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Source: *Bulletin of Miscellaneous Information (Royal Botanic Gardens, Kew)*, Vol. 1912, No. 2 (1912), pp. 75-85

Published by: Springer on behalf of Royal Botanic Gardens, Kew

Stable URL: <http://www.jstor.org/stable/4104540>

Accessed: 27-06-2016 06:37 UTC

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ROYAL BOTANIC GARDENS, KEW.

BULLETIN

OF

MISCELLANEOUS INFORMATION.

No. 2.]

[1912.

VI.—NOTES ON TREES SUITABLE FOR EXPERIMENTAL FORESTRY.* III. AMERICAN CONIFERS.

W. DALLIMORE.

THE REDWOOD (*Sequoia sempervirens*, Endl.). If free growth and rapid development were the only qualifications necessary to make this tree a success in British forests, it might be planted without further delay, but it remains to be proved whether the timber will be good enough to warrant extensive plantations. The important place occupied by the species in the lumber trade of America, is, however, a sufficient recommendation to warrant it a good trial here.

An idea of its rapid growth in the British Isles may be gathered from the fact that, although it was not introduced before 1846, there are numerous trees between 70 and 110 feet in height, with girths ranging from 8 to 14 feet. As fast growth is quite natural to the tree, there is no reason to suppose that the timber from forest-grown examples would, on that account, be so coarse as that produced by ornamental specimens.

Sequoia sempervirens is a native of California and is found from the northern boundary of the State, southward to the southern boundary of Monterey County, on the mountain slopes and on flat lands near the rivers, where the atmosphere is moist and the temperature fairly equable.

The United States Department of Agriculture, Forestry Section, has published a Bulletin, No. 38, on "The Redwood." It is divided into three parts, i, "A Study of the Redwood"; ii, "The Brown Rot Disease of the Redwood"; iii, "Insect Enemies of the Redwood." In this Bulletin, which is well illustrated, the redwood and its peculiarities are dealt with very fully, and the following notes have been extracted. The tree reaches its greatest size on the flats where the soil is moist and the atmosphere misty. Under such conditions it grows to a height of 350 feet with a diameter of

* The previous articles were published in *K.B.*, 1911, p. 211 and p. 303.

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20 feet. On the slopes its maximum height is 225 feet and its greatest diameter 10 feet. Most of the large redwoods are from 400 to 800 years old, but the trees begin to die down and growth falls off after the age of 500 years has been reached. The oldest redwood recorded in the above work showed 1373 annual rings.

The chief requirement of the redwood is moisture at the roots and the nature of the soil appears to be a matter of secondary consideration. According to the Bulletin mentioned above, "moisture available for the roots is the first need of the redwood, as any hilly tract of forest will show. Whenever a small gully, or bench, or basin is so placed as to receive an uncommon amount of seepage, or wherever a creek flows by, there the trees are sure to be largest. Even if the soil be not rich, but merely gravel, and it contains much moisture, the redwood will grow more abundantly there than on richer but drier ground."

Although the redwood may be propagated from seeds, forests are usually replenished by means of sprouts from the old stumps left after felling operations. These sprouts are produced very freely and grow rapidly. Several plates in the Bulletin show how the forest is reproduced by this means. The yield of virgin redwoods under the most favourable conditions is given at from 125,000 to 150,00 cubic feet per acre. In less favoured places it is sometimes as low as 20,000. These figures appear to represent the quantity of timber actually marketed.

Sequoia sempervirens is naturally a light demanding subject, but it is said that trees which have been partly suppressed have the faculty of recovering quickly and growing away again freely as soon as more room and light is given. The wood and its uses are spoken of as follows:—"Redwood possesses qualities which fit it for many uses. In colour it shades from light cherry to dark mahogany: its grain is usually straight, fine, and even; its weight is light; its consistency firm, yet soft. It is easily worked, takes a beautiful polish, and is the most durable of the coniferous woods of California. It resists decay so well that trees which have lain five hundred years in the forest have been sent to the mill and sawed into lumber. The wood is without resin and offers a strong resistance to fire, as is indicated by the record of fires in San Francisco, where it is much used. Insects seldom injure it, because of an acid element its lumber contains. In sea water, however, the marine teredo eats off redwood piling as readily as other timber. Redwood is used for all kinds of finishing and construction lumber, for shingles, railroad ties, electric-light poles, paving blocks, tanks, and pipe staves. It is an excellent wood for all these purposes. As a tie its average life, under heavy traffic, is six to eight years; as shingles it will last as long as 40 years. The chief difficulty in working redwood lies in the seasoning process. The tree absorbs so much moisture that the butt logs will sink in water. Left in the sun, they require three or four years to dry."

Isolated specimens in this country often lose their tops by wind, hence the necessity for forming pure rather than mixed plantations, and planting in valleys rather than on exposed hill sides.

THE DECIDUOUS CYPRESS (*Taxodium distichum*, Rich.).—The many fine examples of this species which are to be found in the British

Isles leads one to suppose that it will prove successful as a forest tree if planted under suitable conditions. Being naturally a moisture-loving subject, it could hardly be expected to thrive under conditions which would suit the Scots pine for instance, but there are many low-lying places where the water is near the surface which would probably provide it with an ideal home. That it is able to grow in water is shown by a tree which has been surrounded by water for several years in the lily pond in the Arboretum at Kew, whilst on Mr. Newdigate's estate near Nuneaton a tree with no soil visible about the base is to be seen growing in the middle of a large lake. Trees perpetually surrounded by water cannot be expected to make such satisfactory progress, however, as those which stand clear of the water, but close enough for the roots to enter. To such trees an occasional flooding is said to cause no inconvenience.

Sargent, "Silva of North America," x. pp. 151-154, gives a description of the species and its peculiarities. The wood is soft, close, straight-grained, not strong, easily worked, and very durable in contact with the soil. Hough, "Elements of Forestry," p. 311, mentions three grades of lumber from this tree known in the timber trade—red, black, and white cypress, differing in the colour of the heartwood. The red and black are most valued, as they are less liable to split than the white. The tree has been described as "one of the great resources of the Southern States," its wood being highly valued for general constructive purposes—railway ties, posts, shingles, cooperage, &c.

It is found from 100 to 150 feet in height and four or five feet in diameter, although trees have occasionally been recorded with a diameter of 11 feet. Though sometimes growing on dry land, it is more frequently confined to low swampy ground in the vicinity of rivers, or to wet hollows amongst forests of other trees. It is distributed from Southern Delaware to Florida and Texas, its largest dimensions being attained towards its more southerly limits.

Fine examples have been recorded from many gardens in the British Isles. These range from 60 to 100 feet in height and from 7 to 13½ feet in girth. Some of them have developed the remarkable knees or upright growths from the roots which are peculiar to the tree when growing in swampy ground in America.

A number of the finest trees about London are to be found at Whitton Park, Hounslow, and Syon House, Brentford. In the former case there are several specimens between 80 and 100 feet in height, the largest one having a girth of 13 feet 7 inches at five feet from the ground. The largest one at Syon is recorded in the "Catalogue of Syon House Trees and Shrubs," 1910, as being 111 feet high and 12 feet in girth. In 1849 it is said that 23 specimens existed there, all of them being more than 50 feet in height.

There can be little doubt that the deciduous cypress is suitable for a pure stand, while it would probably succeed with Sitka spruce in wet but not exposed places. Its narrow fastigate habit when young, suggests that close planting would be necessary.

J. R. Batterden, "Timber," 1908, says that the timber of *Taxodium distichum* finds a place in the English market, and, in describing its uses, remarks that it is largely used for tanks, vats,

and tubs, and that in New Orleans 90,000 fresh-water cisterns are said to be made of the wood; its value for the purpose lies apparently in its durability when kept continually wet.

THE PORT ORFORD CEDAR, LAWSON CYPRESS, OR MATCH-WOOD (*Cupressus Lawsoniana*, A. Murr.).—Several landowners are already trying this species under forest conditions in various parts of the country, with apparently good results, though definite proof of its value for British woodlands is not yet forthcoming. In most places where it has been planted for ornamental purposes, it has given satisfactory results, and has grown rapidly after the first few years, therefore it is reasonable to expect that it will prove suitable for forest culture over a wide area and under many conditions.

Its natural range of distribution is very limited, for it is found in a comparatively small district, lying between Coos Bay in south-eastern Oregon and Klamath river in north-eastern California. In this region, where it extends 30 or 40 miles inland at a low elevation from the coast, the climate is marked by a moderate temperature and a heavy rainfall, with a humid and foggy atmosphere and a large proportion of cloudy days.

Under favourable conditions it attains a height of 200 feet with a diameter of from 6 to 12 feet. Old trees have very thick bark, however, and as much as 18 inches has sometimes to be deducted from the diameter for bark.

Hough, "American Woods," x. No. 241, pp. 41-42, describes the wood as follows:—"Wood light, rather hard and strong, very close grained, easily worked and durable in contact with the soil. It is of a light yellow colour with lighter sap-wood and with a pleasant resinous fragrance. One of the most valuable timbers of N. America in the excellence of its lumber for interior finishing, flooring, boat-building, railway ties, fence posts, etc., and is used extensively in the manufacture of matches. In the last-mentioned use its identity is at once asserted by the characteristic fragrance of the smoke of the burning match. Resin of the wood is a powerful diuretic. This property is so active that workmen in the sawmills, when this lumber is being sawn, are so affected that it becomes necessary occasionally to change to other woods."

The variable character of this species under cultivation necessitates precaution in the selection of seed-bearing trees, those only being selected which are typical of the species and of vigorous and erect habit. By collecting seeds haphazard from a collection of decorative varieties, it is unlikely that the seedlings produced will prove satisfactory when planted under forest conditions.

Elwes and Henry, "Trees of Great Britain and Ireland," v. p. 1207, say that the Lawson cypress has been tried in forest plots at different stations in Prussia, the total area being about 30 acres, and also at Grafrath in Bavaria. After 20 years' experience the wood grown in Germany is found to be as good as that of Oregon. Heartwood is said to begin to form in the tenth year with the characteristic fragrant odour of the timber in America. It is a light-loving tree, and people who have tried it recommend that it should be planted at intervals of three feet.

THE YELLOW CYPRESS (*Cupressus nootkatensis*, Lamb.).—This tree is so highly spoken of by American timber experts, that it

appears to be worth a good trial under forest conditions in this country, especially as it gives good results as an ornamental specimen. It is found on the western coast of N. America, from southern Alaska to Mount Jefferson in Oregon, its best proportions being attained about the coast region of British Columbia, in Vancouver Island and in islands off the coast of Alaska, where it ascends to an elevation of from 2000 to 3000 feet. Further south it reaches an altitude of 4000 to 5000 feet in the Cascade Mountains.

Mature specimens are met with up to 100 feet in height with a diameter of from 5 to 6 feet. Elwes, *l.c.* v. p. 1196, records one on the road from Longmire Springs to Paradise Valley on Mount Rainier, as being 108 feet high and 17 feet 10 inches in girth above a place where it forked at 6 feet from the ground, and 26 feet in girth below the fork. The largest tree recorded in England measured, in 1908, 61 feet in height and 5 feet 7 inches in girth. This had been grown in the open and was well branched and of perfect shape. Several other examples between 50 and 60 feet in height are mentioned. These dimensions may be considered as fairly satisfactory, considering that the species does not grow naturally to a very large size and that the trees in question are probably less than 50 years old, for it is only about 60 years since it was first introduced into Europe, through the medium of the St. Petersburg Botanic Garden, though it was discovered by Menzies half-a-century earlier.

Writing of the wood of this tree in "American Woods," x. No. 240, pp. 39-40, Hough, says:—"It is light but moderately hard and brittle, of exceedingly fine, close grain, with a pleasant resinous odour, easily worked and very durable in contact with the soil. It is of a clear, light yellowish colour, with thin, lighter coloured sap-wood." He also says that for cabinet-making it has few equals and that it is exported to China, where it is used as a substitute for satin-wood.

Elwes, *l.c.*, p. 1197, says:—"Though looked on as an ornamental tree only, my experience of it on poor dry soils justifies me in thinking that if it could be procured at a reasonable cost, it would be one of the most valuable trees for such soils that can be planted; because it is not only absolutely hardy under all conditions in every part of the country, but will thrive where no other tree whose timber at all approaches it in value, except perhaps the larch, will grow to any size. Though a slow grower at first, and not likely to attain in this country the dimensions of *Thuya plicata*, it has all the other good qualities of that tree in an even greater degree." On page 1198 he adds that he has such confidence in the tree that he would plant 10,000 under forest conditions on his estate if he could procure them at a forest tree price. On his estate, where he says the soil is not the best kind for Western American Conifers, he contrasts the growth of the Yellow Cypress with that of the Corsican Pine. Six trees of the *Cupressus* planted in 1876 or 1877 were, at the time he wrote, 35 feet high and 2 feet in girth, uniform in height and habit. Corsican Pines planted close by at the same time averaged 40 feet in height.

No difficulty should be experienced in obtaining American seed of this tree and comparatively young specimens in this country

bear seeds freely. The young trees form plenty of fibrous roots and are not difficult to transplant, up to 3 or 4 years of age. Spaced from 3 to 4 feet apart, it might be tried as a pure stand, or it could be mixed with some light demanding subject, for it does not mind a moderate amount of shade. It is probable that it will succeed in the west of England, Scotland and Ireland, rather than in the east of England on account of the more humid atmosphere in the former places.

A number of common names are applied to the tree in addition to that of Yellow Cypress; some of them are Alaska Cedar, Yellow Cedar, and Sitka Cypress. Its cones are sufficiently distinct to enable anyone to distinguish it from Lawson's Cypress, for the scales are pointed, whilst those of *Cupressus Lawsoniana* are plain. The botanical characteristics of the tree are to be found in Sargent's *Silva* of N. America.

THE WESTERN TAMARACK (*Larix occidentalis*, Nutt.). Attention has been directed to the virtues of this species on several occasions during the last few years, and several importations of seeds have been made with the object of establishing it under forest conditions. The chief reason for inducing people to plant it is the hope that it will prove immune from larch canker and so form a good substitute for common larch in those places where *Larix europaea* is so liable to be crippled by disease as to make it an unprofitable species to plant. From descriptions of the timber of *L. occidentalis* and the uses to which it is put, it appears to be very similar in quality to that of the European species, hence the superiority of one kind over the other depends mainly on the constitution of the two species.

The Western Tamarack occupies the basin of the Upper Columbian River, and is found at a fairly high elevation—2000 to 7000 feet. Its largest dimensions are attained on the bottom lands of northern Montana and Idaho, where it is said to attain sometimes a height of 250 feet with a diameter of six or eight feet. On slopes of hills and on mountain sides it is much smaller, though it gives satisfactory results even when growing in poor sandy soil.

Hough, "American Woods," x. No. 250, pp. 52-53, says that the wood is heavy, hard, strong, close-grained, with few resin passages, very durable in contact with the soil, and susceptible of a very smooth polish. It is of a rich, orange-brown colour, with thin brownish-white sap-wood. He describes it as one of the most valuable of the coniferous woods of the continent, and as being used for furniture, doors, interior finishing, railway ties, fence posts, &c. Specimens of the wood may be seen in Museum No. 3, at Kew, also a specimen of resin which is collected and eaten by the natives. Hough mentions this resin, and says that it is sweetish, resembling dextrine in properties, and exudes in abundance.

No large trees of *L. occidentalis* appear to exist in this country. At Kew there are a number of trees, 30 to 38 feet high. These are growing with European larch of a similar age, about 30 years, and there is little to choose between the development of the two species. Elwes and Henry, "Trees of Great Britain and Ireland," ii. pp. 395-402, say that a good seed year occurs in America every two or three years. The cones open and liberate the seeds in

September, therefore it is necessary for collectors of seeds to be at work during the first three weeks of that month. There appears to be some difficulty in obtaining seeds through the usual channels, and most of the importations which have been made were by private enterprise. Though the trees at Kew bear cones freely, they invariably fail to perfect their seeds.

L. occidentalis could be tried either as a pure plantation or as a mixture in the same way as the common larch. The latter method of culture would probably be the more successful one.

THE WESTERN HEMLOCK SPRUCE (*Tsuga Mertensiana*, Carr.). This appears to be the most suitable of the several N. American hemlock spruces for trying under forest conditions in the British Isles for in America it grows to a larger size and produces better timber than *T. canadensis*, Carr., the hemlock spruce of N. E. America, and is hardier than the mountain hemlock, *T. Pattoniana*, Engelm. of California.

Its distribution extends from South-eastern Alaska to San Francisco. It is said to be most abundant in Washington. Oregon and British Columbia; its largest proportions being attained in the humid atmosphere of the coast region from sea level to an altitude of 2000 feet. Where the more favourable conditions prevail, it sometimes attains a height of 200 feet with a girth of 10 feet. Hough says that towards the more northerly parts of its habitat it grows to a larger size than any other forest tree, and he also describes it as the largest representative of the genus.

The wood is described as "light, rather hard, tough, close-grained, susceptible of a good polish, of a pale, yellowish-brown colour with lighter sap-wood" (Hough, *American Woods*, ix. No. 223, pp. 50-51). It is said to be easily worked, stronger and more durable than eastern hemlock, and to be used to a considerable extent for house-building and general construction purposes, though it suffers to some extent on account of the bad reputation the eastern species has obtained for coarseness. In addition to the timber being valuable for lumber, it makes good pulp for paper-making, and the bark is rich in tannin. The bark has been used by the North American Indians for making into a coarse kind of bread. A specimen of this bread is to be seen in Museum No. 3 at Kew, and an account of the nutritive character of the bark may be found in Sargent's "*Silva of North America*," xi. p. 93.

The species grows well as an ornamental specimen in many parts of the British Isles, and it is being tried as a forest tree in a few places. In the "*Transactions of the Royal Scottish Aboricultural Society*," xx. 1907, pp. 101-2, there is a Report on "Experimental Plots at Novar," by Clive Marriott, and *T. Mertensiana* is one of the trees dealt with. Two plots, each one acre in extent, had been planted, one with the hemlock spruce and larch in equal proportions, and the other with pure hemlock spruce. In neither case had the *Tsuga* done well except where a certain amount of shelter was afforded, and the opinion expressed was, that it ought only to be planted in those places where it can have a considerable amount of protection. Compared with Douglas fir grown on another plot, it was a decidedly inferior tree. The plots had been planted from three to five years when the report was drawn up.

THE NOBLE FIR OR OREGON LARCH (*Abies nobilis*, Lindl.).—The noble proportions assumed by this tree in its native country, together with its decorative qualities, have led to its being planted very widely in British gardens. Unfortunately, in many parts of the country, more particularly in the south of England, it is attacked by an aphid, *Chermes abietis*, which causes ugly warty excrescences to appear on the branches. This pest prevents proper development and ultimately kills the tree. Another disease is also prevalent, especially amongst small plants. In this case the irritation set up by a minute insect causes thick gouty swellings on the branches which check growth, and though an affected tree may live many years, it is always an unsightly object, and eventually dies. In Scotland these diseases do not appear to be so common, and on many estates they have not been found; the trees are making rapid progress and promise to provide a good bulk of timber in a comparatively short time.

The species is found from North Washington to a position south of the McKenzie River in Oregon, its largest proportions being attained on the mountains of north-western Oregon at an altitude of from 2000 to 5000 feet. The finest examples are from 250 to 275 feet high, with a diameter of from six to eight feet. Hough, "American Woods," ix. No. 225, pp. 52-54, describes the wood as light, strong, rather hard, close-grained, of a light yellowish-brown colour, with lighter sap-wood. It is used for the interior finish of houses, boxes, &c. The following description of the tree from which Hough's wood sections were taken is given in the work mentioned above. "Height 254 feet, lowest branch 176 feet from the ground; diameter of trunk four feet from the ground, 63 inches. The trunk was as clear and shapely as a mast, and from it eight logs, 16 feet long, and one 32 feet long were cut. The upper end of the topmost log (160 feet from the ground) was 35 inches in diameter, and just above this the material for the wood sections was cut." He further adds, that "the nine logs were eventually cut into 18,142 feet of magnificent clear lumber."

On the Ardverikie estate of Sir John Ramsden, in Inverness-shire, *Abies nobilis* is the most vigorous of the several kinds of conifers grown. It is quite free from disease, and is looked on as likely to become one of the most useful forest trees for the neighbourhood. A large number of trees have been planted, the majority at an altitude of 800 to 1200 feet. Many trees are from 20 to 40 feet in height. The average rate of growth of trees growing at an elevation of 1200 feet for a period of 30 years is said to have been 15 inches. (See account of Ardverikie estate, *Kew Bull.* 1910, pp. 243-246).

THE GREAT SILVER FIR (*Abies grandis*, Lindl.). There appears to be a disposition to plant this tree under forest conditions in various parts of Scotland, and if freedom of growth were the only object in view, there would appear to be good cause for its selection. Unfortunately its timber finds less favour with American consumers than that of several other Conifers from Western N. America, hence the undesirability of forming plantations in places where more profitable kinds might be grown. It is, however, worth including in an experimental area, and the chances are that it may

turn out to be as good as some of the other firs. Descriptions of the species record examples up to 300 feet in height, and 4 to 6 feet in diameter, rising with straight clean, columnar trunks to two-thirds of their height, without a branch. Hough, ix. No. 224, p. 51-52, writes of the wood as follows:—"Wood very light, soft, not strong or durable, coarse-grained, easily worked and yielding a very smooth satiny surface. Light yellowish-brown colour, lighter sapwood. The wood of this tree is occasionally manufactured into lumber for interior finishing, boxes, casks, &c., but hitherto has been little valued as compared with the Douglas spruce, giant cedar, &c."

THE WHITE FIR (*Abies concolor*, Lindl. & Gord.). The handsome, pyramidal outline of this tree, together with its more or less glaucous foliage, make it popular for ornamental planting, whilst its free growth and comparative freedom from disease, suggest that it may be employed profitably for forest planting, for although the timber is of less consequence than that of several other trees from Western North America, it is of sufficient value to warrant the tree a trial.

The species is described in Sargent's "Silva of North America," xii. pp. 121-124. From that description it would appear that the tree attains its maximum dimensions in certain parts of California where it rises to a height of between 200 and 250 feet with a diameter of 6 feet, but elsewhere it is rarely seen more than 125 feet high and 3 feet in diameter. It covers a wide range of country from Southern Oregon to Colorado and New Mexico, and is most frequently met with in moist valleys at an elevation of from 3000 to 9000 feet.

Its timber does not appear to be exported, though it is used rather largely in the Western States for the manufacture of butter-tubs, boxes, packing-cases, &c., which must be made from scentless wood. It is described by Hough as very light, soft, not strong, coarse-grained, compact, and of a light, buff-brown colour, with sapwood scarcely distinguishable.

Writing of this tree Sargent says:—"Growing here [Boston] during the last 25 years always vigorously, compact in habit, beautiful in its various shades of blue, and free from disease and the attacks of disfiguring insects, *Abies concolor* is now more full of promise as an ornament of the parks of eastern America than any other fir tree." These words may also be said to describe the opinion formed of the tree in this country, but it remains to be seen how it will succeed under forest conditions. With it may be included the allied species *A. Lowiana*, *A. Murr.*

THE SITKA OR TIDELAND SPRUCE (*Picea sitchensis*, Trautv. & Mey.).—A great deal of attention has been directed to this tree during the last few years by both British and continental foresters, for it is found to thrive under conditions which are unsatisfactory for the proper development of the common spruce. In cold situations, where the land is wet, young trees are growing well, whereas common spruce under similar conditions has proved a failure. Here and there about the country, more particularly in Scotland, well developed specimens are to be seen, which show that it is not only in a young state that the species is a success. On the

Achnacarry estate in Inverness-shire a tree was noted in 1910 which was 98 feet high and 8 feet 8 inches in girth at 5 feet above the ground. It was possible to compare this tree with a specimen of Douglas fir near by. The latter was apparently the same height, but was 2 inches larger in girth. Both trees were planted in 1865. A small plantation of this species growing under very favourable conditions in Cornwall, was noted a few years ago. Many of the trees had formed leads from 5 to 5½ feet in length as the result of one season's growth. As a contrast to this, young trees planted on boggy land, at an elevation of 800 to 1400 feet in Inverness-shire formed leading shoots, the second year after planting, from 9 to 12 inches in length.

Sargent, in his description of the Sitka spruce in the "Silva," xii. pp. 55-58, says "no tree in the American forest grows with greater vigour or shows stronger evidence of vitality." He also refers to it as "the greatest of all spruce trees," though it does not do well in the Eastern United States.

P. sitchensis occupies an extensive range of country along the Pacific coast, for it occurs from a northerly point in Alaska to Mendocino county in California. It is most abundant and reaches its largest proportions in rich, moist soil in Western Oregon and Washington. In some places it occurs as extensive and almost pure forests, on swampy ground about the mouths of rivers where the influence of the tide is felt. Elsewhere it may be mixed with other trees but either as pure or mixed forest it is common throughout the coastal region. Sargent gives its average height as 100 feet with a diameter of 3 or 4 feet, though he says that it is occasionally met with over 200 feet high with a trunk 15 or 16 feet in diameter, and in its extreme north-western limits, as a low shrub. The timber is of very good quality and is useful for a variety of purposes. Hough, "American Woods," vi, No. 149, pp. 54-55, describes it as "light, soft, strong, with close, straight grain, compact, with satiny lustre, differing from other spruce wood by its dark heart-wood." Amongst other uses, it is employed for general interior finishing, fencing, boat-building, general constructive purposes, cooperage, and wood pulp.

Owing to its partiality for wet places it is probable that it would prove most satisfactory as a pure stand, though where a mild climate prevails a mixture of this tree and deciduous cypress might prove a good combination.

Although the two following species are being planted to some extent, it is very doubtful whether they will ever be of any commercial value in this country.

THE WHITE SPRUCE (*Picea alba*, Link.).—In both England and Scotland an effort is being made to introduce this species as a forest tree, the idea being that it will prove a success in exposed situations where many kinds of trees have little chance. It would, however, be wise to carry on a certain amount of planting of an experimental character before launching out on any great expenditure, in face of the fact that it has not proved to be a very satisfactory ornamental tree in this country, and that, with a few exceptions, the trees of Eastern North America are more difficult

to cultivate successfully in Britain than those from the western side of the continent. Its great hardiness is the principal point in its favour, but it is quite probable that more remunerative trees can be grown quite as well, if not better, than the white spruce up to an altitude at which a paying forest would cease in this country. As a shelter belt for some other tree, it is doubtful whether it would prove a general success on account of its slow growth, therefore there is little that can be advanced in its favour.

Forbes, "Development of British Forestry," p. 119, however, gives an illustration of some nice trees growing at an elevation of 1500 feet in the Pennines.

THE NORTHERN SCRUB PINE (*Pinus Banksiana*, Lamb.).—On some estates in Scotland the cultivation of this pine under forest conditions has been commenced, but it is very doubtful whether it will ever be of any commercial value. At its best it is a scrub pine, and little can be said in its favour except that it is very hardy, and that it might form cover or shelter at a high elevation where little else would grow. Even then it is probable that *P. montana* var. *uncinata* would prove to be the better tree.

VII.—THE GENUS NAUTILCALYX.

T. A. SPRAGUE.

Living plants of three obviously congeneric species of *Gesneriaceae* were presented to Kew in 1910 by Messrs. Sander & Sons, St. Albans, for whom they had been collected by Mr. Forget in Peru. One of them flowered in the same year, and was found to be an undescribed species closely allied to *Alloplectus Lynchii*, Hook. fil. (Bot. Mag. t. 7271). As the latter, however, seemed very different from any previously described *Alloplectus*, a further search was made, with the result that several closely allied species were found in the genus *Episcia*: among these were *E. bractescens*, Hanst. (*Centrosolenia bractescens*, Hook. Bot. Mag. t. 4675) and *E. hirtiflora*, Spruce. *E. bractescens* (*Nautilocalyx hastatus*, Linden) is the type and sole species of *Episcia*, section *Nautilocalyx*, Benth. & Hook. fil. (Gen. Plant. vol. ii. p. 1007). It differs from the other species mentioned above in the large bracts, and in the anticus and lateral calyx segments being connate below, but agrees in other technical characters, and has the same facies. It seemed desirable, therefore, to widen the definition of the section *Nautilocalyx* by excluding the two characters peculiar to the type species, so as to admit *Alloplectus Lynchii*, *Episcia hirtiflora* and their allies.

The question next arose as to whether *Nautilocalyx* should be retained as a section of *Episcia*, transferred to *Alloplectus*, or treated as a distinct genus. A preliminary investigation soon showed that *Alloplectus* and *Episcia* were ill-defined, and that until their distinguishing characters were better understood it would be premature to revive the genus *Nautilocalyx*. On account of the nature of the placentation (see below), it was decided to transfer