

*P. longifolia*. The wood is much used for torches; *jagni*, Pushtu; *marshāl*, Hindi. Chips and small pieces of the wood form an article of trade in the treeless inner Himalaya, under the name of *Lāshi, chānshing*. The cones are useful for lighting fires. The bark is used to roof huts in the forest, and trees are often seen denuded of their bark to a considerable height. The leaves and twigs are much-used for litter; and the leaves of this species, as well as of *P. longifolia*, are mixed with mortar and plaster in building. Madden states that in Kamaon, in a fair dry winter, the leaves and branches get covered with a liquid exudation, which hardens into a white kind of manna, sweet, not turpentine, which is eaten. A similar exudation (Mamme de Briançon) is collected in the French Alps on the leaves of the Larch, and used as a purgative.

*P. Strobus*, Linn., called *White Pine* in America, and *Weymouth Pine* in England, is similar to *P. excelsa*, but has shorter leaves and more slender cones. It is a large and most important timber-tree, formerly often found 200-250 ft. high and 18 ft. in girth, which grows luxuriantly in damp forests mixed with leaf-bearing (deciduous) trees, in the Northern United States from the headwaters of the Mississippi eastward, on the Alleghany Mountains, and in Southern Canada. The wood is white or pale-yellowish white, soft and light (30-35 lb.), free from knots, easily worked, is durable, but has little strength. It is the wood used most in North America for building, furniture, and other purposes, and is exported from Canada. The tree grows rapidly while young, is hardy in England (introduced 1705), France, and Germany, it has been cultivated on a considerable scale in some forest tracts of Germany, where the timber production per acre has been found higher than that of other Conifers.

To the same group, with 5 leaves in one sheath, belongs *P. Cembra*, Linn.: Reichenb. Ic. Fl. Germ. t. 530.—*Arve, Zirbelkiefer*, Germ.; *Cirmolo*, It.; *Cémbrot, cuvrier*, Fr.; *Arolla* of the Alps. A middle-sized, slow-growing, and long-lived tree of the Alps and Carpathian Mountains in Central Europe, which forms extensive but irregular forests between 4000 and 7000 ft., often at the upper limit of arboreal vegetation. The leaves are short, stiff, dark-green, and the cones short, ovoid; the seeds are wingless, broad, ovoid, and somewhat 3-sided. They are eaten.

Of the Section *Pinaster*, with 2 leaves in each sheath, no species except the doubtful one mentioned at p. 506 inhabits North-West India. The remarkable tropical Fir of Tenasserim and Siam, which S. Kurz has identified with *P. Merkusii* of Sumatra and Borneo (Flora, 1872, 264) belongs to this section. It is closely allied to *P. sinensis*, Lambert (Benth. Fl. Hongk. 337)—Syn. *P. Massoniana*, Lamb.; of South China, Formosa and Loo Choo islands. Both species have semicylindric leaves, 7-9 in. long, the convex back marked with numerous prominent lines, and persistent sheaths; the cones are ovoid or ovoid-lanceolate, 2-3 in. long, recurved when ripe, the thickened part of the scales rhomboid. They are much alike, and may perhaps eventually be united. In the Tenasserim specimens the end of the scales (apophysis) is pyramidal, 4-7-sided, while in *P. sinensis* it is flat. The Tenasserim Pine grows in forests of *Dipterocarpus tuberculatus* of the Thoungyeen valley, which occupy vast areas of high ground and dry undulating hills, the moister valleys between being covered with Bamboo forest, often containing Teak. The wood is exceedingly resinous, the stems not very tall (50 ft. to first branch) and not very regularly shaped.

*P. Thunbergii*, Parlatore; DC. Prodr. xvi. ii. 388—Syn. *P. Massoniana*, Sieb. et Zuccar.; Fl. Jap. t. 113, 114—is a large tree of Japan, Corea, and North China, hardy in England, with stiff rigid leaves 3-5 in. long.

The following are the more important European species of the section *Pinaster* :—

\* *P. sylvestris*, Linn., Hook. Stud. Fl. 348; Reichenb. Ic. Fl. Germ. t. 521.—*Scotch Fir*. *Kiefer*, *Föhre*, Germ.; *Pin sylvestre*, Fr. A large tree with tall stem, clear of branches to a great height, bark red, foliage greyish, sometimes bluish green, crown pyramidal while the tree is young and growing vigorously upwards, rounded afterwards. Leaves glaucous, 2-4 in. long, remaining on the branches 2-3 years; sheath short. Cones pedunculate, recurved, not shining, ovoid-lanceolate, unequal-sided,  $1\frac{1}{2}$ -2 $\frac{1}{2}$  in. long, ends of scales rhomboid, rugose, with a transverse keel, sometimes pyramidal and beaked. Wings 3 times the length of seeds. Central and North Europe. Also on the mountains of Spain, North Asia, Caucasus, mountains of Asia Minor and of North Persia. A variety with longer cones (3 in.), the lower scales with a thick blunt beak, leaves and twigs fragrant when bruised, is described by Andrew Murray as sub-sp. *Haynensis* (Gardeners' Chronicle, 1869, p. 473). It was raised from seed supposed to have been received from the North-West Himalaya. The tree, however, has not yet been found in India, unless it is *P. Royleana* mentioned before. It seems not impossible that some Scotch Fir cultivated in the Himalaya has been the origin of *P. Haynensis* and *Royleana*. In the northern Alps its upper limit is 5000, and in the southern 6000 ft. In the Maritime Alps inland from Mentone its range is from 1770 to 5100 ft. On the Pyrenees it grows between 3000 and 5000, and on the Sierra Nevada between 5000 and 6500 ft. Fl. May; the cones ripen in the autumn of the second year, but often do not open until the following spring. Eminently gregarious, forms extensive natural and generally pure forests in the Highlands of Scotland, in the plains of North and East Germany, and in the Baltic provinces of Russia. Thrives best on soil which transmits water readily, particularly in sandy soil. Attains under favourable circumstances 150 ft., with clean stems 70-80 ft. long. Such dimensions are not rare in the Scotch Fir forests of Franconia, particularly in the Steigerwald, between Würzburg and Bamberg, where it is grown with an underwood of Beech. Sapwood large, enclosing a distinctly-marked reddish heartwood, durable and strong. Weight 25-46 lb. The seedlings require much light, but forests of Scotch Fir can, under favourable circumstances, be regenerated by natural reproduction. Imported into England from the Baltic and Norway, under the names of *Red Memel*, *Dantzig Fir*, and *Red Deal*.

2. *P. montana*, Mill.; Willkomm Forstl. Flora, 169.—Syn. *P. Mughus*, Scop. *P. Pumilio*, Hænke; *P. uncinata*, Ramond; *P. obliqua*, Saut.; Reichenb. Ic. Fl. Germ. t. 522, 523. *Pin à crochets*, Fr.; *Krummholz*, *Legföhre*, *Latsche*, Germ. A slow-growing moderate-sized tree, with branches down to the base, unless growing in close masses; crown pyramidal, not rounded or tubular when old, the lower part of the stems mostly bent down and prostrate along the ground; bark dark-coloured, greyish-brown, never red, foliage dark green. Leaves green, rigid, 2 in. long, remaining 3-5 years on the branches, the sheaths a little longer than those of *P. sylvestris*. Cones sessile, erect or spreading, not recurved, shining, ovoid or ovoid-lanceolate, unequal-sided,  $1\frac{1}{2}$ -2 $\frac{1}{2}$  in. long; ends of scales rhomboid, often with a recurved beak, always with a black ring round the centre. Wings 3-4 times the length of seed. Alps and mountains of Central Europe, from the Pyrenees to Bukowina, also on the mountains of Spain and Calabria. Forms a large extent of dense but low forests on the plateaus of the Schwarzwald above 2000 ft., the stems creeping and interlacing in a remarkable manner, but always sending up erect leaders. Much of this land, wet and swampy formerly, has now been drained and planted with spruce. An important forest-tree on the Bavarian Alps between 2000 and

5000 ft. The wood is much heavier than that of the Scotch Fir, very durable, mainly used as fuel and for charcoal; but the chief value of the tree in the Alps consists in its thriving on poor soil and in exposed situations, and serving to clothe steep stony, dry and wet slopes, preventing their denudation, and affording protection against slips and avalanches. Young plants bear more shade than *P. sylvestris*.

3. *P. Laricio*, Poiret; Willkomm Forstl. Flora, 184; Reichenb. Ic. Fl. Germ. t. 524.—Syn. *P. austriaca*, Endl.; *Schwarzkiefer*, Germ. A large tree, with tall straight cylindrical stem, clear of branches to a great height, foliage dark green, branchlets turned up at the ends. Leaves green, 2-5 in. long, persistent, 3-4 years on the branches, with a sharp whitish point. Cones sessile, 2-3 in. long, spreading, ovoid-lanceolate, shining, yellowish red when ripe. Seeds large, wing 3-4 times the length of seeds. Mountains of South Europe and Asia Minor, forming extensive forests in Spain, in Corsica at 3000-5000 ft., and lower Austria (Wiener Wald). Fl. May; the cones of this, as of the other allied species, ripen in autumn of the second, and shed their seed in spring of the third year. Attains 150 ft. in Corsica. Wood very resinous, sap large, heartwood red, very durable, heavier than Larch, up to 56 lb. (Mathieu). Mathieu, Fl. Forest, 398, records an instructive series of measurements of the number of rings of sap- and heartwood of the wood from Corsica. A tree 90 years old, with a radius of 235 mm., had 73 rings of sapwood, in the aggregate 185 mm. broad; and a tree of 375 years, with a radius of 380 mm., had 190 rings of sap, measuring 80 mm. and 185 rings of heartwood. The Austrian Pine is tapped for resin in Austria, and of late years the splendid forests of *P. Laricio* in Corsica have been worked on a large scale for resin, the mode of procedure being the same as in the forests of *P. Pinaster* in France. In its youth the tree has a rapid growth, and long powerful leading shoots. In England the Corsican and Austrian Pine are considered distinct varieties.

4. *P. Pinaster*, Solander; Reichenb. Ic. Fl. Germ. t. 525.—Syn. *P. maritima*, Lamarek; *Cluster Pine*—*Pin maritime*, Fr. A large tree, with a tall but not very straight stem attaining great girth, branches high up, forming a rounded crown; bark very thick, cut by deep fissures, foliage dense, dark green. Leaves thick, rigid, 1 line broad, 5-8 in. long, remaining 3 years on the branches. Cones purple when quite young, clustered at the end of the current year's shoots, when ripe sessile, spreading or reflexed, in whorls and dense clusters of 5-10 or more, ovoid-cylindric, nut-brown, shining, 4-5 in. long, and 2-3 in. diam. at base, ends of scales sharply and transversely keeled, with a dark-grey conical, sharp tip. Mediterranean region, Algeria, Portugal, Spain, South and West France, Corsica, where it forms, with *Quercus Ilex*, a zone intermediate between the evergreen *Maki* of the coast and the forests of *P. Laricio*. Italy, Dalmatia. Fl. April, May; the cones ripen in autumn of the second year. Prefers a light sandy soil, and thrives luxuriantly on the white shifting sands of the Dunes along the coast of Gascogne, which, by means of sowings steadily continued ever since 1789, have now been converted almost entirely into forests of this tree. It also forms extensive nearly pure forests, to a great extent planted, on the heaths of the "Landes."

The wood has numerous large resinous ducts, and the tapping of the tree is carried on in a methodical manner in Gascogne, which should be imitated in India if it be resolved to work any of the Himalayan Pines systematically for resin. When the tree has attained a girth of 3-4 ft., a flat cut is made near the ground through the bark into the wood, a few inches high, and about 5 inches wide; the resin which exudes is collected in small earthen pots, fixed at the base of the cut, into which it runs over a flat piece of zinc. From time to time, once or twice a-week during the season (1st March-15th Oct.), the cuts are extended upwards.

and this is continued until the flat scar or cut (*carre*) is 10-12 ft. high. This is generally accomplished at the end of 5 years, and then the old scar is abandoned, and a fresh scar is opened at the opposite side of the tree, and when this has been completed, a third and at last a fourth scar are opened. In this manner a tree can be worked for resin during a considerable period, the old scars healing over by the formation of fresh bark, while fresh scars are opened, often on the place of an old scar. This procedure, when only one scar at a time is worked, is called "*gemmage à vie*." But when a tree is to be cut, then numerous scars are opened and worked simultaneously, and this is styled "*gemmage à mort*." In the same manner, when young trees are to be thinned out, they are tapped at a much earlier age, and as much resin got out of them as possible. As the scars advance in height the pots are raised also, and in order to get up to them the workmen carry a short pole with notches, which serves as a ladder. Fire in summer is the great risk in forests worked for resin, and in order to prevent its spread, broad fire-paths are cleared throughout the forests. *P. Pinaster* has been cultivated on a considerable scale in the sand-dunes near Boulogne; it was introduced into England as early as 1596, and there are splendid specimens in Windsor Park (Belvidere), Fulham, and elsewhere. An attempt has also been made to plant it on the sands of the Madras coast, but a tropical climate is not apparently adapted to the requirements of this tree. The tree grows with great rapidity while young, and in South-West France often forms two whorls of branches in one season. It has powerful descending and spreading roots, and is thus peculiarly adapted for fixing loose movable sands.

5. *P. halepensis*, Mill.; Christ in Flora, 1863, p. 370; Lambert, Pinus, ed. 1832, t. 7; Reichenb. Ic. Fl. Germ. t. 526.—Syn. (the Greek tree) *P. maritima*, Lamb. l. c. t. 6; Sibthorp Fl. Græca, t. 949. *Pin d'Alep*, Fr. A moderate-sized tree, sometimes shrubby, with light foliage, of a light-green or bluish-green colour, and a rounded crown. Bark on branches and young stems smooth, shining, silver grey, on older stems dark coloured, furrowed. Leaves slender, 2-4 in. long, grey or bluish green, remaining two, often only little more than one year on the branches, hence the thin foliage; sheaths  $\frac{1}{2}$  in. long, whitish, membranous. Cones on peduncles  $\frac{1}{2}$  in. long, recurved, solitary or 2-3 together, lanceolate, 2-4 in. long, reddish brown, and mostly shining when mature, the ends of scales rhomboid, flat or convex, with or without a distinct transverse keel. Mediterranean region, from Portugal and North Africa to Syria and Arabia. Taurus in Asia Minor, where it forms extensive pure forests. Ascends in Spain to 3000, and on the Taurus to 3500 ft. Fl. April, May; the cones require two years to ripen, and do not shed their seeds until July and Aug. of the third year. Hardy in the south of England. Might be tried in the plains of the Panjab. In Prevence, where this pine is common in the vicinity of the sea, it is tapped for resin, but is less productive than *P. Pinaster*. In Greece the tree (*πεύκος*, modern Greek) is abundant, forming extensive but irregular and open forests on the stony and rocky hills of Attica, Megara, around the Gulf of Lepanto, on the islands of the Archipelago, and in the Morea, ascending to 3000 ft. on Hymettus and Pentelicus. The wood is used for building, and the tree is largely tapped for resin; pieces of the resinous wood are used as torches, and the bark is employed for tanning. Link, after having seen the Greek tree in Attica, in 1838, maintained it under the name of *P. maritima*, Lamb., as distinct from *P. halepensis*, distinguishing it mainly by the (light) green colour of the foliage, which is generally more grey or glaucous in the tree of Italy and France (Linnæa, xv. (1841) 495). He added, however, that these 2 species were difficult to distinguish. Christ (Flora, 1863, 371) shows that the forms from Greece, Italy, and France vary exceedingly in the end of the scales (apophysis), and equally so in the other characters, and that no fixed distinction



can be maintained between the two species. Grisebach, however, retains *P. maritima*, Lamb., as a distinct species, peculiar to the evergreen region of the eastern Mediterranean, distinguishing *P. halepensis* by shorter leaves and the ends of the scales transversely keeled (Flora, 1861, 597, and Vegetation d. Erde, i. 315).

*P. pyrenaica*, Lapeyr.; DC. Prodr. xvi. 384.—Syn. *P. Brutia*, Tenore Fl. Neap. t. 200, is a large tree, forming extensive forests in the mountains of Central Spain, and on the south face of the Pyrenees (2000-3000 ft.), also found in Calabria (2400-3600 ft.), Crete, Cyprus, the Taurus of Cilicia, and in Syria and Bithynia, with subsessile spreading cones 2-3 in. long, conical, with a flat base, and in dense clusters of 3-15 or more, ends of scales almost flat; leaves 4-8 in. long, dark green, narrow, lax, not rigid.

6. *P. Pinea*, Linn.; Reichenb. Ic. Fl. Germ. t. 428, 429. *The Stone Pine*. Pignon, Fr.; Pigno, It.; *Pinie*, Germ. A large tree with a tall not very straight stem, clear of branches to a great height, and bearing a flat umbrella-shaped crown. Leaves 3-6 in. long, rigid, with a sharp point, remaining 3 years on the branches, narrower than those of *P. Pinaster*. Cones large, ovoid or subglobose, 4-6 in. long, smooth, shining, the ends of scales convex-pyramidal with 4-6 rounded faces, seeds  $\frac{3}{4}$  in. long, without wings, edible, forming an important article of trade. Throughout the Mediterranean region, chiefly in the vicinity of the coast, and often in forests of large extent. The celebrated Stone Pine forest "*Pineta*," near Ravenna, stretches for a distance of 20 miles along the coast of the Adriatic. Stone Pine forests are in Tuscany, Portugal, Andalusia, on Mount Athos in Macedonia, and in Asia Minor. The original home of the Stone Pine is probably the eastern Mediterranean region. The tree is hardy in the south of England, and its cultivation might be tried in the sub-Himalayan tract of the Panjab. Fl. April, May; the cones take 3 years to ripen.

## 2. CEDRUS, Link.

Evergreen monoicous trees. Leaves needle-shaped, single on elongated shoots and on the first shoots of seedlings, otherwise in dense fascicles on short arrested branchlets. Catkins single, cylindric at the ends of the leaf-bearing branchlets. Anther-cells 2, dehiscing longitudinally, adnate to the under side of imbricate scales, which are prolonged into flat ovate-oblong, obtuse, denticulate crests. Ovules inverted, in pairs at the base of the carpellary scales, these in the axils of small bracts, which disappear before the fruit ripens. Cones ripening the second year, lateral, erect, formed of broad obtuse carpellary scales, with a thin edge and a thickened woody base. Seeds oily, with a hard woody testa, and broad membranous wings.

1. *C. Deodara*, Loudon; Cleghorn l. c. t. 1.—Syn. *Pinus Deodara*, Roxb. Fl. Ind. iii. 651. *Deodar*, *Himalayan Cedar*. Sans. *Devadāru* (the divine tree). Vern. *Nakhtar*, *Imanza*, Afg.; *Diār*, *deedar*, *deodār*, *dedwar*, *dadār*, Hazara, Kashmir, Garhwal, and Kamaon; *Palūdar*, Hazara; *Kelu*, *keoli*, *kilar*, *kilei*, Chenab to Jumna; *Kelmang*, Kunawar; *Giam*, Tibet.

A large tree with dark-coloured bark, the extremities of branchlets drooping while young. Foliage (in North-West India) dark green, lighter

sometimes bluish green in young trees. Leaves 1-1½ in. long, rigid, sharp, triquetrous, the leaves of 3-5 years on the branches. Cones erect, 4-5 in. long and 3-4 in. diam., ovoid or ovoid-cylindrical, obtuse, scales closely imbricate, broadly cuneate, 2-2½ in. broad and 1-1½ in. long, the upper edge rounded. Seeds ½ in. long, wings large, triangular, with rounded sides.

The Deodar, so far as known at present, has a limited range of distribution. It is indigenous on the mountains of Afghanistan and North Beluchistan, and in the North-West Himalaya, where its eastern limit is below the Niti Pass on the Dauli river, one of the main feeders of the Alaknanda. No indigenous forests of it are known east of 80° or west of 66° long. On the Safedkoh it grows between 6000 and 10,000 ft., and in the Himalaya generally between 4000 and 10,000 ft., but descends in places to 3500 and ascends to 12,000 ft. The tree is commonly planted in Kamaon near villages and in temple-groves, and here and there in Nepal. It is gregarious and forms extensive forests in the basin of the main tributaries of the Indus, on the Tonse, Jumna, and Bhagirati rivers, and on two feeders of the Alaknanda. In these forests the Deodar alone covers large areas, or is associated with *Pinus excelsa* and *Abies Smithiana*, less commonly with *Abies Webbiana*, and the three Oaks, *Quercus incana*, *dilatata*, and *semecarpifolia*, the *Cypress*, *Birch*, *Taxus*, and in Kunawar and Pangri *Pinus Gerardiana*, are also companions of the Deodar. It extends to the limits of the arid zone, but does not enter it as *Pinus excelsa*. On the Chenab it ceases at Galing above Triloknath, and in the Sutlej valley the upper limit is the Hangarang Pass on the right and Dabbling on the left side, and on the Baspa it ceases below Rakcham. In these valleys and on the Indus *P. excelsa* grows much higher up. It is wanting in Lahoul. The Deodar was introduced into England in 1822, and is hardy in England and Scotland, also in South Europe, France, and South-West Germany. On the Rhine at Coblenz, Bonn, and Cologne it suffers from late spring frosts. On the other hand, at Tharant in Saxony, where the winter is more severe, the Deodar seems to do well. In the Himalaya it is found on gneiss, granite, and silicious shales, and is not wanting on limestone (Jaunsar, Chenab).

The male catkins appear in September, and shed their yellow pollen in October, which is blown about in abundant profusion. In the ensuing spring the young cones are about 1 in. long; in October, twelve months after flowering they have attained half size, and ripen in October or November of the second year, thus requiring 24-26 months to come to maturity. The scales and seeds fall, and in November and December the persistent scaleless axis of the cones is often seen on the same tree with the half-formed cones of the preceding year and the female catkins recently fertilised. The Deodar seeds freely and regularly, but every third or fourth year the cones are apt to fail. In April a flush of young leaves comes out at the ends of the tuft-like branchlets, of a light, often bluish-green colour, forming a striking contrast with the older darker green foliage of the previous years. Owing to the close proximity of the leaves of successive years on the stunted branchlets, it is not easy to say how many years they persist, 3-5 years seems to be the average. The foliage of young Deodars grown in Europe is generally bluish green; in the Himalaya this colour is seen occasionally, but as a rule the foliage, save the youngest shoots of spring, is green and rather dark. Young Deodar requires shelter and bears a good deal of shade; the terminal shoots, like the extremities of the branches, are soft and drooping, nevertheless, they pierce with great vigour through thickets of other trees, and it is not a rare occurrence to see the proportion of Deodar in an Oak forest increase by self-sown seedlings, which come up under the shelter of the Oak and make their way through its foliage. In compact forests the tree

clears itself early of its side branches, and forms tall clean straight cylindrical stems, which carry their girth well up to a great height. The tallest Deodar which I have measured was in the Nachar forest on the Sutlej (Oct. 1864), 250 ft. high, 20 ft. in girth at the base, and more than 550 years old, and there was a considerable number of trees in the same forest above 200 ft. high. This, however, was an exceptional case; the forest had grown up close together on terraces of fields deserted centuries ago, and the trees had found ample nourishment in the deep and loose soil of these terraces, the old walls of which were still standing (Bussahir Forest Report, 1865, 3).

In this place, as under similar circumstances elsewhere, the Deodar carries its girth well up, as illustrated by the following measurements of the girth of five trees in Nachar, at the base of the stem, at 40 and at 80 ft. :—

	AT BASE.		AT 40 FEET.		AT 80 FEET.		
	ft.	in.	ft.	in.	ft.	in.	
1.	9	10	7	6	6	6	5' 11" at 94 ft.
2.	9	7	7	11	4	6	
3.	10	9	8	7	7	6	
4.	15	10	11	2	10	2	8' 7" at 122 ft.
5.	14	7	12	7	11	0	7' 1" at 150 ft.

Taking the girth at base at 100 in. and the sectional area at 100 sq. in., the girth and sectional area (square of quarter girth) would on an average be as follows, at heights of 40 and 80 ft. :—

Average girth,	100 in.	78 in.	65 in.
Av. sec. area calculated by sq. of qr. girth.	100 sq. in.	60 sq. in.	42 sq. in.

When isolated, the tree has in its youth a pyramidal crown with branches close to the ground. At a certain age, which varies according to locality and circumstances, the Deodar loses its leading shoot, the uppermost branches spread out and form a flat tabular top. Trees which grow isolated on the crest of ridges or otherwise in exposed positions, have these flat tabular tops in a very marked manner. Isolated trees attain large girths, the largest on record, in Kunawar, are 30-36 ft.; and Dr Stewart measured one at Kūarsi in the Ravi basin, at 7500 ft. elevation, 44 ft. 2 in. at 2, and 36 ft. 4 in. at 6 ft. from the ground. A tree measured in October 1864 above the village of Purbani in Kunawar, was 34 ft. 4 in. in girth, and judging by the annual rings of trees felled in that neighbourhood, probably about 900 years old.

The bark is 1-1½ in. thick, dark grey, often blackish with a brown or purple tinge, cut by long vertical dark furrows and short transverse cracks into long irregularly truncate scales. The wood of mature Deodar, unless very old, is generally sound throughout, but there are exceptions. Thus in the following blocks of the Bhagirati forests the proportion of unsound first-class trees was found to be as follows :—

Hirsil,	sound	920,	unsound	736.
Tailgari,	"	1179,	"	589.
Dinargad,	"	35,178,	"	22,386.

(Colonel Pearson's Report on the Bhagirati Forests, 1869.)

It has not been ascertained whether this unsoundness should be attributed to the practice of burning the forest for temporary cultivation or to other causes. The sapwood is whitish and not durable, in mature trees it is 1½-3 in. thick, the heartwood has a fine light-brown colour, is fragrant and somewhat oily, com-

pact, even-grained, does not readily warp or split, and is exceedingly durable. The timber from the Jhelam forests is reckoned the best; it is very oily and darker coloured. The weight of seasoned Deodar varies between 25 and 44 lb. In the Panjab it is generally supposed to weigh 40 lb. The transverse strength is less than that of *P. longifolia*, so far as recorded experiments go. The values of P. are as follows: I. Panjab timber, nine experiments made at Rurki—549 to 669; ten experiments by Major Robertson and Captain Henderson—461 to 649; thirty-three experiments by Cunningham—189 to 858; average of Panjab timber, 575. II. Garhwal timber, eight experiments made at Rurki—390 to 798; average, 592. III. Kamaon timber, twenty experiments made by Captain Wm. Jones, and recorded by Madden in Journ. Agric. Soc. of India, vii. 1850, at Almora in Oct. 1844—viz., ten with timber cut Sept. 1844, weight 38 lb., value of P. 443, and ten with seasoned timber, weight 40 lb., value of P. 560. In this case, as in the experiments with *P. longifolia* noted above, it is remarkable that the average weight of seasoned timber is about the same as of that cut a month previous. It should, however, be mentioned, that the Almora experiments do not give *P. longifolia* a much greater transverse strength than Deodar; and it has been stated, but probably on insufficient grounds, that the transverse strength of Deodar is greater than that of either *Pinus longifolia*, *Pinus excelsa*, or *Abies Smithiana*. A larger series of systematic experiments to determine the physical and mechanical qualities of the timber of the more important Himalayan Conifers is much wanted. The sapwood commences to decay while the logs are seasoning in the forest, much of it is knocked off on the slides by which the timber is sent down to the water's edge, and during the long water transit to the plains, while the logs are rubbing and bumping against the numerous rocks in the rivers. The heartwood is by far the most durable of the Himalayan timbers of this tribe (*Abietinæ*), and in the climate of Kashmir and the Panjab it is almost imperishable. Stewart states (Panjab Pl. 220) that the Deodar pillars of the great Shah Hamaden mosque in the capital of Kashmir are probably more than 400 years old (the date, 804 Hijra, 1496 A.D., is entered in an inscription over the door), and that to all appearance they are perfectly sound. Some of the bridges in Srinagar are said to be of still greater antiquity; the wood of which the piers are constructed is Deodar, and part of it is alternately wet and dry. These piers, it is believed, have never been renewed since the bridges were built. White ants eat the sap, but rarely attack the heart-wood. The boats built of it on the Panjab rivers are said to last forty years. Owing to these excellent qualities, combined with lightness, Deodar has from time immemorial been the wood most prized in the Panjab and Sindh, and the timber-trade on the five rivers and their feeders is of very old date. The consumption of the wood, however, has, like that of most of our more valuable Indian woods (Teak, Sissoo, Sal, Blackwood), increased largely and rapidly since the British occupation of the country. Barracks and other public buildings, bridges, canals, and mainly the construction of railways, have created a large and pressing demand, the first effect of which has been the destruction, beyond hope of recovery, of numerous and extensive forests formerly stocked with fine Deodar. Not only were the forests cut down wholesale without any regard to their regeneration, but of the timber felled a small proportion only was utilised, the greater part being destroyed by the forest-fires, or broken to splinters on their way to the river over precipices and rough slides, and another portion being jammed up in numerous narrow rocky passages in the river, or caught and abstracted by the people living near the banks. This state of things was first prominently brought to notice by Dr Cleghorn, who was deputed in 1861 to report on the timber resources of the Panjab; and thorough and vigorous action to remedy these evils was taken by the late Dr Stewart, who in 1864 was appointed the first Conservator of Forests in the Panjab.

During the first 3-4 years of its life Deodar grows slowly, attaining 12-20 in. in height, with spreading roots, which do not go deep down. In this shrubby and stunted state the young plant can maintain its existence under the shade of other trees for a considerable number of years without making much progress, but when light overhead is given, then a leader is at once formed, which shoots up rapidly. At a more advanced age the rate of growth of the Deodar is determined without difficulty by counting the annual rings: they are well-marked, and as vegetation rests completely in winter at the elevation where the tree grows, there is no reason to doubt that each concentric ring indicates one year's growth, in the same manner as is the case in the coniferous trees of Europe. It has been asserted that the *Wellingtonia gigantea*, and several other coniferous trees, form two rings a year. There is no ground to suppose that this is the case in the Deodar or in any of the other Himalayan Conifers; and we have from the commencement employed the same methods for ascertaining the fundamental facts upon which the plan for working these forests must be based, which are used for regulating the management of coniferous forests in France and Germany. The data available show clearly that the rate of growth of the Deodar is much influenced by the greater or less moisture of the climate. Thus, in the forests at the head-waters of the Bhagirati river, in a dry climate, the tree requires upwards of 200 years to attain a girth of 6 ft.; whereas in the Jaunsar forests, in the outer hills, with a heavy rainfall, 70 years suffice to attain this size. The present estimate is, that in the upper Bhagirati forests it takes a Deodar on an average 86 years to increase in girth from 4 ft. 6 in. to 6 ft., and that in Jaunsar this is accomplished in 23 years. In the upper Kunawar forests, in a dry climate, where vineyards occupy the lower slopes of the valley, and where *Pinus Gerardiana* and *Quercus Ilex* are associated with the Deodar, the age of a tree 6 ft. in girth is 140 years or more; while in the outer hills, in the vicinity of Simla, with an annual rainfall of 50-80 in., it is usual to find that trees 70-100 years old have attained that size. Again, the Deodar timber floated down the Cabul and Swat rivers to Peshawar, which is produced in the comparatively dry climate of Afghanistan, shows a slow rate of growth—logs from the Cabul river having at the butt end, for a girth of 6 ft., on an average 214, and timber from the Swat river 156 rings. In the case of the Cabul timber the lower temperature has, probably in addition to the dry climate, a considerable influence in retarding the rate of growth. Besides climate, there are other elements which influence the rate of growth of Deodar, as well as of other trees in mountainous countries. Foremost stands elevation, in the second place the greater or less steepness of the slope, and the nature of the soil. Again, trees which have grown up in a crowded state lay on wood more slowly, and have necessarily narrower rings, than trees which have stood more isolated and bear a fuller head of branches. Of these elements several are often found combined, and it is not therefore in all cases easy to determine the influence of each separately. The rate of growth of Deodar in the Bussahir and neighbouring forests was studied with special care in autumn 1864, with the view of determining the data which should form the basis of a preliminary plan for working these forests, and the results are recorded in the official Report already quoted. Additional data have since been collected in other forest districts. At page 9 of that Report an abstract statement is given, exhibiting the results of the examination in detail of the annual rings near the base of 380 trees, classified in three great divisions—forests with slow, average, and rapid rate of growth. As explained before, the forest tracts classed under the first division (age of trees 6 ft. in girth above 140 years) are mostly situated in a dry climate in the vicinity of the arid zone of the inner Himalaya; those classed under the third division (age of trees 6 ft. girth below 110 years) are mostly in the outer ranges under the full influence of the monsoon; and those with an



intermediate rate of growth are chiefly situated in the intermediate ranges and valleys. There are, however, several noteworthy exceptions, showing that various circumstances besides moisture influence the rate of growth of the Deodar. Thus, in the Phinla, Kiuden, and Kilba forests, 138-154 years were found as the average age of a tree 6 ft. in girth—a slow rate, although these forests are situated in the lower, that is, moister portion of Kunawar. The high elevation of these forests (8000-10,000 ft.) explains this apparent anomaly. Again, Col. Pearson records an average of five rings to an inch of radius in the Bodia forest of Jaunsar at an elevation of probably 6000 ft., and eight rings in the Tutwa forest, north of the Karama Peak, several thousand feet higher. Another exception is the Nachar forest, at the bend of the Sutlej valley, at about 7000 ft. elevation, under the influence of a heavy monsoon, on level ground with deep and rich soil, as mentioned above. Yet the growth of 30 trees examined gave an average of 149 rings for a girth of 6 ft. Here the trees had grown up close together, hence the unusually tall stems and slow growth. To a certain extent this circumstance may have contributed to keep down the rate of growth in the Phinla and Kilba forests. The influence of the gradient was exemplified by a number of trees examined in the Serinche forest, on the Baspā river above Sangla. Here 10 trees, which had grown on level ground, attained a girth of 6 ft. in 62 years on an average; and 4 trees on a slope of 30 degrees had required 132 years to accomplish this,—the extremes being, in the first case, 36 and 83, and in the second case 102 and 173 years.

Regarding the crop of timber per acre in a mature Deodar forest, our information is scanty. The large mass of the natural pure Deodar forests is imperfectly stocked; most of those from which the timber could readily be sent down to the river are nearly exhausted, so that the opportunities for examining fully-stocked tracts have not been numerous. The following data are recorded in the Report quoted above:—

	AREA SURVEYED. ACRES.	AGE OF FOREST. YEARS.	TREES PER ACRE.	CROP PER ACRE. Cub. ft.
1. Jaunsar, Mayeshak forest, . . .	0.69	70	54	2464
2. " above Khattowa village, . . .	0.46	84	69	3661
3. " Chilara forest, . . .	0.34	88	70	4323
4. Kunawar, Kiuden forest, . . .	1.60	180	56	3512
5. " " " " " " " " " " " "	0.33	180	90	8972
6. " Nachar forest, . . .	2.30	250	62	12,300

Cub. contents calculated by square of quarter girth.

This includes, not the tops and branches, but only that portion of the stem which, under existing circumstances, yields marketable timber. In the Nachar forest, the available length was taken at 80 ft., and in the other forests at 50-60 for first-class (above 6 ft. girth), and at 25-30 for second-class trees (4-6 in. to 3 ft. girth). That portion of the Nachar forest in which this survey was made, contained (before felling operations commenced) per acre 54 first-class trees, yielding 218 cub. ft., and 8 second-class, containing 66 cub. ft. each. The other forest tracts contained between 54 and 90 trees of the two first classes—that is, exceeding 4 ft. 6 in. in girth. By way of comparison it may be stated that, in North Germany, forest tracts of limited extent, exceptionally well stocked, and older than 120 years, have been found to yield the following crop:—

Scotch fir 85-95 ft. high, 565 cub. metre per hectare, 8,074 cub. ft. per acre.				
Beech above 95 ft. " 600 " " 8,574 "				
Spruce 95-130 ft. " 760 " " 10,860 "				

Cub. contents calculated by exact measurement, not by squares of the quarter girth.

Some of the mixed forests of spruce and silver fir in the Schwarzwald, 150-170 ft. high, contain more, probably about 12,000 or 13,000 cub. ft. per acre. In mature forests of average quality the crop is between one-half and three-fourths of these figures. These quantities do not include tops and branches, but they include all wood above 7 centimetre diam., or 8½ in. in girth, and they are calculated by exact measurement; whereas in calculating the data relating to Deodar, that part of the tree only was taken into account which was supposed to be marketable at the time the surveys were made, and consequently nothing under 3 ft. girth was included, and the calculation was made by the square of the quarter girth. In the Nuchar forest, moreover, the length of available timber was arbitrarily assumed at 80 ft.; because, though the average height of the trees was 150-200 ft., yet, on account of breakage, a greater length was not as a rule supposed to be utilised (Bussahir Forest Report, p. 24). If in the Nuchar forest the entire length of stem down to 9 in. girth had been taken, and the calculation made by exact measurement, the result would probably have been 18,000 cub. ft. per acre. These, however, were exceptional cases of compact and pure Deodar forests of limited extent. Excluding such exceptional cases, there seems no ground to expect that regular Deodar forests will yield timber crops heavier than those of the Spruce and Silver Fir in Central Europe. The great mass of Deodar-producing tracts in the N.W. Himalaya is very poorly stocked with mature timber. The result of 20 surveys made by me in June 1863 in the different parts of the Jaunsar forests on an aggregate area of 485 acres, gave 1195 first- and 1662 second-class, or a total of 2857 Deodar trees above 4 ft. 6 in. girth, amounting to nearly 6 trees per acre of both classes; and 82 surveys made in the Bussahir forests in October 1864, in conjunction with Capt. E. Wood and the late Dr Stewart, gave 3743 Deodar trees of the first and 4099 of the second class—total, 7842 trees of both classes, amounting to 12 trees above 4 ft. 6 in. girth per acre. The survey of the Bhagirati forests, which was made in 1869 under the direction of Colonel Pearson, gave a total of 116,700 first- and 53,660 second-class trees on 11,500 acres, or about 15 trees above 4 ft. 6 in. girth per acre on an average. The second-class trees in this case were fewer than those of the first; as a rule, most surveys in forests already worked have hitherto shown an excess of second over first class trees. A great portion of the Bhagirati forests, however, had never been worked when the survey was made; but many of those I surveyed in Bussahir had been much impoverished by felling, and in the majority Deodar was not the only tree, but was associated in varying proportions with *Pinus excelsa*, *Abies Smithiana*, and a few other trees.

The great demand for Deodar wood has naturally called forth estimates of the total quantity of mature timber available for the requirements of the present generation. The foregoing remarks regarding the irregular character of these forests will explain that these estimates could not be made from areas stocked with Deodar, but the only way in which a result could be obtained was to make approximate estimates of the number of trees available. In December 1868, the late Dr Stewart estimated the number of first-class Deodar trees in the Kashmir forests, which could be made available for the market without great trouble and expense, at 117,000 trees, and he thought that the Panjab forests in British territory, and those leased from the Rajahs of Chumba and Bussahir might probably yield the same quantity. The Jaunsar forests on the Deodar ridge, between the Tonse and Jumna river, were estimated by Colonel Pearson in May 1869 to contain 34,000 available first-class trees, and the Bhagirati forest (not including the Nilang valley), as mentioned above, 116,700 first-class trees. If to these are added the probable contents of the available forests on the headwaters of the Tonse and Jumna rivers, the total number of first-class Deodar trees which were considered readily available for the market in 1868 and 1869 did not at that time exceed 500,000. Regarding this estimate, it should be borne

in mind that most of the northern forests, from the Jhelam to the Sutlej, had been worked excessively during the last 25 or 30 years, and that in the Panjab those localities only were included in the estimate which were situated on slopes immediately overhanging the river or its main tributaries, whereas a large portion of the south-eastern forests on the feeders of the Jumna and the Ganges rivers were intact, and that here forests situated at a distance from the main river were included in the estimate. In addition to the quantity mentioned, there are extensive forests containing Deodar in side valleys, on small tributaries, and in places difficult to work, which it is hoped may be found to contain twice or three times the quantity estimated to stand in the vicinity of the main rivers. Nevertheless it is evident from these data that the quantity of Deodar growing in the N.W. Himalaya is limited. The natural regeneration of this valuable tree by self-sown seedlings is good when the climate is moist, the soil ample, and the slopes not too steep, save where a complete clearance has been made, for then herbs, brambles, and brushwood occupy the ground and prevent the growth of seedlings. And this is noticed equally where the clearance has been effected by felling and where the forest has been cut down by avalanches. Deodar requires shelter while young, and does not come up without it. Most forests, however, contain a large proportion of young trees. In the Bhagirati forest (area 11,500 acres), excluding the Nilang, the number of trees of the different classes was reported as follows:—

First class above 6 ft. in girth, . . . .	116,700 trees.
Second class 4 ft. 6 in. to 6 ft. girth, . . .	53,660 "
Third class 1 ft. 6 in. to 4 ft. 6 in girth, . .	127,536 "
Fourth class below 1 ft. 6 in girth, . . . .	213,281 "

and the proportion is similar in other forests. Speaking broadly, the trees which now belong to the two first classes must be made to last until a sufficient number of the younger classes and planted Deodar shall have attained a marketable size—that is, for a period which will be found to vary in the different forest tracts between 50 and 100 years.

As compared with other Conifers of the tribe of *Abietineæ*, Deodar has a great power of reproduction, and its branches often show a tendency to form straight leading shoots. In many parts, particularly in the outer ranges, the tree near villages is lopped of its branches to a considerable height. The naked stem reclothes itself with side branches in a short time. Trees are often found with the main stems, instead of running up straight, dividing into numerous branches, each forming a separate leader. This division sometimes takes place near the ground, sometimes at a height of 10 ft. or more. These leaders form tall and well-shaped tops, so that at a distance the forest has a deceptive appearance. The trees appear to be tall and well formed, whereas on approach they are found to be worthless for timber, being only the candelabrum-like branches of a short stem. Forked stems also are not rare, with two parallel leaders instead of one; and when young trees grow up isolated, with branches down to the ground, it sometimes happens that one of the lower branches sends up a straight leader at some distance from the stem. This tendency to form secondary leaders sometimes shows itself in Deodar planted in England; in the Himalaya it is particularly marked where the main leader has been cut or mutilated, or crushed by snow, or where avalanches have passed through the forest. In the vicinity of villages, and particularly near the edge of the arid and treeless tract, the Deodar is much cut to furnish material for building and fencing; and in places, e.g., in upper Kunawar, it is customary to cut the upper part of the stem only (the top of the tree answering the purpose with less labour), upon which the side branches left on the stem lower down repair the damage by taking the lead and forming straight ascending secondary stems. The Deodar has so great a

power of reproduction that if only a small branch is left on the stump of a felled tree, numerous shoots grow up, which almost have the appearance of coppice-shoots. Unlike most other trees, the trees of the Pine tribe do not coppice from a leafless stump; but so great is the power of reproduction in the case of the Deodar that the appearance is often deceptive, and indeed it has, though I believe without sufficient data, been asserted that Deodar coppices like Oak, Teak, and other leaf-bearing trees (Laubhölzer, Bois feuillus).

*C. Libani*, Barr.—Syn. *Pinus Cedrus*, Linn., and *C. atlantica*, Manetti—the *Lebanon* and *Atlas Cedars*—are so closely allied to the Deodar that it is not possible to separate them by constant specific characters. This has been clearly proved in Dr Hooker's important paper in the Natural History Review, 1862, 11, on the Cedars of Lebanon, Taurus, Algeria, and India. Both have shorter leaves than the Deodar, and the extremities of the branches are stiff and not drooping. Under cultivation in England the three Cedars show each a peculiar habit of growth, the Atlas Cedar being particularly distinguished by a stiff erect rigid leader, and stiff spreading branches with short leaves. The foliage of the Lebanon and Atlas Cedar is generally dark, that of the Deodar is often light or bluish green, but there is a silvery variety both of the Atlas and Lebanon Cedar, and, as mentioned above, Deodars with bluish foliage are not wanting, though rare, in the N.W. Himalaya. Old trees of all three kinds when growing isolated, particularly in exposed situations, are apt to form tabulated tops; and, on the other hand, where the Lebanon Cedar grows up crowded in groups or compact masses, it forms tall and erect stems, like the Deodar in the Himalaya. The male catkins, the cones, and seeds furnish no difference of importance. At Kew the Deodar is the first to come out with a flush of young leaves, the Lebanon Cedar follows a fortnight later, and the Atlas Cedar comes last, after another interval of a few days. The early commencement of the vegetation in the case of the Deodar explains its being less hardy on the continent of Europe than the Lebanon Cedar, which thrives well and attains a considerable size all along the Rhine from Basle to Cologne. In central France young trees often suffer from frost (Mathieu, Fl. For. 379). On their native mountains all three Cedars have a distinctly marked heartwood, which is brown, close-grained, and aromatic; but the wood of trees planted in Western Europe has a pale-reddish colour, is light, spongy, soft, and slightly aromatic. The wood of the Lebanon Cedar grown in England weighs 30 lb., and Mathieu quotes 29 lb. as the weight of wood grown at Nancy (age 19 years, diam. 14 in.), while a piece of wood from the Atlas (age 88 years, diam. 7 in.) weighed 48 lb.

In Western Europe the Lebanon Cedar has an extremely rapid growth. Mathieu cites one, 125 years old, and 23 ft. girth at 6 ft. from the ground (Fl. For. 381). Of the numerous instances of rapidly-grown Cedars in England, it will suffice to quote a group at Bayfordbury, Herts, mentioned by Selby (British Forest Trees, 539), of 12 or 14 trees, 90 years old, and measuring 10-14 ft. in girth near the base. The Atlas Cedar grows on the higher mountains of Algeria, where it forms extensive forests at an elevation between 4000 and 7000 ft. The Lebanon Cedar is found in Asia Minor on the Anti-Taurus (lat. 40°) between 3900 and 4200 ft., and, farther south, on the Taurus mountains, where it forms (with *Pinus Laricio*) the upper forest region between 4000 and 6400 ft. up to the limit of arborescent vegetation. It also occurs in the northern part of the Lebanon chain, where Ehrenberg found it in forests of Oak; and the last outpost is that remarkable grove of about 400 trees, at the head of the Kedisha valley (lat. 34° 14'), which has been mentioned by many travellers, and which Hooker has well described in the paper quoted above. The grove measures about 400 yards in diameter, it stands in a broad shallow valley, drained by a feeder of the Kedisha, which runs to the Mediterranean, at an elevation of about 6500 ft.

above the sea, which, as the crow flies, is only 18 miles distant, and 3500 ft. below the highest point of the Lebanon, which is about 3 to 4 miles farther north. The trees stand in nine groups on the broken ground of an ancient moraine, the relic of a colder period when the Lebanon was covered with perpetual snow, and sent its glaciers down into this valley. The largest tree is 40 ft. in girth, but 8 trees only measure above 20 ft., and the smallest have a girth of 18 inches. The growth, as might be expected at that elevation, has evidently been slow; no young growth is coming up. At present this grove does not recruit itself by self-sown seedlings, which are all destroyed by goats, but appears destined to diminish slowly by the death and destruction of the old trees.

It is a remarkable fact that the natural habitat of the *Deodar*, *Pinus excelsa*, and several other coniferous trees, is limited to high elevations on large mountain-ranges, that they are nowhere found indigenous in the plains, and that their area of distribution is interrupted by great distances.

### 3. ABIES, Tournef.

Evergreen monoicous trees. Leaves single, not tufted, needle-shaped, or narrow linear. Branches whorled and scattered. Male catkins single, cylindric, in the axils of leaves; anther-cells 2, dehiscing longitudinally, transversely, or in an irregular manner, adnate to stipitate scales. Ovules inverted, in pairs at the base of the carpellary scales, which are in the axils of membranous or coriaceous bracts. Cones ripening the same year, terminal or lateral, hanging or erect, formed of numerous, obtuse, imbricate, carpellary scales, with a thin edge and a woody base, deciduous or persistent. Seeds oily, winged.

Cones at the ends of branches; scales persistent after the seeds fall; bracts small, drying up and not apparent in ripe cones

(*Abies* of Loudon, *Picea* of Link, and *Tsuga* of Carrière).

Cones cylindric, pendulous, 4-6 in. long; leaves green

Cones ovoid, spreading or drooping, 1 in. long; leaves white beneath

Cones lateral, erect; scales fall with the seeds (*Picea* of Loudon, *Abies* of Link).

1. *A. Smithiana*.

2. *A. dumosa*.

3. *A. Webbiana*.

I follow Asa Gray, Botany of Northern United States, 471, and Willkomm, Forstl. Flora, 58, in uniting *Abies*, *Picea*, and *Tsuga*.

1. *A. Smithiana*, Forbes, Pinetum Woburnense, t. 36; Cleghorn, l. c. t. 5.—Syn. *A. Khutrow*, Loudon; *A. spinulosa*, Griffith; *Pinus Smithiana*, Wall. Pl. As. Rar. t. 246; *P. Khutrow*, Royle Ill. t. 84; *Picea Morinda*, Link. in Linnæa, xv. 522. Vern. *Wesha*, *bajūr*, Afg.; *Kachan*, *kachal*, Hazara and Kashmir; *Rewari*, *ban būdar*, *sangāl*, *salla*, *salle*, *sarei*, *kāulī*, *roī*, *rāg*, *rāo*, *bang re*, *krok*, Panjab Himalaya; *Landar*, *anandar*, timber depots in the plains; *Rau*, *raiang*, *re*, *Sutlej*; *Rāi*, *Jaunsar*; *Kandre*, *re*, *rhāi*, *rāo*, *kudrau* (*khutrau*, Royle), *riālla*, *rāgha*, *morinda*, *kail*, *kilu*, Garhwal and Kamaon; *Sh*, Sikkim.

A large tree with tall straight stem, pyramidal crown, dark-green foliage, and pendulous branchlets. Leaves single, scattered in spirals all round the branches, persistent 5 years, stiff, sharp, 4-sided, 1-1½ in. long. Cones terminal, pendulous, cylindric, obtuse, 4-6 in. long, 1-2 in. diam., dark brown when ripe; scales broadly ovate from a cuneate base, upper



edge thin, sharp, rounded. Seeds small,  $2\frac{1}{2}$  lines long, with large spatulate wings.

Afghanistan, Kafiristan, Gilgit, north of the great bend of the Indus. Common in the Panjab Himalaya, in Jaunsar, and in the Bhagirati forests, less common in Kamaon. Is generally found on northern and western slopes, between 6000 and 11,000 ft., alone, but more commonly in mixed forests with leaf-bearing trees, or associated with *Deodar*, *Pinus excelsa*, and *Abies Webbiana*, growing 500 ft. higher than *Abies Webbiana* on the Harang Pass in Kunawar, but generally remaining below the upper limit of that tree. In lower Kunawar *A. Smithiana* is commonly associated with *Deodar*; it forms a large proportion of the Dippi, Jani, and Punang forests, some of those in the Baspa valley, and of the Barang forests above the mouth of the Baspa river. It does not, however, extend into the arid tract, its upper limit being Pangri on the right, and the Tidong river (Rispa) on the left bank. In upper Kunawar *Pinus Gerardiana* takes its place in the *Deodar* forests. In Sikkim and Bhutan *A. Smithiana* grows in the innermost valleys between 7800 and 10,000 ft. Hardy in England and Scotland, where it grows with great vigour, often grafted on the common Spruce.

In April a flush of young light-green leaves at the tips of the branchlets gives the tree a variegated appearance, the old foliage being dark green, slightly darker than that of *Deodar*, but not so dark as *A. Webbiana*. The bud-scales generally cohere, like a conical cap at the end of the young shoots, until they at last fall off. The flowers appear in April, the young cones increase in size rapidly and ripen in Oct. and Nov. of the same year. In the N.W. Himalaya the tree attains 100-120, and sometimes 150 ft., with a girth of 8-10, often of 12-15 ft. Dr Stewart records one of 21 ft. The tree is covered with branches down to the ground, except where it grows in compact masses; the branches are whorled and horizontal, spreading out farther than those of *A. Webbiana*; their extremities are very bushy, with numerous hanging vertically, leafy, tassel-like branchlets, which give the tree a peculiar and graceful appearance. The crown is tall, conical, and the foliage dense. The bark is pale- or brownish-grey, tessellated by shallow cracks into small irregularly four-sided scales.

The wood is white, the outer wood turning red and decaying rapidly. It is even- and straight-grained, and is good for packing-cases, planking and indoor work, but as a rule not durable, except under shelter; yet in many places it is used by the hill people for shingles, and for construction. It is generally somewhat heavier than the wood of *A. Webbiana*. The bark is used to roof shepherds' huts, and water-troughs are made of it. Twigs and leaves furnish litter and manure. The young cones form part of the drug sold as *gaz-pipal* in the Panjab bazars.

Nearly allied to *A. Smithiana* is the *European Spruce*, *A. excelsa*, DC.—Syn. *Pinus Abies*, Linn.; *Picea excelsa*, Link.; *Epicéa*, Fr.; *Fichte*, *Rothtanne*, Germ.; *Pezzo*, It., extensive forests of which are found in the mountains of Central Europe, in East Prussia, the Baltic provinces, Norway and Sweden, and in a great part of Russia. \* On the south side of the Alps the Spruce forms large forests in Friaul on the head-waters of the Piave and Tagliamento rivers, which have from time immemorial furnished building timber to the eastern Mediterranean. The fact that most of these belong to towns and villages, has enabled the communities of these districts to build roads, bridges, and schools, and has thus served largely to increase the prosperity of the country. It is found in the Cansiglio forest near Treviso; on the maritime Alps, inland of Nice and Mentone, where it descends to 1800 ft. (M. Moggridge), on the north side of Mount Ventoux, and on the Pyrenees, but it is wanting in Turkey, in Italy south of the Euganean hills, in Corsica, and in Spain. It is not indigenous in

Western France, or in Britain. A variety with smaller cones (Siberian Spruce) forms large forests on the Ural Mountains, in Siberia, and Dahuria. In plantations the Spruce succeeds more readily than most conifers. It is the principal tree in the forests of the higher Harz, and of a great portion of the Saxon forests, where it is almost exclusively regenerated by planting. On the other hand, on the Schwarzwald, on the Vosges, and on the Jura, it reproduces itself without difficulty from self-sown seedlings. The resinous ducts of the wood are few and small, but the bark is highly resinous, and in former times the Spruce on the Schwarzwald and in Thuringia were largely tapped for resin. For this purpose a narrow longitudinal cut was made into the bark to the wood, and the dry resin which collected in this channel was from time to time scraped off; the cut was occasionally enlarged, and thus old trees may still be seen on the Schwarzwald the trunks of which are furrowed with numerous deep longitudinal channels, 4-5 ft. long. The wood of the Spruce, however, is much more liable to dry-rot than that of *P. Pinaster*, and the result is that almost all the old Spruces tapped for resin are found rotten in the heart as high up as the channels, and often higher, so that the lower part of the stem is useless. Apart from this, there are other circumstances, not yet sufficiently investigated, which often cause unsoundness in the heart of the Spruce. The wood, known in England under the name of *White Pine*, or *White Deal* (imported from Norway and the Baltic), has no distinct heartwood, and the cub. ft. weighs between 21 and 27 lb. (Nördlinger).

2. *A. dumosa*, Loudon.—Syn. *Pinus dumosa*, Don Prodr. Fl. Nep. 55; DC. Prodr. xvi. ii. 429. *P. Brunoniana*, Wall.; Pl. As. rar. t. 247. *Hemlock Spruce*, of Nepal. Vern. *Tangshing*, *changathasi dhūp*, Nepal; *Semudung*, Sikkim.

A large tree with spreading branches and pendulous branchlets. Leaves narrow-linear,  $\frac{1}{2}$ -1 in. long, edge recurved and finely serrulate near the apex, covered beneath with a white mealy substance. Male catkins short, subglobose, axillary, shorter than leaves, pedunculate; numerous lax ovate bracts at the base of peduncle. Cones terminal, erect or horizontal, ovoid, 1 in. long, scales persistent, broad-elliptic, obtuse, bracts not apparent when the cone is ripe. Seeds winged.

North-East Kamaon, first discovered by Capt. Webb, and found again by Mr T. Webber, late of the Forest Dept. of the N.W. Provinces, Nepal. In the inner valleys of Sikkim descending to 8000, and ascending to 10,500 ft. Bhutan, Fl. May, June. Dr Hooker records one in Sikkim 120 ft. high and 28 ft. girth, Him. Journ. ii. 108. The leaves are apt to fall from branches cut or broken off, and on this account Wallich first called it *Pinus decidua*. Not quite hardy in England; suffers from late spring frosts. Wood soft, white, not durable; bark used for roofing.

The *Hemlock Spruce* of Canada, *A. canadensis*, Michaux, with short linear distichous leaves, white beneath, and small terminal drooping cones, is a large tree of Canada and the northern United States. Wood not durable, and often spirally twisted, but the bark extensively used for tanning leather. Hardy throughout North Europe.

The *Douglas Spruce*, *A. Douglasii*, Lindl., is a tree forming extensive forests in the valleys of the Rocky Mountains, in Vancouver's Island, Columbia, and other parts of North-West America, which attains 300 ft. and more near the coast of the Pacific, and furnishes valuable timber, very strong, believed to be equal to the best Larch, has narrow-linear leaves 1 in. long, white

beneath, and cylindric cones 3 in. long, with lax rounded scales, much shorter than the linear-oblong persistent bracts, which are deeply trifid at the apex, the middle segment longest,  $\frac{1}{2}$  in. long, spinescent. Hardy, and of very rapid growth in England and Scotland. Introduced 1827; at Dropmore there is a tree which, at the age of 44 years, was 100 ft. high with 9 ft. 7 in. girth, at 3 ft. above the ground. Many specimens in Perthshire raised from layers and cuttings since 1846, were in 1871 40-70 ft. high (Gardeners' Chronicle, 1870).

3. *A. Webbiana*, Lindl.; Pinetum Woburnense, t. 41; Link in Linnaea, xv. 532; Griff. Ic. Pl. As. t. 371.—Syn. *A. Pindrow*, Royle Ill. t. 86. *Picea Webbiana*, Loudon; Cleghorn, l. c. t. 6. *P. Pindrow*, Loudon. *Pinus spectabilis*, Lambert; Don Prodr. Fl. Nep. 55. *P. Webbiana*, Wall.; DC. Prodr. xvi. ii. 425. *P. Pindrow*, Royle; ib. 424. *Himalayan Silver Fir*. Vern. *Palūdar*, *revari*, Jhelam; *Badar*, *būdar*, *tūng*, Kashmir; *Dhūnu*, *rāg*, *rail*, *pe*, *re*, *salle*, *sara*, Chamba; *Tos*, Kullu; *Spun*, *pun*, *krok*, *kalrai*, Kunawar; *Bharda*, *thanera*, Shali; *Pindrau*, *pindrai*, Hattu; *Kūdrom*, Muttiana; *Burūl*, *būrra*, *būldu*, Baji; *Kalrai*, *satrai*, *chūr*, Kotkai; *Raho*, *roie*, *chilrow*, *kilaunta*, Chūr; *Morunda*, *morinda*, Taroché, Jaunsar, and Garhwal; *Chilrow*, Kullū, Garhwal; *Ragha*, *rao ragha*, *ransla*, *raisalla*, Kamaon; *Wūman*, Byans; *Gobria*, (*gobra*), *salla*, Sikkim; *Dūn shing*, Sikkim, Bhutan; *Partial*, *palt*, Panjab plains at timber depots.

A large tree with a dense cylindric crown of dark-green foliage. Leaves single, spirally arranged all round the branchlets, but generally more or less spreading in one plane so as to appear distichous, flat, narrow-linear, 1-3 in. long, 1 line broad, narrowed into a short terete petiole, apex emarginate, or with 2 sharp teeth, under side with 2 whitish longitudinal furrows on either side of the raised midrib, upper side dark green, shining. Duration of leaves 8-10 years, catkins axillary, cylindric, obtuse, about 1 in. long. Cones erect, subsessile, cylindric or ovoid, often clustered, obtuse, 4-6 in. long,  $1\frac{1}{2}$ -3 in. diam., dark purple or brownish purple when ripe. Scales closely imbricate, broadly cuneate or obovate, edge rounded, bracts many times shorter than scales. Seeds oblong or obovoid, half the length of the broad obovate truncate wing. Two varieties, considered as species by Royle, Madden, and Parlature:  $\alpha$ . *A. Webbiana*, on exposed rocky ridges at higher elevations, a smaller tree, with shorter, less bifarious leaves, and usually thicker and shorter cones:  $\beta$ . *A. Pindrow*, on better soil, in sheltered places, a large tree, with longer leaves and generally cylindric cones. The scales fall when the seed ripens, and leave the naked persistent axis of the cone standing upright on the branches.

North Afghanistan and Kafiristan, on the Safedkoh, between 8000 and 9000 ft. Himalaya, from the Indus to Bhutan, forming extensive forests, in the North-West, pure or mixed with *Acer* and other leaf-bearing trees, at high elevations with *Betula Bhojpattrā*; often associated with *Abies Smithiana* and *Pinus excelsa*. In the Panjab it is usually found between 7000 and 11,500 ft., but descends occasionally to 5500, and ascends to 12,500 ft., which is its upper limit in Kunawar. Up the Sutlej valley it extends to Lipi on the right, and Dabing on the left side. On the Chūr its lower limit is 10,000 ft. In Jaunsar, Garhwal, and Kamaon its limits are 7500 and 13,000 ft., and here it is only found in the middle ranges at a distance of 35-40 miles from the plains. In the

inner ranges of Sikkim and Bhutan *A. Webbiana* forms, with *Abies dumosa*, the *Yew*, together with *Oak*, large *Rhododendrons*, and small *Bamboo*, the upper zone of coniferous forest, between 9000 (sometimes 8500) and 13,000 ft. In the outer ranges it does not descend below 10,000 ft. (Hook. Him. Journ. i. 191).

In the North-West Himalaya it thrives best in cold damp glens, with a north or west aspect, and in such places it often constitutes alone, or associated with the alpine Birch, the upper forest belt; *Pinus excelsa* often going higher, and always extending farther into the arid tract. A flush of young leaves breaks out in April and May, of a bright green colour, contrasting strongly with the dark-green old foliage. At a distance the foliage looks almost black; and, like the silver fir of Central Europe, the tree has given the name of Black Forest (Kala ban) to several mountain forests of the N.W. Himalaya. Fl. April; by the end of May the cones are about 3 in. long, and they ripen in Sept. of the same year, the scales and seeds falling in October. In North Europe the tree suffers in spring, because it starts into growth too early; it succeeds in Ireland and South-West England. Attains 120-150 ft., and a girth of 9-15 ft. Several instances are recorded of trees exceeding 20 and even 30 ft. in girth. Except in very compact and dense forests, the branches go low down, nearly to the ground; they are short, spreading nearly horizontally, and forming a tall narrow cylindric crown, the outline resembling that of the Cypress or Lombardy Poplar. Bark of young trees smooth, silvery grey, of old stems darker grey or brownish grey, cut into long narrow acute scales by deep narrow vertical grooves, often running in spirals round the trunk, and anastomosing at acute angles. The wood is whitish, inodorous, open-grained and soft. Exposed to the weather it is not durable. Weight, 21 lb. (Wallich), 27-35. Value of P. (average of 10 exp.) 440, Capt. W. Jones, Oct. 1844, cut Sept. 1844. In Bhutan the wood is used for house-building; from Sikkim it is exported to Tibet. "It splits well, is white, soft, and highly prized for durability," Hook. Him. Journ. ii. 44. In Kullu and near Marri shingles are made of it; indoors it is said to last 3-6 years in Kullu, and 8-10 years at Marri. In the dry climate of Lahoul and Kunawar it is much valued for construction. Pieces of the bark are employed to roof shepherds' huts. On the Jhelum the twigs and leaves are used for fodder, and are stored for the winter. According to Wallich, a violet dye is extracted from the cones in Nepal. A large yellowish fungus (*unglân*) grows on the roots in N.E. Kamaon, eagerly eaten by the Bhoteas (Madden).

The Silver Fir of Europe is *A. pectinata*, DC.—Syn. *Pinus Picea*, Linn.; *P. Abies*, Du Roi; *Picea pectinata*, Loudon; *Sapin*, Fr.; *Tanne*, *Weisstanne*, *Edeltanne*, Germ.; *Abete*, *abezzo*, Ital.—the largest of the European conifers, which, when grown in compact masses on good soil and under exceptionally favourable circumstances, attains a height of 180 to 200 ft. The leaves persist 8-10 years, they are linear, apex emarginate, dark green and shining above, and white beneath. The cones are erect as in the Himalayan Silver Fir, the bracts pointed, longer than the scales, which fall after the seed ripens. The tree is indigenous in the mountains of South and Central Europe. It forms splendid forests on the north face of the eastern Pyrenees, south of Carcassonne and Limoux in the Département de l'Aude. In Spain it is found on the mountains of Catalonia and Aragon; in Corsica it constitutes a belt of forest between the *Pinus Laricio* and the *Beech*, and is associated with the latter near the limit of arborescent vegetation. Forests of it, though unfortunately less extensive than might be desirable, are in several places on the crest of the Apennines. In the Vosges and the Schwarzwald it is the most important tree; and Silver Fir is found in some of the Spruce forests of Saxony and Thuringia. In Britain and Scandinavia it is not indigenous. While young the Silver Fir bears a

great deal of shade, and is on that account particularly well suited for regeneration by self-sown seedlings. Its artificial cultivation is much more difficult and uncertain than that of the Spruce. The fine Silver Fir forests of the old convent of Vallombrosa, however, below the crest of the Appennines overhanging the Arno above Pontassieve, are an instance of successful reproduction of this tree on a large scale, continued for centuries entirely by planting. These forests are now State property, and are attached to the Royal Italian Forest School of Vallombrosa.

The stems are cylindrical, carrying their girth well up. The Silver Fir has a considerable power of reproduction; trees which have been lopped and mutilated often send up a number of leaders from their side branches, and parallel double or forked stems are not rare. The wood has very few minute resinous ducts. As regards weight, Nördlinger gives it the same range as Spruce, but Mathieu states that as a rule it is somewhat heavier (Fl. For. 365). In the same place he records that the wood of the Aude Silver Fir was found to possess a greater transverse strength and elasticity than any other coniferous timber, excepting the wood of *Pinus australis* from Florida. By puncturing the bark small quantities of turpentine are obtained.

Closely allied to the Silver Fir is the Cephalonian and Greek Silver Fir, united with it by Parlatore and Grisebach, but distinguished by Loudon, Link, and Willkomm as *A. cephalonica*, Loudon—Syn. *A. Apollinis*, Link, and *A. Regina Amalie*, Heldreich. It is supposed to be distinguished by acute, often sharply-pointed leaves, and by spindle-shaped cones. This tree forms extensive forests on the mountains of Cephalonia and Greece, generally commencing above 3000 ft., but sometimes descending to 1500 ft., often forming the upper limit of the forest where the mountains are sufficiently high, sometimes associated with *P. Laricio*. For the Indian forester this tree has a special interest, as it is one of the few abietineous trees, which are supposed to have the power of throwing up coppice-shoots from the stump. A full account of it is given by T. v. Heldreich in Regel's *Gartenflora*, 1860, p. 313. Two Greek Forest Officers, Balsamaki and Origoni, visited in 1859 an extensive forest of this fir in Central Arcadia in the district of Tripolitza. The inhabitants of the neighbouring villages had been in the habit from time immemorial of cutting the upper part of the stems at different heights, according to the size of the scantling required, and the result was the same as that described, p. 523, in the case of the Deodar in upper Kunawar—the side branches below the cut had sent up a number of vertical shoots, which often attained 18-20 ft. in length, and a diameter of 1½ ft., thus forming candelabrum-like trees, exactly like the Deodar in mutilated forests of the N.W. Himalaya. It was even stated that young trees cut down above the root had thrown up regular coppice-shoots. This last statement, however, seems to require confirmation. All that is proved at present is, that the Deodar and the Greek Silver Fir have (compared with other trees of the Pine tribe) great powers of reproduction; it remains for farther inquiry, whether they actually throw up coppice-shoots from leafless stumps.

*A. Nordmanniana*, Link, a stately tree with dark compact foliage, and ovoid cones, of late years much cultivated in England, forming forests in the Crimea and the Caucasus, is regarded as a variety of the Silver Fir by Parlatore and Grisebach.

*A. Pinsapo*, Boissier, is a beautiful tree with regularly whorled branches, rigid, short broadly linear thickly set leaves, erect, at right angles, all round the branches in a regular spiral. Male flowers numerous, purple. Cones cylindric-ovoid, 4-5 in. long, the bracts shorter than the seed-scales. On the Serrania de Ronda, in the province of Malaga, between 3000 and 3600 ft., and lately found on the Atlas mountains in Algeria (*A. baborensis*). Extensively cultivated in England, where it thrives remarkably well.



4. **LARIX**, Tournef.

Deciduous resinous trees. Leaves needle-shaped, single on elongating shoots and on the first shoots of seedlings, but otherwise in dense fascicles on arrested branchlets, which do not as a rule lengthen out and develop into side branches. Male catkins sessile, lateral on short thick scaly but leafless peduncles (stunted branchlets). Anther-cells 2, longitudinally dehiscent. Female catkins often on the same branches as the male, at the ends of arrested leaf-bearing branchlets. Ovules inverted, in pairs at the base of the carpellary scales, these in the axils of cuspidate, 1-nerved bracts, which are longer than the scales. Cones erect; scales persistent, with a thin obtuse edge; bracts generally protruding between the scales when the fruit is ripe. Seeds oily, winged.

1. **L. Griffithii**, H. f. & Th.; Hook. III. Him. Pl. t. 21.—Syn. *Pinus Griffithii*, Parlat. in DC. Prodr. xvi. ii. 411. Vern. *Sah, saar*, Sikkim.

A graceful tree with conical crown and long pendulous branches. Leaves slender, narrow-linear, about 1 in. long. Male catkins ovoid-cylindric,  $\frac{1}{2}$  in. long. Cones cylindric, 2-3 in. long, erect—*i. e.*, on recurved branchlets on the pendulous branches. Bracts reflexed, subulate, twice the length of the carpellary scales, persistent in fruit.

Inner ranges of West Bhutan, Sikkim, and East Nepal, between 8000 and 12,000 ft. Said to extend west to the sources of the Dūd Kosi river, which descends from Mount Everest. Fl. May, the fruit ripening in Oct. of the same year. Wood white, soft, without heartwood, but splits well, and is reckoned the most durable of the coniferous timbers exported into Tibet from Sikkim (Hook. Him. Journ. ii. 44).

The European *Larch* is *L. europæa*, DC.—Syn. *Pinus Larix*, Linn.; *Lärche*, Germ.; *Méleze*, Fr.; *Larice*, Ital.—a large tree with small ovoid cones 1-1½ in. long, the bracts dry when the cones ripen, and barely protrude beyond the lower carpellary scales. Indigenous in the Alps and Carpathian mountains, forming extensive forests in the French Alps, pure, or mixed with *Pinus Cembra* and *P. montana*, less abundant, and generally associated with the Spruce in Switzerland, the Bavarian and Austrian Alps. It ascends to the limit of arborescent vegetation, and is not rarely the highest tree in company with the Spruce and *P. Cembra*. The Siberian Larch, *L. sibirica*, Led., which forms large forests in the plains of Russia and Siberia, and is found on the Ural and Altai mountains, is a different species. The heartwood of the European Larch is well defined, red, compact, even-grained, strong, and very durable, does not warp nor split, and is prized more than Oak in the mountains where it is indigenous. Resinous ducts numerous, small or moderate-sized. The Romans prized the wood much. Pliny mentions a beam 116½ ft. long and 23½ in. square, brought to Rome by the Emperor Tiberius. The cubic ft. weighs 27-49 lb., and even more. On account of the value of the wood, its rapid growth, and the certain success of plantations while young, the Larch has been cultivated on a very large scale far beyond the limits of its natural habitat, particularly in Germany, Scotland, and France. Speaking broadly, the result is favourable up to a certain age. Larch plantations, which are cut down at the age of 40-60 years,

have in many instances been found to give most satisfactory results; beyond that age, however, its progress is not satisfactory on a large scale, and a disease has shown itself of late years which has in many cases seriously injured plantations of much younger age. Considerable quantities of Larch seed have at different times, by well-meaning persons, been imported to the N.W. Himalaya, but as yet without any result. Except on the borders of the arid tract, beyond the range of the Deodar—*e.g.*, in Lahoul, Piti, and Ladak—there seems no inducement to repeat these experiments, as the Deodar is at home in the N.W. Himalaya, and is fully equal in value and in rapidity of growth to the best mountain Larch. The wood of the Larch yields large quantities of turpentine, which is used medicinally under the name of Venetian turpentine. A number of holes, about 1 in. diam., and somewhat inclined towards the circumference, are bored into the trunk, but not quite to the heart of the tree, small channels of wood are inserted in each hole, and the turpentine which runs out during summer is collected in wooden buckets placed underneath. Holes that cease to run are closed, and yield a fresh supply when reopened. In autumn all holes are carefully closed with wooden stoppers, and if this precaution is duly observed, it is said that a tree will continue to yield during 40-50 years; but the wood of the trees thus tapped is said to lose its good quality, and can only be used as fuel. This is the practice in the valley St Martin, Pignerolo district of Piedmont, between Mont Cenis and Monte Viso. It is described by Duhamel in his 'Traité des Arbres et Arbustes,' 1755, and quoted by Mohl. The editor of the 'Nouveau Duhamel' (1812), states that it is the practice in the Swiss Canton de Vaud, probably a mistake. In South Tyrol one hole only, 1 in. diam., is bored about a foot above the base of the trunk fully to the centre in spring, and is at once firmly closed by a wooden stopper. In autumn the hole is opened and emptied of the turpentine which has collected in it during summer, and is then closed again. It is again opened and emptied in the second autumn, and so on during a number of years. In this way all large trees are tapped in certain forests of South Tyrol, as described by Mohl in 'Botanische Zeitung,' 1859, p. 329, and the wood of the trees thus tapped is said not to deteriorate in any way. Mohl's paper discusses the connection between the different modes of tapping coniferous trees for resin and the distribution of the resinous ducts in wood (*Larch*, *Pinaster*, and *Laricio*), and bark (*Spruce* and *Silver Fir*). The bark of the Larch is used for tanning and for dyeing.

### 5. CUPRESSUS, Linn.

Evergreen aromatic trees, with small closely adpressed scale-like broad-based opposite leaves, imbricate on the younger branchlets, distant, decussate, and often less closely adpressed on older branchlets. Male catkins numerous, small, cylindrical, sessile at the ends of branchlets; scales stipitate, peltate, each bearing 2-4 subglobose anther-cells under the edge. Female catkins terminal, fewer than male; scales few, decussate, each bearing at the base 8 or more erect ovules narrowed at the apex. Cone subglobose, requiring somewhat longer than a year to ripen, consisting of thick woody peltate, angular scales, with numerous seeds, attached to the stalk of the scales. Cotyledons 2-3.

Crown narrow-cylindrical; branches erect; cones few, 1 in. diam.

Crown broad-pyramidal; branches spreading; cones numerous, clustered,  $\frac{1}{2}$  in. diam.

1. *C. sempervirens*.

2. *C. torulosa*.

1. *C. sempervirens*, Linn. ; DC. Prodr. xvi. ii. 468 ; Reichenb. Ic. Fl. Germ. t. 534. In India only the cylindrical (so-called pyramidal) variety occurs, *C. fastigiata*, DC. *Cypress*.—*Cipresso*, Ital. Vern. *Saru*, *sario*, *sarās*, N.W. India.

A tall tree with a fluted stem ; branches erect, often adpressed to the trunk, forming a narrow dense cylindrical crown of dark-green foliage. Branchlets four-sided, leaves ovate-oblong. Cones few, 1 in. diam., and grey when ripe, greatly varying in shape, on peduncles  $\frac{1}{4}$  in. long ; scales rough, with a projecting point or boss, convex or keeled. Seeds ovoid or oblong, angular, with a narrow wing.

Planted in gardens in Afghanistan and N.W. India, *e.g.*, at Agra, Ajmir, Delhi, also in Kashmir and the outer Himalaya, in Kamaon to 3000 ft. Grows in Calcutta. Cultivated throughout the Mediterranean region. Hardy in England. The pyramidal variety is not found wild anywhere ; the variety with spreading branches, regarded by Grisebach and others under the name of *C. horizontalis*, as a distinct species, is wild on the west side of Lebanon, on the mountains of Crete and Asia Minor, and probably also in North Persia. Fl. Feb.-April ; the fruit ripens during summer of the second year, and is often long persistent on the tree. In N.W. India the tree attains 6-7, occasionally 9 ft. girth, and 70-80, occasionally 100 ft. in height. Its growth is slow ; Grisebach mentions two cypresses found by him near a convent on Mount Athos, proved by inscriptions to be more than 1000 years old, the radius of which had increased at the rate of  $\frac{1}{10}$  inch only a-year. Near Somma, in Lombardy, a cypress is shown which was renowned in Cæsar's time on account of its size and beauty. The bark is thin (less than  $\frac{1}{2}$  in.), dark grey or brown, with numerous longitudinal wrinkles and shallow furrows. The wood is reddish or brownish-white, close-grained, but not hard, the inner belt of each annual ring (spring wood) soft, the outer belt (autumn wood) harder and reddish. Medullary rays numerous and distinct. Very fragrant, with a strong peculiar and pleasant scent. It is exceedingly durable, and in the Levant and Greece is prized for trunks and boxes, the contents of which are proof against most insects.

2. *C. torulosa*, Don ; Prodr. Fl. Nep. 55.—*Himalayan Cypress*. Sans. *Surāhva*. Vern. *Devi diār*, Ravi ; *Deodar*, Kullu, Baji ; *Leauri*, Jaunsar ; *Raisalla*, Naini Tal.

A large tree ; branches horizontal, whorled, with drooping extremities, forming a broad pyramidal crown. Branchlets round or indistinctly four-sided ; leaves ovate-triangular, white-margined. Cones numerous, clustered, erect, bluish when ripe,  $\frac{1}{2}$  in. diam. ; scales flat or convex, rugose, but smoother than those of *C. sempervirens*. Seeds compressed, convex on both sides, with a narrow orbicular wing.

Outer ranges of the Himalaya from Chamba to Nepal, but more local and less common than most other Himalayan conifers, generally, but not always on dry warm rocky slopes. Several small patches on the Ravi, more abundant in part of Kullu, between 5500 and 8000 ft. (not in Mandi, where, according to Stewart, Vigne and Moorcroft mistook a small Deodar forest for Cypress.) Common, on limestone, on the north side of the Shali and Tikka ridge north of Simla, associated with *Deodar*, *Abies Smithiana*, *A. Webbiana*, and *Taxus*. In Jaunsar, on the limestone rocks of the Lokandi and Moila Hills, on limestone below the Karama Peak, associated with *Deodar* and *A. Smithiana*. On the south-east

face of Chinar Peak, above Naini Tal, on clay-slate, but in the vicinity of limestone rocks. Not uncommon in Garhwal and Kamaon, and in Nepal. Grows at Saharanpur, at Poona, at Calcutta, and thrives vigorously on the Chikalda Hill in Berar at 3000 ft. elev. Madden states that the tree is indifferent to the nature of the rock, and that it is found both on limestone and on silicious rocks. What I have seen of its growth makes me think that it prefers limestone. Fl. Jan.-Feb., the cones ripen in Oct.-Nov. of the second year, and are often long persistent on the trees. Attains generally 70-80 ft., and a girth of 6-8 ft., but larger trees are not uncommon. Dr Stewart records one near Girar on the Belj, a feeder of the Ravi, at 6500 ft., 15 ft. girth, and over 120 ft. high; and Madden speaks of 15-17 ft. girth, and a height of 150. The roots often embrace masses of rock, and the base of the trunk swells out in such cases. At Naig, south of Lobha, Stewart records a famous grove, the trees 12-17 ft. girth, and one 27 ft. girth near the ground, with enormous roots clasping great rocks, probably not under 1000 years old. The growth, as far as known, appears to be slow. Dr Stewart records 12-18 rings on one inch of radius. Bark very thin, barely  $\frac{1}{4}$  in. thick, the outer layer peeling off in numerous long narrow dark-grey thin strips, which are often spirally twisted round the trunk; inner substance of bark reddish brown. The surface of the bark is rougher and darker than that of *Juniperus excelsa*, with which this Cypress is often confounded. Wood white, with a tinge of red or yellow, deeper coloured in the centre, fragrant, the scent similar to the scent of the Cypress wood from Turkey and Greece, even-grained, not hard, easy to work, but not strong. Medullary rays distinct, somewhat darker than the rest of the wood, annual rings consist of an inner softer and an outer harder and darker belt. At Naini Tal it has been much used for building, particularly for indoor work, and on the Ravi and Sutlej it is sometimes used for beams. But, as a rule, the tree is not used for secular purposes. In Kulla images are made of it, and the poles to carry the sacred ark, for which purpose Birch and Elm are also employed. The wood is often burnt as incense in temples.

*C. glauca*, Lam.; DC. Prodr. xvi. ii. 470; Dalz. Bomb. Fl. Suppl. 83.—Syn. *C. lusitanica*, Willd. Commonly cultivated in gardens in Western India above Ghat; does not succeed below Ghat, according to Dalzell. Largely cultivated in Portugal, believed to have been introduced from Goa. Supposed to be distinguished from the two preceding species mainly by the bluish colour of the leaves and cones, and by the projecting subulate boss of the scales. The value of the former character, however, is demonstrated by the Deodar, which is commonly bluish when cultivated in Europe, and occasionally in the Himalaya, but the great mass of which, in its native forests, is dark green. The character taken from the scales of the cone may be more constant, but the specific distinctions between the three Cypresses described, *sempervirens*, *torulosa*, and *glauca*, seem to invite farther inquiry.

*C. funebris*, Endl.; the weeping Cypress.—Vern. *Chandang*, Sikkim—an elegant tree, with hanging distichous branches and lanceolate mucronate leaves, with a spreading apex, is planted in China near pagodas, also planted in Bhutan near temples and monasteries, between 2000 and 7000 ft., and on the great Ranjit river in Sikkim near convents and cemeteries; also in Nepal. Grows at Calcutta.

*Biota orientalis*, Endl.—Syn. *Thuja orientalis*, Linn., the *Arbor vite*, is a small evergreen tree, indigenous in Japan and China, much cultivated in India and Europe, with the foliage similar to that of the Cypress, but the cones consisting of 3-4 pairs of decussate oblong woody scales, with the apex recurved, and at the base of each 1 or 2 unwinged seeds.

*Callitris quadrivalvis*, Vent. ; DC. Prodr. xvi. ii. 452.—Syn. *Thuja articulata*, Vahl—is a small tree of Western North Africa, where, according to Mathieu, it covers large areas either alone (Fl. For. 355), or mixed with *Pinus halepensis*, *Phillyrea*, and other evergreens, and is remarkable on account of the compact heavy and very fragrant heartwood, which has a rich brown colour, and takes a most beautiful polish. The tree coppices readily, and the forest-fires, which are lighted by the Arab herdsmen (as they are by the pastoral population of India), frequently kill the stem to the ground, when abundant shoots spring up from the root, which attains a great age, and often a considerable size. These masses of root have a beautifully mottled grain; exquisite ornaments and small articles of furniture are made of them, and veneers for the most elegant cabinet-work. This wood was one of those called *Kéδpos*, *citrus* (see p. 56), was highly prized by the Romans, and fabulous prices were paid for tables made of it. The branchlets are green, articulate, and bear at the base of each joint 4 minute decussate scale-like leaves. The fruit is  $\frac{1}{2}$  in. diam., four-sided, consisting of 4 valvate scales, and containing 6 winged seeds. The tree exudes a strongly-scented resin (Gum Sandarach).

## 6. JUNIPERUS, Linn.

Evergreen trees or shrubs, with distinct, generally red-coloured heartwood. Leaves either all linear or subulate, erect or spreading, in whorls of three or dimorphous, viz., on the first shoots of seedlings, and on luxuriant shoots, subulate and spreading, and on the other branches scale-like, opposite, generally decussate, and imbricate. Flowers monoicous or dioicous, terminal or axillary. Male catkins small, cylindrical or ovoid; scales whorled, imbricate, bearing each at its base 3-6 anther-cells. Fruit ripening the second year, fleshy, subglobose, consisting of 3-6 connate carpellary scales (the lower sterile), the tips of which are often visible on the surface of the ripe fruit. Seeds 1-3, with coriaceous testa embedded in the resinous pulp of the berry (galbulus).

All leaves whorled, erect or spreading, linear, pungent; catkins axillary.

1. *J. communis*.

All leaves whorled, subulate, pungent, the upper adpressed, imbricate; male catkins terminal; female catkins at the ends of short lateral branchlets.

2. *J. recurva*.

Leaves dimorphous, those on the great mass of branches scale-like, decussate, adpressed and imbricate, on others subulate, pungent, erect or spreading.

Foliage bushy; branchlets four-sided; the scale-like leaves oblong, more or less keeled at the back, apex not closely adpressed; berries ovoid, subacute, 1-seeded. (A shrub in the N.W. Himalaya, in Sikkim a tree).

3. *J. Wallichiana*.

Foliage light and open; branchlets spreading, indistinctly four-sided; the scale-like leaves ovate, convex, closely adpressed, with a large resinous gland on the back; berries globose, very resinous, 2-5-seeded. (A tree in the N.W. Himalaya).

4. *J. excelsa*.

1. *J. communis*, Linn.; Hook. Stud. Fl. 348; Reichenb. Ic. Fl. Germ. t. 535.—*Juniper*. *Genévrier*, Fr.; *Wachholder*, Germ. Vern. *Nûch*, *pâma*, *pethra*, *bentha*, *betar*, Kashmir, Chamba, and Kulla; *Lang shûr*, *thelu*, *lewâr*, Kunawar; *Chûni*, *shûpa*, Piti.



A dense, diffuse shrub, in Europe sometimes a small tree, procumbent at great elevations. Foliage greyish green. Leaves spreading, in whorls of three, linear,  $\frac{1}{4}$ – $\frac{1}{2}$  in. long, pungent, narrowed at base, nearly flat and bluish green above, light green, convex or obtusely keeled beneath, persistent 3–4 years. Catkins axillary, supported at the base by small bracts; the male ovoid, yellow; the antheriferous scales broad-ovate, acuminate; the female flowers small, resembling leaf-buds. Berries subglobose, on short scaly stalks  $\frac{1}{4}$ – $\frac{1}{3}$  in. long, crowned at the apex with the tips of the carpellary scales; pulp sweet and resinous. Seeds generally 3.

South side of Safedkoh at 9000 ft. North-West Himalaya, but not in the innermost arid tract, abundant in places as far east as the Sulej, less common beyond it. Hills near the mouth of the Sindh valley, Kashmir, at 5400 ft.; in the Butna valley ascending to 11,000; in Lahoul to 12,500 ft.; in Kunawar between 9000 and 11,000 ft.; to 14,000 ft. on the Bias and in Garhwal; easternmost point entrance of the Biāns valley in North-East Kamaon. Throughout Europe to the North Cape. In Greenland, North Asia, also on the Caucasus and on Mount Ararat. In North and Central Europe it is found both on the plains and on mountains. On the Riviera, near Nice and Mentone, it goes down to the coast, but farther south it is found on mountains only. Thus in Spain it occurs (according to Willkomm) on the Guadarama mountains from 3500 to 6000 ft., in the Sierra Nevada from 6500 to 8000, and on Mount Athos in Macedonia (according to Grisebach) from 5200 to 6000 ft. *Juniperus nana*, Willd., which many botanists consider as a variety merely of the common Juniper, ascends even higher, and is found in the Alps and on the mountains of South Europe, in the Alpine zone far beyond the forest belt. On the dry stony hills of the Muschelkalk formation in North and Middle Germany the Juniper is sometimes a useful nurse of plantations, and it often affords shelter in such localities to self-sown seedlings of other trees. In East Prussia and the Baltic provinces the Juniper is often gregarious, covering large extents of ground with open brushwood; and under partial shelter it becomes arborescent, extending over large areas, associated with other trees (Willk. Forstl. Fl. 217). In the North-West Himalaya the Juniper is chiefly found on high dry bleak slopes, usually gregarious, sometimes mixed with *J. recurva*, often in patches forming a belt above the upper limit of the forest. Fl. March, April; the fruit ripens in August and September of the second year.

Generally an irregularly-shaped shrub with stiff branches, branchlets erect or spreading, procumbent at high elevations. In the Himalaya it rarely attains more than 6–7 ft. with a disproportionately thick stem, 18–24 in. girth. In Europe the tree occasionally grows 30–40 ft. high with a girth of 4–5 ft. Bark whitish grey, exfoliating in thin flakes, leaving the brown inner substance exposed. Sapwood large, white; heartwood brown, fine-grained, compact, the annual rings distinctly marked by a dark narrow line. Used for fuel, very acceptable on high passes. The twigs are resinous and aromatic; they are placed before the Deota in temples, and, like the wood, are burnt as incense (*dhūp*). The fruit is sweet, aromatic, and very resinous. In Kamaon it is added to spirits distilled from barley. (In North Germany the berries are largely collected and exported to Holland for the manufacture of gin.) They are sold as medicine in the bazars of North India under the name of *Abhūl*, *hūber*, administered in decoction as a stimulant, diuretic, and emmenagogue.

2. *J. recurva*, Ham.; DC. Prodr. xvi. ii. 481.—*Weeping Blue Juniper*, Hook. Him. Journ. ii. 28. Vern. *Wetyar*, *bettar*, *chūch*, *thelu*, *telu*,

*talū, phulu*, Pb.; *Bettir, bhedāra, bendhāra, bidelgunj, thelu, phulu, jhora, gūgal, bil, urū, agāni*, N.W.P.; *Pāma*, Tibet; *Deechū*, Sikkim.

A gregarious shrub or moderate-sized tree; branchlets decurved or drooping. Leaves adpressed,  $\frac{1}{2}$  in. long, in whorls of 3, generally approximate and imbricate, distant on older branchlets, lanceolate, pungent, back convex. Catkins and berries at the ends of short lateral leaf-bearing branchlets. Berries oblong or ovoid-oblong, pointed,  $\frac{1}{2}$ – $\frac{1}{3}$  in. long, with the tips of carpellary scales near the apex, green at first, olive or blue afterwards, dark-brown or almost blackish-purple, smooth shining when ripe. Seed 1, oblong, obtuse.—*J. squamata* is a procumbent variety with broader, curved leaves.

South side of Safedkoh near Pekar Pass 8000–9000 ft. Himalaya 7500 to 12,000 ft., ascending to 13,000, and on the Niti Pass to 15,000 ft. In Sikkim and Bhutan at 9000–12,000 ft. Occasionally planted near temples, e.g., at Panwi in Kunawar. Fl. chiefly in June, July; the fruit ripening July to October of the second year. In Sikkim and Bhutan attains 30 ft. with a pyramidal crown, and drooping branchlets. In the North-West Himalaya it is only known as a gregarious shrub, often covering large areas, either pure or mixed with *J. communis*, the stems decumbent, at times 6 in. diam., very long, running over or under the surface of the ground, and from these creeping stems rise numerous short erect branches, which make it very difficult to traverse such thickets. Bark smooth, cinnamon-coloured, generally peeling off in conspicuous flakes which curl up. Heartwood reddish-brown, fragrant, useful as fuel at high elevations. The sprigs are used in the distillation of spirits; coarse barley-flour is made into balls, covered with the sprigs and leaves, wrapped up in blankets and kept warm for 3–4 days until it ferments, when it is used in the distillation of arrack from rice. The shrub is sacred, and the resinous twigs are used for incense (*dhūp, gūgal*).

3. *J. Wallichiana*, Hf. & Th. in Herb. Kew.—*Black Juniper* of Sikkim, Hook. Him. Journ. ii. 55. Vern. *Tchokpo*, Sikkim.

In the north-west a large gregarious shrub, in Sikkim a large tree, with densely massed bushy branchlets. Leaves dimorphous, the scale-like leaves oblong, back almost keeled, obtuse, in 4 rows, so as to make the branchlets 4-sided, apex not quite adpressed, those on the lower branchlets linear, pungent, and somewhat spreading. Male catkins terminal. Berries numerous, erect, on lateral leaf-bearing branchlets of variable length, ovoid, acute,  $\frac{1}{2}$ – $\frac{1}{3}$  in. long, blue, shining when ripe, 1-seeded.

Himalaya 9000 to 15,000 ft. from the Indus to Sikkim. Fl. April, May; fr. Aug. Bark brown, smooth, exfoliating in large flakes. This is the large tree Juniper of the inner ranges of Sikkim, attaining 60 ft., with spreading branches. The wood of the Sikkim tree resembles *J. excelsa* in structure.

*J. Pseudo-Sabina*, Fisch. et Meyer; Ledeb. Fl. Ross. iii. 682, a shrub of Siberia, mountains of Davuria and Songaria, is identified with this species by Parlatores in DC. Prodr. xvi. 482; but the fruit, which is 1-seeded like that of *J. Wallichiana*, is described as recurved, not erect. The classification of the Junipers of Asia seems to require critical revision.

4. *J. excelsa*, M. Bieb.—Tab. LXVIII.—DC. Prodr. xvi. ii. 484.—Syn. (partly) *J. chinensis*, Linn., as accepted by Parlature in DC. Prodr. 487. *Himalayan Pencil Cedar*. *Apurs, uppurs*, Beluchistan; *Chalai, chalai*, Jhelam; *Shūkpa, shūr, shūrgu, lewar*, Chenab and Sutlej; *Shūr-būta, shūrgū, shūkpa*, Tibet; *Dhūp, padmak, sūrgi*, N.W.P.; *Dhūpi, dhupri chandan, shūkpa*, Nepal.

A small or middle-sized tree, stunted at high elevations, with slender, terete, nearly distichous branchlets. Foliage light green, not unlike in colour that of *Pinus excelsa*. Leaves of two kinds (dimorphous), on the upper and outer branches scale-like, closely adpressed, imbricate, ovate, acute or pungent, back convex with a resinous gland; on the lower branches, subulate, pungent,  $\frac{1}{2}$  in. long. Male catkins terminal. Berries very resinous,  $\frac{1}{4}$  in. diam., subglobose, black when ripe, at the ends of lateral leaf-bearing branchlets of variable length,  $\frac{1}{2}$ – $\frac{1}{2}$  in. long, seeds 2-5.

Afghanistan and North Beluchistan. Arid tract of the North-West Himalaya and West Tibet, generally gregarious on rocky slopes. At the head of the Kunhār river (the westernmost feeder of the Jhelam), in Kaghan, at the head of the Sind river in Kashmir, on the upper Chenab, Bias and Sutlej (above the Tidong valley and the Werang Pass), on the upper Indus and its tributaries, and at the head-waters of several feeders of the Ganges. Said to be plentiful in inner Nepal, but not found farther east. The range of elevation is from 5000 ft. (Rondou on the Indus) to 14,000 ft. in Ladak. It grows at the Saharanpur garden, and is hardy in England. Beyond India it is difficult to define the limits of this tree, as there are several species closely allied to it which will be noticed below. The Indian tree seems to be identical with that found in the Crimea, on the Caucasus, and the Ural mountains. In the N.W. Himalaya it flowers in summer, and the berries ripen in September of the second year. The tree does not generally attain a height exceeding 50 ft., the trunk is short, but of great girth, 10 ft. and 6-7 ft. at higher elevations (11,000 ft.) being not uncommon, and several over 20 ft. girth being known. The trunk is generally crooked and gnarled, and divides into many large, diffusely spreading twisted boughs, which rapidly diminish in girth, and grow to no great height. An extreme specimen is in Lahoul, 33½ ft. girth, divided into contorted branches not over 30 ft. high. The crown has often an irregular and grotesque shape. The branchlets are slender, glaucous, erect or spreading, shorter and less pendulous than those of *Cupressus torulosa*, but very like it in hand specimens. Bark of branchlets reddish-brown, shining, with a cinereous silvery pellicle peeling off. The bark of the trunk is reddish-brown or grey, smooth between longitudinal cracks, exfoliating in long fibrous strips. Inner substance compact, fibrous. The rate of growth is slow, three sections recorded by Stewart gave 24, 40, and 44 rings per inch of radius respectively. The sapwood is large, light-coloured, the heartwood light or dark red, even- and close-grained, with a scent similar to that of the pencil cedar, but less powerful; it is much harder than the American pencil cedar. Like the wood of most Junipers, the annual rings in the wood of *J. excelsa* are distinctly marked by a dark narrow line. The medullary rays are often darker than the rest of the wood. Weight, 25-37 lb. per cub. ft. In Quetta and Kelat it is much used for rafters and building. In the bare and arid tracts, where it is chiefly found, it is used for many purposes. Supports of water-channels are made of it, and the heartwood is said to be almost imperishable in moist earth. In Lahoul it is used, alternating with stones, for the walls of houses, as well as for beams. In Kunawar some of the temples are built of it; it is made into drinking-cups and walking-sticks.

At Leh it is largely used as fuel (the driftwood that comes down the Zaskar river); it burns quickly with a peculiar smell. Charcoal is made of it in places. In Kunawar it is burnt for incense, and is exported for that purpose. The fruit is very turpentine and not eatable; under the name of *Ahüber*, it is medicinal in Sindh, and is said to be used as incense.

The species closely allied to this are: 1. *J. chinensis*, Linn., China and Japan, very similar to *J. excelsa*. 2. *J. foetidissima*, Willd.; DC. Prodr. xvi. ii. 485 (united with *J. excelsa* by Grisebach Veg. der Erde, i. 572). Forms forests with other conifers on the mountains of Greece, Macedonia, Asia Minor, Armenia, Syria, and is also found on the Caucasus; 1½ seeds, according to Parlatores. 3. *J. procera*, Hochstetter, on the mountains of Abyssinia and Arabia Felix; 2-3 seeds. 4. *J. thurifera*, Linn.; Portugal, Spain, and Algeria, above 3000 ft. elevation; 2-3 seeds. All these are trees, sometimes attaining a considerable size; and in addition to them Grisebach distinguishes 5. *J. agavea*, from the Greek Archipelago, with sessile fruit. 6. *J. Sabina*, Linn., is generally a shrub, rarely a small tree; seeds generally 1-2, rarely 3-4, Parlatores; fruit smaller than that of the preceding species, except *J. procera*, which also has small berries. The distinguishing characters between these species are somewhat uncertain.

*Juniperus virginiana*, Linn., the American Pencil Cedar, near the coast of the Atlantic from Maine to Florida, with compact scented red heartwood, and *J. bermudiana*, Linn., of the Bermudas, the West Indies, and Florida, mainly yield the wood of which pencils are made.

*Juniperus drupacea*, Labill.; DC. Prodr. 476—Syn. *Arceuthos drupacea*, Antoine & Kotschy—is a dioicous shrub or small tree, with large subglobose fleshy and eatable fruit 1 in. diam., consisting of 9 scales, the tops of which are prominent in 3 whorls, 6 near the apex and 3 at the base of the fruit. Leaves in whorls of three, lanceolate, rigid, pungent,  $\frac{3}{4}$  in. long, 1-1½ lines broad. Mountains of Asia Minor, on Lebanon and Antilebanon, rare on the higher mountains of Greece. Attempts might be made to cultivate this useful tree in the drier parts of the Panjab Himalaya. Hardy in England.

## 7. TAXUS, Tournef.

Slow-growing and long-lived evergreen trees or shrubs, with tough red heartwood. Leaves linear, distichous. Flowers sessile in the axils of leaves, usually dioicous. Male catkins subglobose, stipitate, supported at the base by empty bracts, the axis bearing at its end numerous peltate scales, each on its lower edge with 3-6 anther-cells, dehiscing longitudinally. Female flowers resembling leaf-buds, consisting of a few imbricate scales, enclosing an erect ovule, surrounded at the base by a disc which is membranous in flower, but enlarges into a red fleshy cup, surrounding the seed. Testa bony, embryo with 6-7 cotyledons.

1. *T. baccata*, Linn.; DC. Prodr. xvi. ii. 500; Hook. Stud. Fl. 349; Reichenb. Ic. Fl. Germ. t. 538.—Syn. *T. nucifera*, Wall. Tent. Fl. Nep. t. 44; *T. Wallichiana*, Zucc. *Few. Eibe*, Germ.; *If*, Fr.; *Tasso*, It. Vern. *Sarāp*, badar, Afg.; *Birmi*, barma, tung, thūnu, sungal, piästül, chogu, Kashmir, Chamba; *Rakhal*, Bias; *Barmi*, Shali; *Thūna*, Hattu; *Yandal*, Kunawar; *Thūner*, geli, gallu, lüst, N.W.P.; *Nhare*, Tibet; *Tingschi*, Sikkim.

A large tree with dense, dark-green foliage. Leaves linear, 1 line broad and 1½ in. long, apex sharp, base narrowed into a short petiole,

decurrent along the branch with two raised lines. Male flowers yellow. Fruit a red ovoid berry, somewhat more than  $\frac{1}{3}$  in. long, open at the mouth, so that the top of the dark olive-green seed appears.

Kafiristan, south side of the Safedkoh. Himalaya from the Indus to Bhutan, abundant in places, but very local. Not uncommon in Hazara, common in the dense forests of *A. Webbiana*, *A. Smithiana*, *Acer*, *Pavia*, *Juglans*, on the upper part of the northern slopes of the range stretching from the Shali to Narkanda, also on the sides of Hattu, both north and south, in the Balsan forests east of the Giri, opposite to Imbri, and in many other places between Sutlej and Ganges. In Kunawar it is found, here and there, above 9000 ft.—*e. g.*, above the Nachar forest, and in the Baspa valley. In Garhwal and Kamaon it is generally found between 6000 and 8500 ft., ascending to 11,200 ft. at Kedarnath. It grows in Sikkim, on the outer ranges at 9500 to 10,000 ft., in the inner ranges descending to 7000 ft. in Bhutan and on the Kasia hills (at 5000 ft.), and has been found in upper Burma. As defined by Parlatores, this species extends throughout Europe, North Africa, and is found on the mountains of Asia Minor, Armenia, and on the Caucasus; he enumerates 5 species besides, two from Japan and three from North America, which Hooker regards as all forms of the same species. In Central and North Europe the Yew is indigenous both in the plains and on the mountains, but in the Mediterranean region it is only found at a considerable elevation. In some regions of the Himalaya its lower limit is not exactly known; it does not extend into the inner arid zone. It is certain that the Yew was more common formerly in many forests of Central Europe than it is at present; the young plant requires shelter, and, like the Holly, thrives in deep shade. Any system of forest management, therefore, which requires entire or partial clearances, impedes its growth and prevents reproduction by self-sown seedlings. In the Himalaya the Yew clothes itself with young brilliant green shoots in April and May, and the flowers open between March and May. In Europe it flowers, according to latitude and elevation, between March and May, and the young shoots generally appear a week after flowering (Willkomm, Forstl. Fl. 223). The fruit ripens (in India and Europe) from Sept. to Nov. of the year of flowering.

In the Himalaya the Yew attains a considerable size; Madden records a tree at Gangūtri 100 ft. high and 15 ft. girth. In the Panjab Himalaya the common size is 5-6 ft. girth; in Hazara 8-9 ft. is not uncommon. In Europe the largest and oldest Yew-trees are recorded in Britain; specimens 10 ft. diam. and 30 ft. girth are not rare in England and Scotland, and some are on record with a diam. of 15-20 ft. The growth of the tree is slow; and there is no doubt, from an examination of the annual rings and from historical records, that some of the Yew-trees now in existence in England are considerably more than 1000 years old. The bark is thin, brownish-grey, hard and smooth, cleft longitudinally and peeling off; inner substance fibrous. The growth is very slow, 20-32 rings per in. of radius are recorded from the Himalaya, and this accords with the experience of the growth of the tree in Europe. Sapwood whitish, the heartwood is reddish-brown, compact, hard and heavy, 46-59 lb. per cub. ft. It is strong and elastic, and takes a beautiful polish. In Europe it is used for all kinds of turnery, for carving, and other purposes which require a firm and elastic wood. Whip-handles are made of the branches, and from time immemorial it has been the principal wood used for bows. The Indian wood, as far as known, has the same qualities as that of the European tree; bows, carrying-poles, and native furniture are made of it, but it might be more extensively used. The tree is held in great veneration in some parts of the N.W. Himalaya, it sometimes is called *Deodār* (God's tree); the wood is burnt for incense, branches are carried in religious processions in Kamaon, and in



Nepal the houses are decorated with the green twigs at religious festivals. The bark (*sang, sangha*) is exported to Ladak from Kunawar, to be mixed with tea, and to be used as a red dye. In Kunawar a decoction of it is administered for rheumatism. The branches are used to support earth roofs. The leaves (*birmit*) are exported to the plains of the Panjab, and used medicinally as a stomachic; in Europe they are considered poisonous, but not everywhere nor under all circumstances. Goats, rabbits, and sheep eat them freely (Selby, Brit. Forest Trees, 374). The berries are sweet and harmless, and are eaten by the natives of the N.W. Himalaya.

*Podocarpus neriifolia*, Don; DC. Prodr. xvi. ii. 514, is a large evergreen tree with somewhat whorled branches and alternate, coriaceous, linear-lanceolate leaves with a prominent midrib, 4-5 in. long; male catkins axillary, cylindric, antheriferous scales with 2 anther-cells; fruit axillary, fleshy, 1-seeded, ovoid, on a fleshy receptacle.

Nepal, Sikkim, Kasia, ascending to 3000 ft. A remarkable tree in Burma, nearly allied to it, which S. Kurz, however, refers to *P. bracteata*, Blume, of the Indian Archipelago, grows in the evergreen forests of the Bithoko range, between the Yonzaleen and Salween rivers, above 2000 ft., where I found it in March 1859, also on the coast-range of the Tenasserim provinces. It is called *Thit min, the Prince of trees*, in Burma. The wood is close-grained and highly prized in Burma.

#### ORDER LXXVII. PALMÆ.

Stem solid, either an underground perennial rhizome, producing flower-stalks and tufts of leaves, or more commonly above ground, erect, scandent or supported by other trees and bushes. The stem above ground is, with few exceptions, simple and without leaf-bearing side branches. The vascular bundles do not unite into concentric masses of wood and bark, separated by a continuous cambium layer, but are distinct, scattered in the cellular tissue of the trunk. They consist of vessels, varying in size, which on a horizontal section appear as pores; secondly, of elongated or polygonous cells, generally forming a mass of softer tissue, immediately surrounding the vessels; and, thirdly, of a mass of long thick-walled bast-cells or fibres, of which the hard horny portion of the bundle is composed. Near the circumference the bundles are generally more numerous, smaller and harder, owing to the predominance in them of the bast-cells or fibres, while near the centre they are sparse, containing a relatively larger proportion of cells and vessels. The result is, that the centre of a Palm stem is generally the softest part, not rarely becoming hollow by the decay of the cellular tissue. The vascular bundles can be traced from the interior of the stem to the base of the leaf, which is generally broad, and in most cases cylindric and sheathing. The youngest leaf in the terminal bud is at the top in the centre; as the bud expands it enlarges, and at last encloses the circumference of the stem, hence the vascular bundles descending from it bend inward towards the centre. Lower down these same bundles gradually bend outward toward the circumference, where they can be traced for a considerable length in a vertical direction under the surface. This explains a remarkable feature in the structure of the Palm stem, which shows itself most distinctly in a vertical section made parallel to

the radius, but may also be observed in a horizontal section. In vertical sections a portion of the vascular bundles will be found to run straight downward, but they are crossed by other bundles at oblique angles. The latter are those portions which bend outward towards the base of the leaf or the lower part of the stem. In transverse sections some bundles may generally be noticed, cut through in a slanting, not horizontal direction; these were cut across in their outward course towards the circumference of the tree. Again, the structure of each bundle is different in its upper and lower part: in its upper part it contains all three classes of elementary organs enumerated above, vessels, fibres, and cells; whereas the lower part is almost entirely composed of fibres. This will explain the different composition of the vascular bundles near the centre, and the circumference of the stem. The stem of many Palms has a distinct rind composed of thick-walled cells, and inside of it the outer vascular bundles (consisting mainly of thick-walled fibres) are sometimes nearly confluent, but never entirely so. But though the outer stratum is harder, there is no distinct bark that can be stripped off, and no continuous confluent cambium layer as in Dicotyledons and Conifers. Nor are there any annual rings in the wood of Palms. After the stem has once attained a certain size, it does not materially increase in thickness, though it sometimes swells out in an irregular manner.

As regards the surface, one group of Palms has smooth and shining stems, annulate with raised rings, which are not quite horizontal, but slightly and alternately inclined to opposite sides. These rings are the scars of fallen leaves, and according to the length of the joint or internode, they are at greater or less distances from each other. The *Rattans* (*Calamus*) and the *Betel Palm* (*Areca*) are instances of this group. In another group (*Chamarops*, *Borassus*, *Cocos*, *Phoenix*) the surface of the stem is rough with the persistent base of the petioles, and in this group the internodes are always short, and the leaves and scars of petioles are arranged around the stem in a series of close spirals. It will be readily understood that in the Palms of the second class the leaves always stand close together, forming a dense tuft at the end of the stem, while in those of the first group the leaves stand at some distance, often covering a considerable length of the stem (*Calamus*).

The leaves of seedlings are always undivided; those which are formed at a later period are generally either pinnately or palmately divided, the pinnae or segments being linear or lanceolate, mostly folded longitudinally with numerous and parallel nerves. The segments of palmatifid leaves are frequently bifid, those of pinnately divided leaves are either entire or irregularly lobed (*Wallichia*, *Caryota*, and allied genera), and in that case the edge or outline of the leaf runs partly with the nerves, partly across at an oblique angle, a portion of the outline appearing dentate by the projecting ends of the nerves. The petiole is always broad-based, and generally amplexicaul or sheathing.

The inflorescence is terminal in some Palms (*Corypha*, *Metroxylon*), but lateral in most cases, either in the axils of existing or fallen leaves. It is generally a panicle enclosed in bud by large sheathing bracts (spathes),

the common peduncle (spadix) being often branching, thick, and sometimes woody. The flowers are rarely bisexual, generally dioicous, monoicous, or polygamous. Calyx and corolla, as a rule, consist of 3 segments or leaves each, those of the fertile flowers are commonly persistent in fruit. Stamens 6, rarely 3, 9, or numerous; anthers 2-celled, opening longitudinally. Ovary 3-celled, one ovule in each cell; sometimes 3 distinct 1-celled carpels. Seed albuminous, albumen cartilaginous, horny, or oily. Embryo small, cylindric, when germinating the upper end remains enclosed in the seed, enlarging considerably at the expense of the albumen, while the lower part lengthens out, throwing out lateral rootlets, and at a greater or less distance from the seed, the plumula emerges from the slit, bearing one or two truncate sheaths, which surround the undivided leaves of the seedling.—Royle Ill. 394; Martius, *Historia Naturalis Palmarum*, folio, vol. i. iii., 1823-1850. Griffith, *The Palms of British India in the Calcutta Journal of Natural History*, vol. v., 1845, and (with plates and additions) in folio in the *Posthumous Papers: Calcutta*, 1850.

This Family, which comprises upwards of 680 species, is commonly divided into the following six Tribes:—

*Borassineæ*.—Leaves fan-shaped; flowers unisexual, commonly dioicous; male flowers in the axils of whorled closely imbricate bracts, in thick cylindric spikes; albumen horny or cartilaginous—*Borassus*, *Hyphæna*, *Lodoicea*.

*Coryphineæ*.—Leaves fan-shaped, base of petiole broad-based or sheathing, sheath fibrous; flowers bisexual or polygamous, in compound panicles; carpels 3, distinct or cohering; albumen horny—*Chamærops*, *Corypha*.

*Phaniceinæ*.—Leaves pinnate, leaflets entire, petiole on a short reticulate fibrous sheath; flowers dioicous, in long spikes at the end of a compressed, often woody peduncle; carpels 3; fruit fleshy, 1-seeded, enclosing a hard seed with bony albumen—*Phoenix*.

*Arecinæ*.—Leaves pinnate, leaflets entire or jagged; petioles sheathing; flowers monoicous, inflorescence of long drooping spikes at the end of a thick, almost fleshy peduncle; seeds hard with horny albumen—*Wallichia*, *Caryota*, *Areca*, *Ceroxylon*, *Arenga*.

*Cocoinæ*.—Leaves pinnate, leaflets entire, petioles amplexicaul, with a fibrous base; flowers monoicous, inflorescence of long drooping spikes at the end of a thick sometimes branched peduncle; albumen oily or cartilaginous—*Cocos*, *Elaeis*.

*Lepidocaryineæ*.—Leaves pinnate, leaflets entire, petioles on long sheaths, petioles and sheaths with prickles, scattered or in oblique lines or rings; flowers monoicous or dioicous, in compound panicles, with sheathing bracts at the ramifications, common peduncle, petiole or sheath often terminating in long thorny whip-like thongs; ovary 3-celled; fruit covered with closely adpressed, imbricate, recurved scales; albumen horny—*Calamus*, *Metroxylon*, *Sagus*.

Leaves fan-shaped.

Flowers dioicous, in paniculate spikes; male spikes thick, cylindrical, flowers fasciculate in the axils of broad whorled imbricate connate bracts, ovary 3-celled.

Flowers polygamous, in compound panicles without bracts; carpels 3, distinct.

Leaves pinnate or pinnatifid.

Pinnæ cut and jagged, often cuneate.

Pinnæ linear or lanceolate, entire.

Leaves terminal.

Flowers dioicous; fruit fleshy, enclosing a hard seed with bony albumen.

Flowers monoicous; pericarp fibrous, endocarp hard, bony, albumen oily.

Leaves distant, lateral, on long thorny sheaths; flowers in long panicles with sheathing bracts.

1. BORASSUS.

2. CHAMÆROPS.

3. WALLICHIA.

4. PHENIX.

5. COCOS.

6. CALAMUS.

### 1. BORASSUS, Linn.

Stem tall cylindric, with a large terminal crown of fan-shaped leaves. Petiole semiterete, broad-based, edges serrate, with hard horny spinescent serratures. Flowers dioicous, spadix with few simple branches, lower part covered with numerous large sheathing coriaceous and fibrous imbricate bracts. Male inflorescence composed of thick cylindric spikes, in pairs or in threes at the ends of the branches of the spadix. Axis thick, cylindric, covered with numerous broad whorled closely set and imbricate bracts, connate at the edges, each bearing in its axil a fascicle of 10-12 flowers and numerous membranous bracts, the flowers concealed in bud, but becoming exerted on expansion by the lengthening out of the corolla tube. Calyx campanulate, trifold to the middle; segments narrow-oblong or linear. Corolla a slender solid tube, which, lengthening out, rises above the bract, and expands into a 3-partite limb, with oval concave segments. Stamens 6, inserted on the solid corolla tube; filaments short; anthers sagittate; no rudiment of ovary. Female spikes paniculate, with numerous annular sheathing bracts, each flower consisting of 8-12 unequal, closely imbricate, rounded coriaceous concave leaves (bracts sepals and petals), all similar in shape and texture. Ovary 3-celled, surrounded by 6-9 small sterile stamens; stigma sessile. Fruit enclosed by the enlarged and partly fleshy closely imbricate perianth and bracts, 3-seeded. Albumen horny.

1. *B. flabelliformis*, Linn.; Roxb. Cor. Pl. t. 71, 72; Fl. Ind. 790. *The Palmyra Tree*.—Sans. *Trinarāja* (king of grasses). Vern. *Tāl, tāla, tār*, Hind.; *Potu tādī*, the male, *penti tātī chettu*, the female tree, Telugu; *Htanben*, Burm.

Young stems covered all their length with the dry leaves or lower part of petioles, old stems marked with the hard black long and narrow scars of the fallen petioles. Base of stem surrounded by a dense mass of numerous long cylindrical rootlets, consisting of a tough central vascular axis surrounded by a mass of fibres and a layer of thin brittle bark. Segments

of leaves 60-80, parchment-like, smooth, shining, folded along the midrib, linear-lanceolate, connate to half their length, entire, at last bifid, 18-30 in. long, diameter of the leaf 3-5 ft.; petiole 2-4 ft. long. Male spikes drooping, flowers delicate, pink and yellow, one flower only opening at a time in each bract. Fruit subglobose, depressed, 5-7 in. diam., smooth, shining, dark brown shaded with yellow, rind coriaceous, enclosing a yellow pulp mixed with tough straw-coloured fibres, which surround the seeds. Seeds 2-4, generally 3, broad, heart-shaped; albumen white, cartilaginous.

Cultivated in the Indian Archipelago, the trans-Gangetic peninsula, Ceylon, South and Central India, Bengal, and Lower Sindh. In North-West India as far north as Alligarh and Shahjehanpur. Isolated trees in gardens in Rohilkhand and the Upper Ganges Doab as far as Saharanpur. Also on both sides of the Persian Gulf, attaining there about the same latitude as in North-West India—30° N.L. Fl. March; the fruit ripens in April or May. Generally 40-60 ft. high, but attains 100 ft. in Burma (in the splendid Palmyra groves of the Prome district), and perhaps elsewhere. Forked and branching stems are occasionally found. Diam. of a full-grown tree above the generally thick base, about 18-24 inches. The heart of the tree is soft, but the outer wood is hard, heavy, and durable, consisting of numerous thick black vascular bundles. Weight, 65 lb.; value of P. 944, Skinner. The stems are hollowed out and employed as water-pipes; cut half through lengthwise they serve as gutters and open channels. The outer wood is used for posts, rafters, and building generally, also for furniture. The leaves are, like those of *Corypha*, universally employed for writing upon (with a pointed iron style); documents written on Palm-leaves last several centuries; the leaves are also used as thatch and for mats and basket-work. The pulp of the fruit is eaten, raw or roasted, and a preserve is made of it in Ceylon. The unripe seeds, and particularly the young plants 2-3 months old, are an important article of food. But the most valuable produce of the tree is the sweet sap which runs from the peduncles cut before flowering, and collected in Bamboo tubes or in earthen pots tied to the cut peduncle. Nearly all the sugar made in Burma, and a large proportion of the sugar made in South India and the Konkan, is the produce of this Palm. The sap is also fermented into toddy and distilled.

To the same genus belongs the *Deleb Palm*, *Borassus Ethiopum*, Mart., a common tree in a large tract of tropical Africa south of the Sahara, from Timbuktu to the Nile, and from Lake Tehad to the Nyassa Lake. The fruit, but still more the young seedlings, which are raised on a large scale for that purpose, are important as an article of food. Two other remarkable Palms are classed under the tribe of *Borassineæ*: 1. *Lodoicea Secellarum*, Labill.; Bot. Mag. t. 2734-38, the *Coco de Mer*, *Double Cocoa-Nut*. A tall Palm with distinctly annulated stem, crowned with a tuft of 12-20 gigantic leaves, folded up when young like a shut fan, expanding afterwards into a broadly ovate blade, numerous lateral ribs diverging from a prominent midrib at acute angles, the edges more or less deeply cut; petiole as long as leaf. The flowers are dioicous, and similar to those of *Borassus*; the male flowers, however, have 15-20 monadelphous stamens. The fruit takes several years to come to maturity. It attains a gigantic size; the weight of the ripe fruit is often 40-50 lb., and consists of a thick fibrous rind, enclosing 1, sometimes 2 or 3, hard nuts, which are 2-lobed, sometimes 6-lobed. When ripe the albumen of the seed is horny, but when unripe the inside of the fruit is soft and eatable. The unripe fruit is eaten, and the hard black shell of the nut is carved into orna-



ments, and Fakirs' drinking-cups. The leaves when young yield a beautiful material for basket and plaited work; hats, fans, and various other articles are made of them; when full-grown they are used for partitions and roofs of houses. This Palm is only found on two or three small rocky islands of the Seychelle group north-east of Madagascar. These islands were discovered in 1749, but long before that time the double Cocoa-nut had been known in India, and on the Indian Archipelago, having been washed upon the Maldivé Islands by the monsoon, and the tree being unknown, wonderful stories were current regarding the nature and origin of these curiously-shaped nuts. 2. *Hyphæne thebaica*, Mart.; Hist. Nat. Palm. t. 131, 132, 133, the *Doum Palm* of Upper Egypt and Nubia, extending west to the Niger near Timbuktu, one of the few species of this Order, the stem of which habitually and normally divides into bifurcating branches, each branch bearing a crown of fan-shaped leaves. The flowers are dioicous; the fruit is in long hanging clusters, irregularly shaped, surface shining brown, 1-seeded, with a sweet fibrous mealy rind which has a taste like gingerbread—is eaten, and forms an important article of food in some parts of Africa. Rosary-beads are made of the horny albumen.

## 2. CHAMÆROPS, Linn.

Stems densely covered while young with the lower parts of petioles. Base of old stems indistinctly annulate. Leaves fan-shaped, forming a rounded terminal crown; petioles sheathing, the sheath fibrous, edges of petioles mostly aculeate. Flowers yellow, polygamous, often dioicous, inflorescence a compound panicle on a thick peduncle (spadix), enclosed in bud by a coriaceous oblique sheath. Calyx tripartite, corolla of 3 petals, valvate in bud, petals and calyx-segments often more numerous. Stamens 6-9. Carpels 3, distinct. Berries 3, or fewer by abortion. Albumen horny or cartilaginous; embryo dorsal.

1. *C. Martiana*, Wall. Pl. As. rar. t. 211.—Syn. *C. Khasyana*, Madden, On the occurrence of Palms and Bamboos at considerable elevations in the Himalaya, Trans. Edin. Bot. Soc. iv. 186 (1853). Vern. *Jhangra*, *jhaggartal*, Kamaon; *Taggu*, the Newar name in Nepal.

A tall slender tree, 40-50 ft. high, stunted on dry ground or in otherwise unfavourable localities, with a globose crown of dark shining leaves. Petioles 3 ft. long, the sheathing base consisting of 2 layers, the inner layer, which separates from the outer, being composed of a network of brown tough fibres, crossing each other at oblique angles, forming a close network of rhomboid meshes; upper part of petiole half-round, woolly, edges slightly denticulate. Blade orbicular, consisting of 30-40 linear segments 15-20 in. long, connate to one-third or one-half their length, emarginate or shortly bifid at the top. Inflorescence a drooping compound panicle covered with dark rust-coloured down, with several stout main branches, each in the axil of a large coriaceous sheathing bract. Petals three times longer than calyx, ovate, concave, whitish. Stamens 6, filaments subulate, nearly free, longer than anthers. Ovaries and rudiment of ovary hairy. Berry 1, oblong, yellow at first, dark glossy blue when ripe. In Wallich's figure, and Martius' description which accompanies it, the fruit is yellow, probably because unripe.

Grows in great numbers, forming clumps and rows, on the Thakil Mountain in eastern Kamaon, in the fork between the Sarju and Kali rivers, between 6500 and 7800 ft., where snow generally covers the ground from Nov. till March, above the zone of *Pinus longifolia* in the region of *Quercus*, *Rhododendron*, *Andromeda*, and *Taxus*, in damp shady glens on the north and south-east, but chiefly on the north-west side. Also on Dhuj Mountain, north-east of the Thakil, on the Kalimoon range between the Ramgunga and Gori rivers, and in the Sarju valley near Bagesar. Dwarf specimens were found by Madden in two localities of north-west Kamaon—viz., at the base of the Satbūnga Mountain, south-east of the Gagar Pass, in very dense forest at 6500 ft. elevation, and on the Berchula, a spur of the Bhatkot Mountain, considerably farther in the interior, and at about 8000 ft. elevation, which probably is its western limit. Also in great abundance at Bunipa in the great Nepal valley 5000 ft. elevation (Wallich). Fl. April, May; fr. Oct. The fruit is eaten, though the pulp is scanty and almost tasteless.

*C. khasyana*, Griff.; Calcutta Journ. Nat. Hist. v. 341, on precipices at Mūsmāi and Mamlū, Kasia, alt. 4000 ft.—Vern. *Pakha*, Hook. Him. Journ. ii. 279—is described as a distinct species, differing by the petioles toothed throughout, the nature of the fibrous net of the petiole sheaths, and the thick white paleaceous tomentum with which the young leaves are covered. The fruit is blue when ripe, like that of *C. Martiana*, and both Madden and Hooker have suggested the identity of the two. In Griffith's posthumous work (Palms of British India, 134), Thakil in Kamaon is given as a locality of *C. khasyana*. In Voigt's Hort. Suburb. Calc. 641, the Kasia Palm is mentioned as cultivated in the Calcutta gardens (without having flowered) under the name of *C. Griffithiana*, Wall. MSS. In the Revue Horticole of 1870, 276, *C. Griffithii*, Lodd, is described and figured as a Palm 10 ft. high, petiole unarmed, without serratures, but white-tomentose when young; received at Paris in 1839 from Dr Wallich in Calcutta. This probably is *C. Martiana* of Nepal and Kamaon. The question whether the Kasia plant is a distinct species is a matter for farther inquiry. No *Chamærops* has yet been reported from Sikkim.

Hermann Wendland, as quoted by Gay (*Chamærops excelsa*, Thunb. in Bulletin de la Société Botanique de France, 1861), classes the two species mentioned, together with *C. excelsa*, Thunb., of Japan and North China, under a new genus, *Trachycarpus*, distinguished from *Chamærops* by an elongated inflorescence, subulate filaments, hairy ovaries; the embryo dorsal, but situated above the middle; whereas in *C. humilis*, and allied species of *Chamærops* proper, the embryo is situated near the base of the back, the ovaries are glabrous, and the filaments short, broad, and connate at the base. *C. excelsa* is a most useful plant; the leaves are made into hats and waterproof cloaks, and rope is manufactured of the inner fibrous layer of the sheath.

*C. humilis*, Linn., is a widely spread Palm, with small semicircular leaves of 20-30 segments, of the western Mediterranean region and North Africa, its northernmost limit being the Riviera near Nice, N.L. 43°. In Spain it covers large extents of waste land, and is sometimes found difficult to eradicate, on account of its deep and tough roots. Mats and baskets are made of the leaves, and they have of late years been employed to make paper. The hard horny ruminated albumen of the seed is made into rosary-beads.

2. *C. Ritchieana*, Griff. Calc. Journ. Nat. Hist. v. 342.—*Mazri*. Vern. *Mzarai*, trans-Indus (*maizurrie*, Pushtu, Griff.); *Kilu*, *kaliūn*, Salt range. The fibre is called *patha* in the Panjab. *Pfis*, *pesh*, *pease*, *fease*, *pfarra*, *pharra*, Sindh, Beluchistan.

A low gregarious shrub with greyish-green coriaceous leaves. Petioles entire and unarmed, 6-12 in. long, base without any reticulate inner layer, but with a mass of rust-coloured wool. Segments 8-15, linear, rigid, 12-15 in. long, induplicate, deeply bipartite. Inflorescence erect, a slender compound panicle, branches and branchlets from the axils of tubular membranous sheathing bracts with prominent reticulate longitudinal nerves; branchlets bifarious, with numerous flowers in the axils of turbinate membranous sheathing bracts, with a thin membranous edge. All the bracts are closed sheaths, with a short subulate or triangular apex; they are spirally arranged, though apparently distichous on the principal axis and the main branches. Male (bisexual?) flowers enclosed, while in bud, in the sheathing bracts, and supported by a hyaline 2-nerved, and bicuspidate bracteole (similar to the palea of grasses). Calyx gamosepalous, thin, hyaline, 3-dentate; petals 3, oblong obtuse; stamens 6, and a glabrous conical, syncarpous rudimentary (?) ovary. Anthers sagittate, attached at the back above the base to the subulate filaments. Fruit an ovoid or subglobose 1-seeded berry, with the rudiments of 2 abortive carpels, supported by the marcescent calyx, petals, and the remains of the 6 filaments. Fruit subglobose or oblong, varying in size, from  $\frac{1}{4}$  to  $\frac{1}{2}$  in. diam., surface minutely wrinkled. Albumen horny, with a large central cavity. Embryo basal.

This species is altogether unlike a *Chamærops*, and will eventually form a new genus, the inflorescence, bracts, and 2-nerved bracteoles resembling those of some species of *Calamus*. The materials available (unripe fruit and young buds of male or possibly bisexual flowers) do not admit of establishing the generic characters in a satisfactory manner at present. This interesting Palm is recommended to the attention of botanists who may visit its native habitat.

Abundant in the Peshawar valley, in Kohat, and in the trans-Indus territory along the eastern skirts of the Sulimān range, ascending to 3000 ft.; also on the hills which form the western boundary of Sindh. Common locally on a limited area in the central Salt range, between 2500 and 5000 ft., and on Mount Sakesar. Also found by Dr Stewart in one place in the Siwalik tract east of the Jhelam, near Sumāni above Bhimbur. Common in the Khaiber Pass, and generally in the low arid mountains of eastern Afghanistan. Everywhere up to 5000 ft. in Beluchistan and Mekran, except near the coast. The fruit ripens in summer. It is generally stemless, the tufts of leaves arising from a creeping underground rhizome, and in this shape it covers large tracts of rough rocky ground. But a stem grows up sometimes; in Sindh Stocks notes it 6-8 ft. high, and Dr Stewart records a specimen planted in the Saharanpur garden, from seed brought by Dr Jameson from Kohat more than twenty years ago, with a trunk 10-12 ft. high. It is a most useful plant in the arid regions where it is common. The stems, petioles, and leaves serve as fuel, the delicate young leaves are eaten as a vegetable, the reddish-brown moss-like wool of the petioles is impregnated with saltpetre (steeped in the juice of Mulberry-leaves, Bellew), and used as tinder for matchlocks. Excellent matting is made of the leaves (superior to that made of *Phœnix*, Aitchison). Rope is also made of leaves and leaf-stalks; at the Jhelam bridge of boats it was used one season, when *mūnj* (*Saccharum Sara*) was scarce, but Dr Stewart records that it snapped with a strain which it is supposed *mūnj* would have resisted. The leaves are also made into fans, sandals, baskets.

pouches, brushes. Trans-Indus, a rude kind of drinking-cup is made of the entire blade, by tying together the tops of the segments. The seeds are pierced, made into rosaries, and are exported for that purpose to Mekka via Muscat, from Gwâdur on the Beluchistan coast west of the Indus.

*Corypha umbraculifera*, Linn. Roxb. Fl. Ind. ii. 177, the *Talipot Palm* of Ceylon and the Malabar coast, has bisexual hexandrous flowers in a large erect compound pyramidal panicle, which is terminal in the centre of the crown of leaves, and as tall as the trunk of the tree. After the seeds ripen the vegetation of the terminal shoot is completed, and the tree dies. The leaves are nearly orbicular, with a diameter of 10 ft., segments 40-50; united beyond the middle, and bifid. Fans, mats, and umbrellas are made of the leaves, and the segments of this as well as of a closely allied species, *C. Taliera*, Roxb. Cor. Pl. t. 255, 256—Sans. *Tali*; Vern. *Tara*, Beng.—which grows in Bengal, are used for writing, like the leaves of *Borassus*, and books of these leaves last for centuries. There is a third species, *C. elata*, Roxb. Fl. Ind. ii. 176—Vern. *Bajâr*, Beng., also a native of Bengal, trunk 60-70 ft. high, and inflorescence one-fourth the length of the trunk. Roxburgh records that two trees of this species at Calcutta came into flower when about thirty years old. The two Bengal species flower in March and April, the seed ripening 8-9 months afterwards. The albumen of *Corypha* is horny.

### 3. WALLICHIA, Roxb.

Cæspitose shrubs, generally monoicous, with tufts of leaves or slender reed-like stems, from an underground rhizome. Leaves pinnatifid, petioles with short fibrous sheaths; pinnæ white beneath, lanceolate or cuneate, sinuate or lobed, alternate, the upper generally broader and confluent, the lower often subopposite and fasciculate; lateral nerves fine, numerous, separating at oblique angles from the prominent midrib, and terminating in unequal subulate teeth, where they do not run parallel to the edge of the leaf. Male and female flowers in distinct inflorescences, enclosed in bud by numerous imbricate sheaths. Calyx of male flowers gamosepalous, stamens 6 (subgenus *Harina*), or 3 sepalous, stamens numerous (subgenus *Orania*). No rudiment of ovary. Calyx and corolla of female flower deeply 3-partite, generally coriaceous. Ovary 2-celled. Fruit fleshy, with acrid juice, 2-seeded or (by abortion) 1-seeded; albumen uniform, horny, embryo in the convex part (back) of the seed.

1. *W. densiflora*, Martius; Bot. Mag. t. 4584.—Syn. *Harina oblongifolia*, Griffith Palms, t. 237, A.B.C. Vern. *Kala Amsa* (black reed), *gor amsa*, Kamaon. *Ooh* (ūh) of the Lepchas in Sikkim.

A stemless palm, forming thick tufts of large leaves 10 ft. long or more, which die to the ground after the fruit ripens. Petiole angular, naked in the lower half or two-fifths of its length, the edges separating into black fibres covered with dark-brown scurf; pinnæ linear-lanceolate, 9-18 in. long. Male flowers nearly white, crowded, in numerous densely packed spikes, which form a compact drooping, ovoid panicle, enclosed before flowering in large ovate, imbricated, dark-purple sheaths, streaked with yellow. Calyx tubular, truncate, 2 lines long; petals linear, twice the length of calyx, connate at the base with each other and the stamens into a short fleshy stalk. Stamens as long as petals. Female flowers in rigid

spreading spikes, forming an erect panicle. Fruit crowded in erect spikes, ovoid-oblong, brown and purple, supported at the base by the persistent coriaceous perianth; pulp scanty, with a mucilaginous acrid juice; seeds 2, plano-convex.

Hills east of Chittagong, Kasia hills, ascending to 4000 ft. Assam, Sikkim, up the Teesta valley to Chakūng, at 4400 ft., growing side by side with the birch, willow, alder, and walnut (probably this species, Hook. Him. Journ. ii. 18). Kamaon, in shady and moist valleys, ascending to 3500, and at times to 4000 ft., forming extensive thickets in the valleys of the Kali and Sarju. Bamauri Pass, below Naini Tal, and in the Patli Dun, which seems to be its north-west limit. Fl. May, July. In Kamaon the leaves are used as thatch, and are said to be imperishable. *W. caryotoides*, Roxb. Cor. Pl. t. 295.—Syn. *Havina caryotoides*, Ham.; Griff. Palms, p. 174, differs by cuneate pinnae, and narrower ovate-lanceolate sheaths of the male inflorescence. Roxburgh's plate gives the calyx of the male flower subglobose, but the description makes it cylindrical. Chittagong, where, according to Roxb., it is called *Chilpatta* or *Bel-patta*. Dense evergreen forest in the Rangoon district of Pegu (Pounglin, Bonee, *Zanlingben*). Tab. 237, in Griffith's Palms, marked *H. caryotoides*, is evidently intended for *H. oblongifolia*.

Nearly allied is *Caryota urens*, Linn.; Roxb. Fl. Ind. iii. 624; Mart. Hist. Nat. Palm. t. 107; Griff. Palms, p. 169—the *Mhār Palm* of Western India. A splendid tree with a smooth annulate stem, large bipinnate leaves 18-20 ft. long, 10-12 ft. broad, petioles sheathing, nearly amplexicaul, panicles wedge-shaped, the lateral nerves terminating, as in *Wallichia*, in numerous short subulate teeth. Flowers monoicous, the male and female flowers on the same inflorescence, one female between two larger male flowers. Inflorescence long, hanging, 10 ft. long and more, consisting of a thick cylindric peduncle (spadix), surrounded at its base by numerous imbricate sheaths, and bearing at its end numerous slender simple pendulous spikes. Calyx and corolla coriaceous, anthers numerous, on short monadelphous filaments. No rudiment of ovary. Fruit with a thin acrid pulp, producing a burning sensation on the tongue, whence the name, 2-seeded, or 1-seeded by abortion; seeds compressed, oblong,  $\frac{1}{2}$  in. long, albumen horny, ruminate, with black simple lines. Embryo at the back of the seed. Evergreen forests of the Western Ghats, extending north to the Sattara district. Also in Ceylon and eastern Bengal, ascending to nearly 5000 ft. in Sikkim (Hook. Him. Journ. i. 143), Burma (*Mimboen*). The centre of the stem is generally soft, the cells being filled with a Sago-like farina (starch), which is made into bread, and eaten as gruel. The outer part is heavy and hard, with numerous firm, black vascular bundles, which are closely packed, but not confluent near the circumference, it is strong and durable, and is much used for building and agricultural implements. The fibres of the sheathing petioles, and of the peduncle (spadix), are made into rope and fishing-lines, which are said to be indestructible. But the main value of this Palm consists in the abundance of sweet sap which is obtained (as in *Cocos* and *Borassus*) from the cut spadix, and which is either fermented or boiled down into syrup and sugar.

Allied to *Caryota urens* is *Arenga saccharifera*, Labill.; Griff. Calc. Journ. v. 472; Palms, t. 235 A.—Syn. *Saguerus Rumphii*, Roxb. Fl. Ind. iii. 626—30-40 ft. high, with long leaves, 15-25 ft. long, 10 ft. broad, petioles sheathing, with a network of black horsehair-like fibres, which surround the stem, and are used for cordage; pinnae fasciculate, linear, dentate, and jagged at the apex with numerous longitudinal nerves, white underneath. Fruit 2 in. long, fleshy, yellow when ripe, 3-seeded, pulp very acrid. The heart of the stem contains



large quantities of Sago, and the cut flower-stalks yield a sugary sap, of which sugar and palm wine is made. Malay Peninsula, Indian Archipelago. Said to grow on the hills of Orissa, Hook. & Thomson Fl. Ind. 142.

To another subdivision of the same tribe (*Arecineæ*) belongs the *Areca Palm*—Sans. *Guwaka* : Vern. *Supari* : *Areca Catechu*, Linn. Roxb. Cor. Pl. t. 75 ; Fl. Ind. iii. 615 ; the *Betel Palm*—a tall slender annulate stem, attaining 80 ft. and more, with a diam. of only 12-15 in. Leaves pinnatifid, petiole on a long smooth green sheath, pinnæ linear-oblong, with a broad base and numerous parallel basal nerves, several of which are more prominent. Flowers monoicous, male and female on the same inflorescence. Peduncle thick fleshy, erect, from lateral buds below the lowest leaf, branching, the branches bearing solitary female flowers and numerous slender spikes, thickly set with fragrant male flowers. Stamens 6, on short broad filaments, surrounding a rudimentary ovary. Sepals and petals of female flowers imbricate, ovary 3-celled, surrounded by 6 sterile stamens. Fruit orange-coloured, ovoid, 2-2½ in. long, supported by the persistent coriaceous calyx and corolla. Pericarp fibrous, 1-celled. Seed depressed-conical, obtuse, 1 in. diam. or less ; albumen horny, ruminated with numerous dark-brown or black curly radial lines ; embryo basal. Cultivated throughout the Indian Archipelago, in Ceylon, the west side of India, below and above Ghat, in Burma, Siam, Cochin-China, Bengal, Silhet. Believed to be originally a native of the Sunda islands. The use of the seed for chewing with lime and the leaves of *Piper Betel* in India, the countries of the trans-Gangetic Peninsula, the Indian Archipelago and China, is well known. The finest groves of the Betel Palm which I have seen are in British Burma, on the hills between the Sitang and Salween rivers, and in the valleys drained by the feeders of the Yonzaleen and Beeling rivers, and the Thoukyeghat and other tributaries of the Sitang. In the valleys of these hills are flourishing Betel Palm gardens to an elevation of nearly 3000 ft. Large quantities of Betelnuts are brought down these rivers, and exported from Rangoon and Moulmein, and a grove of these Palms is a small fortune. For a new plantation the ground is trenched and prepared with the greatest care ; long irrigation channels, winding along the sinuosities of the hills, bring the needful water to the spot ; and the result is seen in large compact groves, which in dells and sheltered places sometimes attain an average height of 80 ft., or even more. Examples of flourishing Betel Palm groves in a comparatively dry climate are the plantations on the plateau of Mysore, below the great tanks, and irrigated by them. In Mysore, Canara, and Malabar, as in Burma, a fresh plantation is always made under the shelter of Plantains. In western India the Betel Palm is generally planted along with the Cocoa-nut, and often with Cardamoms. The soft but tough sheaths of the leaves are used in Burma and in western India to wrap up eatables, tobacco, and other articles ; also as paper to write upon. Necklaces, the tops of walking-sticks, and other small objects, are turned of the seeds.

*Ceroxylon andicola*, Humboldt and Bonpland, Pl. Æquinoct. i. t. 1, also classed among *Arecineæ*, a tall elegant Palm with whitish stem, attaining 190 ft., is remarkable, because, like *Chamærops Martiana*, it grows at high elevations. Humboldt first discovered it at the foot of the snow-clad volcano of Tolima, on the Parama di Quindiu, the high pass which leads across the central Cordillera, from the Magdalena to the Cauca river. It has since been found by other travellers, particularly by Albert Berg, who has represented it towering over the forests of Oak and *Podocarpus*, in plates 5 and 6 of his admirable work, 'Tropical Vegetation of South America,' London, 1854. At an elevation between 6500 and 9700 ft. N.L. 4° 35", it grows in abundance, associated with another alpine Palm, *Oreodoxa frigida*, Humb. et Kunth. The trunk is an-

nulate, covered all over with a thin coating of a whitish substance, which is scraped off, mixed with tallow, and made into candles. It consists of vegetable wax, and a crystalline resin called *Ceroxylin*.

Another wax-yielding Palm, attaining 200 ft., is described by Karsten (Flora Columbiæ, i. t. 1), as *Klopstockia cerifera*, from the mountains in the vicinity of Caracas in Venezuela, at an elevation of 5000 ft. Vegetable wax is also obtained and used to make candles from the young leaves of *Copernicia cerifera*, the *Carnaba* wax-Palm of Brazil, which are coated with it. This Palm has fan-shaped leaves, and belongs to the tribe of *Coryphineæ*.

#### 4. PHŒNIX, Linn.

Low shrubs or tall trees, the upper part of the stem closely covered by the bases of the petioles, the lower part rough with their scars, rarely annulate. Leaves pinnate, pinnae entire, linear, rigid, folded longitudinally and attached obliquely with their folded base to the laterally-compressed petiole, the lowest pinnae often transformed into spines. Petiole semiterete below the leaves, base a reticulate fibrous amplexicaul sheath. Flowers dioicous; a rigid, often woody axillary compressed peduncle, bearing near its upper end numerous long slender but rigid spikes, which are interrupted in the female, compact in the male inflorescence; peduncle enclosed in bud in a single thickly-coriaceous keeled sheath. Calyx cup-shaped, 3-toothed; petals 3, oblong and valvate in the male, ovate or rounded and imbricate in the female flowers. Male flowers: Stamens commonly 6, rarely 3 or 9, surrounding a rudimentary ovary. Female flowers: Carpels 3, distinct, with recurved styles. Fruit a single, generally oblong 1-seeded berry. Seeds with a longitudinal furrow. Albumen horny, embryo dorsal.

Tall trees; leaflets opposite or alternate, not fasciculate.

Foot of stem often surrounded by root-suckers; leaflets making a very acute angle with the common petiole . . . . .

No root-suckers; leaflets making half a right angle with common petiole . . . . .

A low shrub with a bulbous stem, or a small tree with a slender stem; leaflets fasciculate . . . . .

1. *P. dactylifera*.

2. *P. sylvestris*.

3. *P. acaulis*.

1. *P. dactylifera*, Linn.; Roxb. Fl. Ind. iii. 786. — Vern. *Khajūr*, *khaji*. The fruit: *Khūrma*, *chūhāra*, *kukyān*, *khujjiyān*, *kujran*.

A tall tree, attaining 100-120 ft., trunk covered with the persistent bases of petioles, the foot often surrounded by a dense mass of root-suckers, Leaves grey, longer than those of *P. sylvestris*; pinnae 8-16 in. long, regularly distichous, often approximate in twos or threes on the same side of petiole; petiole grey, laterally compressed, almost flat. Male panicles white, compact, 6-9 in. long, on a short peduncle; flowers  $1\frac{1}{2}$  in. long, sweet-scented; sheaths outside with rusty down. Peduncles of female inflorescence  $\frac{1}{2}$ -1 in. broad, sometimes broader below, spikes 12-24 in. long. Fruit oblong, 1-3 in. long, generally reddish- or yellowish-brown when ripe, pulp fleshy sweet. Numerous varieties cultivated, differing in colour, shape, and taste of the fruit. Seed cylindric, with a longitudinal furrow in front, and a small cylindric embryo in the middle of the rounded

back. When the seed germinates, that end of the embryo which remains enclosed in the albumen enlarges at the expense of the albumen, the horny substance of which is converted into sugar and other soluble substances, which are absorbed by the embryo furnishing the substance for its early growth. The process is analogous to the conversion into sugar of the starch which fills the cells of the albumen of wheat, maize, rice, and bamboos, during germination; with this difference, that the starch forms the contents of the cells, whereas, in the stone of the date, the walls of the cells themselves furnish the food of the growing embryo.

In India the Date Palm is cultivated and self-sown in Sindh and in the southern Panjab, particularly near Multan and Muzaffargarh, also in the Sind Sagar Doab and trans-Indus territory. Near Dhera Ghazi Khan, Date Palms are very numerous on a strip 10 to 12 miles long from north to south. A few trees are found planted at many places in the eastern Panjab, also at Saharanpur, and here and there in the Ganges Doab and Bandelkhand. Is grown in the Dekkan and Guzerat, but does not thrive in Bengal. The tree was probably introduced into India at the time of the first Mahomedan conquest of Sindh, in the commencement of the eighth century. Its home is believed to be the lower part of the Euphrates and Tigris Doab, Arabia, Palestine, the Oases of the great African Sahara, and the eastern Canary Islands. It thrives luxuriantly in the arid rainless regions of North Africa and West Asia, where it is exposed to extreme heat in the day-time, and not uncommonly to frost at night, but it requires a certain amount of moisture in the soil. In Europe it is cultivated in Spain, where it was introduced by the Arabs, and where it produces eatable fruit; also on the Hyères islands, the Riviera near Nice, St Remo, and Genoa, where it attains its northernmost point at 44° 30' N.L. There is a wood of Date Palms at Bordighera near St Remo, said to contain over 4000 stems, cultivated mainly to yield Palms for Palm Sunday at Rome. In South Italy, Sicily, and Greece, the tree is not uncommon, but the fruit is small and poor. On the island of Delos, Date Palms, sacred to Apollo, had been planted before Homer's time. In Syria and Palestine the cultivation of the Palm-tree is older than the first historical records in existence. On the south shores of the Caspian Sea the Date Palm was formerly cultivated to a large extent.

The tree flowers in March and April; male trees are generally less numerous than female trees, the female flowers are fertilised artificially. In Sindh (near Karachi), in Arabia, and elsewhere, this is done before the flower-sheaths open; a hole is made in the sheath of the female flower, and a few bits of the male panicle are inserted (Stoeck in Hooker's Journ. of Bot. vii. 551). The fruit ripens Sept., Oct. Branching stems are occasionally found in the Panjab; it has been supposed (Stewart, Pb. Plants, 244) that these branches are merely apparent, caused by seeds germinating in the axils of the petioles; this view, however, is improbable. Many Palms have occasionally bifurcating stems, and sometimes develop a large number of side branches. A remarkable instance of a branched *Phoenix sylvestris*, in the Residency garden, Indore, with a trunk 22 ft. high to the first branch, and with 22 vertical closely-packed branches, is mentioned in the Gardeners' Chronicle of 1874, p. 116.

The wood of the Date Palm is lighter than that of *Cocos* and *Borassus*. The cellular tissue is soft; the vascular bundles generally show, on a horizontal section, an oval shape with two distinct large pores (vessels) at one end, the hard woody portion grey; on a vertical section, they appear as shinning narrow lines. The wood of male trees and of trees past bearing is used for building, water-channels, bridges, and various other purposes. Of the leaves, mats and the bag-like baskets universally used in the whole Mediterranean region, and in other countries, are made. In the Panjab mats and fans are made of the leaves; they

are called *Būtra* or *pattra* in Muzaffargarh, and *khūshab* in Shahpur. The petioles make excellent light walking-sticks, split up they furnish material for crates and baskets; the fibrous network, which forms the sheathing base of the petioles, is called *kabāl* or *khajūr ka bokla* in Muzaffargarh, pack-saddles for oxen are made of it, and the fibre separated is made into ropes. It is also known as *khajūr mānj* (Powell, Pb. Products, 517). The fruit, however, is the most useful product of the tree; it furnishes, fresh or dried, the staple food of the inhabitants of Arabia, part of Syria, and the desert tracts of North Africa. In Sindh the Date is called *khūrma* when pulled ripe, and *chawarar* when plucked before it is fully ripe, and boiled and dried in the sun. In the Panjab, Dates form an important article of food in certain districts, and they are sold in the bazar under different names, according to quality and the mode of preparation. Thus, according to Coldstream (Powell, Pb. Products, 268), the most esteemed kind is called *chirni* in the Muzaffargarh district; this is the Date of the best Palms, split up in the middle and dried in the sun. The second best is called *vind*; it is eaten as it comes from the tree, without farther preparation. The least esteemed kind is *būgri*, taken from inferior trees and boiled in oil and water. The Panjab Dates are smaller than those of Arabia or Egypt, but they are very good, and particularly so when there has been little or no late rain. When beginning to get ripe, a piece of matting is often put over the cluster of Dates to prevent birds eating them. The kernels are deemed medicinal. The large succulent head, cut from among the mass of leaves, is eaten—*gaddah*, Hind.; *gāri* or *galli* in Muzaffargarh. The tree yields a gum, called *hukm chil*. Attempts have been made, but without much success, to tap the Date-trees of Multan for their sugary sap (Stewart, Pb. Plants, 245).

2. *P. sylvestris*, Roxb. Fl. Ind. iii. 787; F. Hamilton in Trans. Linn. Soc. xv. 86; Griffith Calc. Journal of Nat. Hist. v. 350; Palms, t. 228, A. *Wild Date Palm*. Sans. *Kharjūra*. Vern. *Khajūr*, *khaji*. In the North-West Himalaya, *Salma*, *thalma*, *thakil*.

A tree, attaining 30-40 ft., stem rough with the prominent scars of fallen petioles, no root-suckers. Leaves greyish-green, 7-12 ft. long, pinnæ very numerous, 6-18 in. long, alternate and opposite, not fascicled; petiole compressed in the leaf-bearing part, brown at base. Inflorescence and flowers similar to those of *P. dactylifera*, peduncles of female flowers often 3-4 ft. long and 2-3 in. broad. Fruit oblong, about 1 in. long, green at first, reddish-yellow when ripe, pulp scanty, sweetish and astringent.

Indigenous in many parts of India, forms extensive forests in Rohilkhand, on the low ground along the Ramganga river, and on the plateau of Mysore between Shimoga and Tumkūr, in moister stretches of low ground which intersect and drain the rocky undulating granite hills. Not uncommon in the Siwalik tract and the outer Himalaya, often associated with *Pinus longifolia*, attaining 5000 ft. in Kamaon, with stems 40-50 ft. high (Madden, arborescent form of *P. humilis*). Ghiaunla in Garhwal at 3500 ft., 24-30 ft. high (Jacquemont). Banks of the Bias above Mandi (Cleghorn). In the Jamu hills at 2000 ft. elevation (T. Thomson, Him. Journ. 320). Salt range. Commonly planted and self-sown in most parts of India and Ceylon, except in Sindh and South Panjab, where *P. dactylifera* takes its place. Most abundant in Bengal, Behar, on the Coromandel coast, and in Guzerat. Fl. in March; the fruit ripening in Sept. and Oct. Mats and baskets are made of the leaves, but the chief product of the tree is the sugary juice, which is extracted during the cold season from Nov. to Feb. The lower leaves and their sheaths are removed, and a deep notch is cut

into the trunk, which then bleeds for some time, a thin slice being taken off every day from the surface of the cut. When the bleeding stops the tree is allowed a short rest, after which it is cut again and begins to bleed afresh. In the ensuing year the tree is allowed rest, and in the third season a notch is cut on the opposite side of the trunk. This is the account given by Martin (Drury, Useful Plants of India, 340), and he adds that a tree is fit to be cut when ten years old, and continues to yield for about twenty years. The juice is either fermented or boiled down into sugar and molasses, and a large portion of the sugar made in Bengal, on the Coromandel coast, and in Guzerat, comes from this source. The wood of the *Khajūr* is lighter than that of *Borassus* and *Cocos*, 39 lb., value of P. 512 (Skinner). The vascular bundles are not black, but light-brown. It is used for building, water-tubes, and other purposes.

Roxburgh describes the leaves of *P. sylvestris* as standing in subopposite fascicles, pointing four ways. This to a certain extent is the case in young leaves and leaves of young trees, but on full-grown trees the leaflets are always distichous, opposite or alternate. Dalzell (Bombay Flora, 278), points out the mistake.

*P. humilis*, Royle, is probably synonymous with *P. sylvestris*. Madden, Journ. As. Soc. xviii. 629, states that at Almora the fruit ripens in July and is then of a black purple colour, sweet, and eaten; and that on warm aspects and in a dwarfed state it reaches 7000 ft. on Binsur. It is for farther inquiry whether the black-fruited kind of the North-West Himalaya is a distinct species (see below *P. acaulis* var. *melanocarpa* and *P. farinifera*, Roxb.)

3. *P. acaulis*, Roxb.; F. Hamilton in Linn. Soc. Trans. xv. 88; Roxb. Fl. Ind. 783; Griff. Calc. Journ. v. 345; Palms, t. 228. Dwarf Date Palm. Vern. *Khajuri*, *pind khajūr*, *jangli khajūr*.

A low Palm with a thick, short, ovoid stem like a bulb, densely covered with the persistent and hardened bases of petioles. Leaves 2-6 ft. long, petiole flat below, laterally compressed or 4-sided above; pinnae narrow-linear in remote, nearly opposite fascicles, the upper 12-18 in. long, the lower short, straight, rigid, and ending in sharp spines. Flower-panicles of varying length, half buried in the ground, or peduncle 1-2 ft. long. Fruit ovoid,  $\frac{1}{2}$  in. long, fleshy, bright red, sweetish. A variety with black fruit is described by Griffith (Calc. Journ. v. 346) as *P. acaulis* var. *melanocarpa*.

Common on dry stony ground in the sub-Himalayan and Siwalik tract, extending west to the Jumna, and ascending to 2500 ft. Often associated with *Sal* and *Pinus longifolia*. Abundant in the Sal forests of Oudh and the Satpura range. Chota Nagpur, Behar, Sikkim Terai, and Sal forests of the Runjit valley (*Shaap* of the Lepchas, Hooker). *Ein* or *Dipterocarpus* forest of Burma. Fl. cold season; fr. ripens April, May.

To *P. acaulis* I am inclined to refer two species described by Griffith in Palms of East India, p. 138, 139, *P. Ouseleyana* from Chota Nagpur and Assam, and *P. pedunculata*, common and very gregarious on open ground of the hilly country about Courtallum and Kunur on the Nilgiris, at 6000 ft. elevation, both stemless with fasciculate leaflets and long fruit peduncles (fruit red and sweet in *pedunculata*). Gærtner's *P. pusilla* (Fruct. p. 24, t. 9), seems to be near this, but his specimens are said to have come from Ceylon, where only *P. sylvestris* is reported to grow (Thwaites, Enum. Pl. 329). Whether the Palm described doubtfully as *P. acaulis*, in Bentham's Fl. Hongkong, 340, belongs to this species, remains for farther inquiry.



On the Bababuden hills in Mysore, on the Satpura range, and in other parts of South and Central India, is found a small *Phoenix*, stemless, or with a slender stem, attaining 6-10 ft., leaflets slender, fasciculate, in twos and threes, less rigid than those of *P. sylvestris* and *acaulis*, fruit on long erect peduncles, 12-24 in. long, and  $\frac{1}{4}$ - $\frac{1}{2}$  in. broad, with numerous spikes 4-6 in. long, apparently the same plant, from the Ghat forests, which Dalzell (Bombay FL 279), doubtfully refers to *P. paludosa*. I have often found it, but do not know whether the fruit turns black when ripe, or whether it is red. This, however, may not be a character of great moment. Roxburgh, FL Ind. 785, describes *P. farinifera* with shining black fruit, stem 1-2 ft. high, 6 in. diameter, leaflets rigid, opposite. If it were not for the description of stem and leaves, I should be disposed to identify the slender-stemmed *Phoenix* of South and Central India with *P. farinifera*, Roxb. Hamilton (Trans. Linn. Soc. xv. 87) states that what Roxburgh calls *P. farinifera*, is common in all the hills of India south of the Ganges, and is called *Palawat* in North India; he adds, that its leaves, which are not so rigid as those of the other species, are bruised and twisted into ropes. Roxburgh states that it is a native of dry barren ground, chiefly of the sandy lands at a small distance from the sea near Coringa. FL Jan., Feb.; the fruit ripens in May. He mentions that mats are made of the leaves and baskets of the split petioles, that the exterior or woody part of the trunk encloses a large quantity of farinaceous substance, used as food in times of scarcity, and adds, that in 1791 and 1792 it saved many lives. The identification of Roxburgh's tree, *P. farinifera*, is a matter of importance on account of the food produced by it. The Telugu name given by him, *Chilla-cita*, is *Chittita-chettu* in Elliot's Flora Andhrica.

A marked species, which cannot be confused with any of the others, is *P. paludosa*, Roxb. FL Ind. iii. 789; Griff. Palms, t. 229, A. B. It forms impenetrable thorny thickets throughout the Sandarbans, in the Delta of the rivers Irawaddie and Salween (*Thimbuang*, Burm.), in Penang and on the Andamans. The stems are slender, 6-20 ft. high, annulate below, the upper part densely covered with the thorny base of petioles. Leaflets narrow flaccid, white beneath, fruit ovoid, first yellow, then red, at last black-purple,  $\frac{1}{2}$  in. long, not eatable.

## 5. COCOS, Linn.

Tall Palms, mostly with smooth annulate stems. Leaves pinnate, terminal, petioles amplexicaul with fibrous base. Flowers monoicous, inflorescence of numerous simple spikes on a short and generally thick, sometimes branching peduncle (spadix), enclosed in bud in 1 or 2 boat-shaped hard coriaceous, often woody sheaths, opening longitudinally at the time of flowering. Male flowers more numerous than female flowers, generally in the upper part of the inflorescence; calyx 3-sepalous; corolla of 3 oblong or lanceolate petals, valvate in bud. Stamens 6, filaments subulate, with or without a (minute) rudimentary ovary. Female flowers: calyx of 3 imbricate broadly ovate or rounded sepals, supported by 2 bracts similar to sepals; petals smaller than sepals. Ovary 3-celled, surrounded by 6 sterile stamens. Fruit 1-seeded; pericarp consisting of an outer fibrous layer and an inner hard osseous kernel, which has 3 pores at the base. Albumen fleshy, oily, with a central cavity; embryo cylindric at the base of the albumen, when germinating protruding through one of the pores of the kernel.

1. *C. nucifera*, Linn.; Roxb. Cor. Pl. t. 73, FL Ind. iii. 614; Mart.

Hist. Nat. Palm, ii. t. 88. *The Cocoa-nut Tree*. Sans. *Nārikera*, *nārikela*, *lāngalin*. Vern. *Narikel*, Beng.; *Narel*, *nariyal*, Hind.; *Kobbarichettu*, Tel.; *Ung ben*, Burm.

Trunk annulate, often curved or flexuose. Leaves 6-12 ft. long, pinnae distichous, equidistant, linear-lanceolate. Sheath of inflorescence of a woody texture, cylindric, 2-3 ft. long, outside with numerous longitudinal elevated lines, inside smooth shining. Peduncle (spadix) erect, stout, divided into short thick branches, female flowers on these and at the base of the numerous slender drooping spikes which are thickly covered with the male flowers. Fruit ovoid, indistinctly 3-cornered, 10-15 in. long, the fibrous pericarp covered by a thin membranous epidermis. Cavity of the albumen large before maturity, filled with sweetish acidulous juice (Cocoa-nut milk), from which, as the seed ripens, the cellular tissue of the albumen is gradually formed. When the seed germinates, the growing embryo is maintained at first by the oil which fills the cells of the albumen, and which is gradually transformed into sugar and other substances soluble in water.

Cultivated nearly throughout the tropics, particularly in the vicinity of the sea, in Asia, in parts of Africa, in America, and on the islands of the Pacific; somewhat beyond the tropics, on the Canary Islands, in Lower Sindh and Bengal. On the Mysore plateau, cultivated like the Betel Palm in irrigated groves below the large tanks. Its original home and the history of its spread are not yet sufficiently known. The Sanscrit name indicates its ancient cultivation in India; it was, however, not known to classic writers, and it seems certain that it was introduced by the Portuguese into Western Africa and the Cape Verde Islands, and that it did not exist in the West Indies, Guiana, nor Brazil at the time of the discovery of America. It has been supposed to be indigenous in the Indian Archipelago and on the Nicobar and Cogo islands of the Bay of Bengal—and this would explain its early cultivation on the coasts of India and Ceylon. But the nineteen species of this genus enumerated by Martius are all indigenous in Mexico or South America, excepting *C. nucifera* and *C. mamillaris*, Blanco, which Blume (Rumphia, iii. 84) considers as a dwarf variety with small fruit of the Cocoa-nut. Considerations of botanical geography would therefore point to the west coast of Central America as its home. Martius, indeed (Palms, i. 188), considers it not improbable that the original home of this Palm was on the islands near the Isthmus of Panama, and that the nuts were transported thence by westerly currents to Cocos Island, 200 miles west of the coast, which was found densely covered with Cocoa-nut trees, by its first discoverer, without any sign of human habitations. From there it is not difficult to explain the farther spread of the nuts by the regular currents and by storms to the Sandwich, Marquesas, and other islands of the Pacific, and to the islands of the Indian Archipelago, whence it may have been introduced into India. The Cocoa-nut is said to preserve its vitality for a long time floating in sea-water of a certain temperature. A. De Candolle, Géographie Bot. ii. 976, seems inclined to accept the American origin of the Cocoa-nut, and Grisebach (Vegetation der Erde, ii. 11) entertains no doubt on the subject. In India the Cocoa-nut flowers in the hot season, and the nuts require 9-10 months to come to maturity.

The manifold uses of the Cocoa-nut tree are well known: the outer wood of the stem is close-grained with dark-brown vascular bundles; it works smooth and takes a good polish. It weighs 70 lb., value of P. 608, Skinner; 46 lb.

value of *P.* between 436 and 838, Puckle. Commonly known as *Porcupine* wood, made into ornaments and fancy articles; the wood of trees past bearing is used for building. The leaves are employed for thatching, and the web-like net of fibres which surrounds the stems at the base of the petioles is made into bags and paper. The cut flower-stalks, like those of *Borassus* and *Caryota*, yield sugar and toddy, from which arrack is distilled and vinegar made; but the nuts are the most valuable part of this useful tree. The thick fibrous rind (coir) is made into ropes, mats, carpets, brushes, and a variety of other articles. The hard inner shell of the nut is made into spoons and cups, and is carved into all kinds of ornaments. The oil forms an important article of trade, it is used for cooking and burning, and in Europe for the manufacture of soap and candles. For a detailed account of the cultivation and uses of the Cocoa-nut tree, see Drury, *Useful Plants of India*, 147.

*Elais guineensis*, Linn.; Mart. Hist. Nat. Palm, ii. t. 54, 56, of the tribe of *Cocoinæ*, is indigenous in tropical Western Africa, and cultivated in Brazil. Both the albumen and the flesh of the orange-coloured or red drupe are, like seed and pulp of the Olive, full of fat oil, the *Palm Oil* of commerce, which during the last fifty years has become a most important article of trade. The flowers are monoicous, but on distinct erect, compact, many-flowered panicles. The male flowers are crowded in numerous thick cylindric spikes, anthers 6 on the teeth of a cylindric tube. The drupes, 1-2 in. long, are ovoid, closely packed, 600-800, with lanceolate bracts between, in a huge ovoid compact panicle, often weighing 40 lb. A second species, *E. melanococca*, Gært., with a partly decumbent and creeping stem, is indigenous in South America.

## 6. CALAMUS, Linn.

Stems long flexible, scandent or supported by trees and Bamboos, rarely short, stiff, and erect; the upper part covered with leaves and the sheaths of fallen leaves, the lower part annulate. Leaves pinnate, alternate, remote; pinnae flat, linear, rarely oblong or cuneate, often armed along nerves and edges with spinous bristles; petiole and the long persistent amplexicaul sheaths armed with rigid dark-coloured prickles, often flat and placed in continuous, horizontal or oblique lines, sometimes forming complete rings; petioles or sheaths terminating in long whip-like thongs armed with prickles, scattered, or in oblique lines or rings. Flowers monoicous or dioicous, in long axillary or extra-axillary panicles; peduncles often connate at base with the sheath of the next following leaf, armed with prickles, the main branches in the axils of cylindric sheaths, truncate or terminating in a flat or concave blade; branches and branchlets generally enclosed in a succession of cylindric or funnel-shaped sheaths. Male flowers in distichous, often scorpioid spikes, in the axils of an outer, generally broad-ovate and acute bract, with an inner, bicuspidate and cup-shaped bract, which may be regarded as analogous respectively to the flowering glume and palea of grasses. Calyx campanulate, 3-dentate. Petals 3, valvate in bud. Stamens 6, surrounding a rudimentary 3-fid ovary; anthers sagittate, adnate at the back. Female flowers often pedicellate, supported by 3 or more imbricate bracts, spirally arranged on the branchlets; calyx and petals like those of male flowers. Ovary 3-celled, surrounded by 6 sterile stamens, closely covered with imbricate reflexed scales, styles 3, recurved, 1 erect ovule in each cell. Fruit 1- rarely 2-seeded, nearly dry, with a

hard shining rind, composed of numerous retrorse imbricate scales, spirally arranged on the surface of the fruit. Albumen more or less ruminant near the outside, embryo basal.

1. *C. Rotang*,\* L.; Mart. Hist. Nat. Palm, iii. 334; Roxb. Fl. Ind. iii. 777; Kunth Enum. Plant, iii. 207.—Syn. *C. Roxburghii*, Griff. in Calc. Journ. of Nat. Hist. v. 43, and Palms, t. 192. *Common Rattan*. Sans. *Vetra, vetasa*. Vern. *Bet*.

Stems long, slender, climbing, enveloped in the prickly sheaths of the leaves, without the sheaths  $\frac{1}{4}$ – $\frac{1}{3}$  in. diam. Leaves 18–36 in. long, no whip at the end of petiole, but sheaths generally furnished with long prickly whip-like thongs; leaflets equidistant, opposite or alternate, linear-lanceolate, with numerous longitudinal nerves, 4–9 in. long, fine spinescent hairs along the edges and nerves. Prickles on sheath scattered, rigid, straight, with a thick concave or flat base, those on petiole chiefly at the insertion of leaflets, similar, but stouter and often recurved. Common peduncle of inflorescence with stout recurved prickles, main branches paniculate, in the axils of cylindric prickly sheaths wider and obliquely truncate at the mouth, 2–6 in. long. Fruit straw-coloured, with scanty sharply acid pulp, 1-seeded, ovoid or subglobose,  $\frac{1}{2}$  in. long.

Abundant in damp places, near Jheel, in the eastern Dehra Doon, locally in the Siwalik tract, the outer hills of Garhwal and Kumaon, in Nepal. Eastern part of the Khairigarh forests, and a few places in Gonda, in Oudh. Bengal, the Terai of Sikkim, valleys of the Satpura range (vern. *Pepa, prabba, chettu*; I have not seen specimens). Western Ghats, South India, and Ceylon. Fl. July; fr. in the cold season. Yields the common Rattan of North-West India, which is largely exported to the plains; chairs, door-blinds, and many kinds of basket-work are made of it.

Griffith, Palms t. 191, described a second species from the Doon as *C. Royleanus*, and Martius (Palm. iii. 335) adopted it. According to Griffith, it differs in solitary long spines of petioles and sheaths, linear leaves, the corolla as long as the calyx, and the fruit globose, not ovate. Martius adds that the fruit of this has 15, and that of *Rotang* 19–20 rows of scales; but as far as known at present, the arrangement of these scales is subject to great variations in the same species. I do not consider *C. Royleanus* distinct; but the cane-brakes of the N.W. Himalaya require farther study.

Nearly allied are the following species, which may be found within the range of this Flora. They have whip-like thongs on the sheaths, not at the end of the petiole.

*C. tenuis*, Roxb. Fl. Ind. iii. 780; Griff. in Calc. Journ. v. 45, and Palms, t. 193, A.B.C. Scandent, monoicous, flowers in pairs, female and male flowers on the same spike, leaflets equidistant, alternate, 3-nerved. Stems when cleaned not thicker than a common quill. Vern. *Bet*. Common in Assam, Silhet, and Chittagong.

*C. fasciculatus*, Roxb. Fl. Ind. iii. 779; Griff. in Calc. Journ. v. 52; Palms, t. 195, A.B. Erect when young, afterwards leaning in search of support, and climbing over trees and bushes. Leaflets collected in fascicles of 2, 3, or 4, on opposite sides of the petiole, prickles on petioles 1–2 in. long, in twos or threes

\* Linnæus's name *C. Rotang* included several species; Griffith abandoned it on that account, but Martius, after considering Griffith's objections, restored it.

at the base of the pinnæ, on sheaths broad-based, and often in oblique lines, sheaths and petioles with brownish-white mealy tomentum. Bracts of male flower-spikes large, funnel-shaped. Bengal, in the plains as well as in the hills: walking-sticks are made of the stems.

The Rattan, which yields the long rope-like canes in Burma (*Yaimatta*, *Kyein*), used in the place of ropes on timber rafts, and of which the cables stretched across the Salween river at the rope-station are made, grows in moist valleys in Martaban and Tenasserim, often 200 ft. long, the elegant crown of leaves surmounting gigantic trees, over which it climbs. It is referred to *C. latifolius*, Roxb. Fl. Ind. iii. 775; Griff. Palms, t. 198, leaflets fasciculate, broadly lanceolate, petioles of older leaves ending in prickly whip-like thongs; prickles on sheaths and petioles, large in oblique rings. Also found in Eastern Bengal. The various kinds of canes and Rattans imported into Europe from India, Siam, Cochin-China, and the Indian Archipelago, are chiefly the produce of species of *Calamus* and allied genera. The Malacca cane of Sumatra is generally ascribed to *C. Scipionum*, which Loureiro described from Cochin-China.

Sago is chiefly the produce of several species of *Metroxylon* (*Sagus*) which belong to the same tribe as *Calamus*, but have tall erect stems and the heart filled with farinaceous substance. *Metroxylon Rumphii*, Mart. Hist. Nat. Palm. t. 159, and *M. laeve*, Mart., grow in the Indian Archipelago, Malacca, and Siam.

Two remarkable genera, *Nipa* and *Phytelephas*, resemble Palms in general habit, and their large pinnate leaves, but they differ essentially in the structure of the flowers. *Nipa fruticans*, Thunb.; Mart. Hist. Nat. Palm. t. 171, 172, is abundant in the mud of the Sundarbans, in the delta of the Irawaddee and Salween rivers, and elsewhere on the coasts of the Bay of Bengal, and on the islands of the Indian Archipelago. A creeping stem bears tufts of gigantic feathery pinnate leaves often more than 20 ft. long. The flowers are monoicous on one inflorescence, a thick spadix with numerous bracts, bearing numerous lateral deciduous male catkins, and at the ends of each branch a few heads of female flowers. The male flowers are triandrous, the 3 stamens connate into one column; the female flowers are without any perianth. The fruit forms large compact rounded heads, consisting of numerous 1-seeded fibrous angular drupes with a hard horny albumen.

*Phytelephas macrocarpa*, Ruiz et Pavon; Bot. Mag. t. 4913, 4914, has hard seeds which are largely imported into England, under the name of Vegetable Ivory, and used extensively for turning. Like *Nipa fruticans* it is gregarious, and has a creeping stem often 20 ft. long, with large pinnatifid leaves, 18-20 ft. long. The flowers are generally dioicous; the male flowers with numerous stamens; the female flowers with a 6-9-celled ovary, and a long erect 6-9-fid style. Western South America, between the 9th degree of north and the 8th of south latitude.

## ORDER LXXVIII. GRAMINEÆ.

Annual herbs with a fibrous root, or a perennial underground stem (rhizome) producing annual or perennial stems (culms), generally in tufts or clusters. Rhizome mostly branching, composed of vascular bundles scattered in cellular tissue. Stems jointed, usually hollow between joints; the joints near the ground often with rings of adventitious rootlets (speci-



ally in Bamboos). Leaves alternate, consisting of a tubular sheath, split to the base, and a narrow, linear or lanceolate blade (in *Bamboos* joined to the sheath by a petiole); inner face of sheath often prolonged into a membranous or coriaceous ligule. Flowers mostly bisexual, arranged in distichous 1- or many-flowered spikelets. Spikelets supported at the base and often enclosed by two or more bracts (empty glumes), the axis or rachis bearing one or numerous distichous bracts (flowering glumes). Each flowering glume bears in its axil, on the short axis of the flower, the palea, a membranous, generally transparent bract, mostly 2-keeled. Between palea and the flowering glume are a 1-celled ovary, with 2 distinct, often lateral, styles, or 1 terminal style, generally 2- or 3-fid, surrounded by 3, 6, rarely more or fewer stamens, and 2 or 3 membranous, often ciliate scales (lodicules). Anthers 2-celled, cells contiguous, opening longitudinally. Fruit a 1-seeded caryopsis, pericarp generally closely adhering to the testa, and sometimes (*Oats*, *Barley*) adhering to the palea and flowering glume. Embryo at the base of the albumen on the outside, small, its position conspicuous on the surface when the pericarp is thin and closely adhering to the testa; not conspicuous when the pericarp is thick, coriaceous, woody or fleshy. Albumen farinaceous, composed of thin-walled cells, filled those near the outside with albuminous (nitrogenous) substances, the mass of the cells chiefly with grains of starch. Embryo consisting of a broad cotyledonary body (scutellum) contiguous to the albumen, a basal radicle and the plumule. When germinating, the scutellum remains enclosed in the seed, the radicle protrudes and lateral root-fibres emerge from it, while the plumule, in the opposite direction, unfolds its leaves. During the process of germination the starch of the albumen is gradually converted into sugar and other soluble substances, which pass into the embryo through the scutellum, and serve as the food of the plant in the first stage of its growth.

Grasses comprise upwards of 4500 species, grouped under numerous tribes. Those here described all belong to the tribe *Bambuseæ*, which are characterised by woody, mostly perennial stems (culms) with numerous branches at the nodes, leaves petiolate, articulate at the base of the petiole, deciduous, leaving the branchlets surrounded by persistent, generally coriaceous sheaths, stamens 3 or 6, rarely more, style 1, 2-3-fid, rarely undivided. As in Palms, the vascular bundles in the inner part of the Bamboo stem are composed of vessels, cells, and fibres, while those near the surface consist of fibres only. These are close together, almost confluent, forming the hard outer rind of the Bamboo. At the nodes the vascular bundles cross from one side of the stem to the other, forming the principal mass of the hard horizontal partition walls which separate the joints. The stem of Bamboos with hollow joints has much less cellular tissue than the stem of Palms, and the vascular bundles differ in shape also. Morphologically and with regard to its anatomical structure, the underground stem (rhizome) of Bamboos has more analogy with the perennial stem of Palms like *Phoenix*, *Borassus*, *Cocos*; but these points demand farther study. An excellent monograph of Bamboos by General Munro is published in the 26th volume of the Transactions of the Linnean Society, where the number of species described is 170.

Cæspitose shrubs with slender, mostly annual stems; spikelets pedunculate, racemose or paniculate; stamens 3.

Branches of panicle in the axils of small linear bracts .

1. ARUNDINARIA.

Branches of panicle in the axils of large amplexicaul bracts

2. THAMNOCALAMUS.

Compact clumps of tall perennial stems; spikelets generally sessile, in interrupted spikes; stamens 6.

Lodicules 2 or 3; style deciduous, deeply 2- or 3-fid; embryo conspicuous on the surface of the caryopsis

3. BAMUSA.

Lodicules none; style filiform, undivided or 2-3-fid at the apex, base persistent; embryo not conspicuous on the surface of the caryopsis . . . . .

4. DENDROCALAMUS.

### 1. ARUNDINARIA, Michaux.

Stems slender, generally annual, erect, cæspitose, with small leaves. Inflorescence generally terminal, paniculate or racemose; in some species the flowers are on distinct leafless culms. Spikelets 2-12-flowered, flowers distant, distichous, imbricate, mostly bisexual, the terminal generally sterile. Empty glumes 2, narrow, with few nerves, the lower smaller than the upper. Flowering glume concave, with numerous nerves. Palea 2-keeled, narrow, generally shorter than the flowering glume. Scales 3, ciliate. Stamens 3. Style divided at the top into 2 or 3 plumose stigmas. Caryopsis terete, with a deep furrow.

1. *A. falcata*, Nees; Munro in Trans. Linn. Soc. xxvi. 26.—Syn. *A. utilis*, Cleghorn. Vern. *Nirgāl, nigāl, ringal, nagre, narri, garri, gero*. Local n. *Spüḡ, gorwa, spikso, pitso*, Kunawar; *Kacci*, Tibet; *Prong*, N.W.P.

Stems annual, 6-10 ft. high, densely cæspitose,  $\frac{1}{4}$ - $\frac{1}{2}$  in. diam., hollow, internodes 6-12 in. long, the sheaths on young shoots thinly membranous, glabrous 6-7 in. long, tapering into a subulate apex  $1\frac{1}{2}$  in. long. Branches slender, numerous, in compact half-whorls. Leaves linear, 4-5 in. long,  $\frac{1}{4}$ - $\frac{1}{2}$  in. broad, glabrous above, with scattered soft long hairs underneath; midrib prominent, whitish, longitudinal nerves numerous, 3-5 pair, prominent; no transverse veins. Flower-bearing stem leafless; branches slender, numerous, in compact half-whorls. Spikelets in paniculate racemes, the principal ramifications in the axils of short linear or ovate membranous bracts. Spikelets lax,  $\frac{1}{2}$ - $\frac{3}{4}$  in. long, 2-3-flowered, the terminal flowers generally sterile. Empty glumes 2, about half the length of the lowest flower, membranous, with prominent longitudinal nerves, apex obtuse, ciliate. Flowering glume scabrous, acute, 7-9-nerved, membranous, hairy at the apex. Palea as long as the flowering glume, 2-keeled, with longitudinal nerves outside the keels. Scales 3-nerved and fimbriate. Style deeply bifid.

North-West Himalaya between 4500 and 10,000 ft., ascending to 12,000 ft. from the Ravi to Nepal, abundant in places, gregarious, often forming underwood in moist forests of *Abies Smithiana*, *A. Webbiana*, *Quercus semecarpifolia*. Fl. May, the seeds ripen in August. Clusters compact, of 100 or more stems, attains 20-40 ft. according to Madden. Hardy in England. Two kinds are generally distinguished, one growing at lower elevations (up to 7000 ft.), thinner,

with solid or nearly solid culms and narrow leaves, the other, growing between 8000 and 12,000 ft., with shorter, thicker, and hollow culms and broader leaves, the foliage more feathery. Vern. *Garu girch* (Powell, Panjab Products, 518, 567). It is a matter for inquiry whether one of these is not *Thamnocalamus spathiflorus*, or another species of *Arundinaria*. The solid kind is said to be the tougher of the two, and is used, when dry, a year after cutting, to support the earth-roofs of the hill-cottages. It is also made into mats and basket-work. The hollow kind is made into shepherds' pipes, fishing-rods, and is exported to the plains for Hooka-tubes; it is also employed for basket-work.

The small Bamboo of the Nilgiris is *A. Wightiana*, Nees; Bedd. Fl. Sylv. Anal. Gen. t. 28; annual stem 6-12 ft. high; flowers in terminal slender-branched panicles at the end of leaf-bearing culms, spikelets 2-5-flowered,  $\frac{1}{2}$ - $\frac{1}{3}$  in. long, single, on long filiform peduncles, leaves with indistinct transverse veins, sheaths persistent, coriaceous, adpressed to branchlets.

## 2. THAMNOCALAMUS, Falconer.

Characters of *Arundinaria*, excepting the bracts subtending the main branches of the inflorescence, which are lanceolate or ovate-lanceolate, enclosing the racemes of spikelets in bud, and exceeding half their length when fully developed.

Leaves with prominent transverse nerves; sheathing bracts 3 in. long . . . . .	1. <i>T. spathiflorus</i> .
Leaves without transverse nerves; sheathing bracts less than 1 in. long . . . . .	2. <i>T. Falconeri</i> .

### 1. *T. spathiflorus*, Munro l. c. 34.—Vern. *Ringall*, Deoban range.

Stems caespitose,  $\frac{1}{4}$  in. diam., internodes 4-8 in. long, brown, shining, branches 12-18 in. long, in fascicles or in half-whorls; the sheaths on young shoots glabrous, with numerous prominent nerves, fimbriate at the mouth and edges, narrowed somewhat abruptly into a distinct, subulate apex 2 in. long. Leaves 3-5 in. long,  $\frac{1}{2}$ - $\frac{1}{3}$  in. broad, distinctly petiolate, 3 prominent secondary nerves on either side of midrib, transverse nerves conspicuous; sheath 2 in. long, striated with raised longitudinal lines, fimbriate at the mouth, with a long ligula, persistent after the leaves fall, forming an acute angle with branches. Flowers in large panicles, with slender drooping branches. Racemes of 2 or 3 spikelets in the axils of large amplexicaul oblong multinerved bracts 3 in. long. Spikelets linear-lanceolate, 1-1 $\frac{1}{2}$  in. long, of 6-8 hairy distinct flowers. Empty glumes 2, white, membranous, glabrous, linear-lanceolate. Articulation of rachis between two flowers  $\frac{1}{4}$ - $\frac{1}{3}$  the length of flowering glume. Flowering glume  $\frac{1}{2}$ - $\frac{3}{4}$  in. long, long-acuminate, 7-9-nerved, roughly hirsute, with long hairs at the base. Palea much shorter than flowering glume, 2-ribbed, with 2 nerves between the ribs, and 2 on each side. Scales 3, lanceolate. Stamens 3. Style 3-fid.

Upper part of Hattu (8400 ft.), T. Thomson, Aug. 1847. Deoban (8000 ft.) D.B., May 1863. Dūdatoli in Garhwal (8500 ft.), Stacey and Winterbottom. In Kamaon, Nepal, and in Sikkim on Mount Singalelah at 11,000 ft. Hooker.

### 2. *T. Falconeri*, Hook. fil.; Munro l. c. 34.

Leaves thin, 3-4 in. long,  $\frac{1}{2}$ - $\frac{1}{3}$  in. broad, narrowed into a slender petiole; sheaths membranous, truncate below the petiole. Flowering branches (on leafless culms?) numerous, slender, 12-18 in. long, bearing numerous distant short racemes. Racemes sessile, 1 in. long, supported at the base by 6-8 imbricate membranous bracts, the outer shorter, ovate, the inner ovate-lanceolate, nearly as long as spikelet. Spikelets glabrous, of one fertile and a terminal sterile flower; empty glumes 2, more than half the length of spikelet.

Madhari Pass, Kamaon (8000 ft.), Strachey and Winterbottom. Nepal.

### 3. *BAMBUSA*, Schreber.

Large, mostly erect, often gigantic Bamboos, the stems generally massed together in compact clumps or clusters. Flowers in a few species on leaf-bearing stems, generally on stems without leaves, which die after the seed is ripe. In some species one or a few stems only of the entire cluster bear flowers at one time—these are the Bamboos which flower annually; in others all or nearly all stems of one cluster come into flower at the same time, followed by the death of the entire cluster—these are the Bamboos which flower after long periods, for it generally happens that all or most clusters of the same species come into flower simultaneously in one district, so that in one year all Bamboos of one species die over extensive areas, followed by a dense mass of seedlings, which come to maturity and bear flowers after a period varying according to circumstances. Spikelets generally many-flowered; empty glumes 2 or more, the lower shorter, the upper similar to the flowering glumes. Palea 2-keeled, keels generally fimbriate. Scales 3, ciliate, membranous or hyaline. Stamens 6. Caryopsis with a deep longitudinal furrow, often adhering to the palea and flowering glume.

Branches spinescent; leaves small. . . . . 1. *B. arundinacea*.  
Branches unarmed.

Spikelets terete.

Leaves middle-sized, pale and soft-pubescent beneath, transverse veins none, spikelets 1-2 in. long, joints of rachis elongated, thickened into a hairy disc under the flowering glume; scales cuneate, thickened at base, but without prominent nerves. . . . .

2. *B. Tulda*.

Leaves large, concolorous, glabrous but scabrous along edges, transverse veins distinct; spikelets  $\frac{1}{2}$ - $\frac{1}{3}$  in. long, joints of rachis short, glabrous; scales ovate or obovate, with distinct longitudinal nerves. . . . .

3. *B. Balcooa*.

Spikelets laterally compressed, flowers distichous; leaves with distinct transverse veins. . . . .

4. *B. vulgaris*.

1. *B. arundinacea*, Retz; Munro l. c. 103; Roxb. Cor. Pl. t. 79; Fl. Ind. ii. 191; Bedd. Fl. Sylv. t. 321.—Sans. *Vansa*. Vern. *Magar bāns*, *nāl bāns*, Pb.; *Bāns*, *kattang*, *kuttung bāns*, N.W. and Central India; *Mandgay*, Bombay (Dalzell); *Veduru*, Telugu.

Stems tall, green, shining, with spinescent branches, packed close in

large compact clumps of 30-100, generally 30-50 ft. high, but attaining much larger dimensions on the west coast and in the Satpura. Joints 4-9 in. diam., walls thick, cavity small; lower branches stiff, green, spreading, spinescent, with a few leaves; upper branches alternate, regularly distichous. Spines strong, sharp, curved, either in pairs at the base of a branch, or in threes, the middle one the largest. Leaves small, thin, lanceolate, 4-8 in. long, and  $\frac{1}{3}$ - $\frac{2}{3}$  in. broad, generally glabrous, sometimes with scattered hairs underneath, 5-6 pair of prominent longitudinal nerves on either side of midrib; sheaths persistent, coriaceous, 1-2 in. long, glabrous or pilose with scattered hairs, more or less fimbriate at mouth or edges. Flowers at long intervals, probably at the age of thirty years, all stems of one clump being covered with flowers at the same time, a few leaves often appear with the flowers. Spikelets mostly sessile, in dense half-whorled clusters at the nodes, glabrous, shining, the fimbriate edges of the palea prominently apparent. Empty glumes 2-4; flowering glumes 4-10, the upper generally stamiferous only and sterile. Flowering glume thickened and mucronate at the apex, wholly glabrous, not ciliate at the edges, often shorter than the palea. Scales 2, hyaline, fimbriate. Anthers with an obtuse glabrous point between the cells. Ovary glabrous; style deeply 2- or 3-fid, stigmatic branches long-plumose. Caryopsis  $\frac{1}{2}$  in. long, enclosed in glume and palea.

Throughout South India, particularly abundant in the Anamallays, Wynad, the adjoining forests of Mysore, Coorg, Malabar, and Canara. In Belgaum, the Khandeish Dangs, at Sironcha on the Godavery. On two feeders of the Bagh river, a tributary of the Wainganga at the base of the Satpura range. Jubbulpur, Bengal, and (cultivated) in the sub-Himalayan tract of the Panjab.

The stems attain 70-90 ft. in the forests of Bejagarh near the Bagh river, and on the western coast. The manifold uses of this Bamboo for building, scaffolding, ladders, carrying and tent poles, the masts of boats, water-pipes, and various other purposes, are well known. Continued immersion of Bamboos in water, or better still in a solution of sulphate of iron or lime-water, renders them more durable. It forms thick and impenetrable hedges. In Hyder Ali's time, the town of Bednor in north-west Mysore, was defended by a deep trench filled with clumps of this Bamboo.

Isolated flowering clumps of this Bamboo are found occasionally, but as a rule all clumps in one district come into flower simultaneously, a few clumps flowering in the previous, and some in the succeeding year. After the seed ripens, the stems die down to the ground, and in the following year a dense mass of seedlings springs up, forming during a series of years a close thicket of slender stems, until the young rhizome gets sufficient strength to produce larger shoots. Shoots of a full-grown rhizome attain their full length in one or two months, being covered in that stage with large leafless hairy sheaths. Subsequently the leaf-bearing branches develop in the axils of their sheaths, and the stem gradually matures and gets hard and firm. It is a matter for farther inquiry whether this and other Bamboos come into flower after they have attained a certain age. Beddome (Fl. Sylv. Manual, p. 229) is of opinion that this species generally flowers at an age of about 32 years, there being a flowering on record (on the western coast) in 1804, 1836, and 1868. In Canara, however, this species (probably, *Bidungulu*, Can., flowered in the Sûpa forests in 1864. This difference is in accordance with what I have observed in the case of other species (*B. polymorpha*, *Kyathounwa*, *B. Tulda*, *Teinca*), that



though the Bamboos of the same kind in one district flower simultaneously, those in another district follow a few years later. The large Bamboo (this species probably) on the Nerbudda between Jubbulpur and Mandla flowered and died in 1839, and the same happened a few years ago. Dr Hooker (Him. Journals, i. 155) is of opinion that Bamboos do not flower at any prescribed age, but at any period when full-grown and the circumstances of the season are favourable to their flowering. The question is by no means cleared up, and more accurate records of the flowering, not of Bamboos generally, but of certain species, are wanted. It also is a matter for farther inquiry, whether the rhizomes of those Bamboos, all stems of which flower and seed, die or produce fresh shoots. What I have seen in Burma and India, leads me to think that they die, and that in such cases reproduction takes place entirely from seed. It is different with those kinds of which a few stems only of one clump come into flower. The seed of this and other species of Bamboo has often saved the lives of thousands in times of scarcity, 1812 in Orissa, 1864 in Canara, and 1866 (probably *B. Tulda*) in Malda. When young, the hollow joints of Bamboos are partly full of a watery liquid, which gradually dries up as the stems get older. It is not impossible that the well-known silicious deposit (*Tabasheer*), which is found in the joints of this and other species, may be the residuum of the fluid which often fills the joints. The ashes of all Bamboos are rich in silica.

*B. spinosa*, Roxb. Fl. Ind. ii. 198; Munro l. c. 104; Bedd. Fl. Sylv. 231, is believed to differ in more solid stems, a paler-coloured and more striated flower-panicle, smaller and more coriaceous spikelets, with fewer flowers and generally smaller leaves often hairy on the under side. Bengal and Burma, and, according to Beddome, on the north-east (not on the west side) of the Madras Presidency. S. Kurz, however, calls the Burmese *Kyakatwa*, *B. arundinacea*, and I have never been able to find any difference either in growing or in herbarium specimens between the thorny Bamboo of Western India and Burma. Pending farther research, I am inclined to unite the two species.

2. *B. Tulda*, Roxb. Fl. Ind. ii. 193; Munro l. c. 91. — Vern. *Peka Bans*, Hindi; *Tulda Bans*, Beng.; *Theiwa*, Burm.

Stems tall, unarmed, the joints with a large cavity and thin walls. Leaves lanceolate, 6-9 in. long, about 1 in. broad, glabrous above, underneath pale and with short soft pubescence, edges scabrous; 6 pairs of slightly prominent secondary nerves, transverse veins none; sheaths glabrous, with 2 distinct rounded, auriculate, often fimbriate lobes at the base of the short flat petiole. Flowers at long intervals, all stems of one clump bearing flowers at the same time, each stem being converted into an "immense oblong waving panicle, composed of innumerable supra-decompound ramifications" (Roxb.) Spikelets lanceolate, 1-2 in. long, sessile, in clusters of 4-10, in long slender, interrupted, often branching spikes, 12-24 in. long, 1 or several stout and woody branches at each node, bearing numerous lateral spikes, and surrounded at the base by fascicles of slender sometimes branching spikes. Spikelets glabrous, shining, 4-10-flowered, with 4-6 empty glumes at the base, which are often gemmiparous. Joints of rachis elongated, thickened into a hairy disc under the flowering glume, and distinctly articulate at that point, joints one-third the length of the flowering glume. Flowering glume mucronate, with 13-15 broad, whitish, prominent nerves, slightly pubescent at the edges near apex. Palea sharply 2-keeled, keels long-ciliate,

but not conspicuous without removing the flowering glume; 7 prominent nerves between the keels. Scales cuneate-oblong, obliquely truncate, irregularly cut and fimbriate with broad subulate teeth, base thickened, particularly on one side, edges and upper part transparent, no distinct nerves, the third lodicule generally long, linear. Anthers glabrous, connective with a short blunt apex. Ovary obovate-oblong, hirsute; style deeply 3-fid.

The common Bamboo of Bengal. Not uncommon in the deciduous forest of Pegu, generally occupying lower and moister stretches of ground in company with *Tinava* (*Cephalostachyum pergracile*, Munro), the dry hilla surrounding being covered with *Dendrocalamus strictus*. Also associated with *Bambusa polymorpha*, Munro, *Kyathounava*. Fl. May. Generally used for roofs and scaffolding, found more durable if soaked in water previous to being used. The young shoots are pickled. Used largely to make mats for the walls and roofs of cottages. Baskets, fans, and window-blinds are made of it.

*B. nutans*, Wall.; Munro l. c. 92, of Nepal, Assam, Kasia hills, and Silhet, agrees with *B. Tulda* in all essential characters; the leaves are of medium size, pale beneath and with slight soft pubescence, the spicules are long, with elongated distinctly articulate clavate joints of the rachis, terminating in a hairy disc under the flowering glume, the fimbriate edges of the palea are not conspicuous on the face of the spikelet, the connective of the anthers terminates in a blunt glabrous point, and the lodicules are cuneate, with a thick base and without prominent nerves. Munro states that it is a much smaller plant, with a slender and nearly solid stem, the leaves whiter below, and few fertile spikelets. Nepal, Sikkim at 5000 to 7000 ft. (vern. *Mahlo*), Assam (*Bidhuli Bans*, *Mukial Bans*), Kasia, Silhet, and, according to Dr Stewart, in the Siwalik tract, probably extending west to the Ganges.

3. *B. Balcooa*, Roxb. Fl. Ind. ii. 196; Munro l. c. 100.—Vern. *Balku Bans*, Beng.

Stems tall unarmed, stouter and often taller than of *B. Tulda*. Leaves oblong-lanceolate, with a large rounded subcordate base, 6-12 in. long and 1-2 in. broad, glabrous, green on both sides, edges scabrous; secondary nerves 7-11 on either side of midrib, not very prominent; transverse veins distinct but distant; sheath truncate at the base of the short petiole; ligula membranous, broadly triangular. Spikelets  $\frac{1}{2}$ - $\frac{1}{3}$  in. long, ovoid-lanceolate, 4-6-flowered, conspicuous by the fimbriate keels of palea, sessile, in compact half-whorled clusters on long interrupted spikes. Empty glumes 2, unequal. Flowering glumes thin, membranous, with a broad concave base, and a wide membranous edge, ciliate near the top, with prominent longitudinal nerves. Rachis not distinctly articulate, joints short, glabrous, not much thickened below the flowering glume. Palea as long as flowering glume, fimbriate at keels and hairy at edges; nerves indistinct; lodicules ovate or obovate, with longitudinal branching nerves, each branch terminating in a long subulate cilia or tooth. Anthers glabrous, connective terminating in a short dark point.

Bengal, Assam (*Bara Baluka*), Cachar. Reckoned the best Bamboo in Bengal for building, scaffolding, and other works requiring both size and strength. Long immersion in water tends to make it firmer, and proof against the

attacks of Bostrichi (Roxb.) To *B. Balcooa* I am inclined to refer the large Bamboo which is cultivated near villages in the outer hills below Simia, as high as Sairi (5500 ft.), but not higher. The stems attain 40 ft., they are branchless to a height of about 5 ft., the rings at the nodes are nearly horizontal, the joints 12-18 in. long and 3 in. diam.; the sheaths of young shoots are large, densely covered with black hairs, their breadth at base about half their length, narrowed into a triangular apex, longer than broad, and about  $\frac{1}{3}$ - $\frac{1}{4}$  the length of the sheath. Leaves large, 9-12 in. long, 1-2 in. broad, very scabrous at edges, otherwise glabrous; secondary nerves 7-11 on either side of midrib, not very prominent, transverse veins distinct, but distant. I have never found it in flower.

*B. Falconeri*, Munro l. c. 95, is a remarkable species, described from flowering specimens collected by the late Dr Falconer in the Dehra Doon in Sept. 1840. Spikelets lanceolate, wholly glabrous, nearly 1 in. long, about 10-flowered, the upper 4-5, fl. male or sterile, with short effete anthers. Flowering glumes mucronate, with numerous broad prominent nerves somewhat resembling those of *B. Tulda*. Palea much shorter than glume, 2-keeled, keels fimbriate; 7 distinct nerves between keels, and 2 lateral nerves on either side of keels. Anthers pilose at the top, lodicules 3, with prominent longitudinal nerves terminating in subulate teeth. Leaves, supposed by Munro to belong to the same species, collected by Falconer in the previous year (Oct. 1839), and by Strachey and Winterbottom at 4000 ft. elev. on Okenath in Garhwal, are 16 in. long, 3 in. broad, with 14 to 16 pair of prominent secondary nerves and distinct transverse veins, concolorous and glabrous, but scabrous beneath, they resemble the leaves of *Dendrocalamus Hamiltonianus*. The identification of the large Bamboo of the Dehra Doon and of the outer ranges between Kalka and Sairi remains for farther inquiry.

4. *B. vulgaris*, Wendl.; Munro l. c. 106; Dalzell Bombay Fl. 299; Bedd. Fl. Sylv. Manual, p. 232.—Syn. *B. Thouarsii*, Kunth; *B. arundinacea*, Aiton. *Kulluk, bamboo*, Bombay; *Una gass*, Ceylon.

Stems tall unarmed, 20-50 ft. high, green, yellow, or with green and yellow stripes, joints 4 in. diam. and more, with thin walls. Leaves thin, linear-lanceolate, 6-10 in. long,  $\frac{3}{4}$ -1 $\frac{1}{2}$  in. broad, very scabrous on the longitudinal nerves close to the edge, secondary nerves conspicuous, 6-8 on either side of midrib, transverse veins numerous. Flowering stems often leaf-bearing. Spikelets sessile, oblong-lanceolate, laterally compressed,  $\frac{1}{2}$ -1 in. long, glabrous, 4-12-flowered, distichous, so that the flowers of each side appear distinct, and separated by a furrow, fasciculate, or in compact half-whorls on long, interrupted, paniculate spikes. Empty glumes 2; flowering glumes ovate-lanceolate, narrowed at the base, longitudinal nerves prominent near apex, indistinct below, mucronate and ciliate at the apex, fimbriate keels of palea conspicuous near the top of flowering glume. Lodicules transparent, thinly membranous. Anthers penicillate at the apex, with short hairs. Style slender, filiform, 2-3-fid at the end.

Cultivated in many districts of India, particularly in the western Dekkan, Kolapur, Sattara, Poona, Silhet, Cachar, Chittagong. In the eastern Panjab, according to Stewart. Abundant in Ceylon, up to 2000 ft. (Thwaites Enum. 375). Indian Archipelago, tropical America, and the West Indies. Commonly grown in conservatories in Europe, where it not rarely comes into flower.

## 4. DENDROCALAMUS, Nees.

Characters those of *Bambusa*, several species (*D. strictus*, *D. Hookeri*) are known to flower annually. Scales none. Ovary hirsute; style long, filiform, undivided, or 2-3-fid at the apex, base persistent. Caryopsis with a thick pericarp, narrowed into the persistent base of the style; position of the embryo generally not conspicuous on the surface.

Spikelets linear-lanceolate, spinescent	:	1. <i>D. strictus</i> .
Spikelets cuneate, soft-membranous	:	2. <i>D. Hamiltonii</i> .

1. *D. strictus*, Nees.—Tab. LXX.—Munro l. c. 147; Bedd. Fl. Sylv. t. 325.—Syn. *Bambusa stricta*, Roxb. Fl. Ind. ii. 193, not Cor. Pl. t. 80, which is *Oxytenanthera Thwaitesii*, Munro, a Bamboo of Ceylon, the Nilgiris, and Shevaroy hills—Munro l. c. 129. *Mole Bamboo*. Vern. *Bāns*, North India. *Myinwa*, Burma. *Bās*, *Udha*, Bombay.

A middle-sized, generally deciduous Bamboo, stems with small cavity, or entirely solid, closely packed in dense clumps, the lower part of stem often variously bent, with fasciculate, stiff, horizontal, generally leafless branches, the upper part spreading out in all directions, often curved downwards, or nearly horizontal, with fasciculate slender flexuose solid branches, the leaves on fasciculate branchlets enclosed in coriaceous shining persistent sheaths; joints 12-18 in. long, 1-3 in. diam. Sheaths of young shoots shorter than joints, glabrous, shining outside, tapering into a triangular apex. Leaves distichous, hairy beneath, rough and often hairy above, exceedingly variable in size, generally middle-sized, 3-9 in. long,  $\frac{1}{4}$ -1 in. broad, with 6 pairs of secondary nerves, and no transverse veins. Flowers annually, 1 or a few stems of each clump only producing flowers, often mixed with leaf-bearing branches. Spikelets spinescent, hairy, forming, with a number of sterile spikelets, dense globose spiny heads arranged in long interrupted spikes, joints between the flower-heads about 1 in. long. Empty glumes 2-6, flowering glumes 2-3, generally 2, spinescent, hairy. Palea of lower flower 2-keeled, keels pilose, of upper flower convex, not keeled, 8-nerved. Ovary stipitate, hairy, style long filiform. Caryopsis brown, shining, ovoid,  $\frac{1}{4}$  in. long, narrowed into the persistent hairy style, pericarp (perigynium, Munro) coriaceous, separable from the seed, narrowed into the hairy persistent base of style.

Widely spread, and very common throughout India and Burma, up to the borders of the arid tract. On the Aravalli hills, where I found it wild near Todgarh in Mairwara. In the Panjab only in the sub-Himalayan tract, locally in a few places, and on the east side of the Salt range; not in Sindh. Not in Ceylon, but in Java. Ascends to 3000 ft. in the Peninsula, and to 3500 ft. in the outer N.W. Himalaya. In the Panjab it is common near the Sutlej, forms two forests of importance on the left bank of the Bias, several small tracts on the Chenab, and covers a considerable area west of the Jhelam, north of Rawalpindi. Generally gregarious, forming extensive forests on dry hot stony hills. The young foliage, which appears in May, is bright green, the old leaves get yellow and fall during winter, except on moist ground, where this Bamboo remains green

throughout the year. Fl. between Nov. and April, the seed ripening in June. The stems that have flowered die after the seed ripens. Attains 20-40 ft. in the Panjab, in South India it grows 30-50 ft. high; in Burma, on dry hills, 20-40, and on moist ground 100 ft. The stems attain their full height in a few weeks at the commencement of the rains; in the Panjab they do not harden fully during the first year. The stems are strong and elastic, they are much used for roofing, basket- and wattle-work, and they make excellent spear-handles. In the Bamboo forests of the Panjab and the North-West, the different sizes and descriptions of this Bamboo, as they are brought to market, are classified under a multitude of names.

2. *D. Hamiltonii*, Nees et Arnott; Munro l. c. 151.—Vern. *Pao* of Lepchas, *Wah* of Mechis in Sikkim.

Stems tall, 40-60 ft. high, joints short, 4-7 in. diam., with thick walls. Leaves firm, subcoriaceous, 6-15 in. long, 2 in. broad, glabrous above, rough, often hairy and generally pale beneath, transverse veins and 12-15 pairs of secondary nerves prominent on the under side, indistinct on the upper side of leaf; sheath of leaf projecting considerably on both sides beyond the short petiole, continued into an obliquely truncate coriaceous ligula. Flowers annually; spikelets in long interrupted panicle spikes, common peduncle thick, hollow, with numerous elevated longitudinal lines. Spikelets soft, membranous, glabrous, not spinescent, cuneate, in rounded compact lateral heads, each head supported by several broad shining bracts. Empty glumes 2, subequal, flowers 2-4, one only fertile. Style long, filiform, 3-fid at the apex.

Sikkim and Bhutan 2000-5600 ft., Assam. The young shoots are boiled and eaten.

*D. Parishii*, Munro l. c. 149, is described from flower-spikes only, believed to have been collected in the Panjab Himalaya by Lt. Parish. It is closely allied to *D. Hamiltonii*, but differs by ovate-lanceolate acute spikelets. If the specimens were really found in the Panjab, then it is not impossible that they belong to the large-leaved Bamboo of the Dehra Doon, or to the one of the outer hills below Simla, which has been doubtfully referred to *Bambusa Balcooa*, for the leaves of both, particularly of the former, resemble those of *D. Hamiltonii*.

Another Himalayan Bamboo of this group is *D. Hookeri*, Munro l. c. 151. Leaves similar to *D. Hamiltonii*, but larger, 15 in. long and 3-4 in. broad, secondary nerves 15 pairs, with transverse veins very prominent on the under side, indistinct on the upper side of leaf. Spikelets ovate, apex tapering, hairy. Assam, Kasia hills, Vern. *Assey*. Nearly allied, but a smaller-sized Bamboo, 20-30 ft. high, with a longer 8-flowered spikelet, is *D. latiflorus*, Munro l. c. tab. vi., of Hong Kong and Formosa.



## ADDITIONS AND CORRECTIONS.

P. 3. *Schizandra grandiflora*, H. f. and Th. ; Fl. Ind. i. 44.—Syn. *Kadsura grandiflora*, Wall. Tent. Fl. Nep. t. 14 (*Magnoliaceae*). A glabrous climbing shrub, without stipules, with white, fragrant, drooping axillary flowers ; ovaries numerous, imbricated on a conical receptacle, which lengthens in fruit into a cylindrical fleshy axis, 6-9 in. long, bearing numerous scarlet, fleshy, 2-seeded carpels. Himalaya, Suttlej to Bhutan, between 6000 and 10,000 ft. Fl. April, May ; fr. Oct. The fruit is eaten.

P. 3, line 17 from below, *dele* "gynophore stalked."

P. 3 " 4 " *read* "carpels in a loose stalked spike," *instead of* "capsules sessile on an elongated stalk."

P. 5. *Polyalthia cerasoides*, Benth. & Hook. Prome district, S. Kurz.

P. 8. *Stephania rotunda*, Lour. ; Hook. Fl. Ind. i. 103.—Syn. *Cocculus Roxburghianus*, Wall. *Cissampelos glabra*, Roxb. Fl. Ind. iii. 840. *Menispermaceae*. Vern. *Gajera*, *garjial*, Kamaon. A large glabrous climber with a sub-globose tuberous root. Leaves peltate, broad-ovate or suborbicular, often repand or sinuate-lobed, pale beneath, 3-7 in. diam. Flowers yellow, in axillary cymose umbels. Male flowers : sepals 6-10, narrow-cuneate, biseriate, petals 3-5, obovate, anthers 6, connate, inserted round the top of the staminal column, bursting transversely. Female flowers : sepals 3-6, petals of the male. Drupe glabrous, endocarp compressed, horseshoe-shaped, dorsally tubercled, sides hollowed and perforated. Seed almost annular. N.W. Himalaya, ascending to 7000 ft. Kasia hills, Burma. Fl. April-June. For the structure of the wood see Hooker & Thomson, *Flora Indica* (1855), p. 195.

P. 8. *Tinospora cordifolia*, Miers.—Vern. *Gurcha*, Kamaon.

P. 8. Under *Anamirta Cocculus*. For a full description of this climber, see Wallich, *Descriptions of Indian Plants in Asiat. Researches*, xiii. 403.

P. 10. *Cissampelos Pareira*, Linn.—Vern. *Pari*, Kamaon. The botanical origin of the various stems and roots known as *Pareira Brava* and *Radix Pareirae* has lately been investigated by D. Hanbury (*Pharm. Journ.* 1873, Aug. 2d and 9th). The result is, that the drug is not yielded by this plant. One of the best kinds is the root of *Chondrodendron tomentosum*, Ruiz and Pavon, a large climber of the same family in Brazil, with bunches of large oval berries.

P. 12. *Berberis asiatica*, Roxb.—Vern. *Kilmora*, *kingora*, Kamaon.

P. 12. *B. Lycium*, Royle.—Vern. *Kingora*.

P. 12. *B. nepalensis*, Spreng.—Vern. *Pande kilmora*, *chotara*, *chotra*, Kamaon. Hardy against walls in England.

P. 13. *Hottbottlia latifolia*, Wall.—Syn. *Stauntonia latifolia* and *S. angustifolia*, Wall. Vern. *Gophla*, Kamaon. The fruit is eaten.

P. 14. *Capparis aphylla*. A common and characteristic shrub of Soudan.

N.L. 15°-20°, as far as Timbuktu on the Niger, according to Barth.—(Grisebach Veg. d. Erd., ii. 123.)

P. 15. *Capparis horrida*, Linn. fil.—Vern. *Uta kanta*, *bipua kanta*, Kamaon.

P. 20. Other species of *Tamarix*, of North-West and Central India, are 1. *T. salina*, Dyer; Hook. Fl. Ind. i. 248, a glabrous, glaucous shrub, with cordiform, subamplexicaul, strongly impress-punctate leaves; pentandrous (like *T. gallica*, *dioica*, and *articulata*). Salt range. 2. *T. ericoides*, Rottler.—Syn. *Trichaurus ericoides*, W. & A. Prodr. 40; Wight Ill. t. 24 B, Ic. t. 22. A small decandrous shrub, with foliage like the common Tamarisk, but larger flowers; seeds rostrate, beak straight, feathered with long spreading hairs. Common in the rocky river-beds of the Dekkan, often associated with *Rhabdia* and *Homonoya*. 3. *T. stricta*, Boiss.; Hook. Fl. Ind. i. 249, decandrous, hoary with impress-punctate glands. Sindh. Beluchistan.

P. 28. *Thespesia Lampas*, Dalzell; Bombay Fl. 19. *T. populnea*, Correa, the *Bendy* tree of Bombay, *Portia* tree of Madras.—Vern. *Poresh*, Beng., a fast-growing tree, with cordate, long-acuminate leaves, and close-grained wood, readily grown from cuttings, is often found in gardens and avenues of Central India.

P. 32, l. 20 from above, read "4" instead of "5."

P. 39. In Hooker's Fl. Ind. i. 387, the name *G. scabrophylla* is substituted for *G. sclerophylla*. The latter, however, is the older and more suitable name.

P. 40. *G. vestita*, Wall., should be called *G. elastica*, Royle, the name being supported by figure and description.

P. 44. *Hiptage Madaglot*, Gaertn.—Sans. *Pundraka*.

P. 45. Hooker, in Fl. Ind. i. 421, calls the Garhwal and Kamaon plant, with subcordate leaves and silky white tomentum, *Aspidopterys Wallichii*, and the eastern plant, Nepal to Burma, leaves not cordate, *A. nutans*, Hook. f.

P. 47. *Zanthoxylum alatum* is found up the Sutlej valley as far as Wangtu.

P. 48, 49. *Limonia acidissima*, *Murraya Koenigii* and *Clausena pentaphylla*, common in Burma, S. Kurz.

P. 50. *Skimmia Laureola*. Fl. sweet-scented, drupes with 2-3, 1-seeded cartilaginous kernels. Flowers both in spring and autumn, according to Madden, As. Soc. Journ. xviii. i. 606.

P. 50, line 16, add: leaves (of *Citrus*) more or less dentate.

P. 51 " 25 " Risso calls the five species accepted by him: 1. *C. Aurantium*, the sweet; 2. *C. vulgaris*, the bitter orange; 3. *C. Limetta*; 4. *C. medica*; 5. *C. limonum*. Risso and Poiteau classify what they call types or races, with regard to the shape of the oil-vesicles in the rind, as follows: *C. decumana*, with flat or convex vesicles, *C. Aurantium*, *Lumia*, *limonum*, with convex, *Bigaradia*, *Bergamia*, *Limetta*, with concave vesicles of oil in the rind.

P. 53, line 17, read "2000 and 4000" instead of "4000 and 3000."

P. 53 " 22, add the following remarks concerning what are believed to be wild oranges on the Nilgiris. 1. *C. vulgaris*, Risso; Wight Ic. t. 957. On the slopes below Kotagiri and Kunnur (Nilgiris), apparently wild, with large elliptic dentate leaves, petiole more or less winged, flowers large, white; fruit orange-coloured, roundish or slightly elongated or depressed; pulp acid or bitter. 2. *C. Limetta*, Risso; Wight Ic. t. 958. In the Orange valley near Kotagiri, flowers Aug.-Sept., certainly wild; a low, very ramous, erect, thorny bush, covered during the flowering season with a profusion of beautiful white fragrant flowers; leaves ovate, dentate, petiole winged or margined; flowers small white, fruit pale yellow, ovoid or roundish, terminated by a knob; pulp watery, acid or sweetish, occasionally slightly bitter.

P. 56. *Feronia Elephantum*. Wild in the Prome district, Pegu, S. Kurz.

P. 58. *Ailanthus malabarica*. Forests of the Pegu Yoma, S. Kurz.

P. 60. *Ochna pumila*, Ham.; Don Fl. Nep. 224, add Syn. *O. nana*, Royle Ill. 165.

P. 61. *Bursera serrata*, in Burma.—Vern. *Thadiben*, S. Kurz.

P. 61, line 6 from below, read "*Boswellia serrata*, Roxburgh in Asiatic Researches, ix. 379."

The correct name of this common and well-known tree has not yet been finally settled. H. T. Colebrooke, in a paper on Olibanum or Frankincense, As. Res. ix. 377 (London edition of 1809), gives Roxburgh's figure and description of it under the name of *B. serrata*. Colebrooke found it frequent in the forest between the Sone (Soane) and Nagpūr (vern. *Salāi*), on the route by which he travelled to Berar in 1797, and came to the conclusion that it was the tree yielding the Olibanum of commerce. In a note at the end of his paper he stated, that if the genus had not already received a botanical name, it might have been suitably denominated *Libanus thurifera*. In a later volume of the Asiatic Researches, xi. 152 (Calcutta edition of 1810), Dr John Fleming published a catalogue of Indian medicinal plants, the names and characters of new species being, as he says, transcribed from Roxburgh's manuscript, and among them will be found, at page 158, *Boswellia thurifera*, Roxb. (*Salai*, Hindi). Fleming refers to Colebrooke's paper in the ninth volume, and there is no doubt that he means the same tree. It is evident, therefore, that Roxburgh, soon after the publication of Colebrooke's paper, probably by way of compliment to the author's suggestion, altered the name from *serrata* into *thurifera*. Since that time both names have been employed by different botanists.—Roxburgh Catalogue, p. 32, and Flora Indica, ii. 383, Graham (Cat. 42), and Wight & Arn. (Prodr. 174) adopt the name *thurifera*, while De Candolle (Prodr. ii. 76, 1825), Colebrooke in a paper on *Boswellia* (Trans. Linn. Soc. xv. 363, 1827), and Wallich (Cat. 5486) give the name *B. serrata* to the same tree. De Candolle quotes Stackhouse, Extracts from Bruce's Travels in Abyssinia respecting the Balsam and Myrrh Trees, Bath, 1815, as authority for the name, but Stackhouse, p. 19, calls it *B. serrata*, Roxb., and refers to Colebrooke's paper in the Asiatic Researches, from which he extracts his account of the tree. It cannot be said that either of the names has been more generally used by botanists, and, under these circumstances, the older name, *B. serrata*, ought to take precedence. There is, however, this against it, that the leaflets, though described as serrate, are obtusely dentate, and often entire.

*B. glabra*, Roxb., first described in the Coromandel Plants, iii. p. 4, is, as explained at p. 62, a doubtful species. Graham (Cat. 42) identifies it with the *Salai* of the bare rocky hills of the Dekkan and the Satpura range.

P. 67. In Burma, I have seen *Melia indica* and *M. Asedarach* only cultivated, but S. Kurz informs me that *M. indica* is wild in the Yoma hills of the Prome district, and I find a note in my herbarium that *M. indica* is wild beyond the British frontier. This is a subject for farther inquiry. According to Mason, the Persian Lilac is called *Kamakha*, and the *Neem*, which is cultivated by the Burmans on account of its medicinal qualities, *Thimbau kamakha*, indicating importation by ship (*thimbau*) from beyond the seas, as in the case of *Thimbau thi* (*Carica Papaya*) and other foreign trees introduced into Burma.

P. 68. Royle, Ill. 141, mentions two species of *Melia* in North India besides the *Neem*, one the *Bakāin*, the other the *Dek*; but Madden, in As. Soc. Journ. xviii. i. 638, points out that there is no difference between them.

P. 69. *Melia composita* has the inside of the staminal tube covered with white hairs, which protrude at the mouth.

P. 69. *Amoora Rohituka*, common in Burma.—Vern. *Thitni* (red wood).

P. 71. *Soymida febrifuga*, Burma.

P. 72. The characters here given to distinguish *C. serrata* from *Toona* demand farther inquiry on the spot. In Kunawar, *C. serrata* has its upper limit opposite Chergāon.

P. 75. *Cassipouera Rheedii*. Common in Prome district, S. Kurz.

P. 77. *Ilex odorata*, Ham.—Syn. *I. serrata*, Royle. Vern. *Garshūn*, *Gar-kaula*, Kamaon.

P. 84. Several climbing shrubs of this Order are found in Central India and the sub-Himalayan forests, belonging to the tribe of *Gouaniæ*, with the ovary adnate to the calyx: 1. *Gouania leptostachya*, DC.; Wight & Arn. Prodr. 166.—Vern. *Kala lag*, Kamaon. Leaves ovate-acuminate, crenate, with 5-6 main lateral nerves, arcuate. Flowers greenish in long slender, panicked racemes, tendrils simple, generally at the base of racemes. Fruit dry, inferior, with 3 broad wings,  $\frac{1}{4}$  in. across, separating into 3 coriaceous, 1-seeded, indehiscent carpels. Sub-Himalayan tract of Kamaon. Bengal. 2. *G. microcarpa*, DC.; Wight & Arn. Prodr. 167. Similar, but racemes, branchlets, and young leaves rusty-tomentose while young; leaves entire, glabrous and subcoriaceous when full-grown, and smaller fruit. South and probably Central India. 3. *Helinus lanceolatus*.—Syn. *Gouania lanceolata*, Wall. A slender twining shrub with entire lanceolate leaves, branchlets ending in short simple tendrils, flowers umbellate, fruit obovoid, not winged, coriaceous. Plains of N.W. India, common in the sub-Himalayan tract of the Panjab and Kamaon, ascending to 4000 ft. Fl. in May, June.

P. 85, l. 10 from below, read "*Acajou*" for "*Acayou*."

P. 95. The shrub mentioned as *Paliurus aculeatus* in the Bassahir Forest Report, p. 63—Vern. *Thūm*, upper limit in Kunawar at Javi—is *Sageretia theesans*, Brongn. *Paliurus* is a shrub similar to *Zizyphus*, but fruit with a broad orbicular membranous wing 1 in. diam., of the Mediterranean region, common in Palestine, found east as far as Armenia, Kurdistan, and North Persia.

P. 96. S. Kurz informs me that the common *Ventilago* of Burma is *V. calyculata*.

P. 99. E. Regel, in a late paper on the American, Chinese, and Japanese species of *Vitis*, unites *V. parvifolia*, Roxb., with *V. vulpina*, Linn., and *V. lanata*, Roxb., with *V. Labrusca*, Linn. *V. vulpina* and *Labrusca* inhabit North America and Japan. In the same paper he advances the opinion, that *V. vinifera* is no original species at all, but the product of long-continued cultivation of the two last-named species. It is true that the grape-vine agrees with them as well as with *V. parvifolia* and *lanata*, in pentamerous flowers and petals cohering at the apex; but its cultivation commenced in Western Asia, and neither *V. lanata* nor *parvifolia*, nor any of the forms of *V. Labrusca* and *vulpina*, have, as far as I am aware, been found in Western Asia.

Pp. 99-101. *Vitis latifolia*, *lanata*, *indica*, *adnata*, *lanceolaria*, are common in Burma, S. Kurz. *V. himalayana* is found in Kunawar as far as Urni.

P. 102. *Leca macrophylla*. Common in Burma.

P. 104. At high elevations the Indian *Horse-Chestnut* is bare in winter, the young leaves appearing some time before the flowers. The buds are small and membranous, those of *A. Hippocastanum* are large and viscid. Cultivated in Kunawar, upper limit in the valley, Jangi on the right and Purbani on the left side.—Vern. *Pū*.

P. 114. *Staphylea Emodi*. Kunawar as far up as Chergaon.

P. 117. *Sabia campanulata* has purple, not green flowers; the flowers of *S. paniculata*—Vern. *Bakal pata*—Kamaon, are yellow, and the ripe fruit of an ultramarine blue (Madden).

P. 117. Character of *Anacardiaceæ*, add: ovary free.

P. 118. In Kunawar upper limit of *Rhus Cotinus* above Wangtu, and of *R. semialata*, Urni.

P. 122. *Pistacia integerrima*, J. L. Stewart. Upper limit in Kunawar: Urni on the right, and Kilba on the left bank.

P. 152. *Dalbergia volubilis*. Common in Burma, S. Kurz.

- P. 154. *Derris robusta*. In Burma, vern. *Thitpagan*—read *D. Krowee*, Roxb.
- P. 158. *Acrocarpus fraxinifolius*. Burma, S. Kurz.
- P. 162. *Bauhinia Vahlia*. Burma, S. Kurz.
- P. 167. Line 6 from below, read "*Mimosa scandens*, Linn."
- P. 174. *Pithecolobium lobatum*, Benth., is a large tree in the moister forests of Burma, with large, lobed pods and seeds similar in size and shape to those of *Entada scandens*; eaten as a condiment in Burma. Fl. Jan., Feb. (*Tanyin*, Burm.) Also Indian Archipelago.
- P. 175. *Albizia procera*. Indian Archipelago, Philippine Islands, and North Australia.
- P. 176. *Albizia Lebbeke*. Burma, S. Kurz.
- P. 177. *Albizia Julibrissin*. In the Kunawar valley extends as far as Wangtu.
- P. 179. *Albizia amara*. In Kamaon, Madden.
- P. 180. *Acacia arabica*.—Sans. *Khadira*.
- P. 181. Line 24 from below, *dele* "uniformly distributed."
- P. 183. *A. eburnea* has sometimes 5 or 6 pairs of pinnæ. The twisted and broad pod represented in t. 199 of Roxb. Cor. Pl. does not belong to this species; it may possibly belong to *A. planifrons*, W. & A. Prodr. 276, a small thorny tree of South India, which differs from *A. eburnea* by having the shorter spines crooked, not straight. The *Acacia* from Kamaon (*Bhes*), mentioned at p. 180 under *A. Latronum*, is probably a villose variety of *A. eburnea*. This appears from the full description given by Madden in p. 631 of his second paper on the Terai and outer mountains of Kamaon (As. Soc. Journ. xviii. i. 631). Young branches, petioles, and thorns very villous with rufous down, pinnæ 3-5, leaflets 4-10; flowers white; pods in umbels of 3-7, flat, smooth, linear, nearly straight, pendulous, 3-8-seeded, 3-5 in. long, less than a quarter of an inch broad, the border with a long shallow sinus between each seed. All this agrees well with *A. eburnea*, except the colour of the flower. Common in Garhwal up to the Ganges, but apparently confined to the banks of the streams and rivers where they enter the plains and Doons.
- P. 184. Mr Bentham informs me that *A. rupestris* is closely allied to, and perhaps not specifically distinct from, *A. Senegal*, Willd., which is synonymous with *A. Vereke*, Guill. et Perr., mentioned at p. 186.
- P. 191. *Prunus persica*, cultivated in Kunawar as far as Sungnam on the right, and Morung on the left bank.—Vern. *Rek*.
- P. 194. Line 6 from above, read "for" instead of "but."
- P. 195. *Prunus Mahaleb*. Mountains of Greece in the region of the Silver Fir.
- P. 196. *Prinsepia utilis*. Found in Kunawar as far as Urni.—Vern. *Bekting*.
- P. 196. *Rubus cordifolius*, Don.—Vern. *Katrola, katrola*, Almora, is, according to Madden, synonymous with *R. tiliaceus*.
- P. 199. Two more species are mentioned by Madden in As. Soc. Journ. xviii. i.: *Rubus hypargyryus*, Edgew., with red flowers and yellow woolly fruit. Crest of Chinar near Naini Tal—p. 605. *R. affinis*, Madden, near *R. flavus*, Ham., very green and glossy. Gagar Pass, Binsar, to 7300 ft., in shade only—p. 624.
- P. 202. *Rosa Webbiana*.—Vern. *King yal*. Commences at Pangri in Kunawar.
- P. 204. *Pyrus Pashia*, Hamilton in Don's Fl. Nep. 236, is the older name, and should take precedence of *P. variolosa*, Wall. In Kunawar as far up as Urni.
- P. 208. *Photinia japonica*.—Syn. *Eriobotrya japonica*, Lindley; W. & A. Prodr. 302; Wight Ic. t. 226; *Mespilus japonica*, Thunb.; Roxb. Fl. Ind. ii. 510; Bot. Reg. t. 365; the *Loquat*—is a well-known fruit-tree, indigenous in Japan and China, and now cultivated in Bengal, South and North-West India. Leaves large, lanceolate or ovate-lanceolate, tomentose beneath, with prominent lateral nerves, flowers white, fragrant, in terminal tomentose panicles.



P. 216. *Parrotia Jacquemontiana*. In Kunawar near Shoang at 9000 ft.—Vern. *Shā*.

P. 219. Line 12 from below, read "*malabarica*" and "*parviflora*."

P. 221. *Combretum decandrum*. Burma, S. Kurz.

P. 223. S. Kurz makes *Pangāh*, Burm., a distinct and new species, *T. tomentella*, marked by a glabrous smooth calyx-tube, smaller fruit, and more copious cupreous pubescence.

P. 226. For an account of the *Tussch* silkworm (*Phalæna Paphia*), which lives on the leaves of *Terminalia tomentosa* and *Zizyphus Jujuba* in Behar, see Roxb. in Trans. Linn. Soc. vii. 33.

P. 246. According to another account, the *Prickly Pear* was destroyed in 1849-50 in the Jalandhar district. The insect was collected largely by the cloth-dyers, and yielded a brilliant colour.

P. 255. According to Dr Stewart, *Lonicera angustifolia* is common in Zanskar, Ladak, Nubra, ascending to 15,000 ft.—Notes of a Bot. Tour in Western Tibet, Trans. Bot. Soc. Edin. 1869, p. 207. Is this not *L. spinosa*, Jacquem. ? *L. glauca*, H. f. & Th. Journ. Linn. Soc. ii. 166, a small shrub, with linear-oblong obtuse leaves, glaucous beneath, and large ovate-oblong ciliate bracts, common in Zanskar, Piti, Nubra, Pangong lake, Tibet, 13,000-16,000 ft.

P. 258. Madden (As. Soc. Journ. xviii. i. 609) gives the following additional vern. names for some of the *Viburnums* of the N.W. Himalaya : 1. *V. cotinifolium* (black fruit), *Gūya*, Kamaon. 2. *V. Mullaha*, Hamilton in Don's Prodr. Fl. Nep. 141, which name, being older, should take precedence of *V. stellulatum*, Wall., with abundant red, bitter fruit. *Eri*, Simla. 3. *V. fœtens*, Decaisne. *Gūya*, Kamaon ; *Thelain*, Bussahir.

P. 260. *Sambucus adnata*, Wall. ; H. f. & Th. in Journ. Linn. Soc. ii. 180, is an undershrub with furrowed branches and red berries of Sikkim (6000-11,000 ft.) Nepal, and, according to Royle Ill. 236, on the mountains of Kashmir (?)

P. 269. A species, nearly allied to *Wendlandia tinctoria*, is *W. puberula*, DC. Prodr. iv. 412. Leaves with less prominent lateral nerves, and long hairs, particularly along midrib and nerves. Corolla-tube funnel-shaped (not tubular, as in *W. tinctoria*), twice or barely twice the length of segments. Anthers linear (not elliptic, as in *W. tinctoria*). Common in Kamaon and Garhwal, ascending to 4000 ft. Nepal.

P. 282. *Rhod. Anthopogon*.—Vern. *Talsir*, Bussahir. Sans. *Tātisa patra* (Madden).

P. 299. *Symplocos ramosissima (nervosa)*, of Madden Journ. As. Soc. xviii. i. 625, is "evergreen, with beautifully glossy leaves, common on the north side of the Gagar Pass, and in similar shady places on Binsar, Būra Pinnath, and Panjok Khal in Garhwal, from 6000-8000 ft."

P. 303. *Fraxinus excelsior*, Linn.—*Ash*. *Esche*, German ; *Frêne*, French. Weight 34-52 lb., according to Dr Hurst's edition of Tredgold, 454 (1871). Nördlinger's data correspond to 35-58 lb.

P. 304. In Kunawar *F. Moorecroftiana* is found as far as Spūi on the right, and Namgia on the left bank.

P. 305. *Schreberia swietenoides*.—Vern. *Ghant*, *ghanta* (not *ghaut*), *patali*, *ghanta parali* (*Bell Bignonia*), Bandelkhand.

P. 307. The name *Olea ferruginea*, Royle, ought to take precedence of *O. cuspidata* of Wallich's Catalogue, being supported by description and figure.

P. 310. *Ligustrum compactum*, common by brooks in the warmer valleys of Kamaon and Kyūntal near Simla, has a very bitter leaf.—Madden. As. Soc. Journ. xviii. i. 633.

P. 318. *Buddleia paniculata*.—Vern. *Dūsheria* ; ascends to 7500 ft. in Kamaon (Madden).

P. 334. *Pergularia pallida*, Kosilla at 4000 ft. (Madden).