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WINTER HARDINESS OF TREES AND SHRUBS GROWING IN THE ARNOLD ARBORETUM

(*Concluded*)

CONIFERS AFTER A SEVERE WINTER. IN recent numbers of this Bulletin, (Nos. 7, 8, and 9), beside a consideration of the factors contributing to winter injury, lists have been given of injuries or destruction caused among the collections of the Arnold Arboretum by the extremely severe winter of 1933-34. These lists pertained largely to deciduous plants, particularly shrubs and woody climbers. References to conifers were purposely deferred because injuries were less immediately noticeable. Even now, at the end of the growing season, the real extent of the damaging effects of the winter cannot be fairly estimated.

The following observations were made mostly in the Arnold Arboretum, but many plants in gardens and plantations in and around Boston have been used as checks or for the purpose of comparison.

The yew and the conifer families suffered much from the cold although on the whole the damage was less than the injury to many of our broad leaved, deciduous trees and shrubs. On some species of conifers the flower buds, or most of them, were destroyed. In some instances the buds which ordinarily would have developed into new shoots or twigs were so greatly injured that they failed to make normal growth. As a result, affected trees will probably lose many of their branches and much of their symmetry, or may even die. While the Japanese yew, *Taxus cuspidata*, generally passed safely through the winter there were many plants of this species which distinctly showed some injury. This often took the form of arrested development of the terminal buds and shoots which usually showed a browning of leaves.

Generally the dormant buds had started and a checked growth developed as the season advanced. The European or English yew, *Taxus baccata*, suffered severely in some instances. Branches have died or tips of branches have failed to show life and pruning has become necessary. A careful inspection of such injured branches in June showed very small latent buds developing in the axils of leaves or leaf scars. These in another year should develop into good normal shoots or branches. In such cases pruning should be done and then very carefully. It should be noted that some of the plants which have been named as hybrids between the Japanese and European yews have shown less hardiness than the Japanese parent, though hardier than *Taxus baccata*. Several plants of *T. media*, one of such hybrids, show some injury on the tips of the branches, while *T. media Hatfieldii* was much more seriously hurt.

After growing in the Arboretum for many years, during which time it flowered and fruited, the Japanese *Torreya nucifera* was nearly killed but, although the terminal parts of the branches failed to recover, new shoots developed on the basal portions so that there is a prospect of the trees regaining a green aspect and good form after several years.

Among the conifers, the pines as a group suffered less than some other genera. Browning of the foliage occurred in some foreign species, even in Scotch pine, but during the summer, twigs and buds have developed a normal number of leaves which cover superficially any defects. Individuals of the same species varied much in their resistance to damage. Injuries to flower buds were noted in some foreign species.

On the whole, the hardy native American spruces (*Picea*) wintered well. On the other hand, the fine Sitka spruce, *Picea sitchensis*, cannot be grown here, while the very rare Brewer or weeping spruce, *Picea Breweriana*, of the mountains of southern Oregon and northern California, will live but does not thrive well. The single plant, now 7 feet high, in the Arboretum had most of its buds killed last winter. Some of the stronger terminal buds survived and have developed new growths of from one to two or three inches in length. It is a straggling plant difficult to grow and unworthy of planting in this climate. Some of the long-introduced foreign species have done well. The Norway spruce is bearing a good crop of cones and the trees show little or no winter injury. This condition may be due to the fact that the original seed came from a northern part of its range in Europe, rather than from a southern district. The spruces which show the greatest damage from the severity of the winter are those which were collected for us in central and western China, in the provinces of Hupeh and Szechuan. The latitude ranges from about 28° to 33°. Probably few interested

people realize that the latitude of this Chinese collecting ground, which has been repeatedly explored to furnish plants for our northern gardens, largely correspond to that of northern Florida and the southern half of Georgia. Florida ranges from a few feet above sea level over the greater part to rarely 300 or 400 feet at the highest points. Southern Georgia averages higher than Florida, but much of the territory is well under a thousand feet in altitude and rarely exceeds two thousand, although higher hills and mountains are more common above 33° of latitude. Trees or shrubs from the Florida and Georgia zones would rarely be considered as worth introducing for permanency into our northern states. The climate of the same latitude in western China, however, has the advantage of the general altitude of the country, which is from one or two thousand feet on the lower levels to ten or twelve thousand feet in the higher mountains. However, the rule which compensates latitude by altitude does not always work out satisfactorily because of precipitation, prevailing winds, temperatures, geologic features, soil and other factors. This estimation of latitude as related to altitude may be roughly stated in the allowance of one degree of latitude to 450 or 500 feet of altitude. As already stated much depends upon other ecological factors. Later studies have shown that the dozen or fifteen supposedly new species and varieties of spruce recently brought from China may easily be reduced to less than half a dozen species, some of which had already been found by earlier collectors and had been given names. Some of these species or so-called species show very serious injury from the effects of the past winter. For all practical or ornamental purposes they would be generally worthless for eastern Massachusetts if we had occasional repetition of such a winter as that of 1934.

Picea asperata and its described forms have proved to be undependable and undesirable under such conditions as prevailed last winter. In the Arboretum an examination of several trees in August showed that about fifty per cent of the winter buds failed to develop or to make any appreciable growth. When such a large proportion of buds is killed, the surviving terminal or other buds often produce unusually long new shoots due to the concentration of growth into a few rather than many twigs. Under such circumstances the trees are likely to become permanently unsymmetrical. The difference in hardiness of the plants which have been called *P. asperata* may well be due to altitude, latitude and other ecological factors occurring within its natural range. This species is clearly not adapted for successful plantings in regions with more severe winter climate than that prevailing at Boston

and even here it is liable to serious damage in unusually severe years or situations, although there are nurseries or plantations in the vicinity where the plants are reported to have come through in fairly good order. It may be that hardier races will be found in western China.

Picea Balfouriana, which is probably the same as the older known *P. likiangensis*, is another of the so-called new species which has suffered such damage from the cold of the past winter that it may be considered unsuitable to plant in this climate for permanent landscape effects. A tree 14 feet high showed all buds dead or badly checked. On August first, the tree showed new leaves forming about the old dormant buds, but no new growth of twigs.

Picea purpurea, which is possibly still another synonym for *P. likiangensis*, was very badly injured and is rather unpromising for this region although it may be a very desirable acquisition under less severe conditions.

Picea Watsoniana, 12 feet high, showed in August a very large proportion of buds permanently blasted; a few escaped unhurt and exhibited extra long new shoots. These few abnormally vigorous twigs surviving among the multitude of buds which have failed must eventually produce an unevenly developed and undesirable tree for northern gardens.

The true firs, belonging to the genus *Abies*, have long had a peculiar attraction for gardeners and landscape planters. Naturally, there is an especial interest in all species which are reported hardy in our New England climate. We have few American species which thrive satisfactorily in the climate of Boston, probably the best being *Abies concolor* or the white fir of our western mountains. But to be hardy and satisfactory in New England the seed of this species must be procured from the drier, colder territory east of the Rocky Mountains, as in Colorado, for if grown from seed collected from west of the Rockies, in the same latitude, the results are far less satisfactory. This is true of all other splendid Pacific coast firs; they are far too tender for satisfactory growth in central New England. European firs, like the Nordmann fir, *Abies Nordmanniana*, and the Cilician fir, *A. cilicica*, have long been grown here with much satisfaction but the past winter proved seriously injurious to both species. The injury took the form of causing the death of the hearts of a great many of the winter buds. The percentage of injury varied on different trees in different exposures. Usually on the most damaged trees some buds escaped. The result has been that by the first of August, when all new length growths should have been completed for the season, the major part of the twigs and

buds still appeared the same as last winter except for a few twisted green leaves developing at the sides of the dead buds, or new, very short twigs being found. The few buds which escaped injury have produced abnormally long new shoots as a result of the failure of a majority of the buds to develop. The twigs, apparently dormant even now, may be found developing scattered, small buds in the axils of the leaves of last year. These new buds on old shoots should grow next spring and carry on growth a year late. The result is likely to produce very irregular and undesirable trees for ornamental purposes.

It was hoped that the introduction of firs from Japan and western China would add greatly to our available ornamental trees. However, the experience of the past winter has shown that, danger from climatic changes is risked in using most of these species. In favored situations, they may appear to be doing well during a number of ordinary winters. Still a time may come when their growth may prove very disappointing. On the large trees of the Japanese Nikko fir, *Abies homolepis*, for example, planted on low ground, a goodly proportion of buds were winter killed and the struggle to produce new buds and leaves is very apparent. If these new buds survive and continue growth next year, the result will be, unattractive or unsymmetrical trees. On higher, sheltered ground with good air drainage the trees show only a small amount of injury, although the conspicuous male flower buds, a third of an inch long, still remain hard and inert and are black and dead within. The beautiful *Abies Veitchii* shows similar disheartening effects of the winter. Recent studies of the firs introduced from western China tend to show that the number of species credited to that region is less than has been claimed.

The behavior of the Japanese umbrella pine, *Sciadopitys verticillata*, was interesting inasmuch as out of the six trees growing near together in the Arboretum three retained their usual number of leaves while the other three lost most of their foliage. As the buds were still sound a new growth of leaves developed to carry on growth. The end of the growing season, however, shows the damaged trees much less attractive and with fewer leaves than those which were uninjured.

The deciduous bald cypress, *Taxodium distichum*, of our southern states, in this latitude usually loses the tips of branches and twigs but this defect is soon overcome by new growth. In the past winter this trouble was decidedly more apparent but as the trunks and main limbs withstood the test they have put forth belated new shoots and leaves. But the trees are not ornamental.

Rather curiously, the pond cypress, *Taxodium ascendens*, which we

have regarded as more tender than the other since its range is more southerly, came through the winter in fine condition and quickly produced its cover of light green foliage. As the two species are growing on the same northerly incline and within a few yards of each other the disparity in behavior is very interesting and unexpected.

The arborvitaes (*Thuja*) behaved much as in other seasons, the giant western arborvitae, *Thuja plicata*, wintering wonderfully well both on the top of Hemlock Hill and in the cedar and juniper collection near its base. This was true also of the genus *Chamaecyparis*, commonly called cedar or cypress, names also applied to some other genera. Perhaps more than usual injury was caused by browning and other minor injuries. Similar damages may be noted after the average winter. Even the somewhat uncertain Lawson cypress, *Chamaecyparis Lawsoniana*, came through with apparently little injury on Hemlock Hill although it makes poor growth on low land. Some injury was noted on junipers (*Juniperus*), sometimes causing the shedding of minor twigs with their leaves so that the trees or affected portions lost their full, clean greenness. But the branchlets usually appeared alive to near the tips, new growths appearing and giving promise that in another year the trees may present a more normal appearance. The dwarf spreading and the dwarf pyramidal junipers occasionally showed dead branches which probably succumbed after being weakened by other causes.

Incense cedar, *Libocedrus decurrens*, 35 feet high, in the shelter of hemlocks on Hemlock Hill, wintered much better than might have been expected considering that it is a Pacific coast tree, west of the crest of the Rocky Mountains.

The hardy race of Cedar of Lebanon (*Cedrus libanotica* or *C. libani*), introduced from Asia Minor, proved gratifyingly resistant to the unusual cold to which it was subjected. Some trees lost a considerable proportion of their foliage in the spring, giving them a very open and naked appearance, but as few leaf buds were injured beyond recovery new leaves soon appeared so that by next year the trees will probably have returned to almost normal aspect.

The larches (*Larix*) came through the winter in good order except that in some cases the flower buds were destroyed.

For several successive years the Japanese golden larch, *Pseudolarix amabilis*, has flowered and fruited freely. This past winter all of the flower buds were destroyed by the extreme cold, so that the trees are not bearing any of their interesting cones this season. The trees, however, were otherwise apparently uninjured, a fortunate circumstance as the species is one of the most beautiful and interesting of hardy



deciduous conifers.

The famous *Cryptomeria japonica*, of Japan and China, unfortunately has so far proved unadaptable to the climatic conditions of Boston although it may be long persistent and attain some size. In the past winter trees 20 or 25 feet high had a large proportion of the weaker lateral twigs and leaves killed but stronger buds at and near the ends of the branches survived and carried on new growth.

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EXPLANATION OF THE PLATE

Fruiting branch of ***Pseudolarix amabilis*** showing cones produced during a normal season.

(*Photographed in the Arnold Arboretum.*)



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