows," is the name given by Freeman-Mitford for the paired leaves that distinguish the species in a sunny site. Culms are bright green, often shaded purple. The sheaths, downy at first, are not persistent.



Pseudosasa japonica.

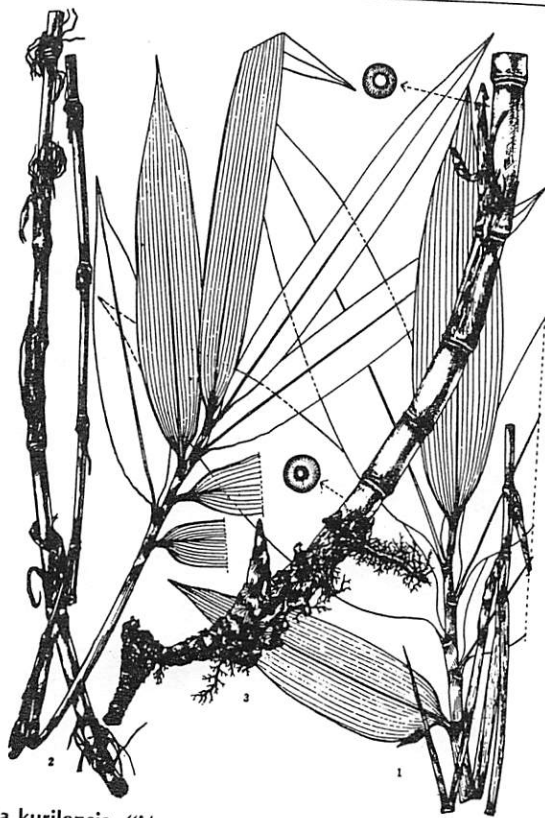
Uninflated nodes are 4–6 inches apart; branches generally one per node but sometimes in pairs. Leaves are somewhat downy, $2\frac{1}{2}$ inches by $\frac{3}{4}$ inch, with fine bristles on both edges, bright green above, a dull flat green below. *S. disticha* has active rhizomes that can be fairly invasive.

Zones: hardy as far north as Philadelphia on the Atlantic Coast and most of the Pacific Coast.¹⁰⁰

**Sasa kurilensis*: 10 feet by $\frac{3}{4}$ inch.

The most important *Sasa* economically is *S. kurilensis*, which abounds even in deep snow farther north than any other bamboo. Culms are 3+ meters high, 1–2 centimeters ($\frac{3}{8}$ – $\frac{3}{4}$ inches) in diameter, yield 45 tons per hectare (about 18 tons per acre) for particle boards, according to the Experiment Forest at Hokkaido University. The species "prevents erosion, but disturbs regeneration of trees and hinders foresters in summer work. . . . In 1978, about 600 tons of *Sasa* shoots were used for food in Japan, and 87,000 bundles of culms were produced for agricultural, horticultural uses, and bamboo works in Hokkaido Prefecture."¹⁰¹

In Hokkaido, *Sasa* species represent 100 million tons of vegetation, one sixth of the total wood growing, so industrial use is being



Sasa kurilensis, "Nemagari-dake" in Japan, braves more northern latitudes than any other bamboo in the world.

researched. Fiber dimension makes *Sasa* pulp better for thick paper and fiberboard than for thin papers. Cost of gathering and bundling *Sasa* for pulp products is an economic block. Research on pulp production dominates the intense *Sasa* studies of the last thirty years, but a possible cancer cure from *Sasa* leaf extract has recently stirred keen interest. "This species often covers whole mountains. On January 23, 1902, 211 soldiers of the Aomori Regiment started for Mt. Hakkoda, but they lost their way, and owing to the violent snow storm strayed by accident into a vast growth of this species and almost all of them were frozen to death on January 25." (Fuji 1963:64.)

**Sasa palmata*: 7½ feet by ½ inch, 0°F. (*Arundinaria palmata*, *Bambusa palmata*). Native to Japan, *S. palmata* covers huge areas in the mountains there, and its thick-walled culms are used as a pulp source in manufacturing hardboard. Introduced into Europe in the 1880s and into the United States in 1925. New culms are a brilliant green, often curved at the base, a powdery white below nonprominent nodes roughly 6 inches apart; internodes later covered with brown splotches. Culm sheaths, a greenish white turning straw colored, hang on until

ragged. Branches are single at some mid and upper culm nodes, with one or two secondary branches often growing later from the primary branch. Leaves 4–15 inches long by 1½–3½ inches wide, bright pea green above, silvery below, thick and leathery to the touch, clustered "palmately"—like a hand and hence the name—on the tips of culm and branches. Only *Sasa tessellata* among the *Sasas* has larger leaves (up to 24 by 4 inches). According to Young, *palmata* is a "strikingly handsome . . . outstanding ornamental."¹⁰² Leaves wither at the tips and margins in very cold weather, replaced by fresh bright greenery in the spring. Aggressively invasive. Confine it unless you want it everywhere and your neighbors agree. Hardy as far north as Boston on the Atlantic Coast, to the Columbia River or farther on Pacific; does not thrive as well in long southern summers.¹⁰³

Sasa pumila: 2½ feet by ¼ inch.

(*Arundinaria pumila*, *Bambusa pumila*, *Nipponocalamus pumilis*, *Pleioblastus pumilis*). Native to Japan (Honshu, Shikaku, and Kyoshu districts), an extremely hardy and hyperinvasive dwarf species, useful in erosion control. The only smaller bamboo is *Sasa pygmaea* (10 inches by ⅙ inch). The slender, dull purple culms—dull green when new—are distinguished by a thick white bloom beneath the uninflated nodes, 6 inches apart, where single, sometimes paired, branches bear five to seven leaves up to 7 inches long by ¼–¾ inch wide. The dark green leaves are sharply tapered, hairy on both surfaces, bristled at the edges, clearly tessellated, a dull matt green on their lower surface. The moderately persistent culm sheaths, purple fresh, straw colored dry, are covered by a ring of hairs at the base in those at upper culm nodes. This last feature serves to distinguish this species from *A. vagans* with which it is often confused. *Pumila* means "little." The species was named by Freeman-Mitford when introduced into England in the late nineteenth century.¹⁰⁴

Sasa pygmaea: 6–18 inches by ⅙ inch.

(*Arundinaria pygmaea*, *Bambusa pygmaea*, *Pleioblastus pubescens*, *Pleioblastus pygmaeus*, *Sasa variegata*, var. *pygmaea*).

The world's tiniest bamboo, native to Japan where it carpets the forest floors of Honshu, Kyushu, and Shikaku provinces, this speedy midget among dwarves moves horizontally with a rapidity that equals the vertical vitality of other bamboo species. The solid bright green diminutive canes are flattened and purple towards their tips. Inflated, bristled nodes bear persistent sheaths that are dull green when fresh and weather to a "dull muddy straw."¹⁰⁵ Branches are solitary, sometimes paired, bear three to seven leaves 5 inches long by ¾ inch wide, bristly at edges and covered with hairs on both sides that are finer below than above.

Dixie, or Dixieland:

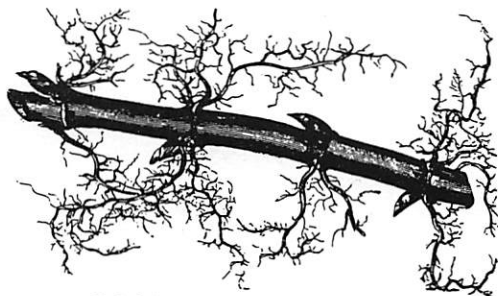
the southern states; probably from *dix*, dixie, a \$10 note, widely current in Louisiana before the Civil War, with a large French *dix* (ten) in the center of the reverse. (Webster's New Collegiate Dictionary.)

stifling it, foster a love of leaves early in our homes, gardens, schools, and rituals. Then, perhaps, bamboo will be the cheerful friend of our forests, instead of the replacement that McIlhenny imagined. Broad cultivation and use of bamboo's versatile fiber can help us lean more lightly on the woods and thus encourage trees to come back to live with us again.

BASIC GARDEN GUIDELINES**Propagation.**

Hardy *monopodial* bamboo is generally propagated from young rhizomes with or without an attached culm. The rhizome should be yellowish, 15–40 inches long, with at least ten good buds. Cut with a saw to avoid shock, and plant 1 foot deep. The attached culm should be young, of the same or preceding year. It is trimmed to about 5 feet, the lower branches left—or culm can be cut off to within 1 foot of ground level. A rhizome alone, some 20 inches long with ten to fifteen nodes and plenty of roots, can also be used. The soil should be washed off and the rhizome wrapped in damp moss or burlap and plastic if it is to be sent any distance. By this method, up to one hundred suitable rhizomes may weigh as little as 3 pounds so it is shipment efficient. Rhizomes without culms are preferably planted 8 inches deep in a nursery and transplanted the following spring when new shoots appear.

For *sympodial* species, a healthy culm is selected with its rhizome and similarly planted at the



A *monopodial* rhizome (*Phyllostachys viridi-glaucescens*) prepared to plant.



The rhizome has produced a leafy shoot, but has not yet rooted.



Propagation of *P. viridi-glaucescens* with rhizome and attached culm.

beginning of the rainy season in early spring. Divisions of clumping bamboos are obtained by cutting culms just above the second or third node. As many as three culm stumps may be included in a single division, which may weigh up to 30 pounds, or more, depending on the species. In an eight-hour day, a laborer may perhaps prepare only three such divisions, whose weight and bulk greatly increase transportation costs. The growth of the parent clump is also retarded by the division, and the amount of propagating material per clump is quite limited.

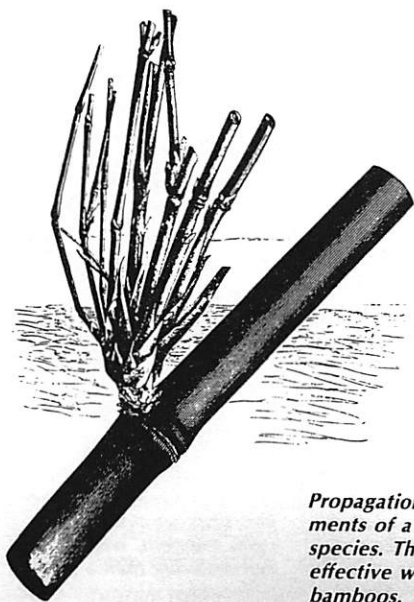
Whole-culm plantings are also practiced with tropical bamboos as is propagation by culm segments: a length of two-to-three-year-old culm, 20–40 inches long without branches, horizontally planted 1 foot deep will also root easily in many sympodial species. This method, however, is rarely productive with monopodial bamboo.

Transplanting by whatever method should be done as quickly as possible to prevent the culm and rhizome from drying out, and newly planted bamboo should be watered at least weekly.

Unlike many woody plants, especially deciduous species in a dormant state, uprooted bamboo plants or cuttings dry up easily if exposed for any length of time to sun or wind. Disregard of this fact is probably responsible for more failures or partial failures in bamboo plantings than all other causes combined.¹

SOIL AND SITE. Bamboo likes moderate water in a soil that is fertile, well drained, and mixed with gravel. It grows well on slopes where rhizomes and dense leaf fall both help retard erosion. Strong sun should be avoided, except for black bamboo which darkens well in direct sunlight. Sites facing west into a harsh afternoon heat are not ideal. In warm or mild climates, locations facing north are preferred; in colder regions, the south.

CUTTING. For the first three years of a new grove, all shoots should be allowed to grow. Thereafter, young bamboo should not be cut, but five-to-six-year-old culms should be removed each autumn to



Propagation by culm segments of a Gigantochloa species. This method is ineffective with temperate bamboos.



Gigantochloa species two years after propagation. Culm segments propagate most readily in species with branches swollen at the base. These repeat the

anatomy of the bulbous sympodial rhizome at the base of the culm, and assume its functions when planted.

reduce insect damage and make room for new sprouts. Cutting thin culms at two years and leaving larger culms uncut favors the rhizomes producing sturdier culms and tends to increase the average culm diameter in the grove. Thinning is important. Greater density can mean fewer new culms each year and less harvest weight. One grove, reduced from 1,200 to 900 and then 750 culms, steadily increased the number of new culms produced annually from 165 to 179 to 218. The harvest weight rose from 1,650 to 1,920, to 2,180 pounds.

OVERTHINNING. Overthinning can result in excessive sunlight, which yellows the culms and dries the ground. Enough culms should be left to provide good shade for the grove itself even in broad daylight. Harvest three-year culms, which implies keeping track of their age: a thin wire can be loosely placed each fall around the base of new culms. A code of twists in the wire serves to indicate the year of growth.

"Too much beauty can get out of hand."

Listen, bamboo, chief mischief of my yard, thou shalt not chew the concrete of my neighbor's drive. Feel these sheets of corrugated metal, two dozen inches deep? There ends your bed, my lovely. So by all means stay green, tall, and beautiful, but *stay put*.

The average American homeowner wants to construct a brief Eden in his yard for green relief from commuting to the job. He doesn't want to come home from battling his boss to battle his bamboo. Ruth McClure, brisk widow of F. A. McClure, is insistent in her warnings: "I'm afraid I'm not much use to you. I just keep warning people that bamboo's sneaky. My husband knew a man who *died* trying to get it out of his yard. Sure, it's beautiful, but too much beauty can get out of hand. So my husband always warned anyone he gave bamboo to: *it has to be contained if you don't want it everywhere.*"

McClure issued his warning in print as well: "*Sinobambusa tootsik*, a Chinese bamboo once highly prized as a garden ornamental in Honolulu, has come to be regarded as a dangerous weed there because it escaped from cultivation and now dominates many acres of once pure native vegetation."²

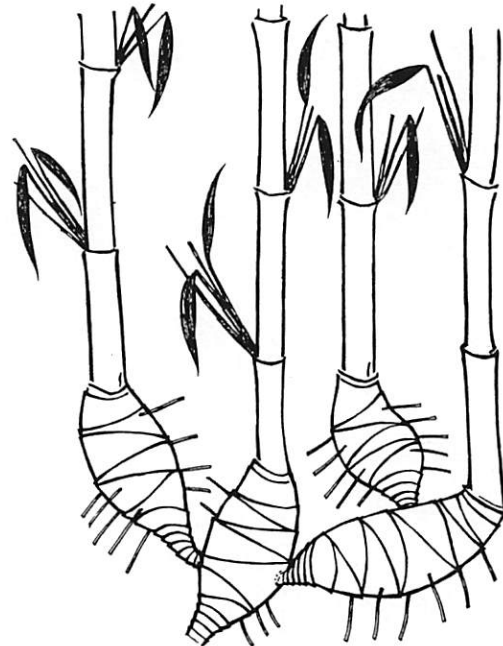
FERTILIZING. Compost or, less recommended, commercial fertilizer, increases grove vitality enormously. The number of culms and harvest weight can be doubled, with culms both taller and greater in diameter. Ten parts nitrogen, six parts silicate, five parts each of potassium and phosphate are applied about a month before spring shoots appear and again before the onset of rhizome growth, which immediately follows completion of culms. For 1 acre, apply 80 pounds of nitrogen to 48 of silicate, 40 of potassium and 40 of phosphate. Bamboo leaves, roughly equivalent in weight to the annual harvest in some species, are left in the grove. A dense leaf fall of up to 4 inches annually provides fertilizer and excellent mulch. They are 6 percent silicate, and their decomposition increases the availability of this toughening component of bamboo. Theoretically, older groves should produce harder culm wood. (Fertilizing bamboo is not recommended where durability, not quantity, is sought: see below, Soil and site, pp. 215–216.)

CONTROL. If bamboo is to be confined to a limited area, rhizome growth in some monopodial species must be controlled. Galvanized metal sheets or 1–2 inch concrete slabs are sunk 20–24 inches deep, with about 2 inches above ground. Concrete made with peat moss replacing some or all of the sand

provides a barrier porous enough to allow groundwater to pass. Pebbled paths around the grove will harden the soil, reduce the shoots, and also reduce rhizome development. Sprouts that emerge where unwanted should be eaten or kicked over while still young and brittle. Make sure you *need* to control your specific species before you go to the trouble and expense of confining it. See p. 215 for more on the bamboo invasion. Also, "Eat your lawn," p. 278, for direct action.³ Basically, bamboo becomes a problem only if you choose the wrong species, and don't *use* it. If you can't use your harvest, call the crafts teacher at your local school and offer a copy of this book and free harvest in exchange for taking your bamboo abundance off your hands.

TRANSPORT**Selecting and shipping bamboo starts.**

Go to the grove prepared with digging and pruning tools and enough waterproof material to wrap plants and keep them moist at all times. Find an area in the grove where small, strong, disease-free plants seem most plentiful. Make exploratory digs to get a clear picture of underground organization of rhizomes. At the young edge of a clump, choose three to four adjacent culms. One or more of them should be at least one year old with branches or visible buds at nodes below a height of 18 inches.



A group of sympodial rhizomes prepared for shipping and planting. Two or more connected rhizomes, two or more nodes of a culm segment, will survive more readily than a single propagule.

Cultivation Table

SPECIES	POOR SOIL AND CLIMATE		GOOD SOIL AND CLIMATE	
	FEET APART	PLANTS PER ACRE	FEET APART	PLANTS PER ACRE
<i>Bambusa longispiculata</i>	15	223	25	80
<i>B. textilis</i>	12	348	20	125
<i>B. tulda</i>	18	158	25	80
<i>B. tuldooides</i>	15	223	25	80
<i>Sinocalamus oldhami</i>	18	158	25	80

cause they haven't enough room, but for commercial production of bamboo it is an applicable rule. Plant 8-10 feet apart, 550 rhizomes per acre, roughly—depending, as with tropical bamboos, on local climate and soil as well as rhizome vigor of the species in question.

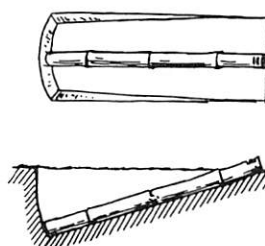
Propagation notes.

For reasons of economy, culms are usually taken up singly, but a unit composed of a new culm and its "parent" gives much surer and quicker results. The earth is dug away from the rhizome, and the culm or the unit is severed from its parent by a transverse cut through the narrow "neck" at the base of the rhizome. Too great stress cannot be placed upon the importance of care in digging and in making the cut. One careless stroke of the hoe or knife can ruin a bud, and this damage to the tissues can cause the loss of the plant or serious impairment of its growth through the introduction of fungi.

Bamboo species that normally lack branches, and even branch buds at the lower nodes, present a special problem. Make sure that the culm is severed at a point high enough to ensure the presence of at least one, preferably several, strong branch buds or better still, a complement of fully developed branches. Foliage, when present, should be

Whole-Culm Planting

SPECIES	NUMBER OF PLANTS PER 10 FEET OF CULM	AGE OF PROPAGATING MATERIAL IN YEARS
<i>Gigantochloa apus</i>	9.5	3
<i>Guadua angustifolia</i>	9.1	2
<i>Sinocalamus oldhami</i>	8.2	3
<i>Bambusa ventricosa</i>	7.4	2
<i>Bambusa tulda</i>	6.8	3
<i>Cephalostachyum pergracile</i>	4.1	2



Age aids vitality: Meter-long basal cuts of B. vulgaris, var. vittata were used in an experiment to determine the effect of culm tissue age on the yield of rooted plants. Six age groups were tested, with a code indicating each group on the visible tip of culm segment above ground, as shown. Vitality increased steadily with age to five years, the oldest cuttings tried.

AGE GROUP (MO.)	NO. OF CUTTINGS	PRODUCED ROOTED SHOOTS (PERCENT)	PRODUCED UNROOTED SHOOTS (PERCENT)	DIED (PERCENT)
< 2	110	20	22	58
ca. 6	256	19	18	63
12-18	283	26	19	55
24-30	228	30	19	51
36-40	98	51	29	20
48-60	44	50	34	16

reduced drastically, but a few leaves or parts of leaves should be kept on unless plants are likely to dry out. The aim of Chinese experts seems to be to keep the water in the plant moving upward, if possible, by keeping some foliage functioning continuously. It is claimed that chances of success are greatly enhanced if this condition is maintained.²⁰

Whole-culm planting.

Although unproductive with monopodial species, experiments have shown that whole-culm planting works well in tropical bamboos. Species, position on culm, and age of material are three important variables.

Ten species were tested, with material one, two, and three years old. Material two and three years old was superior consistently to one-year-old

highest priorities facing the world community of friends of bamboo.

HARVEST METHODS

Dating culms.

Bamboo should be three years old before harvesting. This requires a convenient system of marking the shooting year. One way is to rub the thin waxy film from a small area of a new culm with a piece of coarse cloth and paint on the year with India ink. Oil paint on a 1/2-inch brush also works. These methods last three to four years under ordinary conditions. Years can be color coded as well. A quick method used successfully at Savannah USDA groves is to stamp new culms with a small hammer and steel die which gives a permanent mark that needn't be so deep as to injure the culm. Mark all culms at same level for ease later in finding the year.

Clear versus selective cutting.

"Clear cutting at determined intervals and selective cutting are two general methods to manage groves. At first thought, cutting selectively, at a rate determined by ecological conditions, removing only mature culms three years old, would be the most natural procedure for maintaining a grove in a condition of sustained yield. The functioning of the grove as an organism is minimally disturbed, and removal of mature culms that would die eventually in any case would provide a natural stimulus to regeneration, similar to that produced by the moderate pruning of any plant.

"But economics might limit this biologically sound preference for selective cutting, which is several times more costly than clear cutting. Comparative, long-term yields, per unit of area and unit of time under the two harvesting systems must be determined by actual trial.

"A combination of the two methods may be best: immature culms, a small percent of the total stand, would be allowed to stand, providing a sustained source of nutrition to the network of rhizomes from which new growth would be produced."²⁶

Harvest rules from Dehra Dun.

1. Cut no culms younger than three years or in the rainy season or from a flowering grove.
2. No cuts lower than second node or higher than 30 cm above ground.
3. Remove branches, culm tips, and all harvest trash: Debris obstructs growth,

encourages disease, and makes later harvests more difficult.

4. Leave leaves for mulch. Their 6 percent silica helps harden later culms.
5. A minimum of six mature culms are left uncut in each clump of tropical species, to sustain grove vitality and insure steady yield.

Horseshoe harvest.

Clumping, sympodial bamboo's growth form presents a harvesting problem. Centrifugal growth of new culms around the grove edge leaves oldest stems most fit for harvest surrounded by immature culms whose silica content, and consequent hardness, is still increasing. The solution is a horseshoe harvest. Cut into the grove from the direction that sacrifices the fewest younger culms. Store these

A horseshoe harvest is imposed by dense tropical clumps in order to cut a minimum of young culms on the periphery and reach the seasoned canes at the core. Dark circles indicate harvested culms.



separately for basketry or other use. Harvest third-year mature culms from within the grove, gradually extending the harvest year by year to ripening younger culms. Some feel it's better to cut smaller species with a saw to avoid leaving dangerous points to wound later harvesters.²⁷

Battle beetles better with clump-cured culms.

Harvest bamboo at the beginning of the dry season. Leave culms standing four to eight weeks in the groves, propped on stakes or rocks, with branches and leaves uncut to increase evaporation surface and diminish insect entry points offered by freshly cut skin. This clump cure not only reduces starch content, which the bamboo beetles seek, it also greatly decreases the tendency to crack while producing a pleasing uniform color on the culms. *Bambusa vulgaris* cured this way was 91.6 percent less attacked by beetles than untreated culms in USDA Puerto Rico experiments at Mayaguez.²⁸

Removing branches.

Although bamboos harvested for construction obviously require less care than culms cut to make flutes

A stake in the basal internode keeps the culm off the ground during a clump cure.



or furniture, scratching a culm diminishes beauty and value. One way to avoid scratching the culm when removing branches is to cut a third of the branch thickness from underneath with a hacksaw. (A molybdenum blade is best with eighteen to twenty-four teeth per inch.) Then snap down on branch. If cutting with a machete, always cut up-culm, that is, towards tip. Swinging down-culm tends to scalp the internode below the branch removed.

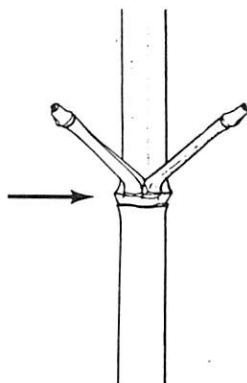
Making the crooked straight.

Practicing any of the following cures for the bamboo bends will quickly communicate the commercial importance of ramrod erect species like *A. amabilis* or *B. textilis*, which don't require the touch of human correction to find the shortest distance from toe to tip.

Low tech, long term: hang a curved pole, when freshly cut, by the tip in the shade, tying a stone or other weight to the base. Two to four months will straighten it, depending on the curve, the species, the weather, and the weight used.

Drive a line of nails at 16-inch intervals along

*To remove branches, cut at arrow and snap down. Leave branch stubs or entire branches to support tomato, bean, and other garden crops without tying. (A *Phyllostachys elegans* midculm node is shown.)*



a board or floor. Bind crooked culm to them where necessary, weight where it curves up from floor surface. Presoaked dry poles also respond to this treatment.

Heat is the most common, fast, and effective treatment to straighten crooked culms: with wood or charcoal fire, with blowtorch, Bunsen burner, or gas stove. Steam heat, where available, is best. But all these alternatives, enacted on a large scale, are energy dear; so long-term bamboo development implies growing erect species, not burning up the local forest to straighten the local groves. Ridiculous waste levels, unadvisable for the individual, impossible for a planet norm, can no longer be so casually included in our cultural designs. But straightening a few culms over campfire is neither costly nor difficult. You can adapt the following method of professionals in India to your particular hearth and need.

Market preparations in India.

Few forest operations in India are more interesting to watch than the preparations of raw bamboos for the market and the conversion of the rough, crooked, dirty-looking stem as it comes from the forest into the highly polished, rich brown lance stave or tent pole. Extremely primitive methods effect this remarkable change, as efficient as more up-to-date appliances. First, stems are cut to length and nodes are cleaned by a gang of small boys with sharp adzes. A broken skin means a ruined stem, so knot cleaning requires a certain skill. After an apprenticeship on cheaper grade bamboos, the boys become remarkably good, rarely making a bad shot . . . the *kammagars* then warm each stem over a hot fire of two large logs. This supple the culm, imparts the fine brown color, and by melting the dirty waxy covering gives the stem a clean and polished appearance. Once the stem is sufficiently pliable, curve and kinks are taken out by handing with some force in an opposite direction. Two tools are used: for heavy stems, an upright pole, bored with slanting holes, is planted in the ground. The *kammagars* put the warm bamboo in a hole and press with considerable force to bend it in the right direction. For lance staves and other delicate work, the *kammaggar* holds a stout stick with a groove in it in his right hand, in his left the stem to be straightened, which he works carefully along its entire length. Several firings may be required for perfect straightness. Considerable skill is necessary to warm without scorching the bamboo, then bend without breaking the fibers.²⁹

Straightening *Arundinaria amabilis* in China.

"Each worker has a thick-walled earthenware fire-pot, without a chimney, in which a kind of smoke-