

THE GYMnosPERMS GROWING ON THE GROUNDS OF STANFORD UNIVERSITY

after L. R. Abrams, Stanford Univ. Publ.. Univ. Ser., 1913; nomenclature revised according to L. H. Bailey, Man. Cultivated Plants, 1949.

Subdivision I. Gymnospermae.

Trees or shrubs, mostly evergreen, usually with needle-like or scale-like leaves; ovules and seeds borne naked; ovuliferous scales commonly in cones; ovules becoming dry or drupe-like seeds.

Seeds 1, rarely 2, drupe-like or berry-like; embryo with 2 cotyledons.

Leaves fan-shaped, usually bilobed, deciduous. 1. Ginkgoaceae.

Leaves needle-shaped or linear, persistent, mostly 1-1/2-4" long.

Fruit fleshy, borne on a thickened stalk. 3. Podocarpaceae.

Fruit fleshy, not borne on a thickened stalk.

Leaves 1/2 to 1-1/4" long, either with pale green to tawny bands beneath or with 2 glaucous lines narrower than the 3 green ones; branchlets alternate or subopposite. 2. Taxaceae.

Leaves 1-3" long, with 2 glaucous lines beneath broader than the 3 green lines; branchlets opposite. 4. Cephalotaxaceae.

Seeds several or many, in a more or less woody dry cone or (in Juniperus) in a berry-like cone formed by the union of several scales; embryo with 2-several cotyledons.

Leaves alternate, ovate-lanceolate, 1/3" or more in width at base; each cone-scale with 1 ovule. 5. Araucariaceae.

Leaves alternate, opposite, or whorled; needle-shaped, linear, or scale-like; usually narrower at base; each cone-scale with 2 or more ovules.

Leaves opposite or whorled, usually scale-like; cotyledons usually 2.

All leaves less than 1" long. 8. Cupressaceae.

Some leaves 3-6" long. 7. Taxodiaceae.

(Sciadopitys)

Leaves alternate or fascicled, usually linear or needle-like; cotyledons commonly more than 2.

Cone-scales in axils of distinct bracts; scales flattened, with 2 seeds. 6. Pinaceae.

Cone-scales without bracts; scales often peltate, with 2-9 seeds. 7. Taxodiaceae.

1. Ginkgoaceae. Ginkgo Family

A single species is the sole survivor of this ancient group of gymnosperms.

1. Ginkgo biloba L. Ginkgo or Maidenhair Tree.

Leaves deciduous, clustered on short stubby twigs, fan-shaped, thickened on the margin and usually divided, parallel-veined; flowers dioecious; staminate in slender aments; ovulate in pairs on long stalks; fruit drupe-like, with an ill-scented fleshy coat surrounding a smooth oval stone.

Native of China and Japan. Handsome staminate trees are on the grounds of the Stanford Residence, and few young trees are planted on the Campus.

2. Taxaceae. Yew Family.

Evergreen trees or shrubs. Leaves alternate or rarely opposite, often 2-ranked, usually linear. Plants dioecious; staminate flowers solitary or in small spikes in axils of leaves; ovulate flowers of 1 erect ovule. Fruit berry- or drupe-like, consisting of a bony-coated seed surrounded by the fleshy aril.

- Aril surrounding seed open at apex, scarlet; staminate flowers globose; albumen of seed uniform. 1. Taxus.
- Aril completely surrounding seed, green or purplish; staminate flowers oblong; albumen of seed ruminant. 2. Torreya.

1. Taxus L. Yew.

Trees or shrubs with spreading or erect branches and scaly bark. Leaves flat, linear, 2-ranked. Flowers dioecious, axillary; pollen-sacs 6-8, arranged in a circle. Fruit with a bright red, fleshy, viscid, open cup partly enclosing the erect stone.

A genus of approximately 8 closely related species, distributed through the north temperate regions.

1. Taxus baccata L. English Yew.

Leaves linear, 2-ranked, usually falcate, shortly acuminate, dark green above, pale beneath, 1/4-3/4" long; fruit 1/3-1/2" broad, with almost globose aril.

The English Yew is a native of Europe, western Asia, and northern Africa. It has long been cultivated and many garden forms exist. Several shrubs are in the neighborhood of the Cactus Garden, especially near the entrance.

1a. Taxus baccata var. stricta Laws. Irish Yew.

Leaves linear, as in the typical form, but spreading from all sides of the erect fastigiate branches.

Specimens are on the borders of the Cactus Garden.

1b. Taxus baccata var. adpressa Carr.

This variety is distinguished by its broader and shorter, oblong, obtuse leaves.

Our specimens are the compact erect form. They are on the east and west sides of the Cactus Garden.

2. Torreya Arn.

Leaves flat and linear, appearing 2-ranked, spiny-tipped. Flowers dioecious, axillary; pollen-sacs 4, arranged in a semicircle; fruit drupe-like, the greenish aril completely enclosing the stone; endosperm nutmeg-like.

A genus of 4 species, widely separated geographically and of very local distribution. One is in Florida, one in California, and the other two are in China and Japan.

1. Torreya californica Torr. California Nutmeg.

Leaves 1-1/2 to 2" long, 1/8" wide, tapering slightly to the sharp-pointed apex, dark glossy green above, pale beneath; fruit 1- 1-1/2" long.

Tree sometimes 80' high, with spreading or drooping branches and smooth scaly bark. Native of central and northern California in the Coast Ranges and the Sierra Nevada.

3. Podocarpaceae. Podocarpus Family.

1. Podocarpus L'Her.

Trees or sometimes shrubs with linear or lanceolate, alternate or opposite, evergreen leaves. Fruit drupe-like, borne on a thickened foot-stalk; seeds inverted.

A genus of over 40 species, chiefly in the tropics and subtropics of the southern hemisphere. Many species are valuable timber trees.

1. Podocarpus macrophylla Don.

Leaves alternate, lanceolate, sometimes falcate, 2-5" long, about 1/2" wide, bright green and lustrous above, pale beneath; fruit greenish, on a thickened purplish foot-stalk.

One specimen, planted by Professor Dudley, is on the lawn at 8 Alvarado Row.

4. Cephalotaxaceae. Plum-yew Family.

1. Cephalotaxus Sieb. & Zucc. Plum-yew.

Leaves linear, acute and often sharp-pointed, spirally arranged but usually appearing 2-ranked. Flowers dioecious, pedunculate, clustered in small heads. Fruit drupe-like; endosperm uniform.

A small genus containing but 4 species, all of which are native to Japan and China.

Leaves 1/2-3/4" long, abruptly acute.

1. C. harringtonia.

Leaves about 2" long, gradually tapering from near base.

2. C. fortunei.

1. Cephalotaxus harringtonia Koch.

Leaves appearing 2-ranked and opposite, 1/2-3/4" long, scarcely 1/8" wide, abruptly acute, margins not revolute; fruit elliptic, about 3/4" long; stone smooth.

Native of northern China and Japan, where it attains a height of 30-40'. One ovulate shrub is at the west end of Encina Garden and a couple of small staminate specimens are in the nursery.

2. Cephalotaxus fortunei Hook.

Leaves 2-ranked, margins thin, slightly revolute, gradually tapering to the sharp-pointed apex, about 2" long, over 1/8" wide.

Tree 40-60' high with long, slender, drooping branches. Native of northern China. One small staminate tree is north of the live oak on the Mausoleum lawn.

5. Araucariaceae. Araucaria Family

Evergreen resinous trees. Branches whorled; leaves awl-shaped to broad-ovate, compressed. Plants dioecious or rarely monoecious; staminate flowers large and cone-like, axillary or terminal on short branches; ovulate flowers in terminal heads becoming a large woody deciduous cone; scales with 1 seed, without distinct bracts.

Scales persistent; seeds free.

1. Agathis.

Scales deciduous; seeds adherent.

2. Araucaria.

1. Agathis Salisb.

Leaves opposite or alternate, ovate-lanceolate, attenuate, parallel-veined, and of a firm leathery texture. Flowers dioecious, solitary; the staminate elongated. Cones ovate to globose, axillary; scales persistent; seeds winged only on one side, free.

1. Agathis alba (Rumph.) Warb. Amboyna Pine.

Leaves opposite or sometimes alternate, 1-1/2 to 4" long, ovate-lanceolate, glaucous-green; staminate flowers 2" long; cones globose or turbinate, 3-4" long.

A large forest tree, often 8-10' in diameter and 100' or more high. Native of the mountains of the Malay Archipelago. One young specimen, which seems perfectly hardy in this climate, is in Professor Durand's garden.

2. Araucaria Juss.

Leaves evergreen lanceolate or short-ovate to awl-shaped, usually sharp-pointed. Flowers normally dioecious; cones erect, their scales deciduous; ovules and seeds 1 to each scale, pendent; anthers with several elongated, pendent pollen-sacs.

Araucaria is represented by 10 species, all of which are restricted to the southern hemisphere.

Leaves lanceolate to ovate.

Leaves lanceolate; spiny tip of scale about 1/2" long.

Leaves 2-ranked, dark green; scales nearly as broad as long; bract and scale distinct toward the apex.

Leaves spreading from all sides of the branches; scales over twice as long as broad; bract and scale completely united.

Leaves broadly ovate, concave, stiff, and very spiny-tipped; spiny tip of scale 1-1/2" long.

Leaves awl-shaped; bark exfoliating.

1. A. bidwillii.

2. A. brasiliana.

3. A. araucana.

4. A. cunninghamii.

1. Araucaria bidwillii Hook. Bunya-bunya Pine.

Leaves narrowly ovate-lanceolate, flat, rigid, sharp-pointed, dark green and shiny, those on the branches twisted and 2-ranked, 1-2" long; cones ovate-globose, 8-10" long; scale and bract distinct above the middle, free part of scale 3/4" broad; bract 2" long, nearly as wide, thin, sharply and very prominently keeled at apex, terminated by a reflexed linear-lanceolate spine 3/4" long.

A forest tree 100-150' high. Native of the Brisbane Mountains, Australia, where it is known as the Bunya-Bunya. A large tree is on the grounds of the Stanford Residence, and smaller specimens are near the Mausoleum avenue and in Encina Garden.

2. Araucaria brasiliana Rich. Brazilian Pine.

Leaves linear-lanceolate, tapering to a spiny tip, flat, straight, spreading from all sides of the branches, rather pale glaucous-green, 1-2" long; cones globose, 6-8" long; bracts and scales completely united and indistinguishable, wedge-shaped and somewhat 4-sided, 2" long, 3/4" broad, terminated by a linear-lanceolate spine 1/2" long.

A tree 75-100' high. Native of southern Brazil. Two small trees are between the Cactus Garden and the Mausoleum.

3. Araucaria araucana Koch. Monkey Puzzle.

Leaves broadly ovate, closely set and spreading from all sides of the branches, straight, concave, rigid, very sharp-pointed, 3/4-1" long; cones globose, 6-8" long; scales wedge-shaped, 2" long, about 1" broad, terminated by a slender subulate spine 1-1/2" long.

A forest tree, often 100' high, forming extensive forests in the Andes of southern Chile. A good specimen is on the Mausoleum lawn, and other smaller trees are on the Campus.

4. Araucaria cunninghamii Ait. Hoop Pine.

Leaves awl-shaped, enlarged at base, 1/2" long, spreading from all sides of the branches, rigid; cones ovate-globose, 3-4" long; scales wedge-shaped, 1/2" broad, terminated by an awl-shaped awn 1/3 its length.

A large tree 100-150' high, with exfoliating bark. An Australian species forming extensive forests in New South Wales and Queensland. One tree is at the east end of Roble Garden and another is on the southwest border of the Cactus Garden.

Araucaria excelsa R.Br., the Norfolk Island Pine, resembles A. cunninghamii but the branches are in very symmetrical and rather distinct whorls. This species is not cultivated on the grounds but is planted in gardens in San Jose and San Francisco.

6. Pinaceae. Pine Family.

Resinous trees furnishing valuable timber and ornamental subjects. Leaves spirally arranged, solitary or fascicled, linear, needle-like, mostly persistent, sometimes deciduous. Plants usually monoecious; flowers borne in cones; staminate cones with many stamens having 2 pollen-sacs; ovules 2 on inner surface of a scale; fruit a woody cone with dry, usually winged seeds.

Leaves in 1-5-leaved clusters, surrounded at base by membranous sheaths; cones maturing the second year.

1. Pinus.

Leaves without basal sheaths, scattered or clustered on short stubby branchlets; cones maturing the first year.

Leaves clustered on short stubby branchlets; cones erect. 2. Cedrus.

Leaves single, spirally arranged or appearing 2-ranked.

Cones pendent; scales persistent.

Branchlets rough with the persistent, woody leaf-bases; bracts not exerted.

3. Picea.

Branchlets smooth; leaf-bases sessile; bracts 3-parted, well exerted.

4. Pseudotsuga.

Cones erect; scales deciduous; branchlets smooth.

5. Abies.

1. Pinus L. Pine.

Trees or a few shrubs. Leaves evergreen, needle-shaped, in clusters of 2-5 (solitary in one species) from the axils of scale-like primary leaves, each cluster surrounded at base by a persistent or deciduous sheath of membranous scales; cones maturing the second year, their scales persistent, woody, often thickened or awned with a prickle at apex. Seeds usually winged.

The pines, with approximately 80 living species, constitute the largest genus of the Gymnosperms. They are restricted to the northern hemisphere and chiefly to the temperate regions.

Sheaths deciduous; leaves with 1 vascular bundle, in fives (except P. quadrifolia and P. edulis); wood light-colored and soft.

Cones cylindric; scales thin; wings elongated; leaves in fives, serrulate.

White Pines.

Leaves not sharp-pointed; resin-ducts not surrounded by strengthening cells.

Leaves grayish green, soft, recurved or drooping; branchlets glabrous.

Leaves 5-8" long, drooping; cones 6-10" long; scales abruptly pointed at apex.

1. P. griffithii.

Leaves 2-4" (rarely 5) long; cones 2-4" long; scales rounded at apex.

2. P. strobus.

Leaves bluish green, stiff and erect; branchlets puberulent; cones 4-11" long; scales pointed.

3. P. monticola.

Leaves sharp-pointed and stiff, 2-4" long, dark bluish green; resin-ducts surrounded by strengthening cells; cones 12-20" long.

4. P. lambertiana.

Cones not cylindric; scales thickened; wings reduced to a ring; leaves not serrulate. Stone Pines.

Leaves in fives; cones 2-1/2 to 3" long.

5. P. cembra.

Leaves in twos or fours; cones 3/4-2" long.

Leaves in fours.

6. P. quadrifolia.

Leaves in twos.

7. P. edulis.

Sheaths persistent; leaves with 2 vascular bundles, in twos or threes (except P. torreyana); wood resinous. Pitch Pines.

Leaves in fives, about 10" long.

8. P. torreyana.

Leaves in twos or threes.

Leaves in threes.

Cones with the umbo ending in a stout hooked projection; leaves 8" or more long.

Leaves grayish green, drooping; cones chocolate-colored, ovate.

9. P. sabiniana.

Leaves dull green, spreading; cones light brown, cylindric-ovate.

10. P. coulteri.

Cones with rounded or flattened apophysis; umbo with or without a slender prickle.

Umbo with a prominent prickle; apophysis but little thickened.

Branchlets glaucous; leaves bluish green.

11. P. jeffreyi.

Branchlets not glaucous; leaves bright yellowish green.

12. P. ponderosa.

Umbo without or with a rudimentary prickle.

Leaves slender, drooping, 8-10" long; cones cylindric, 4-8" long; apophysis low-pyramidal.

13. P. canariensis.

Leaves not drooping, 4-6" long dark green; cones ovate and unsymmetrical; apophysis on the outside rounded.

14. P. radiata.

Leaves in twos.

Cones unsymmetrical; scales much enlarged on the outside; armed with prominent prickles.

15. P. muricata.

Cones nearly symmetrical; prickles none or inconspicuous.

Leaves slender and flexible, 2-4" long; apophysis flattened, deep lustrous brown.

16. P. halepensis.

Leaves stout and rigid.

Cones and leaves 4" long or more.

Seeds 3/4" long, with a very short wing; apophysis low, somewhat 6-sided.

17. P. pinea.

Seeds scarcely 1/2" long, much shorter than the wings; apophysis pyramidal and sharply keeled.

18. P. pinaster.

Cones and leaves 1-1/2 to 3" long.

Trees of good size.

Leaves flattened; cone-scales with a flattened apex projecting beyond the dorsal umbo.

19. P. sylvestris.

Leaves rounded on the back, grooved beneath, 2-3" long; apex of scale not projecting.

20. P. nigra.

Low dwarf shrub with dense foliage of dull green leaves.

21. P. montana.

1. Pinus griffithii McClelland.

Branchlets greenish brown, glabrous, glaucous; leaves very slender, flaccid, drooping, grayish green, 6-8" long; cones on stalks 1-2" long, cylindric, 6-10" long; scales sharp-pointed; seeds 1/3" long; wings 1" long, acute.

A native of the Himalaya Mountains, where it attains a height of 150'. One tree is in the Arboretum northeast of the Cactus Garden.

2. Pinus strobus L. White Pine.

Branchlets glabrous, green or greenish brown; leaves soft and very flexible, 2-5" long, light bluish green; cones on stalks 1/2-1" long, cylindric, 2-4" long; scales oblong-obovate, flexible; seed reddish brown, mottled with black, 1/4" long; wings four times as long, acutish.

A native of eastern America, extending from Newfoundland to Manitoba, south to Georgia and Iowa. Specimens are along Pine Avenue, between University Avenue and the automobile road, and in the nursery south of the lath-house.

3. Pinus monticola Don. Mountain White Pine.

Branchlets puberulent, yellowish or reddish brown; leaves stiff, bluish green and glaucous, 1-1/2 to 4" long; cones short-stalked, cylindric, 5-11" long, yellowish brown; scales pointed by the slightly thickened umbo; seeds 1/3" long, reddish brown, mottled with black; wings three times as long, acute.

A native of western America, extending from British Columbia to Idaho and the high mountains of California. One tree east of Cactus Garden; a few others are scattered through the Arboretum.

4. Pinus lambertiana Dougl. Sugar Pine.

Branchlets pubescent, brown; leaves 3/4" long, stout, sharp-pointed, dark bluish green with conspicuous white lines on back; cones on stalks, 2 to 3-1/2" long, cylindric, light brown, shiny, 10-20" long; seed 1/2" long, dark brown or nearly black; wing rounded at apex.

A Pacific Coast species, extending from southern Oregon to northern Lower California. The largest and most magnificent of all the pines. Several trees are north of the Angel of Grief, and one or two fairly large trees are north of the Stanford Residence.

5. Pinus cembra L. Swiss Stone Pine.

Branchlets with yellowish brown tomentum; leaves straight, dark green on back, bluish white inside, 2 to 3-1/2" long; cones short-peduncled, ovate, light brown, 2-1/2 to 3-1/2" long; scales rounded at apex; apophysis much broader than high; seed 1/2" long.

Native of the Alps and extending northward to Russia and northern Asia, where it attains 70' or occasionally 120'. One small tree which has not fruited is at the entrance of the Cactus Garden.

6. Pinus quadrifolia Parl. Parry's Pinon.

Branchlets puberulous, light grayish brown; leaves 3-5 (usually 4), rigid, incurved, light green on back, whitish inside, 1-1/2 to 2" long; cones subglobose, 1-1/2 to 2" long, chestnut brown; apophysis thick, pyramidal, conspicuously keeled; umbo with minute recurved prickles; seed 1/2" long.

Tree attaining 40', with spreading branches forming rounded top; bark dark brown tinged with red, shallowly fissured. Native of the extreme southern part of California and extending into the mountains of northern Lower California. There are no specimens of this tree in the Arboretum, but one tree which fruited in 1911 is at 17 Salvatierra Street, and another small specimen is at 8 Alvarado Row.

7. Pinus edulis Engelm. Pinon.

Leaves in twos or rarely threes, stout, rigid, incurved, dark green on the back, marked within by several rows of stomata, 3/4 to 1-1/2" long, persistent for three or four years or sometimes longer; staminate flowers dark red; cones 3/4 to

1-1/2" long and nearly as broad; seeds ovate, dark red-brown below, orange-yellow above, 1/2" long; wings 1/8" wide.

A small tree with a divided trunk, 30' to 40' high. Native of the southern Rocky Mountains, extending from eastern Utah and southwestern Wyoming southward to the mountains of northern Mexico. One young tree is in Professor Durand's garden.

8. Pinus torreyana Parry. Torrey Pine.

Branchlets greenish or purplish, glabrous; leaves rigid, dark green, 8-12" long; cones broadly ovate, 4-6" long, chocolate brown; apophysis low-pyramidal; umbo elongated, reflexed, with a short spiny tip; seed 3/4" long; short-winged.

Tree 40' or occasionally 60' high with spreading branches and dark brown bark. Perhaps the rarest pine, known only in two small groves: one is at Del Mar, San Diego County, and the other is on Santa Rosa Island off the coast of southern California. Good-sized trees are near the middle of the Arboretum just west of University Avenue.

9. Pinus sabiniana Dougl. Digger Pine.

Leaves slender, drooping, grayish green, 8-12" long; cones pendent on stalks 2" long, light red-brown, 6-10" long; apophysis pyramidal, sharply keeled, flattened at the straight or incurved apex; seeds 3/4" long; short-winged.

Tree 50-80' high with the trunk usually divided into several stems, forming a round-topped head. Native of the Inner Coast Ranges and the foothills of the Sierra Nevada, California. Specimens are in the Roble Garden, near the Museum, and in the Nursery.

10. Pinus coulteri Don. Coulter Pine.

Leaves stout, acuminate, dark bluish green, not drooping, 6-12" long; cones short-stalked, cylindric-ovate, yellowish brown, 9-14" long; apophysis elongated-pyramidal, gradually narrowed into straight or incurved umbo; seed 1/2" long.

Tree 80' high, forming a loose pyramidal head. Native of the Coast Ranges of California. Trees are planted in the Roble Garden near the Museum and elsewhere.

11. Pinus jeffreyi Murr. Jeffrey's Pine.

Leaves stout, 5-8" long, pale bluish green; cones conic-ovate, light brown, 6-12" long; apophysis depressed, keeled; umbo elongated into a slender recurved spine; seed about 1/2" long.

Forest tree attaining a height of nearly 200', with short spreading branches forming an open pyramidal head. Native of the mountains of Oregon and California. Specimens are in the Nursery south of the lath-house.

12. Pinus ponderosa Dougl. Western Yellow Pine.

Branchlets reddish brown; leaves dark yellowish green, 5-10" long; cones ovate-oblong, light reddish brown, 3-1/2 to 5" long; apophysis flattened, keeled; umbo triangular, ending in a stout, straight or incurved prickly; seed 1/4" long; wing 1" long.

Tree 150' or occasionally 230', forming a spire-like head. Native of western America, extending from British Columbia to Mexico, and from western Nebraska and Texas to California. A row of trees is west of the Nursery lath-house, others are between University Avenue and the Mausoleum, and a few large trees are north of the Stanford Residence.

13. Pinus canariensis C. Smith. Canary Island Pine.

Branchlets yellowish; leaves slender, 8-11" long, light green, flexible, usually drooping, flattened; cones ovoid, 4-7" long, light brown, lustrous; apophysis low-pyramidal, umbo obtuse or sometimes depressed; seed 1/2" long.

Tree 80' high with slender branches forming a round-topped head. Native of the Canary Islands and Teneriffe. Several trees are west of the Nursery and one near Mausoleum Avenue. Some of the trees west of the nursery which were severely burned three or four years ago are sending out new shoots from the burned branches and trunks. The primary leaves on these shoots are silvery-glaucous.

14. Pinus radiata Gord. Monterey Pine.

Leaves bright green, 3-6" long; cones light brown, lustrous, conic-ovate, unsymmetrical, 3-5" long, 2-4" broad; scales on upper surface with rounded apophysis, those on the lower surface with nearly flat apophysis; prickles very minute; seeds black, 1/4" long, half the length of the wing.

Tree 80'-100', broadly pyramidal or with round-topped head. Native of the coast of California and abundant at Monterey. Commonly cultivated on the University grounds.

15. Pinus muricata Don. Prickle-cone Pine.

Leaves bright green, rather stout, 4-6" long, strongly serrate; cones 2 to 2-1/2" long, very unsymmetrical by the enlargement of scales on outside; prickles prominent; seeds 1/5" long; wings 1/2" long.

A compact pyramidal or branching tree 50-90' high, with dense foliage. Native of the California coast. Specimens are among the pines between the Post Office and the Quadrangle. Others were formerly back of the Chemistry Building.

16. Pinus halepensis Ait. Aleppo Pine.

Leaves dull green, very slender for the group, 2-1/2 to 3" long, tufted at the end of the branches; cones conical, smooth, 2-1/2 to 3" long, deep lustrous brown; scales flattened, 3/4" broad; apophysis but slightly thickened, flat and smooth, except for a rather faint transverse ridge.

A low spreading tree with an open, thin, and straggling aspect, 20-40' high. Native of the Mediterranean region, extending from Portugal to Asia Minor. Several trees are planted in the Arboretum; one especially fine specimen is between the Mausoleum and the Museum.

16a. Pinus halepensis pityusa Stevens.

Larger tree than the typical form, with leaves 4-5" long and cones 3-5" long. Native of the eastern Mediterranean region. Specimens are south of the Nursery.

17. Pinus pinea L. Italian Stone Pine.

Leaves stout, straight, deep shiny-green, 5-8" long; cones 5-6" long, broadly ovate, lustrous-brown; scales thick and heavy, 1" broad; apophysis but slightly elevated, often 6-sided; umbo with a short blunt prickle; seeds 3/4" long, with broad but very short wings.

Tree 25-60', with a broad rounded head. Common on the sandy shore of Tuscany. One tree is north of the Nursery lath-house.

18. Pinus pinaster Ait. Cluster Pine.

Leaves glossy-green, very stout, stiff, and twisted, acute, 5-9" long, appearing in definite and somewhat remote bands; cones, in the older trees, clustered,

conic-oblong, 4-7" long; apophysis nearly 3/4" broad, low-pyramidal, conspicuously keeled with a prominent triangular umbo; seed 1/3" long; wing about 1" long.

Tree 100' high with regular pyramidal habit and rapid growth. Native of the coastal region of southern Europe. A variety has been extensively used in Europe to reclaim wastes of maritime sands. Several trees are in the row of pines between the Post Office and the Quadrangle. A handsome specimen is in the rear of Madrone Hall, and a few trees are south of the Nursery.

LAW SCHOOL AREA

19. Pinus sylvestris L. Scotch Pine.

Leaves light green, flattened and twisted, stiff, 1 to 1-1/2" long; cones 2 to 2-1/2" long, light brown; scales 1/2" broad; apophysis, at least of the middle scales, with a dorsal, knob-like, keeled, and truncated thickening and a thin, somewhat recurved apex; seed 1/4" long; wing narrow, acute.

A forest tree 70-100' high with pyramidal head and scattered foliage. The Scotch Pine is one of the important timber trees of Europe. Several trees are in the Nursery north of the lath-house, and one is about in the middle of the Arboretum near University Avenue.

20. Pinus nigra Arnold. Austrian Pine.

Leaves stout and very rigid, 1-1/2 to 2-1/2" long, abruptly sharp-pointed, rounded on the back, deeply grooved beneath, dark green; cones 2-1/2" long, light brown; scales about 1" long, 3/8" broad; apophysis low-pyramidal, slightly keeled and with a minute prickle.

This species is more generally known under the name Pinus austriaca. It is a native of southeastern Europe. A small tree is southwest of the Nursery lath-house.

21. Pinus montana Mill. Swiss Mountain Pine.

Leaves stout and crowded, 3/4-2" long, bright green, acutish; cones 3/4 to 2-1/4" long, light grayish brown; apophysis low-pyramidal, with a black band surrounding the umbo.

A variable species, often a low dwarf shrub, or sometimes a pyramidal tree 40' high. Native of the mountains of central and southwestern Europe. One dwarf specimen is on the west side of the Cactus Garden.

2. Cedrus Loud. Cedar.

Large forest trees with stiff, 4-sided, more or less sharply pointed leaves in clusters at the ends of short, stubby, lateral branchlets. Flowers monoecious, erect; cones ovate, 3-5" long, with broad, thin, closely imbricated scales.

A genus of 3 closely allied species, confined to northern Africa, Asia Minor, and the Himalaya Mountains. These are the true cedars, although the name is applied to a number of totally different genera, such as Libocedrus, Juniperus, Thuja, and Chamaecyparis.

Branches stiff-horizontal or ascending, not pendulous; cones truncate and often concave at apex.

Branches mostly ascending; leading shoots not nodding; leaves mostly less than 1" long, thicker than broad.

Branches horizontal; leading shoots nodding; leaves 1 to 1-1/4" long, broader than thick.

Branches and leading shoots pendulous; cones obtuse; leaves often 2" long.

1. C. atlantica.
2. C. libani.
3. C. deodara.

1. Cedrus atlantica Manetti. Mt. Atlas Cedar.

Leaves mostly less than 1" long, rigid, dark or glaucous-green, thicker than broad; cones 2-3" long, light brown.

A pyramidal tree 120' high with ascending branches and erect, or at least not drooping, leading shoots. A horticultural variety, glauca, has leaves very glaucous with a silvery hue. Native of the mountains of northern Africa. Frequently planted on the University grounds. A handsome specimen of the variety is east of the Cactus Garden.

2. Cedrus libani Loud. Cedar of Lebanon.

Leaves 1" long or more, dark green or in some forms bluish green or even silvery, broader than thick; cones 3-4" long, brown.

Large forest tree with widespreading horizontal branches and nodding leading shoots. Native of the mountains of Syria and Asia Minor. Two trees are east of the Cactus Garden, near the silver-leaved Mt. Atlas Cedar, and another is in the western part of the Nursery, surrounded by a cluster of the Mt. Atlas Cedar.

3. Cedrus deodara Loud. Deodar.

Leaves 1-2" long, dark bluish green, rigid, as thick as broad; cones 3-1/2 to 5" long, reddish brown.

Large forest tree, often 150' high, with branches and leading shoots pendulous. Several horticultural varieties are in cultivation; one, argentea, has silvery leaves. Native of the Himalaya Mountains. Specimens are in Encina and Roble Gardens, and the variety argentea is in the Arboretum north of the Mausoleum.

3. Picea A. Dietr. Spruce.

Trees with spreading or sometimes pendulous branches. Leaves linear, flat or 4-sided, spirally arranged, sometimes appearing 2-ranked, not narrowed into a leaf-stalk; leaf-scars raised on prominent woody pedicels, which give the twigs a decided roughness after the leaves have fallen. Cones pendulous, their scales persistent, completely concealing the very short bracts.

The 18 known species are confined in their distribution to the north temperate and subarctic regions.

Leaves quadrangular with stomata on all 4 sides.

Cone-scales rounded at apex.

Leaves 1/3-2/3" long, obtuse; branchlets not long-pendulous.

Young twigs glabrous; cones 1-1/2 to 2" long.

Young twigs pubescent; cones 3-5" long.

Leaves 1-1/4 to 2" long, sharp-pointed.

Cone-scales not rounded at apex; leaves acute or sharp-pointed.

Leaves dark green, abruptly acute; cone-scales firm on the margins, truncate at apex.

Leaves blue-green, acuminate and callous-tipped; cone-scales rhomboidal, their margins flexuose.

Leaves flattened, with 2 silvery bands of stomata above.

1. P. Glauca.

2. P. orientalis.

3. P. smithiana.

4. P. abies.

5. P. pungens.

6. P. sitchensis.

1. Picea glauca Voss. White Spruce.

Leaves spreading from all sides of glabrous twigs, 1/2-2/3" long, 1/24" side, sharp-pointed, dull glaucous-green; flowers pale red or yellowish; cones 1-1/4 to 2" long, about 1" broad; scales rounded at apex, 1/3" wide.

A tree 50-150' high with a symmetrical pyramidal head. Native of North temperate and subarctic America, extending from Alaska to Labrador and from Montana to New England. One tree is near the center of the Cactus Garden.

2. Picea orientalis (L.) Carr. Caucasian Spruce.

Leaves spreading from all sides of the pubescent twigs, 1/3-1/2" long, 1/12" wide, 4-sided, blunt at apex, dark lustrous-green; flowers carmine; cones 3-5" long, about 1-1/2" broad; scales rounded at apex, 2/3" wide.

Native of the Caucasus and Asia Minor. Two trees are near the center of the Cactus Garden.

3. Picea smithiana (Wall) Boiss. Himalaya Spruce.

Leaves spreading from all sides of the long pendulous branches, 1-1/4 to 2" long, 1/20" wide, sharp-pointed, light green; cones 5-7" long, about 2" broad; scales firm and shiny, about 3/4" wide, crowded into close spirals, rounded at apex.

A common tree in the coniferous forests of the Himalaya Mountains. One tree is on the west side of the Cactus Garden and two others are near the Angel of Grief.

4. Picea abies Karst. Norway Spruce.

Leaves spreading from all sides of the sparsely pubescent, light brown twigs, 1/2-2/3" long, 1/24" wide, 4-sided, sharp-pointed, bright green; cones 2-3/4 to 5" long, about half as broad; scales 2/3" wide, their exposed tips 3-sided, the 2 lateral margins oblique from a truncate and erose apex.

Native of the mountains of central and northern Europe. One tree is on the west side of the Cactus Garden, and others are planted elsewhere on the Campus.

5. Picea pungens Engelm. Blue Spruce.

Branchlets glabrous; leaves stout, rigid, acuminate and sharp-pointed with a callous tip, 3/4-1-1/8" long, or less on fertile branches, bluish green or sometimes silvery, marked on both sides with 4-7 rows of stomata; staminate flowers yellow tinged with red; cones oblong-cylindric, about 3" long, pale chestnut brown and glossy; scales rhomboidal, flexuose on the margins, erose at the summit; seeds 1/8" long; wings twice as long.

Forest tree 80-150' high with a trunk sometimes 3' in diameter. Native of the mountains of Colorado, eastern Utah, and Wyoming. A young tree is in Professor Durand's garden.

6. Picea sitchensis Carr. Tideland Spruce.

Leaves spreading from all sides of the light brownish yellow, glabrous twigs, green and rounded below, flat, slightly keeled and with 2 broad silvery bands above, sharply acute, 1/2-1" long; cones cylindric-oval, 2-1/2 to 4" long; scales rounded and erose at apex.

Tree 100-200' high with slender horizontal branches. Native of the northwest coast, extending from Alaska to northern California. One tree is in the Arboretum between the automobile road and the carline near the old Sempervirens avenue. This tree was apparently identified as Picea parryana in Dudley's key.

4. Pseudotsuga. Carr.

Large evergreen forest trees, with flat, indistinctly 2-ranked leaves, narrowed at base into short petiole; leaf-scars sessile. Cones pendent, their 3-pronged bracts much exserted; seeds prominently winged.

A genus of 3 species; two in western America and one in Japan.

1. Pseudotsuga taxifolia Britt. Douglas Fir.

Leaves $3/4$ to $1-1/2$ " long, obtuse, dark green above, paler beneath; cones oblong-ovate, 2-4" long, light reddish brown, with broad rounded scales and well exserted 3-parted bracts.

The Douglas Fir is the most important timber tree of western America. It often attains a height of 200' or even more, and a trunk diameter of 12'. Frequently planted in the Arboretum. Native trees are growing on the Palo Alto estate at the north end of Jasper Ridge.

5. Abies Mill. Fir.

Trees generally pyramidal in outline, with their branches in whorls. Leaves solitary, scattered along the twigs in definite spirals but often appearing 2-ranked by a twist near the base, linear, flat or slightly 4-sided, sometimes narrowed at base but not into a distinct leaf-stalk; leaf-scars sessile on the smooth twigs. Cones erect on the branches, their scales deciduous, and bracts exserted beyond scales or concealed by them.

A genus of 24 known species, which inhabit the northern or mountainous parts of the northern hemisphere.

Leaves stomatiferous and alike in color on both surfaces.

Leaves rigid, spreading from all sides, $1/3-1/2$ " long, closely crowded on the twigs, their much enlarged bases nearly contiguous.

Leaves $1/3-1/2$ " long, steel green, $1/12$ " wide, somewhat 4-angled.

Leaves $1/2-2/3$ " long, dark green, $1/8$ " wide.

Leaves curved upward on twigs, more or less 2-ranked, pale glaucous green, 1-2" long.

Leaves stomatiferous only on lower surface.

Leaves bright green on lower surface, distinctly 2-ranked.

Leaves silvery on lower surface with 2 broad bands of stomata.

Leaves not pungently acute.

Leaves obtuse.

Leaves distinctly 2-ranked, forming flat sprays; twigs ill-scented when bruised.

Leaves mostly curved upward; twigs not ill-scented.

Cones 6" long or less; bracts projecting beyond scales; leaves $2/3-1$ " long, bright green on upper surface.

Cones 8" long; bracts concealed by scales; leaves 1-to $1-1/4$ " long, dark green on upper surface.

Leaves acute.

Leaves pungently acute; bracts long-exserted.

1. A. pinsapo.

2. A. humidica.

3. A. concolor.

4. A. firma.

5. A. grandis.

6. A. nordmanniana.

7. A. cilicica.

8. A. cephalonica.

9. A. venusta.

1. Abies pinsapo Boiss. Spanish Fir.

Leaves dark steely green on both surfaces, rigidly spreading from all sides of the twig, crowded, their much enlarged bases nearly contiguous, $1/3-1/2$ " long, $1/12$ " wide, slightly keeled on both surfaces, stomatiferous on both surfaces, with inconspicuous gray bands, obtuse but curved upward at tip and appearing acute; cones about 8" long, $1-1/2$ to $1-3/4$ " broad; scales wedge-shaped, 1" wide; bracts short, rounded, not stalked.

The Spanish Fir is a native of central and southern Spain, where it forms extensive forests on the mountains at altitudes of 4,000-6,000'. Excellent specimens of this species are at the southeastern border of the Cactus Garden.

2. Abies humidica De Lannoy. Algerian Fir.

Leaves dark lustrous green on both surfaces, rigidly spreading from all sides of twig, enlarged at base, less crowded than in the preceding, 1/2-1/4" long, 1/8" wide, rounded at apex, flat but keeled on both surfaces, stomatiferous bands inconspicuous on both surfaces; cones 10" long, dull grayish brown; scales rounded at apex, tapering to base, 1 to 1-1/2" wide; bracts short, rounded.

Native of Mt. Babor, Algeria, where it is found with the Mt. Atlas cedar. It is a forest tree, often 60' high, with compact branches forming symmetrical pyramidal heads. Two trees are along the eastern border of the Cactus Garden near Abies grandis.

3. Abies concolor Hoopes. White Fir.

Leaves ascending or indistinctly 2-ranked, glaucous-green and stomatiferous on both surfaces, 1-2" long, 1/12" wide, obtuse or acutish, faintly grooved above, keeled below, with 2 lateral shallow grooves; cones 6-10" long, 1 to 1-3/4" broad; scales broader than long, rounded at apex, gradually tapering to the base; bracts half the length of scales, oblong, denticulate and mucronate at the emarginate or truncate apex; seeds 3/12-4/12" long, dark dull brown; wings rose-colored, widest near the middle.

A large forest tree, sometimes 200' or more high, with a trunk 6' in diameter, dull grayish brown bark and short, stout, horizontal branches in remote whorls. Native of western America, extending from southern Oregon to the high mountains of northern Lower California and eastward to New Mexico. A number of young trees are scattered along Mausoleum Avenue, and others are planted elsewhere on the Campus.

4. Abies firma Sieb. & Zucc. Momis Fir.

Leaves appearing 2-ranked, flat, 3/4-1-1/4" long, 1/12-1/8 wide, grooved and bright green above, faintly keeled and bright yellowish green beneath, inconspicuously emarginate; cones 2-3" long; scales transversely oval or reniform, 1-1/2" wide, 3/4" long, lateral margins dentate; bracts stalked, 2/3 as long as scales; spatulate, mucronately pointed.

The Momis Fir is a Japanese species and is often cultivated in Japanese gardens and about the temples, where trees over 100' high and 6' in diameter are to be found. One small tree is north of the Cactus Garden and another is behind the Angel of Grief.

5. Abies grandis (Dougl.) Lindl. Lowland Fir.

Leaves appearing 2-ranked, forming a flat spray, 2/3 to 1-1/3" long, thin and flexible, deeply grooved and dark lustrous-green above, silvery white below, with 2 broad bands of stomata, emarginate; cones cylindric, slightly narrowed at rounded apex, 2 to 3-1/2" long, 1 to 1-1/2" broad; scales broader than long, rounded at apex, abruptly or gradually narrowed to the stalk-like base; bracts about 1/4 the length of scales, obcordate, irregularly serrate, mucronate; seeds 1/2" long, light brown; wings 1/2-3/4" long.

A large forest tree, sometimes attaining a height of 250' and a diameter of 4-5' clothed with long, downward, sweeping branches. The wood is ill-scented and is known among lumbermen as Stinking Fir. Native of northwestern America, ranging from Vancouver Island southward along the lowlands of the coast to Mendocino County, California, and eastward to the Bitterroot Mountains of western Montana and the Blue Mountains of eastern Oregon. One tree is situated on the western border of the Cactus Garden and a number of young trees are planted elsewhere in the Arboretum.

6. Abies nordmanniana (Steven) Spach. Caucasian Fir.

Leaves curved upward, 3/4- to 1-3/4" long, 1/12" wide, obtuse, slightly grooved and dark shiny-green above, keeled, and with 2 broad silvery bands of stomata below; cones about 8" long, 1-3/4" broad; scales 1-1/2" wide, lateral margins lobed near the apex, serrate, tapering to a short slender stalk; bracts 1-1/4" long, their recurved mucronate apex exserted beyond scales.

The Caucasian or Nordmann Fir is a native of Crimea and the Caucasus, where it inhabits the mountains at about 2000'. It is a large forest tree, sometimes attaining 150' in height and 6' in diameter. Two handsome trees are in the Cactus Garden and other smaller trees are planted on the University grounds.

7. Abies cilicica (Ant. & Kotsch.) Carr. Cilician Fir.

Leaves curved upward, closely resembling those of the preceding, but darker green above and usually longer, 1 to 1-3/4"; cones about 10" long, 1-3/4" broad; bracts not exserted.

The Cilician Fir with the Cedar of Lebanon forms extensive forests in the Cilician Taurus at elevations of 4000-6000'. Two large trees are near the center of the Cactus Garden.

8. Abies cephalonica Loud. Cephalonian Fir.

Leaves spreading at right angles from all sides of the twig, dark shiny green above, with 2 silvery bands beneath, tapering from base to the sharp-pointed apex, their bases dilated lengthwise; cones cylindric, 5-6" long; scales rounded above and entire, wedge-shaped toward base; bracts projecting beyond scales, linear-oblong, unequally toothed at apex.

Native of the island of Cephalonia, Greece. One specimen is on the southwest border of the Cactus Garden.

9. Abies venusta (Dougl.) Koch. Santa Lucia Fir.

Leaves appearing 2-ranked, 1- 1-1/4" long, 1/8" wide, tapering at both ends and ending in a sharp spiny tip at apex, bright green above, grayish beneath with 2 broad bands of stomata; cones ovate, 3-4" long; bracts much exceeding the scales.

Native of the Santa Lucia Mountains. Tree often 100-150' high, narrowed toward the top into a spire-like head. A young tree is on the left-hand side of the Palo Alto entrance to the Campus, another is in Encina Garden.

7. Taxodiaceae. Taxodium Family

Widely distributed resinous trees of about 8 genera. Evergreen or deciduous; leaves spirally arranged or whorled, needle- or scale-like; ovulate flowers in terminal cones, each scale bearing 2-9 ovules; cones woody, without bracts; seeds with small wing-like borders.

Leaves in whorls, elongated.

1. Sciadopitys.

Leaves spirally arranged or appearing 2-ranked.

Leaves persistent for more than one season; seeds several to a scale.

Cone-scales with several sharp projections.

2. Sequoia.

Cone-scales without sharp points.

3. Cryptomeria.

Leaves deciduous with the slender twigs, or sometimes persistent for a year;

seeds 2 to a scale.

4. Taxodium.

1. Sciadopitys. Sieb. & Zucc.

Evergreen pyramidal tree, with long needle-like leaves in whorls. Flowers monoecious; staminate with spirally arranged 2-celled anthers. Cones ovate-oblong, with broadly orbicular scales.

1. Sciadopitys verticillata Sieb. & Zucc. Umbrella Pine.

Leaves in whorls of 15-30, 3-6" long, grooved on both surfaces, dark green above, and with white band beneath; cones 3-4" long.

This species, which is the only member of the genus, is a native of Japan. One young specimen is temporarily placed in the Nursery lath-house.

2. Sequoia. Endl.

Tall massive forest trees with trunks usually heavily buttressed at base, covered with thick fibrous bark. Leaves evergreen, linear or scale-like, decurrent on the twigs. Flowers terminating the branchlets, monoecious; pollen-sacs several on the lower half of the connective. Cones maturing the first year, with spirally arranged, peltate scales. Seeds several to each scale, reddish brown.

Once a genus of several species widely distributed over North America, Europe, and Asia but now reduced to two and restricted to the Coast Ranges and the Sierra Nevada of California.

Leaves of 2 kinds, ordinarily flat, linear and 2-ranked, but on leading shoots often scale-like and spreading from all sides of the branchlets.

1. S. sempervirens.
Leaves all scale-like and scattered on all sides of the branchlets.
2. S. gigantea.

1. Sequoia sempervirens Endl. Redwood.

Leaves distichously spreading, about 3/4" long, or those on leading shoots smaller and scale-like; cone oblong, 3/4-1" long.

Tall, magnificent, forest trees often 200-300' high. The tallest tree authentically measured is 340'. Native of the fog belt of the California Coast Ranges, extending from southwestern Oregon to the Santa Lucia Mountains in Monterey County, and inland not more than 20-30 miles. Frequently planted on the University grounds but enduring badly in the dry soil. Native trees are on the estate along San Francisco Creek. A notable individual is the "Palo Alto" at the railway bridge between Palo Alto and Menlo Park.

2. Sequoia gigantea Decne. Giant Sequoia.

Leaves scale-like, arising from all sides of the branchlets, 1/8-1/4" long, glaucous-green; cone ovate-oblong, 2 to 3-1/2" long.

The Giant Sequoia is the largest and probably the oldest of trees. It is 200'-325' high and attains a diameter of 30'. Native of the western slopes of the Sierra Nevada, where it usually occurs in small isolated groves, but it forms rather extensive forests in the basins of the Tulare, Kings, and Kaweah Rivers. Frequently planted on the University grounds, and apparently better adapted to our local climate and soil than the Redwood.

3. Cryptomeria. D. Don.

Pyramidal tree with reddish brown bark. Leaves linear-subulate, arising from all sides of the twigs, decurrent. Flowers small, monoecious, staminate ones oblong, pistillate ones globose. Cones globose, with thick, wedge-shaped scales furnished

with a recurved projection on the back and pointed lobes at the apex.

A monotypic Japanese genus.

1. Cryptomeria japonica D. Don. Japanese Cedar.

Leaves compressed, somewhat incurved, 1/2-1" long; cones reddish brown.

A handsome evergreen tree extensively planted in Japan, especially about temples. A few trees are planted on the University grounds, but it does not thrive in our dry soil. An excellent specimen is at 9 Lasuen Street.

1a. Cryptomeria japonica var. elegans Mast.

Low dense tree or shrub, with horizontal branches and pendulous branchlets; leaves linear, flattened, soft, bright green changing to bronze in winter.

A garden form. Good specimens are on the grounds of the Stanford Residence, and in front of the Chemistry Building.

4. Taxodium Rich.

Tall, deciduous or evergreen trees with cinnamon brown, flaky bark. Leaves linear, 2-ranked, falling off in the autumn or the second year with the short slender lateral twigs; flowers monoecious, the staminate with 4-5 pollen-sacs to each anther, the pistillate solitary or in pairs at the ends of the branchlets of the previous year; cones globose or nearly so, maturing the first year, their scales spirally arranged, thickened at apex and mucronate; seeds 2 to each scale, triangular, winged.

Leaves deciduous; flowers appearing in the spring.

1. T. distichum.

Leaves persistent; flowers appearing in the autumn.

2. T. mucronatum.

1. Taxodium distichum Rich. Bald Cypress.

Leaves deciduous in the autumn, narrowly linear, light green, 1/2-3/4" long; staminate flowers purplish, in panicles 4-5" long; cones 1" long, without mucros at maturity.

Tall tree becoming 150' high, with a buttressed trunk, sometimes 12' in diameter. Native of the southeastern United States. A handsome specimen of this very ornamental tree is near the Angel of Grief, and another young tree is at 23 Salvatierra Street.

2. Taxodium mucronatum Tenore. Mexican Bald Cypress.

Similar to the last but leaves persistent through the winter; flowers appearing in the autumn instead of the spring; pollen-sacs 7-9 instead of 4-5.

Native of eastern and southern Mexico. Several notably large trees are known; one of these, the Cypress of Montezuma, was a noted tree four centuries ago. A young specimen that is withstanding our winters badly is in Professor Durand's garden. This specimen has now passed through three winters, and although the tips of the young shoots have been killed by frost, the leaves have retained their persistent character.

8. Cupressaceae. Cypress Family.

Resinous trees and shrubs of about 15 genera. Leaves opposite or whorled, usually scale-like and decurrent, rarely linear; stamens with short filaments and several pollen-sacs; cones woody or leathery or sometimes berry-like with 1-many erect ovules at base of scales.

Cones woody.

Scales flat or wedge-shaped, imbricate.

Seeds 4-5 to each scale; branchlets frond-like; leaves with broad scales.

Seeds usually 2 (1-3) to each scale.

Leaves appearing in whorls of 4, flat.

Leaves decussately opposite.

Scales peltate

Cones maturing the second year; seeds many to each scale.

Cones maturing the first year; seeds few to each scale.

Cones becoming fleshy and berry-like.

1. Thujaopsis

2. Libocedrus.

3. Thuja.

4. Cupressus.

5. Chamaecyparis

6. Juniperis.

1. Thujaopsis Sieb. & Zucc.

Evergreen forest tree with a pyramidal head. Leaves decussately opposite, convex above and somewhat sac-like. Flowers monoecious, solitary and terminal; staminate cylindric; cone subglobose, with 8-10 wedge-shaped scales; seeds 5 to each scale, compressed.

A monotypic Japanese genus.

1. Thujaopsis dolabrata Sieb. & Zucc. Hatchet-leaved Arborvitae.

Leaves glossy green above, silvery white beneath, rounded at apex, the upper and lower appressed, the lateral spreading, hatchet-shaped; cones 1/2" long; scales reflexed at apex.

A native of canyons and moist slopes of Japan. Two young trees are at 9 Lasuen Street.

2. Libocedrus Endl.

Evergreen aromatic trees, with fibrous bark and flattened spray-like branchlets. Leaves scale-like, imbricate in 4 rows. Flowers monoecious; staminate with 12-16 stamens; pollen-sacs 4. Cones oblong, with 6 scales, the lower pair much reduced, only the middle pair fertile; seeds 2 to each scale, winged.

A genus of about 8 species; one is a California species, the others are in western South America, New Zealand, New Caledonia, New Guinea, Formosa and southwestern China.

1. Libocedrus decurrens Torr. Incense Cedar.

Leaves yellowish green, appearing in whorls of 4, the lateral nearly covering the obscurely pitted inner ones; cones 4/5" long, about 1/3" thick; scales with a short recurved mucro.

Tree sometimes 150' high, with an irregularly lobed trunk tapering from a broad base, and a reddish brown, fibrous bark. Native of the Sierra Nevada, and the Inner Coast Ranges, extending from southern Oregon to northern Lower California. The row of trees back of the Engineering Buildings is of this species. Other trees are planted elsewhere on the University grounds.

3. Thuja L. Arborvitae.

Evergreen trees with thin scaly bark and decussate scale-like leaves. Flowers monoecious; staminate ovoid, with 4-6 pollen-sacs. Cones ovoid-oblong, erect or drooping, maturing in one season; scales 8-12, the middle 2 or 3 pairs fertile.

Four species are recognized in this genus, two in North America and two in Asia

Cones pendulous; scales thin, with a minute mucro.

1. T. plicata.

Cones erect; scales angled on the back, with a stout, recurved, dorsal hook.

2. T. orientalis

1. Thuja plicata Don. Western Red Cedar.

Leaves bright green and glossy above, dark green beneath, with whitish triangular markings; cones cylindric-ovoid, scarcely over 1/2" long; scales 8-10, elliptic-oblong, usually the 3 middle pairs fertile; seeds compressed, notched at the apex, with 2 narrow wings.

A large forest tree 200' high with short horizontal branches often with pendulous tips. Native of northwestern America, extending from Alaska to northern California. A specimen is in the eastern part of Encina Garden and another is near Mausoleum Avenue.

2. Thuja orientalis L. Oriental Arborvitae.

Leaves acute, bright green, with a small dorsal gland; cones erect, globose-ovate, 3/4" long; scales usually 6, oval; angled on the back and with a dorsal horn-like process, the uppermost pair sterile; seeds wingless.

Pyramidal trees 25' high or bushy. Native of Persia and extending to eastern Asia. There are many garden forms of this extensively cultivated species. Abundantly planted on the University grounds.

4. Cupressus L. Cypress.

Evergreen trees or rarely shrubs. Leaves decussately opposite, appressed, small, scale-like. Flowers monoecious, very small, terminating short branchlets. Cones globose or nearly so, consisting of 3-7 pairs of peltate woody scales, each bearing many seeds, maturing the second year.

Branchlets terete or quadrangular, not forming flat sprays.

Leaves glandless or with an obscure dorsal gland.

Branchlets erect or spreading, the ultimate rather short and stout.

Ultimate branchlets terete or nearly so; cones usually 1-1/4" long or more.

1. C. sempervirens.

Ultimate branchlets 4-sided; cones globose, 1" or less broad.

Staminate cones subglobose, with 2 lateral anthers in each row; seeds dull grayish or blackish brown.

2. C. macrocarpa.

Staminate cones oblong-ovoid, with 3 anthers to each row; seeds reddish brown.

3. C. goveniana.

Branchlets usually pendulous, the ultimate terete, slender, elongated; cones globose, 1/2" broad.

4. C. torulosa.

Leaves conspicuously glandular and very fragrant.

5. C. macnabiana.

Branchlets flattened, forming frond-like sprays on long pendulous branches.

6. C. funebris.

1. Cupressus sempervirens L. Italian Cypress.

Tree attaining 80', the typical form with erect branches forming a narrow columnar head; leaves closely appressed, ovate, glandless or with inconspicuous dark pits; staminate flowers cylindric, with 4 lateral anthers in each row; cones oblong or subglobose, 1-1/4" long or more, glossy; seeds nearly 1/4" long, reddish brown, with light-colored hilum.

The columnar form is the classical Cypress of the Greeks and Romans, and is much cultivated in southern Europe. It is the type of the species, but is not now known in the wild state. Commonly planted on the University grounds.

1a. Cupressus sempervirens var. horizontalis Gord.

Branches horizontal, forming a broad pyramidal head, otherwise like the typical form.

This form is also common on the Campus.

2. Cupressus macrocarpa Hartw. Monterey Cypress.

Branchlets short and stout, arising from all 4 sides of the twig; leaves dark green, glandless or glands marked by a dark pit; rhombic-ovate, acutish; staminate flowers subglobose, with 2 lateral anthers in each row; cones globose to oblong, 3/4 to 1-1/2" long; scales 8-12, with a short obtuse umbo; seeds sharply angled, 3/16" long, chestnut brown, with a conspicuous light-colored hilum.

Tree attaining 40' or occasionally 70', broadly oval in outline, with spreading branches or, especially in its native habitat, with horizontal branches forming a broad flat-topped head. The Monterey Cypress, which is the most abundantly planted tree on the University grounds, is restricted in its wild state to two small groves occupying the two promontories, Point Lobos and Cypress Point, that mark the boundary of Carmel Bay.

3. Cupressus goveniana Gord.

Branchlets arising from all 4 sides of the twigs, quadrangular; leaves ovate, acute, glandless or with an inconspicuous dark pit; staminate flowers oblong, with 3 lateral anthers; cones subglobose or oblong, 1/2-3/4" broad; seeds reddish brown with hilum of similar color.

Tree attaining 50', with slender, spreading or erect branches, forming a broad, open or pyramidal head. Native of the coastal region of northern and central California. Two trees are on either side of the first cross-street between the Library and the Gymnasium.

4. Cupressus torulosa Don. Himalayan Cypress.

Ultimate branchlets usually arising from only 2 sides of the twig, terete, slender; leaves ovate, acute, bluish green; staminate flowers cylindric, with 3-4 lateral anthers in each row; cones globose, 1/2" broad; scales 8-10 with a small sharp umbo; seeds light brown, glossy, flattened and broadly winged.

Tall slender tree attaining 150', with short horizontal branches and slender pendulous branchlets. Native of the Himalaya Mountains. Several trees are around the Cactus Garden.

5. Cupressus macnabiana Murr. MacNab Cypress.

Leaves ovate, obtuse, thickened at apex, conspicuously glandular and very fragrant; staminate flowers very small, globose, with 1-2 lateral anthers in each row; cones subglobose, 1/2-3/4" broad; scales usually 6, with a prominent conical umbo; seeds reddish brown, with a broad light-colored hilum.

Low spreading tree or shrub, or sometimes forming a pyramidal tree 20' high or more. Native of northern California, extending from Lake County to the vicinity of Mount Shasta, and also in Lassen County. Several trees are between the Library and University Avenue. Flowers are produced abundantly almost the year round.

6. Cupressus funebris Endl. Funeral Cypress.

Branchlets somewhat flattened; leaves deltoid-ovate, light green; cones short-peduncled, globose, 1/3" broad; scales 8, with a short mucro.

Tree often 60', with widespreading branches curved upward and bearing long, slender, pendulous branchlets. Native of China. Several trees are near the Cactus Garden and others are on the west side of University Avenue near the center of the Arboretum.

5. Chamaecyparis Spach. False Cypress.

Evergreen trees with flattened branchlets densely clothed with opposite scale-like leaves in 4 rows. Flowers monoecious on separate branchlets; staminate oblong, pistillate subglobose. Cones globose, maturing the first year; scales abruptly dilated and flattened at apex, with short prominent points; seeds 1-5 to each scale, slightly compressed.

Six species are known. They are confined to the Atlantic and Pacific Coast regions of North America and to Japan and Formosa.

1. Chamaecyparis lawsoniana Parl. Lawson Cypress.

Leaves closely appressed to the flattened frond-like branchlets, bright green and with a gland on the back, paler beneath with whitish markings; staminate flowers red; cone about 1/3" broad, red brown.

Tree sometimes 200' high with horizontal, spreading, and usually pendulous branches. Native of the coastal region of Oregon and northern California. A variable species with over 60 garden forms. Young trees are along Alvarado Row, others are in the Arboretum but they endure our dry season badly. A handsome specimen is in the lawn at the Stanford Residence and another is at 9 Lasuen Street.

6. Juniperus L. Juniper.

Evergreen trees with opposite or ternate, scale-like or needle-shaped leaves. Flowers are dioecious or monoecious, minute; staminate ones oblong-ovate; anthers with 4-8 pollen-sacs. Cones globose or oblong, with 2-3 series of fleshy coalescent scales, berry-like, maturing the second year. Seeds 1-several, ovate, terete or angled.

A genus of about 30 species widely scattered over the northern hemisphere from the Arctic Circle to the mountains of the subtropical regions.

Flowers monoecious, axillary; leaves jointed at base, spreading and needle-shaped.

1. J. communis.

Flowers dioecious, terminal; leaves not jointed at base, often scale-like.

Leaves all alike, in threes, slightly spreading; prostrate shrub.

2. J. recurva var. squamata.

Leaves often of 2 kinds, those on vigorous shoots in threes, acicular, those on foliage branches in twos, minute and scale-like.

Trees; fruit erect.

3. J. virginiana.

Low shrub with procumbent branches; fruit pendulous on recurved peduncles.

4. J. sabina

1. Juniperus communis L. Common Juniper.

Leaves widely spreading, jointed at base, narrowly linear-lanceolate, sharp-pointed, 1/2" long or less, concave and with a broad white band above; fruit sessile, dark blue and glaucous, 1/4-1/3" broad.

A small tree or erect shrub. Widely scattered over the northern hemisphere. variable species with many geographical varieties and garden forms. One specimen in west of the Cactus Garden.

1a. Juniperus communis var. hemispherica Parl.

A low dense shrub; leaves 1/3" long or less, stouter and stiffer than those of the typical form

A geographical variety found in the mountains of southern Europe and northern Africa. One bush on the west side of the Cactus Garden near the typical form.

1b. Juniperus communis var. oblonga Loud.

Erect shrub with widely spreading branches and pendulous branchlets; leaves strongly concave, the longest $3/4$ " long.

A geographical variety, native of Transcaucasia. One specimen is west of the Cactus Garden.

2. Juniperus recurva Buch.-Ham. var. squamata Parl.

Leaves in threes, straight, slightly spreading, linear-lanceolate, $1/4$ " long, sharp-pointed; fruit $1/3$ " broad, 1-seeded.

Prostrate shrub with long trailing branches. Native of the Himalaya Mountains. One specimen is on the southwest border of the Cactus Garden.

3. Juniperus virginiana L. Red Cedar.

Leaves of leading shoots acicular, in threes, those of the foliage branches in twos, small and scale-like, acute or acutish; fruit erect on short peduncles, globose or ovoid, $1/3$ " broad, 1-seeded.

Tree with a maximum height of about 100', with spreading branches and often pendulous branchlets. A variable species with many garden forms. Native of eastern North America. One tree with wide, spreading branches and pendulous branchlets is east of the Cactus Garden, and another smaller and more compact specimen is west of the Cactus Garden, near J. communis.

4. Juniperus sabina L.

Leaves of leading shoots often in threes and acicular, those of the foliage branches scale-like, in twos, obtusish; fruit pendulous, on elongated curved peduncles, globose, 1-3-seeded.

A variable species with many garden forms. Native of eastern North America, Europe, and Asia. There are several staminate specimens along the border of the Cactus Garden.