

A Guide to the Firs (*Abies* spp.) of the Arnold Arboretum

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Twenty-five of the thirty- to forty-odd species (and hybrid species) of the wide-ranging Northern Hemisphere genus *Abies* currently grow in the Arnold Arboretum

Abies is the scientific name of the firs, or, as is more common in Britain, of the silver firs. Botanists took many years to agree upon it (Warren, 1982). Virgil (70–19 B.C.) applied the word “abies” to the wood employed for the ribs of the Trojan horse (Virgil, circa 19 B.C.). This may have led to the modern naming of the genus; certainly it influenced the naming, in 1883, of a species from northwestern Anatolia—*Abies equi-trojani* Aschers & Sint.

The English word “fir” is of Scandinavian (Old Norse) origin and referred originally to pine, which in that part of the world is Scotch pine (*Pinus sylvestris* L.). Many English still refer to their pines as “firs.” Their use of “silver fir” as the common name for members of the genus *Abies* is due to the whiteness of the undersides of the leaves in most species.

The aims of this guide are, first, to highlight the morphologic characters of the genus *Abies* so that it may readily be distinguished from related genera and, second, to accentuate the characters that clearly separate the species of *Abies* from each other.

The Genus *Abies*

The genus *Abies*, as do the genera *Pinus*, *Picea*, and *Larix*, grows widely in the North Temperate Zone around the world, reaching from the Arctic Circle (*Abies sibirica*) to the Tropical Zone, at 15 degrees North latitude (*Abies guatemalensis*) in Central America. In general, it is not as hardy in Arctic climates as are members of the genus *Picea*, but *Picea* does less well than *Abies* in southern cli-

mates like that of the Mediterranean area.

There are some thirty to forty species in the genus *Abies*, depending on the author. Liu (1971), for example, lists forty-one species, sixteen varieties, and six hybrids. *Abies* competes for third place with *Picea* as the genus of conifers in the Northern Hemisphere containing the greatest number of species (*Pinus* contains about one hundred species and *Juniperus* about sixty). This guide is based on the species of *Abies* in the Arnold Arboretum—twenty-three species and two named hybrids, twenty-five in all (see the list on page 13).

Opposite: Drawings made by Charles Edward Faxon of various macroscopic and microscopic structures of the grand fir (*Abies grandis* Lindley). From Charles Sprague Sargent's *The Silva of North America*. (See page 29.)

Habit

Erect. Narrow. Pyramidal. With the notable exception of *Abies nordmanniana*, the branches do not droop. The leader is seen upright and rigid against the sky as in *Picea* (not nodding as in *Tsuga*).

Bark

Smooth at first but stippled with horizontal rows of resin blisters appearing like lentils. With age the lower bark in most species becomes rough. Departures from these generalizations form the basis for the identification of certain species.

Buds

Ovate or round (less pointed than in *Picea*). Resinous or not resinous. It is to be noted that the resinosity or nonresinosity of the buds is useful in distinguishing species but is of no use after they have broken open in the growing season (May through July) until the new ones have formed. The resin may present to the eye either as semicrystallized white granules or as glairy, clear material. Both are sticky to the touch.

Branchlets

Surface generally even in contour but often fissured or undulate. Not roughened nor scaled. Hairy or not hairy according to species. When the leaves fall off the branchlet symmetrical, round leaf scars are left. These scars are different from those on the branches of *Picea*, which are at the tips of woody pegs, or projections from the branchlet surface called *sterigmas*. The leaf scars in *Pseudotsuga* (Douglas fir) are also rounded but are slightly raised from the branchlet surface.

Foliage

Leaves are in two ranks, each rank consisting of two or more rows in which the shorter leaves are above. They tend to be arranged in a pectinate fashion, with a "V" between the rows above and less of a V below. Prominent exceptions are *Abies koreana*, and *Abies pinsapo*, whose leaves, although more dense

below, are arranged all around the branchlet. Also, the nearer the situation of the branchlet to the crown, the greater the tendency to suppression of the V.

Leaves

Flattened, linear. Above: few or no stomata (exceptions showing stomata above, such as *Abies concolor*, *Abies lasiocarpa*, *Abies magnifica*, *Abies pinsapo*, and *Abies procera* give a first clue to identity), a groove usually being present. Below there are two longitudinal bands made up of several rows each of stomata varying in color from white to gray-green. The bands are framed by three longitudinal, slightly raised, green ribs, the midrib, and the sideribs. The tip of the leaf is rounded or pointed or notched. The attachment of the leaves to the branchlet is by a rounded end of the pedicel, which looks like a suction cup.

Resin Canals

Resin canals are tubular channels in the leaf tissue lined with resin-secreting cells. Their position in the leaf relative to other structures seen in cross section is of use in distinguishing between species, as is true to some extent in all conifers. This is particularly so in the genus *Abies*, where the position is more constant and reliable than in other conifers.

Firs have two resin canals. They are seen with a lens as two holes in the cut surface of a transected leaf from which drops of resin emerge (see the figure, page 10). The two categories of position are marginal, wherein the canal edge touches the hypoderm, and median, when it does not.

Since the relative position of the canal within the leaf may vary between its base and its tip, make the section of the leaf near its middle. Use a very sharp instrument, such as a razor blade, and wipe away the emerging resin droplet, which may be so large as to obscure the position of the canal. A hand lens and a good light are needed. A dissecting microscope is a useful "luxury."

Cones

The barrel-shaped, upright megasporangiate cones of *Abies* occur, as they do in most conifers, in the uppermost branches of the tree. The young cones of most species are purple, but the color changes to brown later in the year. A few conspicuous exceptions have cones that are green when young—*Abies nephrolepis* forma *chlorocarpa*, *Abies homolepis* var. *umbellata* (*Abies* \times *umbellata*), and *Abies veitchii* var. *olivacea*, for example. Ovuliferous (seed-bearing) scales of *Abies* cones are woody, each bearing two winged seeds on its adaxial surface. They mature in one growing season and disintegrate on the tree. The scales detach in the fall, and the seeds are dispersed by the wind. The central spikelike element of the cone denuded of scales remains erect on the branchlet for up to a year or more.

The bracts of *Abies* cones are in certain species longer than the cone scales. The tips are then visible, and they are described as "exserted." This is a helpful lead toward identity. All species of the genus *Abies* are monœcious. Pollination is by wind.

Similar Genera and Distinguishing Characters

Genera of evergreen trees that might be confused with are *Picea* spp. (the spruces), *Tsuga* spp. (the hemlocks), *Pseudotsuga* spp. (the Douglas firs), and *Taxus* spp. (the yews). The salient differences among them are tabulated on page 12.

The first important step is examination of the branchlet for the character of the leaf scars. The next is the leaves themselves. The bud and the cone, when available, are extremely, if not definitively, important, but they are not as dependably available as the leaves. Study of the bark and habit should come next. Having accomplished examination of these, then reexamination of the specimen in more detail (hairiness and color of branchlet, resin canals in leaves) is advisable. This order of examination can obviously be changed if one is in the presence of the tree

itself from the outset. The habit and the bark will then naturally be examined first.

The following seventeen species, in addition to those listed on page 13, which grow in the Arnold Arboretum, are recorded as belonging to the genus *Abies*. Some have in the past been tried in the Arnold Arboretum and failed and therefore have not been included in this report. We make note of them here for completeness in overviewing the genus but have appended no descriptions. We will refer to them occasionally.

Abies bracteata (D. Don) D. Don ex Poiteau
Abies chensiensis Van Tieghem
Abies ernestii (Rehder) Liu
Abies delavayi Franchet
Abies durangensis Martinez
Abies guatemalensis Rehder
Abies hickeli Flous & Gaussen
Abies kawakamii (Hayata) Ito
Abies mariesii M. T. Masters
Abies mexicana Martinez
Abies nebrodensis (Lojacono-Pojero) Mattei
Abies numidica De Lannoy ex Carrière
Abies pardei Gaussen*
Abies pindrow (Lambert) Royle
Abies religiosa (von Humboldt, Bonpland & Kunth) Schlechtendal & Chamisso
Abies squamata M. T. Masters
Abies vejari Martinez

Having determined that an unknown is a member of the genus *Abies* one must establish which, if any, of the above species best fits the characters observed. Since keys are often difficult to follow, we have chosen to present the material in tabular form (pages 6 and 11). Smoothness of bark, resinosity of buds, ridges or grooves on the branchlet surface, hairiness of branchlet, stomata situated on the upper surface of the leaves in addition to the underside, whiteness of stomata, position of resin canals, and degree of exsertion of scale bracts of the cones are considered the most significant characters.

* A plant designated "*A. pardei*" does grow in the Arnold Arboretum, but an irregular taxonomic feature (glabrous branchlets) casts doubt on its identity and prompts us to omit it from the list.

Tabulations According to Important Characters

Bark

Young bark is relatively smooth (i.e., is not scaly or ridged). "Smoothness" does not rule out a "pigskin," pebbly character, and the old bark roughened with flat or elevated plates or ridges. The following are exceptions:

Old bark smooth

Abies sachalinensis
Abies veitchii

New bark rough

Abies holophylla
Abies homolepis

Bud

Most buds in firs, as in spruces and pines, are resinous. The following five exceptions are useful only when the buds are unbroken:

Abies alba
Abies cephalonica
(occasionally resinous)
Abies cilicica
(occasionally resinous)
Abies holophylla
(occasionally resinous)
Abies nordmanniana

Ridges or grooves on surface of branchlet

Branchlets conspicuously ridged and grooved (gentle undulations and shallow fissures not included):

Abies firma
Abies holophylla
Abies homolepis
Abies nephrolepis
Abies pinsapo
Abies sachalinensis

Hairiness of branchlet

Hairiness of branchlets is best looked for on the previous year's growth. A hand lens is helpful. A thorough examination is necessary to derive a concept of the trend. Scattered hairs are occasionally found in the grooves of those listed as not hairy.

Conspicuously hairy

Abies alba
Abies balsamea
Abies Xborisii-regis
Abies concolor
Abies fraseri
Abies grandis
Abies lasiocarpa
Abies magnifica
Abies nordmanniana
Abies sachalinensis
Abies sibirica
Abies veitchii

Slightly hairy

Abies amabilis
Abies firma
Abies nephrolepis
Abies koreana
Abies procera

Not hairy

Abies Xbornmuelleriana
Abies cephalonica
Abies cilicica
Abies fargesii
Abies holophylla
Abies homolepis
Abies pinsapo
Abies recurvata

Stomata on upper surface of leaves

The leaves are the most important vegetative element of a conifer for distinguishing the species from each other.

Leaves with stomata on their upper surface (when present here, stomata concentrate on the tip and in the dorsal groove):

General

Abies concolor
Abies magnifica
Abies pinsapo
Abies procera

Partial

Abies amabilis
Abies Xborisii-regis
(occasionally)
Abies Xbornmuelleriana
Abies cephalonica
Abies fraseri
Abies lasiocarpa
Abies sibirica

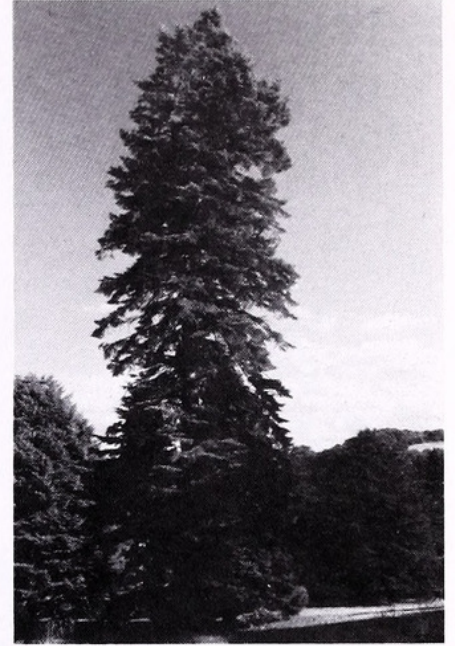
The fourteen other species show no stomata on the upper surface.

Stomata on underside of leaves gray or green (not white)

Abies Xborisii-regis
gray-green
Abies cilicica
gray-green
Abies concolor
glaucous
Abies firma
gray-green
Abies holophylla
gray-green
Abies lasiocarpa
gray
Abies pinsapo
gray
Abies recurvata
green

The seventeen other species show white stomata on the lower surface.

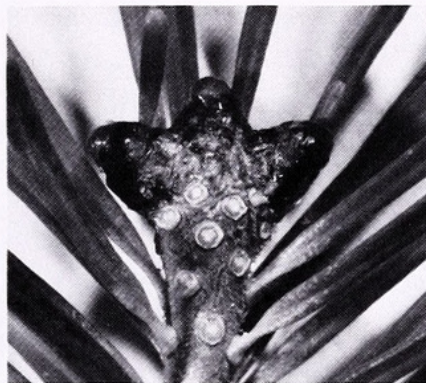
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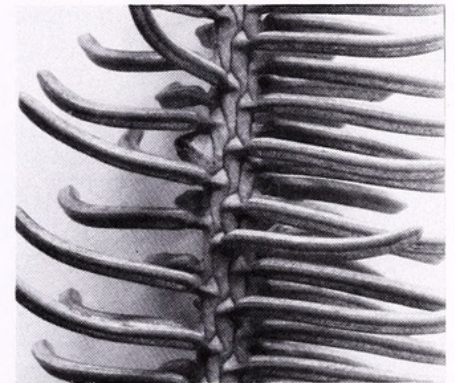
View toward the south in the Arnold Arboretum's Pinetum (left). *Abies concolor* is in the foreground, *Abies homolepis* in the background. The small plant is *Abies concolor* 'Candicans', which was damaged by vandals. A fine, 25-meter-tall, 60-year-old specimen of *Abies concolor* (right). All photographs on pages 7 through 10 were taken by Ethan W. Johnson.



a



b



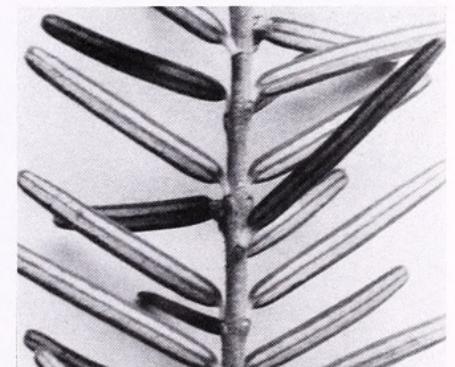
c



d



e

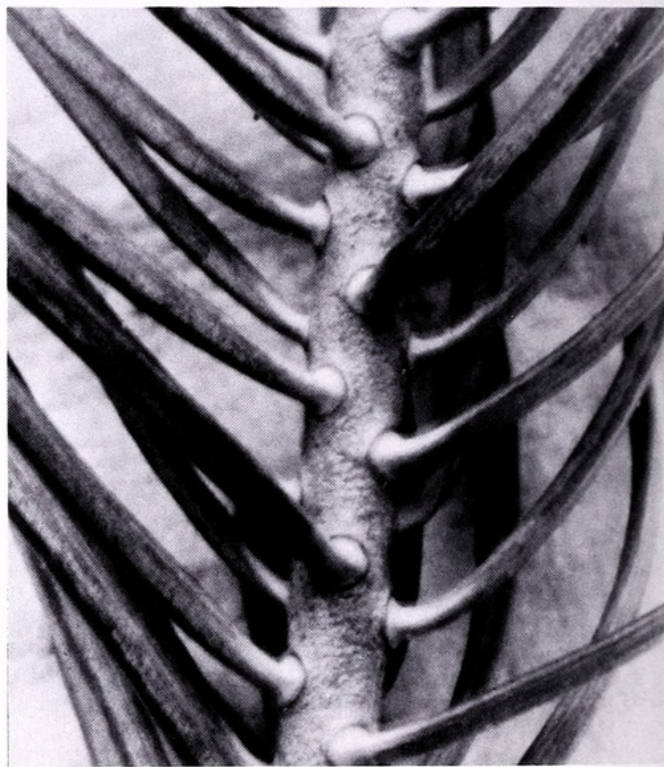


f

Leaf attachments of coniferæ. *Abies concolor*: leaf bases resembling suction cups (a); *Abies veitchii*: leaf scars circular (b); *Picea koyamai*: pegs, or sterigmata (c); *Pseudotsuga menziesii*: leaf scars slightly raised, oval (d); *Taxus cuspidata*: oblique, easily peeling attachments (e); *Tsuga caroliniana*: petioles tiny, leaf scars raised (f).



Bark. Abies balsamea: resin blisters numerous on otherwise smooth bark (left); Abies holophylla: bark flaking off in papery strips (right).



Grooving of branchlets. Abies homolepis: Branchlets grooved (left); Abies concolor: branchlets not grooved (right).



Hairiness of branchlets. Abies alba: hairs on branchlets visible to the naked eye (left); Abies concolor: hair on branchlets short, best observed with the aid of a magnifying glass (right).



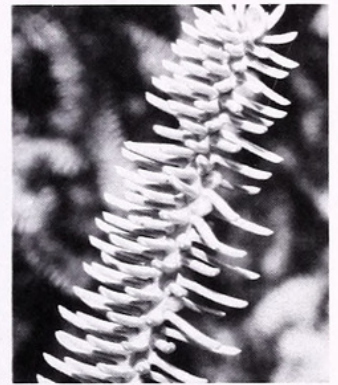
a



b



c



d



e



f



g

Leaf attitudes and contours. Abies firma: leaves on lower (immature) branches with bifid tips (a); Abies procera: leaf bases curved in hockey-stick fashion (b); Abies recurvata: leaves pointing back, away from terminal (c); Abies pinsapo 'Gluca': leaves short, stiff, and stout (d); Abies lasiocarpa: leaves long, slender, and supple (e); Abies grandis: leaves spreading nearly at right angles to the branchlet (f); and Abies koreana: leaves that reach out on all sides of branchlet, no "V" (g).



a



b



c



d

Leaf markings and resin canals. Abies cephalonica: dorsal stomata often present in groove at tip of leaves (a); Abies lasiocarpa: dorsal stomata usually above middle of leaves (b); Abies concolor: resin canals marginal (c); Abies holophylla: resin canals median (d).



Cones. Abies koreana: bract scales exserted (left); Abies concolor: bract cones hidden in cones (right). A silvery resin is dripping from the cone.

(continued from page 6)

Position of resin canals

Species accompanied by an asterisk (*) appear in both columns.

Marginal

- Abies alba*
- Abies amabilis*
- **Abies* × *borisii-regis*
- Abies* × *bornmuelleriana*
- Abies cephalonica*
(occasionally submarginal)
- **Abies cilicica*
- Abies concolor*
- Abies grandis*
- Abies nordmanniana*
- Abies procera*
- Abies recurvata*

Median

- Abies balsamea*
- **Abies* × *borisii-regis*
(occasionally on fruiting branches)
- **Abies cilicica*
(occasionally on fruiting branches)
- Abies fargesii*
- Abies firma* (occasionally more than two resin canals)
- Abies fraseri*
- Abies holophylla*
- Abies homolepis*
- Abies koreana*
(occasionally submarginal)
- Abies lasiocarpa*
- Abies magnifica*
- Abies nephrolepis*
- Abies pinsapo*
- Abies sachalinensis*
- Abies sibirica*
- Abies veitchii*
(occasionally submarginal)

Cones

In *Abies*, cones are harder to obtain than are those of other conifers. The most conspicuous characteristic in differentiation of species is the exertion of the bract scales, or their lack of exertion. Other features, such as cone-scale shape, color, and size, and shape of cone, are less important.

Cone bracts**Markedly exerted**

- Abies alba*
- Abies* × *borisii-regis*
- Abies* × *bornmuelleriana*
- Abies cephalonica*
- Abies fargesii*
- Abies firma*
- Abies fraseri*
- Abies procera*
- Abies veitchii*
(occasionally slightly)

Slightly exerted

- Abies nephrolepis*
- Abies nordmanniana*
- Abies sachalinensis*
(often hidden)
- Abies koreana*

Hidden

- Abies amabilis*
- Abies balsamea*
- Abies cilicica*
- Abies concolor*
- Abies grandis*
- Abies holophylla*
- Abies homolepis*
- Abies lasiocarpa*
- Abies magnifica*
- Abies pinsapo*
- Abies recurvata*
- Abies sibirica*

Genera of Coniferae with Pectinate, Linear Leaves

Character	<i>Abies</i>	<i>Picea</i>	<i>Pseudotsuga</i>	<i>Taxus</i>	<i>Tsuga</i>
Branchlet	Circular, flush leaf scars	Leaf scars on woody sterigmas	Leaf scars circular, very slightly raised, like <i>Tsuga</i>		Leaf scars on small, prickle-like pegs
Bud	Round or ovoid, usually resinous	More pointed than <i>Abies</i> , resinous in all species	Conspicuously long and pointed, as in <i>Fagus</i>	Very small	Very small
Bark	In youth gray, smooth but for resin blisters; in age, rough	Dark gray, rough, in large or small thin plates	Brown-gray, often like <i>Picea</i> with thicker plates; older trees have ridges with deep fissures	Pink-brown, shredding in thin, flat plates of varying length	Brown to dark green, long, 2-5 cm wide, broken plates, appressed, longitudinal, not shredding
Leaves (cross section)	More flattened (two-sided) than rhomboid (four-sided)	More rhomboid than flattened	Flattened	Flattened	Flattened
Leaves (stomata)	Stomata on lower surface only in most species	Stomata on four sides in most species	Stomata on lower surface only	Stomata (green) on lower surface only	Stomata on lower surface only
Cone	Upright; scales deciduous; bracts exserted in some species; monœcious	Pendent, deciduous; monœcious	Pendent, deciduous, trident bracts exserted; monœcious	Single seed almost covered by an aril; diœcious	Pendent, deciduous; monœcious

The Firs of the Arnold Arboretum

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Standardized Approach

*In describing the genus **Abies** and those of its species that grow in the Arnold Arboretum, we list characters in the same sequence. Though we do not provide a key, we do provide summary tabulations that group by character the species that possess it (see pages 6, 11, and 12).*

*Examine an unidentified specimen in the sequence suggested—that is, its habit first, then its bark, branchlet including bud, foliage, leaf, and, finally, cone. There may be some disagreement on definitions of the above terms because they overlap. Some categories, such as “branchlet,” “foliage,” and “leaf,” have been arbitrarily defined. “Branchlet” as used here includes both the new shoot and the adjacent growth of recent years. Except in late summer and fall, the previous year’s growth usually is the most useful for determining color, hairiness, and texture of the surface. We deal with leaf scars under “Branchlet” rather than under “Leaves,” while the arrangement of leaves on the branchlets we treat under “Foliage.” Leaf color we usually discuss under “Leaves,” unless there was some particular advantage in describing the color imparted to the whole leaf, as in the blue Spanish fir, *Abies pinsapo forma glauca*, in which case we refer to it under “Foliage.”*

The descriptions are based on our personal inspection of living material, most of it from the Arnold Arboretum. References from the literature reinforce our observation. When we refer to trees growing in the Arnold Arboretum they are older, established plants. We include infraspecific taxa and cultivars if they grow at normal rates; slow-growing taxa and dwarfs we refer to only if they are the sole representatives of the species in the Arnold Arboretum or if they possess some special feature that is worthy of note.

Dimensions

The dimensions of the species are based on cultivated trees unless we specifically state that we are dealing with a native habitat. Conifers in cultivation in the United States today usually are no more than one hundred fifty years old and thus do not indicate the size they eventually will achieve in their natural habitats.

Foliage

The foliage available for examination usually is taken from the tree at a level between 1.5 and 3 meters from the ground. Foliage on the upper, better-lit, “fruiting” branches differs from that lower down on the tree. At the high levels the branchlets and leaves are thicker and stiffer, and the leaves, in addition, are shorter, more upswept, pointed, and curved

with resin canals that become, in plants where they are typically marginal, more median.

Cone

Be prepared to do without a cone for examination. With few exceptions the cones of *Abies* are borne in the crown of the tree and disintegrate there when mature. So climbing or using some other method of reaching the upper part of the tree is necessary unless one is fortunate enough to find a cone-bearing top branch knocked off by a strong wind or a heavy load of snow. The only other conifer genus whose cones behave in the same way is *Cedrus*, but in *Cedrus* some cones grow lower down the tree and therefore are more accessible from the ground.

Variations within Taxa

In pursuing the identification of plants by morphologic characters one is dealing with unstable factors and must not expect a single individual in a taxonomic category to be exactly like another. George Russell Shaw, in his monograph *The Genus Pinus* (1914), quoted Schimper:

There are species...and this is equally important for the systematist and the physiologist,...which so completely react to the changing requirements of moisture that extreme forms can appear to belong to dissimilar species.

In the following treatment it has been necessary to seem positive about the presence or absence of certain characters, knowing that a small proportion of the specimens do not conform. The character of hairiness versus hairlessness of the branchlet, for instance, may depend on whether a high magnification is used. The branchlets of *Abies concolor* generally appear glabrous to the naked eye or through a hand lens, but the dissecting microscope will show short hairs. The foliage of

Abies ×bornmuelleriana is listed as pectinate on the upper surfaces of the branchlets, but one of our trees does not show this. The undersides of the leaves of *Abies nephrolepis* are recorded as having no midrib, but one of our plants does show a thin one.

The great importance of looking at all the characters in a given plant and being prepared to choose which ones are determining cannot be overemphasized. A certain amount of familiarity with the species is necessary in achieving an authoritative opinion. The tabulations are guides only, not infallible descriptions. But this is true also of keys.

A Note on the Symbols and Terms Used

The most important characteristics for distinguishing a species from similar ones are signalled by the device "☞" and are set in **boldface italic type**. In many cases the degree to which a character expresses itself is rated as "0," "+," "1+," "2+," "3+," or "4+."

The hardiness zones used to indicate the cold hardiness of species are those of the Arnold Arboretum, not those of the United States Department of Agriculture.

***Abies alba* Miller: EUROPEAN SILVER FIR**

Abies alba grows widely in Europe, mostly in mountain areas, from 38° North latitude to 52° North latitude between 30° and 27° East longitude. In Britain, where, it is cultivated very widely and has been for centuries, it is almost regarded as native. It is the most common on the continent of Europe.

Abies alba is hardy in Zones IV–VII in the eastern United States and in the Arnold Arboretum, which grows 9 specimens. All

but 3 are less than 20 years old. One of the 3 oldest plants is a magnificent tree of approximately 25 m in height; its trunk is 66 cm in diameter. The record is not available, but it is known to have been growing there for at least 60 years. The next oldest is 50 years old and 16 m tall.

No infraspecific relatives of *Abies alba* grow in the Arnold Arboretum.

Habit Reaching 50 m in height Pyramidal when young	Foliage <i>Above</i> Leaves pointing forward 90°–60° from branchlet Pectinate, with a wide V <i>Below</i> ♂ Pectinate, pointing 80° from branchlet	<i>Above</i> Shiny green No stomata (occasional excep- tions) Shallow groove No midrib <i>Below</i> Stomata white Margins not revolute Not keeled Resin canals marginal
Bark Gray, smooth, except in old trees, on which it is rough and fissured		
Bud Very small Round to conical ♂ Not resinous	Leaves 2 cm x 2 mm Flattened, linear Sides parallel Tips round or slightly notched Not curved Margins entire Flexibility 2+	Cones 11 x 4 cm Cylindrical 1+ tapered both ends Green–purple, turning brown Bracts exserted
Branchlet Light tan to dark brown 2+ hairy, scattered Surface regular to slightly un- dulating Flexibility 2+		

Similar Species

- *Abies nordmanniana*: leaves above point forward, eliminating the V and concealing the branchlet surface
- *Abies balsamea*: upper surfaces of leaves less glossy; resin canals median; buds resinous; resin blisters on bark
- *Abies amabilis*: leaves arranged like those of *Abies nordmanniana* but more curved and often with scattered stomata on their upper surfaces
- *Abies veitchii*: leaves 4+ flexible with strikingly blue–white, chalky bands beneath

Abies amabilis (Douglas) J. Forbes: RED FIR

Abies amabilis grows from southern Alaska to the Oregon-California border at medium elevations. It is very common on the Olympic Peninsula in Washington. One of its common names is "lovely fir," a translation of the Latin *amabilis*. It lives up to the epithet, its spirelike crown distinguishing it from the slightly rounded tops of other firs of the

same stature, such as *Abies procera*. *Abies amabilis* is hardy in Zones V-VII.

The Arnold Arboretum contains only one mature specimen of *Abies amabilis*, the slow-growing cultivar 'Spreading Star', an attractive dwarf accessioned in 1971 and now 40 cm tall.

Habit

Pyramidal, graceful, spirelike
Growing to 80 m in its native habitat

Bark

White-gray
Smooth, except at base, which on old trees is very rough

Bud

Small
4+ resinous

Branchlet

Gray-brown
Dense, with short hairs
Surface undulating

Foliage

Above

Leaves pointing forward
40°-60° from branchlet

☞ *A rank of appressed, forward-growing leaves occupying center and covering branchlet*

☞ V wide

Below

Pectinate, leaves pointing forward 70°-80° from branchlet

Leaves

Up to 3 cm x 2 mm
Flattened, linear
Sides parallel
Tip truncated, occasionally notched
Curved slightly (1+) in flat and lateral dimensions
Margins entire
Flexibility 3+

Above

Shiny green
Occasional patches of stomata at tip or rarely scattered sparsely in lines
Grooved shallowly

Below

Stomata 3+-4+, white
Margins not revolute
Not keeled
Resin canals marginal

Cones

10-15 x 5-6 cm
Barrel-shaped
Purple, becoming brown
Bracts (with rare exceptions) hidden

Distinguishing Characters

- Crushed foliage reputed to smell of tangerines
- A specimen of *Abies* with leaves like those of *Abies veitchii* but longer and more curved, and arranged like those of *Abies nordmanniana*, but appressed in the center of the V, and having few stomata above and marginal resin canals likely to be *Abies amabilis*

Similar Species

- *Abies nordmanniana*: leaves flexible, point forward covering the branchlet, but with median resin canals and no white patches of stomata near tips on upper surface; cones with exserted bracts
- *Abies veitchii*: leaves with similar very white lines of stomata below, flexible, and pointing forward above the branchlet, but with median resin canals

***Abies balsamea* (Linnæus) Miller: BALSAM FIR**

Abies balsamea is native to the northern United States and Canada, from Newfoundland to Alberta. It is fragrant with a balsam odor and is used for pulp and Christmas trees in the northeastern United States. The name "balsam fir" is applied to other firs in various localities: to *Abies fraseri* in the Appalachians, *Abies lasiocarpa* in the Southwest, and *Abies concolor* in the Sierra Nevada of California. All members of the genus *Abies*, in fact, possess varying amounts of resin (or balsam).

A cold-climate tree, *Abies balsamea* does not do well in the Boston area. It is hardy to Zone II, but Zone V is often too mild; some

trees native to the warmer coastal parts of New England do well in Zone V, however. One of the best specimens in southern New England, a tree transplanted from southern Maine as a seedling, is approximately 12 m tall; it grows next to a small pond in northeastern Connecticut (Storrs).

The Arboretum grows two specimens of *Abies balsamea*; accessioned about thirty years ago, they are 11 m and 12 m tall, respectively.

Its only infraspecific taxa in the Arnold Arboretum's collections are slow-growing forms.

Habit ☞ Growing slowly, reaching no more than 20 m in 50 years Symmetrical, conical; crown spirelike, lasting into mature years In maturity, not distinguished as an ornamental	Branchlet 2+ undulating ridges covered with fine hairs	Above Dark green, not conspicuously shiny No stomata Grooved No midrib Below 2 white bands of stomata, ☞ 8 or fewer rows to each band Margins not revolute Midrib 1+ prominent Not keeled Resin canals median
Bark Gray-green ☞ Smooth except for prominent resin blisters Rougher in old age	Foliage Above Leaves pointing forward 80°–45° from branchlet Pectinate, with a wide V Below Pectinate, leaves pointing 45°–90° forward	Cones 5–8 cm long Cylindrical Green–purple, turning brown ☞ Bract tips usually hidden
Buds Small, less than 6 mm 4+ resinous	Leaves 1.5–2 cm x 1.5–2 mm Flattened in cross section Sides parallel Tip entire, occasionally with a tiny notch Not curved Margins entire Flexibility 2+	

Similar Species

- *Abies alba*: buds nonresinous; leaves shiny; resin canals marginal
- *Abies amabilis*: leaves shiny above, 3 cm long, flexible
- *Abies fraseri*: shoots densely hairy; 8–12 rows of stomata in each band on undersurfaces of leaves; tips of cone bracts exerted
- *Abies nordmanniana*: leaves project forward, covering the shoot; buds nonresinous; resin canals marginal
- *Abies veitchii*: leaves 4+ flexible; conspicuously chalky white stomata on undersurface of leaves

Abies ×borisii-regis Mattfeld: BULGARIAN FIR

A hybrid of *Abies cephalonica* and *Abies alba*, *Abies ×borisii-regis*, the Bulgarian (or King Boris) fir, grows in Bulgaria and Greece. It was described in the early 1920s and named for King Boris of Bulgaria, who was monarch at the time the plant was identified as a separate species. A previous name was *Abies alba* var. *acutifolia*, a useful point to remember because one of its outstanding characteristics is its pointed leaves. The hybridization may have taken place when *Abies alba* mi-

grated southward in Europe as the cooling for the Ice Age began.

Abies ×borisii-regis is hardy in Zones V–VII. In the Arnold Arboretum 3 magnificent 60-year-old specimens grow. Acquired as seeds from trees growing wild in Greece, they are 16 to 20 m tall and 60 cm in diameter.

No infraspecific relatives of *Abies ×borisii-regis* grow in the Arnold Arboretum.

Habit

A handsome, densely branched, dark tree with glossy foliage and a broadly conic crown

Bark

Very dark gray
Smooth; high on old trees

Bud

Pink-brown, ovoid-conical
4 mm
Resinous

Branchlet

Light brown
3+ hairy
Surface 1+ grooved
Flexibility 2+

Foliage

Above

Pectinate
V very wide
Leaves pointing forward 60° from branchlet

Below

Pectinate
Leaves pointing 80°–90° from branchlet

Leaves

3–3.5 cm x 2.5 mm
Flattened, linear, tapering at tip
Sides parallel
☞ **Tip long, pointed**
Curved 2+ in flat dimension
Margins entire
Flexibility 3+

Above

☞ **Very shiny deep green**, no stomata except occasionally scarce at tip

Grooved prominently
No midrib

Below

Stomata gray-green
Margins subrevolute
Not keeled

Resin canals marginal but reported to be median on fruiting branchlets

Cones

8–12 x 3–4.5 cm
Cylindrical, gradually tapering from base to broad rounded tip
Bracts markedly exserted

Similar Species

- The long, pointed leaves suggest *Abies holophylla*, but in that plant the branchlets are not hairy, the resin canals in the leaves are in the median position, and the bud is only slightly resinous. The cone of *Abies holophylla*, furthermore, does not expose its bracts. The leaves of *Abies holophylla* are lighter green.

A striking feature of the specimens in the Arnold Arboretum is the glossiness of the upper surface of their leaves. This is often matched by one of its parents, *Abies alba*, which plant differs, however, in having nonresinous buds and shorter, less pointed leaves.

***Abies* × *bornmuelleriana* Mattfeld: TURKISH FIR**

Named for Joseph Bornmüller (1862–1948), a German botanical explorer in Asia Minor, *Abies* × *bornmuelleriana* is native to the north shore of Asia Minor, on the Black Sea. A hybrid between *Abies cephalonica* and

Abies nordmanniana, it was described in 1925.

Abies × *bornmuelleriana* is hardy in Zone V. The Arnold Arboretum has 2 specimens, the older of which is 27 years old and 6 m tall.

Habit Broad Rounded conical	Foliage <i>Above</i> Not pectinate (occasional exceptions) Incomplete V Leaves pointing forward 30° from branchlet <i>Below</i> Pectinate	<i>Above</i> Shiny green Stomata scarce in groove at tip Shallow groove No midrib <i>Below</i> Stomata whitish gray Margins not revolute Keeled by midrib Resin canals marginal
Bark Gray, smooth, but pebbled like pigskin Old bark rough		
Bud Resinous 2+	Leaves 2.5–3 cm x 2 mm Linear Sides bitapered Tip a rounded, entire point, occasionally emarginate Curved 2+ in the flat plane Margins entire Flexibility 1+	Cones 12–15 x 4 cm Cylindric turret-shaped Bracts exserted
Branchlet Glabrous Undulating Greenish tan		

Distinguishing Characters

- *Abies* × *bornmuelleriana*: evenly placed between its two parents, sharing some qualities of each (both have marginal resin canals and exserted cone bracts, although in *Abies nordmanniana* they are less conspicuous than in *Abies cephalonica*), but *Abies* × *bornmuelleriana* has the glabrous branchlets and resinous buds of *Abies cephalonica* (not seen in *Abies nordmanniana*)

Similar Species

- *Abies nordmanniana*: leaves point forward above the branchlet but buds nonresinous
- *Abies cephalonica*: stomata on the upper surface but leaves more pointed and never emarginate

***Abies cephalonica* Loudon: GREEK FIR**

Abies cephalonica is native to Greece and other parts of the southern Balkans, where it grows in mountainous areas. Widely planted elsewhere in Europe, it is hardy from Zone V to the milder parts of Zone VII. Three mature specimens grow in the Arnold Arboretum. They are 103, 88, and 33 years old and measure 23 m, 22 m, and 13 m in height and 70–75 cm in diameter.

Habit

Conical with a dome-shaped crown
Transverse branches, long and strong
Bark green

Bark

Gray–brown, occasionally with a touch of pink
Younger parts of the tree with beech-gray bark, smooth but for pigskin stippling
Older parts fissured into 2 x 3-cm plates

Bud

Round, with domed tip
Resinous 1+–2+
☞ *Bud-scale tips slightly reflexed*

Branchlet

Light brown
Shallow fluted grooves
☞ *Glabrous*
Flexibility 1+

Foliage

Above
Leaves pointing 70°–90° from branchlet
☞ *Leaves going around shoot to some extent, leaving the upper side without a V*
Below
Incompletely pectinate, but leaves less dense below than above, pointing 60° from the branchlet

Leaves

2–3 cm x 2 mm
Flattened, linear with 2+ keel
Sides parallel but tapered at both ends
☞ *Tips pointed, entire on most specimens but occasionally rounded and notched*
Curved 2+ in flat plane
Margins entire
Flexibility 1+–2+

Above

☞ *Shiny dark green, with a patch of stomata at the tip*
Groove present
No midrib
Below
Stomata in two white rows
Margins not revolute
Midrib prominent, making a keel
Resin canals marginal or sub-marginal, very small

Cones

10–23 x 5 cm
Cylindrical
Tip sharply tapered, but with a point
Bracts exserted

Distinguishing Characters

- Leaves dark green, stiff-pointed, often with small patches of white stomata at the tip of upper surface; bud scarcely resinous

Similar Species

- *Abies pinsapo*: leaves stiff, pointed, but unlike those of *Abies cephalonica* dramatically stiff, distributed all around the shoot with no semblance of a V above or below, and with rows of stomata beside the midrib and below
- *Abies ×borisii-regis*: branchlets hairy; leaves shinier and shorter
- *Abies ×bornmuelleriana*: shingled arrangement of leaves on the upper surface like *Abies nordmanniana*

***Abies cilicica* (Antoine & Kotschy) Carrière: CILICIAN FIR**

Abies cilicica grows in Turkey, Syria, and Lebanon. (Cilicia is on the southern coast of Asia Minor directly west of Syria.) It has to some extent the same distribution as *Cedrus libani*. Hardy in Zone V, it is not common in cultivation, but the Hunnewell Pinetum in Wellesley, Massachusetts, has three specimens. One of them (of unknown age) is a patriarch 18 m in height and with a trunk 100 cm in diameter. Two 50-year-old specimens

grow in the Arnold Arboretum's Pinetum area; they are 9.5 m and 14 m tall.

Abies cilicica and *Abies nordmanniana* are closely allied. Their geographic ranges touch southern Turkey (*Abies cilicica*) and northern Turkey (*Abies nordmanniana*). *Abies cilicica* has been termed "a weak *nordmanniana*."

No infraspecific relatives of *Abies cilicica* grow in the Arnold Arboretum.

Habit

Narrow columnar, with spirelike crown

Bark

Beech gray, with stippling arranged circumferentially
Fissured on old trees and scaly low down

Bud

Ovoid, with conical tip
Chestnut brown
Scale tips free
Nonresinous

Branchlets

Light brown to yellow
Grooved longitudinally in very shallow, wide grooves
Hairy 2+
Flexibility 2+

Foliage

Above

Incomplete V

Leaves curved forward at 30°–60°, loosely covering shoot

Below

Incompletely pectinate, pointing 45° forward

☞ *On all sides leaves standing apart from each other, "trying" to point all around the branchlet*

Leaves

3.0+ cm x 2 mm
Flattened, linear
Sides parallel all the way except at base and tip
Tip rounded, with a tiny notch
Curved 2+ in flat plane
Margins entire
☞ *Flexibility 3+*

Above

Pea-green to dark green, shiny
Scattered stomata in dorsal groove at the very tip in most plants

Grooved

No midrib

Below

Stomata gray-green
Margins not revolute
Midrib prominent 2+
Keel 3+
Resin canals marginal (on cone-bearing branchlets the resin canals are reported to be median)

Cones

14 x 4 cm
Cylindrical, with noticeable taper toward tip, which is rounded
Peduncle very short
Bracts hidden

Similar Species

- *Abies nordmanniana*: buds nonresinous; resin canals marginal; leaves on upper side of shoot cover it without a V, but much more densely arranged; cone bracts exserted (not hidden as in *Abies cilicica*); stomata on the lower surface of leaves far whiter than those of *Abies cilicica*

***Abies concolor* (Gordon) Engelmann: WHITE FIR**

Abies concolor's native range is a scattered one. On the Pacific coast it is principally in California, in the Sierra Nevada and the coastal range extending into Mexico. It also is found in the southern Rocky Mountain states: Utah, Colorado, Arizona, and New Mexico. The epithet "*concolor*" refers to the fact that both surfaces of the leaf show the same blue-gray color.

Abies concolor is hardy in Zone IV–VII, and it flourishes in the Arnold Arboretum. Along with *Abies homolepis*, it was one of the favorite conifers of Charles Sprague Sargent when he was Director. Of the total of 19 normally fast-growing specimens of *Abies con-*

color (13 *Abies concolor*, 3 *Abies concolor* 'Violacea' [bright-blue foliage], 2 *Abies concolor* 'Conica', and 1 *Abies concolor* 'Candicans' [very light pale-blue foliage]), the Arboretum grows 10 that date from the Nineteenth Century, most of them over 20 m tall, with sturdy trunks of 50–70 cm in diameter at breast height.

In the Arnold Arboretum *Abies concolor* seem to have been particularly vulnerable to hurricanes. The records show that of 64 specimens introduced since 1874, 41 are no longer with us; of those, 21 were uprooted in the hurricanes of 1938, 1954, and 1985.

Habit

Conico-columnar, rounded, different trees favoring one or the other of these contours, not entirely depending on whether they grow crowded or in the open
Crown rounded
Old trees massive, growing to 60 m in their native habitat
Handsome; one of the best for cultivation

Bark

Smooth whitish gray, with resin blisters, in young trees or on new branches of old trees
Rough and fissured into 5 x 12-cm plates on the lower boles of old trees
Can be of corky texture, somewhat resembling *Pseudolarix amabilis*

Bud

Broad
Conico-globular
7 mm long
Resinous 2+
Scale tips appressed

Branchlet

Yellow-green or olive-green
Glabrous or scarcely hairy
Surface regular, no grooves

Foliage

Above
Leaves pointing forward
30°–40° from branchlet
Gray-green
No V
Below
Wide V
Pointing 80° from branchlet
Spreading, curving upward
❖ *Leaves above and below widely spaced*

Leaves

❖ 5–6 cm x 2 mm
Linear, flattened in cross-section
Sides parallel
Tips rounded, no notch
Curving 3+ towards upper side
Margins entire
Flexibility 3+

Above

Light glaucous green
❖ *Stomata so numerous, though small, as to give a homogeneous glaucous color*
❖ *No midrib, but a suggestion of a shallow groove*

Below

Stomata as above but with a 1+ midrib
Felt as a keel
Resin canals marginal

Cones

5 x 12 cm, but many sizes
Purple when young, brown later
Columnar, but with gradually curving sides and a taper
Ends rounded
Bracts concealed

Distinguishing Characters

- The widely spaced, glaucous leaves with their characteristic curve are distinctive

Similar Species

- Abies grandis*: leaves as long as those of *Abies concolor*, resin canals also marginal, and buds also resinous, but with no stomata on the upper surfaces of its leaves and the leaves not curved (*Abies concolor* var. *lowiana* tends to resemble *Abies grandis* in these features)

arnoldia

New England
Horticultural
and Botanical
Calendar

(Late Winter–Spring 1988)

Horticultural and Botanical Calendar

Please be sure to mention Arnoldia whenever you attend an event that was listed in the New England Horticultural and Botanical Calendar

Through April 13

"Orchids: Jewels of the Plant Kingdom." Arnold Arboretum (AA). A photographic exhibition on orchid biology by Dr. Kerry S. Walter. Hunnewell Visitor Center, AA, Arborway, Jamaica Plain, MA. No charge. *Information:* (617)524-1718.

Through May 20

Semester in Sustainable Design. New Alchemy Institute (NAI) and National Audubon Society Expedition Institute. College-level program in sustainable agriculture, resource systems, and ecologically sound technologies (permaculture design, organic market gardening, solar-greenhouse management, integrated pest management, energy-efficient building design). Academic credit available. *Information:* Virginia Rasmussen, NAI, 237 Hatchville Road, East Falmouth, MA 02536; (617) 564-6301.

Through June

Guided Spring Walks. Winterthur Museum and Gardens (WMG). Admission charge. Reservations suggested. *Information, reservations:* WMG, Winterthur, DE 19735; (302)654-1548.

March 31

"Landscapes and Architecture: A Delicate Balance." Frederick Law Olmsted National Historic Site (FLO NHS) and Department of Landscape Design, Graduate School of Design (GSD), Harvard University. Lecture by Cynthia Zaitzevsky, historian and author. No charge. 7 p.m., Piper Auditorium, GSD, 48 Quincy Street, Cambridge, MA. *Information:* Visitor Services Office, FLO NHS, 99 Warren Street, Brookline, MA 02146; (617)566-1689.

"A Garden for All Seasons." Human Services of Dedham-Endicott Greenhouse (HSD-EG). Lecture by Elsa Bakalar. 8 p.m., Noble and Greenough School Auditorium (Pine Street entrance), Dedham, MA. Admission charge. Register by mail. HSD-EG, Post Office 1305, Dedham 02026.

April 7

"Tropical Rain Forest, Part 1." Connecticut Forest and Park Association. Lecture and slide program by Professor Joel Meisel. James L. Goodwin Forest and Park Center (JLGFP), 16 Meriden Road (Route 66) Middlefield. *Information:* Linda Rapp, JLGFP, Middletown 06457; (203)346-2372.

April 9-May 8

Spring Bulb Display. Blithewold Gardens and Arboretum (BGA). Thousands of daffodils, scyllas, tulips, and crocuses in bloom. 10 a.m.-4 p.m., BGA, Ferry Road (Route 114), Bristol, RI 02809-0417. No charge. *Information:* (401)253-2707.

April 12

"The Saint Vincent Botanical Garden: Captain Bligh and the Breadfruit." Massachusetts Horticultural Society (MHS). Lecture by Professor Richard A. Howard, past Director of the Arnold Arboretum. 7 p.m., Pine Manor College, Chestnut Hill, MA. Registration fee. Preregistration required. *Information:* MHS, 300 Massachusetts Avenue, Boston 02115; (617)536-9280.

April 15-29

"A Finnish Scientist Describes North America." Helsinki University. Exhibit of photographs, first printed reports, Swedish editions of travel accounts, manuscripts, plant specimens from the travels of Pehr Kalm in North America, 1716-1779. Thomas Jefferson University (TJU), Philadelphia, PA. No charge. *Information:* Jill M. Pasternack, Office of the Dean, College of Graduate Studies, TJU, Philadelphia 19107; (215)928-5799.

April 16

Opening Party. Garden in the Woods. Tour of the Garden, books, plants for sale. 3-5 p.m., Garden in the Woods, Hemenway Road, Framingham, MA 01701. *Information:* (617)7630-237-4924.

April 21

"Tropical Rain Forest, Part 2." Connecticut Forest and Park Association. Lecture and slide program by Professor William Jahoda. James L. Goodwin Forest and Park Center (JLGFP), 16 Meriden Road (Route 66) Middlefield. *Information:* Linda Rapp, JLGFP, Middletown 06457; (203)346-2372.

April 22-24

Ninth Annual Conference. Hydroponic Society of America. Tours, speakers, exhibits. Clarion Hotel, Millbrae, CA. Registration charge. *Information:* Gene Brisbon, Hydroponic Society of America, Post Office Box 6067, Concord, CA 94524; (415) 682-4193.

April 23 and 24

Family Days. Garden in the Woods. Children, no charge; charge for adults. Garden in the Woods, Hemenway Road, Framingham, MA 01701. *Information:* (617) 877-7630; 237-4924.

April 23-May 1

Historic Garden Week in Virginia. Garden Club of Virginia. Private homes, gardens, and historic landmarks open to the public. *Information:* Detailed guidebook available free of charge after March 1, 1988, from: Historic Garden Week Headquarters, 12 East Franklin Street, Richmond 23219 (by mail, \$1 postage and handling); (804) 644-7776, 643-7141.

Third International Heritage Roses Conference and Seventh Huntington Symposium on Old Roses. Huntington Library and Botanical Gardens. "Rose Gardens and Historic Restoration." Lectures, private viewing of rare rose books, tours, workshop-clinic, displays and exhibits, sale of root roses. *Information and registration form-brochure:* Clair G. Martin III, Chairman, Huntington Botanical Gardens, 1151 Oxford Road, San Marino, CA 91108.

April 24

Walking Tour of North Easton, Massachusetts. Frederick Law Olmsted National Historic Site (FLO NHS) and Easton Historical Society. No charge. 1 P.M., meeting at the North Easton Train Station, 80 Mechanic Street. Tour of Olmsted and H. H. Richardson design landmarks in the pastoral village of North Easton. *Information:* Visitor Services Office, FLO NHS, 99 Warren Street, Brookline, MA 02146; (617) 566-1689.

April 26

"Perennials Plus." Massachusetts Horticultural Society (MHS). Lecture by Pamela Harper, author, lecturer, photographer. 7 P.M. Pine Manor College, Chestnut Hill, MA. Registration fee. Preregistration required. *Information:* MHS, 300 Massachusetts Avenue, Boston 02115; (617) 536-9280.

April 30

Arbor Day. Massachusetts Arborists Association (MAA). Ruth Ippen Tree Walk, Belmont. *Information:* MAA, 1357 Washington Street, West Newton, MA 02165; (617) 332-8683.

May 4-6

Brandywine Valley Gardens Conference. "Country Houses and Gardens of the Brandywine Valley." Hagley Museum and Library, Longwood Gardens, Mount Cuba Center, Nemours Mansion and Gardens, Rockwood Museum, and Winterthur Museum and Gardens. Major symposium on the past, present, and future of the unique enclave of gardens, museums, and estates clustered along a ten-mile stretch of the Brandywine River from Wilmington, Delaware, north into nearby Pennsylvania. Illustrated presentations, tours. Registration fee. *Information:* Brandywine Valley Conference, Hagley Museum and Library, Post Office Box 3630, Wilmington 19807; (302) 658-2400, extension 305.

May 7

Plant Sale. Blithewold Gardens and Arboretum (BGA). "Garden Favorites": hard-to-find annuals and perennials. Gardening books, tools, accessories for sale in shop. 10 A.M.-3 P.M., BGA, Ferry Road (Route 114), Bristol, RI 02809-0417. *Information:* (401) 253-2707.

May 10

"Victorian Gardens." Massachusetts Horticultural Society (MHS). Lecture by Professor Diane McGuire, author, garden historian. 7 P.M., Pine Manor College, Chestnut Hill, MA. Registration fee. Preregistration required. *Information:* MHS, 300 Massachusetts Avenue, Boston 02115; (617) 536-9280.

May 19

The Hidden Gardens of Beacon Hill. Beacon Hill Garden Club. Self-guided tour of Boston's Beacon Hill Historic District. 9 A.M.-5 P.M., rain or shine. Tickets in advance (on tour day if available). *Information:* Gail Weesner, 54 Pinckney Street, Boston, MA 02114; (617) 227-9648, -4392.

May 28-June 5

Festival of Flowers and Gardens. The Lakeside Group. Public exhibition of contemporary approaches to horticulture, floral and landscape design (outdoor promenade, galleries, marketplace, special events). 12 NOON-8 P.M. (weekdays), 11 A.M.-7 P.M. (weekends), Navy Pier, Chicago, IL. Admission charge. *Information:* The Lakeside Group, 600 North McClurg Court, Suite 1302A, Chicago 60611; (312) 787-6858.

May 31-June 15

"Landscapes that Stirred the Imagination: Studies in English Romantic Literature and Art." Radcliffe Seminars of Radcliffe College. Study tour of sites in England associated with Romantic writers and painters. Fee. *Information:* Center for Continuing Education, Radcliffe College, 6 Ash Street, Cambridge, MA 02138; (617) 495-8600.

June 4

Secret Garden Tour. Benefactors of the Arts Ltd. Tour of the Historic Point Section of Newport, RI. Admission fee (tickets in advance or on day of tour). *Information:* Benefactors of the Arts, 33 Washington Street, Newport 02840; (401) 847-0514.

June 6-9

Rare Species Management Conference (in conjunction with Fifteenth Annual Natural Areas Conference and Tenth Annual Meeting of the Natural Areas Association). "Rare Species and Significant Habitats." College of Environmental Science and Forestry, State University of New York, Syracuse (CESF). *Information:* Dr. Donald J. Leopold, CESF, Syracuse 13210.

June 7-8

Flower Show. Rhode Island Federation of Garden Clubs. "Blithewold Revisited." 1-8 p.m. (June 7), 10 a.m.-6 p.m., Blithewold Gardens and Arboretum, Ferry Road (Route 114), Bristol, RI 02809-0417. *Information:* (401)253-2707.

June 11

Plant Sale. New England Wild Flower Society (NEWFS). Over 150 varieties of wildflowers, a wide selection of perennials. Staff members will be on hand to answer questions. 10 A.M.-2 P.M., Garden in the Woods, Hemenway Road, Framingham, MA; *Information:* (617) 877-7630, 237-4924.

Mid-June-mid-August

Professional Development Courses. Graduate School of Design, Harvard University (GSD). Forty-four summer courses and workshops for architects, landscape architects, and other professionals in design and related fields. Registration fees. *Information:* Office of Special Programs, GSD, 48 Quincy Street, Cambridge, MA 02138; (617)495-9340.

June 16

"The Victorian Landscape in America: The Garden as Artifact." Morris Arboretum. Symposium. Morris Arboretum, Philadelphia, PA. Registration fee. Reservations required. *Information:* Agatha H. Hughes, (215)257-5777; Morris Arboretum, 9414 Meadowbrook Avenue, Philadelphia 19118.

July 16-19

World Congress. International Federation of Landscape Architects. Boston.

August 3-5

National Meeting. American Conifer Society. Longwood Gardens, Kennett Square, PA. Tours of Longwood, area gardens, nurseries; fountain show; talks. (Post-conference tours, August 6, 7.) *Information:* Longwood Gardens, Post Office Box 501, Kennett Square 19348-0501; (215)388-6741, extension 504 (8-11:30 A.M., 12:30-4 P.M.).

NEWS

FROM THE ARNOLD ARBORETUM

Number 3

Winter 1988

Students and Volunteers in Children's Program Explore the Arboretum's Botanical Bridge to China

China's contribution to the floral riches of the western world is evident at the Arnold Arboretum. Hundreds of species now growing on the grounds are products of a botanical bridge to China that spans nearly a century (see the article about

Ernest Wilson on page 3).

The most recent addition to the Arboretum's children's field studies is an expansion of "Around the World with Trees" and is based on the past and present experiences of the Arnold Arboretum's plant explorers to China. A multidisciplinary classroom curriculum to complement this field study is being developed and tested with the teachers and students of the Baldwin School in Brighton.

According to Diane Syverson, Children's Program Coordinator, "The new field study helps children explore the ways different value systems affect and are reflected in a society's social and natural environment."

Students are transformed into plant explorers, not only learning about explorers who for centuries have travelled the globe in search of new plants for agricul-

tural and ornamental use, but also about plant diversity and identification as they use word-maps and compasses to discover some of the famous trees brought back by plant hunters and growing along Chinese Path in the Arboretum.

For the past five years, Children's Program volunteers have served elementary schools by providing hands-on lessons in botany, ecology, horticulture, and natural history. The Program is funded by grants from the Junior League of Boston, the Institute of Museum Services, and private donations. In the last year, thanks to 25 volunteers, more than 1,500 third through sixth graders were able to participate in one of the four field studies offered by the Arboretum to supplement schools' science curriculum.

A SPECIAL THANKS TO LAST YEAR'S CHILDREN'S VOLUNTEERS

SYLVIA ANDERSON, BROOKLINE
BARBARA BALASA, NEWTON
ANNE SOPHIE BAUER, BOSTON
SUSAN DeSTAFANO,
WINCHESTER
MARGARITA DROZDOFF,
CAMBRIDGE
KATRINA EBBE, BROOKLINE
JENNIFER FITILIS, BOSTON
JIM GORMAN, SOUTH BOSTON
CATHY HALLIGAN, CHELMSFORD
ANDRIA LAWSON,
CHESTNUT HILL
MARIANNE LILLE, HINGHAM
BETTY LINDEMANN, WELLESLEY
CHRIS McARDLE, BROOKLINE
TISH MEAD, CHESTNUT HILL
ELEANOR PEACOCK,
JAMAICA PLAIN
MARKIE PHILLIPS, WESTON
DENNIS PIANA, SOMERVILLE
TINA RAWSON, BOSTON
LAURIE RUSSELL, WAYLAND
HONI SCHIFFMAN,
JAMAICA PLAIN
DIANE SILLARI, SOMERVILLE
KIM STREETMAN,
NEWTON HIGHLANDS
SISTIE TORREY, WESTON



Students of the Baldwin School in Brighton perform a flower dance at their parents' day celebration in the Arboretum. These students participated in the development of the fourth- and fifth-grade curriculum packet that uses the Arboretum's Chinese collections.

Arboretum and Boston Visual Artists Union Announce Art Competition for 1988 Lilac Sunday Poster

More than 20,000 lilac lovers turn out for the legendary celebration known as Lilac Sunday and during the three weeks the

Arboretum's lilacs are in peak bloom. Since 1982 the Arboretum has produced a poster for each Lilac Sunday, usually

commissioning an artist to create the poster. This year the Arboretum, working in conjunction with the Boston Visual Artists Union, announces a special Art Competition for the Lilac Sunday Poster.

Fifty "Best Lilacs for New England"

Everyone agrees that the springtime view of the Arboretum is among the more spectacular sights in New England. One of the reasons for this is the lilac collection. But some of the lilacs have suffered a severe decline and are being removed to allow for new plantings, so this year visitors to the collection will find a major restoration under way. Included in a group of new lilacs planted this fall is the Arboretum's choice of 50 "best lilacs for New England." A list of these 50 lilacs is available to the public. For a copy, send a stamped, self-addressed envelope to Jo Procter, Arnold Arboretum of Harvard University, Jamaica Plain, MA 02130-2795.

For Booklovers Who Garden...

Joan Poser, an Arboretum volunteer and the book buyer for The Shop at the Arboretum, suggests it's time to settle down with a good garden book when the cold weather and the snow force even the most ardent plantsperson indoors. Reading during the winter is certain to sow some fresh ideas for the garden.

Poser was asked to select the "Ten Best Titles for Booklovers Who Garden," and she divided her choices into two categories of books: large, handsome, lavishly illustrated books suitable for "strolling" through by either the novice or the expert gardener, and the "how-to" books for the gardening enthusiast.

Her choices are:

- ☐ **Flowering Trees and Shrubs**, by Judith Leet (Abrams, \$29.95)
- Trees**, by Benjamin Perkins (Salem House, \$24.95)
- A Garden of Roses**, by Alfred Parsons, R.A. (Salem House, \$29.95)
- Private Gardens of England**, by Penelope Hobhouse (Harmony, \$40.00)
- Lanning Roper and His Gardens**, by Jane Brown (Rizzoli, \$37.50)
- ☐ **Wyman's Garden Encyclopedia**, by Donald Wyman (Macmillan, \$50.00)
- Manual of Woody Landscape Plants**, by Michael A. Dirr (Stipes, \$30.00)
- Right Plant, Right Place**, by Nicola Ferguson (Summit Books, \$14.95)
- Perennials: How To Select, Grow & Enjoy**, by Pamela Harper and Frederick McGourty (HP Books, \$9.95)
- Gardening by Mail 2**, by Barbara J. Barton (Tusker, \$16.00)

The last book, according to Poser, is a compilation of mail-order services for everything from African violets to zinnias; a good present for armchair gardeners who thought they had everything.

Poser has been an Arboretum Associate and volunteer since 1982. Prior to coming to the Arboretum, she edited children's books for both Random House and Franklin Watts, was a free-lance editor of medical literature, and edited the publications of the Robert Hull Fleming Museum and the Shelburne Museum in Vermont.

Artists are requested to submit original, two-dimensional artwork. Any size or medium, with the exception of photography, is acceptable. Abstract and realistic interpretations are equally valid. One artwork will be selected to be used as the image on the 1988 Lilac Sunday poster. The artwork will be used intact, and the poster will be designed and produced by the Arnold Arboretum.

A jury chosen by the Arboretum and the Artists Union will select the winning entry. In addition, some of the entries will be selected for display in an exhibition and benefit auction in honor of the Lilac Collection, whose refurbishment begins this year. The jury also will select the entries to the Lilac Collection Exhibition.

The entries selected will be on exhibit at the Arboretum for three weeks prior to Lilac Sunday (May 22). Artists will price their original works for sale.

On Friday, May 20, the Arboretum will host a Champagne Evening Benefit for the Lilac Collection. For ticket information, please call Jo Procter at the Arboretum, (617) 524-1718. Tickets are \$35 per person, \$60 per couple. Then, the artists' original work will be auctioned by silent auction (with artists' prices being the floor for bids). Artists will receive 75 percent of the sale price, with 25 percent being contributed to the Arboretum and the Lilac Fund.

February's Chinese New Year Celebration Awakens Memories of Wilson's Contributions to the Arnold Arboretum

Perhaps a bit like the rhyme, "If February give much snow/A fine summer it doth foreshow," Ernest "Chinese" Wilson's extensive plant collecting in the Orient did foreshow the luxuriant plantings now growing in the Arboretum. And, providentially, February, the month of Wilson's birth, also marks the beginning of 1988's Chinese New Year (the year 4686).

Wilson's collection and introduction of plants found during his trips to the Orient in the early part of this century were his legacy to the Arboretum. Trained as a "nursery-lad," he became a gardener at the Birmingham Botanical Garden and Kew. Deciding he preferred botany to horticulture, he enrolled in the Royal College of Science in South Kensington, but scarcely had he begun his studies than the Veitch nursery asked him to go to China, plant hunting for them. On his way to China he came to Boston, where he met Charles Sprague Sargent, spending five days with him at the Arboretum.

Then, when Sargent made the decision to plant hardy woody plants collected from the entire North Temperate Zone, rather than exclusively North American and European plants, he asked Wilson to make an expedition for the Arboretum to China. Wilson went to China for the Arboretum in 1907 and 1910. During these expeditions, he wrote approximately 80 letters to Sargent describing his observations.

In 1984, Carin Dohlman, at the suggestion of Mary Ashton, came to the Arboretum as a volunteer. She had a master of library of science degree from Simmons College and had worked for the China Trade Museum. As a volunteer, she undertook the transcription of Wilson's letters, which, she says, "are a thorough report of what he had seen on these plant expeditions."

The results of his trips to China for the Arboretum were impressive: 2,262 packages of seeds, 1,473 kinds of living plants and cuttings, and 30,000 herbarium specimens of around 2,500 species, plus his photographic plates.

Today, visitors to the Arboretum can see some of Wilson's introductions or collections along the Chinese Path. Some to look for are *Davidia involucrata* 'Vilmoriniana', *Acer griseum*, *Cotoneaster divaricatus*, *Pyrus pyrifolia*, *Albizia julibrissin* 'Ernest Wilson', and *Malus torinoides*.

Wilson happened to be one of the best collectors of his time. His plant expeditions also took him to Japan, Korea, Taiwan, South Africa, Australia, India, New Zealand, and Tasmania.

In his letters and his journals, Carin Dohlman says, "He described his observation of plants growing in the various far corners of the earth."

A 1986 Institute of Museum Services grant to the Arboretum, with Sheila Connor, the Arboretum's horticultural archivist, as principal investigator, made it possible for Carin Dohlman to assist by transcribing Wilson's collection notes, diaries, journals, and approximately 100 letters from this trip to Japan, Korea, and Taiwan.

While Alfred Rehder estimated the number of species Wilson introduced into cultivation in England and the United States at more than a thousand, there is no way of determining the exact numbers. At the time of his death Wilson was working on a book of his introductions. In preparing materials for this book, Dohlman reports, Wilson wrote to his English friends, who had planted his introductions. In one of his letters, he wrote, "No parent could be prouder of reading his school report of his favorite child.... My plants are as children to me."

Kaye Is Named to Top Library Post

Geraldine C. Kaye has been appointed Librarian of the combined botanic libraries, including the Arnold Arboretum's collections. The Arboretum's libraries in the Hunnewell Visitor Center and the Harvard University Herbaria in Cambridge grew from the collection gathered by Charles Sprague Sargent, first director of the Arboretum and author of *The Silva of North America*. The Arboretum's holdings number over 91,000 volumes, with its horticultural collection at Jamaica Plain and its works on systematic botany, floras of the Old World, and other scientific literature in Cambridge.

Recently, Gerry Kaye recounted how she became interested in botany and libraries.

Which came first, your interest in plant sciences or library science?

It is interesting to look back and see where and when our career decisions were influenced. I was born in Winnipeg, Canada, and lived along the northern edge of Canada in gold-mining camps—my father was a miner—until I developed bronchial asthma and went to live with an uncle and aunt in British Columbia. My uncle was a market gardener who made a specialty of knowing the Latin names of the plants he was growing.

Was that influence felt early in your career? Did you major in botany in college?

No, I went into chemistry because I'd had a marvelous high-school teacher who made chemistry exciting. I did extensive work in biology, too; but when I graduated from McGill University, I got a job in cloud physics. We'd track the path of storms across the landscape, trying to work out the dynamics of the circulation of air, how storms build up, and their life histories. We wanted to be able to predict

KAYE

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KAYE

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them more accurately, with eventual thoughts of controlling them. Bad storms are a tremendous economic blow to crops.

How did you come to Harvard?

I have a rather checkered career, as do many women my age who stopped for a while to raise a family. But I first left Canada to come to Harvard Square; it was a magnet for young people in the 1960s, and I wanted to see what it was like. I got a job at Bolt Beranek and Newman, a research and consulting firm that was then specializing in acoustics and information technology. There I met my husband, who is now a consulting acoustician and who designs sound systems for large places. He designed the sound systems for the Orange Bowl and for Great Woods, in Mansfield, Massachusetts, and "wired" Halifax, Canada, for the Pope's visit.

While I was "retired" to raise our two children, I gardened in the Fenway and practically wore out the books in the Massachusetts Horticultural Society's library. During summer vacations, I studied the plants of Cape Cod and the rest of the year visited the Arboretum in Jamaica Plain whenever I could.

When your children were in school, did you come back to work?

Yes. In 1973 I was offered a part-time job in a fungal-genetics lab at Harvard. I joined a project looking at the wild relatives of the commercial mushroom. We started surveying wild relatives to see if we could find a wider gene pool. This is, after all, something that is being done for all kinds of domestic crops because of concern that a monoculture (having no variety in genetic materials) means a disease could come along and wipe out an entire crop plant, leaving nothing to fall back on.

I know you are involved in mycology. This was the beginning of your interest?

Yes, I joined the Boston Mycological Club, began collecting and identifying wild mushrooms, and learning more and more about mushrooms. In 1978 when the lab project closed, Donald Pfister, Director of the Harvard University Herbaria, asked me if I'd like to work in the Farlow Library. (The Farlow is the mushroom taxonomic institution.) I found I liked library work so well that I went to Simmons College for my master of library science degree and became Librarian in 1983. In 1985 I was made Acting Botany Librarian of the Economic Botany Library, also.

Briefly noted...

Al Fordham, formerly the Arboretum's Plant Propagator, was awarded a Certificate of Appreciation and Honorary Life Membership by the International Lilac Society and The Walter F. Winkler Award for outstanding achievement from the

New England Chapter of the American Rock Garden Society.

Jennifer Guigley, Research Assistant in the Records Office, has just been appointed to the Board of Directors of the Rock Garden Society.

Plant Propagators Meet

Four Arnold Arboretum plants—people participated in the 37th annual meeting of the International Plant Propagators Society (Eastern Region), held in Chicago recently.

Al Fordham, an Arboretum Associate and the retired plant propagator at the Arboretum, delivered a paper on the "Propagation of *Davidia involucrata* 'Vilmoriniana' and *Aesculus parviflora*."

Gary Koller, managing horticulturist at the Arboretum, discussed "Runts, Rogues, and Rejects: The Search for Dwarf and Compact Flowering Shrubs."

Rob Nicholson, a plant propagator at the Arboretum, gave a paper on "Propagation of Rare Woody Endemics of Eastern North America."

Jack Alexander, plant propagator at the Arboretum, and Koller moderated the new plant forum, in which plants, both new and old, that deserve greater landscape use, are presented. These included the Arboretum's *Leycesteria formosa*, *Betula apoiensis*, *Schizophragma hydrangeoides* (seeds of these three are available for distribution), and *Pinus nigra* 'Arnold Sentinel'.

Koller is a director of the International Plant Propagators Society.

News from the Arnold Arboretum is written by Jo Procter, the Arboretum's Public Affairs Officer. Members of the Friends of the Arnold Arboretum are invited to send news of awards, honors, horticultural achievements, and personal news of note to her for this column, "Briefly noted..." Please address your correspondence to her at the Arboretum, 125 Arborway, Jamaica Plain, MA 02130-2795.

Organization Meetings

A Faithful Catalog of Horticultural and Botanical Meetings Scheduled for the New England Area

Some organizations hold meetings at regular intervals, others do not. All of the meetings listed below are open to the public. Organizations always welcome new and prospective members. It is advisable to verify the information given below directly with the contact person listed. Please do not call the Arnold Arboretum.

Meetings Regular

AMERICAN RHODODENDRON SOCIETY (MASSACHUSETTS CHAPTER)

Third Wednesday (varies), beginning in September, 7:30 P.M., Suburban Experiment Station, 241 Beaver Street, Waltham. Contact: Barbara Emeneau (617) 729-0725.

BONSAI STUDY GROUP OF THE MASSACHUSETTS HORTICULTURAL SOCIETY

First Sunday, 2 p.m., Wellesley College Greenhouse, Wellesley. Contact: John Palmer (617) 443-5084.

CONNECTICUT HORTICULTURAL SOCIETY

Third Thursday, 8 P.M., Hoadley Auditorium, Connecticut Historical Society, 1 Elizabeth Street, Hartford. Lecture followed by plant forum and plant auction. Contact: Connecticut Horticultural Society, 150 Main Street, Wethersfield 06109; (203) 529-8713.

CONNECTICUT ORCHID SOCIETY

Second Wednesday, 7:30 P.M., at different locations. (June, members only; July, August, no meetings.) Contact: E. M. Wolf (203) 456-1657.

GARDENERS AND FLORISTS CLUB

Third Tuesday, 7:30 P.M., Wellesley College Greenhouse, Wellesley, MA. Contact: Del Nickerson, Wellesley College Greenhouse.

GREEN INDUSTRY COUNCIL

First Wednesday, 12 NOON-1:30 P.M., Case Estates, Weston, MA. Information: (617)435-6335.

HOBBY GREENHOUSE ASSOCIATION OF EASTERN MASSACHUSETTS

Second Saturday, alternate months (January, March, May, etc.), 1:30 P.M., Wellesley College Greenhouse, Wellesley. Members need not own greenhouses. Contact: Joseph Rajumas, 8 Davis Street, Holliston 01746.

INDOOR GARDENING SOCIETY OF AMERICA (CONNECTICUT CHAPTER)

Fourth Wednesday, 7:30 P.M., Cooperative Extension Service Building, 1280 Asylum Street, Hartford. Contact: Michael Archaski, 64 Rhodes Street, New Britain 06051; (203) 225-5828.

MASSACHUSETTS ORCHID SOCIETY

Second Tuesday, 7:30 P.M., Suburban Experiment Station, 241 Beaver Street, Waltham. Occasional special workshops at 7 p.m. Contact: D. Fye, (617) 358-7547; C. Lee (617) 443-6566; or M. A. Grigg, 38 Monadnock Road, Worcester 01609.

MOBY DICK AFRICAN VIOLET SOCIETY

Second Thursday, 7 P.M., Dartmouth Library, South Dartmouth, MA. Contact: Mrs. Ruth Warren (617) 679-1189.

NEW ENGLAND BROMELIAD SOCIETY

Third Sunday, September-June, 1 P.M., Wellesley College Greenhouse, Wellesley, MA. Contact: Paul R. Carlberg (617) 791-1533 or (617) 757-5012; or DeeDee Bundy (617) 526-1952.

NEW HAMPSHIRE ORCHID SOCIETY

Second Saturday, 1:30 P.M., Concord Public Library, Concord. Location may change. Contact: Paul Sawyer, RFD 2, Box 174, Canaan 03741; (603) 523-7410 after 5 P.M.

Meetings Irregular

AMERICAN BEGONIA SOCIETY (BUXTON BRANCH)

Suburban Experiment Station, 241 Beaver Street, Waltham, MA: November 12, 8 P.M.; January 30, 1988, 9 A.M.; February 20, 1988, 9 A.M.; March 23, 1988, to be announced; April 27, 1988, to be announced; May 11, 1988, 8 P.M.; June 8, 1988, 8 P.M. *Contact:* Wanda Macnair (617) 876-1366.

AMERICAN FERN SOCIETY (SOUTHERN NEW ENGLAND CHAPTER)

Approximately monthly, changing locations. *Contact:* Peggy (617) 799-5897.

AMERICAN GLOXINIA AND GESNERIAD SOCIETY (NEW ENGLAND CHAPTER)

Approximately monthly, 1 P.M., Suburban Experiment Station, 241 Beaver Street, Waltham, MA. *Contact:* H. Friedberg (617) 891-9164.

AMERICAN HEMEROCALLIS SOCIETY (NEW ENGLAND CHAPTER)

Second Saturday, 10:30 A.M.-4 P.M., Suburban Experiment Station, 241 Beaver Street, Waltham, MA. Location subject to change. *Contact:* Suzanne Mahler (617) 878-8039.

AMERICAN ROCK GARDEN SOCIETY (NEW ENGLAND CHAPTER)

Saturday or Sunday, February-October (approximately monthly, at changing locations). *Contact:* Helga Andrews (617) 443-8994.

IRIS SOCIETY OF MASSACHUSETTS

September, November, January, and March. *Contact:* Mrs. John H. Burton, 188 Sagamore Street, South Hamilton 01982; (617) 468-3646.

NEW ENGLAND HOSTA SOCIETY, INC.

Meetings irregular, usually Sunday, 10 A.M.-2 P.M., at changing locations. *Contact:* Mabel-Maria Herweg, 11 Puritan Lane, Dedham, MA 02026; (617) 326-1939.

NORTHEAST HEATHER SOCIETY (CHAPTER OF THE NORTH AMERICAN HEATHER SOCIETY)

Meetings held at least four times a year on weekends, at various locations throughout New England. *Contact:* Walter K. Wornick, Post Office Box 101, Alstead, NH 03602; (603) 835-6165.

Ongoing Activities

ARNOLD ARBORETUM

The Arborway, Jamaica Plain, MA 02130-2795. A 265-acre public park of hardy trees, shrubs, and vines from all over the world, many of them from China and Japan. Open daily, sunrise-sunset. No charge. Visitor Center at Main Entrance open Tuesday-Sunday, 10 a.m.-4 p.m. Exhibits, slide show, public information, rest rooms. Arboretum Shop sells books, postcards, film, gift items, etc. Group van or guided walking tours available by appointment. Driving permits issued to elderly or handicapped, Monday-Friday, 9 A.M.-4 P.M. *Information:* (617) 524-1718; *recorded information on lectures, events:* 524-1717.

Volunteers are always needed to work in every area, with staff or on independent projects, on the Living Collections; in the library, gift shop, or herbarium; guiding tours; etc. Volunteers receive training and other benefits. *Contact:* Volunteer Coordinator, Arnold Arboretum, Jamaica Plain, MA 02130-2795; (617) 524-1718.

Horticultural and Botanical Calendar. Published in each issue of *Arnoldia*, the quarterly magazine of the Arnold Arboretum. It serves organizations in the New England area, though events taking place elsewhere are often listed. A standard form for submitting announcements accompanies each issue of the Calendar. *Arnoldia* invites your participation. Copy deadlines are December 15, March 15, June 15, and September 15 for the Winter, Spring, Summer, and Fall issues, respectively. *Mailing address:* Calendar, *Arnoldia*, Arnold Arboretum, Jamaica Plain, MA 02130-2795; *information:* (617) 524-1718.

Certificate in Gardening Arts. Arnold Arboretum. Botany and horticulture courses on theories and practices of good gardening (propagation, maintenance, design, plant selection, plant systematics, etc.). Work towards certificate may commence at any time during the year (some required courses may be entered only in spring). No time limit for fulfilling requirements, but final project (required) will usually be prepared within one year of completion of coursework. *Details and catalog:* (617) 524-1718.

Plant Information Hotline. Monday and Tuesday, 1–3 P.M. (617) 524-1718.

Field Study Experiences. School programs of the Arnold Arboretum for third- to sixth-grade classes. "Plants in Autumn: Seeds and Leaves" (September–November); "Hemlock Hill" (all seasons); "Around the World with Trees" (all seasons). Fee. Weekdays, 10 A.M.–12 NOON (advance registration required).

Barkley Begonia Collection, Northeastern University Greenhouses, 135 Cambridge Street (Route 3, 1 mile south of Route 128), Woburn, MA 01801. Open Monday–Friday, 8 A.M.–12 NOON, 1–5 P.M., other times by appointment. Group tours by arrangement. Closed weekends and holidays. No charge. *Information:* Wanda Macnair, 177 Hancock Street, Cambridge, MA 02139; (617) 876-1356.

Margaret C. Ferguson Greenhouses, Wellesley College, Route 135, Wellesley, MA 02181. Exhibits of desert and tropical plants, ferns, orchids. Seasonal displays. Open daily, 8 A.M.–4:30 P.M. Guided tours available by appointment. No charge. *Information:* (617) 235-0320, extension 3094.

Frederick Law Olmsted National Historic Site ("Fairsted"), 99 Warren Street, Brookline, MA. Boston offices of F. L. Olmsted and his two sons, surrounded by landscaped grounds. Open Friday–Sunday, 10 A.M.–4:30 P.M. No charge. Group tours by appointment. *Information:* U. S. Department of the Interior, National Park Service, 99 Warren Street, Brookline 02146; (617) 566-1689.

Garden in the Woods, Hemenway Road, Framingham, MA 01701. A 45-acre botanical garden containing the largest landscaped collection of wildflowers and native plants in the Northeast. Informal walks (10 A.M., Tuesday). Group tours by reservation. Open Tuesday–Sunday, 9 A.M.–4 P.M.; closed Monday. Admission charge. *Information:* (617) 877-7630; 237-4924.

Ashumet Holly Reservation and Wildlife Sanctuary of the Massachusetts Audubon Society, 286 Ashumet Road, East Falmouth, MA 02536. Two trails meander amid hollies and past an Oriental lotus pond. Open Tuesday–Sunday, DAWN–DUSK. Admission charge. *Information:* (617) 563-6390.

New Alchemy Institute, 237 Hatchville Road, East Falmouth, MA 02536. Research institution founded to develop ecologically sound food systems through organic gardening, integrated pest management, solar ponds, solar greenhouse design and management, tree crops, energy conservation. Film, guided tours. Open 10 A.M.–4 P.M., Monday–Friday; 12 NOON–4 P.M., Saturday, Sunday. Guided tours, Saturday, 1 P.M. Admission charge. *Information:* (617) 563-2655.

Lowell Holly Reservation, South Sandwich Road, Mashpee, MA 02649. One hundred thirty-five acres with two miles of shoreline, stands of beeches and hollies, walking trails. Open daily, 10 A.M.–SUNSET, free on weekdays, parking and boat-landing fees on weekends. *Information:* (617) 749-5780, 921-1944.

Mytoi Gardens, off Dike Road, Chappaquiddick Island, Marthas Vineyard, MA 02539. Eleven-acre Japanese-style garden with small pond, azaleas and rhododendrons, Hanoki cypress, hollies, daffodils. Open daily, SUNRISE–SUNSET. No charge. *Information:* (617) 794-5780, 921-1944.

Sedgwick Gardens at Long Hill, 572 Essex Street (Route 22), Beverly, MA. Collection of some 400 species of plants, including weeping Japanese cherries, azaleas, tree peonies, koelreuterias, oxydendrons, sophora, and stewartias, all identified and catalogued with their scientific names. Open daily, 8 A.M.–SUNSET. Admission charge. *Information:* The Trustees of Reservations, 572 Essex Street, Beverly 01915; (617) 922-1536, 921-1944.

The Stevens-Coolidge Place, 5 Wood Lane, North Andover, MA. House and carefully maintained grounds with expansive lawns, colorful gardens accented by formal hedges, specimen trees. A Trustees of Reservations property. House open Sundays 1–5 P.M. (admission charge); grounds open daily, 8 A.M.–SUNSET (no charge). *Information:* Superintendent, Stevens-Coolidge Place, North Andover 01845; (617) 682-3580.

Moseley Estate State Park, Curzon's Mill Road, Newburyport, MA. Scenic and historic Nineteenth Century estate; 476 acres of gardens, rolling agricultural land, pine forest, and mountain laurel. Open daily, 8 A.M.–SUNSET.

Rhododendron State Park, Fitzwilliam, NH 03447 (off Route 119). Sixteen-acre park with wild rhododendrons that bloom in mid-July. Open daily, 8 A.M.–SUNSET. No charge. *Information:* (603) 532-8862.

Maple Hill Farm, 117 Ridge Road (off Routes 122 and 133), Hollis, NH 03049. Herb garden, reflecting pool, perennial beds, rock garden, arbor, drying-plant beds, 1,600 acres of water, woods, and meadows. Open all the time, year round. No charge. *Information:* Beaver Brook Association, 117 Ridge Road, Hollis; (603) 465-7787 (9 A.M.–12 NOON, Monday–Friday).

Botany and Woodland Trails, Southern Vermont Art Center, Mount Equinox, Manchester 05254. Botany Trail on slopes of mountain, with woods, wildflowers, ferns, pool, scenic vistas. Open Tuesday–Saturday, 10 A.M.–5 P.M. (admission charge), Sunday, NOON–5 P.M. (free). *Information:* (802) 362-1405.

Tower Hill Botanical Garden, 30 Tower Hill Road (Route 70), Boylston, MA 01505. Grounds open weekdays, 8:30 A.M.–5 P.M., weekends (May–October), 10 A.M.–4 P.M., closed holidays. *Information:* Worcester County Horticultural Society, 30 Tower Hill Road, Boylston; (617) 869-6111.

Elliott Laurel Reservation, Route 101, Phillipston, MA 01331. Thirty-three acres of open fields, hardwood forest, pine woods, and mountain laurel. A property of the Trustees of Reservations. Open daily, SUNRISE–SUNSET. No charge. *Information:* (617) 921-1944, 537-2377.

Norcross Wildlife Sanctuary, Monson–Wales Road, Wales, MA 01081. Three miles of trails through over 3,000 acres of woodlands. Open Monday–Saturday, 9 A.M.–5 P.M. No charge. *Information:* (413) 267-9654.

Berkshire Garden Center (BGC), Routes 102 and 183, Stockbridge, MA. Fifteen-acre botanical garden with herb garden, display gardens, perennial borders, solar greenhouses. Open daily, 10 A.M.–5 P.M. Admission charge. *Information:* BGC, Stockbridge 01262; (413) 298-3926.

Champion Greenhouse, One Champion Plaza, Stamford, CT 06921. Ongoing program of horticultural shows, exhibits, and displays. Open 11 A.M.–5 P.M., Tuesday–Saturday. Group tours by appointment. *Information:* (203) 358-6688.

Abies fargesii Franchet: FARGES'S FIR

This slow-growing fir comes from China, where it grows at elevations of between 2,000 m and 3,900 m in the provinces of Hupeh, Szechuan, Sikiang, Shensi, and Kansu. It was discovered by the French missionary Père Paul Guillaume Farges, probably about 1892, and introduced by Wilson and planted in 1911. It is hardy in the Arnold Arboretum

(Zone V), where there are 2 specimens. The taller is 10 m in height. *Abies fargesii* is rare in collections in the United States, but there is 1 specimen of it in the Hunnewell Pinetum in Wellesley, Massachusetts.

No infraspecific relatives of *Abies fargesii* are recorded.

Habit
Subconical
Branches upturning, short; reaching 35 m in its native habitat
Thick
Crowns of old trees flattened

Bark
Rough and scaly, even in youth

Buds
Columnar
Resinous
6 mm
Reddish

Branchlet
☞ *Homogeneous reddish brown*
Glabrous
Undulant grooves and ridges

Foliage
Above
Dark, shiny green
V present
Leaves pointing at right angles (80°–90°) from branchlet, those on the upper side becoming dramatically shorter (to 1 cm) towards the end of branchlet
Below
Pointing 60°–90° from branchlet

Leaves
1.5–2.5 cm x 2.5 mm
Flattened, linear
Sides bitapered (taper greater at base, almost club-shaped)
Tip short, rounded with notch
Not curved
Margins entire
Flexibility 2+

Above
Dark, shiny green
No stomata
Shallow groove
No midrib
Below
Stomata gray-white
Margins nearly revolute
Not keeled
Resin canals median

Cones
Peduncle short
5–8 cm x 3–4 cm
Bracts markedly exserted and reflexed

Similar Species

- In mid-southern China, *Abies fargesii* has several neighbors with overlapping habitats: *Abies chensiensis* (plus its varieties *smithii*, *fabri*, and *georgii*), and *Abies fargesii*'s own varieties *faxoniana* and *sutchuensis*. These all have bright red-brown branchlets, except for *Abies chensiensis* and *Abies recurvata*, on which they are yellow. Because of the rarity of these in cultivation in New England, they are merely listed, not discussed, here. Other than these, *Abies fargesii* has no competitors for identification.

***Abies firma* Siebold & Zuccarini: MOMI FIR**

The range of *Abies firma* is the southern half of the Japanese archipelago. It is widespread there, growing at elevations of 50–1,600 m, between 30° and 39° North latitude. It thus also contains the habitat of *Abies homolepis*, which is discontinuous within it but at a higher elevation, and which it resembles somewhat.

Abies firma reaches 50 m in height in its native range and has been called the most beautiful of the Japanese firs, but, as Charles Sprague Sargent pointed out, although it is

very hardy in Massachusetts, environmental stress prevents it from assuming the beautiful proportions it demonstrates in Japan. The epithet "*firma*" means stout. Sargent wrote of trees in Japan with trunk diameters of 4–6 feet (1.2–1.8 m). It is hardy in Zone VI in cultivation in the United States. The Arnold Arboretum has 1 mature specimen that is 50 years old and 18 m tall.

No infraspecific relatives of *Abies firma* have been reported.

Habit

Reaching 20 m in cultivation when mature
Wide, with horizontal branches
Pyramidal crown becomes broad and often irregular in old age
Has been called the most beautiful of the Japanese firs (Bean, 1976; Liu, 1971)

Bark

As in other species of the genus, young trees and recent growth on old trees having gray bark that is smooth but of a pebbly, pigskinlike texture
Old bark on old trees rough, with peeling scales rather than thick plates

Bud

Round, with a slightly conical tip
5 x 4 mm
Milk-chocolate brown, scarcely resinous
Bud scales appressed

Branchlet

Brown-green to yellow-green
Surface with shallow fissures as in *Abies homolepis*, but far less conspicuous
Hairs in the fissures, not on the ridges
Flexibility 1+

Foliage

Above
Pectinate, with a wide V
Leaves pointing forward to a 75° angle with the branchlet
Below
Pectinate; angle with branchlet 60°–80°

Leaves

2–3 cm x 2–3 mm
Flattened, linear
Sides bitapered
☞ *Tip on young trees bifid, forming a notch with two sharp points on either side of it*
Curved 1+–2+ toward lower side and 1+ laterally
Margins entire
Flexibility 1+

Above

Shiny green
No stomata
Shallow groove
☞ *No midrib*
Below
Stomata gray-green
☞ *Margins revolute*
Not keeled

Cones

10–12 x 4.5 cm
Cylindrical but tapered from base to outer end, which is rounded
Peduncle short
Green, turning brown
Bracts markedly exserted

Distinguishing Characters

- The characteristic notch at the outer end of the leaf set between two spiny tips is diagnostic, even if the tree is an older one and may show this on a very limited number of leaves. If an example does not come forward and no leaf tip is notched, one must look for the very flattened, broad, bitapered leaves with revolute margins, nonwhite stomata below, and scarcely resinous buds.

Similar Species

- *Abies homolepis*: fissures in the branchlets more distinct; leaf stomata whiter below
- *Abies recurvata*: leaves mostly recurved and leaf stomata green below; buds very resinous; resin canals marginal
- *Abies chensiensis* (not discussed here): can have sharp-pointed, notched leaves, but resin canals marginal and cone bracts hidden

Abies fraseri (Pursh) Poiret: FRASER FIR

Abies fraseri has been called the more southerly version of *Abies balsamea*. Its range is the southern Appalachian Mountains, the mountainous areas of Virginia, North Carolina, and Tennessee. Although listed as hardy to Zone IV and being a mountain tree,

it has not done well in the Arnold Arboretum. At present our 2 specimens, which were acquired as seedlings from the National Arboretum, are 13 years old.

No infraspecific relatives of *Abies fraseri* grow in the Arnold Arboretum.

Habit

A small tree, reaching no higher than 25 m
Conical in shape when young
Like *Abies balsamea*, favored for Christmas trees
Branches tending to ascend from the trunk at an angle of 45°

Bark

Dark gray, with resin blisters
Becoming rough and fissured on old trees

Bud

Small (2 x 3 mm)
Reddish brown
Scales seen as prominent through the invariable coat of resin

Branchlet

Yellow-gray to red-brown
Hairs short, stiff, red, in confluent patches
Surface undulating
Flexibility 2+

Foliage

Above
Medium-wide V, often violated by aberrant leaves
Leaves pointing forward 60°–80° from branchlet
Below
Pectinate
Leaves pointing forward 45° from branchlet

Leaves

2 cm x 1 mm
Flattened, linear
Sides parallel
Tip rounded, with tiny notch
Not curved
Margins entire
Flexibility 2+

Above

Green, more matte than shiny
Stomata often in a patch in the tip of the groove
Groove shallow
No midrib

Below

☞ *Stomata in two ranks of 8–12 rows each, whiter than in Abies balsamea*
Resin canals median

Cones

4–6 x 2.5–3.5 cm
Cylindrical, but tapered on both ends
Green, turning brown
Sessile

☞ *Bracts markedly exserted*

Similar Species

- *Abies balsamea*: also has resin blisters on bark of young trees

Distinguishing Characters

- Has more rows of stomata on the under surface of the leaves and thus shows a whiter underside than does *Abies balsamea*
- Cones, if present, with bracts exserted

Abies grandis Lindley: GRAND FIR

Abies grandis is hardy in Zone IV and very commonly cultivated in Britain but rare in New England. The Arnold Arboretum has two specimens, one 86, the other 97 years of age, that were planted on Hemlock Hill, where there was good protection by the mature hemlocks at that time. They have grown

successfully to heights of 21 m and 22 m and to diameters of 90 cm and 92 cm, but now are hidden away from their neighbors. They are well worth a visit because of their unique pectinate foliage.

No infraspecific relatives of *Abies grandis* grow in the Arnold Arboretum.

Habit

True to its name, the tallest of the true firs, growing to 100 m in its native habitat. Popular in cultivation in climates where it is truly hardy, growing rapidly (up to 1 m a year). Branches pendulous at their bases, turning up at the end so that the tree in its prime is narrow columnar and the crown spirelike.

Bark

Young bark (less than 50 years old) gray with a pebbled surface. Old bark thickened, in broad, deep grooves with prominent plates in between.

Bud

Round, resinous. Very small (<5 mm). Scale tips divergent.

Branchlet

Olive green to bright red-brown. Faint hairs. Shallow longitudinal grooves. Flexibility 3+.

Foliage

Above
Leaves widely pectinate at 70°–80° angle from branchlet.

Below

☞ As in "Above"

Leaves

2–5 cm x 2 mm. Flattened, linear; proximal ends sharply twisted. Sides parallel. Tip rounded and notched. Not curved. Margins entire. Flexibility 3+.

Above

Shiny, dark green. No stomata. Prominent groove. No midrib. *Below*
Stomata gray-white. Margins subrevolute. Not keeled. Resin canals marginal.

Cones

7–10 x 3–3.5 cm. Submarine shaped. Rounded at both ends. Green, turning brown. Bracts concealed.

Similar Species

- *Abies concolor* var. *lowiana*: stomata on upper surface of leaves

Distinguishing Characters

- The long, parallel-sided, pectinately arranged, separately spaced leaves making the branchlets flattened sprays, to an extent not seen in any other fir (except *Abies concolor* var. *lowiana*)

***Abies holophylla* Maximowicz: NEEDLE FIR**

Introduced by Ernest H. Wilson in 1905, *Abies holophylla* comes from northeastern China and Korea, where it has a limited distribution along the border. It is hardy in Zones V and VI and may prove successful in colder and warmer areas as well.

The Arnold Arboretum grows 6 plants, but none of the original Wilson introductions survive. The oldest are 2 specimens received

as plants from the Ames private collection in North Easton, Massachusetts, in 1923. They are, respectively, 20 m and 18 m tall and have boles 67 cm and 30 cm thick. The bark consists of slightly raised, thin, 2.0–2.5-cm-square plates.

No infraspecific relatives of *Abies holophylla* are recorded.

Habit

Reaches 40–50 m in its native habitat
Branches short and ascending, crown broad and pyramidal
A graceful, tall tree

Bark

☞ *Bark in thin plates on all plants, young and old*
☞ *The smooth, gray, homogeneous bark of most young firs not seen in Abies holophylla*

Bud

5 mm
Ovate-conic; light brown
Scales appressed, with contours easily visible
Resinosity varies but averages slight (1+–0); in very occasional plants, 3+

Branchlet

Prominently ridged and sharply fissured longitudinally; both ridges and fissures shallow and broad, unlike those of *Abies homolepis*, which are narrow
Glabrous
Milk-chocolate brown

Foliage

Above
V wide
Leaves pointing forward 80° from branchlet
Below
Imperfectly pectinate, pointing forward 45° from branchlet
☞ *Leaves on both sides standing apart from each other*

Leaves

Length: 2.5–3.5 cm
Width: 2 mm
Flattened, linear
Sides parallel
☞ *Tip long drawn-out point, no notch*
0–1+ curved in flat plane
Margins entire
Flexibility 2+
Above
Matte green
No stomata
Groove very shallow
No midrib
Below
☞ *Stomata gray-green*
Margins not revolute
Not keeled
Resin canals median

Cone
8 x 10 cm
Cylindrical, with rounded ends
Peduncle short
Bracts concealed

Distinguishing Character

- Youngest bark scaly on trees of any age

Similar Species

- *Abies borisii-regis*: leaves often pointed, but darker green; branchlets hairier
- Firs with conspicuously pointed leaves (excluding *Abies bracteata*, which is extremely rare and has the widest [3 mm] and longest [up to 6 cm] leaves of the firs): leaves orderly, glossy green above and white below
- Firs with leaves that stand apart from each other (e.g., *Abies concolor*, *Abies grandis*, and *Abies cilicica*): tips of leaves not pointed

***Abies homolepis* Siebold & Zuccarini: NIKKO FIR**

Abies homolepis grows in the southern half of Japan, between 33° and 37° North latitude at elevations of between 700 m and 2,200 m. Its range, which is discontinuous, overlaps that of *Abies firma*, which is more densely distributed. "*Homolepis*" means "similar scales." It formerly was called *Abies brachyphylla* ("short leaves"), in contrast to many other firs. It is hardy to Zone V. Charles Sprague Sargent, writing 70 years ago, remarked on how well *Abies homolepis* and *Abies concolor* flourished here in their early years. They have continued to do so.

The Arnold Arboretum's holdings of *Abies homolepis* and its infraspecific relatives are 18 trees, several about 100 years old. (The total number of plants of this group of *Abies homolepis* growing in the Arnold Arboretum is: *Abies homolepis*, 9; *Abies Xumbellata*, 8; *Abies homolepis forma tomomi*, 1; or, 18 in all. Seven were acquired before 1900 and others soon thereafter [2 in 1902 and 4 in 1908].) As with *Abies concolor*, the tallest are 20–25 m tall, and their boles are up to 100 cm in diameter. They are important features of

the Arboretum's Pinetum, having fulfilled Sargent's predictions. It is of interest, however, that of all 34 specimens of *Abies homolepis* and its relatives planted starting in 1880 none of the 16 that are no longer with us were uprooted in hurricanes. For contrast with *Abies concolor* in this respect, see page 23.

Abies Xumbellata

Abies Xumbellata is a relative of *Abies homolepis*, recognized by Ernest Wilson under the name *Abies homolepis* var. *umbellata*. It differs in that its cone tips are umbilicated to more than those of the species. Most recent opinion considers it to be a hybrid between *Abies homolepis* and *Abies firma*, and its name has been changed to *Abies Xumbellata*.

Abies homolepis forma tomomi

Abies homolepis forma tomomi has slightly shorter leaves and is less densely branched than the species.

Habit

A broad-growing tree with long branches and a dome-shaped crown, conspicuously broad in old age

Bark

Rough and scaly over the resin blisters, unlike most other firs, even on young trees
Scales small and thin at first, in old trees coarse, with 3 x 10-cm scales

Buds

Rounded, with a conical point 6 mm
Resinous 2+
Scales appressed but prominent

Branchlet

Yellow-brown
Glabrous

✧ ***Longitudinally ridged and fissured with fissures so narrow that the whole contour is grossly smooth***

Flexibility 1+

Foliage

Above
Conspicuous V
Leaves pointing 80°–90° from branchlets

Below

Incompletely pectinate, pointing 60°–90° from branchlet

Leaves

2.5 cm x 2 mm
Flattened, linear
Sides parallel to 1+ bitapered
Tip rounded, sometimes entire but usually a small notch
Curved 0–1+

Above

Dark green, not conspicuously shiny

No stomata
Groove medium

No midrib

Below

Stomata gray-white
Margins not revolute
Midrib 1+
Not keeled
Resin canals median

Cones

8 x 3 cm

Purple when young, brown when
mature

Evenly bitapered (submarine-shaped)

Sessile

Bracts hidden

Distinguishing Characters

- The sturdy, yellow, glabrous branchlets with the tight, deep fissures are nearly unique

Similar Species

- Abies holophylla*: branchlets prominently ridged but not with narrow fissures; leaves long and pointed
- Abies firma*: tips of young leaves bifid; Even without that, leaves broad, very flat, bitapered; furrows of branchlets not narrow and deep

Abies koreana E. H. Wilson: KOREAN FIR

The range of *Abies koreana* is southern Korea and the volcanic island of Cheju Do (Quelpart) up to elevations of 2,000 m. The type specimen is in the herbarium of the Arnold Arboretum in Cambridge, Massachusetts. It is hardy from Zone V to Zone VII.

The Arnold Arboretum grows six specimens of *Abies koreana*, one of them an original specimen from the group introduced to the West by Ernest Wilson in 1917. It is 18 m

tall and has a trunk 70 cm in diameter.

The prostrate forms, usually called *Abies koreana* 'Prostrate Beauty', follow the tendency of the types to set cones when young. They are popular in dwarf-conifer collections. Six specimens are growing in the Arnold Arboretum's collections of dwarf conifers, where there are also two plants of *Abies koreana* 'Aurea'.

Habit

A slow-growing tree, rarely reaching more than 20 m in height
Pyramidal when young
Crown becoming broad with age
Foliage dark and rather dense

Bark

Gray
Smooth when young, later very rough, with deep grooves and plates
Resinous

Bud

5 mm
Round, with blunt, pyramidal tip
Covered with resin that obscures the scales

Branchlet

Light gray-green
Lustrous
Scattered hairs
No undulations or furrows

Foliage

Above and below
☞ *Leaves pointing all around*, less dense below
No V
Pointing forward at angles from branchlet of 45° to almost 90°
Viewed end-on, a circular rosette of green leaves offsetting the cluster of three resinous buds, with flashes of white to the under surface

Leaves

1–1.5 cm x 2+ cm
Flattened, linear
Sides bitapered but wider at tip
Tip curved, with tiny notch or no notch

Curved 1+ toward upper side

Margins entire
Flexibility 1+–2+

Above
Matte dark green

No stomata
Shallow groove
No midrib

Below
Stomata very white and broad
Margins not revolute
Not keeled
Midrib narrow
Resin canals median (occasionally submarginal)

Cones

5–7 x 2.5–2.8 cm
Cylindrical; narrower at rounded ends
Violet when young
Bracts markedly exserted
Cones readily produced
☞ *Many young plants bear cones*

Similar Species

- *Abies sachalinensis* and *Abies veitchii*: leaves longer but conspicuously more flexible than those of *Abies koreana*
- *Abies sachalinensis*: stomata on undersides of leaves dull white; bark smooth until an advanced age
- *Abies veitchii*: undersides of leaves very white but bark smooth and bract scales of the cones hidden or their tips barely visible
- *Abies nephrolepis*: leaves also longer than those of *Abies koreana*, linear (not bitapered), with dull-white stomata below; bark smooth; more hairs on branchlet; cone scales kidney-shaped

Abies lasiocarpa (Hooker) Nuttall: SUBALPINE FIR

With the exception of *Abies balsamea*, *Abies lasiocarpa* is the most widely distributed species of *Abies* in the United States. Hardy in Zones V–VI, it grows from southern Alaska to the Mexican border in the Rocky Mountains (35°–63° North latitude), often in association with *Picea engelmannii*. In addition, it occurs in the mountains of Washington and Oregon.

"*Lasiocarpa*" (meaning "hairy fruit") refers to the hirsuteness of the cones. "Subalpine," an adjective commonly applied to this species, is appropriate, since *Abies lasiocarpa* is a mountain tree.

Alfred Rehder stated that *Abies lasiocarpa* "does not do well in the eastern states." It is hardy in the Arnold Arboretum, which contains three mature trees in addition to the variety *arizonica*. The growth of the three

has been slow to average. Acquired in 1942, 1958, and 1966, they are 11, 3, and 2.5 m tall, respectively.

Abies lasiocarpa var. *arizonica*

Abies lasiocarpa var. *arizonica* (Merriam) Lemmon is a common variety, more popular as an ornamental than the species. It is distinguished from the species by its more intensely whitish blue leaves, which have emarginate tips, and by its corky bark (hence its common English name, cork-bark fir). There is one handsome specimen in the Arnold Arboretum. Dating from 1932, it is now 20 m tall; its trunk is 40 cm in diameter.

In the Arboretum's dwarf-conifer collection there are three specimens of *Abies lasiocarpa* 'Compacta'.

Habit

Narrow, spirelike, with short, upcurved, dense branches
Can grow to 40 m but winds at timberline in its native habitat discourage such statures

Bark

Smooth, gray, slightly roughened when young, with resin blisters
Bark of older trees rougher, fissured
Bark on some plants with rusty tinge

Bud

5–6 mm
Ovate
Resinous
Scales obscured by the resin

Branchlet

Silvery tan, almost fawn-colored on some plants
Grooved shallowly
No fissures
Hairy 1+–scattered, in grooves

Foliage

Above
Gray
Incomplete V or no V
Leaves pointing forward at 45° from branchlet
Below
Incompletely pectinate, leaves pointing forward 30°–40° from branchlet

Leaves

2.5 cm x <2 mm
Flattened, linear
Sides parallel
Tip round, with tiny notch
Curved 1+ toward upper surface
Margins entire
Flexibility 2+

Above

☞ *Matte green–gray*
☞ *Distal half with two bands of several rows of tiny stomata*

☞ *Shallow groove*

No midrib
Below
Two bands of light-gray stomata
Margins not revolute
Midrib prominent
Resin canals median

Cones

8–10 x 3.5 cm
Cylindrical to submarine-shaped
Bracts hidden
Purple when young

Distinguishing Characters

- One of the few members of the genus with full lines of stomata on the upper surface of leaves, the others being *Abies concolor*, *Abies magnifica*, *Abies pinsapo*, and *Abies procera*

Similar Species

- *Abies concolor*: leaves much longer and more widely spaced; resin canals marginal
- *Abies magnifica*: leaves quadrangular in cross section and running parallel to the shoot before spreading from it
- *Abies pinsapo*: leaves 4+ stiff, at right angles to the branchlet, very pointed
- *Abies procera*: leaves like those of *Abies magnifica* but not quadrangular in cross section

***Abies magnifica* A. Murray: RED FIR**

Abies magnifica grows in northern California and southern Oregon, its range being more southerly and at slightly higher elevations (35° 40'–45° 3' North latitude and 1,400–2,700 m) than that of *Abies procera* (41°–48° 30' North latitude and 900–2,000 m), which in some ways it resembles, particularly in the presence of stomata on the upper surface of its leaves and the arrangement of the leaves at their origins from the branchlets. It is reputed to be hardy in the warmer parts of Zone V but less frost hardy than *Abies procera*. The name "red fir" derives from the color of the bark. The translation of the Latin name to "magnificent fir" is more appropriate and is sometimes used.

The Arnold Arboretum grows only 1 specimen—*Abies magnifica* 'Nana'—which is 50

cm tall and not thriving, but no specimens of the species. We list it here chiefly for comparison with *Abies procera*, which also appears in the Arboretum only in its dwarf form. The Hunnewell Pinetum in Wellesley, Massachusetts, does possess a specimen 17 years old and 1.5 m tall. It is healthy but not fast-growing.

Abies magnifica* var. *shastensis

Even though the Arnold Arboretum does not possess a specimen of it, we list *Abies magnifica* var. *shastensis* Lemmon here because it is well known as a natural variety. It is distinguished from the type because the bract scales on its cones are exserted. This suggests that it is a hybrid between *Abies magnifica* and *Abies procera*.

Habit

A columnar tree with a spirelike head, one of the most elegant known
Can grow to 70 m in the wild (trees cultivated in Britain for over 100 years have reached about half that height)
Trunks of mature trees often branchless for half their heights

Bark

Smooth (but for resin blisters in youth) and very light gray
Becoming deeply furrowed in age, revealing reddish inner bark

Buds

Ovoid, acute at tip
Brown
Small, 4 mm
Hard to see because terminal leaves crowd about them
Resinous on the upper aspect

Branchlets

Red-brown
Shallowly grooved longitudinally
Hairy

Foliage

Above
Gray-green
No V, leaves paralleling branchlets at their origins, then turning at right angle outward and upward
Below
As in "Above," but spray more flattened

Leaves

2–3 cm x 2 mm
Flattened, linear
Sides parallel
Tips rounded, without notch
Not curved but angled as described
Margins entire
Flexibility 1+

Above

Gray-green
☞ *Stomata present in two full bands*
☞ *No groove*
Small midrib
Below
Stomata in two gray-white ranks
Keel present
Resin canals marginal

Cones

15–25 x 10–12 cm
Sessile or nearly so
Purple at first, brown when mature
Nearly cylindrical, thick
Bract scales hidden

Similar Species

- *Abies procera* (its only "look-alike"): leaves with dorsal groove (appear diamond-shaped in cross-section); cone bracts not hidden

Abies nephrolepis Maximowicz: KHINGHAN FIR

The native range of *Abies nephrolepis* is North Korea. Some have called it the eastern-Asiatic form of *Abies sibirica*. The specific epithet "*nephrolepis*" refers to its cone scales, which, when looked at individually, are kidney-shaped; this characteristic is not different enough to distinguish it from other members of the genus. Alfred Rehder and

Ernest Wilson considered that its name should be *Abies sibirica* var. *nephrolepis*.

The Arnold Arboretum has 3 specimens, all of them over 60 years of age. One, *forma chlorocarpa* Wilson (cones green when young), was introduced by Wilson in 1917 and is now a beautiful tree 20 m in height. No other infraspecific forms are known.

Habit

Columnar, broad, conical, short branches
Crown conical, becoming irregular

Bark

Beech gray, pebbly
Becomes shallowly fissured on old trees

Bud

Conical, blunt
Light reddish brown
Resinous
Scales prominent in relief under the resin

Branchlet

Yellow-gray
Shallowly ribbed or grooved
Hairy 2+

Foliage

Above
V; pointing forward 60° from branchlet
Below
Pectinate; pointing forward 60° from branchlet

Leaves

2 cm x 2 mm
Flattened, linear
Sides parallel
Tip rounded, with notch
Not curved
Margins entire
Flexibility 3+

Above

Dull green
No stomata
Groove present
No midrib

Below

Stomata dull white
Margins not revolute
Not keeled, midrib thin
Resin canals median

Cones

5 x 2.5 cm
Cylindrico-ellipsoid
Purple, turning brown
Bracts exserted

Similar Species

- *Abies sachalinensis* and *Abies sibirica* (see the table on page 45)

***Abies nordmanniana* (Steven) Spach: CAUCASIAN FIR**

The range of *Abies nordmanniana* lies just east of the eastern shore of the Black Sea. Introduced to the West (Britain) in 1836, it is a strong, beautiful addition to collections in the British Isles. Named after Alexander Nordmann (1803–66), a Finnish botanist and one of its discoverers, *Abies nordmanniana* is hardy in Zones V–VII.

The Arnold Arboretum acquired two mature, narrow and tall specimens from a nursery in Holland in 1903. Twenty-six meters

tall and with boles 55 and 64 cm in diameter, they are among the most impressive specimens in the Arboretum's Pinetum.

The only infraspecific relative in the Arnold Arboretum is *Abies nordmanniana* 'Pendula', which grows at the same rate as the species but differs from it by the exaggerated pendulosity of its branches. Although 30 years old, it has lost its crown and is only 2 m tall.

Habit

Growing to 60 m in the Caucasus Mountains

Conical, with a narrow, spirelike crown

Main branches horizontal, lower branches sweeping downwards

Living up to its reputation of having an impressive, lordly aspect

Starting to grow late in spring (a characteristic useful in cultivation), which makes it insensitive to late frosts

Bark

Smooth above to rough below
Grayish when smooth;
brownish when rough

Bud

☞ *Red-brown, conical-ovate, not resinous*

Branchlet

Olive, with a brownish tinge

Surface shallowly grooved (fissured) longitudinally

No undulations or ridges

Covered with moderately dense, short, stiff hairs

Foliage

Above

☞ *Leaves on most shoots shingled, i.e., no V, but all pointing forward at an angle of 35°–45° from the shoot and covering it*

Below

Leaves pointing forward at a 60° angle

Imperfectly pectinate, making a wide, irregular V

Leaves

2–3 cm x 2.5 mm

Linear, curving 2+ in the flat plane

Midrib 2+, thickened in a keel, as are the side ribs

Sides parallel

Tip rounded, notched

Curving 2+ in the flat plane

Margins entire

Flexibility 1+

Above

Glossy 1+

No stomata

Groove prominent

Midrib prominent

Below

Stomata white-gray

Margins not revolute

Keel on midrib

Resin canals marginal

Cones

5 x 14 cm

Cylindrical, tip pointed

Bracts just exerted

Similar Species

- *Abies alba*: leaves also shiny, with notched tips, nonresinous buds, and hairy branchlets, but arranged in a pectinate V above the branchlet
- *Abies amabilis*: leaves above likewise cover the branchlet but are flexible 3+ and occasionally have some stomata on the tip of the upper surface

***Abies pinsapo* Boissier: SPANISH FIR**

The native range of *Abies pinsapo* is a localized one near Ronda in southern Spain, where it was discovered and described and whence it was introduced to cultivation early in the Eighteenth Century by Pierre Boissier (1810–85). Because its short, stiff, sharp leaves emerge at right angles, it has been called by some the “hedgehog fir.” It is not uncommon in cultivation and is hardy from

Zone VI into parts of Zone VIII.

Infraspecific Relatives

The most common horticultural variety is ‘*Glauca*’, one specimen of which is in the holdings of the Arnold Arboretum. It was accessioned 44 years ago and is a sturdy plant 7.5 m tall.

Habit

Relatively short branches set in pseudowhorls, making for a columnar, or narrow, pyramidal tree
Growing up to 30 m

Bark

Remaining remarkably smooth on the lower trunks of certain trees, but rough in most

Bud

Small (3 mm)
Resinous
Scale tips visible in relief under the resin

Branchlet

Glabrous
Surface rusty red
Conspicuously grooved and fissured

Foliage

☞ **Short leaves radiating around branchlet**

Above

Leaves at right angle (90°) to branchlet

Below

Leaves at right angle (90°) to branchlet
No V on either side but leaves less dense on underside
Some leaves occasionally recurved

Leaves

1–1.5 cm x 2 mm
Flattened, linear
Sides parallel, bordering on bitapered

☞ **Tip an obtuse horny point; not notched**

Curving 1+ toward underside
Margins entire

☞ **Flexibility 0**

Above

Matte green
Covered with tiny white stomata in two bands on either side of slightly elevated midrib
Below

Two bands of gray stomata
Midrib definite but not conspicuous
Not keeled
Resin canals median

Cones

10–12 x 3–4 cm
Subcylindrical, submarine-shaped
Sessile
Bracts hidden

Distinguishing Characters

- Leaves short, stiff, at right angles to branchlet

Similar Species

- Looks superficially like a spruce, particularly the tiger-tail spruce (*Picea polita*), which has similarly stiff leaves
- The roughness of the branchlet surfaces at the points where the leaves are attached resembles that seen in *Picea polita*
- If no sterigmas at the leaf attachments and if specimen belongs to the genus *Abies*, the only confusion would be with a hybrid of *Abies pinsapo* and *Abies nordmanniana*

(*Abies* \times *insignis*), *Abies cephalonica* (*Abies* \times *vilmorinii*), or *Abies numidica* (*Abies* \times *marocana*); though uncommon, these hybrids of *Abies pinsapo* must be suspected in specimens with stiff, short, prickly leaves that are not entirely characteristic of the species, *Abies pinsapo*, itself

Abies procera Rehder: NOBLE FIR

One of the tallest trees of the West Coast ("*procera*" means tall, or slender), the noble fir grows on the western slope of the Cascade Mountains, from Washington to upper northern California. Its range is continuous with that of *Abies magnifica*, which, although it overlaps with that of *Abies procera*, is primarily south of the California–Oregon border. As noted under *Abies magnifica*, these two species can be regarded as "nonidentical twins." They share many characteristics.

Abies procera was described by David Douglas in 1825 and introduced into Great Britain, where it has always flourished. Although none of the original introductions are

still living, some survived until 1968. Specimens planted as long ago as 1840 were registered as still living in the early 1970s (Bean, 1976, Volume 1, page 65). The only examples of the species in the Arnold Arboretum are dwarfs, the well known beautiful cultivars 'Glaucá' and 'Glaucá Prostrata', on which the characteristics of the typical foliage can be studied.

In the United States *Abies procera* is just hardy to Zone V but not common. The Hunnewell Pinetum in Wellesley, Massachusetts, grows one specimen (under its earlier name, *Abies nobilis*). It is 4.5 m high, and the bole is 5 cm in diameter at breast height.

Habit

Reaching 80 m in its native habitat
Bole straight; can remain unbranched for over 40 m
Branches relatively short, making for a narrow crown that is, however, rounded at its top

Bark

Smooth, reddish gray for many years, eventually becoming rough with soft plates

Bud

Very small, about 3 mm (hard to see among the terminal forward-growing leaves)
Resinous
Scale tips divergent

Branchlet

Reddish brown
Hairy 1+
Surface regular
Suggestion of longitudinal grooves

Foliage

Above
Incomplete V; most leaves in a wide V, but many singles arising in center of it; all pointing 70°–90° from the branchlet
Below
Pectinate with occasional strays; pointing forward 60°–80° from the branchlet
✿ *Leaves both above and below characteristically running forward parallel to the branchlet for 2 mm before departing at the angle mentioned* (seen more easily from the lower aspect of the branchlet); similar in this feature to *Abies magnifica*

Leaves

2–3 cm x 2 mm
Linear, flattened
Tip rounded, notched or not notched
Curved 1–2+ toward lower surface
Margins entire
Flexibility 1–2+

Above

Matte green
✿ *Stomata in bands on both sides of shallow groove (in some cases a lens is needed to observe this)*
No midrib, but upper surface can be slightly convex and surmounted by the groove, which can change to a midrib near the tip
Below
Stomata small, numerous, white
Margins not revolute
Midrib prominent
Resin canals marginal

Cones

10–15 x 6–7 cm
Subcylindrical (submarine- or blimplike)
Green when young, turning brown
Bracts strongly exserted and reflexed

Similar Species

- *Abies concolor*: stomata in full bands on the upper surfaces of leaves but leaves long, flexible, widely spaced
- *Abies lasiocarpa*: stomata in full bands on the upper surfaces of leaves but leaves extend from the branchlet directly, with no appressing of the initial few millimeters; resin canals median; cone bract scales hidden
- *Abies magnifica*: stomata in full bands on the upper surfaces of leaves (resembles *Abies procera* more than any other species), but leaves have no groove on their upper surface and cones have hidden bracts [**Note:** Cone bracts of *Abies magnifica* var. *shastensis* exserted; if none available, one must rely on leaf characteristics]
- *Abies pinsapo*: stomata in full bands on the upper surfaces of leaves but leaves rigid 4+, with no groove on upper side; tips horny; at right angles to branchlets
- See also *Abies lasiocarpa*

***Abies recurvata* M. T. Masters: MIN FIR**

The English name of *Abies recurvata* derives from the Min River in central China (Szechuan), where the tree grows between 25° and 45° North latitude. Hardy in Zone V, it is uncommon in cultivation.

Three plants grow in the Arnold Arboretum, all from the original introduction by

Wilson in 1911. It has been a slow grower; the tallest of the Arboretum's trees is 9 m tall. The Hunnewell Pinetum in Wellesley, Massachusetts, grows one plant.

Abies recurvata is not recorded as having cultivars or infraspecific forms.

Habit

Reaches 40 m in its native habitat
Pyramidal, the crown becoming flattened with age

Bark

Gray or red-brown
Smooth in youth, later becoming rough with 2- to 3-cm-long flaking plates

Bud

5-7 mm or larger
Light grayish brown with a roseate tinge
Covered with gray resin through which the outlines of the prominent bud scales can be seen in relief

Branchlet

Silvery yellow-gray
Glabrous
Flexibility 1+
Surface undulate with shallow, wide grooves and ridges

Foliage

Above
Stiff, sturdy leaves point backwards, often to 60° from branchlet

☞ *Many leaves nearly at a right angle, occasionally slightly forward*

Below

Same as "Above"

Leaves

2-3 cm x 3 mm
Flattened, linear
Sides bitapered
Tip pointed
Flexibility 1-2+

Above

Shiny green, often pale
No stomata
Shallow groove
No midrib

Below

Stomata green
Margins revolute 1+
Not keeled
Resin canals marginal

Cones

6 x 4 cm
Chunky, conical, with rounded ends
Purple until maturity, then brown
Bracts hidden

Distinguishing Characters

- Leaves recurved and green beneath, making it difficult to confuse *Abies recurvata* with any other species of *Abies*

***Abies sachalinensis* M. T. Masters: SACHALIN FIR**

Abies sachalinensis (formerly called *Abies veitchii* var. *sachalinensis*) is restricted to the Kurile and Sachalin Islands and to Hokkaido, the northern island of Japan. Its relationship to certain neighboring firs—*Abies sibirica* and *Abies nephrolepis*—has been noted. It is hardy from Zones II–VI. The Arnold Arboretum grows seven specimens, two of them at the Case Estates in Weston, Massachusetts. Two of those growing at the Arnold Arboretum itself (in Jamaica Plain) are 105 and 93

years old and 17 and 18 m tall, respectively. One of our specimens is the variety *mayriana*, which came as seed in 1932 from Hokkaido. It is now 12 m tall.

In addition to *Abies sachalinensis* var. *mayriana* Miyabe & Kudo, the only other recorded infraspecific relative is *Abies sachalinensis* var. *nemorensis* Mayr, which has smaller cones than the species and hidden bracts; it does not grow in the Arnold Arboretum.

Habit

Growing to 40 m
Columnar
Dense foliage in the crown

Bark

Gray
Pebbly, otherwise smooth, even in older trees, but in them finally becoming scaly

Bud

Conical, with a domed tip
Resinous 4+
Scales prominently bulging, but tips not spreading
Conspicuously white

Branchlet

Gray-brown
Furrowed gently longitudinally
Hairy 3+

Foliage

Above

Incomplete V, leaves pointing forward 30°

Below

Pectinate with occasional strays; leaves pointing forward 30°; rather closely set

Leaves

3–3.5 cm x 1.25–1.5 mm
Flattened, linear
Sides parallel the whole length of the leaf
Tip blunt, with tiny notch
Curved 1+
Margins entire
Flexibility 3+

Above

Shiny green
No stomata (occasionally a few in the groove at the tip)

Groove well defined

No midrib

Below

Dull white
Stomata very small and numerous in narrow bands
Margins not revolute
Not keeled
Resin canals median and conspicuously large

Cones

7 x 2 cm
Between ellipsoid and cylindrical
Coffee-colored
Bracts exserted

Similar Species

- *Abies nephrolepis* and *Abies sibirica* (which have thin, flexible, regularly arranged leaves) are the species that most resemble *Abies sachalinensis* (see *Abies sibirica* for discussion)

Abies sibirica Ledebour: SIBERIAN FIR

The range of *Abies sibirica* lies between 40° and 140° East longitude, from Moscow almost to the Sea of Okhotsk, the most extensive in the genus *Abies*. Because of its great resemblance to its neighboring species, *Abies sachalinensis*, a systematic descrip-

tion of *Abies sibirica* will not be made below, but only its differences from *Abies sachalinensis* mentioned. It is hardy to Zone II.

The Arnold Arboretum grows one specimen, now 40 years old, that is 12 m tall and 30 cm in diameter.

Similar Species

- *Abies sachalinensis*: branchlets ribbed (not ribbed in *Abies sibirica*), stomata below dull white (white in *Abies sibirica*), cone bracts exserted (hidden or only slightly exserted in *Abies sibirica*). See the table, below.

Notes on Three Similar Species of *Abies*

Three members of the genus *Abies*, neighbors in eastern Asia, *Abies nephrolepis*, *Abies sachalinensis*, and *Abies sibirica*, are strikingly similar. All three have resinous buds; hairy branchlets; narrow, flexible, linear leaves with parallel sides; and large, median resin canals. The following table lists some features—unfortunately not always constant—that help to distinguish them.

Character	<i>Abies nephrolepis</i>	<i>Abies sachalinensis</i>	<i>Abies sibirica</i>
Bark on mature trees	Rough	Rough	Smooth
Branchlet ribbed	No	Yes	No
Stomata on upper side of leaf	No	No	Yes
Color of leaf stomata	Dull white	Dull white	White

Abies veitchii Lindley: VEITCH'S FIR

A rather small fir whose native range extends from central Japan southwards in detached populations, *Abies veitchii* was introduced to cultivation in the West by John Gould Veitch (1839–70), the illustrious English botanist and nurseryman. Veitch made two extensive collecting trips to the Far East, one in 1860 and one in 1864–66. He died in 1870 at the age of 31, leaving his name attached to hundreds of plants, and a legacy of plant collecting that has been carried on in his name for 100 years. It was under the Veitch firm that Ernest Wilson got his start.

Abies veitchii is subalpine and seldom seen below 1,500 m. It is hardy in Zones III–VI.

Habit

Slender, with short, level branches when young
Cylindrical, with a spirelike crown; in maturity, branches more wide-spreading, forming a broadly pyramidal tree

Bark

Gray, becoming only slightly roughened in old age
Smooth, with resin blisters

Bud

4 mm
Spherico-conical
Red-brown
Resinous

Branchlet

Gray-yellow
Covered with short hairs
Surface regular
Unribbed

Foliage

Above
V occasionally incomplete
Leaves pointing forward 45° from branchlet
Below
Pectinate
Leaves pointing forward 45° from branchlet

Leaves

2–3 cm x 2 mm
Flattened, linear
Sides parallel
Tip truncated, notched
Not curved
Margins entire
Flexibility 3–4+

Six specimens grow in the Arnold Arboretum. Two of them are historic. One dates from 1895, having been provided by the Veitch Nursery; it is 17 m tall and has a bole that is 47 cm thick. The other historic specimen is *Abies veitchii* var. *olivacea* (the epithet *olivacea* derives from the olive-green color of the cone when it is young). Introduced by Ernest H. Wilson in 1915, it is 12.3 m tall and has a trunk 40 cm in diameter. A scion of Wilson's tree was grafted onto an understock of *Abies balsamea* in 1959. Planted out in the Pinetum in 1969, it is thriving. These are the only infraspecific relatives of *Abies veitchii*.

Above

Shiny green
No stomata
Groove shallow
No midrib

Below

♂ **Stomata chalky blue-white**
Margins revolute 1+
Midrib and marginal green bands thin
Resin canals median to sub-marginal

Cones

6 x 2 cm
Cylindrical
Sessile
Purple, turning dark brown
Bracts slightly exserted

Similar Species

- *Abies nephrolepis*, *Abies sachalinensis*, and *Abies sibirica*: leaves also parallel-sided, flexible; resin canals median; branchlets hairy; and buds resinous, but the whiteness of the undersides of their leaves far less bright
- *Abies delavayi* group: undersides of leaves also white, but branchlets conspicuously red-brown and midrib and marginal green bands of leaves very prominent; leaves stiffer

and resin canals marginal; undersides of leaves tending to be revolute

- *Abies koreana*: undersides of leaves bright white, but leaves radially arranged and conspicuously shorter than those of *Abies veitchii*; cone bracts prominently exserted and reflexed

Glossary of Terms

Adaxial. Facing toward the axis.

Diœcious. Having staminate and pistillate elements on separate plants.

Emarginate. With a shallow notch at the apex (as of a leaf).

Entire. Margin continuous, not broken by divisions, teeth, or serrations.

Exserted. Projecting beyond an encircling organ or part.

Glabrous. Smooth; free of roughness or hairs.

Hypoderm. In a leaf, the layer of thick-walled cells between the epiderm and the mesophyll.

Glairy. Having the appearance of white-of-egg. (Said of resin.)

Infraspecific. Of taxonomic rank lower than a species. For convenience, the rank of cultivar is included here, although strictly it is inaccurate to do so.

Keeled. Having an under surface longitudinally ridged like the bottom of a boat.

Lenticel. Roughened area on a plant's surface that allows exchange of gasses between the atmosphere and the internal structure of the plant.

Linear. Long and narrow. In the case of a conifer leaf, the term infers that the leaf's sides are parallel.

Midrib, siderib. Narrow, green, longitudinal bands on the under surface of a leaf, framing the bands of stomata. If the midrib is raised, the leaf is "keeled."

Monœcious. Having staminate and pistillate elements on the same plant.

Pectinate. An arrangement, usually of leaves, in which parts relate to each other in a comblike fashion. Most *Abies* leaves spread in two lateral ranks, creating a "V" between them that can vary from wide to incomplete or nearly absent.

Resin canal or resin duct. An intercellular space lined with resin-secreting cells.

Revolute. Rolled backward or downward, as the edge of a leaf.

Sessile. Attached immediately at the base, with no intervening stalk or pedicel.

Sterigama. A peg-shaped projection from the surface of a stem or of a branchlet to which a leaf is attached.

Stoma (plural, stomata). The pore in a leaf, usually on its lower surface, appearing as a whitish or grayish dot, and arranged in rows.

Umbilicate. Depressed or indented like a navel.

References

- Bean, W. J., 1976. *Trees and Shrubs Hardy in the British Isles*. Eighth Edition, Volume 3. London: John Murray. 973 pages.
- Dallimore, W. S., and A. B. Jackson, 1966. *A Handbook of Coniferae and Ginkgoaceae*. Fourth Edition. London: Arnold. 729 pages.
- Flint, Harrison L., 1983. *Landscape Plants for Eastern North America: Exclusive of Florida and the Immediate Gulf Coast*. New York: Wiley. 677 pages.
- Krüssmann, Gerd, 1985. *Manual of Cultivated Conifers*. Translated by Michael E. Epps. Portland, Oregon: Timber Press. 361 pages.
- Liu, T.-S., 1971. *A Monograph of the Genus Abies*. National Taiwan University Press. 609 pages.
- Mitchell, A. F. 1972. *Conifers in the British Isles*. London: Her Majesty's Stationery Office. 322 pages. 322 pages.
- Rehder, Alfred, 1940. *Manual of Cultivated Trees and Shrubs*. Second Edition. New York: Macmillan. 966 pages.
- Shaw, George Russell, 1914. *The Genus Pinus*. Cambridge, Massachusetts: The Riverside Press. 96 pages.
- Virgil (Publius Vergilius Maro), circa 19 B.C. *The Aeneid*. Book II. In: J. W. Mackail, translator, 1950, *Virgil's Works*. New York: Modern Library, 1950.
- Warren, Richard, 1982. "Spruces in the Arnold Arboretum," *Arnoldia*, Volume 42, Number 3, (Summer), pages 102-129.

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Warren, Richard and Johnson, Ethan W. 1988. "A Guide to the Firs (*Abies* spp.) of the Arnold Arboretum." *Arnoldia* 48(1), 3–48.

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