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The Coniferales of Taiwan

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This paper summarizes our present knowledge of the Coniferales of Taiwan. All indigenous species are considered. Descriptions of and keys to the families, genera, and species are given. Introduced genera are also included in the keys but they are not numbered nor described. All cited specimens are deposited in the herbarium of the National Taiwan University.

Key to the families

1. Seeds solitary or rarely 2, berry- or drupe-like, with a usually fleshy aril.
 2. Anthers with 3-9 pollen-sacs; pollen grains not winged.
 3. Branchlets alternate; female flowers of a single ovule.....1. *Taxaceae*
 3. Branchlets opposite; female flowers solitary or of several 2-ovuled carpels forming a small cone, but only 1 or 2 seeds developed.
 4. Male flowers in short-stalked clusters; leaves spirally arranged but generally spreading in 2 ranks.....5. *Cephalotaxaceae*
 4. Male flowers catkin-like, long; leaves opposite...2. *Amentotaxaceae*
 2. Anthers with 2 pollen-sacs; pollen grains winged.....3. *Podocarpaceae*
1. Seeds several or many, forming a dry cone, the cone rarely berry-like and with 1 or several seeds.
 2. Cone large, woody, each scale with 1 ovule; leaves alternate, ovate-lanceolate, broad.....4. *Araucariaceae*
 2. Cone smaller or berry-like, each scale with 2 or more ovules; leaves alternate, opposite or ternate, scale-like or needle-like or linear, rarely linear-lanceolate.
 3. Leaves and cone-scales spirally arranged, the former sometimes fascicled; ovules anatropous; cotyledons 2-10.
 4. Cone-scales and bracts distinct; scales with 2 usually winged seeds.....6 *Pinaceae*
 4. Cone-scales without distinct bracts, flat or peltate, with 2-8 seeds...

-7. *Taxodiaceae*
 3. Leaves and cone-scales opposite or whorled, the former small and usually scale-like; ovules erect; cotyledons 2, rarely 5-6....8. *Cupressaceae*

1. *Taxaceae*

Resinous trees or shrubs. Leaves persistent, alternate, often 2-ranked, linear to lanceolate, entire, with 2 broad grayish green bands below. Flowers dioecious, rarely monoecious. Male flowers cone-like; anthers borne on peltate or apically thickened scales, with 3-9 pollen-sacs. Female flowers usually solitary; ovules erect, 1 or 2, in the axils of a few decussate capillary scales. Seeds drupe-like or berry-like, with a bony shell, surrounded by a fleshy often colored aril; embryo with 2 cotyledons.

Genera 3, with about 13-15 species, the following and *Austrotaxus*, a monotypic genus in New Caledonia, and *Torreya*, with 6 species in eastern Asia and North America.

1. *Taxus* Linnaeus

Trees or shrubs, with reddish scaly bark, the branches usually spreading, the branchlets irregularly alternate. Leaves spirally arranged but spreading in 2 ranks, linear, flat, pointed and stalked, with 2 broad grayish green bands below, without resin-ducts. Flowers axillary, dioecious, rarely monoecious. Male flowers in stalked globose heads of 4-18 stamens, each with 5-9 pollen-sacs. Female flowers consisting of several imbricate scales, the uppermost bearing an ovule with a disk at base. Seed a bony nut, ovoid, slightly angular, partly enclosed by a fleshy scarlet cup-like aril open at the apex.

About 6-8 species in the northern hemisphere, 1 species in Taiwan.

1. *Taxus Wallichiana* Zucc. in Abh. Bayr. Akad. Wiss. 3:803. t. 5. 1843; Yamamoto in Journ. Soc. Trop. Agr. 10:182. f. 42. 1938.

"*Taxus cuspidata*" *sensu* Kanchira, Formos. Trees 616. 1917; Makino & Nemoto, Fl. Jap. ed. 2. 135. 1931; *non* Sieb. & Zucc.

"*Taxus chinensis*" *sensu* Sasaki, List Pl. Formos. 48. 1928; Makino & Nemoto, Fl. Jap. ed. 2. 135. 1931; Masamune, Short Fl. Formos. 34. 1936; Kanehira, Formos. Trees ed. 2. 31. 1936; Nemoto, Fl. Jap. Suppl. 91. 1936; *non* Rehder.

A large tree, with reddish bark, the branchlets short, slender, spreading. Leaves linear-lanceolate, falcate, about 1.2-2.7 cm. long, 2-2.5 cm. wide, abruptly

pointed, the base decurrent and acute, dark green above, pale green and with 2 broad tawny yellow bands below. Seed compressed-ovoid, about 7 mm. long, 3-4 mm. wide, slightly 2-angled, sometimes 3-angled, the fleshy coat reddish in color.

Mt. Rokurin, Niitaka, Tainan, *Y. Hashioka s. n.*

Western China, eastern India and Luzon. Shady, mountainous valleys, in northern and central parts of Taiwan at high altitudes; scarce. A slow growing tree up to 1 m. in diameter.

This Taiwan species is formerly referred to *T. chinensis* Rehder of China from which it differs in having more slender branches, more pointed, keeled bud scales, and narrower linear-lanceolate leaves. It is also near *T. cuspidata* Sieb. & Zucc. of Japan, Korea, and northeastern China differing in having usually 2-angled instead of 3-4-angled seeds and in the falcate instead of straight leaves which are narrower at the base and more abruptly acuminate at the apex.

2. Amentotaxaceae

Shrubs or small trees, glabrous, the branchlets opposite. Leaves opposite, broad, narrowly elliptic, acute, with a prominent midrib and with 2 broad, distinct, white glaucous stomatic bands beneath. Flowers dioecious, on the year's branches. Male flowers 3-4, in spike-like catkins, terminating the branches, long and pendulous, the anthers with 2-8 pollen-sacs. Female flowers solitary, in the axil of bract, on short thick pedicel, the ovule solitary, erect. Seed solitary, large, drupe-like, ovoid, surrounded by reddish-yellow aril open at the apex.

One genus, in western and southern China and Taiwan.

1. Amentotaxus Pilger

Characters of the family.

One species.

1. **Amentotaxus argotaenia** (Hance) Pilger in Engl., Bot. Jahrb. 54:41. 1916; Yamamoto in Bot. Mag. Tokyo 40:453. 1926, Suppl. Icon. Pl. Formos. 3:1. t. 1. 1927; Kanehira in Trans. Nat. Hist. Soc. Formos. 16 (84):80. 1926, Formos. Trees, ed. 2:33. 1936; Kudo in Journ. Soc. Trop. Agr. 3:110. 1931; Masamune, Short Fl. Formos. 34. 1936.

Podocarpus argotaenia Hance in Journ. Bot. 21:357. 1883; Matsum. & Hay. in Journ. Coll. Sci. Jap. Univ. Tokyo 22:399. 1906 (Enum. Pl. Formos.).

Podocarpus insignis Hemsl. in Journ. Bot. 23:287. 1885.

Cephalotaxus argotaenia Pilger in Engl., Pflanzenreich 4 (5):104. 1903; Makino & Nemoto, Fl. Jap. ed 2. 132. 1931; Nemoto, Fl. Jap. Suppl. 90. 1936.

A medium sized or small tree, up to 8 m. high and 30 cm. in diameter, thinly branched. Leaves falcate, 5-7 cm. long, 7-8 mm. wide, dark greenish above, with 2 broad white stomatic bands beneath, the margins revolute. Seed drupe-like, axillary, long-pedicelled, ellipsoid, 25-30 mm. long, becoming dark purple.

Taito, Taririku, S. Sasaki & Y. Yamamoto s. u, Y. Yamamoto s. n.

China: Kwangtung, western Hupeh, western Szechuan. Taiwan, Hunchuen (Kosyuu) Peninsula, rather scarce, at altitudes of 1200-1300 m., in broad-leaved forests at shaded places, near ravines and cliffs.

3. Podocarpaceae

Resinous trees or shrubs. Leaves alternate, rarely opposite, persistent, scale-like, needle-like, linear, or lanceolate, sometimes broad and ovate, entire. Flowers dioecious. Male flowers catkin- or cone-like, terminal or axillary, the stamens with 2 pollen-sacs. Female flowers of 1 to many scales, often very small, the ovule solitary to each scale, usually enveloped by the scale, with several bracts at base which becomes thickened or fleshy after fertilization. Seed with a bony shell, surrounded by a fleshy aril; embryo with 2 cotyledons.

Genera 7, species over 100, mostly in the southern hemisphere, 1 genus in Taiwan.

1. Podocarpus Persoon

Trees, rarely shrubs, the bark gray, shallowly fissured. Leaves alternate, sometimes opposite, linear to ovate. Flowers dioecious, rarely monoecious. Male flowers catkin-like, axillary, solitary or fascicled, with numerous, spirally arranged, imbricate scales, each bearing an anther on the under-side. Female flowers axillary, solitary, rarely at the end of short branches or in spikes, with a 1-2-ovuled scale with several fleshy bracts at base becoming much thickened at maturity and forming a fleshy receptacle bearing the globose or ovoid, drupe- or nut-like seed.

About 70 species, chiefly in the tropic and subtropic regions of both hemispheres, a few extending in Asia to China and Japan. About 6 indigenous species in Taiwan.

Key to the species

1. Leaves without prominent midribs, ovate or ovate-lanceolate.
 2. Leaves with acute apices; receptacles slender, dry.
 3. Leaves longer and broader, 6-8 cm. long, 1.5-2 cm. wide.....1. *P. formosensis*
 3. Leaves shorter and narrower, 5-7 cm. long, 1-1.5 cm. wide.....2. *P. nankoensis*
 2. Leaves with acuminate apices; receptacles large, fleshy.....3. *P. Wallichianus*
1. Leaves with prominent midribs, lanceolate, linear-lanceolate, or linear.
 2. Leaves 5-8 cm. long, the apices acute to slightly obtuse.
 3. Leaves 6-8 cm. long, the apices more or less acute.....4. *P. Nakai*
 3. Leaves 5-6 cm. long, the apices more or less obtuse.....5. *P. costalis*
 2. Leaves 10-15 cm. long, the apices sharply acute.....6. *P. philippinensis*

1. **Podocarpus formosensis** Dummer, Gard. Chron. III. 52:295. f. 132. 1912; Sasaki, List Pl. Formos. 49. 1928; Makino & Nemot, Fl. Jap. ed. 2. 133. 1931 (as *formosanus*); Yamamoto in Journ. Soc. Trop. Agr. 7:146. f. 18. 1935; Nemoto, Fl. Jap. Suppl. 90. 1936; Kanehira, Formos. Trees ed. 2. 707. 1936; Masamune, Short Fl. Formos. 34. 1936.

Podocarpus koshunensis Kanehira, Formos. Trees ed. 2. 36. f. 4. 1936.

Podocarpus nagi var. *koshunensis* Kanehira in Trans. Nat. Hist. Soc. Formos. 21:145. 1931; Nemoto, Fl. Jap. Suppl. 90. 1936.

Podocarpus formosensis Dummer var. *koshuensis* Merr. & Yamamoto ex Yamamoto in Journ. Soc. Trop. Agr. 7:146. 1935; Masamune, Short Fl. Formos. 34. 1936.

"*Podocarpus nageia*" sensu Henry, List Pl. Formos. 91. 1896, *P. P.*, non R. Brown.

"*Podocarpus nagi* var. *angustifolia*" sensu Sasaki, List. Pl. Formos. 49. 1928, Cat. Govern. Herb. Formos. 53. 1930; non Makino.

A tree, the bark purplish brown. Leaves opposite, ovate-lanceolate, 6-8 cm. long, 1.5-2 cm. broad, dark green, the apex acute. Seeds globose, 12-15 mm. in diameter, fleshy.

Daibusan, Y. Shimada 3800.

Hunchuen (Kosyung) Peninsula. Scattered in broad-leaved forests.

Yamamoto, on the basis of actual examination of Dummer's isotypes, concluded that the Taiwan plant originally referred to *P. nagi* by different authors is actually *P. formosensis* Dummer. He said that "most Formosan materials have different characters from Japanese material in forms of leaves and fruits".

2. **Podocarpus nankoensis** Hay, Icon. Pl. Formos. 7:39. 1918; Kanehira, Formos. Trees 613. 1917, ed. 2. 707. 1936; Sasaki, List. Pl. Formos. 49. 1928; Makino & Nemoto, Fl. Jap. ed. 2. 134. 1931; Yamamoto in Journ. Soc. Trop. Agr. 7:147. 1935.

"*Podocarpus nagi*" sensu Kanehira, Formos. Trees 612. f. 1919, ed. 2. 35. 1936; Masamune, Short Fl. Formos. 34. 1936; non Zoll. & Moritzi.

A medium-sized tree, to 50 cm. in diameter. Leaves oblong-lanceolate, 5-7 cm. long, 1-1.5 cm. wide. Seed globose, 12 mm. in diameter.

Taihoku-syu, Buzangun, Y. Shimada 2973, Suzuki-Tokio 9762, 21358, Nakamura 4267, Hayashi s. n.; Taihoku, Mt. Bosizan, T. Sato 163; Urai, E. Matuda 272, Suzuki-Tokio 20456; Mt. Oobi, Suco-gu, Taihoku-syu, Masamune s. n.; Kasugayama, Isikawa Einosuke s. n.

Hainan. Taiwan, in the northern part of the island.

3. **Podocarpus Wallichianus** Presl, Bot. Bermerk. 110. 1884; Yamamoto in Journ. Soc. Trop. Agr. 7:147. f. 19. 1935.

"*Podocarpus nageia*" sensu Henry, List. Pl. Formos. 91. 1896, p. p., non. Brown.

"*Podocarpus latifolius*" sensu Forbes & Hemsl. in Journ. Linn. Soc. Bot. 26:547. 1902; Matsum. & Hay. in Journ. Coll. Sci. Imp. Univ. Tokyo 22:398. 1906 (Enum. Pl. Formos.); Kanehira, Formos. Trees 611. 1917; Sasaki, List. Pl. Formos. 49. 1928; Makino & Nemoto, Fl. Jap. ed. 2. 1931; Masamune, Short Fl. Formos. 34. 1936; non Wall.

A tree. Leaves opposite or nearly opposite, coriaceous, without prominent midrib, ovate to ovate-lanceolate, about 7.5-10 cm. long, 2-3 cm. wide, the apex acuminate, the base rounded, to broadly acute. Seeds ovoid, about 1.2 cm. wide, purplish when mature.

Taihoku, Byoho, Nakazawa s. n.

India, Burma, Indo-China to southern China. Taiwan, confined to northern part of the island but rare, probably introduced.

4. **Podocarpus Nakaii** Hay., Icon. Pl. Formos. 9:66. 1916; Kanehira, Formos. Trees 613. 1917, ed. 2. 36. f. 5. 1936; Sasaki in Trans. Nat. Soc. Formos. 12:167 19 30; Makino & Nemoto, Fl. Jap. ed. 2. 1931; Nemoto, Fl. Jap. Suppl. 91. 1936; Masamune, Short Fl. Formos. 34. 1936.

"*Podocarpus macrophyllus*" *sensu* Matsum. & Hay. in Journ. Coll. Sci. Imp. Univ. Tokyo 22:398. 1916 (Enum. Pl. Formos.); Kanehira, Formos. Trees 612. 197; *non* D. Don.

"*Podocarpus neriifolius*" *sensu* Hay., in Journ. Coll. Sci. Imp. Univ. Tokyo 30. (1); 307. 1911 (Mat. Fl. Formos.); Kanehira, Formos. Trees 613. 1917; Makino & Nemoto. Fl. Jap. ed. 2. 135. 1931; Masamune, Short Fl. Formos. 34. 1936; *non* D. Don.

A medium-sized or large tree, to 60 cm. in diameter, the bark grayish, fibrous. Leaves lanceolate, 6–8 cm. long, 8–12 mm. wide, the apex acute. Seed ovoid, pointed at the apex, receptacle large, oblong-conical.

Taiyu, Tosei, Y. Hashioka s. u.; Taiyu, Rengench, Yamamoto s. n., K. Mori s. n., Hibino & Suzuki s. n.; Taichun, inter Gogio & Rengench, Yamamoto & Mori s. n.; Hassenzan, S. Suzuki 2890; Baibara, S. Suzuki s. n.; Gyochi, Y. Yamamoto s. n.; Baran ad Nichigetsutan, Kudo & Sasaki 15033; Sintiku, Suzuki-Tokio 20212; Nanto, Kanehira & Sasaki s. n.

Endemic to Taiwan, in the northern and central parts of the island, scattered in forests.

This species is near *P. macrophyllus* Don of China, differing in having more acutely pointed leaves and in the ovoid seed which is acute at the apex. Kanehira reduces the plant of Taiwan, known as *P. noriifolius*, a species of the Himalayas and western China, as also belong to this species.

5. ***Podocarpus costalis*** Presl, Epim. Bot. 236. 18549; Yamamoto, Suppl. Pl. Formos. 2:15. 1927; Makino & Nemoto, Fl. Jap. ed. 2. 133. 1931; Kanehira, Formos. Trees, ed. 2:35. 1936; Nemoto, Fl. Jap. Suppl. 90. 1936; Masamune, Short Fl. Formos. 34. 1936.

A dwarf tree. Leaves lanceolate, 5–6 cm. long, 8–12 mm. wide, coriaceous, the apex acute, the margins somewhat revolute. Flower and fruit unknown.

Botel Tobago, Hosokawa 8185, S. Sasaki 378.

Philippine (Luzon), Botel Tobago, along coasts among rocks.

6. ***Podocarpus philippinensis*** Foxworthy in Philip. Journ. Sci. 6. Bot.: 163. 1911; Sasaki, List Pl. Formos. 49. 1928; Makino & Nemoto, Fl. Jap. ed. 2. 135. 1931; Nemoto, Fl. Jap. Suppl. 91. 1936; Kanehira, Formos. Trees ed. 2: 39. f. 6. 1936; Masamune, Short Fl. Formos. 35:1936.

A medium-sized tree. Leaves linear-lanceolate, falcate, 10–15 cm. long, 10–12 mm. wide, the midrib prominent on both surfaces, the apex acute, the base attenuate. Seed globose; receptacle large, oblong-conical.

Taito. Sinsuiei, Shimada 3738. 3887.

Philippine. Taiwan, in Hunchuen (Kosyun) Peninsula, scattered in forests at medium altitudes.

4. Araucariaceae

Resinous trees, the branches whorled. Leaves ovate-lanceolate, broad, coriaceous, spiral. Flowers dioecious, rarely monoecious. Male flowers cone-like, large, with numerous spirally arranged stamens, the anthers with many pollen-sacs. Female flowers very numerous, spirally arranged, in a globose or terminal head becoming a large woody cone, the scales with 1 anatropous ovule each. Seeds with or without wings.

Genera 2, *Agathis* and *Araucaria*, with about 30 species, chiefly in the southern hemisphere. *Agathis alba* Foxw. of the Philippines and several species of *Araucaria* from Australia are in cultivation in Taiwan. Both are large evergreen trees with broad flat leaves. In *Agathis*, the ovule is free from the scale. In *Araucaria*, the ovule is concrescent with the scale.

5. Cephalotaxaceae

Trees or shrubs, the bark gray, fissured, the branchlets opposite. Leaves dense, persistent, spirally arranged but spreading in 2 ranks, with a prominent midrib above and 2 broad glaucous bands below. Flowers dioecious, axillary. Male flowers in short-stalked cluster, the anther with 3-9 pollen-sacs. Female flowers in a small cone, in the axils of scales at base of the branchlets, consisting of several pairs of 2-ovuled carpels. Seeds only 1 or 2 developed on a stalk, ellipsoid, enclosed in fleshy envelope, drupe-like.

One genus.

1. *Cephalotaxus* Siebold & Zuccarini

Characters of the family.

Five species in eastern Asia, 1. *C. Wilsoniana* Hay., endemic to Taiwan,

1. ***Cephalotaxus Wilsoniana*** Hay., Icon. Pl. Formos. 4:22. 1914; Kanehira, Formos. Trees 595. 1917, ed. 2. 31. f. 1. 1936; Makino & Nemoto, Fl. Jap. ed. 2. 132. 1931; Nemoto, Fl. Jap. Suppl. 90. 1936; Masamune, Short Fl. Formos. 35. 1936.

A medium-sized tree, to 10 m. high and 40 cm. in diameter, the bark smooth, fibrous, the branches pendulous. Leaves linear, flat, slightly falcate, 3-4 cm. long, 3 mm. wide, the apex acute, the base narrowed, the midrib prominent

above, the margins slightly revolute, with 2 grayish white bands below. Seed ovoid to obovoid, about 2.5 cm. long.

Taito, Keito, Yamamoto & Kawakami s. n.; Inter Kiriama et Tiponzae, S. Suzuki 11000; Mt. Taihei, S. Suzuki 3833, 12328; Mt. Taihesenzan, N. Fukuyama s. n., Mt. Arisan, Uryoko, S. Suzuki s. n.; Taityu-syu, Tatumi, K. Mori s. n.; Taihoku-syu Bakokuru, Suzuki-Tokio 18293; Rokuzyo-taizan, N. Fukuyama 3277, 3436; Musya-santinozyo, G. Masamune 2431; Kuarusu, E. Matuda 242; Taihoku-syu, Hibino & Yoshikawa s. n.; Taito, Idzumo, Y. Yamamoto 483.

Endemic. Widely distributed in Taiwan, but very scarce, growing under large trees in both broad-leaved and coniferous forests at altitudes of 1400-2000 meters. A slow growing tree.

This species is very near the common *C. drupacea* Sieb. & Zucc. of China and Japan, differing in its acute leaves, longer peduncles, and much larger cones.

6. Pinaceae

Resinous trees. Leaves linear, spiral or fascicled, persistent, rarely deciduous. Flowers monoecious, cone-like. Male flowers consisting of numerous scales bearing 2-6 anthers, the anthers with 2 pollen-sacs. Female flowers with numerous scales, spirally arranged, with a lower smaller and a upper larger portion, each with 2 anatropous ovules on the under side. Cone becoming more or less woody at maturity. Seeds 2 to each scale, usually winged; embryo with 2-15 cotyledons.

About 9 genera, and 130 species, in the northern hemisphere from the sub-arctic to subtropical zones.

Key to the genera

1. Branches with only long shoots; leaves solitary.
 2. Cones upright.
 3. Cone-scales deciduous; leaves grooved above, usually with glaucous bands below.....1. *Abies*
 3. Cone-scales persistent; leaves keeled above, pale green below.....2. *Keteleeria*
 2. Cones reflexed or pendulous the scales persistent.
 3. Bracts exserted, conspicuous; branchlets not roughened by leaf-bases...5. *Pseudotsuga*
 3. Bracts not exserted; branchlets roughened by persistent leaf-bases.
 4. Leaves flattened and with stomata below or on both surfaces; short-petioled, with only 1 resin duct in each leaf; cones small.....

-6. *Tsuga*
4. Leaves usually quadrangular or flattened, with stomatic bands above, sessile, with 2 resin duct in each leaf; cones large.....
-3. *Picea*
1. Branches with long and short shoots; leaves in fascicles or clusters of 2 or more, solitary only on long shoots.
2. Leaves in fascicles of 2-5, sheathed at base by scarious bud-scales; cone-scales usually much thickened at apex.....4. *Pinus*
2. Leaves many, clustered on short thick spurs; cone-scales flat at the apex.*Cedrus*

1. *Abies* Miller

Trees, of pyramidal shape, the bark smooth and thin on younger trees, often thick and furrowed on old ones, the branches whorled, spreading. Leaves in 2 ranks, spreading, linear or linear-lanceolate, flat, with 2 white stomatic bands below, and with 2 lateral resin ducts. Male flowers pendent, ovoid to cylindric-oblong. Female flowers ovoid to oblong, consisting of numerous scales, the scales imbricate, each with 2 ovules. Cones large and erect, the scales falling off with the seeds. Seeds ovoid or oblong, with large thin wing; embryo with 4-10 cotyledons.

About 40 species in temperate regions of the northern hemisphere, generally mountain trees, 1 in Taiwan.

1. *Abies Kawakamii* (Hay.) Ito in Encycl. Jap. 2:167. 1909; Kanehira, Formos. Trees 594. f. 1917, ed. 2, 39. f. 7. 1936; Hay., Icon. Pl. Formos. 9: 108. 1920; Makino & Nemoto, Fl. Jap. ed. 2. 138. 1931; Nemoto, Fl. Jap. Suppl. 92. 1936; Masamune, Short Fl. Formos. 35. 1936.

Abies Mariesii Mast. var. *Kawakamii* Hay. in Journ. Coll. Sci. Imp. Univ. Tokyo 35(19): 223. f. 14. 1908 (Fl. Mont. Formos.).

A large tree, to 16 m. tall and 100 cm. in diameter, the bark grayish brown, scaly, the branches horizontal. Leaves broadly linear, flat, 10-15 mm. long, the midrib prominent, the apex rounded-obtuse. Cones erect, cylindric or oblong, 4 cm. in diameter, purplish, the scales fan-shaped, 15-18 mm. long, 20-25 mm. wide, the margins irregularly serrate; seeds angled, winged, 15 mm. long.

Mt. Taihezan, S. Suzuki s. n.; Mt. Tugitaka, Mori s. n.; Mt. Nütaka, Kawakami & Suzuki s. n.; T. Wakatsuki 1425; Mt. Shyoha, Sintiku, Y. Hashioka & H. Shimada s. n.; Sikayo-taizan, Suzuki-Tokio 15230, 17552; Ritritori, Bunatke, Masamune & Mori s. n.; Mt. Sikayau, K. Mori s. n.

Endemic. Occuring extensively at high altitudes of 2800-3300 meters along the central ranges, usually forming pure stand.

2. *Keteleeria* Carriere

Trees, pyramidal while young, flat-topped in old age, the bark gray, furrowed, the branches whorled, spreading. Leaves persistent, appearing 2-ranked, linear, rigid, lustrous above, pale and keeled below, spiny to obtuse. Male flowers clustered. Female flowers composed of numerous scales subtended by small bracts, the scales 2-ovuled. Cone erect, ovoid to cylindric-oblong, ripening the first year, the scales broad, woody, persistent, the bracts half as long as the scale; embryo with 2 cotyledons.

2 or 3 species in China, 1 also in Taiwan.

1. *Keteleeria Davidiana* (Franch.) Beissner, Handb. Nadelh. 424. 1891; Matsun. & Hay., in Journ. Coll. Sci. Imp. Univ. Tokyo 22:397. 1906 (Enum. Pl. Formos.); Kanehira, Formos. Trees 602. f. 1917, ed. 2:39. f. 8. 1936; Masamune, Short Fl. Formos. 35: 1936.

Abies Davidiana Franch. in Nouv. Mem. Mus. Paris 4:96. 1884.

Keteleeria Davidiana var. *formosana* Hay. in Gard. Chron. III. 43:194. 1908, in Journ. Coll. Sci. Imp. Univ. Tokyo 35(19):221. f. 11. 1908 (Fl. Mont. Formos.); Makino & Nemoto, Fl. Jap. ed. 2. 144. 1931; Nemoto, Fl. Jap. Suppl. 96. 1936.

Keteleeria formosana Hay. in Gard. Chron. III 43:194. 1908.

A very large tree, up to 35 m. high and 2.5 m. in diameter, the young branchlets short-pilose or glabrous, the bark dark gray, irregularly furrowed. Leaves flat, linear, 2-4 cm. long, 3-4 mm. wide, keeled on both surfaces, the apex acute to obtuse or emarginate, the margins more or less revolute. Cone solitary, erect, cylindric-oblong, 5-15 cm. long, 4-4.5 cm. in diameter, greenish while young, pale chestnut color when mature. Seeds about 1 cm. long, with 1 wing as long as or longer than the seed.

Taihoku-syu, Bunzangun, Kinkwaryo, S. Suzuki s. n.; Taihoku-syu, Heirinbi, Kanehira & Sasaki s. n., S. Suzuki s. n.

Central and western China. In Taiwan, it occurs at the extreme northern parts at 300-600 m. and the extreme southern parts at 500-900 m., usually in association with broad-leaved trees in open places; now scarce in both parts.

3. *Picea* A. Dietrich

Trees, of pyramidal habit, the branches whorled. Leaves spirally arranged, form well marked pulvini, linear, 4-angled or flat, with 2 marginal resin-ducts. Male flowers axillary, catkin-like, yellow or red, consisting of numerous spirally arranged anthers. Female flowers terminal, green or purple, consisting of numerous bracted scales, the scales 2-ovuled. Cones ovoid to oblong-cylindric, at first erect, ultimately pendulous, the scales persistent, sub-orbicular to rhombic-oblong, subtended by small bracts. Seeds 2 under each scale, small, compressed, winged.

About 40 species in the temperate zone of north hemispheres, 1 in Taiwan.

1. *Picea morrisonicola* Hay., in Journ. Coll. Sci. Imp. Univ. Tokyo 35(19): 220. f. 10. 1908 (Fl. Mont. Formos.); Kanehira, Formos. Trees 604. f. 1917, ed. 2. 41. f. 9. 1936; Makino & Nemoto, Fl. Jap. ed. 2. 147. 1931; Nemoto, Fl. Jap. Suppl. 97. 1936; Masamune, Short Fl. Formos. 35. 1936.

"*Picea Glehnii*" *sensu* Matsum. & Hay. in Journ. Coll. Sci. Imp. Univ. Tokyo 22:400. 1906 (Enum. Pl. Formos.), *non* Masters.

A large tree, up to 50 m. in height and 1.5 m. in diameter, the bark brown, fissured into thin flakes, the branches dense, horizontal, the branchlets glabrous. Leaves linear, 10-15 mm. long, acute. Cone cylindric-oblong, purplish, about 7 cm. long, the scales obovate, 15 mm. long, rounded at apex, entire; seeds 10-12 mm. long including the wing.

Mt. Arisan, Kanehira & Sasaki s. n., Sasaki s. n.; Mt. Taiheizan, S. Suzuki 3883, s. n.; Nankotaizan, Masamune 3088; Inter Matsumine et Hokku, S. Suzuki 5584; Mt. Kodama, Nitakayama, Y. Hashioka s. n.; Taito, Y. Yamamoto 375.

Endemic. At high altitudes of about 2500-3000 meters in the central ranges, of scattered occurrences in ravines and mountain slopes, usually mixing with other trees.

4. *Pinus* Linnaeus

Resinous trees, the bark furrowed or scaly, the branches whorled, spreading. Leaves dimorphic, those on the primary shoots spirally arranged, usually reduced into small scarious bracts, those on the secondary shoots fascicled, persistent, acicular, semi-terete or triangular, borne on undeveloped branchlet in clusters of 2-5, surrounded at base by sheaths of 8-12 bud-scales. Flowers monoecious. Male flowers axillary, clustered at the base of the young shoot, catkin-like,

yellow, orange, or scaly, consisting of numerous spirally arranged anthers, the pollen-sacs 2. Female flowers lateral or subterminal, consisting of numerous spirally arranged scales, each scale subtended by a small bract and bearing 2 ovules inside near the base. Cone subglobose to cylindric, the scales usually with much thickened apex; seeds usually with long wing, rarely with short wing or wingless; embryo with 4-15 cotyledons.

About 80-90 species, spread over the northern hemisphere from the arctic circle to tropics, 4 indigenous species in Taiwan.

Key to the species

1. Leaves 5 in a fascicle, triangular in section, with 1 vascular bundle.
 2. Seeds wingless, about 8-12 mm. long; leaves with 3 resin-ducts.....1. *P. Armandi*
 2. Seeds winged, about 20 mm. long, leaves with 2 resin-ducts2. *P. morrisonicola*
1. Leaves 2 in a fascicle, semi-orbicular in section, with 2 vascular bundles.
 2. Leaves more slender, usually 12-20 cm. long; with 5-9 resin-ducts; seeds 20 mm. long including the wing.....3. *P. Massoniana*
 2. Leaves more rigid, about 8-11 cm. long, with usually 4 resin-ducts; seeds 15-18 mm. long including the wing.....4. *P. taiwanensis*

1. ***Pinus Armandi*** Franch. in Nouv. Arch. Mus. Paris Ser. II. 7:95. t. 12. 1884; Makino & Nemoto, Fl. Jap. ed. 2. 147. 1931; Kanehira, Formos. Trees 605. f. 1917, ed. 2. 42 f. 10. 1936; Nemoto, 1. Jap. Suppl. 97. 1936; Masamune in Journ. Soc. Trop. Agr. 2:31. 1930, Short Fl. Formos. 35. 1936.

Pinus Mastersiana Hay. in Gard. Chron. III. 43:194. 1908.

Pinus Armandi var. *Mastersiana* Hay. in Journ. Coll. Sci. Imp. Univ. Tokyo 35(19):215. f. 8. 1908 (Fl. Mont. Formos.).

Pinus amamiana Koidz. in Bot. Mag. Tokyo 38:113, 1924; Makino & Nemoto, Fl. Jap. ed. 2. 147. 1931.

A large tree, up to 20 m. high and 100 cm. in diameter, the branches wide-spread, horizontal, the branchlets glabrous. Leaves 5 in a fascicle, slender, 8-15 cm. long, serrulate, bright green, triangular in cross section, with 3 resin-ducts. Cones peduncled, ovoid, up to 10-20 cm. long and 8 cm. in diameter, rounded at apex or tapering into an acute point, sometimes slightly recurved, the scales rhombic, 3 cm. long; seeds ovoid, compressed, without wings, with a sharp

edge all around, 8-12 mm. long.

Mt. Rokurinzan, Tainan, *Suzuki-Tokio* 10621; Ritozan, *E. Matuda* 471; Seizunizan, Kwarenko, *Nakamura* 3702; Mt. Shyoha, Sintiku, *Y. Hashioka & Shimada* s. n.; Yusuo, *S. Suzuki* 5152; Mt. Niitaka, *G. Nakahara* 387, *Kawakami & Mori* 386; Arisan, *Kyu-Kindo* s. n., *Yamamoto & Mori* s. n.; Taito, *Yamamoto* 371, 372, 415; Mt. Daibu, *Masamune* 1558; Nanto, *Sato* s. n.; Sikayau-taizan, *S. Suzuki* 5508; Nankotaizan, *S. Suzuki* s. n.

Central and western China to Korea. In Taiwan, in the northern and central parts at altitudes of 2300-3350 meters.

2. ***Pinus morrisonicola*** Hay. in *Gard. Chron.* III. 43:194. 1908; Makino & Nemoto, *Fl. Jap.* ed. 2. 147. 1931.

Pinus formosana Hay. in *Journ. Coll. Sci. Imp. Univ. Tokyo* 35(19):217. f. 9. 1908 (*Fl. Mont. Formos.*); Kanehira, *Formos. Trees* 607. f. 1917, ed. 2. 44. f. 11. 1936; Makino & Nemoto, *Fl. Jap.* ed. 2. 138. 1931; Nemoto, *Fl. Jap. Suppl.* 97. 1936; Masamune, *Short Fl. Formos.* 35. 1936.

Pinus Uyematsui, Hay., *Icon. Pl. Formos.* 3:192. t. 35. 1913; Kanehira, *Formos. Trees* 610. f. 1917; Makino & Nemoto, *Fl. Jap.* ed. 2. 150. 1931.

"*Pinus parviflora*" sensu Matsum. & Hay. in *Journ. Col. Sci. Imp. Univ. Tokyo* 22:397. 1906 (*Enum. Pl. Formos.*), non Sieb. & Zucc.

A large tree, up to 15-25 m. high and 120 cm. in diameter, the trunk often crooked, the bark smooth on young trees, fissured on old ones. Leaves 5 in a fascicle, 8 cm. long, triangular in cross section, with 2 resin-ducts. Cones ovoid to oblong-ovoid, to 10 cm. long and 4-5 cm. in diameter, the scales oblong-ovate, the apex rounded; seeds winged, about 2 cm. long.

Nanto, *Mori* s. n.; Taityu, Tosei, *K. Mori* s.; Sintijku, Byoritu-gun, Tusyo-Hoanrin, *Suzuki-Tokio* 20458; Taihoku-syu, Bunzangun, Babokuru, *Suzuki-Tokio* 18273; Mt. Tencho to Kiraikei, *Kudo & Mori* 2013; prope Chikudo a Nichigetsutan, *Kudo & Sasaki* 15593.

Endemic. At altitudes of 300-2300 meters throughout the island, usually scattered and in association with broad-leaved trees, now scarce at lower elevations and mostly present at higher elevations and less accessible places.

3. ***Pinus Massoniana*** Lambert, *Desc. Pinus* 1:17. t. 12. 1803; Matsum. & Hay. in *Journ. Coll. Sci. Imp. Univ. Tokyo* 22:396; (*Enum. Pl. Formos.*); Kanehira, *Formos. Trees* 608. f. 1917, ed. 2. 44. f. 12. 1936; Makino & Nemoto, *Fl. Jap.* ed. 2. 149. 1931; Nemoto, *Fl. Jap. Suppl.* 98. 1936; Masamune, *Short Fl. Formos.* 36. 1936.

A tree to 18 m. high and 80 cm. in diameter, the trunk crooked, forming an irregular usually broad head, the lower barks gray, irregularly furrowed, the upper orange-red, fissured into thin scales. Leaves 2 in a fascicle, semi-circular

in cross section, 12-20 cm. long, slender, with 5-9 resin-ducts. Cones ovoid to conic-ovoid, 5-7 cm. long, brown, short-stalked, the stalk about 3 mm. long; seeds winged, about 2 cm. long.

Taihoku, Sozan, *E. Matuda s. n.*, *Suzuki s. n.*; Taihoku, *Nakasawa s. n.*; Taihoku, Mt. Bosizan, *S. Suzuki 4229*; Taihoku, Bunzangun, *Shimada 3328*, Taihoku, Shinko, *Y. Hashioka s. n.*; Taihoku, Sugenchu, *S. Suzuki s. n.*; Taiheizan, *S. Suzuki 6270*; Taityu, Tosei, *K. Mori s. n.*

Widely distributed in southern China. In Taiwan mostly in the northern parts, also along the eastern coastal hills.

4. *Pinus taiwanensis* Hay. in Journ. Coll. Sci. Imp. Univ. Tokyo, 307, 1911 (Mat. Fl. Formos.); Kanehira, Formos. Trees 609. f. 1917, ed. 2. 48. f. 13. 1936; Nemoto, Fl. Jap. Suppl. 98. 1936; Masamune, Short Fl. Formos. 36. 1936.

Pinus brevispica Hay., Icon. Pl. Formos. 3:1913; Kanehira, Formos. Trees 608, f. 1917; Makino & Nemoto, Fl. Jap. ed. 2. 148. 1931.

A large tree, up to 35 m. in height and 80 cm. in diameter, the trunk straight, the branches horizontal, the bark fissured into small scales. Leaves 2 in a fascicle, semi-circular in cross section, more or less rigid, 8-11 cm. long, the margins serrulate, generally with 4 resin-ducts. Cones oblong-ovoid, 6-7 cm. long; seeds winged, 15-18 mm. long.

Mt. Taiheizan, *S. Suzuki s. n.*; Mt. Randai, *Hayata s. n.*; Mt. Nanko, *Y. Yamamoto s. n.*, *Suzuki-Tokio 16549*; Higashinko, Nokogoa, *Kudo & Mori 26*; Pass Pinan, *S. Suzuki s. n.*; Sato, Sintiku, *S. Suzuki s. n.*; Taito, Keiri, *Y. Yamamoto 413*; Mt. Sikayau, *K. Mori s. n.*

Endemic. Frequent in central ranges, at altitudes of 750-3000 meters, often forming large pure stands.

5. *Pseudotsuga* Carriere

Tall trees, the bark smooth, on old trees thick and corky, deeply fissured into scaly ridges, the branches irregularly whorled, smooth. Leaves spirally arranged, spreading in 2 opposite rows, linear, flat, green and grooved above, with 2 white stomatic bands below, with 2 marginal resin-ducts and 1 vascular bundle. Male flowers axillary, cylindric. Female flowers terminal on short branchlets, consisting of numerous spirally arranged scales, each scale 2-ovuled. Cones pendulous, ovoid to ovoid-oblong, the scales persistent, rounded, concave, rigid, subtended by exserted bracts, 3-lobed at the apex with the middle lobe long and narrow; seeds 2 under each scale, winged; embryo with 2 cotyledons.

Seven species in western North America and eastern Asia, 1 or 2 in Taiwan.

1. **Pseudotsuga Wilsoniana** Hay., Icon. Pl. Formos. 5:204. *t.* 15. 1915; Kanehira, Formos. Trees 614. 1917, ed. 2. 48. *f.* 14. 1936; Makino & Nemoto, Fl. Jap. ed. 2. 150. 1931; Nemoto, Fl. Jap. Suppl. 98. 1936; Masamune, Short. Fl. Formos. 36. 1936.

Pseudotsuga Salvadori Flous in Bull. Soc. Hist. Nat. Foulouse 71:145, *pl.* 1937. *syn. nov.*

"*Pseudotsuge japonica*" *sensu* Matsum. & Hay., in Journ. Coll. Sci. Imp. Univ. Tokyo 22:223. 1906 (Enum. Pl. Formos.), *non* Beissner.

A large tree, to 30 m. in height and 200 cm. in diameter, the bark thick, corky, deeply fissured into scaly ridges. Leaves flat, linear, slightly curved, 15-20 mm. long, 1.-1.5 mm. wide, shining green and grooved above, keeled and with 2 whitish bands below, the apex emarginate. Cones ovoid, 6 cm. long, 3-3.5 cm. in diameter, the scales concave, thin, 1.5-2 cm. long.

Sintiku, Y. *Shimada s. n.*; Toyen, *Kanehira & Sasaki s. n.*; Pinan, *S. Suzuki s. n.*; Inter Sirasetu & Sikayan, *S. Suzuki 5179*; Taityu, Tosei, *K. Mori s. n.*; Hassenzan, *S. Suzuki 2838*.

A scarce tree, scattered in the island at altitudes of 800-1500 meters, usually mixing with other trees. Endemic.

This species closely related to the Japanese *P. japonica* (Shirasawa) Beissner, differing chiefly in having larger cones.

2. **Pseudotsuga taitoensis** Kanehira, Formos. Trees e.l. 2:51. 1936, *nomen*. Kanehira mentions briefly this plant from Taitung, which he cannot fully differentiate from the former species on account of incomplete material. The leaves attain to a length 3 cm. His type has not been seen.

6. *Tsuga* Carriere

Trees, the bark cinnamon-red, furrowed, the branches slender, horizontal, often pendulous, the branchlets with prominent pulvini. Leaves spirally arranged, more or less 2-ranked, linear, flat, stalked, grooved above, with 2 white stomatic bands below, with a solitary medium resin duct below, the vascular bundle. Flowers solitary. Male flowers catkin-like, axillary, subglobose. Female flowers terminal on lateral shoots, the scales imbricate, with 2 ovules at base. Cones small, pendulous, ovoid or oblong, the scales concave, woody, persistent, subtended by short bracts; seeds 2 under each scale, small, winged; embryo with 3-6 cotyledons.

About 14 species in temperate North America, eastern Asia, and the Himalayas, 1 in Taiwan.

1. *Tsuga chinensis* (Frauch.) Pritz. ex Diels subsp. *formosana* (Hay.) comb. nov.

Tsuga formosana Hay. in Gard. Chron. III. 43; 194. 1908, in Journ. Coll. Sci. Imp. Univ. Tokyo 35(19): 222. f. 12. 1908 (Fl. Mont. Formos.); Kanehira, Formos. Trees 617. 1917; Makino & Nemoto, Fl. Jap. ed. 2. 153. 1931; Nemoto, Fl. Jap. Suppl. 99. 1936.

"*Tsuga chinensis*" sensu Kanehira, Formos. Trees ed. 2. 51. f. 15. 1936; Masamune, Short Fl. Formos. 36. 1936; non Pritz.

A large tree, up to 50 m. tall and 2 m. in diameter, the bark dark gray, furrowed, the branchlets yellowish, later pale yellowish gray, hairy in grooves. Leaves linear, 1.5-2.5 cm. long, 2-3 mm. wide, the apex rounded or emarginate. Cones ovoid, 1.5-2.5 cm. long, the scales suborbicular, lustrous yellowish brown, the margins slightly irregularly serrate; seeds 7 mm. long including the wing.

Mt. Niitaka, Y. Hashioka s. n., S. Sasaki s. n.; Nankotaizan, Suzuki-Tokio 17551, Masamune 2933, Yamamoto s. n.; Mt. Shyohy, Sintiku, Y. Hashioka & H. Shimada 279, 312; Mt. Noko, Kudo & Mori 42, 2113, S. Suzuki s. n.; Taiheizan, S. Suzuki 377, 926, 3837; Mt. Daibu, Masamune 1518; Tainan-syu, Sekizan, Suzuki-Tokio 19354; Mt. Tyuo-senzan, Kwarensko-syu, Fukuyama & Suzuki-Tokio 15227; Taihoku, Suzuki-Tokio 18367, Kuarsu, E. Maiudai s. n.; Mt. Arisa, Kawakami 3682; Taito, Keiri, Y. Yamamoto 409, 551; Takao, Kizan, Y. Yamamoto 627; inter Muruoahu & Kyanrawa, Taihoku-syu, Suzuki-Tokio 7169.

Taiwan, in forests at high altitudes of 2000-3000 meters, in association with other trees or forming pure stands on cliffs and ridges.

The Taiwan plant, although close to the mainland species, which is widely distributed in southwestern, central, and eastern China, is clearly distinct. It has a uniformly shorter cone of 2-2.5 cm. long. In the typical form of the species, the cone exceeds 3 cm. in length.

7. Taxodiaceae

Resinous trees. Leaves linear to lanceolate, generally opposite, spirally arranged, evergreen. Flowers monoecious, cone-like. Male flowers consisting of many scales, bearing on the underside 2-6 anthers, the anthers with 2-9 pollen-sacs. Female flowers with few to many scales, flat or peltate, with 2-8 ovules, without distinct bracts. Cones more or less woolly, the scales with 2-8 seeds; embryo with 2-15 cotyledons.

Genera 8, species about 15, mostly of the north temperate regions, 2 indigenous genera, *Cunninghamia* and *Taiwania* in Taiwan. In addition, *Cryptomeria japonica* Don of China and Japan, and *Taxodium distichum* Rich. of North America are in cultivation only.

Key to the genera

1. Cone-scales flattened, with 2-5 seeds; branchlets all persistent.
 2. Leaves all alike.
 3. Leaves large, linear-lanceolate, flat, glaucous below; cone-scales with narrow serrulate line above the seeds.....1. *Cunninghamia*
 3. Leaves awl-shaped, curved; cone-scales with an upright toothed crest above the seeds.....*Cryptomeria*
 2. Leaves dimorphic, those on adult stems scale-like, triangular, or falcate, those on younger stems, linear, laterally compressed, sharply pointed; cone-scales smooth.....2. *Taxainia*
1. Cone-scales peltate, with 2 seeds; lateral branchlets deciduous.....*Taxodium*

1. *Cunninghamia* R. Brown

Trees, of broad pyramidal habit, the bark brownish, scaling off in irregular plates and exposing the reddish inner bark, the branches whorled, spreading, pendulous at the ends. Leaves rigid, densely and spirally arranged, but spreading in 2 ranks, linear-lanceolate., serrulate, the base ducurrent. Male flowers cylindric-oblong, in small, terminal clusters. Female flowers globose, 1-2 at the end of the branches. Cones ovoid, the scales coriaceous, broad-ovate, pointed, irregularly serrate, persistent, each with 3 seeds; seeds narrow-winged; cotyledons 2.

Two species in eastern Asia, 1, *C. lanceolata* (Lamb.) Hook. in southern and western China, also cultivated in Taiwan. Another, *C. Konishii* Hay. is endemic to Taiwan.

1. *Cunninghamia Konishii* Hay. in Gard. Chron. III. 43:194. 1908, in Journ. Linn. Soc. Bot. 38:299. t. 23. 1908, in Journ. Coll. Sci. Imp. Univ. Tokyo 35 (19):213. 1908 (Fl. Mont. Formos.); Kanehira, Formos. Trees 598. f. 1917, ed. 2. 51. f. 16. 1936; Makino & Nemoto, Fl. Jap. ed. 2. 142 1931; Masamune, Short Fl. Formos. 36. 1936.

Cunninghamia Kawakamii Hay., Icon. Pl. Formos. 5:207. t. 16. 1916; Makino & Nemoto, Fl. Jap. ed. 2. 142. 1931.

Cunninghamia lanceolata (Lamb.) Hook. var. *Konishii* (Hay.) Fujita in Trans. Nat. Hist. Soc. Formos. 22:49 & 476. 1932; Nemoto, Fl. Jap. Suppl. 94. 1936.

"*Cunninghamia lanceolata*" sensu Sasaki in Trans. Nat. Hist. Formos. 71-80:184. 1925, non Hook.

A large tree, up to 50 m. in height and 1-2.5 m. in diameter, the branches spreading, the bark brownish, fissured into scales. Leaves linear-lanceolate, about 2 cm. long, 2.5 mm. wide, the apex acute, the base decurrent. Cones globose-ovoid, 2-2.5 cm. long, 2 cm. in diameter; seeds 2 or sometimes 3 to a scale, flat, 3-5 mm. in diameter.

Mt. Taiheisan, *S. Suzuki* s. n.; Sintiku, Tikotogun, *Suzuki-Tokio* 20754; Nankotaizan, *S. Suzuki* s. n., *G. Masamune* 2983; Toyen, *Kanehira & Sasaki* s. n.; Pass Pinan, *S. Suzuki* s. n.; Mt. Randai, *Kawakami & Mori* s. n.

Endemic. In the north and central parts of the island at altitudes of 1300-2000 meters, mostly scattered in forests of *Chamaecyparis*, occasionally forming pure stands.

This species is very close to *C. lanceolata*, (Lamb.) Hook. of southern and western China, the only other species of the genus, differing in having smaller and narrower leaves and smaller cones.

2. *Taiwania* Hayata

Large trees, of pyramidal shape when young, the bark brownish, fibrous. Leaves on young trees linear, sharply pointed, grooved on both surfaces, on old trees scale-like, acute, with short stalk, laterally grooved. Flowers polygamo-dioecious. Male flowers 5-7, densely arranged at tip of short branchlets; stamens about 15, each with 2-4 pollen sacs. Female flowers small, terminating the branches, each scale with 2 ovules. Cones globose to oblong-ovoid, with 12-20 scales, each scale with 2 seeds; seeds long, with broad wings, emarginate at both ends; cotyledons 2.

1. *Taiwania cryptomerioides* Hay. in Journ. Linn. Soc. Bot. 37; 330. *t.* 16. 1906, in Bot. Mag. Tokyo 21:21 *t.* 1. *f.* 23. 1907; Kanehira, Formos. Trees 615. *f.* 1917, ed. 2. 53. *f.* 17. 1936; Makino & Nemoto, Fl. Jap. ed. 2 1931; Nemoto, Fl. Jap. Suppl. pp. 1936; Masamune, Short Fl. Formos. 36. 1936.

A large tree up to 60 m. high and 23 m. in diameter, the trunk straight, of pyramidal shape when young, with pendulous branches, when old of a dome-shaped small crown, with few branches, the bark fibrous. Leaves on young trees linear, sharply pointed, about 2 cm. long, on old trees scale-like, acute, triangular, keeled, about 4-5 mm. long. Cones terminating the branches, nearly sessile, 1.5-2.5 cm. long; seeds 5-6 mm. long including the wing.

Mt. Taiheisan, *S. Suzuki* 3575, 12315, 12327; Mt. Arisan. Y. Yamamoto s. n.; Taityu-syu, Rakuraku-Taku, *Suzuki-Tokio* 665, 13259; Nanto, *Sasaki* s. n.

Taiwan, in the central ranges at altitudes of 1800-2600 meters, usually scattered through the forests of *Chamaecyparis*. A slow growing tree.

8. Cupressaceae

Resinous trees or shrubs. Leaves small, usually scale-like or needle-like, opposite or whorled, evergreen. Flowers monoecious or dioecious, cone-like or berry-like. Male flowers consisting of numerous scales bearing on the underside 2-6 anthers, the anthers with 2 pollen-sacs. Female flowers with few to many, opposite or whorled scales, each with 1-2 erect ovules on the upper side. Cones woody or coriaceous and dehiscent with winged seeds or berry-like with fleshy connate scales with terete or angular seeds; embryo with 2, rarely 5-6 cotyledons.

Genera 12, species about 120, widely scattered over tropical and temperate regions of both northern and southern hemispheres, 3 genera in Taiwan. The genera *Callitris*, *Cupressus*, and *Thuja* are introduced and cultivated. Generally planted are *Callitris calcarata* Br., *C. quadrivalvis* Vent., *C. rhomboides* Br., and *C. robusta* Br. all from Australia, *Cupressus Benthami* Endl. from Mexico, *C. funebris* Endl. from China, *C. glauca* Lamk. from India, and *Thuja orientalis* L. from China.

Key to the genera

1. Cones woody, dehiscent.
 2. Cone-scales peltate; cones subglobose.
 3. Each cone-scale with 2, rarely 3-5, seeds; branchlets flattened.....1. *Chamaecyparis*
 3. Each cone-scale with many seeds; branchlets terete or quadrangular, rarely flattened.....*Cupressus*
 2. Cone-scales flattened, imbricate; cone ovoid or oblong-ovoid.
 3. Pairs of cone-scales 4, the upper pair fertile; seeds with 2 unequal wings.....3. *Libocedrus*
 3. Pairs of cone-scales 6-8, the 2 upper pairs fertile; seed wingless or with minute wings.
 4. Leaves & cone-scales in pairs.....*Thuja*
 4. Leaves & cone-scales in whorls of threes.....*Callitris*
1. Cones fleshy, berry-like, with 2-6 connate scales; each scale with 1-2 seeds.
 -2. *Juniperus*

1. *Chamaecyparis* Spach

Tall trees of pyramidal habit, the bark smooth, peeling off in strips or scales or fissured into ridges, the branches spreading, the branchlets usually flattend. Leaves opposite, scale-like, ovate to rhombic, acuminate to obtuse, entire. Male flowers ovoid to oblong, yellow, rarely red, the anther with 2-4 pollen-sacs. Cone globose, ripening the first season, the scales 6-12, peltate, pointed or raised in the middle; seeds 2, rarely up to 5 in each scale, slightly compressed, with thin broad wings; cotyledons 2.

Six species in North America, Japan, and Taiwan.

Key to the species

1. Leaf-apex acute; cone oblong, 8-9 mm. in diameter, the scales 10-13.....
.....1. *C. formosensis*

1. Leaf-apex obtuse; cone globose, 10-11 mm. in diameter, the scales 8-10.....
.....2. *C. obtusa* subsp. *formosana*

1. ***Chamaecyparis formosensis*** Matsum. in Bot. Mag. Tokyo 15:137. 1901; Matsum. & Hay. in Journ. Coll. Sci. Imp. Univ. Tokyo 22:402. 1906 (Enum. Pl. Formos.), in Journ. Coll. Sci. Imp. Univ. Tokyo 35 (19):208. 1908 (Fl. Mont. Formos.); Kanehira, Formos. Trees 597. f. 1917, ed. 2, 56. f. 19, 1936; Nemoto, Fl. Jap. Suppl. 93. 1936; Masamune, Short Fl. Formos. 37. 1936.

A very large tree, the bark more or less thin, light reddish brown. Leaves scale-like, triangular, imbricate, green outside, pale whitish inside, the apex acute to acuminate. Cones oblong-ovoid, 10-12 mm. long, 8-9 mm. across, the scales 10-13; seeds slightly winged around, 3 mm, in diameter.

Mt. Taiheizan, *S. Suzuki* 597, 3804, 3923, 6541, 12312; Shijataizan, *Yoshihida s. n.*; Mt. Arian, *Yamamoto & Mori s. n.*, *S. Suzuki s. n.*, *Y. Hashioka s. n.* *E. Matuda s. n.*, *S. Sasaki s. n.*, Nankotaizan, *Suzuki-Tokio* 17548; Kwarenko-tyu, Tyosenzan, *Suzuki-Tokio* 1615; Sintiku, Rokyuyutaizan, *N. Fukuyama* 3368; Kuarusu, *E. Matuda s. n.*; Taito, Keiri, *Y. Yamamoto* 363; Taihoku, Bunzangun, *Suzuki-Tokio* 11763; Takao, kizan, *Y. Yamamoto* 606.

Endemic. Mountain regions in the northern and central parts of the island, at altitudes of 1000-2900 meters, often forming pure stands or mixed with *Chamaecyparis obtusa*, subsp. *formosana*. This is the largest conifer in eastern Asia, some trees attaining to a diameter of 20 m., and one of the most important timber trees in Taiwan.

2. ***Chamaecyparis obtusa*** Sieb. & Zucc. ***formosana*** (Hay.) stat. nov.

Chamaecyparis obtusa f. *formosana* Hay. in Gard. Chron. III. 43:194. 1908, in Journ. Coll. Sci. Imp. Univ. Tokyo 35(19):208. f. 5. 1908 (Fl. Mont. Formos.).

"*Chamaecyparis obtusa*" sensu Kanehira, Formos. Trees 596. 1916, ed. 2. 58. f. 20. 1936; Nemoto, Fl. Jap. Suppl. 93. 1936, p. p.; non Sieb. & Zucc.

Chamaecyparis taiwanensis Masamune & Sazuki in Sylvia 4:57. 1933; Masamune, Short Fl. Formos. 37. 1936.

A very large tree, up to 40 m. high and 3 m. in diameter, the trunk straight, the bark fibrous, fissured into thin strips. Leaves scale-like, 3-ranked, densely imbricate and closely appressed, dark green above, with white marks below; the apex obtuse. Cones globose, 10-11 mm. in diameter, the scales 8-10, peltate; seeds narrowly winged, about 4 mm. in diameter.

Mt. Hassenzan, *N. Ida* s. n.; inter Doba et Zyuziyo, *S. Suzuki* 6342; Mt. Taiheizan, *S. Suzuki* 254, 413, 937, 3832, 3876, 3976, 4073, 12310, 12313, 12314, 12319; Kankozan, Taihoku, *S. Suzuki* 6226; Taihoku-syu Bunzangun, *Suzuki-Tokio* 11755, 18310; Mt. Randai, *Hayata* s. n.; Mt. Arisan, *Kudo & Suzuki* 16279, 19394.

Endemic. In the northern and central parts of the island mostly at altitudes of 1300-2800 meters, forming pure stands or mixed with *Chamaecyparis formosensis* at low elevations. The most valuable timber tree in Taiwan.

The species *C. obtusa* (Sieb. & Zucc.) Endl. is of Japan. This subspecies differs from the species in the much smaller cones and smaller seeds. As the difference is slight, it seems not worthy of recognition as a distinct species. But as it is geographically distinct from the typical form of the species, it seems more appropriate to treat it as representing a subspecies rather than as a form.

2. *Juniperus* Linnaeus

Trees or shrubs, the barks usually thin, shreddy, rarely scaly. Leaves opposite or ternate, polymorphic, acicular or scale-like, on young branches always acicular. Flowers dioecious or monoecious, axillary or terminal. Male flowers yellow, in an ovoid or oblong catkin, with numerous opposite stamens. Female flowers greenish, globose, of 3-8 pointed scales, some or all bearing 1 or 2 ovules. Cones berry-like, indehiscent, succulent, consisting of fleshy united scales, subtended by scaly-bracts, ripening the first, second, or third year. Seeds 1-12, usually ovoid, terete, or angled, often grooved, brown; embryo with 2 or 4-6 cotyledons.

About 60 species widely distributed throughout the northern hemisphere, 3 species in Taiwan. Several introduced species are in cultivation.

Key to the species

- 1. Leaves longer than 10 mm.
 - 2. Leaves glaucous beneath.....1. *J. formosana*
 - 2. Leaves green or concolored on both surfaces.....1a. *J. formosana* var. *concolor*
- 1. Leaves shorter than 10 mm.
 - 2. Erect shrub or tree.....2. *J. squamata*
 - 2. Low decumbent shrub.....3. *J. tsukusiensis*

1. ***Juniperus formosana*** Hay. in Gard. Chron. III. 43:198. 1908, in Journ. Coll. Sci. Imp. Univ. Tokyo 25(19):209. t. 38. 1908 (Fl. Mont. Formos.), Icon. Pl. Formos. 7:39. 1918; Kanehira, Formos. Trees 600. f. 1917. ed. 2. 60, f. 21. 1936; Makino & Nemoto, Fl. Jap. ed. 2. 143. 1931; Nemoto, Fl. Jap. Suppl. 95. 1936; Masamune, Short Fl. Formos. 37. 1936.

"*Juniperus taxifolia*" *sensu* Hay. in Bot. Mag. Tokyo 20:19. 1906; Hay. & Matsum. in Journ. Coll. Sci. Imp. Univ. Tokyo 20:403. 1906 (Enum. Pl. Formos.); *non* Hook. & Arn.

A small tree, about 4-5 m. in height, sometimes to 12 m., with a straight trunk usually dividing into several stems, with spreading or ascending branches and pendulous branchlets. Leaves linear, 1.2-2 cm. long, 1-2 mm. wide, the apex spiny-pointed, with 2 broad white bands above, glaucous and keeled beneath. Cones subglobose, fleshy, orange-red, about 8 mm. in diameter, the base bracted. seeds 3, triangular-ovoid. angular.

Mt. Arisan, Kanehira & Sasaki s. n.; Mt. Taihei, S. Suzuki s. n. Mt. Tencho, Kudo & Mori 2012; Mt. Niitaka, S. Suzuki 15067, Y. Hashioka s. n.; Daibusan, S. Suzuki 6872, E. Matuda 52; Taroko, Suzuki-Tokio 16354, S. Suzuki 9091; Nanto, Sato n. n.; Taito, Keiri, Y. Yamamoto 130, 284, 408; Sinitku, Mt. Shyoha, Y. Hashioka & H. Shimada 280, 313.

China. Taiwan, in central ranges at altitudes of 2300-3000 meters, generally in *Chamaecyparis* forests as an under shrub.

1a. ***Juniperus formosana*** Hay. var. ***concolor*** Hay., Icon. Pl. Formos. 7:39. f. 25. 1918; Makino & Nemoto, Fl. Jap. ed. 2, 144. 1931; Kanehira & Sasaki in Journ. Soc. Trop. Agr. 4:74. 1932; Kanehira, Formos. Trees ed. 2. 60. 1936; Nemoto, Fl. Jap. Suppl. 96. 1936; Masamune, Short. Fl. Formos. 37. 1936.

A shrub or small tree, about 4 m. high and 20 cm. in diameter, decumbent. Leaves 2 cm. long. Cones orange-red, 10-12 mm. in diameter.

Besegan, Kwarenko, Hayata & Sasaki s. n.

Endemic. Known only from the type collection, along seashore at the base of Busegan, between Kwarenko and Guan. According to Hayata, the variety differs from the species in the leaves being not glaucous beneath and in the stomatic bands being broader. These characters, however, are not obvious in the available specimen.

2. ***Juniperus squamata*** Lambert, Desc. Gen. Pinus 2:17. 1824; Kanehira, Formos. Trees ed. 2. 60. f. 22. 1936; Makino & Nemoto, Fl. Jap. ed. 2. 144. 1931; Nemoto, Fl. Jap. Suppl. 95. 1936; Masamune, Short Fl. Formos. 37. 1936.

Juniperus morrisonicola Hay. in Gard. Chron. III. 43:194. 1906, in Journ. Linn. Soc. Bot. 37:298. 1908, in Journ. Coll. Sci. Imp. Univ. Tokyo 35 (19): 211. f. 7. 1908 (Fl. Mont. Formos.), in l. c. 30 (1):307. 1911 (Mat. Fl. Formos.); Kanehira, Formos. Trees 600. f. 1917, in Journ. Soc. Trop. Agr. 4:75. 1932.

A shrub or tree, procumbent, to 5-10 m. in height and up to 1 m. in diameter, the branches long-decumbent, the branchlets ascending. Leaves linear, 3-5 mm. long, densely and ternately arranged, concave and whitish above, convex and grooved below, green, the apex sharply and finely pointed, narrower on young branches. Cones globose or ellipsoid, 6-8 mm. long, reddish brown when young, purplish black when mature, bracted at base; seeds solitary, globose or ovoid.

Mt. Kiraisyu, Shimada s. n., Kudo & Mori 2238; Mt. Tugitaka, S. Suzuki 5997, K. Mori s. n.; Nankotaisan, Suzuki-Tokio 17457; Mt. Niitaka, T. Wakatsuki s. n., Masamune 3775; Sintiku, Mt. Shyoka, Y. Hashioka & H. Shimada 281; Central Range, water-divide, Mori s. n.; Mt. Niitaka, S. Suzuki 10658, 13313, Y. Hashioka s. n.

China and the Himalayas. Taiwan, in central ranges at high altitudes of over 3000 meters, the highest growing conifer of the island, forming a dense nearly impenetrable scrub or on open exposed slopes growing as a tree 5-10 m. high in ravines and sheltered places.

3. ***Juniperus tsukusiensis*** Masamune, Prel. Rep. Veg. Yakus. 39. 1929, *nomen nud.*, in Bot. Mag. Tokyo 44:50. 1930, in Mem. Fac. Sci. Agr. Taihoku Imp. Univ. 9. Bot. 4:131. 1934, Short. Fl. Formos. 37. 1936.

Juniperus chinensis L. var. *tsukusiensis* Masamune in Journ. Soc. Trop. Agr. 2:152. 1930, 3:20. 1931, Kanehira, Formos. Trees ed. 2. 60. 1936; Nemoto, Fl. Jap. Suppl. 95. 1936.

"*Juniperus Sargentii*" *sensu* Sasaki, List. Pl. Formos. 53. 1928, *non*. Takeda.

"*Juniperus chinensis* L. var. *Sargentii*" sensu Sasaki, Cat. Govern. Herb. Formos. 57. 1930, non. Henry.

A shrub, about 2 m. high, procumbent. Leaves scale-like, triangular, about 1 mm. across, or rarely linear, spiny. 2-3 mm. long. Cones globose, about 4 mm. in diameter.

Seizuizan, Kwarenko, *S. Suzuki* s. n.;

Japan: Yakusima. Taiwan only from the original collection at Seizuizan, Kwarenko, at an altitude of 2200 meters.

4. *Libocedrus* Endlicher

Trees, the bark scaly, the branches spreading, the branchlets flattened, dorsal-ventral. Leaves decussate, scale-like, with decurrent base, with or without gland. Flowers monoecious, the 2 sexes on different branchlets, rarely dioecious. Male flowers oblong, with 12-16 decussate stamens. Female flowers oblong; fertile scales with 2 ovules. Cones oblong, with 4-6, valvate, woody, flat scales, the scales mucronulate at the apex, the lower pair short, reflexed and sterile, the middle pair much longer, oblong, and fertile, the upper pair if present connate into an erect partition; seeds with one short and one long wings, nearly equalling the scale; embryo with 2 cotyledons.

Species 9, widely scattered in western North and South America, New Zealand, New Caledonia, New Guinea, southern China, and Taiwan.

1. *Libocedrus formosana* Florin in Svensk. Bot. Tidskrift 24:126. f. 2. t. 2. 1930; Kanehira, Formos. Trees ed. 2. 56. f. 18. 1936; Nemoto, Fl. Jap. Suppl. 96. 1936; Masamune, Short Fl. Formos. 37. 1936.

Libocedrus macrolepis Benth. var. *formosana* (Florin) Kudo in Journ. Soc. Trop. Agr. 3:16. 1931.

"*Libocedrus macrolepis*" sensu Hay. in Journ. Coll. Sci. Imp. Univ. Tokyo 35 (19):207. f. 4. 1908 (Fl. Mont. Formos.); Kanehira, Formos. Trees 602. f. 1917; Makino & Nemoto, Fl. Jap. ed. 2. 145. 1931; non Benth. & Hook. f.

A large tree, up to 30 m. in diameter at base, the trunk often crooked, the bark smooth, purplish red-brown. Leaves scale-like, obtuse, about 1.5-2.5 mm. broad, dark green outside, pale green within. Cones oblong, 1-1.5 cm. long, slightly curved, the scales 4, the 2 lateral ones fertile; seeds 1-2 to each scale, 8-12-mm. long including the wing.

Taiheizan, *St. Suzuki* s. n.; Taichu, Rengenchu, Yamamoto & Mori s. n.; Taityu, Tosei, K. Mori s. n. Taihoku, Bunzangun, *Suzuki-Tokio* 15399, 19256 Mt. Randai, E. Matuda s. n.

Endemic. In the northern and central parts of the island, at altitudes of 300-1900 meters.

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