

3. *E. insignis*, Müll. Arg.—Syn. *Falconeria insignis* and *F. Wallichiana*, Royle Ill. t. 84^a. *F. malabarica*, Wight Ic. t. 1866. Vern. *Dūdda*, *bīlodar*, *bīloja*, *karālī*, Pb.; *Khinna*, *khāna*, *tienda*, *lenduwa*, *tinda*, N.W.P.

A middle-sized or large, glabrous, milky, deciduous tree, with thick branches and bright-green foliage. Leaves oblong-lanceolate, acuminate, dentate, blade 6-15 in., petiole thick, 1-2 in. long, with 2 stipitate circular glands at the apex, main lateral nerves arcuate, 15-20 pair. Flowers in long, somewhat fleshy, naked terminal spikes, male and female flowers on distinct branches (dioicous, Wight). Male flowers shortly pedicellate, in circular fascicles, the inner flowers, which expand first, falling off from the persistent base of their pedicels. Calyx of 2 broad, nearly distinct thin membranous segments. Fruit a spike of numerous, sessile, ovoid capsules, $\frac{1}{4}$ in. long, on a thick rachis, the capsules 2-3-celled, fleshy at first, dry and irregularly dehiscent when ripe.

Sub-Himalayan tract and warm valleys of the outer hills, extending west to the Bias, and ascending to 4000 ft. (in Kamaon to 5500 ft.), Chittagong, Burma, Karnūl hills (Bedd.) and Western Ghats, known as far north as Nassik. Leafless during the dry season; the young foliage appears in May. Fl. Jan.-March, while the tree is bare; fr. May, June. Attains 50-60 ft., trunk 12 ft. long and 3 ft. girth. At 5000 ft. in Kamaon a stunted tree, 10-12 ft. high, and not rarely killed to the ground by frost. Bark grey, smooth, shining, with large broad longitudinal wrinkles. All parts of the tree are full of an acrid milk, said to be poisonous. Wood whitish, very soft, spongy and brittle, used to make the cylinders of native drums.

E. Agallocha, Willd.; Roxb. l. c. 756, is a small, glabrous, crooked, and stunted milky tree in the Sundarbans, on the sea-coast of Bengal, the peninsula, the Indian Archipelago, and North Australia (*Geria*, Beng.), with coriaceous, elliptic-lanceolate, slightly crenate leaves, lateral nerves indistinct, and dioicous, fragrant flowers in axillary spikes. Male flowers fasciculate, calyx of 4 linear sepals, anthers 3, on long exerted filaments. Capsule 3-lobed, coriaceous, $\frac{1}{4}$ in. across. The white milk is acrid and poisonous. The *Agallochum* wood is not the produce of this tree, but of *Aquilaria Agallocha*, Linn. (p. 387).

To the tribe of *Hippomaneæ* belong also:—

Jatropha Curcas, Linn.; Roxb. Fl. Ind. iii. 686, is a glabrous soft-wooded shrub, with long-petiolate cordate, angular leaves, and yellow flowers in axillary pedunculate panicle cymes. Calyx-segments 5, imbricate in bud. Petals twice the length of calyx-segments. Disc of 5 glands alternating with petals. Stamens 10, the 5 inner connate into a central column, the 5 outer free. Ovary 3-celled, 1 ovule in each cell. Capsule ovoid, 1 in. long, 3-celled, 3-valved with 3 dark brown or black seeds. Indigenous in tropical America; cultivated in most tropical countries and naturalised in India. Common at the foot of the hills in Oudh and Kamaon—Vern. *Safed ind* (Madden). The oil of the seed (*English Physic Nut*) is a strong purgative (Pharm. Ind. 203).

Givotia rottleriformis, Griff.; Wight Ic. t. 1889; Bedd. Fl. Sylv. t. 285, a middle-sized tree, young shoots, inflorescence, and under side of leaves densely grey-tomentose with stellate hairs, leaves alternate, broad-ovate or rotundate with cordate base, crenate. Flowers dioicous, in axillary slender panicles, calyx nearly to the base 5-cleft, petals alternating with the sepals in both male and female flowers. Fruit fleshy indehiscent, 1-seeded. Mysore and Dekkan. Wood soft and light, used to carve figures, toys, and the like, which are lacquered and painted.

Codicum variegatum, Blume—Syn. *C. pictum*, Hook. Bot. Mag. t. 3051 ; *Croton variegatum*, Linn.—a shrub with glabrous, shining, entire, oblong leaves with prominent lateral nerves, often variegated, and cultivated on that account in gardens of tropical and sub-tropical India. Male flowers with petals ; fruit a dehiscent capsule. Indigenous in the Indian Archipelago.

4. TREWIA, Linn.

A deciduous tree, with opposite long-petiolate leaves. Flowers dioicous, the male in long drooping racemes, the female in few-flowered racemes. Calyx-segments 3-4, in the male flowers equal and valvate, in the female flowers unequal and imbricate. Petals none. Stamens central, numerous, filaments free, anthers dehiscing longitudinally, connective not prolonged beyond the anthers. Ovary 3-4-celled, 1 ovule in each cell ; style 1, short, with 3-4 long filiform very papillose stigmas. Fruit a fleshy drupe, not dehiscing, with a hard bony, 3-4-celled endocarp. Seeds without arillus, flat cotyledons and superior radicle in a fleshy albumen.

1. *T. nudiflora*, Linn. ; Roxb. Fl. Ind. iii. 837 ; Wight Ic. t. 1870, 1871 ; Bedd. Fl. Sylv. t. 281.—Syn. *F. macrostachya*, Klotzsch Reise des Prinzen Waldemar, t. 23. Vern. *Tumri*, *khamara*, *Kamaon* ; *Bhillaur*, *bhillaura*, Oudh ; *Pitali*, Beng. ; *Petari*, Bombay.

Youngest parts with caducous tomentum, ovary soft-tomentose, otherwise glabrous. Leaves cordate or broad-ovate, glabrous, with 5 basal nerves, the midrib penniveined, blade 6-9, petiole 3-4 in. long. Flowers greenish yellow ; male racemes 4-9 in. long ; flowers on short slender pedicels, in bracteate fascicles of 3-4 ; female flowers on longer pedicels, solitary or in few-flowered racemes. Calyx-segments of female flowers thinly membranous, caducous. Stigma 1 in. long. Drupe depressed-globose, mucronate, 1 in. diam.

Sub-Himalayan tract, west to the Jumna, and ascending to 3000 ft. Common in the Dehra Doon, the Kamaon Bhabar, and in Oudh. Banks of the Nerbudda between Jubbulpur and Mandla. Bengal, South India, Burma, Ceylon and Java. Banks of rivers, in swamps and damp places. The leaves are shed Jan.-Feb., and the young foliage comes in March, April. Fl. Nov.-April. Attains 60 ft. with a straight trunk, 30 ft. to the first branch, and 6-7 ft. girth. These are the dimensions of male trees in the Oudh forests. Female trees are smaller, with shorter trunks and more straggling branches (R.T.) The leaves somewhat resemble those of *Gmelina arborea* and *Thespesia populnea*. Bark $\frac{1}{2}$ in. thick, smooth, whitish, greenish, or greenish-brown, inner bark greenish-yellow, fibrous. Wood whitish, straight-grained, moderately tough, no distinct heartwood. Used to make the cylinders of native drums, and for agricultural implements.

5. MALLOTUS, Loureiro.

Shrubs or trees with alternate (rarely opposite) long-petiolate stipulate leaves. Flowers usually dioicous, in racemes or spikes. Calyx 2-5-cleft, valvate in the bud. No disc or petals. Stamens numerous, central on a raised receptacle, filaments free or cohering at the base, anther-cells distinct, longitudinally adnate. Ovary 2-5-, generally 3-celled, 1 ovule in each cell ; styles as many as cells, simple, recurved, plumose along the inner side. Capsule tomentose or muricate, 2-5-celled and 2-5-valved.

1. *M. philippinensis*, Müll. Arg.; Bedd. Fl. Sylv. t. 289. Syn. *Rottlera tinctoria*, Roxb. Cor. Pl. t. 168; Fl. Ind. iii. 827. Sans. *Punnāga, kesara*. Vern. *Kamela, kamāla, kamal, kambal, kembal, kāmīla*, North India; *Rūen, riūna, roli*, Kamaon; *Rohni*, Oudh; *Rāuni rori*, C.P.; *Shendri*, Bombay; *Taw thidin*, Burm.

A large shrub or small tree, branchlets, inflorescence and under side of leaves hoary. Leaves alternate, ovate or ovate-lanceolate, entire, glabrous above, hoary and with minute red glands beneath, blade 4-9 in., petiole 2-3 in. long, 2 depressed glands at the base of leaf, 3 basal nerves, midrib penniveined, the nerves joined by numerous parallel veins at right angles to the midrib. Flowers white and yellow, dioicous, subsessile, in axillary and terminal paniculate bracteate spikes. Ovary tomentose, 3-celled, styles 3, $\frac{1}{4}$ in. long, thickly papillose. Fruit a 3-lobed, 3-celled, 3-valved capsule, $\frac{1}{8}$ in. diam., dehiscing loculicidally, and densely covered with a bright red powder, consisting of minute stellate hairs and fine grains of a red resinous substance soluble in alcohol and ether.

Common in the sub-Himalayan tract, extending nearly to the Indus, and ascending to 4500 ft. Common in Oudh, Bengal, Central-South-India and Burma. Ceylon, the Indian Archipelago, Formosa and Loo Choo islands, and North Australia. Fl. Nov.-Jan.; the fruit ripens in the hot season. Never leafless; the leaves are renewed Nov.-Dec. (Oudh, R.T.) Attains 20-30 ft., generally with branches from the base, sometimes with an erect but short, generally fluted and irregularly-shaped trunk, 3-4 ft. girth. Bark $\frac{1}{4}$ in. thick, inner substance compact, fibrous, reddish-brown, visible at the bottom of numerous, shallow reticulate longitudinal wrinkles, surface between the wrinkles light- or dark-grey, at times nearly black. Wood light-brown, only used for fuel. The bark is used for tanning; leaves and fruit are applied externally, with honey, against the bite of poisonous animals. The most important produce, however, is the powder which covers the ripe fruit (*Kamela, Kamala*). It is used for dyeing silk, also as a purgative and anthelmintic (Pharm. Ind. 202). The seeds are sold in the Panjab bazaars as a medicine under the name of *baobrang*, and at Almora they are said to be sold as *bebarang* (*Embelia Ribes*, p. 284).

M. albus, Müll. Arg.—Syn. *Rottlera tetracocca*, Roxb. Fl. Ind. iii. 826; *R. mappoides*, Dalz. Bomb. Fl. 230—is a large tree with large cordate, often subpetiolate alternate leaves, branches and under side of leaves tawny with dense stellate tomentum, ovaries 4-celled, capsules generally 4-celled, 4-valved, tomentose, and covered all over with soft hairy appendices.—Bengal, Indian Archipelago, Western India, perhaps in Nimar.

M. repandus, Müll. Arg.—Syn. *Rottlera dicocca*, Roxb. Fl. Ind. iii. 829, is a weak subsucculent shrub, tawny tomentose, with cordate leaves 2-4 in. long, ovaries 2-celled, styles 2, capsules 2-lobed, 2-valved, hairy. Bengal, Indian Archipelago, South India.

6. HOMONOYA, Loureiro.

Shrubs with alternate leaves, stipules caducous. Flowers generally dioicous, the male flowers in spikes, the female flowers in spiciform racemes. Calyx of the male flowers of 3, of the female flowers of 5 nearly distinct segments, those of the former valvate, of the latter imbricate in bud. Disc and petals none. Stamens polyadelphous, anthers numerous,

1-celled, adnate to a many-branched central column. Ovary mostly 3-celled, 1 ovule in each cell. Capsule small, 3-seeded.

1. *H. riparia*, Lour.—Syn. *Adelia neritifolia*, Roth; Roxb. Fl. Ind. iii. 849; Wight Ic. t. 1868. Vern. *Taniki*, Tel. *Yay-tagiyiben*, Burm.

A small shrub, somewhat resembling a willow, branches hairy. Leaves linear-lanceolate, 4-8 in. long, penniveined, under side with circular scales and scattered hairs. Flowers dioicous, in axillary bracteate spikes about half the length of leaves. Anthers and stigmas red. Capsule tomentose, 3-celled, 3-valved, 3-seeded.

Common in rocky river-beds of South and Central India. Attains 6-8 ft., and flowers Nov.-March.

H. retusa, Müll. Arg.—Syn. *Adelia retusa*, Wight Ic. t. 1869—has sessile obovate or oblanceolate dentate leaves, female flowers in short spikes, male flowers in axillary fascicles. River-beds in the Dekkan.

Ricinus communis, Linn. Roxb. Fl. Ind. iii. 639—Sans. *Eranda*; Vern. *Rand*, *arand*, *rendi*, *erendi*, *ind*, Hind.: Local n. *Aueru*, Chenab; *Harnauli*, Salt range; *Tirki*, the small kind in Guzerat; *Haradu*, Canar.—the well-known Castor Oil or Palma Christi plant, a soft-wooded tree, of short duration, which is often cultivated as an annual, e. g., in Guzerat and Bengal, for its oil, is nearly allied to *Homonoya*, but differs, apart from the peltate palmately lobed leaves, by monoicous flowers, and a fleshy appendage on the seed near the funicle. The large prickly capsules consist of 3 subcylindrical lobes rounded at the ends, with 3 spotted seeds. Cultivated in the Mediterranean region, the United States, the West Indies, India, China, and the Indian Archipelago. Naturalised in the sub-Himalayan tract of the Panjab, indigenous in Arabia and North Africa. As a small tree, it is cultivated near villages in Bengal to feed the Arindi silk-worm (Roxb. in Trans. Linn. Soc. vii. 42). Regarding the cultivated varieties of the Castor Oil plant in India, see Hamilton in Trans. Linn. Soc. xiv. 248.

Para Rubber, the finest and most durable caoutchouc as yet known, is the produce of several species of *Hevea*, a South American genus, particularly of *H. brasiliensis*, Müll. Arg.—Syn. *Siphonia brasiliensis*, Willd.; Hayne *Arzneigewächse*, xiv. t. 5; Collins' Report on Caoutchouc, 1872, 1—a large evergreen tree, indigenous in the province of Para, and on the Orinoco river, with alternate, glabrous, ternate, long-petiolate leaves, leaflets entire, acuminate. Flowers monoicous, in large white-tomentose lateral panicles. Calyx campanulate, 5-lobed, petals none. Anthers adnate to a central column. Fruit a large 3-lobed, 3-valved capsule, having the appearance of 3 slightly connate cylinders, rounded at the ends, thick, woody-fibrous. Seeds 3 large, smooth, shining, spotted, with a thick brittle testa.

7. BISCHOFFIA, Blume.

Leaves trifoliate, stipules early caducous. Flowers dioicous or monoicous, in axillary panicles. Calyx of 5 valvate segments, those of the male flowers concave, enclosing the stamens at first, afterwards reflexed, those of the female flowers lanceolate. Petals none. Stamens 5, opposite the segments, and inserted round a raised circular central body (rudimentary ovary), filaments very short. Ovary 3-celled, 2 ovules in each cell, styles

linear, entire. Fruit a globose drupe, enclosing 3 indehiscent 1-2-seeded cocci.

1. *B. javanica*, Blume.—Syn. *B. oblongifolia*, Dne. in Jacq. Voy. Bot. t. 154; *Andrachne trifoliata*, Roxb. Fl. Ind. iii. 728; *Microelus Roeperti*, W. & A.; Wight Ic. t. 1880; *Stylodiscus trifoliatus*, Bennett; Dalz. Bomb. Fl. 235. Vern. *Kein*, Garhwal; *Korsa*, Kamaon; *Irum*, Oudh.

A large glabrous tree. Leaflets petiolulate, crenate, elliptic, acuminate 4-6 in. long. Flowers pale-greenish yellow, on short pedicels, bracts lanceolate, deciduous.

Moist shady ravines in the sub-Himalayan forests of Kamaon and Garhwal. Common in the Gonda forests of Oudh, and in the Gorakhpur forests. Bengal, South India, Burma, Indian Archipelago, South China, Polynesia. The leaves are renewed in Feb. and March. Fl. March, April. The fruit ripens in April of the ensuing year. An exceedingly handsome tree, attaining 70 ft., and 7 ft. girth, with a shady oval crown. In dry places a stunted tree 15-20 ft. high. The foliage is deep green, and turns red before falling. Bark $\frac{1}{2}$ in. thick, dark grey, brown or blackish, smooth or rough, with cracks, and exfoliating fibrous angular scales, inner bark reddish, fibrous. Wood pale red, fine- and close-grained, greyish or reddish brown, seasons well, is said to be durable. Used for furniture.

8. *ANTIDESMA*, Burm.

Trees or shrubs with alternate, entire, stipulate, penniveined leaves. Flowers dioicous, numerous, small, the male flowers in deciduous spikes, the female flowers in spikes or spike-like racemes. Calyx of 3-5 imbricate lobes. Petals wanting. Stamens opposite to calyx-lobes, inserted round a rudimentary ovary, filaments free. Disc of distinct glands, alternating with filaments and calyx-segments. Ovary 1-celled, with 2 pendulous ovules, styles 3 or 4, short, united at the base. Fruit an indehiscent, generally 1-seeded drupe.

Soft-tomentose; flowers sessile; calyx deeply 5-cleft; stamens 5. 1. *A. Ghæsembilla*.
Extremities with scattered rust-coloured hairs; flowers pedicellate; calyx cup-shaped; stamens 2-3. 2. *A. diandrum*.

1. *A. Ghæsembilla*,* Gærtn.; Benth. Fl. Austr. vi. 85; Bedd. Fl. Sylv. Man. 200.—Syn. *A. paniculatum*, Roxb. Fl. Ind. iii. 770; Wight Ic. t. 820. *A. pubescens*, Roxb. Cor. Pl. t. 167; Wight Ic. t. 821. Vern. *Byaitsin*, Burm.

A small deciduous ramous tree with light grey bark, branchlets, young leaves and inflorescence soft-tomentose. Leaves oval or obovate, 2-3 in. long, short-petiolate, main lateral nerves 4-6 pair, stipules subulate, as long as petiole. Flowers greenish yellow, male spikes 1-2 in. long, female spikes somewhat shorter, both in short terminal panicles and very tomentose, female flowers sessile. Calyx deeply 5-cleft, stamens 5. Drupes small, dark purple when ripe, pulp agreeably acid.

* It appears doubtful what Gærtner included under *A. Ghæsembilla*. See Tulasne Ann. Sc. Nat. ser. iii. xv. 238. I follow Müller, Bentham, and Beddome in identifying it with this sp.

Nepal, Oudh forests (common), Bengal, South India, Ceylon, Burma (in the Eng forest of *Dipterocarpus tuberculatus*), Indian Archipelago, Hong-Kong. Fl. May, June. Fruit eaten.

2. *A. diandrum*, Tulasne.—Syn. *Stilago diandra*, Roxb. Cor. Pl. t. 166; Fl. Ind. iii. 759. Vern. *Amlī*, *sarshoti*, *sarsheti*, Garhwal; *Dhakki*, *Gūr mussureya*, *Ban mūssureya*, Oudh, Gorakhpur.

A small deciduous tree, branchlets, petioles, and under side of leaves along midrib, with scattered rust-coloured hairs, otherwise glabrous. Leaves lanceolate or ovate-lanceolate, shortly petiolate, 2-4 in. long, glabrous, shining, stipules lanceolate. Flowers greenish-yellow, male and female on short pedicels, in the axils of subulate bracteoles, spikes (racemes) terminal, solitary, or 2-3 together, slender; male spikes 2-3 in. long, female spikes shorter. Calyx cup-shaped, 5-dentate. Stamens 2-3. Drupes small, of a pleasant acid taste.

Sā forests of Garhwal, Kamaon, and Oudh. Behar, Bengal, South India, Java. Fl. May, June; fr. Dec.-Jan. The leaves turn brick-red before falling. Bark thin, smooth, whitish, scooped, inner bark pale red, fibrous. Trunk often channelled. Wood pinkish white, hard, and close-grained. The leaves are acid, and made into preserve (chutney); the fruit is eaten.

9. *BUXUS*, Tournefort.

Evergreen shrubs or undershrubs, with 4-sided branchlets and opposite, exstipulate leaves. Flowers monoicous, in axillary clusters. Calyx, of male fl. deeply 4-cleft, the segments opposite in pairs, of female fl. deeply 6-cleft, the segments in two circles of 3 each. Stamens 4, opposite the calyx-segments, inserted around a 4-sided rudimentary ovary. Ovary 3-celled, 3-cornered, with a flat top, the corners terminating in thick short styles, which alternate with the 3 inner calyx-segments. Capsule coriaceous, loculicidally 3-valved, each valve ending in 2 horns, being the halves of 2 of the styles, dissepiments attached to the valves. Seeds 3-6, trigonous.

1. *B. sempervirens*, Linn.; Hook. Stud. Fl. 330.—Syn. *B. Wallichiana*, Baillon; DC. Prodr. xvi. i. 18. *Box*, *Buchsbaum*, Germ.; *Buis*, Fr.; *Bosso*, It. Vern. *Shanda laghūne* (barren *Daphne*), Afg.; *Chikri*, Kashmir; *Pappar*, *papri*, *pāprang*, *shamshād*, *shumaj*, Pb.

A shrub, or small tree, extremities and petioles hairy. Leaves evergreen, coriaceous, glabrous, shining, varying in shape from linear-lanceolate to ovate, 1-3 in. long, narrowed into a short petiole, the tissue of the leaf consisting of two distinct strata, cohering at the edge, the upper stratum containing midrib, nerves, and veins. Flowers sessile, yellowish, with a powerful, unpleasant smell (Himalayan tree), in short, sessile, axillary heads or spikes, the terminal flower generally female, surrounded by numerous male flowers. Styles (in the Himalayan specimens) half the length of ovary, shorter in the European specimens.

Trans-Indus on the east side of the Suliman range (3000-4500 ft.) Salt

range, common here and there in the N.W. Himalaya between 4000 and 8000 ft. (e.g., in Khagan; on the Ruttun Pir and near Pünch in Kashmir; opposite Chiergaon on the left bank of the Sutlej in Kunawar, &c. Also in Bhutan, at about 6000-7000 ft. A widely spread tree, Central and South Europe, North and West Asia. China and Japan.

Fl. March-May. The fruit ripens Aug.-Oct., the open empty capsules remaining on the tree a long time. Gregarious, attains 15-16 ft., with a short, erect, straight trunk 20-30 in. girth, generally stunted from lopping. Growth slow, 15-20 rings per inch of radius. Bark $\frac{1}{4}$ - $\frac{1}{2}$ in. thick, somewhat corky in texture, grey or yellowish, often irregularly tessellated in small polygonal plates by wrinkles and deep furrows. Wood yellowish-white or grey, no distinct heart-wood, but the colour often deeper near the centre. Very close-grained, compact, and heavy. Himalayan Boxwood resembles that from Europe, Smyrna, and the Black Sea in structure and mechanical properties; the pores are uniformly distributed, exceedingly fine and numerous; its weight is 60-65 lb. per cub. ft. The use of Boxwood for engraving, carving, turning, and mathematical instruments is well known; the Himalayan wood has by some authorities been stated to be softer and less fitted for these purposes; others, again, have found it equal to the best wood from Europe and western Asia. Boxwood to be used for engraving, requires careful and lengthened seasoning. In the N.W. Himalaya small boxes for butter, honey, snuff, and tinder are made of it, and in the plains it is carved into combs. The branches of the Himalayan Box are often placed on roofs of houses in the hills under the layer of earth with which they are covered, and last well when thus employed. The leaves are poisonous to cattle; only goats eat them sparingly with impunity. In the south of France the leaves are largely used as manure in vineyards.

Baillon (Monographie des Buxacées, Paris, 1859) and Müller, DC. Prodr. xvi. i. 18, distinguish the Himalayan Box as a distinct species, under the name of *B. Wallichiana*, the difference mainly consisting in the length of the styles: The unpleasant smell of the flowers is also noticed in the Box grown in France (Mathien Fl. For. 211).

Sarcococca saligna, Müll. Arg.—Syn. *Buxus saligna*, Don Fl. Nep. 63; *S. pruniformis*, Lindley Bot. Reg. t. 1012; *S. trinervia*, W. Ic. t. 1877; *Lepidodermis podocarpifolia*, Klotzsch in Reise des Prinzen Waldemar, t. 22—is a small evergreen glabrous shrub with alternate lanceolate or ovate-lanceolate leaves, more or less distinctly triplinerved, yellowish-white flowers in short axillary racemes, a few female flowers at the base of the racemes, and small purple ovoid berries. Afghanistan, Himalaya at 4000-7000 ft., Kasia hills, Nilgiris and western coast. Fl. March-May.

10. BRIEDELIA, Willd.

Trees, shrubs, or climbers; leaves alternate, short-petiolate, generally distichous, with prominent parallel lateral nerves. Flowers monoicous, subsessile, in axillary clusters; bracteoles numerous between the flowers. Calyx-tube more or less turbinate, often short and flat; segments 5, valvate in bud. Petals 5, smaller than calyx-segments. Male fl.: stamens 5, inserted on a central column, placed on a flat sinuate disc. Female fl.: ovary 2-celled, the base enclosed in the calyx-tube, and surrounded by an inner membranous, cup-shaped, or tubular disc, variously lobed or lacinate, which is inserted at the mouth of the calyx-tube, and is generally surrounded at its base by an outer fleshy annular disc; styles 2, bifid, more or less connate at the base. Fruit a berry, enclosing 2 indehiscent cocci.

Branchlets and under side of leaves tomentose; bracteoles few, coriaceous.

A tree; lateral nerves 15-20 pair; calyx slightly enlarged in fruit

1. *B. retusa*.

A climbing shrub; lateral nerves 8-12 pair; calyx much enlarged in fruit

2. *B. stipularis*.

Branchlets and leaves wholly glabrous; bracteoles numerous, thinly membranous

3. *B. montana*.

1. *B. retusa*, Sprengel.—Tab. LV.—DG. Prodr. xv. ii. 493; Bedd. Fl. Sylv. t. 260.—Syn. *B. crenulata*, Roxb. Fl. Ind. iii. 734; *B. spinosa*, Willd. ib. 735; *Cluytia spinosa*, Roxb. Cor. Pl. t. 172. Vern. *Pathor*, mark, Pb.; *Khāja*, Bijnaur, Oudh, Gorakhpur; *Kassi*, *khassi*, Oudh and C.P.; *Gauli*, Garhwal; *Angnēra*, Banswara; *Asana*, *asauna*, Bombay; *Tsaikechi*, Burm.

A middle-sized or large deciduous tree, spinescent when young, branchlets and under side of leaves usually soft-tomentose. Leaves short-petiolate, elliptic-oblong, 3-6 in. long, midrib prominent, with 15-20 pairs of prominent, straight, parallel, latreal nerves; stipules subulate, deciduous. Flowers monoicous, yellow, subsessile, crowded in lateral clusters, generally arranged in terminal paniculate spikes. Petals of male flowers on long claws, lamina thick, obovate, lobed; of female flowers lanceolate. Fruit subglobose, green, nearly black when ripe, fleshy, $\frac{1}{2}$ in. diam., supported by the somewhat enlarged coriaceous calyx. *B. crenulata*, Roxb., with axillary flower-heads, is said to be dioicous by Roxburgh. At present I am inclined to regard it as a variety only, chiefly found in Western India.

Sub-Himalayan tract, not common, ascending to 3500 ft., generally in moist ravines, found west as far as the Chenab. Common in the Oudh forests and on the Satpura range, in Bengal, Burma, Ceylon, South India, abundant in the forests of Western India, where I have found it north as far as Banswara near the Mhye river. Commonly associated with Sāl in Oudh and on the Satpura range. A middle-sized tree in North and Central India, not generally exceeding 30 ft. in height and 4 ft. in girth, but a large tree with a straight tall trunk in Bengal, Western India, and Burma, stems and branches of young trees have numerous scattered long sharp spines, which fall off as the tree gets older. Fl. May-July; fr. Oct-Jan. Old leaves shed March-April, young leaves appear May, June. Bark thin, grey or brownish-black, rough, scurfy with small scales, sometime deeply cracked, inner bark reddish, fibrous. Sapwood pale yellowish-white, heartwood grey, yellowish or dark olive brown, compact, even-grained and hard. Medullary rays fine, numerous.

Weight 54 lb. (R. Th., Cent. Prov.), 60 (Skinner), 66 (*Tsaikechi* from Burma, D. B., List No. 23). Not easy to work, but durable. Used for house-building, agricultural implements, and cart-building. The bark is very astringent and is used for tanning, the leaves are valued as cattle-fodder, and the tree is frequently lopped. The fruit is sweetish and eatable.

2. *B. stipularis*, Bl.; DC Prodr. xv. ii. 499.—Syn. *B. scandens*, Roxb. Fl. Ind. iii. 736; *Cluytia scandens*, Roxb. Cor. Pl. t. 173. Vern. *Mad-latāh*, *undergūpa*, Oudh.

A large, more or less climbing shrub, with drooping branches; branchlets and under side of leaves with soft tawny tomentum. Leaves short-

petiolate, elliptic or obovate, 2-6 in. long; lateral nerves 8-12 pair, with prominent transverse veins at right angles; stipules broad-lanceolate. Flowers monoicous, yellow-tomentose, subsessile, crowded in lateral heads, in the axils of leaves or bracts, generally arranged in terminal paniculate spikes. Broad-lanceolate tomentose bracteoles between the flowers. Calyx-segments long-triangular, persistent and considerably enlarged in fruit. Drupes oblong-ovoid, often 2-seeded, nearly $\frac{1}{2}$ in. long, black when ripe.

Sub-Himalayan tract, ascending to 2000 ft., from Junna to Sarda. Abundant in the Ondh forests. Bengal, South India, Ceylon, Burma, Malay peninsula, Indian Archipelago. Fl. at various seasons, mainly May-Oct.

3. *B. montana*, Willd.; Roxb. Fl. Ind. iii. 735.—Syn. *Cluytia montana*, Cor. Pl. t. 171. Vern. *Geia*, Oudh, N.W.P.; *Kargnalia*, Kamaon.

A middle-sized tree, wholly glabrous, branchlets tuberculate. Leaves elliptic or obovate, pale beneath, 4-8 in. long, main lateral nerves 10-15 pair; stipules deciduous. Flowers monoicous, greenish, short-pedicellate, crowded in compact axillary heads with numerous, thin, membranous, ciliate and fimbriate bracts between the flowers; male and female flowers in the same head. Petals oblanceolate. Drupes ovoid-oblong, or globose (Roxb.), $\frac{1}{4}$ in. long, on short thick stalks, supported by the not enlarged membranous calyx.

Sub-Himalayan tract, west to the Jhelam, ascending to 3500 ft. Oudh forests (ravines in the hills). Bengal, Orissa, Behar. Fl. April, May; fr. Sept.-Nov. The leaves are lopped for cattle-fodder.

11. LEBIDIEROPSIS, Müll. Arg.

A small tree with alternate, short-petiolate, oval leaves; lateral nerves not prominent. Flowers monoicous or dioicous, subsessile, in axillary bracteolate clusters, male and female flowers in distinct clusters. Calyx-tube flat, shortly turbinate, segments 5, lanceolate, valvate in bud. Petals minute. Male flowers: stamens 5, filaments inserted on a central column, which is placed on a broad circular disc and prolonged into a short 3-lobed rudimentary ovary. Female flowers: ovary 3-celled, styles 3, bifid. Fruit a hard 3-celled, 6-valved capsule on a thick stalk. Seeds 3, cotyledons flat, fleshy.

1. *L. orbicularis*, Müll. Arg.—Syn. *Cluytia collina*, Roxb. Cor. Pl. t. 169; Fl. Ind. iii. 732. *Briedelia collina*, Wall. Vern. *Garrar*, *gharrar*, C.P.

A large shrub or small tree, with scanty light-green foliage. Branchlets, petioles, calyx and bracteoles hairy. Leaves glabrous, 2-4 in. long, with reticulate venation. Flowers yellowish green. Capsule 1 in. long; brown shining, ovoid or obovoid, indistinctly 3-lobed.

Satpura range, Bandelkhand, South India, Ceylon. Fl. June; fr. Dec., Jan. Bark blackish, very rough. Wood reddish, durable, but brittle. The rind of the fruit is said to be poisonous.

12. **CLEISTANTHUS**, Hooker.

Trees with alternate, short-petiolate, penniveined leaves, lateral nerves prominent. Flowers monoicous or dioicous, subsessile in axillary clusters or short spikes, with bracteoles between the flowers. Calyx-tube turbinate or cup-shaped, segments 5, valvate in bud. Petals 5, those of the male flowers minute. Male flowers: stamens 5, filaments free, inserted round a thick rudimentary ovary. Disc urceolate. Female flowers: ovary partly immersed in the calyx-tube, 3-celled, styles 3, more or less 2-fid. Disc membranous, cup-shaped or cylindric. Fruit a 3-celled 6-valved capsule. Seeds often connate in pairs at the base.

1. **C. oblongifolius**, Müll. Arg.—Syn. *Chytia oblongifolia*, Roxb. Fl. Ind. iii. 731. *Briedelia oblongifolia*, Hooker & Arnott. Vern. *Dukesa*, Silhet.

A middle-sized tree. Leaves elliptic-oblong, acuminate, 6-12 in. long, glabrous above, pubescent beneath. Flowers greenish yellow, in small lateral clusters; bracteoles broad-ovate ciliate. Female flowers: calyx-tube turbinate, disc cylindric, lacinate at the top. Petals obovate, ciliate. Fruit ovoid, supported by the persistent base of calyx, $\frac{1}{3}$ in. long.

Silhet. Sub-Himalayan tract and outer valleys of Sikkim and Assam, ascending to 4000 ft. According to Stewart in the Siwalik tract of Kamaon, extending west to the Ganges. Fl. March-May; fr. Aug., Sept. Wood hard and durable (Roxb.)

13. **PUTRANJIVA**, Wall.

Trees with alternate, coriaceous, stipulate leaves. Flowers dioicous, the male flowers in axillary clusters; the female flowers pedunculate, axillary, solitary or a few together. Calyx of the male flowers 2-5-parted, of the female flowers 4-6-parted, segments narrow. Petals and disc wanting. Stamens 2-3, central, filaments free, monadelphous or diadelphous. Ovary 2-3-celled. Fruit indehiscent, 1-seeded with a hard bony endocarp.

1. **P. Roxburghii**, Wall.—Tab. LIII.—Wight Ic. t. 1876; Royle Ill. t. 83^a; Bedd. Fl. Sylv. t. 275.—Syn. *P. amblyocarpa*, Müll. Arg. DC. Prodr. xv. ii. 444. *Nageia Putranjiva*, Roxb. Fl. Ind. iii. 766. Sans. *Putranjiva*. Vern. *Putājan*, Pb.; *Jia puta*, *joti*, *jūti*, *pūtra jiva*, N.W.P.; *Patji*, Oudh; *Jēputrak*, Hindi.

A middle-sized evergreen tree, with dark-green foliage, branchlets and petioles pubescent. Leaves elliptic-oblong, with unequal-sided base, serrulate, short-petiolate, 3-5 in. long, the upper side glabrous, shining, lateral nerves numerous, joined by reticulate veins; stipules subulate, deciduous. Male flowers small, yellow, subsessile, numerous, collected in sessile irregularly globose axillary heads; calyx 3-5-cleft, stamens 3, filaments more or less connate. Female flowers pedunculate, axillary, often in twos or threes; calyx 5-6-cleft, segments oblong, obtuse. Ovary 3-celled, pubes-

cent, styles 3, short, dilated into triangular lobed stigmas. Fruit ovoid, smooth, white, $\frac{3}{8}$ in. long, nut pointed, very hard, rugose, 1-celled, 1-seeded.

Sub-Himalayan tract, common in places, ascending to 2500 ft., and extending west to the Chenab, frequent in the Oudh forests. Bengal, Burma, South India, Ceylon, often cultivated. Generally in low shady, moist, mixed forests, often associated with *Eugenia* and *Ficus glomerata*. Fl. March-May, and the fruit ripens in Jan.-June of the ensuing year. Leaves renewed in April. A fine shady tree, which merits extended cultivation. Attains 40-50 ft., with a straight erect trunk, 4-5, at times 9 ft. girth, numerous divergent, spreading branches. Bark $\frac{1}{2}$ in. thick, grey, smooth or verrucose, with numerous horizontal lines of round light-coloured specks, inner bark yellow, fibrous. Wood light-grey, streaked with darker lines and patches, not very hard, even-grained and durable. Weight 36.6 lb. per cub. ft. (Wallich), probably heavier. Used in places for tools and in turning. The leaves are lopped for cattle-folders, the nuts are strung up in rosaries and in necklaces for children to keep them in health, whence the name, "life of the child." The nuts of *Elæocarpus Ganitrus* (p. 43) are used in the same manner.

14. PHYLLANTHUS, Linn.

Trees shrubs or herbs; leaves stipulate, mostly distichous, entire, penniveined, short-petioled. Flowers monoicous or dioicous, in axillary or lateral clusters, sometimes solitary. Calyx-segments 4-9, generally 5-6, imbricate, without any appendages at the back. Petals none. Disc of distinct glands, alternating with calyx-segments, sometimes wanting. Stamens central, 2-15, generally 3, filaments free or variously connate. No rudiment of ovary in male flowers. Ovary 2-15-celled, generally 3-celled, 2 ovules in each cell; styles as many as cells, generally slender, bifid, and more or less connate. Fruit always dehiscent, sometimes fleshy. Seeds without arillus or strophiole.

Small trees with ovate or elliptic leaves; no disc or glands at the base of stamens or ovary; anthers 3-6 on a central column; styles connate into a short column; fruit a 4-6-celled capsule with red seeds. (Subgenus *Glochidion*.)

Softly tomentose; anthers 3

1. *P. nepalensis*.

Glabrous; anthers 4-6

2. *P. lanceolarius*.

A climbing shrub with elliptic or obovate leaves; disc of 5 distinct glands alternating with calyx-segments; stamens 5, the 3 inner connate into a central column; ovary 8-12-celled; styles distinct, minute; fruit a dark-purple small succulent berry

3. *P. reticulatus*.

A middle-sized tree with numerous linear leaflets; anthers 3-5 on a central column; ovary half enclosed in a cup-shaped disc; style 1, deeply 3-fid; fruit a large globose pale-yellow 3-celled berry

4. *P. Emblica*.

1. *P. nepalensis*, Müll. Arg. l. c. 291.—Syn. *Bradleia ovata*, Wall. Vern. *Gol kamela*, (*gür*)*sawa*, *sama*, *chamār kas*, *ambli*, *kalm(a)*, *keā-mil*, Pb.; *Mowa*, *bakalwa*, N.W.P.; *Kari*, *korla*, C.P.

A small tree, branchlets softly tomentose. Leaves ovate or elliptic, pubescent on both sides, 2-3 in. long, short-petiolate, main lateral nerves

arcuate, 4-6 pair; stipules subulate. Flowers in axillary fascicles, the female subsessile, the male on long filiform pedicels, male and female generally in the same fascicle. Male fl.: Calyx of 6 lanceolate segments, slightly hairy outside. Anthers 3, oblong, 2-celled, extrorse and cohering at the back, on a short central column, connective prolonged beyond the anther-cells. Female fl.: Calyx of 5-6 ovate segments, hirsute outside. Styles connate into a cylindric column, nearly as thick as the ovary, divided at the top into 4 thick ovate teeth longer than calyx, the lower part hirsute. Capsule 4-6-celled, pubescent, seeds red.

Sub-Himalayan tract and outer ranges, ascending to 5500 ft., and extending west to the Indus. Sikkim, Western Ghats, Canara, and Mysore. *Glochidion velutinum* and *arboreum*, Wight, t. 1907, from the Nilgiris, are probably the same species. Fl. and fruit Feb. to Aug. Attains 25 ft., and 3-4 ft. girth. Bark grey or reddish, with shallow longitudinal furrows. The leaves have a powerful nauseous smell. Wood brownish-white, compact but soft, the bark is used for tanning.

Glochidion neilgherrense, Wight; Bedd. Fl. Sylv. t. 277, a tree of the Nilgiris, is similar, but glabrous.

Phyllanthus bicolor, Müll. Arg. l. c. 311.—Syn. *Briedelia acuminata*, Wall., belongs to the same group, with 3 anthers, but differs by lanceolate leaves, glabrous above, slightly pubescent beneath along midrib, male and female fl. generally in separate fascicles, small 3-5-celled capsules on pedicels longer than the diam. of capsule. Nepal, Sikkim, Kasia hills.

2. *P. lanceolarius*, Müll. Arg.—Syn. *Bradleya lanceolaria*, Roxb. Fl. Ind. iii. 697; *Glochidion lanceolarium*, Dalzell Bombay Flora, 235. Vern. *Bhoma*, Bombay; *Angūti*, Silhet.

A small glabrous tree. Leaves shining, coriaceous, elliptic or elliptic-oblong, acuminate, 4-6 in. long, stipules triangular, main lateral nerves arcuate, 6-8 pair. Flowers pale greenish-cream-coloured in axillary fascicles, the male numerous, on long filiform peduncles, the female few and sessile. Male fl.: Calyx of 6 glabrous, linear-oblong segments. Anthers 4-6, oblong, 2-celled, extrorse and cohering at the back, on a short central column, connective prolonged beyond the anther-cells. Female fl.: Calyx of 6 unequal, thick, imbricate segments. Styles 6, glabrous, connate into a 6-sulcate, glabrous column, much thinner than the hairy ovary. Capsule shortly stalked, depressed, $\frac{1}{2}$ in. diam., 4-6-celled, seeds red.

Kamaon Bhabar, Oudh forests (in moist ravines), Nepal, Sikkim Terai, Eastern Bengal, Burma. Fl. Dec.-April. Bark grey, with longitudinal wrinkles, the outer bark peeling off from the reddish-brown smooth inner layers. Roxburgh states that it grows to be a large useful timber-tree, the wood being hard and durable.

3. *P. reticulatus*, Poiret.—Syn. *P. multiflorus*, Willd. Roxb. Fl. Ind. iii. 664 (not Poiret); *Anisonema multiflora*, Wight Ic. t. 1899; Dalz. Bomb. Fl. 234. Vern. *Panjūli*; (*mākhi*, Bhurtpur).

A large straggling or climbing shrub with numerous stout woody branches, and long drooping branchlets. Leaves membranous, glab-

rous or slightly pubescent, elliptic or obovate, short-petiolate, about 1 in. long; lateral nerves joined by reticulate veins. Flowers in axillary fascicles, on slender pedicels, male fl. more numerous, generally 1 or 2 female fl. in a fascicle of male flowers. Calyx of 5 ovate membranous segments, and 5 distinct glands alternating with them. Stamens 5, the 3 inner longer, on thick filaments, more or less connate into a central column, the 2 outer short, free. Ovary globose, 8-12-celled; styles short. Fruit a black or dark-purple depressed succulent berry $\frac{1}{4}$ in. diam.

Common on low moist ground. North-West India, Sindh (climbing over the largest trees in the Belas along the Indus), Rajputana (Bhurtpur Ghunna), Bengal, South India, Burma, Ceylon, Indian Archipelago. Flowers nearly throughout the year. Bark grey; wood greyish brown, light, soft, pores large and numerous.

4. *P. Emblica*, Linn.—**Tab. LII.**—Roxb. Fl. Ind. iii. 671; Bedd. Fl. Sylv. t. 258.—Syn. *Emblia officinalis*, Gaertn.; Wight Ic. t. 1896. Sans. *Dhātri*, *āmālaka*. Vern. *Ambal*, *ambali*, Pb.; *Daula*, *āmla*, *amlīka*, *aura*, *aurā*, *aola*, North and Central India; *Milli mara*, Gonds of Satpura; *Nelli mara*, Canarese; *Shalbū*, Burm.

A small or middle-sized tree with grey bark and light-green feathery foliage. Leaves linear acute, glabrous, $\frac{1}{2}$ in. long, edge thickened, subsessile, distichous and approximate, imbricate when young, on hairy 4-8 in. long branchlets, having the appearance of pinnate leaves; stipules minute. Flowers small, greenish-yellow, in lateral fascicles on the leaf-bearing branchlets, in the axils of the leaves or on the naked portion of the branch below the leaves, female flowers few, subsessile, male flowers numerous, on short slender pedicels, both on the same branchlet. Calyx of 6 oblong obtuse segments. Disc in the male flowers of 6 minute glands. Anthers 3-5, extrorse on a central column. Ovary 3-celled, half immersed in an annular disc, style short with 3 recurved stigmas, dilated and lobed at the top. Fruit a fleshy globose berry, $\frac{3}{8}$ in. diam., 3-celled, 6-seeded, with 6 prominent lines, pale yellow, sometimes reddish when ripe, of an acid and astringent taste.

Common in dry deciduous forests in most parts of India, except in the extreme north-west corner of the Panjab, ascending in Garhiwal and Kamaon to 4500 ft. Burma, Ceylon, Indian Archipelago. Often cultivated. Fl. March-May; the fruit ripens Oct.-Feb. More or less leafless from February to April. Attains 30-40 ft., and 3-6, occasionally 9 ft. girth, but generally smaller. Trunk often crooked or gnarled, frequently with irregular excrescences, branches strong spreading. Bark thin, grey greenish or brown, with fine, close horizontal wrinkles, and few vertical cracks, inner substance dark red or purple, compact and fibrous. Wood mottled brown, red, and yellow, inner wood darker coloured, but no distinctly marked heartwood, hard, close- and straight-grained. Medullary rays very broad, of a lighter colour than the tissue between, showing on a vertical radial section like shining plates and giving a reticulate appearance on a tangential section. The broad medullary rays give the wood some resemblance to that of *Carallia integerrima*. Weight between 42.5 and 49 lb., value of P. between 532 and 617. Puckle (List of Western Mysore Woods, 1862) gives the weight at 67.5 lb., and the value of P. from 893 to 1052. Used

for agricultural implements, and much valued for well-work, as it is durable under water. The bark is employed for tanning; chips of the wood and small branches thrown into impure or muddy water are said to clear it effectually (Pharm. Ind. 205). The fruit is the Emblic Myrobalan; used as a medicine, for dyeing and tanning, and pickled and eaten.

15. BREYNIA, Forst.

Glabrous shrubs with penniveined stipulate leaves. Flowers monoicous, axillary. Calyx turbinate, 6-lobed. Stamens central; three 2-celled anthers longitudinally adnate to a central column. Disc wanting. Ovary longer than calyx, truncate; styles minute. Seeds without arillus.

1. *B. rhamnoides*, Müll. Arg. l. c. 440.—Syn. *Phyllanthus sepiaria*, Herb. Roxb. (identified by Müller also with *P. Vitis-idea*, Roxb. Fl. Ind. iii. 665). *Melanthesa rhamnoides*, Wight Ic. t. 1898. Vern. *Tikhar*, Oudh.

A large shrub or small tree, wholly glabrous. Leaves ovate, obtuse, shortly petiolate, 1-1½ in. long; stipules triangular, acute. Flowers solitary, axillary, pedicels short, with a few membranous bracts at the base. Fruit a red globose berry.

Oudh forests common, Banda, Bengal, South India. Fl. April, May.

Melanthesopsis patens, Müll. Arg.—Syn. *Melanthesa turbinata* and *obliqua*, Wight Ic. t. 1897, 1898; *Phyllanthus turbinatus* and *patens*, Roxb. Fl. Ind. iii. 666, 667—is a shrub or tree of South India and Bengal, similar to *Breynia rhamnoides*, but distinguished by a trifid style and arillate seeds.

16. SECURINEGA, Juss.

Glabrous trees or shrubs with more or less distichous branchlets and penniveined stipulate leaves. Flowers usually dioicous, the male flowers in axillary fascicles. Calyx 5-cleft, segments imbricate, persistent, the 2 outer somewhat smaller. Petals none. Stamens 5, opposite to the calyx-segments; filaments free, filiform, surrounding a rudimentary 2-3-fid pistil as long as stamens. Disc of 5 glands alternating with the stamens. Ovary glabrous, 3-celled, 2 ovules in each cell, styles 3, connate at the base, generally bifid. Fruit more or less succulent, separating when ripe into 3 (sometimes 2 only) 2-seeded cocci.

Flower-bearing branchlets angular, unarmed	1. <i>S. obovata</i> .
Flower-bearing branchlets terete, spinescent	2. <i>S. Leucopyrus</i> .

1. *S. obovata*, Müll. Arg. l. c. 449.—Syn. *Phyllanthus retusus* and *virens*, Roxb. Fl. Ind. iii. 657, 659. Vern. *Dalme*, *dhāni*, *bakarcha*, *ghāri*, *gwāla dārim*, N.W.P.

A large ramous unarmed shrub or small tree, wholly glabrous, branchlets angular. Leaves subsessile, oval or obovate, 1-2 in. long. Flowers dioicous, on slender pedicels, numerous, in axillary fascicles. Styles

spreading or reflexed, deeply-cleft into 2 or 3 linear-segments. Fruit a white globose dehiscent berry, $\frac{1}{4}$ in. diam.

Trans-Indus at the base of the Suliman range (rare), not common in the sub-Himalayan tract of the Panjab. Common in Kamaon (ascending to 5000 ft.) Nepal, Bengal, South and Central India, Burma, Indian Archipelago, China, and Australia. Fl. (in North India) May, June; fr. July-Oct.; in Bengal in fl. and fr. nearly throughout the year. Attains 25 ft. or more, with a short erect trunk 3-4 ft. in girth. Bark grey, rusty or reddish-brown, with small light-coloured specks. Wood white, said to be close-grained, strong, and durable, and not attacked by insects; it is used for agricultural implements. The bark is very astringent, and is used to intoxicate fish. The fruit is eaten.

2. *S. Leucopyrus*, Müll. Arg.—Tab. LIV.—Syn. *Phyllanthus Leucopyrus*, Roxb. Fl. Ind. iii. 658. *Flüggea Leucopyrus*, Willd.; Wight Ic. t. 1875. Vern. *Perei pastawane*, Afg.; *Karkūn, rūthei, girthan, gargas, bhāthi, bāta, vanūthi, girk*, Pb. (some of these names possibly apply to *S. obovata*); *Hartho, ainta*, N.W.P.; *Kiran*, Sindh; *Challa manta, sālā manta*, C.P.

A large spinescent shrub or small tree, wholly glabrous, branchlets terete. Leaves ovate, 1-2 in. long, petioles $\frac{1}{8}$ - $\frac{1}{4}$ in. long. Flowers dibicous, on slender pedicels in axillary fascicles. Male flowers numerous, female flowers few. Styles erect or spreading, entire or shortly bifid. Fruit a white globose dehiscent berry $\frac{1}{8}$ in. diam.

Trans-Indus, eastern slopes of Suliman range, ascending to 3800 ft. Salt range, not uncommon. Sindh. Sub-Himalayan tract, ascending in Garhwal and Sikkim to 5000 ft. Bengal, Central and South India, Ceylon, Burma, Indian Archipelago, Australia. Fl. chiefly May, June; fr. July-Sept., often remaining long on the tree. Bark ash-coloured, dark-bluish, or dark reddish-brown with small white specks. Wood close-grained, strong, chiefly used as fuel. The fruit is eaten.

17. ANDRACHNE, Linn.

Shrubs and undershrubs with alternate, stipulate, entire, generally ovate leaves. Flowers monoicous, male flowers generally fasciculate, female flowers solitary, axillary on long slender pedicels. Calyx-segments 5-6, imbricate in bud. Petals as many as calyx-segments, shorter than calyx, those of the female flowers minute. Disc of free or connate glands. Stamens 5-6, around a cylindric rudiment of ovary, filaments free or monadelphous. Ovary 3-celled, styles 3, connate at the base, the free portion dichotomous; stigma capitate, minute. Fruit a 6-valved capsule. Seeds without aril or strophiole.

1. *A. cordifolia*, Müll. Arg.; DC. Prodr. xv. ii. 234.—Syn. *Phyllanthus cordifolius*, Wall. *P. Hoffmeisteri*, Klotzsch. Reise des Prinzen Waldemar, t. 24. *Leptopus cordifolius*, Decaisne in Jacq. Voy. Bot. t. 156. Vern. *Kūrkūt, gūrgūli*, Jhelam; *Bersu*, Chenab; *Barotri, madāre*, Ravi; *Mūtkar, chīrmūtti, pūn*, Bias; *Tsūtin*, Sutlej.

A shrub with slender branches, in places only an undershrub, extremities, petioles, and under side of leaves hairy. Leaves ovate-oblong, obtuse, penniveined, blade 1-2 in., petiole filiform, $\frac{1}{4}$ - $\frac{3}{4}$ in. long. Flowers monoicous, axillary, on long filiform pedicels. Disc of male flowers consisting of 5 flat bifid glands. Styles shortly connate at the base, deeply bifid. Capsule $\frac{1}{4}$ in. across.

Common in the North-West Himalaya from the Indus to Nepal, ascending to 8000 ft. (Dippi forest). Fl. May-Sept.

A. telephoides, Linn., is a small undershrub of the Mediterranean region and West Asia, found also in the Panjab Salt range, with ovate or obovate leaves. *A. aspera*, Sprengel, has reniform or orbicular leaves and grows from Egypt to Sindh.

ORDER LXX. BETULACEÆ.

Trees with scaly buds and alternate penniveined simple leaves; stipules deciduous. Flowers monoicous in drooping catkins. Male flowers: bracts stalked, often peltate, bearing on the stalk and on their inner face 2-3 generally tetrandrous flowers with small perianths of membranous, often unequal scales. Anthers 2-celled, cells often distinct. Female flowers: 2 or 3 in the axils of (generally) 3, more or less connate bracts; perianth none. Ovary free, compressed, 2-celled, 1 pendulous ovule in each cell. Fruit a small 1-seeded nut. Seeds without albumen; cotyledons flat, radicle superior. The cotyledons of the germinating embryo are raised above the ground.

Anther-cells distinct; scales of female catkin deciduous	1. BETULA.
Anther-cells more or less connate; scales of female catkin persistent, enlarged and woody in fruit	2. ALNUS.

1. BETULA, Tournefort.

Deciduous trees with serrate leaves, resinous dots beneath. Anthers 8-12 inserted on the inside of the bract, more or less distinctly arranged in tetrandrous flowers, each anther opposite to a membranous scale; anther-cells distinct. Female flowers, 3 in the axil of each bract. Bracts of catkin deciduous in fruit, generally membranous. Fruit with a membranous wing on 2 sides.

Female catkins single; bracts in fruit indurated, deeply 3-lobed, broader than wings; wings narrower than fruit	1. <i>B. Bhojpattra</i> .
Female catkins fasciculate; bracts in fruit membranous, linear-oblong, with 2 small teeth or lobes at the base, narrower than wings; wings much broader than fruit	2. <i>B. acuminata</i> .

1. *B. Bhojpattra*, * Wall.—Syn. *B. Jacquemontii*, Spach.; Jacq. Voy.

* I retain Wallich's name *Bhojpattra* (Pl. As. Rar. ii. 7, 1831), which is adopted by Lindley, Bot. Reg., and Regel (Monographia Betulacearum, 1861, and DC. Prodr. xvi. ii. 177), though it seems certain that Don's *B. utilis* (Prodr. Fl. Nep. 58, 1825) was intended for this tree. But Don's description, "foliis ovatis acuminatis inaequaliter ser-

Bot. t. 158. Sans. *Blurja*. Vern. *Bürj*, *bhūj*, *bürzal*, *phurz*, Pb. Himalaya; *Shäg*, *shak*, *pāl*, *phatak*, *takepa*, Ladak, Lahoul, Piti, Kunawar; *Bhūjpattra*, N.W.P.

A moderate-sized tree, shrubby near its upper limit; extremities, petioles and leaf-buds pubescent, the bark exfoliating in thin broad horizontal belts. Leaves ovate, acuminate, unequally serrate, hairy along midrib, pubescent when young with scattered hairs; blade 2-3 in., petiole $\frac{1}{2}$ in. long; main lateral nerves 8-12 pair, prominent beneath, impressed on the upper side; the under side generally with resinous dots. Bracts of male flowers stalked, the stalk bearing numerous glabrous scales, ciliate at the edge, the lower membranous, transparent, the upper coloured. Anther-cells distinct, glabrous, with a tuft of few hairs at the tip. Bract of female flowers pubescent, deeply 3-lobed, hardened in fruit, broader than the winged fruit; lobes linear-oblong. Wings narrower than greatest breadth of nut.

Higher ranges of the Himalaya, extending far into the inner arid tract, in the Panjab not under 7000, in Sikkim and Bhutan not under 9500 ft., ascending commonly to 11,000, and often to 12,000 ft., in Zaskar, Tibet, and inner Sikkim to 14,000 ft. Chūr at 12,150 ft. Afghanistan. Higher mountains of Japan. Gregarious, forming pure forests, often at the upper limit of arborescent vegetation, generally rising 500 ft. above the upper limit of *Abies Webbiana*; seems to prefer north and west aspects. The leaves are shed in Oct., and the new foliage comes out in April and May. Attains 50-60 ft.; trunk erect, somewhat crooked, 6-7 and at times 10-12 ft. girth; branches erect, twigs drooping, forming a handsome broad-oval crown with light foliage. Bark smooth, wrinkled, reddish- or purplish-brown, with whitish linear or oblong stripes (denticels) and fine parallel lines, the outer bark consisting of numerous distinct paper-like layers, exfoliating in broad horizontal rolls or belts. Wood white, straight-grained, not hard, but tough to cut. Weight 35.5 lb. per cub. ft. (Wall.) In the arid inner Himalaya, where timber is scarce, it is used extensively for building, and other purposes. It is elastic, and has been recommended for turning. The bark is the most valuable part of this tree; it is used as paper for writing and packing, for umbrella-covers, and to line the inside of the hooka-tube. Hindoos use it in various religious ceremonies. It is called *Toz*, *bhoj pattra*, in Kashmir, *drawa* on the Chenab, and *bharangi* in Kamaon, and is largely exported to the plains. In Kashmir and Kunawar it is often placed under the flat earth roofs, and is said to be very lasting. Twig bridges are made of the branches of this Birch, and the trees are often lopped for fodder.

2. *B. acuminata*,* Wall.—Tab. LVI.—Pl. As. Rar. t. 109.—Syn. *B. cylindrostachys*, Wall.; DC. Prodr. xvi. ii. 179. Vern. *Pūya ūdish*, *chambar māya*, Pb.; *Bhūjpattra*, *haur*, *shāu*, N.W.P.; *Shakshin*, Tibet; *Utis*, Nepal.

ratiss utrinque ramulisque villosis basi rotundatis subtus canescentibus," hardly applies to this species, and certainly does not give its distinguishing characters. Don adds, on Wallich's authority, that the epidermis is used under the name of *Bhog Pattra*; but this proves nothing, for both species of Birch are called *Bhuj pattra* in the N.W. Himalaya.

* I retain this name, which is supported by Wallich's plate and description. Don's *B. alnoides*, which he describes as dioicous, and *nitida*, are probably synonyms, but Don's descriptions are insufficient to identify them. *B. nitida*, Don, is retained as a distinct but doubtful species in De Candolle's Prodrömus.

A moderate-sized tree, the current year's branchlets pubescent; root-suckers and luxuriant shoots soft-tomentose. Leaves ovate or ovate-lanceolate, acuminate, unequally serrate, teeth cuspidate, often aristate, more or less pubescent, sometimes soft-tomentose beneath when young, glabrous and often shining when full-grown, with scattered hairs on the under side along midrib, numerous brown red or black resinous dots on the under side; blade 3-6 in., petiole $\frac{1}{2}$ in. long; main lateral nerves 8-12 pair. Catkins fasciculate, short-pedunculate, 3-4 in. long, slender, while in flower, $\frac{1}{4}$ in. diam. while in fruit. Bracts of male catkin subsessile, with 3 tetrandrous flowers on the midrib; perianth of 4 hairy linear leaves; anthers hairy, cells distinct. Bracts of female catkin lanceolate at the base, with 2 obtuse or acute teeth or short lobes, as well as ovaries and styles hairy with long hairs. Wings much broader than fruit, and broader than the membranous bract of the fruit.

Himalaya, generally in the outer ranges, extending west to the Sutlej basin, commonly between 5000 and 10,000 ft. Kasia hills 3000-5000 ft. In shady mixed forests, in valleys near streams, mostly singly, not gregarious. Fl. Nov., Dec.; fr. April, May. Attains 50-60 ft., trunk short, 6 ft. girth and more, branchlets somewhat drooping. Wood whitish, there is some doubt regarding its qualities: Wallich, Pl. As. Rar. ii. p. 7, states that it is hard and greatly esteemed by the inhabitants of Nepal, and is employed for all purposes where strength and durability are required. The bark peels off in thick rolls, the lenticels are shorter than in *B. Bhojpattra*, elliptic or elliptic-oblong.

Betula alba, Linn.; Hook. Stud. Fl. 346—*Birch*; *Birke*, German; *Bouleau*, French—the most important of the numerous species and varieties of this genus in Europe, has long-petioled rhomboid or ovate leaves, solitary female catkins, the fruiting bracts with a cuneate base and a broad 3-lobed apex, wings twice or nearly thrice the breadth of fruit. The wood is yellowish- or reddish-white, with numerous fine medullary rays, and numerous fine, uniformly distributed pores. No heartwood. Weight 32-48 lb. Excellent fuel. Used for carving, furniture, and agricultural implements; in the Highlands of Scotland, and in North Scandinavia also, for building and a variety of other purposes. The bark is used on roofs under a layer of earth like the Himalayan Birch, and is said to be imperishable. Baskets, boxes, mats, and cordage are made of it in Lapland.

B. papyracea, Willd., the *Paper* or *Canoe Birch*, is a most useful large tree in Canada and the Northern United States. The bark splits into fine paper-like layers, is used as paper, for thatching, and ornaments are made of it. But its principal use is to make the light portable canoes used on the lakes and rivers of Canada. In spring the bark is detached for this purpose in plates 10-12 ft. long and 33 in. broad, which are stitched together with fibrous roots of the white Spruce (*Abies alba*, Michaux). Regel classes this Birch as a sub-species under *B. alba*.

2. ALNUS, Tournef.

Deciduous, rarely evergreen trees, with dentate, sometimes entire leaves. Male fl.: either tetrandrous, with 4-lobed perianth, or 6-12 anthers inserted on the stalk of the bract, in the axils of membranous scales, anther-cells connate, rarely distinct. Female fl.: 2 in the axil of each bract; bracts

indurated, woody, persistent in fruit, covered before maturity by a waxy or resinous substance. Nuts with a membranous or coriaceous wing, or unwinged.

Branchlets glabrous; fruit catkins numerous in large erect panicles.

Branchlets pubescent; fruit catkins 3-5 in short erect racemes.

1. *A. nepalensis*.

2. *A. nitida*.

1. *A. nepalensis*, D. Don; Wall. Pl. As. Rar. t. 131.—Vern. *Kohi, koe*, Pb.; *Udis, udish, wūsta*, N.W.P.; *Boshi swa*, Nepal.

A moderate-sized tree; branchlets glabrous. Leaves coriaceous, glabrous, with tufts of hairs in the axils of lateral nerves, elliptic, acute, entire or indistinctly denticulate, blade 4-6, petiole $\frac{3}{4}$ in. long; main lateral nerves 14-18 pair. Flowers appearing after the leaves. Catkins paniculate or racemose. Male catkins subsessile, slender, 4-10 in. long, numerous, in large terminal pedunculate drooping panicles; each bract with 6-12 anthers on short filaments, more or less distinctly separated by ciliate scales into several 2-4-androus flowers; anther-cells connate. Female catkins $\frac{1}{2}$ in. long, pendulous in flower; perianth-leaves and stamens 10-12, in lateral racemes or racemose panicles. Fruit catkins ovoid or subcylindric, short-pedicellate, $\frac{1}{2}$ -1 in. long, in erect lateral panicles. Wings of fruit membranous, narrow, often broader at the top, somewhat irregular.

Himalaya, extending west to the Ravi, between 3000 and 9000 ft. Kasia hills. Mixed forests, often in ravines, or fringing the banks of streams. Fl. Oct.-Dec.; the fruit ripens in winter, and remains long on the tree. Attains 50-60 ft., with an erect, straight trunk and a shady crown. Bark thick, compact, outside purplish or yellowish silvery, somewhat resembling the bark of birch. Wood pale brownish-red, with large very distinct reddish-brown medullary rays. The bark, exported to the plains under the name of *Udis*, is used for tanning and dyeing.

2. *A. nitida*, Endl.—Tab. LVII.—Vern. *Gira*, Afg.; *Shrol, srol, saroli, sawāli, rikūnra, chāmb, chaāp, chāpu, tsāpu, pīāk, kūnsa, kūndash, niū*, Pb. Himalaya; *Rajān, rajāin*, Pb. plains.

A large tree; current year's petioles and branches pubescent. Leaves subcoriaceous, glabrous, with tufts of hairs in the axils of lateral nerves beneath, ovate, acuminate, more or less distinctly dentate; blade 4-6, petiole 1-1 $\frac{1}{2}$ in. long; main lateral nerves 8-12 pair. Flowers appearing after the leaves; catkins racemose. Male catkins short-pedicellate, drooping, 2 in. long, 4-6 in terminal erect bracteate, and at the base often leaf-bearing racemes. Anthers sessile, densely crowded, so that the arrangement into distinct flowers cannot be traced; anther-cells nearly distinct. Fruit catkins ovoid or cylindric, on short stalks, $\frac{3}{4}$ -1 $\frac{1}{2}$ in. long, 3-5 in erect lateral racemes. Fruit with a narrow coriaceous edge.

Common in the Panjab Himalaya, ascending to 9000 ft., and not uncommon along the banks of the main rivers some distance into the plains. On the Sutlej, its upper limit is Spūi on the right, and Namgia on the left bank. Pabur and

Tonse rivers. Generally fringes the banks of mountain-streams and rivers. Fl. Sept.-Oct. Attains 80-90, and at times 100 ft., with a straight tall clear trunk, generally 6-8, often 12, and at times 15 ft. girth. The largest trees are seen in the basins of the Jhelam and Chenab. Bark brown, rough with dark furrows. The wood is whitish, used for bedsteads; the hooked sticks of rope bridges are made of it. The twigs are tough, and are used for tying loads and in the construction of twig bridges. The bark is used for dyeing and tanning.

A. orientalis, Dne.; DC. Prodr. xvi. ii. 185, somewhat resembles this species, but differs by large short ovoid or subglobose fruit catkins, fruit without wing or edge. Syria, Lebanon, Cyprus, Cilicia.

The two sp. of this genus which are important for the forester in Europe are :
1. *A. glutinosa*, Linn.; Hook. Stud. Fl. 346; *Alder*; *Schwarzerle*, German; *Aune glutineux*, French; *Ontanonero*, It., with glabrous glutinous leaves. Europe, North Africa, Cilicia, Asia Minor. Important as coppice-wood in deep marshes. Wood soft, white when fresh cut, turning, on exposure to the air, into orange-red, pale red when seasoned, the wood of knotty trees often beautifully mottled. No heartwood. Weight 26-40 lb. Used for carving; herring-barrels are made of it. Lasts well under water. 2. *A. incana*, Willd.; *Weisserle*, Germ.; *Aune blanc*, Fr.; with pubescent leaves. North-East Europe, and mountains of Central Europe, descending to the plains along the main rivers, and often cultivated. Caucasus, Siberia, Amurland. Throws up abundantly root-suckers. Both have distinctly tetrandrous flowers, 4 on the stalk of each scale, with 4-lobed perianth, fruit with a narrow coriaceous edge.

ORDER LXXI. SALICINÆÆ.

Deciduous, fast-growing but not long-lived trees or shrubs, with scaly buds. Wood soft, light, even-grained. Leaves alternate, simple, stipulate. Flowers dioicous in lateral catkins, which are similar in both sexes, with spirally-arranged scales, each bearing one flower in its axil. A glandular cup-shaped or irregularly-formed disc, in the male fl. with two or more, generally free stamens; in the female fl. with a 1-celled ovary, consisting of 2-4, generally 2, connate carpels which terminate in as many short styles as there are carpels, numerous ovules on parietal placentas adnate to the median line of the valves. Fruit a 1-celled 2-4, generally 2-valved capsule dehiscing from the apex, the valves spreading or rolling back. Seeds numerous, minute, with a mass of long silky hairs on the funicle, which enclose the seed; albumen none; embryo straight; radicle inferior. Fruit catkins not persistent.

Leaves short-petiolate; scales entire; stamens 2-12, generally 2,
long exserted; capsule 2-valved
Leaves long-petiolate; scales cut or jagged; stamens 4-30; cap-
sule 2-4-valved

1. SALIX.

2. POPULUS.

1. SALIX, Tournef.

Leaves lanceolate ovate or elliptic, petioles short, generally less than one-fourth the length of leaf. Stipules deciduous, larger and more persistent on shoots and root-suckers. Scales of catkins deciduous or more or

less persistent, lanceolate rotundate or obovate, entire. Disc of 2 glands or nearly annular. Stamens 2-12, generally 2, long, protruding from the scales, filaments filiform, free or more or less connate. Stigmas 2, often bifid or lobed, at the end of a short or elongated filiform, sometimes bifid style. Capsule 2-valved, the valves generally rolling back, placentas near the base of the valves.

In the following enumeration, a selection has been made of the more important willows of N.W. India, and notes have been added regarding those European willows which are most nearly related to them. The study of this genus is difficult, on account of the numerous hybrids and cross-breeds between the different species. The arborescent willows are most useful trees, and merit great attention on the part of foresters in India.

Willows are invaluable to protect and fix the banks of rivers, and extensive plantations for that purpose may be seen all along the banks of the Rhine and other large European rivers. As coppice-woods with short rotation they are grown in Osier-beds, and cut annually (for basket-work), or when 3-4 years old, for hoops and other larger material. Along roads, brooks, and on meadows they are often grown as pollards. The wood is used for carving and many other purposes. The inner bark is tough and fibrous, fishing nets and lines are made of it in North America.

Stamens 3 or more, free.

- | | |
|--|----------------------------|
| Leaves lanceolate, serrulate; capsules ovoid, long-pedicellate | 1. <i>S. tetrasperma</i> . |
| Leaves linear-lanceolate, entire; capsules ovoid-lanceolate, short-pedicellate | 2. <i>S. acmophylla</i> . |

Stamens 2, free.

Flowers with or after the leaves; catkins on leaf-bearing peduncles.

- | | |
|---|---------------------------|
| A tree with generally drooping branches; leaves linear-lanceolate, glabrous; style short | 3. <i>S. babylonica</i> . |
| A tree with spreading branches; leaves lanceolate, silky beneath; style short | 4. <i>S. alba</i> . |
| A large shrub or small tree; leaves elliptic or obovate-oblong, glabrous, glaucous beneath; style short | 5. <i>S. elegans</i> . |
| A small shrub; leaves broad-elliptic, green on both sides, paler beneath; style long filiform | 6. <i>S. hastata</i> . |

Flowers before the leaves; catkins sessile or subsessile.

Stigma sessile or subsessile.

- | | |
|---|----------------------------|
| Leaves elliptic or obovate, rugose, crenate | 7. <i>S. Caprea</i> . |
| Leaves lanceolate or ovate-lanceolate, not rugose, entire | 8. <i>S. Wallichiana</i> . |

Style long, slender.

- | | |
|--|---------------------------|
| Leaves lanceolate, glabrous, serrate, glaucous beneath; capsule glabrous | 9. <i>S. daphnoides</i> . |
| Leaves linear-lanceolate, white-tomentose beneath; margin revolute; capsule grey-tomentose | 10. <i>S. viminalis</i> . |

Stamens 2, connate to the apex or nearly so.

- | | |
|--|------------------------------|
| Leaves linear-lanceolate; scales dark-coloured at top, with long silky hairs | 11. <i>S. pycnostachya</i> . |
| Leaves narrow-linear; scales yellow, glabrous | 12. <i>S. angustifolia</i> . |

1. *S. tetrasperma*, Roxb.—Tab. LVIII.—Cor. Pl. t. 97; Roxb. Fl. Ind. iii. 753; Wight Ic. t. 1954; Andersson in DC. Prodr. xvi. ii. 192; Bedd. Fl. Sylv. t. 302.—Syn. *S. ichnostachya*, Lindl.; Wight Ic. t. 1953.

Vern. *Bed, bet, bent, bāishi*, Hindi; *Laila, bains, bhainsh*, N.W. India. Local n.: *Badha*, Pb. plains; *Bis, bish, beis, bīsa, bīn, bidu, kschme, bakshel, magsher, safedar*, Pb. Himalaya; *Yir*, Kashmir; *Bilsa*, Oudh; *Pani jama*, Bengal; *Wallūnj, bacha*, Bombay; *Momakha*, Burm. *Bed* is the Persian name for willow; no Sanserit name is known.

A small or moderate-sized tree, extremities with long silky hairs. Leaves lanceolate, rarely ovate-lanceolate, 4-6 in. long, serrulate with minute serratures, glaucous beneath, glabrous when full-grown, or with a few soft adpressed hairs, often long persistent and subcoriaceous; main lateral nerves numerous, prominent. Flowers after the leaves, catkins on leafy peduncles; scales pale, those of the female catkins deciduous. Male catkins sweet-scented, lax, drooping, 2-3, sometimes 4 in. long, rachis, scales and base of filaments hairy; fl. 5-10-androus; stamens free, anthers minute, elliptic. Fruit catkins lax; capsules 2 lines long, on slender pedicels half the length of capsule or longer, often in groups or half whorls of 3-4, glabrous or hairy, mostly rugose when ripe, ovoid, base often subglobose, narrowed into a short style with 2 spreading, generally entire stigmas; gland semicircular, many times shorter than pedicel, seeds 4-6. Andersson describes the capsules as "glaberrimæ." Wight (*ichnostachya*) and Beddome figure them as pubescent, and I have found them hairy in several cases. Roxburgh describes them as 4-seeded, whence the name, which Andersson retains on account of the arrangement of the capsules ("capsulæ subquaternatim collectæ").

Common on river-banks and in moist places nearly throughout India; in Sindh and the plains of the Panjab only planted, except near the banks of the Chenab, and other Himalayan rivers. Sub-Himalayan tract and outer ranges of the Himalaya, west to the Indus, ascending to 6000, and at times to 7000 ft. Ascends to 7000 ft. on the mountains of South India. Java. Often gregarious. R. Thompson mentions a forest of great extent in the swamps of Dharmapur in Baraich. Cultivated in Afghanistan. In North India the leaves are shed in Dec. and Jan., the new foliage appearing Feb.-March. In Burma I have seen it leafless during the rains. It flowers in autumn and the cold season, but also in March and April. The seeds in this as in the other willows ripen soon after flowering. Attains 30-40 ft., with a straight trunk, hollow when old, 5-6 ft., and not rarely 10 ft., in girth. Bark $\frac{1}{2}$ in. thick, grey brown or blackish, rough with broad shallow, irregular vertical furrows, and irregularly-shaped plates between the furrows. Where the tree grows near water, particularly if subject to inundation, the lower part of the stem gets covered, often 2-3 ft. high, with numerous small rootlets.

Sapwood large, whitish, heartwood distinct, of dark-brown colour (R. Thompson). The Burma wood weighs 37 lb. (D.B. List of 1862). Not much used. The charcoal has been used in the manufacture of gunpowder. Baskets are made of the twigs, and the leaves are given as cattle-fodder, the tree being often lopped for that purpose. According to Dalzell (Bombay Fl. Suppl. 82), the bark is used as a febrifuge; it is, however, believed not to contain any salicine (Pharm. Ind. 213).

S. pyrina, Wall.; DC. Prodr. xvi. ii. 193, from Nepal, is very similar, only more hairy, and the capsules more elongated.

2. *S. acmophylla*, Boiss.; DC. Prodr. 195.—Vern. *Bed*, Afg.; *Bada, bisu*, Pb. Himalaya.

A moderate-sized glabrous tree; branchlets often pendulous. Leaves linear-lanceolate, entire, wholly glabrous, pale or glaucous beneath, 2-3 in. long. Flowers after the leaves, catkins on leaf-bearing peduncles; scales pale, with long silky hairs, those of female catkins deciduous; male catkins compact, cylindric, erect or slightly nodding, 1-2 in. long, scales and base of filaments with long silky hairs; stamens 4-6; anthers short, elliptic, or nearly circular. Female catkins nodding, 1 in. long, capsules on short pedicels, ovoid-conical, glabrous, style short, with 2 spreading entire stigmas.

Afghanistan, Sindh, N.W. Himalaya (Indus to Bias), and near Delhi. Often cultivated. Persia and Syria. Fl. Feb., March. A handsome tree with a straight trunk 6-7 ft. girth, often much larger, branches lax, forming a rounded crown, the branchlets often pendulous. About Quetta the tree is much lopped for cattle-fodder.

Andersson refers to this *S. glaucophylla* and *dealbata*, two species previously established by him upon specimens collected in North-West India by Jacquemont. Some specimens, however, which evidently belong to this species, in Herb. Kew. were referred by him to *S. octandra*, Sieber, which is identified with *S. Safsaf* in his Monographia Salicum, 1863, p. 10, and in the Prodrômus, p. 196. Aitchison (Cat. 140) calls the tree *S. octandra*, Del., and Stewart referred it to *S. Safsaf*, Forsk. This, however, is a different tree, with serrulate leaves, 8-androus flowers and subglobose capsules on long slender pedicels, common in Nubia, Abyssinia, and Egypt. Geographically, and as regards characters, *S. acmophylla* appears to be intermediate between *S. tetrasperma* and *Safsaf*.

There is another willow in Afghanistan, apparently intermediate between *S. Safsaf* and *S. acmophylla*, with serrulate leaves, wholly glabrous, glaucous beneath, lateral nerves numerous, distinct, small erect male catkins, stamens 3-8, and large ovoid capsules on long slender pedicels. A low shrub with long red branches, in river-beds near Topchi, with *Berberis*, *Tamarix*, *Rosa*, *Hippophaë*, in other places a middle-sized tree with pendulous branches (Griffith).

S. ægyptiaca, L., is, according to Andersson in DC. Prodr. 196, an uncertain species. Dalzell (Suppl. to Bombay Fl. 81) quotes it as growing on the road from Poona to Kandalla, and describes it with very narrow, almost linear leaves, branches not drooping, and the flowers like those of *S. tetrasperma*.

S. triandra, L.; Hook. Stud. Fl. 336—Syn. *S. amygdalina*, L.; Reichenb. Ic. Fl. Germ. t. 604, is a large glabrous shrub or moderate-sized tree. Leaves wholly glabrous, oblong-lanceolate, serrate, with glandular teeth, stipules semi-cordate, flowers with the leaves; catkins on leaf-bearing peduncles. Male catkins slender, slightly drooping; the flowers triandrous, lax; disc of 2 glands. Capsules glabrous, pedicellate, stigma subsessile. Common in Osier-beds, yields excellent material for basket-work. Bark of old trees exfoliating in thin flakes. Throughout Europe, north to Lapland. Caucasus and Siberia.

S. pentandra, L.; Hook. Stud. Fl. 336; Reichenb. Ic. Fl. Germ. t. 612, is a glabrous shrub or large tree. Leaves wholly glabrous, viscid when young, shining, subcoriaceous when full-grown, elliptic or elliptic-lanceolate, obtusely dentate; teeth often glandular. Flowers after the leaves, catkins on long leaf-bearing peduncles. Male catkins compact, cylindric, drooping, the flowers 4-12-generally 5-androus, close together. Capsules glabrous, pedicellate; stigma subsessile. Disc of 2 glands in both male and female flowers. Throughout Europe (north to Lapland), North Asia.

The bark of the two last-named, as well as that of several other species—*c. p.*

S. daphnoides and *purpurea*—is bitter, and contains a crystalline principle called Salicine, which has been used in Europe, with doubtful success, as an antiperiodic and tonic. The bark of some kinds contains as much as 3-4 per cent of this substance.

3. *S. babylonica*, Linn.—Tab. LIX.—DC. Prodr. xvi. ii. 212.—Syn. *S. pendula*, Mærch; C. Koch, Dendrologie, ii. 507. *Weeping Willow*. Vern. *Bisa, bada, bed, kafira, majnun*, Pb.; *Giūr*, Kashmir.

A large tree with drooping branches, glabrous shining branchlets, and thin cylindric acute buds. Leaves glabrous, pale or glaucous beneath, petiole sometimes hairy and the youngest leaves occasionally with a few adpressed hairs, linear-lanceolate, 3-6 in. long, generally not more than $\frac{1}{2}$ in. wide, finely serrulate, midrib whitish, prominent, lateral nerves numerous but not conspicuous; stipules falcate, serrate. Flowers appearing with the leaves; catkins on peduncles with a few small leaves. Male catkins short, cylindric, slender, curved, $\frac{1}{2}$ -1 in. long, of a straw-yellow colour; scales lanceolate, pale, hairy as well as rachis; stamens 2 free, anthers short, elliptic. Female catkins drooping, 1 in. long; scales lanceolate, pale; capsules sessile, conical, glabrous or slightly pubescent at the base; stigmas 2, sessile.

Cultivated in Afghanistan. Commonly planted in the plains of North-West India, westward more common; also in the Himalaya (to 9000 ft. on the Jhelam), Kamaon, Nepal, Sikkim (to 7000 ft.), Bhutan (to 8000 ft.). In North India the male tree is much more common than the female tree. Wild, according to Dr Stewart, in places on the eastern flanks of the Suliman range, and "apparently indigenous," according to Aitchison (Cat. 140), in one locality near Hushiarpur.

Cultivated in South and Central Europe (Britain, Denmark, but not in Northern Scandinavia and Russia), and in most subtropical countries. Possibly wild in North China, Persia, and Kurdistan (the specimens collected by Kotschy are in leaf only). Introduced into Europe, the female tree only, and propagated by cuttings, in the seventeenth century, possibly earlier; represented by Benvenuto Cellini on a basin at Florence, executed in the sixteenth century. (Extracts from Targioni-Tozzetti, historical notes on the introduction of various plants into Tuscany, in Journ. Hort. Soc. of London, ix. 1855, 177.) Not mentioned by classical writers. The *Garab* of the 137th Psalm, which Linnaeus considered the Weeping Willow, and called *S. babylonica*, was, as pointed out by C. Koch l. c. 507, probably not a Willow, but *Populus euphratica*. In the Panjab it is leafless during the cold season, and the new foliage appears in Feb., March. Fl. Feb.-May. Attains 50 ft. with a straight erect trunk, 6-7 ft., at times 10-12 ft. girth, branches numerous large spreading, forming an elegant oval crown, the branchlets always drooping, sometimes nearly reaching the ground exactly as the Weeping Willow cultivated in Europe. Bark $\frac{1}{4}$ - $\frac{1}{2}$ in. thick, grey, yellowish-grey or brownish, cleft into narrow smooth shining plates by wide, shallow, rough furrows and short straight transverse cracks. Wood close and even-grained, takes polish. The chief use of the tree is that the branches are made into baskets, wattles, and are used for weirs and the protection of canal-banks. It is propagated by cuttings, and grows rapidly if sufficiently supplied with water. Dr Stewart records 4-5 rings per in. and a girth of 4 ft. as the average of 6 trees, 10 years planted out.

Andersson classes *S. japonica*, Thunb. Fl. Jap. 21, with longer cylindrical

male catkins and sharply-serrate leaves, as a variety of *S. babylonica*. C. Koch l. c. 506, keeps it distinct, and states that the branchlets are not pendulous. Kämpfer describes the tree with hanging branches. The Weeping Willow of Europe is probably nothing but the pendulous variety of a Willow with erect branches, analogous to the Weeping Ash or the pyramidal Poplar, Oak, and Kikar, and having constantly been propagated from cuttings and not from seed, its characters have not varied. Regarding the character and mode of growth of the original wild forms of this species farther inquiries are needed. The names of *S. tetrasperma* (*laila*) and of *babylonica* (*majnun*) are supposed to relate to the well-known Persian love-story*, the subject of many poems (Stewart Pb. Pl. 208).

4. *S. alba*, Linn.; Hook. Stud. Fl. 337; Reichenb. Ic. Fl. Germ. t. 608.—*Common Willow*. *Saule blanc*, Fr.; *Weisse Weide*, Germ.

A large silky-pubescent tree with grey or whitish foliage. Leaves white beneath with adpressed silky hairs, narrow-lanceolate, denticulate; stipules lanceolate, deciduous. Flowers after the leaves, catkins on leaf-bearing peduncles. Male catkins compact, cylindric, drooping; stamens 2 rarely more, scales yellow or brown, oblong, ciliate. Female catkins lax, scales yellow, ciliate. Capsules pubescent, subsessile; style short, bifid, each branch bearing a bifid stigma.

Cultivated in Ladak, Kashmir, to 6000 ft. (Thomson Western Himalaya, 180). Western Asia, Siberia, North Africa. Europe (introduced from Asia, according to Andersson). Fl. April. Attains 70-80 ft., but is commonly cultivated in Europe as a pollard tree along streams and on moist meadows or pastures. A variety with yellow or reddish branchlets (*vitellina*) is common in Osier beds. The wood of this, as of most Willows, is white near the circumference, yellow or brown towards the centre, the medullary rays are fine and numerous, the pores are very numerous, fine and uniformly distributed. The annual rings are distinctly marked by a dark line. It is soft, and weighs 26-33 lb.

S. fragilis, L.; Hook. Stud. Fl. 336; Reichenb. Ic. Fl. Germ. t. 609.—*The Crack- or Redwood Willow*, is a fast-growing moderate-sized bushy tree, extremities silky-pubescent, branchlets divergent, forming nearly a right angle with the branches, and easily broken off at the junction (whence the name). Leaves glabrous, lanceolate or oblanceolate, crenate or serrate. Flowers after the leaves, catkins generally lax, on leafy peduncles, scales long, pale-yellow, oblong-lanceolate, obtuse ciliate. Male catkins cylindric, drooping, stamens 2, free, sometimes 3-4. Capsules glabrous, short-pedicellate, narrowed into a short bifid style, each branch bearing a bifid stigma. Europe (often cultivated), Siberia, Asia Minor, Aleppo, Caucasus. One (male) specimen from Lahoul (Rev. H. Jaeschke). Cultivated in Ladak with *S. alba* (Thomson l. c. 180). Wood (in Europe) yellowish red, supposed to be more durable than that of other Willows.

S. Russelliana, Sm., the *Bedford Willow*, is a variety of *S. fragilis*; by some it is considered a hybrid between *S. fragilis* and *alba*.

5. *S. elegans*, Wall.; DC. Prodr. xvi. ii. 256.—Syn. *S. Kumaonensis*, Lindl. *S. denticulata*, And.; Reise Prinz. Wald. t. 89. The following names, given in Pb. Pl. 208, partly relate to this species: *Beis*, *bitsu*, *bed*, *bida*, *beli*, *yir*, Chenab; *Badā*, Ravi; *Bāshal*, Sutlej.

A shrub or small tree, branches glabrous, dark brown or black, the current year's branchlets, petioles, and upper side of midrib often pubescent with short hairs. Leaves elliptic- or obovate-oblong, wholly glabrous except midrib on the upper side, glaucous beneath, 2 in. long, when young membranous, afterwards hard, subcoriaceous, lateral nerves indistinct, numerous, joined by prominent reticulate veins. Flowers after the leaves; catkins slender, on pubescent leaf-bearing peduncles, scales yellow or dark brown. Male catkins compact, $1\frac{1}{2}$ in. long; stamens 2, distinct, anthers short-elliptic. Female catkins 3-5 in. long, drooping, scales minute, slightly pubescent; capsules glabrous on short pedicels; styles short, stigmas spreading.

Common in the North-West Himalaya, particularly in the outer ranges from 6000 to 10,000 ft. Lahoul, Sdiling forest Kunawar, Niti Pass at 11,500 ft. Also in Nepal. Known as far north as Marri. Fl. March, April.

G. S. hastata, Linn.; DC. Prodr. xvi. ii. 257; Reichenb. Ic. Fl. Germ. tab. 570.

A small shrub, young shoots with long soft deciduous silky hairs, branches glabrous, dark brown or black. Leaves membranous, glabrous when full-grown, or with long soft hairs along midrib and nerves beneath, green on both sides, but somewhat paler beneath, elliptic, dentate, 1-3 in. long, $\frac{3}{4}$ -2 in. broad; stipules large, broad-ovate or semicordate. Flowers with the leaves; catkins subsessile, supported by a few small leaves, scales small, brown or black, but generally entirely concealed by long white silky hairs. Male catkins cylindric, compact; stamens 2, free, anthers yellow, oblong, protruding with the shining filaments from the dense mass of long silky hairs. Female catkins somewhat lax, 2-6 in. long; capsules glabrous, often $\frac{1}{4}$ in. long, on short pedicels, terminating in a long filiform style with 2 spreading stigmas.

Inner arid Himalaya and Western Tibet, between 9000 and 15,000 ft. Baltal at the head of the Sind valley in Kashmir, head of the Butna valley below the Bardar Pass in Kishtwar, Dras, Lahoul, and the Werang Pass in Kunawar, are the outermost points where this Alpine Willow has yet been found. Alps and mountains of Central Europe, also in Sweden and Denmark. Fl. June-Aug.

This species is nearly allied to two Alpine European Willows which are also found in the mountains of Scandinavia, England, and Scotland—*S. nigricans*, Sm., and *S. phylicifolia*, Linn.; Hook. Stud. Fl. 338, 339. They flower before the leaves, the scales are less hairy, the capsule is pubescent, longer pedicellate and terminating in a long filiform bifid style, with bifid stigmas. *S. nigricans* has ovate-oblong reticulate pubescent and often rugose leaves. *S. phylicifolia* has glabrous leaves, shining above, glaucous beneath, generally elliptic-lanceolate. Both are shrubs, but often attain the stature of small trees.

7. *S. Caprea*, Linn.—Tab. LX.—Hook. Stud. Fl. 337; Reichenb. Ic. Fl. Germ. t. 577.—*Sallow*. *Saule Marceau*, Fr.; *Sahlweide*, Germ. Vern. *Bed mushk* (scented willow), Pb.

A large shrub or small tree. Leaves elliptic or obovate, crenate, glab-

rous above, grey-tomentose beneath, more or less rugose; main lateral nerves prominent, 8-12 on either side of midrib, with shorter intermediate ones between; stipules large, semi-reniform. Flowers appearing before the leaves; catkins densely silky, subsessile, supported at their base by a few foliaceous bracts. Male catkins ovoid-oblong, thick, about 1 in. long, erect, sweet-scented, scales dark-coloured; stamens 2; anthers elliptic-oblong. Female catkins cylindric, 2-3 in. long, nodding; scales black above the middle; capsules downy grey, $\frac{1}{4}$ in. long, cylindric from an ovoid base, on short pedicels; stigmas 2, erect, subsessile.

■ Cultivated at Peshawar, Lahore, Ludiana, and elsewhere in the Panjab, also in Rohilkhand. Wild throughout Europe (Lapland), in North Asia, on the Caucasus, in Asia Minor and Persia. Said to have been introduced in the Panjab from Kashmir by Hari Chand, soon after he conquered that country for Ranjit Singh, but has not been found wild there. Dr Stewart thought that it had been introduced into India by the Moguls. The leaves are shed about the end of December, and the tree is leafless until March. The flowers appear in Feb. while the tree is bare; they are collected and a scented water is distilled from them, which is mixed with sherbet and is a favourite drink of wealthy Musalmans in North India.

As grown in India, it is a small tree 25-30 ft. high, with short erect trunk 3 ft. girth. The Willow-gardens at Lahore, several acres in extent, are on low alluvial moist land near the Ravi, and consist entirely of male trees. The tree is raised from cuttings; they are irrigated occasionally, and are never pollarded. Bark dark grey or yellowish-brown, cut into irregular smooth plates by longitudinal, branching black furrows, with cracked wrinkled edges, and short cross-cracks.

In Europe the Willow occurs generally as a large shrub, as underwood, and in coppice-woods; often a useless companion of more valuable woods in young thickets, plantations, or coppice-woods, and generally thinned out whenever possible. In Kent there were formerly large extents of coppice of this willow, for the production of hop-poles, but they have mostly given way to the more profitable Ash and Sweet Chestnut. In England it flowers about the end of March or the beginning of April, and the flowering branches of the male tree are used instead of palms in Roman Catholic churches on Palm Sunday. The bark of this and of several other Willows contains tannin, and is used for the manufacture of leather in Scotland and the north of Scandinavia. In Europe the wood is reddish near the centre; it is somewhat heavier than that of most other European species. Nördlinger gives 27-39, and Mathieu mentions a piece from Corsica of 46 lb.

8. *S. Wallichiana*, And.—Tab. LXI.—DC. Prodr. xvi. ii. 223.—Vern. *Buir*, Pb.; *Bhāins*, *bhangli*, *katgūli*, N.W.P.

A shrub or small tree, youngest shoots and under side of leaves glossy with grey silky pubescence. Leaves lanceolate or ovate-lanceolate, smooth, not rugose, entire, 2-3 in. long; lateral nerves numerous, not very conspicuous. Flowers appearing before the leaves; catkins densely silky, subsessile, supported at their base by a few foliaceous bracts; scales black. Male catkins erect, cylindric, 1-1 $\frac{1}{2}$ in. long; stamens 2; anthers elliptic-oblong. Female catkins cylindric, 3-4 in. long, drooping, scales black; capsules downy, grey, slender, $\frac{1}{4}$ in. long, short-pedicellate; stigmas 2, erect, subsessile. Distinguished from *S. Caprea* by the shape and silky

tomentum of the smooth leaves and the long female catkins with slender capsules.

Afghanistan, Kashnir valley, common, also cultivated. In the plains near the Chenab. Mahassu near Simla (7000-8000 ft.) Kamaon (2500-9000 ft.) Nepal and Bhutan. Fl. March, April. Baskets are made of the branches, and twigs are used as tooth-sticks.

9. *S. daphnoides*, Vill.—Tab. LXII.—DC. Prodr. xvi. ii. 261; Hook. Stud. Fl. 340.—Syn. *S. pomoranica*, Willd., and *pruinosa*, Wendl.; Reich. Ic. Fl. Germ. t. 602, 603. Vern. *Bed*, *bidai*, *betsu*, *beli*, *bushan*, *bashal*, *mudanu*, *shün*, *thail*, Ph.; *Yär*, Kashmir; *Changma*, *chamma*, *malchang*, *kalchang*, West Tibet.

A tall shrub, sometimes a large tree, with glabrous shining yellowish reddish-brown or nearly black branches, often covered with grey or glaucous bloom, easily rubbed off; youngest shoots slightly pubescent; buds large, ovoid-lanceolate, downy. Leaves 3-5 in. long, linear or elliptic-lanceolate, glabrous, glaucous beneath, serrate; lateral nerves numerous, prominent. Flowers appearing before the leaves; catkins densely silky, sessile, scales fringed with long silky hairs, the upper half black. Male catkins erect, cylindric, 1-1½ in. long; stamens 2, anthers oblong, yellow. Female catkins cylindric, 2-4 in. long, nodding; capsules glabrous, sessile, style long slender, stigmas 2, divergent, entire. The stipules of the Indian and North Asiatic form (*S. acutifolia*, Willd.) are lanceolate, of the European form they are semicordate. The leaves in the inner arid Himalaya are linear-lanceolate, in the outer ranges they are broader, elliptic-lanceolate. There is a variety with velvety branches and leaves.

Common in the inner arid Himalaya, ascending to 15,000 ft. Indus valley near Iskardo (7000 ft.), Ladak, Lahoul, Dras, Shayok, Nubra, Piti, Kunawar. Frequently cultivated (to 14,000 ft. in Ladak). Outer ranges, descending to 2300 ft. (Stewart), Kashmir (Stewart), Mahassu ridge near Simla 8000 ft. (T. Thomson), Deoban range (D.B.), Kamaon, Betali Pass at 8700 ft. (Strachey & Winterbottom). Alps and mountains of Central Europe, descending into the plains along the Rhine and other rivers; coasts of the Baltic; Russia, Siberia, Amur. Introduced to England in 1820, and run wild in Yorkshire. Planted largely, within the last 20 years, in North Germany, to fix the ground on railway embankments and cuttings, and on dry sandhills, for which its strong, long-spreading roots render it particularly suitable. Fl. March, April, later at high elevations.

Attains 60 ft. with a straight erect trunk, 6-7 and at times 9-12 ft. girth, branchlets at times pendulous. In Ladak at 15,000 ft. it is a small tree 15 ft. high and 3 ft. girth. Round gall-like knots are not uncommon on the branches. Bark usually light grey, in old trees and at great elevations often nearly black and rough with furrows. This species (according to Stewart) is much grown in Lahoul between 8500 and 11,000 ft., from cuttings 9-12 in. long, generally near water; it thrives best in light soil, where it sends down long roots. Three trees are usually planted together, and they are often bound round with cloth or branches to protect them against cattle. The twigs are used for baskets and wattles in the N.W. Himalaya. In Ladak the houses are built of willow wattle and daub. Twig bridges of willow branches are found in Piti, Zaskar, and Ladak. The wood of this and of the other species cultivated in the arid forestless inner valleys is used for building, pails, tubs, and tools. But the principal

use of this and other willows in those tracts is to furnish cattle-fodder. The trees are pollarded every 3d or 4th year, at higher elevations every 5th year. This is done in spring, before the new leaves appear, the smaller twigs are given unstripped with the bark of the larger branches, the wood of these being used as fuel. In Lahoul the leaves of willows, like the leaves of most available trees, are used as litter for cattle.

S. insignis, Anders.; DC. Prodr. xvi. ii. 262—Vern. *Bitsu*, Pb.; *Gir*, Kashmir,—is a large shrub or small tree, with many strong branches, with tomentose branchlets and semicordate stipules; differs from *S. daphnoides* by hairy capsules and glabrous, large, obtuse, black scales of the female catkins. Not common. Kashmir (5000-8000 ft.), Piti (9000-12,000 ft.)

10. *S. viminalis*, Linn.; Hook. Stud. Fl. 340; Reichenb. Ic. Fl. Germ. t. 597.—*Osier*, *osier blanc*, French; *Korbweide*, German. Vern. *Bitsu*.

A shrub or small tree, young shoots with dense grey silky pubescence. Leaves linear-lanceolate, margin revolute, 4-5 in. long, pubescent or glabrate above, densely clothed beneath with soft matted silky tomentum; stipules lanceolate. Flowers before the leaves; scales of catkins brown or black at the apex, fringed with long silky hairs. Male catkins sessile, erect, cylindric, 1 in. long; stamens 2, anthers elliptic, yellow. Female catkins subsessile, cylindric, 2-4 in. long; capsules $\frac{1}{4}$ in. long, grey-tomentose, subsessile, narrowed into a long slender style, longer than the divergent stigmas. *S. Smithiana*, Willd., supposed to be a hybrid of *S. viminalis* and *Caprea*, has semicordate stipules, the leaves often broader, and style shorter than the stigmas.

Panjab, Himalaya, Jhelam and Chenab, 5000-9000 ft. Kashmir. Drās to 10,000 ft. Baspa valley, Kunawar at 9000 ft., Lahoul. *S. Smithiana* in Sikkim 5000-8000 ft. Common throughout Europe, where it is the principal and most valuable willow of Osier-beds, on account of its long and tenacious branches, in Siberia, Sogaria, and on the Amur. Fl. March, April.

S. incana, Schrank; Reichenb. Ic. t. 596, has the foliage of *viminalis*, but the catkins are (not at first) pedunculate, the scales and capsules are glabrous. The stamens are more or less connate at the base. South Europe, Asia Minor.

11. *S. pycnostachya*, And.; DC. Prodr. xvi. ii. 309.—Vern. *Changma*, West Tibet.

A shrub or a small tree, young shoots silky-pubescent; branchlets violet, brown red or blackish, smooth, shining. Leaves glabrous when full-grown, lanceolate, entire or serrulate, 2-3 in. long, midrib prominent, lateral nerves numerous, oblique, not conspicuous. Flowers after the leaves, scales fringed with long soft hairs. Male catkins cylindric, nodding, on leaf-bearing peduncles; scales brown, oblong, obtuse; stamens 2, filaments connate to the apex or nearly so. Female catkins cylindric, compact, nodding, 2 in. long; scales black at the top, capsules sessile, silky (glabrous, Andersson); style short, thicker at the top, stigmas 2, broad, bifid.

At high elevations in the inner arid Himalaya, not common. Zaskar

(12,000-14,000 ft.) Ladak, ascending to 15,000 ft., often found dying at the higher elevations. Cultivated at 13,000 ft. in Ladak. Fl. May, June. The leaves turn red in Sept., before falling. Generally a shrub 6-7 ft. high, growing in clumps in dry stream-beds, at times a small tree 16 ft. high, with a trunk 2 ft. girth, and divaricate branches. Red and brown galls occur on petioles and midrib.

S. ozycarpa, And. ; DC. Prodr. 310, is a monadelphous willow closely allied to the preceding sp., and only differing by the fl. appearing with or a little before the leaves ; larger, more pubescent, serrate leaves ; black scales of male and brown of female catkins, catkins longer and less compact, the female attaining 4 in. Kashmir and Kishtwar 6000-11,000 ft. Fl. June. *S. Ledebouriana*, Trautvetter ; DC. Prodr. 308, of the Baikal and Altai mountains, in Songaria ; Elbrus in North Persia, is similar to *S. pycnostachya*. *S. purpurea*, Linn. Hook. Stud. Fl. 342—Syn. *S. Helix*, Linn. Reichenb. Ic. Fl. Germ., tab. 582-585, is a glabrous shrub, with lanceolate serrate, often opposite leaves, fl. before the leaves, scales dark coloured silky, stamens monadelphous, anthers red before bursting, afterwards black, capsules short, ovoid, obtuse, sessile, stigmas subsessile, ovate. Common in Osier-beds of England, France, and Germany. Europe, North Asia, Persia, and Asia Minor. Mixed with this sp. and *S. viminalis* is often found an intermediate form, believed to be a hybrid between the two : *S. rubra*, Hudson ; Reichenb. Ic. Fl. Germ. t. 586, with leaves soft-pubescent beneath, margin revolute, stigmas linear on a shorter or longer filiform style.

12. *S. angustifolia*, Willd. ; DC. Prodr. xvi. ii. 315. -

A low shrub, with long virgate, glabrous branches ; young shoots silky-pubescent. Leaves narrow-linear, $\frac{1}{2}$ in. broad, subsessile, 1-2 in. long, midrib prominent. Flowers after the leaves in subsessile cylindric catkins, with a few leaves at their base ; scales yellow, oblong, obtuse, glabrous. Stamens 2, filaments connate, bearing two 2-celled anthers. Capsules sessile, grey with silky adpressed hairs, narrowed into a short style bearing two 2-cleft stigmas.

Inner arid Himalaya, 7000-12,000 ft. Iskardo, Shayok and Nubra valley (also cultivated), Zanskar, Afghanistan. North Persia, Songaria, Caucasus, Ural. Fl. May.

Several species of Willow form small procumbent shrubs on the higher ranges of the N.W. Himalaya ; the more common are : 1°. *S. flabellaris*, Anders. ; Reise Prinz. Waldemar, t. 90, with obovate acute crenate leaves, blade $\frac{3}{4}$ -1 in., petiole $\frac{1}{2}$ in. long, scales oblong, as long as capsules ; Dras, Lahoul, Kunawar, 11,000 to 15,000 ft. 2°. *S. Lindleyana*, Wall. ; DC. Prodr. 296, with small lanceolate or elliptic-lanceolate leaves, scales ovate, shorter than capsules. Kamaon (11,000-14,000 ft.), Nepal, Sikkim (at 16,000 ft.) Both are wholly glabrous, the catkins appear after the leaves on leafy peduncles, the male fl. are diandrous, the capsules glabrous, and the styles short. They are nearly allied to *S. retusa*, L. ; Reichenb. Ic. Fl. Germ. tab. 558, which inhabits the Pyrenees and the Alps of Switzerland and Austria, and they are somewhat similar to *S. Myrsinites*, Linn. Hook. Stud. Fl. 341 ; Reichenb. t. 559, which, however, has longer cylindric catkins, hairy capsules and reticulate leaves.

2. **POPULUS**, Tournef.

Leaves broad, rarely lanceolate or linear; petioles generally exceeding one-fourth the length of leaf, the leaves of shoots and suckers often differently shaped. Scales of catkins caducous, obovate or rotundate, crenate lobed or cut. Disc flat or cup-shaped, often oblique, membranous or thick and slightly fleshy. Stamens 4-30, inserted on the disc, filaments generally less than twice the length of anthers. Stigmas 2-4, often lobed. Capsule 2-3- or 4-valved, with the valves spreading, each valve bearing a placenta along its median line.

Capsule 2-valved.

Buds viscid; leaves and catkins glabrous 1. *P. nigra*.

Buds hairy; leaves white-tomentose beneath, catkins hairy 2. *P. alba*.

Capsule generally 3- or 4-valved, rarely 2-valved.

Capsule pedicellate; leaves of different shapes, some linear, others broad-ovate, cut and lobed 3. *P. euphratica*.

Capsule pedicellate; leaves cordate, ciliate 4. *P. ciliata*.

Capsule subsessile, rugose; leaves ovate, not ciliate 5. *P. balsamifera*.

1. ***P. nigra***, Linn.; Hook. Stud. Fl. 335; Reichenb. Ic. Fl. Germ. t. 619. *Black Poplar*.—Vern. *Safēda*, Pb. plains; *Frast*, Kashmir; *Prost*, *farsh*, *makkal*, Chenab; *Kramali*, *būns*, *do*, Sutlej; *Yarpa*, *yūlatt*, *kabāl*, Ladak. (*Safēdar* is the Persian for Poplar.)

A large glabrous tree with spreading, or (in N.W. India always) erect branches, forming a narrow cylindric crown (*P. pyramidalis*, Rozier—Syn. *P. fastigiata*, Desf., the *Lombardy Poplar*). Buds viscid. Leaves glabrous, subcoriaceous, broad-ovate rhomboid or almost triangular, nearly as broad as long, crenate and acuminate; blade 2-4, petiole 1-2½ in. long; 3 basal nerves, midrib penniveined. Male catkins compact, red, glabrous, stamens 15-30. Female catkins glabrous, lax, drooping, disc shallow, indistinctly dentate, pedicel shorter than cup; stigmas 2, subsessile, broad, obcordate. Fruiting catkins 4-6 in. long; capsules 2-valved (always?) pedicels shorter than capsule.

Planted in the N.W. Himalaya, particularly in Kashmir, and in the basins of the Jhelam, Chenab, and Sutlej rivers (Kunawar to Spui and Dabbling), between 3000 and 11,500 ft., in Ladak as high as 12,500 ft. Occasionally planted in the plains, at Lahore, Peshawar, Hushiarpur, and elsewhere. Nearly always the cupressiform or pyramidal variety. The tree is common in Afghanistan (wild, according to Griffith, at Shekkabad, near Kabul, at 7500 ft.) The spreading variety is wild in Europe (naturalised, not indigenous in England), and throughout North and West Asia. C. Koch (*Dendrologie*, ii. 489) states that in Hungary, South Russia, and Asia Minor, the tree has more erect branches, forming an elongated crown, similar to that of the Lombardy Poplar. The latter has long been cultivated in Italy; it is not, however, mentioned by classical writers, and must have been brought from Asia by the Arabs, or at a later period. From Italy it was introduced into France in 1749 (Mathieu), and into England in 1758 (London). Like the Weeping Willow, it has maintained its peculiar characters unaltered, having always been propagated from cuttings. Most of the Lombardy Poplars in Europe are male; the female tree of it is known, but

scarce. In India the tree does not often flower, but specimens in young fruit (collected in Kashmir by T. Thomson) are in Herb. Kew. The tree is leafless in winter, and the leaves turn yellow before being shed. The pyramidal Poplar in N.W. India has the same shape, and attains the same size (90 ft. high, 6-8, sometimes 10-12 ft. girth) as the Lombardy Poplar in Europe; it is generally planted as an avenue-tree—a very fine specimen of a poplar avenue is the one near Sirinagar in Kashmir, about a mile long, perfectly straight, lining a road which runs east and west across the fine grassy plain towards the Takhti Suliman. Dr Stewart estimated the number of trees at 1700; they are 90-105 ft. high and 6-7 ft. girth, many of the trees with dry branches at the top. In Ladak the trees do not exceed 50-60 ft.

The Lombardy Poplar, when old, has a furrowed and often twisted trunk; the bark is grey, rough with numerous vertical cracks and fissures. The wood is whitish brown, near centre very soft and light, even-grained; its structure is similar to that of *P. alba*. The weight of the Lombardy Poplar wood is between 24.9 and 27.4 lb., that of the round-headed black Poplar 24.3 to 32.4 lb. per cub. ft. (Nördlinger). In Afghanistan it is, like the white Poplar, used for grape-boxes. In Europe the wood of the black Poplar is used for planking, packing-cases, wooden shoes, and (in Italy) for window-blinds. Paper is also made of it. The wood of the Lombardy Poplar, which is often knotty, is (in France) sometimes used for veneering. The black Poplar pollards well. Both kinds are rapid growers; the black Poplar attains 80 ft. and a diam. of 2 ft. in 50 years; they are always propagated from cuttings; the black Poplar is useful to fix the soil on slopes too dry for the Willow. In India the tree is often lopped for cattle-fodder.

2. *P. alba*, Linn.; Hook. Stud. Fl. 335; Reichenb. Ic. Fl. Germ. t. 614. — *White Poplar*, *Abele*. *Silber pappel*, German; *Peuplier blanc*, French. Vern. *Sperdor*, *spelda*, Afg.; *Chilla* (white) *bagnu*, *safedar*, *jangli frast*, *fras*, *prist*, *rikkan*, *sannun*, *chanun*, *māl*, Pb.

A large tree, the current year's branchlets, buds, petioles, and under side of leaves with dense white, soft, cottony tomentum. Leaves ovate, with obtuse sinuate lobes, those of luxuriant shoots deeply 3-5-lobed, blade 2-4, petiole 1-2 in. long, basal nerves 5, the midrib penniveined. Catkins hairy; male flowers 4-10-androus. Female catkins: disc shallow, entire, stigmas apparently 4, really 2, each of 2 linear lobes. Pedicels longer than disc and shorter than ovary. Capsule short-pedicellate, 2-valved.

Wild and cultivated in the N.W. Himalaya between 4000 and 10,000 ft., on the Jhelam, Chenab, and (planted only) in Kunawar above Miru and Poari, on the Shayok in Chorbat as high up as Turtuk (9200 ft.). Planted in the Peshawar valley, the trans-Indus territory, in the Panjab plains (not common), and in Sindh. Wild and planted in Afghanistan, Beluchistan, North Persia, Caucasus, Siberia, Songaria, Europe, North Africa. Flowers in early spring, before the leaves; these come out in March (in the plains). In India a moderate-sized tree, 30-40 ft. high, girth 6, rarely 8 ft. In Europe often attains 100 ft., with a tall straight stem 50-60 ft. long, and a diam. of 6-10 ft. Bark $\frac{1}{2}$ - $\frac{3}{4}$ in. thick, light- or yellowish-grey, smooth when young, getting darker and rough when old. Wood white, with a reddish tinge, brown near the centre, soft and light, but even-grained. Not much valued in India. In Afghanistan the shallow round boxes in which grapes are packed for export to India are made of the wood of this species and of *P. nigra*. The wood has numerous very fine medullary rays, and numerous small pores

uniform in size and uniformly distributed, annual rings fairly distinct. Weight 25-35 lb. (Nödlinger). In Europe the wood is much in request for packing-cases, the bottom planks of carts and waggons, for turning, and toys. In India it is generally raised from cuttings, often of large size. The growth is rapid; the tree (in Europe) attains a diameter of 2-3 ft. in 50 years (according to Mathien, a diam. of 2 metres in 40 years). Like most *Poplars*, it sends up abundant root-suckers. The Indian tree does not often flower, specimens in fruit, collected in W. Tibet by T. Thomson, are in Herb. Kew. Dr Stewart states that he never saw a tree in flower or fruit.

P. canescens, Sm., the *Grey Poplar* of Europe, leaves hoary, and afterwards glabrous beneath, is by Hooker classed as a sub-species under *P. alba*. The wood takes a good polish.

P. tremula, Linn.; Hook. Stud. Fl. 335; Reichenb. Ic. Fl. Germ. t. 618—the *Aspen*—*Tremble*, French; *Aspe*, *Zitter pappel*, German; belongs to the same group as *P. alba*, with 2-valved capsule and pubescent buds. The leaves are pubescent when young, almost orbicular, on long slender pedicels, dentate with large obtuse teeth, the leaves of shoots and suckers are different, larger and short-petiolate, Europe, North and West Asia, Africa. A moderate-sized, sometimes a large tree, spreads widely by means of root-suckers, and is often very inconvenient in coppice-woods and thickets of hardwood trees. The wood is white, and of late has been much sought after for the manufacture of paper. Burckhardt, in his excellent work, "Säen u. Pflanzen," 451, states that in the north-eastern Harz forests the price of this wood has increased sevenfold within a short time on that account.

3. *P. euphratica*, Olivier.—Tab. LXIII.—DC. Prodr. xvi. ii. 326.—Syn. *P. diversifolia*, Schrenk. Vern. *Bāhan*, *bhān*, *jangli bentī*, *safedar*, Pb.; *Bahn*, Sindh; *Patki*, Brahui; *Hodung*, Ladak.

A large glabrous tree, extremities sometimes hoary; buds slightly pubescent, not viscid. Leaves coriaceous, most variable in shape, those of seedlings, young trees and luxuriant shoots, pollard- and coppice-shoots, linear, short-petiolate, 3-6 in. long, those of older trees and on branches with short internodes, generally broad-ovate rhomboid or cordate, blade 2-3 in. long and equally broad, often broader than long; petiole 1-2 in. long. The broader leaves have generally the upper half dentate, cut or lobed, they have also 3-5 basal nerves, and the midrib penniveined; the narrow leaves are entire, without prominent lateral nerves. All kinds of intermediate forms are frequently seen on the same tree, and on the same branch the lower leaves are often broad, and the upper narrow, lanceolate. (In Tibet the leaves vary much less than in the plains of the Panjab.) Catkins lax, nodding. Male fl.: scales oblanceolate; disc on long slender pedicels, flat, 8-cleft; stamens 8-12, anthers oblong, quadrangular, longer than filaments. Female fl. pedicellate, disc membranous, caducous, tubular with 8-12 linear segments; stigmas 3, more or less irregularly crescent-shaped, narrowed into short styles. Capsule lanceolate, opening into 3, rarely 2 valves, $\frac{1}{4}$ - $\frac{1}{2}$ in. long; pedicel slender, shorter than capsule.

Common in the forest belt of Sindh along the Indus, particularly in upper and middle Sindh, where its seedlings spring up in abundance, some time after

the annual floods have receded, on the fresh alluvial deposits (Katchas) which are formed every year by the action of that river. There the Poplar forms standard trees over the underwood of Tamarisk (p. 22). Not uncommon in the valleys of the Suliman range to 3000 ft. on small feeders of the Indus, and also found in nooks and corners along the main river between Dehra Ismail Khan and Attok. Higher up the Indus and its feeders, it is known in Ladak, it is common in Nubra along the Shayok river, growing in pure sand (Thomson, West. Him. 191). Dr Stewart mentions a tract along the (Nubra ?) river at 10,500 ft. almost a mile long, covered by it, a plot of over a score of trees at 12,000 ft., and an occasional tree at 13,500 ft. The tree is also wild in the Southern Panjab (female more common than male trees), forming thickets along the lower course of the Sutlej river, about Multan and between the Sutlej and Indus. It has not been found, however, wild on any of the other Panjab rivers in the Himalaya or along their upper course in the plains. It has been reported from Lahoul; but Dr Stewart, who botanised over both branches of the Chenab in that district, the Chandra and Bagha, to the upper limit of trees, never found it, nor was it reported by the Rev. H. Jäschke. It is commonly planted in gardens and on roadsides in the plains of the Panjab, and thrives well. The tree is indigenous in Afghanistan (abundant near Kandahar), in Songaria, on the Sir Daria in Turkestan (Fedtschenko), in Kurdistan, on the Euphrates and Tigris, between Shiraz and Aboushir in Persia, in Central Arabia, along the river Jordan in Palestine, and along ravines in the hills of Oran in Algeria (Bourgeau). On the banks of rivers, which form its principal habitat, the tree is often gregarious. It is nearly leafless from Jan. to March, and flowers in Feb., the seeds ripening between April and June. While in flower it is either leafless or with a few old leaves left.

In the Sindh forests the tree attains 40-50 ft., and a girth of 5-8 ft.; the trunk is regularly shaped, but not very straight. In Ladak it is 20 ft. high, with a girth of 3-4 ft. Bark $\frac{1}{2}$ in. thick, marked with irregular vertical furrows; inner bark fibrous. Where the tree is subject to inundation, the lower part of the trunk often gets covered with short horn-like roots, similar to what is seen on Willows, and from the wood of the trunk short hard spine-like processes are often found projecting into the inner part of the bark, as in *Ulmus* (p. 434). The wood is harder and more compact than that of the preceding species; the outer wood is whitish, the inner reddish with dark-brown veins, nearly black in old trees. The medullary rays are fine, numerous, the pores are much larger than in *nigra* and *alba*, they are uniformly distributed, solitary or in groups of 2-5. In the South Panjab the wood is only used for the lining of walls, but in Sindh it is employed largely for beams, rafters, panelling, and turnery. Most of the lacquered Sindh boxes are made of this wood. On the Euphrates and Tigris it is also used for planking and boat-building. It is employed as fuel for domestic use in Sindh and the South Panjab. The heating powers are not great, and it is therefore not much used for the river steamers; but in Ladak, where fuel is very scarce, it is much prized. The leaves furnish fodder for goats and cattle, and the tree is lopped occasionally for that purpose both in the plains and in Tibet. Gun-match is made of the inner bark in Sindh, and the bark is given as a vermifuge. The tree grows rapidly (3-4 rings per in. of radius), the annual rings are often unequal in width; it throws out numerous root-suckers, and becomes troublesome in gardens. It coppices vigorously; in Sindh coppice-shoots are often used for rafters, and it bears pollarding for a long time.

4. *P. ciliata*, Wall.; Royle III. t. 84^a. Vern. *Sufeda*, *bagmu*, *phalja*, *phlassu*, *falās*, *phalās*, *ban phrastu*, *dud phras*, *asān*, *muāli*, *rīkhan*, *saki*, *pābe*, *chanūn*, *krammal*, Pb.

A large tree, with lanceolate, viscid, resinous buds, the yellow resinous gum sometimes secreted in masses; young shoots slightly pubescent. Leaves pale and pubescent along nerves beneath, cordate, acuminate, dentate, with obtuse, glandular, ciliate teeth, otherwise glabrous, blade 3-7, petiole 2-5 in. long; basal nerves 3, the midrib prominent, pinniveined. Female catkins drooping, compact while in flower, lax in fruit. Disc large, enclosing more than half the ovary, dentate with rounded obtuse teeth, pedicel shorter than disc, but lengthening out in fruit. Stigmas 3-4, large, obcordate, sessile. Fruiting catkins 6-9 in. long, pendulous; capsule ovoid, $\frac{1}{4}$ - $\frac{1}{3}$ in. long, 3-4 valved, each valve bearing a placenta on a black median line; hairs of seeds as long as capsule; pedicels as long as capsule.

Himalaya, at 4000-10,000 ft. from the Indus to Bhutan in mixed forests, most common north-west of the Jumna. In Kunawar, Rarang is its upper limit; it is not uncommon near Chini and Pangri, but there is no proof of its having been found in the inner arid tract either on the Sutlej or on the Indus. It has not been found trans-Indus, but Dr Stewart thought that it would probably be found higher up on the Suliman range than where he had been, and in his MSS. he entered *Shāwa* as the Pushtu name of the tree. The leaves are shed in October, and turn light yellow before falling; the new leaves come out early in spring, with or soon after the flowers. Attains 60-70 ft., with a tall, erect straight trunk, 6-8, occasionally 10 ft. girth, often ridged and almost buttressed. Bark grey, smooth with vertical wrinkles. Galls, brittle, brown, subglobose, 1 in. diam., are often found on young branches. The leaves somewhat resemble those of *Ficus religiosa*, and the tree is sometimes called *pahari pipal*, with the least breath of wind they make a continuous fluttering noise. The wood is soft, white; water-troughs are made of it. The leaves are valued as fodder for goats.

5. *P. balsamifera*, Linn.—Syn. *P. suaveolens*, Fisch., and *laurifolia*, Ledebour Fl. Ross. iii. 629. Vern. *Phalsh*, *makkal*, *pakhshu*, *pakh bāt*, *kramal*, Pb. *Berfa*, *changma*, *yarpa*, *magkal*, *māhal*, West Tibet.

A large tree, with long, angled, flexuose, graceful branchlets and viscid resinous buds, youngest shoots slightly pubescent. Leaves often crowded at the ends of short lateral branchlets, subcoriaceous, glabrous, pale, often tawny beneath, ovate, acuminate, dentate, blade 2-5, petiole 1-3 in. long. Male catkins cylindric, drooping, rachis angular, slightly winged; disc pedicellate; stamens 20-30, filaments slender, longer than anthers. Female catkins lax, drooping, 5-6 in. long when in fruit; rachis generally hairy. Disc cup-shaped, or turbinate, sinuate-dentate. Ovary rugose, often hairy; stigmas 2-3, broad, 2-lobed. Capsule sessile, girt at base by the glabrous yellow disc, 2-4-valved, each valve bearing a placenta on the inside along its median line.

Commonly planted in the inner arid N.W. Himalaya. Lahoul (9000-10,800 ft.), Kunawar (8000-9000 ft.), Piti (10,000-13,000 ft.), Zaskar, Ladak (to 14,000 ft.) Wild on the Shāyok in West Tibet, and throughout North Asia and North America (*Tachamac* tree). Also in Afghanistan (Hyderkhet, on the Schmeesh river, Stewart). Hardy in England. Fl. April-May; the fruit ripens in Aug. and Sept. Attains (in Tibet at moderate elevations) 60-70

ft., and a girth of 6, sometimes 9 ft. Trunk not very tall, often gnarled when old, crown broad rounded, or more frequently long, oval, sometimes approximating to the cypress shape. Bark thick, furrowed and rough, dark grey. Galls are common on leaves and branches. Leaves and branchlets are full of balsamic juice, which stains paper; balsam also exudes on a fresh cut between bark and wood. The trees are often lopped for cattle-fodder. A tincture prepared from the buds has been used medicinally in North America.

ORDER LXXII. CUPULIFERÆ.

Trees, rarely shrubs, with scaly buds and alternate simple leaves with deciduous stipules. Flowers monoicous. Male flowers in bracteate spikes, catkins or heads, rarely solitary. Perianth none, or consisting of 5 or more lobes or leaves. Stamens 5, or more, rarely fewer; anthers 2-celled. Female fl.: 1 or several enclosed in an involucre of free or more or less connate bracts. Perianth adnate to ovary, limb minute, indistinct, or more or less regularly toothed. Ovary inferior, generally 2-3-, in a few cases more-celled; styles as many as cells. Fruit indehiscent, generally 1-seeded, more or less enclosed in the enlarged foliaceous or hardened involucre. Seed large, solitary, rarely 2 or 3; testa thin; albumen none; cotyledons thick, fleshy, farinaceous or oily; radicle short, superior.

Male flowers in heads or in lax interrupted catkins or spikes; perianth of 4-10 lobes or leaves; anthers 2-celled, cells connate; ovary 3-7-celled, 2 collateral ovules in each cell. (Order *Cupuliferæ* of most authors.)

Fruit a gland (acorn), solitary, 1-seeded, the lower part (rarely the entire acorn) included in a cup of imbricate scales or concentric belts

Fruit of 1-3 generally 1-seeded nuts, enclosed in a thick coriaceous prickly involucre, opening irregularly

Male flowers in dense cylindrical drooping catkins; perianth none; stamens inserted on the base or inside of a broad scale; anthers 1-celled, or 2-celled with distinct cells; ovary 2-celled, one ovule in each cell. (Order *Corylaceæ* of most authors.)

Fruit small, 1-seeded, in the axil of large foliaceous bracts in drooping spikes

Fruit a large 1-seeded nut, enclosed in a large cut and lobed, sometimes spinescent, sheathing involucre.

1. QUERCUS.

2. CASTANOPSIA.

3. CARPINUS.

4. CORYLUS.

1. QUERCUS, Linn.

Deciduous or evergreen trees, with entire or serrate, coriaceous or subcoriaceous leaves. Male flowers in drooping catkins or erect spikes. Perianth 3-8-lobed, stamens as many as lobes, or more numerous; anthers hairy or glabrous, cells connate. (A rudimentary ovary in subg. *Pasania*.) Female flowers in clusters or spikes, rarely solitary, each flower enclosed in an involucre of numerous bracts, which in fruit form a cup, and are either imbricate or connate into concentric belts. Limb of perianth minutely toothed. Ovary 3-celled, with 2 ovules in each cell; styles 3, stigmatose along the inner surface or at the apex only, often red. Fruit a gland (acorn), with a coriaceous pericarp, 1-seeded, the rudiments of the abortive

ovules at the base or the top of the seed. The cotyledons are thick fleshy, as a rule farinaceous, in a few cases oily (candles are made of the acorns of an oak in New Grenada).

Of this large genus 281 sp. are described in De Candolle's *Prodromus*. A. S. CErsted, in his introduction to "*Liebmann, Chênes de l'Amérique tropicale*," 1868, proposes to divide it into 4 genera, with the following diagnostic characters, three of which contain species, described below:—

Styles stigmatose along the inner surface; male flowers in drooping catkins; leaves generally serrate or lobed.

Scales of cup imbricate 1. *QUERCUS* (1-15).

Scales of cup in concentric belts 2. *CYCLOBALANOPSIS* (16, 17).

Styles stigmatose at the apex only; male flowers in erect spikes; leaves entire.

Scales of cup imbricate 3. *PASANIA* (18).

Scales of cup in concentric belts 4. *CYCLOBALANUS*.

Under this arrangement the species of *Quercus* are American, European, and West Asiatic, whereas the species of the other genera are confined to Eastern Asia and the Indian Archipelago, with one exception, *Pasania densiflora*, CErst. of California. The following clavis includes (in brackets) the more important European and West Asiatic Oaks.

Leaves serrate dentate lobed or pinnatifid; male fl. in pendulous catkins, without rudimentary ovary.

Cup with imbricate scales, adpressed or spreading (*Quercus*, CErsted).

Scales closely adpressed in the ripe fruit, more or less connate at base.

Leaves persistent until winter, generally beyond the appearance of the new leaves; styles linear or linear-clavate.

Full-grown leaves tomentose or pubescent beneath.

Acorn globose, supported at the base by a flat or slightly concave cup; main lateral nerves 8-12 pair, bifurcating 1. *Q. semecarpifolia*.

Acorn cylindrico-conical, the lower half or third part enclosed in a hemispherical cup.

Main lateral nerves 6-12 pair, not prominent 2. *Q. Ilex*.

Main lateral nerves 10-20 pair, prominent.

Leaves 4-8 in. long, rusty or tawny-tomentose beneath; main lateral nerves 10-16 pair 3. *Q. lanuginosa*.

Leaves 3-6 in. long, grey-tomentose beneath; main lateral nerves 14-20 pair 4. *Q. incana*.

Full-grown leaves glabrous on both sides 5. *Q. dilatata*.

Leaves deciduous in autumn; styles short, thick, clavate, and often lobed.

Leaves dentate, deeply lobed or pinnatifid; main lateral nerves 6-12 pair.

Leaves glabrous, short-petiolate, with auriculate base; fruit pedunculate (6. *Q. pedunculata*.)

Leaves pubescent beneath, narrowed into petiole; fruit sessile (7. *Q. sessiliflora*.)

Leaves velvety beneath, pubescent above; fruit short-pedunculate (8. *Q. Toza*.)

Leaves dentate, main lateral nerves 10-14 pair (9. *Q. lusitanica*.)

Scales free, spreading or reflexed in the ripe fruit; styles linear, acute or subulate.

Main lateral nerves 6-10 pair; leaves dentate lobed or pinnatifid.

Branchlets glabrous; leaves deciduous in autumn (in some varieties later), pubescent beneath. (10. *Q. Cerris.*)

Branchlets tomentose; leaves deciduous in spring, tomentose beneath. (11. *Q. Aegilops.*)

Main lateral nerves 6-10 pair; leaves persistent, dentate, tomentose beneath.

Fruit on the current year's shoots. (12. *Q. Suber.*)

Fruit on the previous year's shoots. (13. *Q. occidentalis.*)

Main lateral nerves 14-16 pair, each nerve terminating in a long fine subulate serrature; leaves deciduous.

14. *Q. serrata.*

Main lateral nerves indistinct; leaves persistent, glabrous when full-grown, with spinescent teeth.

(15. *Q. coccifera.*)

Cup with concentric belts (*Cyclobalanopsis*, (Ersted).

Leaves pubescent beneath, 3-6 in. long; main lat. nerves 10-14 pair.

16. *Q. annulata.*

Leaves glabrous, white beneath, 6-12 in. long; main lat. nerves 20-25 pair.

17. *Q. lamellosa.*

Leaves entire; male fl. in erect spikes; stamens surrounding a rudimentary ovary (*Pasania*, (Ersted).

18. *Q. spicata.*

According to A. De Candolle, the abortive ovules are in spp. 1-15 at the base of the fruit, generally attached to a more or less elongated placenta, but in *Q. spicata*, and probably in *Q. annulata* and *lamellosa*, at the top of the fruit.

1. *Q. semecarpifolia*, Smith.—Tab. LXIV.—Wall. Pl. As. Rar. t. 174.—Vern. *Barchar, jangal ka parūngi*, Jhelam; *Kreu, khareu, krūi*, Chenab, Ravi; *Karshu, karsui, karzu, sāuj*, Sutlej to Sarda; *Ghesi*, Nepal.

A large tree, leafless for a few weeks in spring, the spring shoots catkins and young leaves with soft hairs. Leaves coriaceous, rigid, glabrate above, densely clothed beneath with ferruginous tomentum, very variable in shape, subsessile or short-petiolate, elliptic or obovate-oblong from cordate base, obtuse, 2-5 in. long, entire or dentate with long, subulate, spinescent teeth, main lateral nerves 8-12 pair, generally bifurcating and branching at half their length, prominent beneath, and impressed on the upper side of leaf. Male flowers in drooping slender catkins 2-3 in. long, the catkins generally fasciculate, from the base of the spring shoots, or from the axils of fallen leaves on the previous year's branchlets. Bracts broad-ovate, ciliate. Perianth-segments obtuse, ciliate; stamens 6-18, anthers glabrous, apiculate. Female flowers in short-pedunculate spikes; styles 3-5, elongate, linear, recurved. Scales of cup membranous, brown, ovate-lanceolate, obtuse, softly hairy. Acorn globose, 1 in. diam., glabrous, black or dark brown when ripe, supported, but not enclosed, by the small, concave cup; the ripe acorns on the current year's wood. The leaves of young trees or young shoots are generally dentate, but entire and dentate leaves are not rarely found on the same branch.

Saledkoh at 10,000 ft. N.W. Himalaya, mostly on north and north-west slopes,

between 8000 and 10,000 ft., occasionally descending to 6000 and ascending to 12,000 ft. Nepal, Bhutan. Leafless for a short time in April and May, the flowers generally appear with the fresh leaves, sometimes in June; the fruit ripens in August, and soon falls to the ground, where it often germinates within a few days. Generally gregarious, often covering considerable areas to the exclusion of almost every tree of other kinds, not rarely forming the upper limit of forest vegetation. Attains a larger size than any oak of the N.W. Himalaya. Trees 70-80 ft. high, with 7-8 ft. girth, are not rare; they often attain 12 ft., and Dr Stewart measured one 15 ft. girth at 5 ft. from the ground, the trunk bifurcating at 10 ft. In Nepal, Wallich mentions 80 to 100 ft., with a girth of 14-18 ft., as common dimensions. Where the young trees have grown up close together, the *Karzu* has an erect, straight trunk, clear of branches. The growth of the tree is generally slow, 10-15 rings per in. of radius. Bark grey, cut by shallow cracks into small four-sided scales, with truncate corners. Wood greyish-brown, hard and heavy, medullary rays fine and numerous. In the hills it is used for building, door-frames, bedsteads, carrying-poles, helves, and ploughs, but it is said to warp and to be liable to be eaten by insects. Owing to the remote localities where it mostly grows, and to its great weight, it has not been exported to the plains. Yields excellent charcoal. The leaves are commonly stored as winter fodder for cattle.

2. *Q. Ilex*, Linn. *Holm Oak*—*Yeuse*, Fr.; *Leccio*, It.—Syn. *Q. Baloot*, Griff.; DC. Prodr. xvi. ii. 38. Vern. *Charrei*, *serei*, *balūt*, Afg.; *Spercherei*, *pargāi*, *kharanja*, Trans-Indus; *Chūr*, *kharsu*, *kharcu*, *irri*, *yūru*, *yiri*, *heru*, (*kathūn*)*ban*, *bre*, *brekehe*, Pb.

A middle-sized evergreen tree, often only a shrub, the shoots of the current year pubescent, with grey stellate hairs. Leaves 2-3 in. long, coriaceous, exceedingly variable in shape, elliptic or oblong, entire, or with large spinescent teeth, petioles and under side clothed with soft grey tomentum, upper side at first pubescent with stellate hairs, afterwards glabrate, main lateral nerves 6-12 pair, not prominent. Male flowers in slender drooping catkins, the catkins in axillary fascicles, perianth somewhat irregularly divided into 4-5 membranous ciliate segments. Anthers (in the Indian specimens) hairy, shortly and obtusely apiculate. Ovary conical, soft-tomentose, exserted; styles 3-5, linear-clavate, spreading, surmounted at the base by the acute, more or less distinct scales of the perianth. Fruit pedunculate, rarely sessile, generally 2-3 acorns at the end and angles of a flexuose peduncle, shorter than the leaf. Acorns at first nearly enclosed in the campanulate or turbinate cup, when mature cylindric with conical top, light brown, glabrous, shining; scales of cup closely adpressed, hoary, base ovate, narrowed into a linear or lanceolate apex, the ripe acorns on the current year's wood. A variety with eatable seed is *Q. Ballota*, Desf. Th. Kotschy (Die Eichen Europas u. d. Orients, t. 38) describes and figures the anthers of *Q. Ilex* as glabrous, but there are specimens from Greece and other parts of the Mediterranean with hairy anthers. It is a matter for farther inquiry whether in this section of *Quercus* this is a good specific character. The Indian and Afghanistan specimens have densely hairy anthers, and short nearly oval leaves.

North-East Afghanistan, Kafiristan, on the Safedkoh, ascending to 10,000 ft. Abundant on the eastern flank of the Suliman range (5000-6500 ft.) Hills

north of the Peshawar valley at 3500 ft. Arid tracts of the inner Himalaya, on the upper Jhelam, Chenab, Ravi, and Sutlej, generally between 3000 and 8500 ft. In Kunawar its lower limit is Chergaon and Panwi, its upper Teling and Purbni. The Holm Oak is also indigenous in the entire Mediterranean region, extending in the west of France north to the Loire, and in a few places even farther (Sarthe, Finisterre). Forms extensive forests in Provence, Algeria, Spain, Sicily, Corsica (in the region of *P. Pinaster*, above the zone of *Phillyrea*, *Arbutus*, *Pistacia*, and below the forests of *Pinus Laricio*). It is known from Asia Minor, near the Black Sea, and De Candolle quotes it from Palestine; but as far as known at present there is a gap in its range of distribution between the Mediterranean region and Afghanistan, which seems to favour the maintenance of Griffith's species, *Q. Baloot*. There is, however, no essential character separating the Indian from the Mediterranean tree, and I therefore follow T. Thomson, who first identified them (Western Himalaya, 73). The tree was introduced into England in 1581, is commonly planted, and attains a large size. In favourable seasons the acorns ripen regularly at Kew. It is hardy in south-west Germany, not in the north and north-east. Fl. April-May. In France the fruit ripens in Sept. (Mathieu), in England in Nov. In Europe the leaves remain two years on the branches. Gregarious, but not often forming dense or pure forests; in N.W. India sometimes associated with *Olea*.

In India generally attains 20-40 ft., with a short straight trunk 5-6 ft. girth, but is often seen of larger size. In Afghanistan it is often a large shrub, and in central France it grows in the same manner. It is a slow-growing tree, but coppices vigorously; there are extensive coppice-woods for fuel and bark in the south of France (*e.g.*, near Draguignan). Seedlings have a long straight tap-root. The bark is light- and dark-grey, often nearly black, tessellated and cut into quadrangular plates by wavy longitudinal furrows and straight transverse smaller cracks, somewhat resembling the bark of *Reptonia burifolia*. Sapwood small, whitish, heartwood dark-brown, often mottled or with darker patches, and in old trees the centre wood often reddish-brown or nearly black, the annual rings indistinct. Pores small, medullary rays very broad ($\frac{1}{3}$ - $\frac{1}{2}$ line), giving an irregularly reticulate appearance on a vertical section. The wood is close-grained, very hard and heavy; the weight of the European tree varies between 60 and 69 lb. per cub. ft. It warps, twists, and splits much in seasoning, but takes a fine polish. Ploughs and other agricultural implements are made of it where it grows in the N.W. Himalaya; and quantities are imported into the western Panjab from the Suliman range, in the shape of short cylindrical pieces, called *Kharanja ka bazu* (arms of oak), to be made into tool-handles. The wood is excellent fuel, and much of the fuel used in Peshawar consists of it. It yields good charcoal. Fences are made of the branches with prickly leaves, and those without prickles are stored for winter fodder. The acorns are said to be a favourite food of the large white-faced monkey (Langur): the acorns of the sweet variety form an important article of food in Spain and Algeria.

It is not improbable that part of the oak-galls of the Panjab bazaars (*māju*), which are given medicinally as an astringent, and used for dyeing the hair, are from this species.

3. *Q. lanuginosa*, Don Prodr. Fl. Nep. 57.—Syn. *Q. lanata*, Wall. Vern. *Ranj, rianj, rai banj* (King of Oaks), Kamaon; *Banga*, Nepal.

A large evergreen tree; spring shoots and young leaves densely clothed with thick soft rust-coloured or tawny tomentum. Leaves coriaceous, oblong-lanceolate, dentate with distant obtuse triangular teeth, upper side glabrous, shining, under side densely clothed with thick soft tawny or

rust-coloured tomentum; midrib and main lateral nerves 10-16 pair, prominent beneath, impressed on the upper side of leaf, blade 4-8, petiole $\frac{1}{2}$ -1 in. long; stipules ovate or oblong, middle part hairy, edge thinly membranous. Male fl. densely clothed with long soft hairs, in slender drooping catkins, bracteoles acute ciliate. Perianth irregularly divided into 4-5 short lobes; anthers glabrous, shortly and obtusely apiculate. Female fl. densely tomentose, styles linear. Acorns sessile, solitary or in pairs, on the current year's wood, cup hemispherical, with adpressed ovate scales.

Naini Tal and a few other places in Kamaon, between 6000 and 7500 ft. Nepal, Bhutan. Fl. April, May; fr. Oct., Nov. Gregarious, often associated with *Q. incana*, attaining 70-80 ft., with a straight erect trunk. The leaves are used as cattle-fodder.

4. *Q. incana*, Roxb. Fl. Ind. iii. 642.—Vern. *Bān*, *bānj*, *banj*. Local names: *Vari*, Salt range; *Rinj*, *rīn*, Jhelam.

A middle-sized or large evergreen tree, with grey foliage, the current year's shoots and petioles hoary. Leaves coriaceous, oblong-lanceolate, serrate with sharp mucronate teeth, glabrous above, densely clothed beneath with short white tomentum; main lateral nerves 14-20 pair, prominent beneath, blade 3-6, petiole $\frac{1}{2}$ in. long; stipules linear. Male fl. pubescent with soft white hairs, in slender drooping catkins, bracteoles obtuse, longer than perianth. Perianth irregularly divided into 4-5 short lobes; anthers glabrous, shortly and obtusely apiculate. Female fl. axillary, sessile, generally in clusters of 2-5; styles linear-clavate, spreading. Acorns on the current year's wood, sessile or subsessile, cup at first almost entirely enclosing the acorn, afterwards campanulate, enclosing half the acorn, which is at first tomentose, afterwards glabrous, brown and shining; scales rough, closely adpressed.

Outer Himalaya from the Indus to Nepal, generally between 3000 and 8000 ft.; not in the Kashmir valley or the surrounding hills, and not in the arid tracts. Its upper limit in the Sutlej valley is opposite Chergaon. Gregarious, often associated with *Rhododendron arboreum* and *Andromeda*. The leaves are generally renewed in March and April, the flowers appear about the same time, the acorns commence to ripen in August, and frequently remain on the tree until the young fruit of the ensuing year appears. Attains 50-60 ft., with a short straight trunk 6-8 ft. girth (12 ft. has been noted), but at lower elevations it does not generally exceed 30 ft. and 4-5 ft. girth. It can be grown in the plains (Saharanpur). Bark dark-coloured, rough with cracks and fissures.

Sapwood soft, porous, heartwood reddish-brown, compact, hard and heavy; used for building and ploughs, as fuel, and to make charcoal. The bark is used for tanning, and the leaves are lopped for cattle-fodder. The acorns are greedily eaten by pigeons, bears, and the large (Langūr) monkey. They form part of the official *Balūt* of the Panjab bazaars, given as a diuretic and in gonorrhœa.

5. *Q. dilatata*, Lindley; Royle III. t. 84, f. 2.—Syn. *Q. floribunda*, Lindl. Vern. *Zāih*, Kafiristan; *Bān*, *banji*, *banchar*, *barachar*, *barāin*, *banni*, *parūngi*, *chora*, *kālī rīng*, *māru*, *māur*, *moru*, *karsh*, *marghang*, Pb.; *Moru*, *tilanga*, *kilonj*, *tilonj*, *timsha*, N.W.P.

A large evergreen tree, glabrous, youngest shoots only with slight floe-

case pubescence. Leaves glabrous, dark-green, coriaceous, shining, oblong-lanceolate with a rounded or cordate base, entire or with sharp spinose-teeth; blade 2-3 in., petiole $\frac{1}{4}$ in. long; main lateral nerves 8-12 pair, joined by minute reticulate veins. Male fl. in slender, lax, drooping catkins; female fl. in short axillary spikes. Styles 3-5 linear-clavate. Acorns generally solitary, short-pedunculate or subsessile, ovoid, brown, half exserted, the lower half enclosed in a hemispherical cup; scales lanceolate, closely adpressed, the ripe acorns on the branch of the current year.

North-east Afghanistan, Bharaul in Kafiristan (6000-7000 ft.) Safedkoh (9000-10,000 ft.) Eastern flanks of the Suliman range (6000-7000 ft.) Common on the outer ranges of north-west Himalaya from 4500 to 9000 ft., extending east to the Kali. In the Sutlej valley Jani in Kunawar is the upper limit of this species. Flowers and changes its leaves in spring. Gregarious, but generally associated with other trees. Attains 80-90 ft., with a fine close dark-green crown, and a tall, erect, but often gnarled trunk, 8-9 ft., at times 15 or 18 ft. in girth. Madden notes a tree 100 ft. high and 19 ft. 8 in. girth. Bark brownish-grey, with elongated scales, darker and larger than those of *Q. semecarpifolia*. Wood brownish, hard heavy and durable, largely used in building, for agricultural implements, axe-handles, and for Jampan-poles. On the Sutlej the timber of this species is prized more than that of the other Oaks, the order of merit of the others being *Q. incana*, *semecarpifolia* and *annulata*. The leaves are prized as fodder for sheep and goats, and the trees are often severely lopped for that purpose.

6. *Q. pedunculata*, Ehrh. *British Oak*. *Chêne pédonculé*, French; *Stieleiche*, German. A large long-lived timber-tree. Leaf-buds ovoid; leaves deciduous, short-petiolate or subsessile, obovate-oblong, with auriculate base, generally deeply cut into broad rounded lobes, glabrous or slightly hairy beneath along midrib; main lateral nerves 6-12 pair, often alternating with shorter intermediate ones. Perianth-segments of male flower lanceolate; anthers glabrous; styles broad and short. Fruit 1-5 on axillary peduncles 2-6 in. long on the current year's wood. Scales of cup adpressed. Europe, Asia Minor, Ural and Caucasus, forming extensive and often nearly pure forests in the alluvial plains along the principal rivers of Central Europe—e.g., in Hungary, Croatia, on the Oder and Elbe in North Germany, on the Loire and the Adour in France.

7. *Q. sessiliflora*, Sm. *Chêne rouvre*, French; *Traubeneiche*, German. Like the former, but leaf-buds ovoid-lanceolate, leaves obovate-oblong, narrowed into a petiole $\frac{1}{2}$ in. long, deeply cut into oblong or broad rounded lobes, pubescent when young, glabrate or pubescent when full-grown; main lateral nerves 6-10 pair, often alternating with shorter intermediate ones. Fruit in sessile or subsessile clusters. Leaves and flowers generally 10-14 days later than of *Q. pedunculata*. Europe and Asia Minor, forming extensive forests, often associated with the Beech and Hornbeam, rarely pure, on mountainous and hilly ground, not, as a rule, on alluvial soil. *Q. pubescens*, Willd., is a tomentose variety principally found on warm dry hills in South Europe, where it takes the place of the more glabrous *Q. sessiliflora* of the North.

In England and the lowlands of Scotland *Q. pedunculata* is the commoner of the two Oaks, but in North Wales and the hill-parts of northern England *Q. sessiliflora* is more frequent (Benth. *British Fl.* 422). Intermediate forms between these two Oaks are found in England and elsewhere, and the leading systematic botanists of the present day, Bentham, Hooker, and A. De Candolle, unite

them under the name of *Q. Robur*, Linn. Foresters, however, particularly in France and Germany, find no difficulty in keeping them apart. The seedlings of both species have a long tap-root; they coppice vigorously, and the bark is used largely by tanners. The value and uses of Oak-timber for casks and barrel-staves, furniture, house- and ship-building, are well known. There is not much difference in the structure and qualities of the timber of the two species. Sap-wood small, soft, whitish, decays rapidly, and is attacked by insects; the heart-wood well defined, brown, hard, strong and generally durable, except under certain circumstances in contact with iron. Medullary rays of two classes; numerous very fine rays and (comparatively) few very large rays, some commencing at the centre, others at the outside of annual rings; the large rays $\frac{1}{4}$ line wide, 2-3 in. high, giving the wainscot appearance on vertical sections. Annual rings distinctly marked by an inner belt (spring wood) of large pores, close together, and an outer belt of compact wood with fine pores, generally arranged in linear or wedge-shaped patches at right angles to the annual rings, and only visible under the glass. The weight of Oak (seasoned heartwood) fluctuates between 33 and 64 lb. per cubic ft. It is an interesting question, which is not without practical importance, how far the weight of Oak-timber depends upon the width of the annual rings. Mathieu (Fl. For. 234, 240) is of opinion that faster-grown Oak-timber is generally heavier, the porous tissue of the spring wood forming a smaller proportion of the entire wood. The following data, which I have noted on samples of Oak-timber from different sources presented to the Kew Museum by the Admiralty, bear out this view to a certain extent; slow-grown Adriatic timber, for instance, with 20 rings on one inch of radius, weighing 41 lb. per cub. ft., while faster-grown wood from Trieste, with only $6\frac{3}{4}$ rings, weighs 50 lb. Exceptions, however, are not wanting; thus the heaviest timber is a somewhat slower-grown wood from Sardinia with 11 rings per inch:—

Sardinia,	66 rings on 6 in. of rad.	Weight, 59.3 lb.
Trieste,	40 " "	50.6 "
Dantsic,	75 " "	48.4 "
Italy,	72 " "	48.1 "
Tuscany,	84 " "	46.2 "
Adriatic,	120 " "	40.9 "

8. *Q. Toza*, Bosc; Kotschy l. c. t. 22. *Chêne tauzin*, Fr. A small deciduous tree, young shoots silvery white; with long spreading roots, throwing up abundant root-shoots. Leaves petiolate, obovate-oblong, generally pinnatifid, segments linear-oblong, the middle ones often lobed, thick-velvety beneath, and pubescent above with stellate hairs. Perianth-segments of male fl. lanceolate, hairy; anthers glabrous; styles broad and short. Fruit 2-4, short-pedunculate, on the current year's wood; scales of cup adpressed. West of France, Spain, Portugal, probably also in Syria. Forms vigorous coppice-woods on sandy soil, and yields excellent bark for tanning. Wood mainly used for fuel.

9. *Q. lusitanica*, Webb; DC. Prodr. xvi. ii. 17. A large tree, sometimes a shrub, the foliage deciduous in autumn or persistent to the end of winter. Leaves ovate- or obovate-oblong, generally grey-tomentose beneath while young, glabrate when full-grown, dentate with large triangular rounded or oblong teeth; main lateral nerves straight, parallel, undivided, 10-14 pair. Perianth-segments of male fl. lanceolate; anthers glabrous; styles thick, short. Fruit on the current year's wood, sessile or short-pedunculate, solitary or in pairs; scales of cup adpressed. Mediterranean region, Syria and Asia Minor. To this sp. belong, according to A. De Candolle, a. the "*Chêne zeen*" of Algeria, *Q. Mirbeckii*, Durieux, Mathieu Fl. For. 256, a magnificent long-lived tree, attaining 120 ft., with 20 ft. girth, and forming extensive forests, particularly in Eastern Algeria.

β. *Q. infectoria*, Olivier, the *Gall* or *Dyers' Oak*. A shrub or middle-sized tree in Greece, Bosnia, Asia Minor, and Syria, extending east to the confines of Persia, with cylindrical acorns, the leaves grey underneath, yielding the Galls used in medicine and dyeing, which are imported into Europe from the Levant.

10. *Q. Cerris*, Linn.; Reich. Ic. Fl. Germ. t. 650.—Syn. *Q. austriaca*, Willd.; Kotschy Eichen, t. 20. *Turkey* or *Mossy-cupped Oak*. *Chêne chevelu*, Fr.; *Zerreiche*, Germ. A large tree. Leaves petiolate, elliptic or oblong, variously lobed, often pinnatifid, pubescent and pale beneath, glabrous above, main lateral nerves 6-10 pair; stipules and outer bud-scales long, setaceous. Perianth-segments of male fl. 4-6, oblong or ovate; stamens 4-6, anthers hairy; styles linear, recurved. Fruit on the previous year's wood, solitary, or in clusters of 2-4, sessile or on short thick peduncles; cup large, scales free, subulate, spreading or recurved. Asia Minor, North Syria, South Europe, extending north to Hungary and Lower Austria, and in France to the Doubs and Loire. Often associated with the common Oak. Fl. May; the fruit ripens in Sept. of the second year; the leaves fall in Oct. or Nov. The *Lucombe* and *Fulham* Oaks, believed to be hybrids between *Cerris* and *Suber*, are evergreen, or nearly so. Structure of the wood similar to that of the common Oak; the sapwood is larger, the heartwood of a deeper brown, and the large rays more numerous, giving it a most varied and beautiful wainscot grain. Weight, 53-58 lb. It grows more rapidly than the common Oak, with a straight powerful terminal shoot; in England it was introduced in 1735, and trees 10-12 ft. girth are not rare.

Q. pseudosuber, Santi; Kotschy l. c. t. xxxv., differs from *Q. Cerris* by persistent, coriaceous, less deeply lobed leaves which are grey-tomentose beneath. In a few localities of Provence, in Algeria, Sicily, Italy, and Istria. Yields cork of an inferior description.

11. *Q. Egilops*, Linn.; Hook. Trans. Linn. Soc. xxiii. 384, t. 38.—Syn. *Q. Vallonea*, Kotschy l. c. t. 7. *Vallonea Oak*. A moderate-sized tree, leaf-buds obtuse, hoary, branchlets of the current and previous year grey-tomentose. Leaves ovate or ovate-oblong, grey-tomentose beneath, and often on the upper side also, dentate with large triangular cuspidate teeth or deeply lobed and often pinnatifid, main lateral nerves 6-10 pair, midrib flexuose in the upper part of leaf. Male fl. mostly hexandrous, bracteoles lanceolate, caducous, generally longer than perianth, anthers hairy, not apiculate. Styles subulate, recurved. Fruit sessile, solitary, cup large, 1-1½ in. diam., at first enclosing the acorn, afterwards hemispherical, scales free, thick, linear, often angular, hoary, erect or more generally reflexed, acorn ovoid, more commonly cylindrical, 1-2 in. long, green when ripe. Eastern Mediterranean, Asia Minor, Syria. In Syria the tree grows gregariously, never as a bush, but rising on a stout gnarled trunk 3-7 ft. in girth, to the height of 20-30 ft., Hook. l. c. 385. The acorns are eaten raw and boiled, the cupule is used for tanning and dyeing, and is exported in large quantities from Asia Minor under the name of *Vellani*, *Vallonea*. The leaves fall in winter or early spring, a little before or after the young leaves come out.

Q. persica, Jaub. et Spach; DC. Prodr. xvi. ii. 47, of Persia and Kurdistan, differs by oblong or ovate-lanceolate leaves, with 10-16 pairs of main lateral nerves.

12. *Q. Suber*, Linn.—*Cork Oak*. *Chêne liège*, Fr. *Sovero*, *sughero*, It. A middle-sized, long-lived tree, with thick corky bark, and scanty foliage, otherwise resembling *Q. Ilex*. Leaves evergreen, remaining two years on the branches and sometimes longer, branchlets and under side of leaves with short grey tomentum. Leaves ovate or ovate-oblong, acute, crenate or dentate, the teeth sometimes long-cuspidate; blade about 2, petiole ½ in. long. Male fl. in fasciculate, somewhat compact, drooping catkins, perianth campanulate, 6-fid, anthers generally hairy. Styles linear, recurved. Fruit solitary or in pairs, on

short thick peduncles, on the current year's wood. Lower scales of cup ovate, adpressed, upper lanceolate, spreading. Western Mediterranean region, Southern and Eastern Spain, Algeria, South France, Corsica, Italy, Sicily, Dalmatia. Attains a very large size in Andalusia. Hardy in England. The wood is similar to that of *Q. Ilex*, medullary rays very broad, nearly 1 line wide, but larger pores. Cork is the outer bark of the trunk, composed of cellular tissue; it commences to form at an early age, and is generally taken off in intervals of 7-10 years. It is removed during the summer months, and great care is necessary not to injure the surface of the inner bark, and the layer of soft cellular tissue between the inner bark and the cork, from which the latter is regenerated. The naked trunks of the trees from which the cork has recently been removed, have a peculiar reddish colour, until they reclothe themselves with a fresh layer of cork. The first crop (called *liège mâle* in Provence) is cracked and irregular, and is generally without value; the succeeding crops form the cork of commerce, and a tree continues to yield these periodical crops until an advanced age. The principal supply of cork comes from Spain, but France also has fine and valuable Cork-Oak forests; the tree is often mixed with *Q. Ilex* and *Pinus Pinaster*, on the range of hills called Les Maures in Provence, between Hyères and Draguignan, and in Corsica. In Algeria the Cork-Oak forests are more extensive, but they have of late years suffered much from fires. The tree has a thin and light foliage, and thus favours the growth of *Erica arborea* and other underwood, which catches and spreads fire readily during the dry and hot summer months. In Provence, also, destructive forest-fires have at various times damaged extensive forests containing the Cork-Oak. Plants of the Cork-Oak have repeatedly been sent to India, but as yet without much success.

13. *Q. occidentalis*, Gay; DC. Prodr. xvi. ii. 44 (figd. by Kotschy l. c. t. 33 as *Q. Suber*), differs from *Q. Suber*, mainly by requiring two years to ripen its fruit, which is on short stout peduncles on the previous year's wood. Portugal, Galicia, Asturia, South-West France. The leaves remain a little more than a year on the branches. Produces cork of excellent quality, which is collected like that of *Q. Suber*. More hardy than *Q. Suber*, extends considerably farther north; many of the old Cork-Oak trees in England and Ireland belong to this species. Mathieu (Fl. For. 265) relates a remarkable instance of Cork-Oak plantations made at Belle-Isle-en Mer (lat. 47° 20'), in 1826, with plants and acorns brought from Catalonia (*Q. Suber*) and the Landes (*Q. occidentalis*). The former all perished, but the latter survived. In spite of these interesting and well-established facts, it seems doubtful whether *Q. occidentalis* ought to be retained as a distinct species. The duration of the leaves, and the time which the acorns require to ripen, are subject to great variations in several species of this genus; and it seems doubtful whether these characters can, in the present case, be relied upon for specific distinction.

14. *Q. serrata*, Thunb. Fl. Jap. 176 (not of Roxb.)—Syn. *Q. polyantha*, Lindl. in Wall. Cat. 2771.

A middle-sized deciduous tree; buds ovoid-lanceolate, closed, scales acute, floccose, youngest shoots pubescent with soft hairs, flowers tawny-tomentose. Leaves oblong-lanceolate when mature, coriaceous, glabrous, shining, often with tufts of hairs in the axils of the main lateral nerves, young leaves soft-tawny-tomentose beneath, and with scattered hairs on the upper side; main lateral nerves 14-16 pair, parallel, each terminating in a long fine subulate serrature, often $\frac{1}{4}$ in. long, transverse nerves numerous, fine, at right angles to lateral nerves; blade 4-6, petiole slender, 1-1 $\frac{1}{2}$ in. long.

Male flowers in slender pendulous racemes, bracteoles ovate-lanceolate, a little longer than perianth. Female flowers in short axillary spikes, style filiform, with capitate and often bifid apex. Fruit subsessile on the previous year's wood, solitary or in clusters of 2-3, cupule at first enclosing the acorn, opening afterwards, scales numerous, free, linear or subulate, hoary, the outer reflexed, the inner erect; acorn subglobose, glabrous, shining, more than half immersed in the cup, which is $1\frac{1}{2}$ in. diam.

Nepal, Sikkim (3000-5000 ft.), Kasia. Japan, Korea, North and West China. Fl. March-May. The young leaves appear with or after the flowers (in Japan, in May). The wood has middle sized pores and broad medullary rays. This is one of the species of Oak on which the Japanese Oak-silkworm (*Yamamai* or *Yama mayu*, Mountain Cocoon) lives, which yields a strong but rough and hard silk, spun in Japan with cotton or other silk, but not much exported. The tree is either planted in avenues or as short rotation coppice-wood, which is cut over every third or fifth year. The eggs (glued on strips of paper) are tied to the Oak-bushes when the buds begin to swell; sometimes they are bred under cover on Oak-bushes placed in water, and put out upon the trees when they are a few weeks old. This silkworm is also raised on the hills of the Shantung and Sechuen districts in China (Ostr. Ungar. Expedition nach Siam China u. Japan, 1872, Append. 172, 282).

Q. serrata, Roxb. Fl. Ind. iii. 641; Ill. in Herb. Kew, 2393, has male and female flowers, with much soft dark-brown down (Roxb.), in long erect paniculate spikes, and probably is *Castanopsis indica*, A. DC.

15. *Q. coccifera*, Linn.; Sibthorp. Fl. Græca, t. 944; Reichenb. Fl. Germ. t. 643; Kotschy l. c. t. 29. — *Chêne kermès*, Fr. A shrub, sometimes a small tree, branchlets and young leaves with scattered stellate hairs. Leaves ovate or oblong-ovate, dentate with spinescent teeth, small, firm, coriaceous, glabrous, shining, dark green, with prominent reticulate veins and indistinct lateral nerves. Male flowers distant, in lax pendulous catkins, perianth 2-6-fid; stamens 2-6, anthers glabrous, apiculate; styles subulate, recurved. Fruit solitary, sessile on the previous year's wood, scales of cup connate at the base, upper part free, linear, reflexed, the innermost scales erect. Forms large extent of low brushwood on dry hills in the Mediterranean region, used as fuel, the bark for tanning; a Coccus which lives on this species was formerly collected and used largely as a dye.

Q. calliprinos, Webb; DC. Prodr. xvi. ii. 54.—Syn. *Q. pseudococcifera*, Hook. Trans. Linn. Soc. xxxiii. 381, not Desf.; *Chêne garrigue*, Fr.—is supposed to differ from *Q. coccifera*, by oblong leaves with cordate base, the teeth rarely spinescent, and a larger cup with longer but not spinescent scales; but these characters are not constant, and there are intermediate forms, so that possibly they may eventually be regarded as one species only. Mediterranean region and Western Asia to the borders of Mesopotamia. Often a low shrub only, but where protected grows into a stately tree. The famous Oak of Mamre, called "Abraham's Oak," belongs to this species; Hooker (l. c. t. 36) gives a sketch of it, and states that this species is by far the most abundant tree throughout Syria, covering the rocky hills, of Palestine especially, with a dense brushwood of trees 8-12 ft. high, branching from the base, thickly covered with small evergreen rigid leaves and bearing acorns copiously, which like the cup are exceedingly variable in shape.

16. *Q. annulata*, Smith.—Tab. LXV.—DC. Prodr. xvi. ii. 100.—Vern. *Brân, bren, banni, indri*, Pb.; *Pharonj, phanât, phulant*, Kamaon.

A large or middle-sized evergreen tree, nearly glabrous, buds glabrous, shining, ovoid, often more or less distinctly 4-sided, the scales imbricate all round or arranged in four vertical rows. Leaves coriaceous, glabrous and shining above, clothed beneath while young with grey short silky pubescence, lanceolate-oblong with an unequal-sided base, acuminate, lower half entire, upper half with sharp cuspidate and somewhat curved serratures, main lateral nerves undivided, 10-14 pair; blade 3-6, petiole $\frac{1}{2}$ -1 in. long. Male flowers in lax slender drooping catkins, bracteoles lanceolate, twice the length of perianth, hairy, perianth of 5 lanceolate segments. Female flowers sessile, 2-3 on short axillary peduncles, scales of cupule more or less connate into 2-3 concentric sheaths, the outer often 5-lobed, styles 4, broad and short, recurved. Fruit solitary or in pairs, on short stout peduncles, cup hemispherical, consisting of 4-8 concentric grey velvety belts, the inner entire, the outer obtusely dentate, acorn short ovoid, glabrous, shining, the lower half enclosed in the cup.

Q. semiserrata, Roxb. Fl. Ind. iii. 641; Wight Ic. t. 211, from Silhet, is probably this species; the description and the drawing (Ill. in Hb. Kew, 2392) agree, with one exception; the gland is cylindric and four times longer than the cup. Nothing is known regarding the male flower, and I have not seen authentic specimens. It is a common tree in Burma, where it is called *Thitcha*. *Q. velutina*, Lindl., is probably the same species.

Valleys of the outer Himalaya, ascending to 5000 ft., here and there on the Jhelam, Chenab, Ravi, Bias, and Sutlej, more common in Garhwal and Kamaon, Nepal, Sikkim, Bhutan, Kasia hills. Generally on warm dry slopes, often gregarious and associated with *Q. incana* near the lower limit of that tree. These two species form coppice-woods in the Kangra valley with standards of *Albizia stipulata* (Oï). Fl. March, June; the fruit ripens Aug. to Oct. Attains 60 ft. with a straight erect trunk 5-6 ft. girth. Growth slow. Bark dark grey, rough with transverse deep and short thick-edged fissures. Wood similar to that of *Q. incana*, but less valued.

17. *Q. lamellosa*, Smith; Wall. Pl. As. rar. t. 149; Hook. f. Ill. Him. t. 20.—Vern. *Shalshi*, *pharat-singhali*, Nepal.

A large tree, with thick branchlets, and short subglobose leaf-buds, the scales spirally arranged. Leaves firm, coriaceous, white, waxy beneath, and with matted deciduous pubescence, oblong-lanceolate or elliptic, cuspidate-serrate, main lateral nerves 20-25 pair, like the midrib impressed on the upper side and very prominent beneath, joined by transverse veins at right angles, blade 6-12 in., petiole $1\frac{1}{2}$ in. long. Fruit in short pedunculate axillary spikes, cup while young of few, when full-grown of numerous (10-16) concentric belts, hemispherical, attaining 2 in. diam., acorn velvety, subglobose, more than half enclosed in the cup. *Q. paucilamellosa*, Alph. DC. Prodr. xvi. ii. 101, is not specifically distinct, the number of concentric belts is larger in full-grown cups.

Nepal, Sikkim (5000-8000 ft.) One of the commonest trees about Darjiling. Bhutan. Fl. in spring; the fruit ripens in November. Attains 80-120 ft., with a tall straight trunk 40-60 ft. high, and 9-15 ft. girth.

18. *Q. spicata*, Smith; Wall. Pl. As. rar. t. 46.—Syn. *Q. squamata*, Roxb. Fl. Ind. iii. 638; Wight Ic. t. 213. Vern. *Dandwa singali*, *phaco singhali*, *arkaula*, Nepal; *Bara chakma*, Silhet; *Thitcha*,* Burm.

A large evergreen tree, with thick, glabrous branchlets. Leaf-buds open, scales imbricate, lanceolate, cuspidate. Leaves entire, glabrous, shining, coriaceous, thick and firm, elliptic-lanceolate or oblanceolate, narrowed into a short petiole, 6-9 in. long, main lateral nerves 12-18 pair. Flowers in erect terminal and axillary spikes, forming terminal panicles. Male and female flowers on distinct spikes, and often on separate trees. Male flowers in sessile globose or elongated tomentose heads, supported by 3 lanceolate bracts, the middle one longer than the lowest flower, with subulate bracteoles between the flowers. Perianth-segments 5-6, stamens 10-12, surrounding a tomentose rudimentary ovary. Fruit in sessile clusters of 3-5, arranged in erect spikes with woody rachis, 9-12 in. long. Cup with adpressed imbricate scales, enclosing the acorn while young, afterwards flat-concave, supporting the base of the subglobose acorn, adjoining cups generally connate. Acorn hard, $\frac{3}{4}$ -1 in. diam.

Nepal, Sikkim (2000-4000 ft.), Bhutan, Assam, Kasia, Chittagong, Burma, Indian Archipelago. Fl. March, April; the fruit ripens Sept.-Oct. of the second year.

Other common Indian evergreen Oaks of this section with entire leaves and spicate fruit, are: 1. *Q. fenestrata*, Roxb., glabrous; scales of cup imbricate, nearly connate, apex free, spreading. East Bengal, Burma. Wood hard, warps much, medullary rays very broad. 2. *Q. dealbata*, Hook. f. & Th. (probably identical with *Q. acuminata*, Roxb.), leaves white-hoary beneath, scales of cup imbricate. East Bengal, Burma. 3. *Q. lappacea*, Roxb., with pubescent membranous or thinly coriaceous leaves, upper half of cup-scales free, spreading. East Bengal, Burma. 4. *Q. lanceifolia*, Roxb., glabrous; cup with concentric bands, without scales, enclosing $\frac{1}{2}$ of acorn. A species differing from most other Oaks by a ruminant albumen, and by the structure of the wood, which has very fine medullary rays. East Bengal, Burma.

2. CASTANOPSIS, Spach.

Evergreen trees with entire, rarely serrate coriaceous penniveined leaves. Flowers in erect spikes, arranged in terminal panicles, the female flower-spikes generally terminal, the male spikes lateral and more numerous. Male flowers fasciculate; perianth 5-6-lobed; stamens generally twice as many, surrounding a hairy rudimentary ovary; anthers small, 2-celled, cells connate. Female flowers 1-3, included in an involucre of numerous scales. Limb of perianth of 6 liseriate segments. Ovary 3-celled, with 2 ovules in each cell; styles 3, rarely more, linear, stigmatose at the apex. One to three 1-seeded nuts entirely included in the enlarged capsuliform subglobose involucre, which is coriaceous, outside thickly covered with sharp, often branching, prickles, and splits open irregularly. Cotyledons farinaceous.

* *Thitcha* is the Burmese name also for *Q. fenestrata*, *lappacea*, *semiserrata*, and other Oaks.

Leaves entire, glabrous; involucre tomentose, with stout stellate and branching spines	1. <i>C. tribuloides</i> .
Leaves serrate, tomentose beneath	2. <i>C. indica</i> .

1. *C. tribuloides*, Alph. DC.; Prodr. xvi. ii. 111.—Syn. *Quercus armata*, Roxb. Cor. Pl. t. 296; Fl. Ind. iii. 640; Wight Ic. t. 770. *Q. ferox*, Roxb. l. c. 639; Wight Ic. t. 218. Vern. *Tumari*, *katonj*, Kamaon; *Kanta singar*, Assam; *Singhara*, Tipperah; *Kyantsa*, Burn.

A large evergreen tree, youngest shoots slightly pubescent, leaf-buds open, with erect lanceolate scales. Leaves entire, firm-coriaceous, glabrous, shining, pale beneath, lanceolate, 3-6 in. long, narrowed into short petiole, main lateral nerves 8-12 pair. Flowers in erect paniculate pubescent spikes, male and female flowers on distinct spikes, but generally in the same panicle. Male flowers sessile, solitary, or 3-5 together, in small clusters; perianth of 6 segments; stamens 12, on long filaments, surrounding a tomentose rudimentary ovary. Styles long, linear, erect. Fruit on long erect spikes, with woody rachis; acorn ovoid, completely enclosed by the thorny involucre, which is grey-tomentose, and thickly set with stout stellate and branching spines, each about $\frac{1}{2}$ in. long. Cotyledons ruminated.

South-east Kamaon, near the right bank of the Sarla river, between 2000 and 6000 ft. Nepal, Sikkim (4000-7000 ft.), Bhutan, Kasia, Chittagong, hills in Burma above 3000 ft. Fl. April, May; the fruit ripens in autumn of the second year. Wood hard, weight 62 lb.; in Nepal large mortars and pestles for grinding grain are made of it, and it is a favourite wood for carpenters' work.

2. *C. indica*, Alph. DC.; Prodr. xvi. ii. 109.—Syn. *Castanea indica*, Roxb. l. c. 643.

A middle-sized evergreen tree, current year's branchlets and under side of leaves rusty-tomentose, leaf-buds open, scales lanceolate. Leaves subsessile or short-petiolate, elliptic or elliptic-lanceolate, cuspidate-serrate, 6-9 in. long, main lateral nerves 15-20 pair. Flowers in erect paniculate tomentose spikes, male and female flowers generally in distinct spikes, but in the same panicle. Male flowers sessile, in rounded bracteate clusters; perianth of 6 segments; stamens 12, filaments long slender, surrounding a tomentose rudimentary ovary. Female flowers solitary, or 2-3 in one cup, often with short stamens; styles linear, erect, the ends spreading. Fruit in erect spikes, with a thick woody rachis. Acorns often 2 in one cup, which encloses them completely, and is thickly set with fasciculate prickles about $\frac{1}{2}$ in. long. Cotyledons not ruminated.

Nepal, ascending to 4000 ft. Sikkim, Terai, Assam, Kasia, Chittagong. Fl. Aug.-Nov.; the fruit ripens in the following autumn. The seeds are eaten in Silhet, and are said to taste like inferior filberts.

Two genera, *Fagus* and *Castanea*, important as forest-trees in Europe, are allied to the Indian *Castanopsis*. In both, the involucre encloses several female flowers with linear styles, and is enlarged and hardened during maturity into a coriaceous capsule-like covering, which splits into 4 valves, covered, in the case

of *Fagus*, with soft bristles, enclosing a three-cornered nut, and in the case of *Castanea* with numerous sharp stellate prickles, enclosing a rounded nut. The male flowers of *Fagus* are in pendulous heads, those of *Castanea* in long slender erect spikes, having at their base a few involucre with female flowers. The cotyledons of *Fagus* are oily, raised aboveground, and become green when germinating. Those of *Castanea* are farinaceous, and remain underground.

Fagus sylvatica, Linn.; Hook. Stud. Fl. 344, the *Beech*—*Buche*, Germ.; *Hêtre*, Fr. A large, not very long-lived, deciduous tree, with dense shady foliage, under which no grass, and very few shade-enduring shrubs, such as the Holly, will grow, but which enriches the soil. The tree bears a large amount of shade overhead, and forms a most useful mixture with Oak and Scotch Fir, the Beech being cut at 80-100 years, and the Oak and Fir being left to attain twice that age. The wood is white when fresh cut, turning into a reddish-grey when dry; it has no distinct heartwood. The pores are fine, numerous, uniformly distributed; the medullary rays numerous, not long, often interrupted, of two classes, narrow and broad, appearing on a vertical section as shining plates. An excellent fuel, but not durable, and apt to warp and split. Weight, 41-52 lb. The wood is used for tools, furniture, wooden shoes, the keels of vessels; and in France, North Italy, and Austria, after impregnation with sulphate of copper, for railway-sleepers. The wood of clean stems which have grown up in compact masses splits well, and is made (in North Italy, Cansiglio forest near Treviso) into sieve-frames and similar articles. The Beech does not attain the same age as the Oak, but it generally grows more rapidly. The tallest tree I have seen is a renowned beech in the Steigerwald, near Kloster Ebrach, Franconia; 150 ft. high, stem 90 ft. to the first branch, 15 ft. girth at foot, and 9 ft. at the first branch, supposed to be 300 years old. Beeches exceeding 20 ft. girth are not uncommon in England. Its home is Western, Central, and South Europe, not in Greece, and it is common on the Taurus and Caucasus (Talış and Elburg). Its north limit passes through the south of Norway and Sweden; it is not found indigenous in Russia north of the 52d degree north latitude. In South Europe the Beech is only found at a considerable elevation, and sometimes forms the upper limit of forest vegetation. On the mountains of Corsica, for instance, the vertical regions are as follows: 1°. Evergreen brushwood (*Maki*); 2°. *Pinus Pinaster*, *Quercus Ilex*, and *Castanea vesca*; 3°. *Pinus Laricio*; 4°. *Abies pectinata* (the Silver Fir); and 5°. the *Beech*. The tree has a marked partiality for limestone and chalk; well-known instances are the fine beech-forests of Buckinghamshire, the luxuriant growth of the tree on the chalk cliffs of Moen and Rügen, and the magnificent forests on Muschelkalk and Lias in Central Germany.

Castanea vulgaris, Lam.; DC. Prodr. xvi. ii. 114.—Syn. *C. vesca*, Gaertn. *Sweet Chestnut*—*Châtaignier*, Fr.; *Edelkastanie*, Germ. A large, long-lived, deciduous tree, of rapid growth while young, more rapid than the oak, and attaining a gigantic size, stems 30-40 ft. girth and certainly 1000 years old not rare in South Europe, and much larger stems being on record—e.g., the renowned chestnuts of the *Ætna*, two trees, sound and vigorous, 60-80 ft., and one (*castagno dei centi cavalli*) hollow, in 5 pieces, more than 190 ft. girth. Sapwood white, heartwood dark-brown, the annual rings distinctly marked by a belt of large pores close together (spring wood), surrounded by an outer belt of more compact wood with very fine pores, generally arranged in wavy lines. Medullary rays very fine, numerous, which distinguishes chestnut from oak timber at a glance. Weight, 37-54 lb. Old trees have often ring-shakes and central hollows, and the timber is not so durable as that of oak; in the south of Europe it is used for building, furniture, and cask-staves; but the legends of the roofs of old churches and other buildings made of chestnut timber, in France and Eng-

land, are mythical—wherever examined, such timber has been found to be oak. It coppices vigorously; along the Vosges it is grown for vineyard poles, in Kent and Sussex for hop-poles. In the south of Europe the chestnut forms extensive forests more or less cultivated, the fruit being its most valuable produce, forming an important article of food for the inhabitants of the mountainous regions of Central France, Spain, Corsica, Italy, and Greece. It is not certain whether its original home is in Asia Minor and Greece, or whether it is also indigenous in Italy and Spain. In England it was introduced at an early age. The tree has been grown in the N.W. Himalaya, and should be encouraged as an important food-producing tree, wherever it bears fruit.

3. *CARPINUS*, Tournef.

Deciduous trees; buds elongate, closed, with imbricate scales. Leaves membranous, serrate. Male flowers in drooping sessile lateral hairy catkins; perianth none; stamens 6-12 on short filaments, attached to the base of the broad-ovate scales; anther-cells distinct, stipitate, hairy at the tip. Female flowers in slender drooping terminal spikes, in pairs in the axils of deciduous linear-lanceolate bracts, each flower supported by a 3-lobed or undivided persistent involucre, which is enlarged in fruit. Ovary 2-celled, limb of perianth dentate; styles 2, erect, filiform. Fruit 1-seeded, enclosed in a hard pericarp, 6-12-ribbed, crowned by the perianth-teeth, and often by the persistent styles, small, many times shorter than the enlarged membranous 3-7-nerved reticulate involucre bracts.

Leaves ovate-lanceolate, long-acuminate, duplicate-serrate . . . 1. *C. viminea*.
Leaves ovate-oblong, acute, serrate, teeth simple, subulate . . . 2. *C. faginea*.

1. *C. viminea*, Wall., Pl. As. Rar. t. 106; DC. Prodr. xvi. ii. 127. Vern. *Charkhri*, *kār*, Pb.; *Pumne*, *goria*, *chamkharak*, N.W.P.

A moderate-sized tree with slender drooping verrucose branches; leaf-buds cylindric, scales shining, fringed with short soft hairs. Leaves glabrous, ovate-lanceolate, with large serratures serrulate on the outside, long-acuminate, acumen linear, serrate; blade 3-4 in., petiole slender, hairy, $\frac{1}{2}$ in. long. Involucre bracts $\frac{3}{4}$ in. long, 3-5-nerved, lanceolate, unequal-sided, the broad half dentate with large obtuse teeth, the narrow half entire, often with a short lobe near the base; fruit 1-2 lines long (2-seeded, Lindley in Wall. l. c.)

Himalaya, extending west to the Ravi, between 5000 and 7000 ft. Kasia hills. Male catkins appear before the leaves, female fl. with the leaves in spring. Fr. June-Sept. Often found near water. Bark thin, grey. Wood yellowish-white, hard, heavy, believed to be durable. Growth moderately slow, 10 rings per inch.

2. *C. faginea*, Lindley.—Tab. LXVI.—Wall. Pl. As. Rar. ii. 5. Vern. *Shirāsh*, *imar*, Pb.; *Gish*, N.W.P.

A moderate-sized tree; branchlets and petioles soft-tomentose. Leaves pubescent when young, glabrous afterwards, elliptic-oblong, acute, short-petiolate, serrate with simple subulate serratures, 3-5 in. long. Involucre bracts $\frac{3}{4}$ in. long, pubescent, 4-6-nerved, triangular, very unequal-sided, the

midrib close to one side, which is entire, forming the basis of the triangle, the other two sides coarsely dentate.

On the Bias between 4000 and 5500 ft., on the Sutlej at 6000, in Garhwal, Kamaon at 7000 ft. Nepal and Bhutan. Bark dark brown, smooth, lightly wrinkled. Fl. March, April; fr. July, Aug.

Two species of *Carpinus* are in Europe. 1°. *C. Betulus*, L.; Hook. Stud. Fl. 345, the *Hornbeam*—*Charme*, Fr.; *Hainbuche*, German, with duplicate-serrate leaves, 3-lobed involucre bracts, the middle lobe longer; a moderate-sized slow-growing tree, with great powers of reproduction. Coppices vigorously, and makes useful pollards on dry grass-land. Is not injured by frost, and is often seen in Germany fringing the edges of the Beech-forest along the bottom of valleys, where the Beech would suffer. The wood is white, heavy (39-51 lb., Nördlinger), and is marked by numerous medullary rays, which on a vertical section are 3-4 in. high. Great heating power, yields a better fuel than even the Beech. Used mainly as fuel; tool-handles, the teeth of cog-wheels, and screws of wood are made of it. Central and Eastern Europe, very common in Northern and Eastern France, indigenous in the South of England, and of Sweden. Western Asia as far east as Asterabad, south of the Caspian. In Central Europe commonly associated with the Beech.

2°. *C. duinensis*, Scop.—Syn. *C. orientalis*, Lam.; Reichenb. Ic. Fl. Germ. t. 634. A small tree or large shrub, with (generally) small duplicate-serrate leaves and ovate 6-8-nerved involucre bracts. Italy, Dalmatia, Hungary, Greece, Turkey, Asia Minor, Caucasus, Persia, and Turkestan.

Ostrya carpinifolia, Scop.—Syn. *O. vulgaris*, Willd.; Reichenb. Fl. Germ. t. 635—the *Hop Hornbeam*, is a moderate-sized tree, with leaves similar to those of the Hornbeam, from which it is distinguished by the involucre bracts, forming a membranous oval bag enclosing the fruit. Central and Eastern Mediterranean region, not in Spain, and in France only near Nice, and on the coast a little farther west. Forests of it in Greece. Asia Minor, Armenia.

4. CORYLUS, Tourn.

Deciduous shrubs or small trees; buds closed, scales imbricate; branchlets and petioles generally with glandular hairs. Male flowers in drooping cylindrical hairy catkins, catkins fasciculate, or 2-3 on a common peduncle, perianth none, stamens 4, attached to the inside of a broad scale, to the edges of which are attached two smaller scales; anther-cells distinct, with a tuft of hairs at the tip, on short, often partially connate filaments, appearing sometimes as 8 stamens with 1-celled anthers. Female flowers in small sessile ovoid lateral bud-like spikes, with imbricate scale-like bracts, the flowers in pairs in the axils of the upper bracts, each flower enclosed by two or more minute scales (involucre) cleft into numerous narrow lobes. Limb of perianth minutely toothed. Ovary 2-celled, 1 ovule in each cell; styles 2. Fruit usually clustered, each consisting of a hard usually 1-seeded nut, enclosed in the enlarged involucre (scales), which forms a leafy entire or 2-leaved sheath, mouth lobed, lobes sometimes spinose. The oily cotyledons of the germinating seed remain underground.

Leaves ovate-oblong; lobes of involucre spinose; stamens 4,
anthers 2-celled, cells distinct, parallel
Leaves obovate; lobes of involucre not spinose; stamens 8,
anthers 1-celled

1. *C. ferax*.

2. *C. Columna*.

1. *C. ferox*, Wall. Pl. As. Rar. t. 87; DC. Prodr. xvi. ii. 129.

A small tree, with elongate silky buds, the outer scales erect. Leaves pubescent when young, ovate-oblong, acuminate, closely serrate with unequal cuspidate serratures; blade 4-5 in., petiole hairy, $\frac{1}{2}$ in. long. Catkins fasciculate, scales obovate, acute, bearing at their base 4 subsessile stamens, each with 2 distinct contiguous anther-cells. Fruit in clusters of 3-6, involucre villous, thick, almost fleshy, with pinnatifid lobes, the divisions terminating in slender spines $\frac{1}{2}$ in. long. Pericarp hard thick.

Nepal, Sikkim (8000-10,000 ft.) Fl. Sept. Oct. Wood light, compact, and of a pale colour.

2. *C. Colurna*, Linn.—Syn. *C. Jacquemontii*, Dne. in Jacq. Voy. Bot. t. 160. *C. lacera*, Wall. Vern. Urni, Jhelam; *Winri, wiri, warai, wūriya, thangi, thankoli*, Kashmir and Chamba; *Shūrli, sharoli, geh, Sutlej*; *Kapasi, bhotia, badām*, N.W.P.

A small or moderate-sized tree; buds short, nearly hemispherical. Leaves glabrous, obovate, acuminate, base cordate, unequally serrate, main lateral nerves 10-12 pair, each nerve terminating in a more or less distinct lobe; blade 5-6, petiole 1-1 $\frac{1}{2}$ in. long. Catkins fasciculate, scales obovate, acute, bearing along the midrib eight 1-celled anthers on short often more or less connate filaments. Fruit in clusters of 2-3, involucre subcoriaceous, double, the inner sheathing, with numerous elevated ribs, cleft into linear-lanceolate serrate lobes with glandular hairs; the outer of several lacinate bracts.

N.W. Himalaya, 5500-10,000, ascending in places to 10,500 ft., on the Sutlej as far as Pangri on the right, and Poari on the left bank. Also in South-East Europe and Asia Minor. Gregarious, often forming extensive thickets, not rare near the upper limit of tree vegetation, and sometimes associated with *Parrotia*. Often cultivated. Hardy in England. Fl. early in spring; the fruit ripens in July, August. Generally a small tree with short trunk, but often (particularly cultivated specimens) attains 40-50 ft., with an erect somewhat gnarled trunk, 6-7 ft. girth. Growth apparently slow, 10-12 rings per inch of radius. Bark thin, brownish-grey, very rugose with numerous dark wrinkles, equal in width to the intervening low rounded ridges, the ridges divided by short cross-fissures into long scales, which in old trees often detach themselves at the base, and exfoliate upwards, like the bark of *Esculus indica*. Wood compact, not hard or heavy, with fine medullary rays, considered a good timber—(have old trees a distinct, dark-brown heartwood?) The kernels are as good as English hazel-nuts, and form an important article of food in some parts of the hills. In the bazars of the Panjab plains they are sold under the name of *findak* for medicinal purposes. They are imported into England from the Levant as Turkey nuts.

C. Avellana, Linn.—Hook. Stud. Fl. 345, the common *Hazel*—*Hasel*, German; *Coudrier*, French, is a shrub with short-petiolate broadly ovate or rotundate leaves, hairy while young, and a single palmately-lobed involucre. Europe, Caucasus, Armenia, and Asia Minor. Ascends to 5000 ft. in Tyrol. The male catkins are formed in autumn, and open very early, between Jan. and April, long before the leaves are out. The Hazel is common in mixed coppice-woods in England, the North of France, and some parts of Germany. It requires a good

deal of light, but thrives well under standards of Oak, Birch, and Ash. Makes excellent hoops. No heartwood, medullary rays broad, pores fine.

ORDER LXXIII. MYRICACEÆ.

Shrubs or trees, mostly aromatic, with alternate simple, exstipulate, generally serrate, coriaceous leaves with a prominent midrib and often resinous dots beneath. Flowers monoicous or dioicous, the male and female in catkins or spikes. Male fl.: Stamens 2-16, in the axil of lateral bracts, sometimes with 2 or more lateral bractlets; anthers 2-celled, the filaments often connate at the base. Female fl.: Perianth none; ovary 1-celled with 1 basal ovule, in the axil of a lateral bract, generally surrounded by 2-4 more or less adhering bracteoles; stigmas 2, sessile. Fruit a hard-shelled, 1-seeded nut, clothed with a fleshy or waxy pericarp. Seed exalbuminous, cotyledons fleshy, radicle superior.

1. MYRICA, Linn.

(Characters those of the Order.)

1. *M. sapida*, Wall. Tent. Fl. Nep. t. 45.—Vern. *Kaphal*, *kāephal*, N.W. Himal.; *Kobusi*, Nepal.

A moderate-sized (always?) evergreen dioicous tree, the current year's branchlets tomentose or pubescent. Leaves with a faint pleasant aromatic smell when rubbed or broken, alternate, lanceolate or oblanceolate, narrowed into a short petiole, those on older trees 3-5 in. long, entire, coriaceous, on the under side pale or rust-coloured, with numerous black resinous dots; petiole and midrib pubescent; main lateral nerves anastomosing by prominent intramarginal and reticulate veins. Leaves on young plants and shoots 5-8 in. long, membranous, with large and sharp serratures, and more numerous, prominent, main lateral nerves. Male catkins cylindric, $\frac{1}{2}$ in. long, sessile in lax axillary drooping racemes, as long as leaf or shorter. Female flowers in slender axillary spikes, styles red. Fruit a sessile ovoid drupe, several on axillary peduncles, $\frac{1}{2}$ in. long, tuberculate, pubescent while young, glabrous when ripe, with scanty reddish pulp, which is composed of cylindric or clavate fleshy hairs filled with red juice mixed with fine dry hairs or fibres. Nut rugose, pitted.

Himalaya, outer ranges, from 3000 to 6000 ft., extending north-west to the Ravi, but scarce beyond the Sutlej. Assam, Kasia hills. Not gregarious in the N.W. Himalaya, generally in mixed forests. The leaves are renewed in April and May; flowers generally in Oct.-Dec., the fruit ripening in May. It has, however, been found in flower in spring. Attains 30 ft., with a thick erect trunk. Bark dark- or brownish-grey, with deep vertical wrinkles. Wood pale-brown, heavy, compact, and hard. The fruit is eaten, and it is sold in the bazars of the hills, the pulp is scanty, but with a pleasant aromatic sweet and acidulous taste. The bark is the most valuable product of the tree; it is largely exported to the plains, used as an aromatic stimulant, and externally as a plaster against rheumatism (Pharm. Ind. 217).

Wallich identified this with a Japanese tree described by Kämpfer (Amern. Exot. 798) under the name of *Jubai* (vulgo *Jamma momu*). Hooker, Bot. Mag. t. 5727, is of opinion that it may be a variety of *M. Nagi*, Thunb. (*Na*, vulgo *Nagi*, *tsikkura siba*, Kämpfer Am. Exot. 773, 874), to which he refers as a synonym *M. integrifolia*, Roxb. Fl. Ind. iii. 765; Wight Ic. t. 764, 765, a shrub or tree of Silhet, the Kasia hills, and Assam, with an ovoid drupe, the size of a prune, yellow when ripe, which ripens in May, is too sour to be eaten raw, but is pickled and used as a condiment. *M. Nagi*, Thunb., is synonymous with *M. rubra*, Sieb. et Zucc.; Benth Fl. Hongkong. 322; it is a large tree, not uncommon on the hills in Japan (vern. *Jamamo Noki*), and much cultivated on account of its deep-red purple acidulous fruit in Japan and China, which is eaten raw and cooked. The characters by which these three species are generally distinguished are as follows: male catkins simple, not paniculate in *M. Nagi*, paniculate in *M. integrifolia* and *sapida*, the partial catkins short, few-flowered, closely approximate in *M. integrifolia*, with the bracts larger, as long as or longer than the stamens. The number of stamens varies. Dr Hooker's view is probably correct, and when it is fully established, the North Indian tree must then be called *M. Nagi*, Thunb., with a wide range, from the Panjab to Japan, and from China to the sea-coast of Singapore and Borneo, where it grows as a shrub 12 ft. high.

Myrica Gale, Linn.; Hook. Stud. Fl. 347, *Sweet Gale*, or *Bog Myrtle*, is a deciduous gregarious aromatic shrub in peat-bogs, moors, and wet places of Britain, North and Central Europe, North Asia, and North America, which flowers before the leaves come out in April, May, and ripens its fruit (compact resinous spikes) in August.

The following, and probably several other species of this genus yield vegetable wax, which forms the outer covering of the fruit: 1. *M. cerifera*, L., *Bayberry* or *Wax Myrtle*, a small shrub of North America, shores of Lake Erie and sea-coast to Florida, with numerous small nuts encrusted with white wax. 2. *M. cordifolia*, L., the *Wax Myrtle* or *Candleberry* bush of dry sand-hills in South Africa and the Cape of Good Hope. Leaves ovate-dentate with cordate base, fruit $\frac{1}{2}$ in. diam. 3. *M. arguta*, Kunth., a monoicous evergreen shrub on the mountains of Venezuela and New Grenada, and the Andes of Ecuador, Peru, and Bolivia.

ORDER LXXIV. JUGLANDEÆ.

Trees, rarely shrubs, with alternate pinnate often aromatic leaves without stipules. Flowers monoicous, the male in lateral catkins, the female solitary, clustered in erect or drooping spikes. Male fl.: Stamens 3-10, inserted on lateral bracts, generally surrounded by 3-6 membranous scales; anthers 2-celled, filaments short. Female fl.: Perianth adnate to ovary, sometimes enclosed by foliaceous bracts, connate and cup-shaped at the base; ovary 1-celled with 1 erect ovule. Fruit a 1-seeded 2-valved nut, often incompletely 2- or 4-celled at the base, and enclosed by a coriaceous or fleshy pericarp, which remains attached to the nut or eventually separates from it. Seed without albumen, cotyledons fleshy, oily, sinuous or corrugated, 2-lobed, radicle short, superior.

Fruit a large woody nut, enclosed in a thick coriaceous-fleshy pericarp, which separates from it when ripe

1. JUGLANS.

Fruit small, enclosed in large foliaceous bracts, in drooping spikes; pericarp not separating from the nut

2. ENGELHARDTIA.

This small but remarkable family, which has great analogy with *Pistacia* among *Anacardiaceæ*, except the free ovary and curved embryo of the latter, contains, besides these two genera, the following: 1. *Carya*, inflorescence similar to *Juglans*, but male flowers fasciculate, and petals of the female flowers wanting; *C. alba*, Nutt., and several other species of this North American genus (hardy in England) furnish valuable timber, and yield the well-known *Hickory-nuts*. 2. *Platycarya strobilacea*, Sieb. & Zucc. (*Fortunea chinensis*, Lindl.), a tree of Japan and China (hardy in England), with the female flowers at the base of the male catkins, forming a cone when in fruit. 3. *Pterocarya fraxinifolia*, Spach, a tree of Armenia, the Caucasus, and North Persia (hardy in England), with 12 pair of serrate leaflets, the male catkins at the base of the female flower-spikes, which are long, lax, and drooping, the fruit with 2 broad lateral wings.

1. JUGLANS, L.

Aromatic trees. Leaves imparipinnate; petioles broad-based, leaving large scars on falling. Male flowers in lateral catkins from the axils of fallen leaves, on the previous year's wood. Perianth of 3-6 unequal lobes inserted on a lateral bract. Stamens 10-40, filaments free, very short. Female flowers solitary or several together at the ends of branches; calyx tubular, adhering to the ovary, 4-toothed, 4 small petals in the sinus between the teeth. Stigmas 2, more or less fleshy, fimbriate. Fruit with a thick coriaceous or fleshy pericarp, enclosing a hard woody, mostly irregularly-furrowed endocarp or nut-shell. Embryo sweet, edible.

1. *J. regia*, Linn.; Roxb. Fl. Ind. iii. 631.—*Walnut*—*Noyer*, French; *Wallnuss*, German. Sans. *Akshota*, *ākhota*. Pers. *Chārmaghz* (four brains or kernels), used in Kashmir and Afghanistan. Vern. *Akhrot*. Local names: *Ughz*, *vaghz*, Afghanistan; *Akhor*, *chor*, *krot*, *dūn*, Kashmir; *Kābotang*, *thānka*, Pb.; *Starga*, Ladak; *Kā*, Kunawar; *Akhor*, *chor*, *kharot*, *korot*, Jaunsar and Kamaon.

A large tree, youngest shoots velvety or with floccose pubescence. Leaflets elliptic-oblong, entire (rarely serrulate), subcoriaceous, glabrous, with tufts of hairs in the axils of nerves beneath, main lateral nerves prominent, 15-20 pairs; terminal leaflet largest, petiolulate, the lateral, 3-4 sometimes 5-6 pair, subsessile, nearly opposite, those near the base smaller; common petiole 6-12 in. long, glabrous or hoary. Male catkins appearing with the leaves in the previous year's axils and on the previous year's wood, sometimes in pairs, green, pubescent, cylindric, 2-5 in. long; bracts pedicellate, oblong, with 6 perianth-lobes and 10-20 stamens, the buds of the coming year's catkins being ready-formed in the leaf-axils. Female flowers 1-3, limb of calyx minute, indistinctly toothed, petals linear-lanceolate, green, varying in length, sometimes half the length of ovary. Fruit green, ovoid, glabrous, 2 in. long, enclosing a brown, irregularly-furrowed nut, which is 2-valved, acute at the upper end and divided by 2 thin coriaceous dissepiments into 4 incomplete cells, one dissepiment separating the 2 cotyledons, the other dividing them at the back into 2 lobes. Seed with 2 integuments, the outer yellowish brown, the inner white, very fine.

Of the varieties described in DC. Prodr. xvi. ii. 136, the following may

be mentioned. *α. tenera*, shell of nut thin, fragile. *β. belouchistana*, leaflets 2 pair, entire, the terminal leaflet 8-10 in. long. Beluchistan near Quetta (a few trees only, Stocks). *γ. kamaonia*, petiole rusty-tomentose, leaflets oblong-lanceolate, entire, 6-9 in. long, fruit pubescent, shell of nut thick and very hard. Kamaon and Jaunsar (cultivated, and wild on the head-waters of the Dharaghad, June 1873, D.B.)

Wild in many forests of the North-West Himalaya and in Sikkim; also, according to the generally received opinion, in trans-Caucasia and probably in Armenia. C. Koch, however (*Dendrologie*, i. 584), states that the tree is not wild in either of these countries or in Asia Minor, and suggests that its home may possibly be found in Central Asia. Cultivated in Afghanistan, Beluchistan, on the hills in the trans-Indus territory, at 5000-6000 ft. near villages; abundantly in Kashmir, in the North-West Himalaya between 3500 and 10,000 ft., both in the outer ranges and in the inner arid tract, in Nepal, Sikkim, and the Kasia hills. In Kunawar its upper limits are Spui on the right and Namgia on the left bank, and in Nubra it is cultivated up to nearly 11,000 ft. Grown and bears fruit in gardens in Peshawar, grows but does not bear fruit in Calcutta. Commonly cultivated in Europe and Western Asia. In Western Europe the Walnut is grown nearly to 58° N.L. in Ross-shire, but only in sheltered places. Near Edinburgh the tree grows with vigour, but ripens its fruit only in the finest and hottest summers (Selby, *British Forest Trees*, 44). On the east side of Europe it is found to 52°. It was known to the ancients, and Pliny states that it was brought from Persia (A. De Candolle, *Geographie Bot.* 393, 968). Leafless in winter, the new foliage comes out from Feb. to April, according to elevation, and the flowers appear about the same time. The fruit ripens July-Sept. Attains, under favourable circumstances, 80-100 ft. and a girth of 10-15, and not rarely of 20 ft. Instances of large trees are: 22 ft. girth at Sali on the Chenab at 8200 ft.; 28 ft. Kulu, Stewart; 17 ft. and 100 ft. high, Tutwa forest, Dharaghad, Jaunsar, D.B. Old trunks are often buttressed. In Ladak the trees have short trunks not exceeding 7-8 ft. girth, with a low rounded crown. Bark $\frac{1}{2}$ in. thick, silvery or dark grey, sometimes mixed with reddish brown. Sapwood greyish white. Heartwood brown or greyish brown, often veined with darker shades, darker near the centre. Weight, 40-48 lb. (Europe). Medullary rays short, moderately broad, numerous. Pores equal in size and uniformly distributed, solitary or in radial groups of 2-4, annual rings distinct; besides the annual rings, numerous minute concentric lines. The heartwood is very durable, works well and does not warp or split; it is a beautiful furniture-wood and polishes well; the principal use is for gun-stocks. It is also used for turning, and in Kashmir much of the lacquered ware is made of it. The bark is largely exported to the plains, and sold, under the name of *dandāsa*, to clean the teeth and strengthen the gums. It is also used (on the Bias) as a dye-stuff and in native medicine. The twigs and leaves are used as winter fodder, which, with hay, is often stored on the large boughs of the tree. On the Sutlej it is said that trees which are lopped for fodder will continue yielding fruit, provided they get rest every fourth year. The nut, however, is the most important product of the tree; that of the wild tree has a thick, extremely hard shell with a small kernel, which is rarely eaten: the cultivated varieties are numerous, one much valued in Kashmir is called *kaghazi* (paper-shelled). Where the tree is most commonly cultivated, in Kashmir, Pangi, and Kunawar, Walnuts form an important article of food. They are also exported largely to the plains, to Bengal, and the rest of India. Oil is made of them in Europe and in India. The outer covering of the fruit is employed as a dye in Kashmir; in Europe it is used for tanning, as well as the bark of the tree. The tree produces fruit at an early age. On the

Chenab and in Kunawar it does not ripen its fruit well at an elevation above 9500 ft. The wild Walnut merits cultivation as a forest-tree on account of its timber; when grown in compact masses it cannot be expected to produce much fruit, but the timber would probably prove one of the most valuable of the leaf-bearing trees of the North-West Himalaya, and it has the advantage of not being too heavy for floating. The tree, however, requires a rich and deep soil, and will probably not prove to be a rapid grower.

J. nigra, L., the *Black Walnut*, sometimes called *Black Hickory*, of North America, particularly in Ohio and Kentucky, south to Florida and Texas, has serrate, ovate-lanceolate, long-acuminate leaflets, and a spherical incompletely 4-celled nut. Wood beautifully veined, valued for furniture, heavier than that of *J. regia* (lighter according to Nordlinger, Techn. Eigensch. d. Holzes, 522).

J. cinerea, L., the *Butter-nut* of Canada and the Northern States, has oblong-lanceolate, downy leaflets, an oblong nut, 2-celled at the base.

2. ENGELHARDTIA, Leschenault.

Resinous trees or large shrubs. Leaves sometimes apparently paripinnate by the abortion of the terminal leaflet. Male flowers in cylindric lateral catkins. Perianth of 3-6 lobes, adnate to a lateral generally stipitate often 3-lobed bract. Stamens 4-12, anthers subsessile. Female flowers in long drooping bracteate spikes. Calyx adnate to the ovary with a 4-dentate limb. Petals none. Stigmas 2, sessile, linear, papillose. Bract cup-shaped, enclosing the flower, limb divided into 4 unequal segments, the inner rounded, often crenate, the three outer membranous, veined, generally oblong, the middle one longest. Fruit small, enclosed by the enlarged bract; pericarp thin, firmly adhering to the endocarp.

1. *E. Colebrookiana*, Lindl. in Wall. Pl. As. rar. t. 208.—Vern. *Timar rūkh*, Pb.; *Mowā, gobār mowā, bodāl mowā*, Kamaon; *Khusam*, Banda.

A large shrub or moderate-sized tree, the current year's branchlets tomentose or pubescent. Leaves generally approximate near the ends of branches, mostly imparipinnate, leaflets 3-5 pair, nearly opposite or alternate, shortly petiolulate, elliptic-oblong, obtuse or acute, base unequal-sided, subcoriaceous when full-grown, pubescent or tomentose when young, the upper side glabrous when full-grown, the under side tomentose or with minute round yellowish scales; main lateral nerves 10-15 on either side of midrib, joined by prominent reticulate and intramarginal veins. Male catkins numerous, 3-5 in. long, generally clustered at the base of the female spikes. Bract stipitate, more or less 3-lobed, bearing 4-5 oblong obtuse scales, one generally at the base, the others at the top or along the sides of the bract, and 6-8 sessile hispid mucronate anthers. A tuft of hairs, in the place of a rudimentary ovary, not rarely between the anthers. Female spikes pedunculate, 5-6 in. long, drooping, lax when in flower, cylindric, compact when in fruit, outer bracts in fruit spatulate-oblong, obtuse, the middle one 1-1½ in. long, the two lateral ones half that length, each with a prominent midrib, and reticulate veins, with minute round scales, glabrous or pubescent, the inner bract irregularly dentate, hispid with long stiff hairs.

Siwalik tract and outer North-West Himalaya, ascending to 6500 ft., common and often gregarious, covering large areas on dry hillsides in Kamaon and Garhwal, extending to the Chenab, but scarce west of the Jumna. Kalliangarh hills in the Banda district. Leafless during part of winter; the flowers appear with the young leaves in March and April, and the fruit ripens in May. Bark light or dark grey. Attains a girth of 4-5 ft. in North-West India.

Farther researches on the spot will probably show that this species is only a tomentose and small-sized variety of *E. spicata*, Blume Flora Javæ. t. 1, 5, of Nepal, Sikkin, East Bengāl, Burma, and the Indian Archipelago. In Java this is a gigantic tree, 150-200 ft. high, with pale-red, hard, and heavy wood, made into (solid) cart-wheels and gigantic cattle-troughs. The leaves are more glabrous, the leaflets more oblong and acuminate, petiolate or sessile, the female spikes are 12-20 in. with bracts 2 in. long, and the male catkins 4-8 in. long. The bracts of the male flowers often terminate in a mucro, and they are sometimes abnormally lengthened out into a 3-lobed bract, similar in appearance to the outer lobes of the female bracts. The scales attached to these bracts vary in size and shape, from linear-oblong to triangular, and the number of stamens in one flower is between 4 and 10. In the female flower the styles are sometimes bifid.

E. Roxburghiana, Lindl. in Wall. Pl. As. rar. t. 199—Syn. *Juglans pterococca*, Roxb. Fl. Ind. iii. 631—is difficult to identify. Roxburgh's figure exactly represents the habit and fruit of *E. spicata*, Blume, for which it is probably intended. Casimir De Candolle identifies it with that tree, but the representation and description of the male flower is entirely different. Roxburgh describes and figures (III. in Herb. Kew, 2395, copied in Pl. As. rar.) the male flower as consisting of 4 regular scales or sepals, with 3 stamens at the base of each, and in the plate these stamens surround what appears to be intended for a rudimentary ovary. The female flower-spikes also are erect, and not longer than the male catkins. I have seen no specimens at all corresponding to the plate, and probably there was a mistake in the original drawing. Wallich's specimens from Nepal marked *E. Roxburghiana*, agree with *E. spicata*, Blume. It seems remarkable that Wallich, who was acquainted with the tree, should have overlooked the error in the original drawing when publishing it in his Asiatic Plants. Roxburgh states that the bark of *Juglans pterococca* is thick, dark-brown, possessing much tannin, and is reckoned by the natives (of Silhet, where it is called *Bolas*) the best they are acquainted with for tanning.

ORDER LXXV. GNETACEÆ.

Shrubs, climbers, undershrubs, rarely trees, the branches articulated at the nodes. Leaves opposite (*Gnetum*) or rudimentary, consisting of a 2-lobed sheath (*Ephedra*). Flowers monoicous or dioicous, in heads or spikes. Male flowers consisting of 2-8 monadelphous stamens, enclosed in a 2-fid sheathing perianth; filaments connate into a fleshy column; anthers 1- or 2-celled (3-celled in the abnormal genus *Wettitschia*). Female flowers consisting of a naked ovule, enclosed by a sheathing or imbricate bract, and several integuments, one of which is often prolonged into a filiform appendix resembling a style. Fruit 1- or 2-seeded, enclosed in the more or less succulent, persistent fleshy bracts. Embryo in the axis of a copious albumen, with 2 foliaceous cotyledons, radicle superior.—Royle III. 347.

1. EPHEDRA, Tourn.

Shrubs or undershrubs with nodose stems, and articulate opposite or whorled branches. Wood analogous in structure to the wood of conifers, composed of rays and wood-cells with discs. Leaves reduced to a membranous sheath with 2 opposite, sometimes linear lobes. Flowers dioicous, rarely monoicous, in terminal and lateral short, bracteate, sessile or pedunculate spikes, opposite in pairs or whorled. Male flowers in the axils of opposite bracts, forming an ovoid 4-20-flowered spike; anthers 2-10, two-celled, opening by pores at the top. Female spike of 2 flowers, rarely 1, enclosed by a membranous bifid or bipartite sheath, surrounded at the base by numerous imbricate bracts. Seeds two, flat on the inner, convex on the outer face, rarely 1 seed only.

Branches erect, internodes 1-2 in. long; anthers 6-10, stipitate; tube of inner sheath of female flowers short, included within the outer bracts, bifid, lobes exserted

1. *E. vulgaris*.

Branches slender, flaccid, sometimes scandent, internodes 1-4 in. long; anthers 2-5, sessile; tube of inner sheath of female flowers exserted, truncate or indistinctly 2-lobed

2. *E. Alte*.

1. *E. vulgaris*, Rich.; DC. Prodr. xvi. ii. 354.—Syn. *E. monostachya*, and *distachya*, Linn.; Reichenb. Ic. Fl. Germ. t. 539. Vern. *Asmānia*, *būshūr*, *būtshūr*, *chewa*, Pb.; *Khandū*, *khanna*, Kunawar; *Tse*, *teapatt*, *trano*, Ladak.

A small rigid shrub, branches green or brownish, cylindric, with numerous raised scabrous lines, internodes 1-2, sometimes $2\frac{1}{2}$ in. long, sheaths yellow or brown, with a white membranous edge and 2 acute teeth, shorter than sheath. Male spikes yellow, subsessile, in lateral or terminal, often whorled clusters; anthers 6-10, the inner ones stipitate. Female spikes lateral or terminal, in pairs or whorled clusters, subsessile or short-pedunculate; tube of inner sheath short, included within the outer bracts, 2-fid, lobes exserted. Fruit ovoid, succulent, sweet, pale- or bright-red when ripe, $\frac{1}{4}$ in. long, seeds 2.

Dry stony hills, Afghanistan and Beluchistan, inner arid and intermediate Himalaya, Jhelam, Chenab, and Sutlej, between 7800 and 12,800 ft. (Urn the lower limit in Kunawar), West Tibet to 16,600 ft. (Stewart), inner Kamaon and inner Sikkim, and adjoining parts of Tibet, ascending to 16,000 ft., South Europe, North Africa, Western Asia, Caucasus, Siberia. Fl. April-June, later at high elevations; the fruit ripens Aug.-Oct. At high elevations, often not more than a few inches high, lower down attains 2-4 ft., with woody, often gnarled, stems, and numerous, opposite or whorled, straight erect, and often tuberculate branches. Bark grey, rugose, inner substance fibrous, brown, very tough. Wood whitish-yellow. The fruit, which looks pretty, clustered on the dark-green branches, is very sweet, and is eaten in some places—e. g., on the Sutlej. The branches are browsed by goats, the Yak does not touch them. In the treeless parts of Ladak the woody roots and stems are used as fuel.

2. *E. Alte*, C. A. Meyer.—Tab. LXIX.—Versuch einer Monographie d. Gattung *Ephedra*, St Petersburg, 1846, 75.—Syn. *E. ciliata*, Fischer

et Meyer. Arab. *Alte*. Vern. *Kuchan*, *nikki* (small), *kūrkan*, *bratta*, *tundala*, *lastūk*, *nangarwal*, Ph.

A shrub with slender flaccid, generally whorled branches; branchlets often filiform, with numerous raised longitudinal lines, often rough with short hairs, internodes 1-4 in. long, sheaths very short, with two triangular or linear teeth longer than sheath, often prolonged into narrow linear leaves. Male spikes sessile, in lateral or terminal, often whorled clusters; anthers 2-5, sessile. Female spikes pedunculate, solitary or in pairs; tube of inner sheath exserted, truncate or indistinctly 2-lobed. Fruit ovoid, succulent, tasteless, $\frac{1}{4}$ in. long, red when ripe.

Plains of the Panjab and Sindh, ascending in the Salt range to 3000 ft. Afghanistan, Persia, Arabia, Aden, Sinai. Madden, As. Soc. Journ. xvii. i. 404, mentions an *Ephedra* in Rajputana (Vern. *Phāk*, generally the name of *Calligonum polygonoides*); if an *Ephedra*, it probably is this species. Somewhat gregarious, forming dense clumps of low brushwood in the most arid, sandy or stony places; branches brown or somewhat glaucous, often scandent on other trees. Fl. March, April (sometimes in October); the fruit ripens in May, and is often long persistent. Bark brown, bunches of stem and branches are sometimes used for cleaning brass dishes.

E. alata, D^{ne}; DC. Prodr. 358, is a much larger shrub, 9-10 ft. high, with stiff erect branches, marked by having bracts and sheath of female flowers with a broad white membranous margin, the inner sheath of the female flowers nearly 2-partite to the base, and 3-8 subsessile anthers on a long-exserted column. Deserts of North Africa, from Algeria to Egypt, Sinai, Persia.—Aitchison (Cat. 142) quotes "Edgeworth, Multan." I have not seen specimens; Edgeworth in Flora Mallica Journ. Linn. Soc. vi. 194, enters *E. alata* (without auth.), which may possibly be intended for *E. alata*, Schimp., a synonym of *E. Alte*.

Gnetum scandens, Roxb. Fl. Ind. iii. 518—Syn. *G. edule*, Blume; Vern. *Kūmbal*, *ūmbāl*, Bombay—is a stout climbing shrub, with opposite coriaceous elliptic-oblong petiolate leaves, 5-6 in. long, which turn black in drying; flowers monoicous in cylindric verticillate, paniculate spikes, with numerous short annular sheaths, the flowers mixed with articulate hairs closely packed in their axils. Male flowers monandrous, anthers of 2 distinct cells, opening by a slit at the apex, at the end of a thick column, protruding from a thick clavate angular sheath, which splits in two. Female flowers consisting of numerous naked ovules similarly arranged, and mixed with articulate hairs. Fruit an oblong 1-seeded drupe, 1-1 $\frac{1}{2}$ in. long, narrowed into a thick short stalk, red when ripe. The seeds are eaten. Common in the dense forests of the Western Ghats and the Konkan—East Bengal, Burma, Indian Archipelago, China. The wood of *Gnetum* consists of a large number of distinct wedge-shaped ligneous masses, which are arranged in concentric circles, and separated by cellular tissue. It thus resembles the wood of *Menispermaceæ* (p. 10).

ORDER LXXVI. CONIFERÆ.

Shrubs or trees, generally evergreen and resinous. Wood without vessels, hence on a horizontal section without pores, consisting of medullary rays and long thick-walled wood-cells, tapering at the ends, with circular discs (lenticular cavities between the walls of adjoining cells), on the sides parallel to the rays; in the wood of roots on all sides. The tur-

pentine (resin) is generally secreted in large, branching, intercellular ducts lined by thin-walled cells, either in the bark, or in the wood, vertical in the mass of wood-cells, and horizontal in the medullary rays. The annual rings are, as a rule, distinctly marked by a belt of thick-walled wood-cells in the outer (autumn) wood, and a belt of larger wood-cells with thin walls in the inner (spring) wood of the succeeding year. In many coniferous woods the inner belt of each annual ring is soft, and the outer belt compact and hard. Leaves alternate, rigid, scale-like, subulate, acicular or linear, rarely with a broad blade; without stipules. Flowers monoicous or dioicous, without perianth. Male flowers in deciduous catkins. Female flowers solitary, capitate, or in spikes (cones), consisting of one or several ovules adnate to, or surrounded by carpellary scales. Albumen fleshy and oily (in *Araucaria* farinaceous); cotyledons generally more than two, whorled.—Royle III. 348.*

According to Parlature, in DC. Prodr. xvi. ii., this Order comprises 216 species. Those of North-West India belong to the following tribes:—

Abietinæ (*Pinæ*, Parlature).—Fruit a cone, with numerous imbricate, carpellary, generally woody scales, each bearing at its base two seeds (developed from inverted ovules) and inserted in the axil of a bract, the bract often dry and not apparent when the fruit is ripe—*Pinus*, *Cedrus*, *Abies*, *Larix*.

Cupressinæ.—Fruit with few carpellary scales, varying in shape and substance, sometimes fleshy, each bearing at its base, or on the stalk when the scales are pellate, 1 or numerous seeds (developed from erect ovules). No bracts—*Cupressus*, *Juniperus*, *Callitris*, *Biota*.

Taxinæ (a distinct Order of many botanists).—Fruit 1-seeded (1 erect ovule), supported by a few imbricate scales—(in *Taxus* surrounded by a fleshy cup-shaped disc) *Taxus*, *Podocarpus*.

There are two other tribes—*Araucariæ* and *Taxodiæ*—to which the following remarkable trees belong: *Araucaria Bidwilli*, Hook., the *Bunya Bunya* of the aborigines of North-East Australia in 27° S.L. A tall tree with a straight stem and numerous tiers of short rigid whorled branches. The cones, which are said to ripen every third or fourth year only, are nearly as large as a man's head, and contain numerous large farinaceous seeds, which are an important article of food of the inhabitants. The cones of *Araucaria* consist of numerous imbricate carpellary scales, each scale with only 1 seed at the base.

The seeds of *A. imbricata*, Pavon, are also eaten. This tree grows on the higher mountains of Chili (36°-48° S.L.), is hardy, though it is occa-

* Regarding the Coniferous trees of the N.W. Himalaya, the following papers in the Journ. Agric. and Hortic. Society of India contain much valuable information: Madden, Observations on some of the Pines and other Coniferous Trees of the Northern Himalaya, and on Himalayan Conifers, vols. iv. and vii., 1845, 1850; Cleghorn, Notes upon the Pines of the N.W. Himalaya, vol. xiv., 1866. Of official reports, the report on the Deodar forests of Bussahir, by D. Brandis, J. L. Stewart, and Capt. E. Wood, Calcutta, 1865, contains most information on the growth and natural history of the Himalayan Conifers.

sionally injured by severe frost, and extensively cultivated in England, where it was introduced in 1796, the highest specimen being at Dropmore, 50 ft. high in 1871. This, like the other species of this genus, continues its growth throughout the year; the buds are open, not enclosed in scales; and young leaves are being formed at all times of the year. The wood of some *Araucarias* is supposed to have no proper annual rings; the concentric bands are often incomplete, and are believed not to indicate any periodical interruption of the vegetation, like that which causes the formation of annual rings of other coniferous and leaf-bearing trees.

The tribe of *Taxodiæ* includes, besides many other interesting trees of North America, Japan, China, Australia, and South Africa, the two giants of California, *Sequoia sempervirens*, Endl., and *S. gigantea*, Torrey (*Wellingtonia gigantea*, Lindley). The former, the Redwood of the coast, is found in a narrow belt between 34° and 42° N.L. in the mountains of California; it has been known to attain 300 ft., with a girth of 55 ft. Its cones are 1 in. long, the timber is excellent, and it coppices vigorously.

Sequoia gigantea, the *Wellingtonia* or *Mammoth-tree*, is well known as the reputed tallest tree on record, attaining 300 to 330 ft., and a circumference of 80-100 ft. One individual is stated to have been 450 ft. high. As regards height, *Eucalyptus Globulus* and *obliqua* of Tasmania, and other Australian *Eucalypti* (p. 231), rival the Californian tree. *Abies Douglasii* (p. 527) and *Sequoia sempervirens* probably stand in the second rank; and *Antiaris innoxia* (p. 427), with the *Deodar* (p. 518), under exceptionally favourable circumstances, take the third. Of European trees the *Silver Fir* (p. 529) comes next, but it rarely attains, even in the most luxuriant and compact forests of the Southern Schwarzwald, 200 ft. Eng., one-half the height of the *Wellingtonia*; and it remains considerably behind the great variety of trees which compose the dense evergreen forests of Tenasserim and of the crest of the Western Ghats (where not cleared for coffee plantations), which often form a dense mass of vegetation, unbroken for miles, on an average 200 ft. high.

The *Mammoth-tree* has a much more limited range of distribution than any of the other forest giants just mentioned. Like the *Deodar*, *Pinus erecta*, and the *Larch* of the Alps and Carpathians, it is an inhabitant of the mountains, but, so far as known at present, it is only found in a belt 25 miles long in N.L. 38°, in the valleys on the west side of the Sierra Nevada of California at an elevation of 4000 to 7000 ft.

The wood of the *Mammoth-tree* has distinct concentric rings, the inner belt of each being composed of soft spongy wood, while there is a narrow but hard and horny outer belt of darker colour. It has been asserted that two or more of such rings are formed in one year. The cones of *S. gigantea* are 2-2½ in. long; they consist of imbricate scales, like the cones of *Abietinæ*, but each scale has 5 seeds at its base. Both *Sequoias* are hardy in England.

Fruit a cone with imbricate scales.

Leaves persistent, in clusters of 2-5, in the axils of membranous scales; cones ripen the 2d, sometimes the 3d year, scales thickened at the apex

I. *PINUS*.

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| Leaves persistent, numerous, in tufts at the ends of arrested branchlets; cones requiring 2 years to ripen, scales broad with a thin sharp edge | 2. CEDRUS. |
| Leaves persistent, single, not in tufts; cones ripening the same year; scales with a thin sharp edge | 3. ABIES. |
| Leaves deciduous, in tufts; cones ripening the same year; scales with a thin sharp edge | 4. LARIX. |
| Fruit woody subglobose, with peltate scales, tightly closed before maturity; leaves persistent, closely adpressed, scale-like and imbricate, or subulate | 5. CUPRESSUS. |
| Fruit fleshy. | |
| Female catkins ovoid, of 3-6 coalescent scales, fleshy in fruit, ripening the second year forming a 1-3-seeded berry | 6. JUNIPERUS. |
| Female flowers solitary, consisting of an erect ovule seated on a fleshy disc, which enlarges into a fleshy cup surrounding the seed | 7. TAXUS. |

1. PINUS, Linn.

Evergreen monoicous trees, the branches generally in whorls at the base of each year's terminal shoot. Leaves on the first shoots of seedlings and on elongating branchlets single, acicular subulate or squamiform, bearing in their axils arrested branchlets, consisting of a short, tubercular axis, and a number of membranous sheathing scales which surround a cluster of 2-5 acicular leaves. Axillary buds are as a rule only developed into elongated branches at the end of each year's terminal shoot, one whorl of side branches being formed annually, so that the age of a young tree may be ascertained, not only by counting the annual rings of the wood, but also by the number of whorls on the stem. There are, however, exceptions: *Pinus excelsa* and *Pinaster* often form two whorls in one season, and *P. Gerardiana* and others are apt to throw out scattered side branches, not in regular whorls. The male catkins are in the axils of membranous bracts, clustered round the branch in a dense raceme at the base of the current year's shoot, so that in those branches, which habitually bear male flowers, there are often breaks in the foliage indicating the position of previous year's catkins. Antheriferous scales numerous, imbricate, each scale with 2 distinct anther-cells on its under surface, prolonged beyond them into a membranous crest. Female flowers on separate branches, solitary or in whorls, generally at the end of the current year's shoot, subsessile or pedunculate, peduncle with scaly bracts. Ovules inverted, in pairs at the base of the carpellary scales, each scale in the axil of a bract which disappears before the fruit ripens. Cones sessile or stipitate, formed of the enlarged woody carpellary scales, which are more or less thickened at the apex. Seeds oily, with a hard woody testa, in shallow excavations at the base of the scales, often winged. Cotyledons 3-12, linear.

Leaves in clusters of three; cones ovoid or ovoid-conical.

Sheathing scales persistent, fimbriate at the edges; seeds with a large wing

Sheathing scales deciduous; seeds with a short caducous wing

Leaves in clusters of five; sheathing scales deciduous; cones cylindric, scales not much thickened at the top

1. *P. longifolia*.2. *P. Gerardiana*.3. *P. excelsa*.

A two-leaved Pine is described under the name of *P. Royleana*, Jameson (Report upon the Bot. Gardens of the N.W. Provinces, 1854, p. 43, and Journ. Hort. Soc. 1855, 52). The cones, of which a number are in the Kew Museum, are ovoid-conical, 2 in. long, the ends of the scales with a sharp hook similar to the cones of some varieties of *P. sylvestris*. The leaves (which I have not seen) are described as 2 in a sheath, 2-2½ in. long, stiff and light glaucous green, sheaths short and partially persistent. Seeds very small with a broadish wing, rather more than ½ in. long. Cotyledons 6. Jameson states that it was discovered in 1850 by the Garden Seed Collectors on the Gossainthan mountain in Nepal, at an elev. of 10,000 ft. above the sea. Seeds were sent to England, from which plants were raised in the Hort. Soc. Garden in 1853, but this is all that is known regarding this doubtful species, which Parlatores doubtfully suggests might be *P. Kasya* (DC. Prodr. xvi. ii. 390), but it evidently is closely allied to *P. sylvestris*. Another doubtful species, classed by Parlatores under the 2-leaved Pines, is *P. persica*, Strangways (Loudon's Gardeners' Magazine, 1839, p. 130), shape of the cone said to be like that of *P. Pinea*, seeds large, with gibbous wings. Under this name a 2-leaved Pine is cultivated at Kew, believed to be *P. halepensis*. Parlatores describes it with cylindric obtuse cones, and the leaves in threes and fours.

1. *P. longifolia*, Roxb. Fl. Ind. iii. 651; Cleghorn, Pines of the N.W. Himalaya, t. 3; Royle Ill. t. 85. Sans. *Sarala*. Vern. *Nakhtar* (*shāntāi*, splinters of wood), Afg.; *Chīl*, *chīr*, *drāb chīr*, Pb.; *Saral*, Jaunsar; *Chīr*, *salla*, *sapin* (straight tree), *kolon*, *kolan*, *kolain*, *kallon*, Garhw.; *Kamaon*; *Thansa*, Royle, N.W. Him.; *Dhūp*, Oudh. In Sikkim called *Griet-hing* by the Lepchas, and *Teadong* by the Bhotias.

A large tree with symmetrical branches high up on the trunk, forming a rounded head of light foliage. Bark rough, cut into polygonal plates by deep dark-coloured furrows. Leaves in clusters of three, 9-12 in. long, sometimes longer, slender, inner face keeled, so as to be nearly triquetrous, with a rounded convex back. Sheath persistent, greyish brown, of numerous closely imbricate bracts, fimbriate at the edges with long fibres. Cones on short stiff stalks, spreading or recurved, solitary or in whorls of 3-5, ovoid-conical, 4-7 in. long, 3 in. diam. above the base. Scales 1½-2 in. long, ¾ in. broad, and ½ in. thick at the top, the apex (apophysis) forming a spreading or recurved obtuse pyramidal beak, with 4-6 more or less distinct rounded faces. Seeds with a thin membranous wing ½-1 in. long, obtuse, oblanceolate and unequal-sided. Cotyledons 12 on the average (Madden).

Afghanistan, cultivated at Kandahar, 3500 ft. *Kafiristan* at 6000 ft. Eastern slopes of the Suliman range, where Dr Stewart, in 1860, supposed its lower limit to be over 9000 ft., Pb. Pl. 226. Abundant in the Siwalik tract and outer Himalaya from the Indus to Bhutan, generally between 1500 and 6000 ft. elevation, occasionally ascending higher, to 7500 ft. in Kamaon. The lower and upper limits of this tree in the different parts of the Himalaya, under different circumstances, are by no means well known. In the Panjab, north of the Sutlej, 1800 ft. is generally regarded as the lowest, and 5000 ft. as the upper limit; at Simla the tree grows as high as 7000 ft., and this is generally its upper limit in Kamaon. In Sikkim and Bhutan it does not rise beyond 3000 or 4000 ft. In the Sutlej valley this Pine skirts, in open forests, the trees standing far apart, the lower slopes of the hills on both sides of the Sutlej river as far as the Wangtu bridge, where it reaches its upper limit in the valley. Cultivated in the plains of North-

West India, and grows even at Calcutta. In England requires shelter in winter. Gregarious, forming nearly pure, open forests, often with scanty underwood of *Andromeda*, *Berberis*, *Rhus Cotinus*, and locally at lower elevations, of *Carissa diffusa*. Fl. Feb.-April; the cones require 12-15 months to ripen; they open and shed their seeds in April or May, but are long persistent afterwards, so that in autumn there are numerous seedless cones on the trees. Ribbentrop (Panjab Arbo-ricult. 178) states that in the Panjab the seed ripens in October, and that the best time to collect seed is to pick the cones from Dec. to March. The leaves generally remain 2-3 years on the branches, the oldest being shed in May and June. Attains 70, and at times 100-110 ft.; trunk tall, erect, straight, 5-7, rarely 10-12 ft. girth. Crown oval when young, rounded when old, extremities of branch-lets turned upwards, foliage of old trees dark, of young trees lighter green. Bark $\frac{1}{2}$ in. thick, cut up by deep fissures and cracks into irregularly polygonal, sometimes oblong thick, large grey or reddish plates, inner substance reddish-brown, compact. Wood yellowish, reddish-white or brown, no distinct heart-wood. The weight of seasoned Chir, according to experiments made at Rurki, is 27 lb., and the value of P. 932 (average of 10 exp., extremes 818 and 1084). Experiments made at Almora by Capt. Jones in 1844, and recorded by Madden, give 34-45 as the weight of unseasoned wood felled one month, P=626 (15 exp.), and 36-41 lb. for seasoned timber, P=545 (5 exp.). The wood is easy to work, and is extensively used in the hills for building—roof-trees are said to last two generations in Kamaon—also for shingles where slate is not available, at the tea plantations for tea-boxes, and there is a considerable export of it to the plains on several of the Himalayan rivers. On the Sutlej and Bias it is largely employed for the bottoms of boats. As a rule, however, the wood is not durable; it is attacked by insects, and decays rapidly when exposed to wet. In Kamaon, about Piura, and in several places on the Wardwan branch of the Chenab, a large proportion of the trees have the bark and the fibres of the wood much spirally twisted, in the same way, only to a much greater degree than is often seen in horse-chestnuts in Europe. The wood of the twisted trees is useless for any purpose save fuel. It has been supposed that the twist is caused by the local winds, but the twisted are often mixed with straight-grown trees, exactly as is the case in an avenue of horse-chestnuts, and their occurrence is confined to particular localities not more exposed to the action of the wind than the neighbouring tracts.

The Chir probably produces more turpentine and resin than the other Conifers of the North-West Himalaya; it is obtained by making incisions in the stem, or by stripping off the bark. The crude turpentine and resin is called *Biroza* or *gandha firroza*, generally in N.W. India, *dhūp* in Oudh, *berja* or *biroja* in Garhwal, and *khalja* near Simla. The Sanscrit word is *kshūra*, whence probably the name *chir*. In a report on the resinous products of the Garhwal Forest Division, of March 1867, R. Thompson states that the quantity of *berja* annually brought down to the markets at the foot of the hills may be assumed at between 1000 to 1200 maunds of 80 lb. each, at prices varying from 3 to 4½ rupees per maund,—and he describes the procedure as follows: "Several deep triangular-shaped niches are cut into and around the trunk of the tree. The niches are 12-18 in. long, and 6-8 in. deep. The base of the niche is hollowed out so as to form a sort of receiver for the resin after it exudes. These are emptied out as filled, which takes 10-15 days from the time of first cutting. The receivers are filled and emptied several times during the season, which lasts from 15th March to 15th June, or 3 months. The yield of an ordinary-sized tree is 10-20 lb. of *berja* for the first, and about a third of the quantity the second year, after which the tree either dies or is blown down." In the Panjab in 1868 the crude resin sold for 4-7 rupees per maund. Tar (mixed with turpentine and products of destructive distillation of wood) is also made by filling an earthen pot (perforated at the bottom with small holes) with chips of resinous

wood, the pot is closed and luted over with wet mud, pieces of dry cow-dung are heaped over it, and lighted. This fuel burns slowly, and the tar runs into a second smaller pot placed underneath the other in a hole dug in the ground (Journ. As. Soc. ii. 249). Spirit of turpentine is distilled from the crude turpentine in the Panjab, the Bijnaur district, and elsewhere in North-West India; in the Panjab the crude turpentine to be distilled is mixed with water and carbonate of soda. The residue (pale resin, colophony) is called *sindras* in Bijnaur. The wood of stumps and of trees which had been notched and mutilated is often so full of resin as to be translucent, and such wood is used for torches and in place of candles, in houses and mines. The bark is used for tanning, and as fuel for iron-smelting. Charcoal is often made of the wood. The charcoal of the leaves, mixed with rice-water, is used instead of ink. The seeds (*kalghoza*, *chalthatti*) are eaten, and are of some importance as food in times of scarcity; they have a strong taste of turpentine.

The *Chir* requires much light, and seedlings will not spring up under shade. Nevertheless the regeneration of *Chir* forests by self-sown seedlings is good, and will, with properly-regulated cuttings, probably not present any great difficulty wherever fires and cattle can be excluded. It is easily raised from seed, but regarding its cultivation on a large scale not much experience has yet been gained. Ribbentrop (Hints on Arboriculture in the Panjab, 179) states that the tree makes a long tap-root in its early youth, which must not be injured in transplanting. The growth is moderately rapid (4.5 rings per inch). It has much tenacity of life.

Nearly allied is *P. Kasya*, Royle; DC. Prodr. xvi. ii. 390, the Pine of the Kasia hills (2000-6000 ft.), and of the mountains east of Toungoo, between the Sitang and Yunzalin rivers in Burma, where I found it in Feb. 1859, forming extensive forests at elevations above 3000 ft., as a large tree, attaining 200 ft. in height, the wood very resinous. (*Tingyuben*, Burm.) It has shorter and more slender leaves (3 in a sheath), the young cones are recurved, on long bracteate stalks, the ripe fruit is smaller than that of *P. longifolia*, 2-3 in. long, the top of the scales flat or convex, without any prominent beak at the end. On the Yunzalin plateau, the male flowers open in Feb., and at that time cones of several stages of growth are on the trees. Of the tree in the Kasia hills Hooker gives the following account: "They had 5 years' old cones on them as well as those of all succeeding years; they bear male flowers in autumn, which impregnate the cones formed the previous year. Thus the cones formed in the spring of 1850 are fertilised in the following autumn, and do not ripen their seeds till the second following autumn, that of 1852."—*Himalayan Journals*, ii. 288. The time of impregnation of the female flowers of *P. longifolia* merits farther inquiry, also the time which the cones require to ripen. It would be remarkable, though not unexampled (see *Quercus Suber* and *occidentalis*), if two species so closely allied were found to differ in this respect.

2. *P. Gerardiana*, Wall.—Tab. LXVII.—Royle Ill. t. 85; Cleghorn l. c. t. 4. Vern. *Chilghoza*, *jalghoza*, Afg.; *Chiri*, *prita*, *mirri*, *galbeja*, *galgaja*, Chenab; *Kashki*, Ravi; *Ri*, *rhi*, Kunawar; *Kamuchi*, *koniunchi*, *kaninchi*, West Tibet. Called *Konecha*, *kolecha*, by the Juhahir Bhutiyas (Madden). The seeds: *Neozsa*, *nioza*.

A middle-sized tree with a short rounded crown and grey bark, peeling off in large flakes. Foliage dark green, branches smooth, nut-brown. Leaves in clusters of three, 3.5 in. long, stiff, $\frac{2}{3}$ line broad; sheath and bracts deciduous. Cones while young (catkins) erect on stout scaly peduncles 1 in. long, when mature glaucous, ovoid-oblong, 6-9 in. long, 4.5 in. diam.

at base. Lower part of scales $1\frac{1}{2}$ in. long, $1\frac{1}{4}$ in. broad at top, upper part recurved; obtusely triangular, compressed, spinescent. Seeds cylindrical, 1 in. long, with a short caducous wing.

Common in North Afghanistan and Kafiristan, abundant on the Safedkoh and probably also at high elevations on the Suliman range. In the N.W. Himalaya, locally in the inner valleys with a drier climate, beyond the influence of the periodical rains. Indus valley between Astor and Iskardo, and in Gilgit. On the Chenab, common below Kilar, on a short portion of the main river, and on the Marru, a tributary (5800-8000 ft.) A few trees occur at one place on the Ravi (at 8000-8500 ft.) In Kunawar, generally occupying the lower slopes of the mountain-sides near the river, between 6000 and 10,000 ft. (Capt. Gerard states up to 12,300 ft. near Sungnam), from Chergaon and Jani to Hangarang and Dabbling. Planted at Serahn, 15 miles lower down the valley, and within the full range of the monsoon, but does not bear fruit. Also in British Garhwal, between Malari and Bampa, on the route to the Niti Pass, at 6000-10,000 ft. (Dr Jameson, 1846). Gregarious, but not forming dense forests, frequently associated with Deodar, often on dry steep rocky slopes, on granite and clay-slate in Kunawar. The male flowers appear in June and July, and the yellow pollen falls abundantly at that time, and is carried about by the wind. The cones ripen in the second year; at lower levels by the end of September, at higher elevations about the middle of October. The leaves remain 3-4 years on the branches. Attains 30-40, at times 50-60 ft., with a short straight trunk (clear of branches, to 8 or 10 ft.), girth 6-7, rarely 12 ft.; branches strong, horizontal or decurved, the ends turned up, forming a broad oval or rounded compact bushy crown. Bark grey, greenish grey, often silvery, with darker blotches, without fissures cracks or roughness, exfoliating in long thin flakes, leaving exposed patches of the fresh, smooth, darker-coloured inner bark. The peculiarly smooth bark of this species, which is never transformed into a rough outer coating like that of the other pines, was first noticed by Dr W. Hoffmeister, who accompanied Prince Wäldemar of Prussia in his journey through India in 1845 and 1846.

The wood is used for the hook which supports the passenger's seat on the single-rope swing-bridge; it probably is tough, but is hardly ever felled, as the tree is valuable on account of the edible seeds. It is very resinous, and a white resin also exudes abundantly from the bark and cones. Baskets and rough water-buckets are made of the bark. The cones are plucked before they open, and are heated to make the scales expand, and to get the seed out. Large quantities of the seeds are stored for winter use; they form a staple food of the inhabitants of Kunawar, are often eaten ground and mixed with flour. It is a common saying in Kunawar, "One tree a man's life in winter." They are also exported to the plains, and considerable quantities are imported annually into North-Western India from Afghanistan by the Khaiber and Bolan Passes. They are oily, with a slight but not unpleasant turpentine flavour. The seeds and an oil extracted from them are used in native medicine.

To the same section (*Taxa*, with 3 leaves in a sheath) as the preceding species, belong three important trees of Eastern North America: 1. *P. australis*, Michaux, the *Long-leaved* or *Yellow Pine*, also called *Pitch Pine*, a large tree, which clothes extensive dry sandy tracts, known as the Pine Barrens, along the coast of South Virginia, the two Carolinas, Georgia, and Florida. The heartwood is compact, heavy (40-53 lb. per cub. ft.), strong, durable, and much prized in America for house- and ship-building. It is very resinous, and yields the main supply of American resin and turpentine.

Michaux (Forest Trees of North America, 1819, ii. 271) gives the following

description of the mode of procedure, which is confirmed by other accounts. In winter a cavity is cut into the base of the trunk about 3 or 4 inches from the ground, commonly of the capacity of 3 pints, and about 4 in. deep. These cavities are called boxes, and they have the shape of a large distended waistcoat-pocket. When the trees are large, 2 or sometimes 4 boxes are excavated on opposite sides of the trunk. Two oblique gutters are made at the edges of the box, and the surface of the stem is hacked or chipped above the box; this is repeated once a week; the first year the chippings extend 12 in. upwards, and are carried up higher every year, but after 5 or 6 years the tree is generally abandoned. The turpentine begins to run about the middle of March, and the hottest months, July and August, are the most productive. The boxes generally fill every three weeks, and the turpentine is ladled out with wooden shovels into pails. Fires are the great danger, and on that account the ground at the foot of the trees is carefully cleared of leaves and herbage. The solid masses of resin, which concrete on the chipped part of the stem, are collected under the name of scrapings. In ordinary years it is estimated that 3000 trees, which generally form the charge of one person, yield 75 barrels of turpentine and 25 barrels of scrapings in one season, which supposes the boxes to be emptied five or six times during the season. The method of collecting resin of *P. Pinaster*, *Laricio*, and *halepensis*, in France and Corsica, described at p. 514, differs essentially from the American system, the scars being flat, and the turpentine being collected either in earthen pots, or in cavities cut in the roots or made in the sand at the foot of the tree. Large quantities of tar are made from the tops and branches and dead trees of *Pinus australis* in charcoal-kilns, which have the shape of a truncated and inverted cone; Michaux states that a kiln 10-12 ft. high, 20 ft. diam. below, and 25-30 ft. above, yields 100 barrels of tar, which seems a very large quantity. It is evident that the yellow pine is more resinous than most other Conifers. The wood of this tree is extensively used for building in the Southern States, it is also exported largely to the West Indies. The species is distinguished by long cylindrical cones, 6-10 in. long, the scales armed with short recurved spines; the leaves are 10-15 in. long.

2. *P. Taeda*, Linn., the *Loblolly Pine*, grows in the Southern States, mainly in the long narrow marshes that intersect the Pine Barrens. It also is tapped for resin, but is less valued.

3. *P. rigida*, Mill., the *Pitch Pine*, inhabits the Northern States; during last century it yielded large quantities of resin and tar, but the wholesale destruction of the trees has diminished or stopped the supply from that source.

3. *P. excelsa*, Wall. Pl. As. Rar. t. 201; Cleghorn l. c. t. 2.—Syn. *P. Peuce*, Grisebach; *P. pendula*, Griff. Vern. *Piunt*, Afg.; *Biār*, Hazara; *Chöl*, *chür*, *chiltu*, *chüu*, *chün*, from Kashmir to Jaunsar; *Chäla*, Garhwal; *Kail*, Bias and Sutlej (outer hills); *Lim*, *Iläm*, Chamba and Kunawar; *Yara*, *yür*, *yiro*, Kashmir; *Shomshing*, Lahoul; *Räisalla*, *lamshing*, *byans*, on the upper Sarda; *Tongschi*, Bhutan.

A large tree, with dark-coloured bark, divided into small irregular plates. Foliage bluish-green, or greyish-green in exceptional cases, particularly at high elevations. Leaves in clusters of 5, 6-8 in. long, slender, drooping, sheath and bracts deciduous. Cones erect while young, on peduncles 1-2 in. long or longer, pendulous when mature, cylindric, 6-10 in. long; scales closely imbricate, 2-2½ in. long, 1-1½ in. broad, cuneate-oblong, flat, apex (apophysis) not much thickened, rhomboid, the ends rounded. Seeds ovoid, ½ in. long, or a little longer, with an oblong, obliquely truncate wing. Cotyledons usually 9.

Mountains of Kafiristan north of Jellalabad (Griffith), Safedkoh (Griffith and Bellew), near Rundu on the Indus below Iskardo. Himalaya between 6000 and 10,000 ft., from the Indus to Bhutan, extending considerably into the more arid tract. Lahoul, Kunawar as far as Sungham and Namgia. Niti Pass in Garhwal. Nepal, Bhutan. Wanting in central and north-west Kamaon (Madden), and in Sikkim. The tree is occasionally found as low as 5000 and as high as 12,500 ft. *P. Peuce*, which has been identified with *P. excelsa* by Hooker (Journ. Linn. Soc. viii. 145), was first discovered by Grisebach on Mount Pelister or Peristeri near Bitolia in South Macedonia, near the borders of Albania, where it forms a considerable extent of forest at the upper limit of arboresecent vegetation, above the range of the Beech, from 4400 to 5800 ft., descending to 3000 ft. (as a shrub only), and in places ascending to 6100 ft., and has since been found farther north on the Kom mountain in Moit-negro. Between Macedonia and Afghanistan, a distance of 2200 miles, no trace of the tree has yet been discovered. *P. excelsa* is hardy in England, but seems inclined to seed rather early and too freely; its leading shoots are very luxuriant, but often bent and irregular. These peculiarities are noticed near Simla, wherever the tree grows below its normal line of elevation. Introduced 1823, the largest tree at Dropmore is 70 ft. high.

P. excelsa is gregarious, but does not often form pure forests of large extent. It generally is mixed with the *Deodar*, *Abies Webbiana*, and *Smithiana*, and is often found at the edges of mixed forests of leaf-bearing trees. At higher levels it grows among the Alpine Birch (*B. Bhojpattria*), and at lower levels it is not rarely found associated with *Pinus longifolia* near the upper limit of that tree. In Kunawar it forms forests of considerable extent above and below the *Deodar* belt, and is mixed with it. In the Baspa valley *Deodar* ceases at an elevation of about 9500 ft., but *P. excelsa* extends considerably higher, both at the bottom and on the sides of the valley. In the forests on the left bank of the Sutlej above the mouth of the Baspa, it often forms the main portion of the forest between the *Deodar* and the Alpine Birch.

It flowers from the end of April to the middle of June; in October the young cones are 1 in. long, and pea-green, in April they attain 3-4 in., and they ripen in the autumn of the second year. The seedless cones are persistent for a long time, hanging on the branches with their broad gaping scales. The leaves remain 3-4 years before they are shed. Attains 100-120, and sometimes 150 ft. in height. In isolated trees the branches are low, nearly to the ground; they are whorled, horizontal, the ends turned up, except when laden with fruit. Branches smooth, dark-grey, sometimes purplish-brown. Bark dark-coloured, cut into drab-grey rough scales, by parallel vertical fissures and cross-cracks; in old trees the scales are broad, irregularly polygonal, with whitish or silver-grey surface, divided by dark-coloured rough furrows.

Sapwood whitish, heartwood light-brown, often with reddish lines and resinous knots, compact, even-grained, soft and easy to work. As regards durability, it ranks next to *Deodar*, of the north-west Himalayan Conifers, and is preferred to *Abies* and to *Pinus longifolia*. In the Panjab Himalaya, it is said to last 7-8 years as shingles, 8-10 years as beams in walls, and 15 years as ordinary inside planking. Where *Deodar* cannot easily be obtained, it is largely used for house-building, shingles, water-channels, water-troughs, wooden spades, and other implements. It is said to be the best wood available in the Panjab for pattern-making, as it works extremely well and can be got without much resin. It yields an excellent charcoal for iron-smelting. A variety of the wood, valued less than the normal kind, is called *dar chil* at the Ravi and Chenab timber depots. The term is not used in the forests. The wood grown on south aspects is said to be heavier and to contain more turpentine. Turpentine, resin, and tar might be readily obtained from this tree; it probably is nearly as resinous as