

ABIES

Abies, Linnæus, *Gen. Pl.* 294 (in part) (1737); Bentham et Hooker, *Gen. Pl.* iii. 441 (1880); Masters, *Journ. Linn. Soc. (Bot.)* xxx. 34 (1893); Hickel, *Bull. Soc. Dendr. France*, 1907, pp. 5, 41, and 82; 1908, pp. 5 and 179.
Picea, D. Don, in Loudon, *Arb. et Frut. Brit.* iv. 2293 (1838).

EVERGREEN trees belonging to the order Coniferæ; bark containing numerous resin-vesicles; branches whorled. Buds, with numerous imbricated scales, with or without resin, usually two to five at the ends of the branchlets, the central bud terminal and largest, the others surrounding it in a circle on upright shoots, whilst on lateral branchlets those on the upper side are not developed; buds also occur rarely and few in number in the axils of the leaves on the branchlets below. Branchlets of one kind, usually smooth, but in certain species grooved, with raised pulvini; each season's shoot¹ marked by a sheath at the base, composed of the persistent bud-scales of the previous spring.

Leaves on fertile and barren branchlets, often different in length and thickness and in the nature of the apex; arising from the branchlets in spiral order, radially disposed on vertical shoots, but variously arranged according to the species on lateral branchlets; persisting for many years and giving the tree a dense mass of foliage; leaving as they fall circular scars on the branchlets; sessile, but usually narrowed just above the expanded circular base; linear, flattened and thin in most species, quadrangular in section in a few species; ventral surface always with two greyish or white stomatic bands, one on each side of the raised green midrib; dorsal surface with or without stomata, which when present are either in continuous lines, as in the quadrangular-leaved species, or are confined to near the tip of the leaf in the middle line, as in some flat-leaved species; apex acute, acuminate, or obtuse, notched or entire, spine-pointed in one or two species; resin-canals² two, constant in position for each species in the leaves on lateral branchlets, but in some species³ differing in position in the leaves on the upright or fertile branchlets, either *median*,

¹ In *A. bracteata*, all the bud-scales usually fall off, leaving ring-like scars at the base of the shoot.

² The position of the resin-canals is easily seen on examining a thin section with a lens; and can often be made out by squeezing the leaf, after it is cut across, when the resin will be observed exuding from the two canals.

³ In *A. pectinata*, *A. cephalonica*, and *A. Nordmanniana*, the resin-canals are marginal in the leaves of lateral branches, and are median in the leaves of cone-bearing branches. Cf. Guinier and Maire, in *Bull. Soc. Bot. France*, lv. 189 (1908).

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when situated in the substance of the leaf about equidistant between its upper and lower surfaces, or *marginal* or *sub-epidermal*, when placed in the lower part of the leaf close to the epidermis; fibro-vascular bundle simple in some species, divided into two parts in other species.

Flowers monœcious, the two sexes on separate branchlets; male flowers usually abundant and on the lower side of the branchlets over the upper half of the tree; female cones on the upper side of the branchlets, usually only near the top of the tree, but in some species borne all over the upper half of the tree. Staminate flowers,¹ solitary in the axils of the leaves of the preceding year's shoot; stamens spirally crowded on a central axis, anthers surmounted by a knob-like projection and dehiscing transversely. Female cones,¹ arising as short shoots, composed of numerous imbricated fan-shaped ovuliferous scales, and an equal number of much longer mucronate bracts; ovules inverted, two on each scale.

Mature cones erect on the branchlets, composed of closely imbricated woody scales, more or less fan-shaped with short stalks. Bracts adnate to the outer surface of the scales at the base; either concealed between the scales or with their tips exerted and then often reflexed over the margin of the scale next below; dilated at the apex, entire or two-lobed, prolonged into a triangular mucro. Seeds two on the inner surface of each scale, winged, and with resin-vesicles. The cones ripen in one season; and the scales, bracts, and seeds fall away from the central spindle-like axis of the cone, which persists for a long time on the tree. The seedling has four to ten cotyledons, stomatiferous on their upper surface.

The species of *Abies* are distinguishable from all other conifers by the circular base of the leaves, which on falling leave circular scars on the branchlets.

The species of *Abies* have been variously divided into sections by different authors, but no satisfactory arrangement has yet been made out. Mayr proposed three sections based on the colour of the cones; but, as Sargent² points out, colour is not a constant character in several species. The cones are of value in the discrimination of the species, by taking into account their age, general appearance, and characters as a whole; but the scales are often very variable in shape in the same species, and the bracts, while more constant in form, often show considerable variation in their length. It is most convenient, in practice, especially as cones are in most cases not available for examination, to group the species, according to the characters of the buds, branchlets, and foliage, which are, as a rule, very constant in the same species. Hickel³ proposes three sections, based on the characters of the branchlets and buds; but his division is artificial, as it separates species closely allied by the characters of their cones.

Some notes on the genus *Abies*, for which we are indebted to Mr. J. D. Crozier, forester to H. R. Baird, Esq. of Durris, Kincardineshire, are inserted. Mr. Crozier's long experience in the east of Scotland gives a special value to his opinion on their respective qualities for planting in Scotland, which our own

¹ Both the staminate flowers and the young female cones are surrounded at the base by involucre of bud-scales.

² *Silva N. Amer.* xii, 97, *adnot.* (1898). Sargent proposes three sections, based on the characters of the leaves.

³ *Bull. Soc. Dendr. France*, 1907, p. 11.

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could not have, though in almost every case he confirms the conclusions at which we had already arrived.

About thirty species are known, of which twenty-six have been introduced and are distinguished below. The silver firs are natives of the temperate parts of the northern hemisphere, usually occurring in mountainous regions; attaining high elevations towards the south, as in Guatemala, Algeria, Himalayas, and Formosa; and descending to low levels in the extreme north, as Alaska, Labrador, and Siberia.

The following table is based upon characters taken from the foliage, buds, and shoots of lateral branches, occurring on the lower part of the tree. As regards the leaves, their arrangement upon the branchlets, the position of the resin-canals, and whether the apex is entire or bifid must be noted. The presence of stomata on the upper surface of the leaf is peculiar to certain species. The young shoots are either smooth or deeply grooved with prominent pulvini; and are glabrous in some species, pubescent in others, the pubescence when present being either confined to the grooves or spread over the whole branchlet. The buds vary in size and shape and also in the quantity of resin, which in some cases is so slight that they may be described as non-resinous; whilst in other species the scales are covered with or deeply immersed in resin.

Certain species are distinguishable at a glance by some prominent character. *A. bracteata* has a bud entirely different from that of any other species. *A. Pinsapo*, with its short, thick, rigid leaves, standing out radially from the shoot, is unmistakable. *A. cephalonica*, with a more imperfect radial arrangement, is distinguished by its long flattened leaves ending in a single sharp cartilaginous point. *A. firma* is peculiar in its remarkably broad very coriaceous leaves, which end in two sharp unequal points. *A. grandis* has the leaves quite pectinate in the horizontal plane, those of the upper rank about half the size of those below. *A. Mariesii* is distinguished by the shoot being densely covered with a ferruginous tomentum. *A. brachyphylla* and *A. Webbiana* have deeply-furrowed shoots with prominent pulvini, which become more marked in the second year; and the bark begins to scale very early on the branches and trunk of the tree. *A. nobilis* and *A. magnifica* are peculiar in the upper median leaves curving up from the shoot after being appressed to it for some distance. *A. Pindrow* has long pale green leaves very irregularly arranged.

I. *Leaves radially arranged on the branchlets; apex of the leaf not bifid.*

1. *Abies Pinsapo*, Boissier. Spain. See p. 732.

Leaves rigid, short, less than $\frac{3}{4}$ inch long, thick, acute at the apex; resin-canals median. Shoots glabrous. Buds resinous.

2. *Abies cephalonica*, Loudon. Greece. See p. 739.

Leaves thin, flattened, about 1 inch long, ending in a sharp cartilaginous point; resin-canals marginal. Shoots glabrous. Buds resinous.

In var. *Apollinis*, the radial arrangement is imperfect, and the leaves end in a short point.

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II. *Leaves on the lateral branches pectinate in arrangement; the two lateral sets either in one plane, or with their upper ranks directed upwards as well as outwards, showing a V-shaped depression, as seen from above, between the two sets.*

* *Resin-canals marginal.*¹

3. *Abies bracteata*, Nuttall. California. See p. 796.
 Leaves long, 2 inches or more, rigid, ending in a spine-like point. Shoots glabrous. Buds peculiar in the genus, elongated, fusiform, membranous, non-resinous.
 4. *Abies grandis*, Lindley. Western N. America. See p. 773.
 Leaves all in one plane, those in the upper rank about half the length of those below, up to 2 inches long, bifid at the apex; upper surface grooved and without stomata. Shoots minutely pubescent. Buds small, resinous.
 5. *Abies Lowiana*, Murray. California. See p. 779.
 Leaves in a V-shaped arrangement, $1\frac{1}{2}$ to $2\frac{1}{2}$ inches long, bifid at the apex; upper surface grooved and with eight lines of stomata. Shoots and buds as in *A. grandis*.
 6. *Abies firma*, Siebold and Zuccarini. Japan. See p. 762.
 Leaves in a V-shaped arrangement, rigid, very coriaceous, broad, up to $1\frac{1}{2}$ inch long, ending in two sharp cartilaginous points. Shoots pubescent in the furrows between the slightly raised pulvini. Buds small, ovoid, only slightly resinous.
 7. *Abies homolepis*, Siebold and Zuccarini. Japan. See p. 764.
 Leaves in arrangement and appearance like *A. firma*; but shorter, less coriaceous, narrower, and whiter beneath. Shoots with prominent pulvini, glabrous. Buds ovoid, resinous, larger than in *A. firma*.
 8. *Abies pectinata*, De Candolle. Europe. See p. 720.
 Leaves pectinate in one plane or tending to a V-shaped arrangement, about an inch long, slightly bifid at the apex. Shoot grey, with short pubescence. Buds ovoid, non-resinous.
 9. *Abies Webbiana*, Lindley. Himalayas. See p. 750.
 Leaves V-shaped in arrangement, up to $2\frac{1}{2}$ inches long, bifid, silvery white beneath. Shoots with prominent pulvini and deep grooves, with a reddish pubescence confined to the grooves. Buds large, globose, resinous.
- ** *Resin-canals median.*²
10. *Abies balsamea*, Miller. Eastern N. America. See p. 803.
 Leaves slender, scarcely 1 inch long, bifid at the apex, with six to eight lines of stomata in each band on the lower surface. Shoots, smooth, grey, with scattered short erect grey pubescence. Buds globose, resinous.
 11. *Abies Fraseri*, Poiret. Alleghany Mountains. See p. 806.
 Leaves as in *A. balsamea*, but shorter and whiter beneath, with eight to

¹ *A. cilicica* and *A. numidica*, with weak shoots, come in this section. See Nos. 22 and 23.

² *Abies lasiocarpa*, Nuttall, often has the leaves more or less pectinate, and might be sought for here. See No. 26.

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twelve lines of stomata in each band beneath. Shoots smooth, yellowish, with dense reddish curved or twisted pubescence. Buds globose, resinous.

12. *Abies brachyphylla*, Maximowicz.¹ Japan. See p. 765.
 Leaves in a V-shaped arrangement, short, scarcely exceeding $\frac{7}{8}$ inch, slightly bifid, white beneath. Shoots glabrous, with prominent pulvini and deep grooves. Buds conical, resinous.

III. *Leaves on lateral branches not pectinate above, but densely crowded, those in the middle line directed forwards in imbricated ranks, their bases not being appressed to the branchlet. On the lower side of the shoot the leaves are in two lateral sets.*

* *Resin-canals marginal.*²

13. *Abies Nordmanniana*, Spach.⁸ Caucasus, Northern Asia Minor. See p. 746.
 Leaves up to $1\frac{1}{4}$ inch long, with rounded bifid apex. Shoots smooth, with short scattered erect pubescence. Buds ovoid, brown, non-resinous.

14. *Abies amabilis*, Forbes. Western N. America. See p. 782.
 Leaves in arrangement and size like those of *A. Nordmanniana*, but much darker shining green, and with a truncate bifid apex; they emit a fragrant odour when bruised. Shoots smooth, with short wavy pubescence. Buds small, globose, resinous.

15. *Abies religiosa*, Schlechtendal. Mexico, Guatemala. See p. 808.
 Leaves about 1 inch long, gradually narrowing from the middle to the usually entire apex, which is occasionally slightly emarginate. Shoots with prominent pulvini and dense minute erect pubescence. Buds shortly cylindrical, resinous.

The median upper leaves are much less numerous than in the two preceding species.

16. *Abies Mariesii*, Masters. Japan, Formosa. See p. 771.
 Leaves shorter and broader than in *Abies Veitchii*, widest in their upper third, with a rounded and bifid apex. Shoot densely covered with a ferruginous tomentum. Buds small, globose, resinous.

** *Resin-canals median.*

17. *Abies Veitchii*, Lindley. Japan. See p. 768.
 Leaves up to 1 inch long, truncate and bifid at the apex, uniform in width, very white beneath, with nine to ten lines of stomata in each band. Shoots smooth, covered with dense short erect pubescence. Buds small, globose, resinous.

The upper median leaves, pointing forwards, stand off from the shoot at a wider angle than in *A. Nordmanniana*.

¹ *Abies umbellata*, Mayr, is said to be very similar in foliage to this species. See the description of this species, p. 768.

² *A. numidica* with strong shoots, is distinguished from all these species by the leaves of the upper side being directed backwards. See No. 23.

³ *A. cilicica*, with strong shoots, resembles a weak *A. Nordmanniana*. See No. 22.

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18. *Abies sachalinensis*, Masters. Saghalien, Yezo, Kurile Isles. See p. 760.
 Leaves long and slender, up to $1\frac{3}{4}$ inch, uniform in width, with a rounded and bifid apex, white beneath, seven to eight lines in each stomatic band. Shoots with prominent pulvini, and a dense short pubescence confined to the grooves. Buds small, globose, resinous.
19. *Abies sibirica*, Ledebour. N. E. Russia, Siberia, Turkestan. See p. 758.
 Leaves long and slender, up to $1\frac{1}{2}$ inch, uniform in width; apex rounded and either slightly bifid or entire; four to five lines in each stomatic band beneath. Shoots ashy grey, quite smooth, with a scattered minute pubescence. Buds small, globose, resinous.
- IV. *Leaves on lateral branches not pectinate above; those in the middle line covering the branchlet, and curving upwards after being appressed to the shoot for some distance at their base. The leaves are in two lateral sets on the lower side of the branchlet. Resin-canals marginal.*
20. *Abies nobilis*, Lindley. Washington, Oregon, California. See p. 786.
 Leaves above closely appressed by their bases to the branchlet, which they completely conceal; about 1 inch long, entire at the apex, flattened, grooved on the upper surface in the middle line; stomata usually present on both surfaces. Shoots with a dense, short brown pubescence. Terminal buds girt at the base by a ring of acute or subulately-pointed pubescent scales.
21. *Abies magnifica*, Murray. Oregon, California. See p. 792.
 Leaves above appressed at their bases, for a short distance only, to the branchlet, which they do not completely conceal; longer than in *A. nobilis*, up to $1\frac{3}{4}$ inch, entire at the apex, quadrangular in section, not grooved on the upper surface; stomata always present on both surfaces. Shoots and buds as in *A. nobilis*.
- V. *Leaves on lateral branches arranged in two ways, which are often observable on the same tree, and depend upon the vigour of the shoots.*
22. *Abies cilicica*, Carrière. Asia Minor. See p. 744.
 Leaves either (A) pectinate above with a V-shaped depression between the lateral sets, or (B) with the median leaves above crowded and covering the branchlet, as in *A. Nordmanniana*. The leaves are slender, up to $1\frac{1}{4}$ inch long, not conspicuously white below, slightly bifid at the rounded or acute apex; resin-canals marginal. Shoots smooth, with scattered short erect pubescence. Buds small, ovoid, non-resinous.
 Vigorous shoots of this species resemble a weak *A. Nordmanniana*; but with the leaves shorter, more slender, and less white beneath, the buds being much smaller.
23. *A. numidica*, De Lannoy. Algeria. See p. 737.
 Leaves either (A) pectinate above with a V-shaped depression; or (B) crowded and covering the upper side of the branchlet, but different from

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all other species in the median leaves above, in that case, being directed backwards and not forwards. Leaves short, up to $\frac{3}{4}$ inch long, broad, rounded at the entire or slightly bifid apex; in most cases with four to six broken lines of stomata on their upper surface near the tip; resin-canals marginal. Shoots brown, shining, glabrous. Buds large, ovoid, non-resinous.

VI. *Leaves irregularly arranged; those on the lower side of the branches not truly pectinate.*

24. *Abies Pindrow*, Spach. W. Himalayas. See p. 755.

Leaves all directed more or less forwards; those above irregularly and imperfectly covering the branchlet; those below mostly pectinate, but with some directed downwards and forwards. Leaves soft, pale green, up to $2\frac{1}{2}$ inches long, bifid at the apex with two sharp cartilaginous points; resin-canals marginal. Shoots grey, glabrous. Buds large, globose, resinous.

25. *Abies concolor*, Lindley and Gordon. Colorado, Utah, Arizona, New Mexico, Northern Mexico, Southern California. See p. 777.

Leaves imperfectly pectinate both above and below, some in the middle line being always directed forwards and not laterally outwards; up to 2 to 3 inches long; apex entire; upper surface convex and not grooved, bearing fifteen to sixteen lines of stomata; resin-canals marginal. Shoots smooth, olive-green, glabrous. Bud large, conical, resinous.

26. *Abies lasiocarpa*, Nuttall. Western N. America. See p. 800.

Leaves either (A) in an imperfect pectinate arrangement, or (B) with most of the leaves directed upwards, those in the middle line above crowded, and standing edgewise; $1\frac{1}{2}$ inches long, narrow, usually entire, with conspicuous lines of stomata on the upper surface, especially in its anterior half. Resin-canals median. Shoots smooth, with a moderately dense, short wavy pubescence. Buds small, conical, resinous.

Four species, *A. Delavayi*, Franchet;¹ *A. Fargesii*, Franchet;² *A. squamata*, Masters;³ and *A. recurvata*, Masters;⁴ occur in the mountains of western China and are not included in the above list. The two first species are reported by Masters to have been introduced by Wilson; but, on inquiry, we find that only one species of *Abies* from China is now growing in the Coombe Wood nursery. It is probably *A. Fargesii*; but, as the plants are still very young, we are uncertain of this identification, and think it best to leave this species undescribed for the present.

(A. H.)

¹ *Journ. de Bot.* 1899, p. 255; Masters, *Gard. Chron.* xxxix. 212, fig. 82 (1906).

² *Journ. de Bot.* 1899, p. 256; Masters, *Gard. Chron.* xxxix. 212, fig. 83 (1906).

³ *Gard. Chron.* xxxix. 299, fig. 121 (1906), and *Journ. Linn. Soc. (Bot.)*, xxxvii. 423 (1906).

⁴ *Journ. Linn. Soc. (Bot.)*, xxxvii. 423 (1906).

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ABIES PECTINATA, COMMON SILVER FIR

- Abies pectinata*, De Candolle, in Lamarck, *Flore Franç.* iii. 276 (1805); Willkomm, *Forstliche Flora*, 112 (1887); Mathieu, *Flore Forestière*, 525 (1897); Kent, Veitch's *Man. Conifera*, 530 (1900).
Abies alba,¹ Miller, *Dict.* ed. 8, No. 1 (1768); Kirchner, *Lebengesch. Blütenpfl. Mitteleuropas*, i. 78 (1904).
Abies vulgaris, Poiret, in Lamarck, *Dict.* vi. 514 (1804).
Abies Picea, Lindley, *Penny Cycl.* i. 29 (not Miller) (1833).
Pinus Picea, Linnæus, *Sp. Pl.* 1001 (1753).
Pinus Abies, Du Roi, *Obs. Bot.* 39 (1771).
Pinus pectinata, Lamarck, *Fl. Franç.* ii. 202 (1778).
Picea pectinata, Loudon, *Arb. et Frut. Brit.* iv. 2329 (1838).

A tree attaining under favourable conditions about 150 feet in height and 20 feet or more in girth. Bark on young trees, smooth, greyish; ultimately fissuring and becoming rough and scaly. Buds small, ovoid, non-resinous; scales few, brownish, rounded at the apex. Young shoots grey, smooth, with a scattered short erect pubescence, which is retained in the second year.

Leaves on lateral branches pectinately arranged in two lateral sets; those below the longest and directed outwards and slightly forwards in the horizontal plane; those above directed upwards and outwards, forming between the two sets a shallow V-shaped depression. Leaves about 1 inch long, $\frac{1}{2}$ inch broad, linear, flattened, narrowed at the base, tapering slightly to the rounded, bifid apex; upper surface dark green, shining, with a continuous median groove and without stomata; lower surface with two white bands of stomata, each of seven to eight lines; resin-canals marginal.

On leading shoots the leaves are radially arranged, and differ considerably from those on lateral branches; they are thicker, with median resin-canals, acute and not bifid at the apex, and often show lines of stomata on their upper surface towards the tip. Leaves on cone-bearing branches are nearly all directed upwards, very sharp-pointed, and almost tetragonal in section.

Trees, standing in an isolated position, usually begin to flower at about thirty years old; when crowded in dense forests, much later, usually not before sixty years old.

Staminate flowers, surrounded at the base by numerous imbricated scales, cylindrical, about 1 inch long, with greenish-yellow stamens. Female cones, appearing in August of the previous year as large rounded buds, enclosed in brown scales, and situated just behind the apex of the shoot; in spring, when developed, erect, cone-shaped, about 1 inch long, surrounded at the base by fringed scales; bracts numerous, imbricated, denticulate, ending in long, acuminate points, and completely concealing the much smaller ovate, rounded ovuliferous scales.

¹ *Abies alba*, the oldest name under the correct genus, was never in use until lately, when it has been resuscitated by Sargent and some continental botanists. This is one of the cases where adhesion to strict priority would lead to great confusion; and hence we have adopted the name *Abies pectinata*, by which the tree is generally known.

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Cones on short stout stalks, cylindrical, slightly narrowed at both ends, obtuse at the apex, about 6 inches long, 2 inches in diameter, greenish when growing, dull brown when mature, with the points of the bracts exerted and reflexed. Scales tomentose externally, fan-shaped, about 1 inch broad and long; upper margin slightly uneven; lateral margins denticulate, each usually with a sinus, below the slight wings on the outer side of the scale; claw clavate. Bract with an oblong claw, extending up three-quarters the height of the scale, and expanding above into a lozenge-shaped denticulate lamina, which ends in a sharp long triangular mucro. Seed with wing about an inch long; wing about twice as long as the body of the seed.

SEEDLING

Seed sown in spring germinates in three or four weeks. The cotyledons, usually five in number, are at first enveloped, as with a cap, by the albumen of the seed; but speedily casting this off, they spread radially in a whorl at the summit of the short caulicle, and remain green on the plant for several years; about an inch in length, linear, obtuse at the apex, flat beneath, and slightly ridged on the upper surface, which shows two whitish bands of stomata. In the first year only a single whorl of true leaves, arising immediately above the cotyledons and alternating with them, is produced. Primary leaves short, acute, or obtuse, but not emarginate at the apex, and with the stomatic bands on the lower surface. A terminal bud closes the first season's growth, the plant scarcely attaining two inches high. In the second year ordinary leaves, arranged spirally on the stem, are produced. The growth of the plant in the first two or three years is mainly concentrated in the root, which descends deep into the soil, the increase in height of the stem above ground being trifling. The stem branches in the third or fourth year, and produces annually for some years one or two lateral branches, making no great growth in height, reaching in the ninth year an average of two feet. About the tenth year normal verticillate branching begins; and from this onwards the plant makes rapid growth.

VARIETIES

Dr. Klein gives in *Vegetationsbilder* illustrations of some remarkable forms¹ which the silver fir assumes at high elevations in Central Europe, and which he calls "Wettertanne" or "Schirmtanne." These trees have lost their main leader through lightning, wind, or otherwise, and have developed immense side branches which spread and then ascend, sometimes forming a candelabra-like shape. The finest of this type known to him is at St. Cerques in Switzerland, and measures at breast height no less than 7.40 metres in girth, about the same as the largest of the Roseneath² trees.

Other varieties, distinguished by their peculiar habit, occur in the wild state.

¹ These forms are also described by Dr. Christ in *Garden and Forest*, ix. 273 (1896).

² One of the trees at Roseneath, Dumbartonshire, has a similar growth of erect branches, like leaders from some of the horizontal limbs. This is figured, from a photograph by Vernon Heath, in *Gard. Chron.* xxii. 8, fig. 1 (1884). At Powerscourt there is also a large tree, 13 feet 3 inches in girth, with branches prostrate on the ground and sending up several upright stems.

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Var. *pendula*,¹ with weeping branches, has been found in the Vosges and in East Friesland.

Var. *virgata*,² found in Alsace and Bohemia, has long pendulous branches, only giving off branchlets near their apices, and densely covered with leaves.

Var. *pyramidalis*.³ This form, which in habit resembles the cypress or a Lombardy poplar, was found growing wild in the department of Isère in France. A very fine example, about 35 feet high in 1904, is growing in the arboretum of Segrez.

Var. *columnaris*,⁴ very slender in habit, with numerous short branches, all of equal length, and with leaves shorter and broader than in the type.

Var. *tortuosa*, a dwarf form, with twisted branches, and bent, irregularly-arranged leaves.

Var. *brevifolia*, another dwarf form, distinguished by its short broad leaves.

Remarkable variations in the cones have also been observed. A tree, discovered by Purkyne⁵ in Bohemia, bore cones, umbonate at the apex, and with short and non-reflexed bracts. Beissner⁶ mentions a tree, growing in the park at Wörlitz near Dessau, which produced cones a foot in length.

DISTRIBUTION

The common silver fir is a native of the mountainous regions of central and southern Europe. The northern limit of its area of distribution begins in the western Pyrenees about lat. 43° in the neighbourhood of Roncesvalles in Navarre; and crossing the chain it extends along its northern slope as far as St. Béal; from here it bends northwards to the mountains of Auvergne, whence it is continued in a north-easterly direction through Burgundy and French Lorraine, crossing the eastern slope of the Vosges about the latitude of Strasburg. From here it curves for some distance westward, and reaching Luxemburg, is continued through Trier and Bonn to southern Westphalia. Across the rest of Germany, according to Drude, who gives a map of the distribution of the species, the northern limit extends as an irregular line about lat. 51°, which touches Hersfeld, Eisenach, the northern edge of the Thuringian forest, Glauchau, Rochlitz, Dresden, Bautzen, and Görlitz; and ends in the southern point of the province of Posen. Around Spremberg to the north of the limit just traced, it is found wild in a small isolated territory.

The eastern limit, beginning in Posen, extends through Poland along the River Wartha to Kolo, crosses to Warsaw, and descending through Galicia west of Lemberg, reaches the Carpathians in Bukowina; and is continued along the mountains of Transylvania to Orsova on the Danube.

The southern limit is not clearly known as regards the Balkan peninsula, as the silver fir, which occurs in the mountains of Roumelia, Macedonia, and Thrace,

¹ Kottmeier found peculiar weeping silver firs in the Friedeberg forest, near Wittmund in East Friesland, in 1882. Cf. Wittmack's *Gartenzeitung*, 1882, p. 406, and Conwentz, *Seltene Waldbäume in Westpreussen*, 161 (1895).

² Caspary, in Hempel's *Oesterr. Forstzeitung*, 1883, p. 43.

³ Carrière, *Conif.* 280.

⁵ Willkomm, *Forstliche Flora*, 118 (1887).

⁴ Carrière, *Rev. Hort.* 1859, p. 39.

⁶ *Nadelholzkunde*, 433 (1891).