Det Kgl. Danske Videnskabernes Selskab.
Biologiske Meddelelser. IX, 2.

THE SPECIES OF THE GENUS LARIX AND THEIR GEOGRAPHICAL DISTRIBUTION

BY

C. H. OSTENFELD AND C. SYRACH LARSEN

WITH 35 ILLUSTRATIONS AND 8 MAPS

KØBENHAVN
HOVEDKOMMISSIONÆR: ANDR. FRED. HØST & SØN, KGL. HOF-BOGHANDEL
BIANCO LUNOS BOGTRYKKERI A/S
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I. Introduction.

In the course of an excursion undertaken in 1922, the eldest among us saw some larch plantations in Roden Forest, in the south-east of the Danish island of Lolland; in most respects they resembled the Japanese Larch (*Larix Kaempferi*), but differed, nevertheless, from it in several respects, and therefore aroused my interest[1]. This was the cause of my endeavouring to obtain information regarding, and material from, various larch plantations in this country, for the purpose of ascertaining which forms and species we had taken into culture during the course of the past decades. Arising out of these enquiries, my interest became extended to embrace the whole genus Larix, one result being the present treatise, which considers only the larch in the wild state, and its geographical distribution. It is founded upon a comprehensive study of material from various parts of the globe, as well as of the very copious literature extant upon the subject. Duties of many kinds make heavy demands upon my time, and I have taken as collaborator Mr. C. Syrach Larsen, Graduate of Forestry, to whose interest and industry I am indebted, that this paper could be presented in such detail.

We have received assistance from many different quarters; we have had material on loan from the Arnold Arboretum in Massachusetts, where the East-Asiatic species are very well represented. Moreover, the Larix material in the museums at Washington, New York, Ottawa, Kew and London, as well as that in the Gray Herbarium of Cambridge, Mass.,

[1] It is *L. Gmelini*, var. *olgensis*. See p. 55.

has been examined by OSTENFELD on the occasion of his visits to those cities; and the collection of the late Professor HENRY in Dublin has been studied by SYRACH LARSEN, as well as those at Kew and the British Museum. Material has further been placed at our disposal by the kindness of Professor SZAFER in Krakow, Professor B. FEDTSCHENKO and Professor SUKATSCHEW in Leningrad, and, finally, we have, of course, made use of the museum-collection at the Botanical Gardens here in Copenhagen. OSTENFELD has personally seen *L. laricina* and *L. Lyallii* on the spot in Canada, and *L. decidua* in the Alps, while SYRACH LARSEN has studied the various forms of larch cultivated in England from early times, as well as MAYR's cultures in Grafrath. We have been fortunate in having been able to make use of the original material of most of the species or varieties described in recent times, namely: *L. Mastersiana, L. sinensis* (=*L. Potanini*), *L. olgensis* (=*L. Gmelini* var. *olgensis*), *L. Griffithiana, L. occidentalis, L. Lyallii, L. coreensis* (=*L. Gmelini* var. *olgensis*), as well as *L. pendula* (=*L. decidua* × *laricina*), and specimens from the original localities of *L. Principis Rupprechtii* (=*L. Gmelini* var. *Principis Rupprechtii*), and *L. alaskensis* (*L. laricina*), so that we have been enabled to arrive at very fairly definite conclusions with regard to the conception of the species and their more important varieties.

In addition, we have received support from various quarters connected with forestry in this country, numerous owners of woods, and foresters having sent us material; similarly, the director of the Danish Experimental Forestry Service, Professor Dr. A. OPPERMANN, has kindly allowed us to make use of his valuable collection of larches in the Nursery Gardens at Egelund, and has, moreover, evinced warm interest in our work. We have also received

great assistance from the Scottish Department of Forestry, Mr. J. M. MURRAY having on several occasions sent us important material of the Larix species cultivated in Scotland. In this paper, however, as said above, we have restricted ourselves to laying particular stress upon the wild-growing larches, that is to say, the genus Larix as it occurs in nature, and have in most cases deferred the treatment of the cultivated forms.

We take this opportunity of expressing our gratitude to all those who, in one way or another, have assisted us in our labours.

Two maps and a very short summary of some of the results of the results of the present paper were published by us in "Die Pflanzenareale 2. Rh. Heft 7. 1930", as Karte 62—64.

II. Larix, Miller.

Larix, Miller, is a very well-defined genus. It differs from all the other genera of *Pinaceae* in being deciduous, and in the dwarf as well as the long shoots being provided with green leaves. Only its near relative, *Pseudolarix*, also has deciduous leaves, but the latter differs in possessing cones, which drop their scales at maturity.

The genus is only found in the northern hemisphere, in the southern part of which it only occurs spontaneously in mountainous regions, while towards the north, and particularly in the Arctic regions, it goes down to the lowlands, where it forms extensive forests.

The genus is divided into 10 species and three varieties, some of which are but little known even to-day.

They may be classified as follows: —

Key to the Species and Varieties of Larix.

I. Bracts longer than the cone-scales. Leaves slightly or strongly keeled on both sides; the upper-side may, in exceptional cases, be without keel.

A. Bracts reflexed.

a) Bracts much longer than the cone-scales. The cone 5—11 cms. long..... 1. *L. Griffithiana.*

b) Bracts only slightly longer than the cone-scales. The cone 3—5 cms. long. 2. *L. Mastersiana.*

B. Bracts straight or slightly recurved.

a) The cone long and narrow; length to breadth 1,4—1,7; Bracts 0—2 mm. longer than the cone-scales. Leaves deeply keeled on the under-side; slightly less keeled on the upper-side, 1,5—3 cms. long..... *3. L. Potanini.*

b) The cone short and broad. Length to breadth 1—1,5, leaves 2,5—4 cms.

1. The leaves are more strongly keeled on the upper- and under-sides than in the case of any other species. The young shoots are particularly densely pilose. The cone 3,5—5 cms. long. Bracts straight ..... 4. *L. Lyallii.*

2. The leaves keeled on the under-side only. The young shoots at first somewhat pilose, finally smooth. The cone 2,5—3 cms. long. The bracts straight or slightly recurved..... 5. *L. occidentalis.*

II. Bracts shorter than the cone-scales. Leaves not keeled on the upper-side and frequently flat.

A. The cone-scales reflexed. The leaves broad, deeply keeled on the under-side. Both sides provided

with stomata. The young shoots stout, and of reddish-brown colour..... 6. *L. Kaempferi.*

B. The cone-scales straight or somewhat concave. The leaves flat, or slightly keeled on the under-side.

a) The cone-scales distinctly concave.

1. Cones 1,5—2 cms. long. The cone-scales smooth, often shining..... 10. *L. laricina.*
2. Cones narrow, 3—4 cms. long. The scales pilose, most frequently strongly so on the outer-side of the basal portion; dull..... 8. *L. sibirica.*

b) The cone-scales straight.

1. Cones 2,5—4 cms. long, narrow. The scales dull, the free edges evenly rounded or slightly emarginate. The bracts are of the same light colour as the cone-scales, which are smooth or pilose on the outer side. The cone is compact. The scales open only sligthly when ripe.. 9. *L. decidua.*

   var. *polonica.* The cone is more frequently smaller, shorter, and thicker. The free edges of the cone-scales are more rounded, and often pilose on the outer-side.

2. The cones up to 2 cms. long; broad. The free edges of the cone-scales are truncate or emarginate. The bracts are darker in colour than the light-coloured, shining, cone-scales. The cone-scales are most frequently smooth on the outer-side, but may be slightly pilose. The cones as a whole

are of an open, characteristically light construction. The cone-scales open widely when ripe . . . . . 7. *L. Gmelini.*

var. *olgensis.* The cone longer and more cylindrical. The free edges of the cone-scales are rounded or truncate. The usually straight cone-scales may also be slightly concave or slightly recurved. The first year's shoots are more frequently pilose, very often extremely so.

var. *Principis Rupprechtii.* The cone is still longer and more cylindrical than in the case of the former variety; length up to about 4 cms.

The areas of distribution for the various species differ very considerably in extent; the species with restricted areas of occurrence being indigenous towards the south, particularly in Asia, and appear at the same time to be the oldest forms. Some of the other species have very large areas of occurrence.

III. The Species of Larix.

1. **L. Griffithiana** (Lindl. & Gordon, *1850*), Carrière: Traît. Conif. *1855*, p. 278. —

Gordon: Pin. 1858, p. 126. — Willkomm: Forstl. Fl. 1887, p. 157. — Rehder: Man. Trees and Shrubs, 1927, p. 51. —

Syn:

Abies Griffithiana, Lindley & Gordon, in Journ. Hort. Soc. V. 1850, p. 214. —

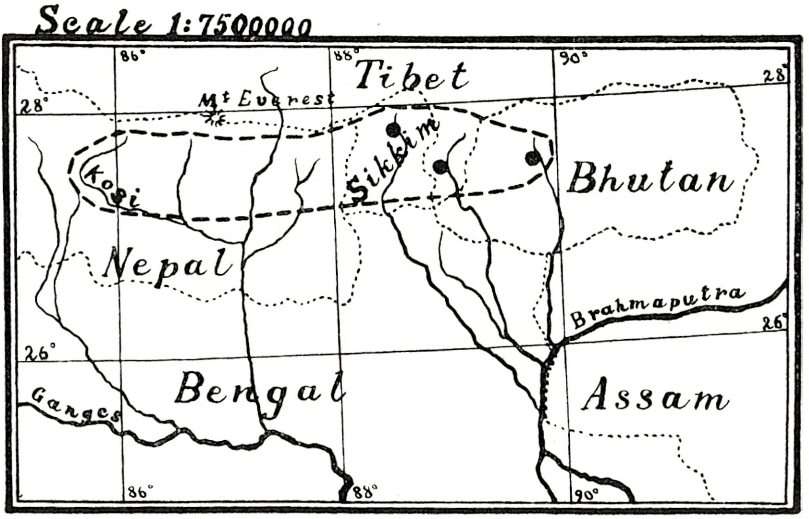
L. Griffithii, I. D. Hooker & Thomson in Cathcart, Ill.. Himal. Pl. 1855, t. 21. — Henkel & Hochstetter: Syn. Nadelh. 1865,

p. 136. — REGEL, in Gartenfl. XX, 1871, p. 106. — Id. in Act. Hort. Petrop. I, 1871, p. 161. — K. KOCH: Dendrol. 1873, p. 264. — I. D. HOOKER: Fl. Brit. Ind. V, 1890, p. 655. — SARGENT: Silva N. Am. XII, 1898, p. 4, Note. — MASTERS, in Journ. Linn. Soc. XXVI, 1902 p. 558. — ELWES & HENRY: Trees. Gr. Brit. and Irel. II, 1907. p. 388. — Bot. Mag. 4' Ser. IV, 1908, t. 8181. — BEISSNER: Nadelholzk. 1909, p. 305. — PATSCHKE in Engl. Bot. Jahrb. XLVIII. 1913, p. 651 (p. p). — REHDER & WILSON: 1914, in Sargent: Pl. Wilson. II. p. 20. — DALLIMORE & JACKSON: Handb. Conif. 1913, p. 286. —

Pinus Griffithii, PARLATORE, in De Candolle: Prodr. XVI, 2', 1868, p. 411. —

The English physician and traveller, WILLIAM GRIFFITH, discovered this larch in 1838 in Bhutan, near the village of Woolakoo, a little S. W. of Punakha in the Himalayas; this has subsequently been shown to be one of the most easterly localities within the inconsiderable zone of distribution, which extends from this spot in a westerly direction, and is assumed to reach about as far as the source of the Kosi river. The whole extent of the area within the bounds of which it is known is hardly 500 km. at its greatest length (from east to west) and 100—150 km. broad from north to south, and the only specimens seen by us are derived from the easterly section, that is to say, from the most westerly portion of Bhutan, extending a short distance into Nepal, together with the interlying Sikkim, and the southern point of Tibet, which extends between Bhutan and Sikkim. More recent discoveries of this larch have been made in localities situated between the most westerly regions of Bhutan, where GRIFFITH found it, and the Nango Mountains, where it was found by I. D. HOOKER in 1848; the only foundation for the report that its zone of distribution extends to the source of the Kosi is the statements of the natives. The whole zone is situated within the Himalayas, where it was first found at a height of from 1800 m.

to 2900 m. above sea-level. Specimens were subsequently found in the Chumbi valley, in the extreme south of Tibet, at an altitude of 3000 m., and in Sikkim it is stated to grow at elevations ranging from 2400 to 3600 m. above sea-level. These facts show it to be indigenous to the



Map I.

highest tree-clad regions of the eastern Himalayas in the neighbourhood of the forest line, and only in the heart of vallies leading from north and south to the mighty peaks, the final and only mantle of which is the eternal snow. Hooker found it growing over ancient moraines at a height of 3600 m. above sea-level, where it attained its best development. He also found it upon grass-clad or thicket-strewn mountain slopes, but only where the soil was stony and the drainage good. It is thus shown to be a pronounced mountain tree, choosing the fresh, light soil for its abode. It represents the most southerly species of the genus, lat. 27°—28° N. (Map. I).

Larix Griffithiana (L. s G.) Carr.

L. Griffithiana was discovered in 1838, but it was not described in detail until its re-discovery by HOOKER in 1848, who thereupon introduced it into England. HOOKER found it only as a small tree, 6—18 m. in height, in the west of Nepal, and it never becomes a tall tree, even although a rather greater height, 19,5 m., has subsequently been reported for specimens in Sikkim, and those found in the Chumbi valley, one of the most recently discovered localities, are possibly a trifle taller still. A tree cultivated at Coldrennick in Cornwall is quoted as being 23,5 m. high, and as such is taller than any noted in their natural haunts. (Gard. Chron. XLI. 1907, p. 130; DALLIMORE & JACKSON, 1923, p. 287).

According to I. D. HOOKER's drawing of a tree in its native habitat in Sikkim (Fig. 1), the crown is broader, the branches differently arranged, and the branchlets longer and more pendulous than in the case of *L. decidua*, and HOOKER also compares it with *L. decidua* var. *pendula* (Gard. Chron. XXV. 1886, p. 719). It differs from most of the other members of the genus Larix in possessing cones of great size, reported by HOOKER as being 5—7,5 cms. long (Fl. Brit. Ind. V. 1890, p. 655). REGEL (1871; fig. 2 in present paper; same fig. in BEISSNER, 1909) has an illustration of a cone nearly 9 cms. long, and three cones from the already-mentioned tree in Cornwall are between 10 and 11 cms. in length. It is probable that the cones from cultivated specimens have a tendency to become larger than they would be in nature, and when DALLIMORE & JACKSON (1923, p. 286) state the size as being 5—10 cms. long, these figures perhaps include specimens from both cultivated and wild individuals.

The bracts are longer than the cone-scales, the same being the case with *L. Mastersiana*, *L. Potanini*, *L. Lyallii*,

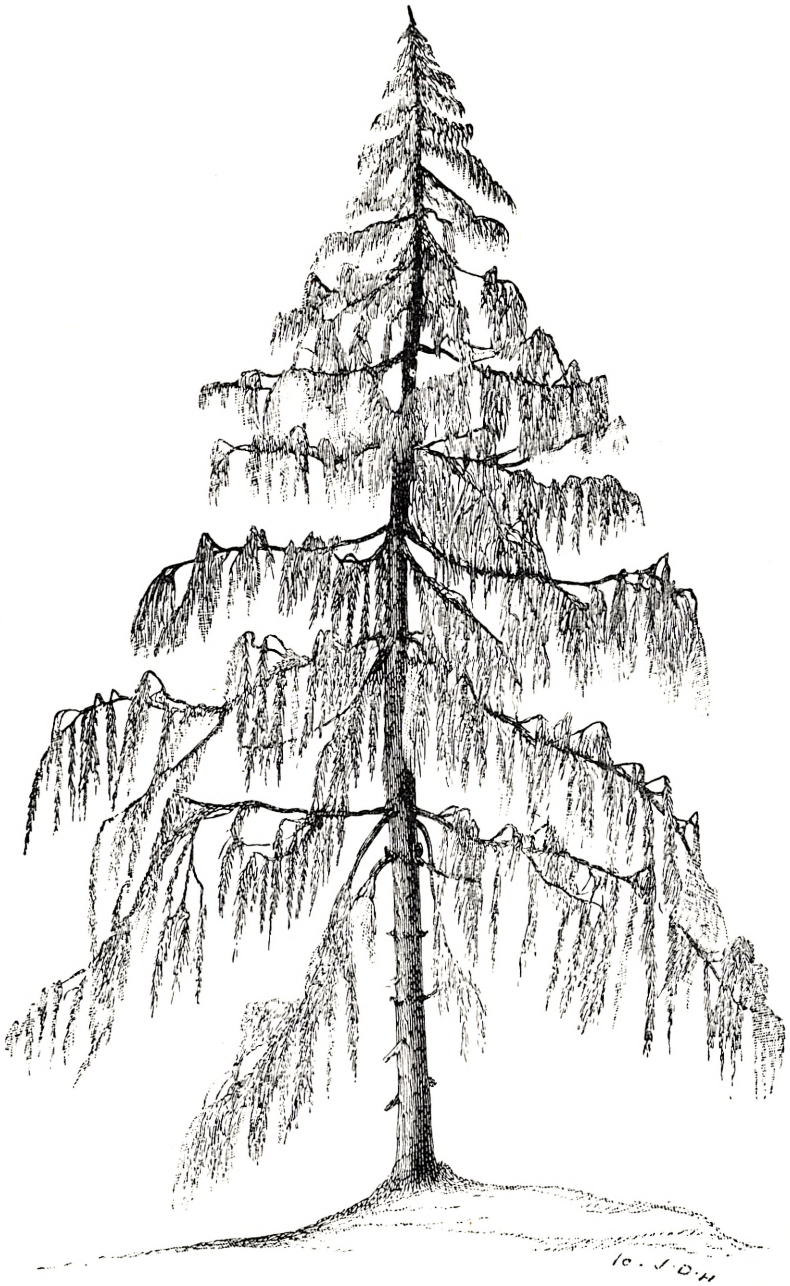


Fig. 1. *Larix Griffithiana* (Lindl. & Gord.) Carr. Habit of a tree, from a drawing by Sir Joseph Hooker (Gardener's Chronicle June 5, 1886).

and *L. occidentalis*, but the difference is greatest in the case of *L. Griffithiana*; similarly, the free tips of the bracts are reflexed in a manner peculiar to this species and to *L. Mastersiana* only, which latter, together with *L. Potanini*, may be said to resemble it most closely. The beautiful dark violet scales of the immature cone are also characteristic (Bot. Mag. t. 8181).

Fig. 2. *L. Griffithiana* (Lindl. & Gord.) Carr. Cone. From E. Regel, in Gartenflora 1871.

Material of *L. Griffithiana* collected by I. D. HOOKER in Sikkim at an altitude of 2700—3300 m. above sea-level is to be found in the »Herb. Ind. Or. Hook. fil. & Thomson«, which gives the following further characteristics. The leaves are placed in bundles containing up to 50, 1,5—3 cms. in length, the under-side being distinctly keeled between the rows of stomata. The first-year's shoots are very slightly pilose, of a shiny reddish-brown colour, with perhaps a slight, glaucous tinge. The material has been collected shortly after leafing, the leaves having attained their full length, but a few $^3/_4$—1 cm. long male flowers still being present. Pollination has taken place, the pollen-sacs being empty. A female inflorescence has also passed the flowering stage. It is $3^1/_2$ cms. long, and the bracts are so strongly recurved as entirely to cover the remaining portion of the yong cone. It is strongly coloured, and was probably dark purple-red, when fresh.

Further original material, No. 4989 of »Herbarium of

the late East India Company« in »Herb. Bot. Haun«. is part of Griffith's private collection. It has been collected at a rather earlier stage than the preceding, but the female inflorescence in this case also has probably passed the flowering stage, and its length of 2 cms. is almost certainly rather greater than that of the immature female flower. The colour appears to have been the same as that in Hooker's material, and the specimens show the same long, strongly recurved bracts, which, presumably, are already found before the flowering stage has been reached. The one-year's shoots have the same colour and the same faint downy covering as in the case of the previously-mentioned specimens. There are only a few leaves attached, which resemble the preceding specimens; the main bulk of loose leaves does not belong to *L. Griffithiana* at all, but apparently to *Cedrus deodora*. The same is true in the case of some of the unattached female flowers. This confusion need not be attributed to Griffith himself, but to subsequent mistreatment of his material (Vide Bot. Mag. 1908).

It is not known with any certainty, whether this species has been introduced into Denmark, as there are no existing specimens of cones from trees grown in this country under the name of *L. Griffithiana*.

Herb. Mat. examined:

E. Himalaya: Bootan, Herb. Griffith No. 4989 (Type, Kew) (Hort. Bot. Haun.); Sikkim reg. temp. 8—12000 Feet, Herb. I. D. Hooker (Kew; Hort. Bot. Haun); Sikkim, J. S. Gamble 1880 (Kew); Sikkim, Sipukung, Rilu & Rhomoo, 1911, (Kew); Smith & Care, Jeune Valley, No. 2771, Fl. of Sikkim 1909 (Brit. Mus.); Smith & Care, Laching, No. 2600, Fl. of Sikkim, 1909, (Brit. Mus.); Lachen, (= Laching) Sikkim, 1885, J. D. Hooker (Brit. Mus.); Fl. of Chumbi Phari, leg. Dungboo, 1879 (Brit. Mus.). Also seen in U. S. Nat. Mus. and in Arn. Arb. from the same localities.

2. **Larix Mastersiana,** Rehder & Wilson, *1914*, in Sargent: Pl. Wilson, II, p. 19. —

DALLIMORE & JACKSON: Handb. Conif. 1923, p. 292. — REHDER: Man. Trees and Shrubs, 1927, p. 51. —

In the west of China, two species of larch are to be found, *L. Potanini* and *L. Mastersiana*, of which the former is the commonest, the later having only a very limited area of distribution.

L. Mastersiana occurs only inside the zone of distribution of *L. Potanini:* all in all, it is only known from three localities, lying north and south in the mountains west of the Min river. In 1908—1910, when WILSON discovered it, it was quite common in this restricted area, and being greatly in demand on account of its valuable timber, has decreased rapidly, but the inaccessability of its habitat prevents its extermination for the present.

It is a small tree, only some 10—20 m. in height. Its branches of the 2nd order are pendulous, although not so strongly as in the case of *L. Potanini* or *L. Griffithiana*, which generally resemble one another in this particular. The one-year's shoots are smooth, or very slightly pilose; the bark has a fresh, yellowish-brown colour. The leaves are placed in bundles of up to forty in number on the dwarf shoots, and are 1,2—3,5 cms. in length, light green in colour, with two light bands of stomata on the under-side. They present no appreciable difference from those of *L. Potanini*, being distinctly keeled on the under-side in similarity with the latter, the keel being less distinct on the upper-side, and only really apparent at the base. The 3—4 cms. long cone is brown, the bracts, which are longer than the cone-scales, are red and recurved. The length is described as being from 3—4 cms., but a cone from an original specimen lying before us (WILSON No. 906) has nevertheless attained a length of 4,5 cms.

L. Mastersiana is the link between *L. Griffithiana* and *L. Potanini*. It differs from the former in the size of the cones, which in the case of *L. Mastersiana* are not more than about half as long as those of the Himalayan larch. The difference in length between the bracts and the cone-scales is also much more marked in the case of *L. Griffithiana* than of *L. Mastersiana*. The two species differ in point of habitus, the branches of the second order of *L. Griffithiana* being considerably more pendulous than is the case with *L. Mastersiana*.

Fig. 3. *L. Mastersiana* Rehd. & Wils. Cones from China Western Szechuan. (leg. E. H. Wilson 1908) (Nat. size, upper row dry, lower row wet, the same two cones).

Compared with *L. Potanini*, the difference is most pronounced with regard to the orange or reddish-brown bark on the one-year's shoots of the latter, together with the comparatively short, straight, bracts, and the purple-red colour of the cones; in comparison, the bright, yellowish-brown shoots, and the longer, strongly recurved bracts, and the red and brown cones of *L. Mastersiana*, are very distinctive.

Following upon his discovery of *L. Mastersiana* in 1908, Wilson sent seeds to the Arnold Arboretum, but the tree is not yet in culture in Denmark.

Herb. Mat. examined:

W. Szechuan No. 906, E. H. Wilson 1908, Type, in Arn. Arb.; also in U. S. Nat. Herb.; Brit. Mus.; Kew Herb.; Hort. Bot. Haun. —

3. **Larix Potanini,** A. BATALIN, in Act. hort. Petrop. XIII, *1894*, p. 385. —

MASTERS, in Journ. Linn. Soc. Bot. XXVI, 1902, p. 558. — Gard. Chron. 3. Ser. XXXIX, 1906, p. 178 (cum icon.). — ELWES & HENRY: Trees. Gr. Brit. and Irel. II, 1907, p. 391. — BEISSNER: Nadelholzk. 1909, p. 307, (cum icon.). — PATSCHKE, in Engl. Bot. Jahrb. XLVIII, 1913, p. 651. — REHDER & WILSON, 1914, in Sargent: Pl. Wilson, II, p. 18. — REHDER, in Journ. Arnold Arb. IV, 1923, p. 121. — DALLIMORE & JACKSON: Handb. Conif. 1923, p. 297. — WILSON in Journ. Arn. Arb. VII, 1926, p. 46, — HSEN-HSU-HU & WOON-YOUNG-CHUN: Icon. Plant. Sinicarum, 1927, Pl. 2 — REHDER: Man. Trees and Shrubs, 1927, p. 50. —.

Syn:

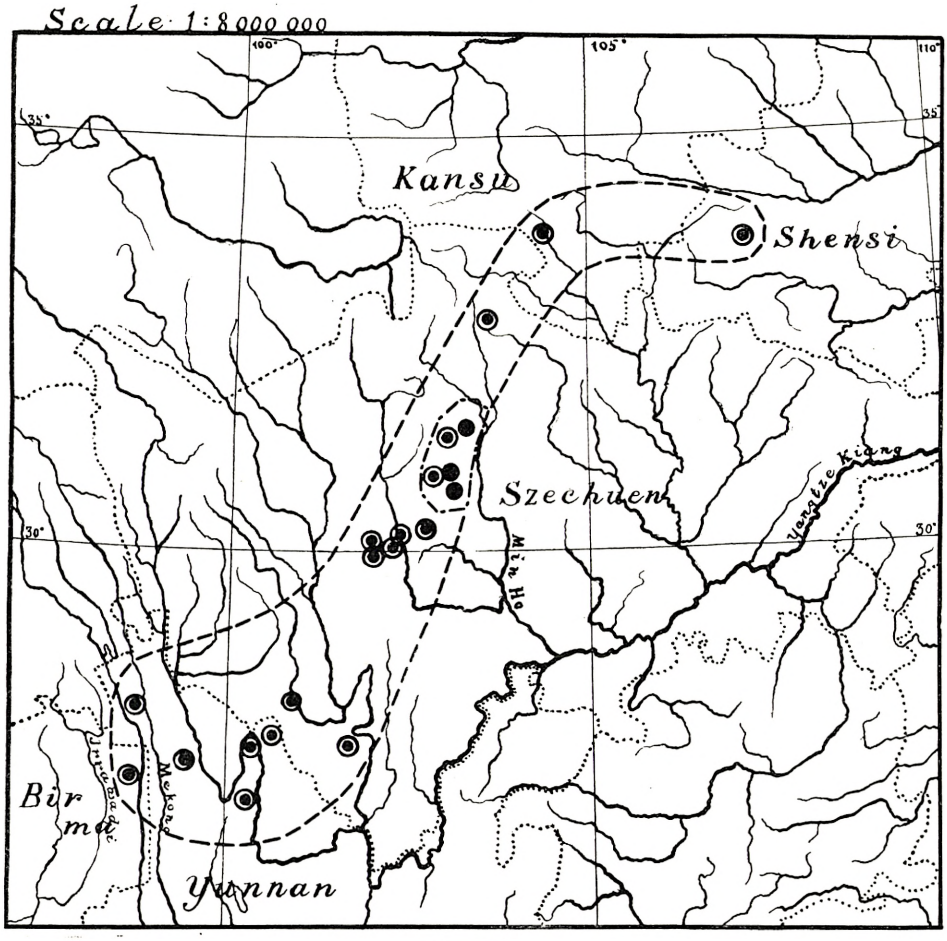
L. chinensis BEISSNER in Mittl. d. dendr. Gesellsch. 1896, p. 68. — DIELS, in Engl. Botan. Jahrb. XXIX, 1901, p. 216. — MASTERS, in Journ. Linn. Soc. Bot. XXVI, 1902, p. 558. — ELWES & HENRY: Trees. Gr. Brit. and Irel. II, 1907, p. 346. — BEISSNER: Nadelholzk. 1909, p. 303, (cum icon.). — PATSCHKE, in Engl. Bot. Jahrb. XLVIII, 1913, p. 651. —

L. tibetica, FRANCHET, in Journ. de Bot. XIII, 1899, p. 262. — DIELS, in Engl. Bot. Jahrb. XXIX, 1901, p. 216. — MASTERS, in Journ. Linn. Soc. Bot. XXVI, 1902, p. 559. —

L. Griffithii, MASTERS, in Journ. Linn. Soc. Bot. XXVI, 1902, p. 558. — PATSCHKE, in Engl. Bot. Jahrb. XLVIII, 1913, p. 746. — Non: HOOK. f. & THOMSON. —

L. Potanini occurs in a belt extending from the north-west of Yunnan, where it is broadest, northwards through Szechuan to a short distance into the interior of Kansu. Thence it follows the great mountain chain of Tsinling-shan eastwards to the extreme south-west corner of Shensi. The majority of finds has been made in Szechuan and in the north-west of Yunnan, where, generally speaking, it is common, and is a valuable forest tree. It is to be found there from an altitude of 2500 m. above sea-level and higher, until it finally disappears at the forest-line. WILSON

(No. 903) found it in 1908 north-east of Ta-tsien-lu at an altitude of 3300—4800 m. above sea-level, and no higher-lying locality has as yet been reported.



Map. II.

● ---- *Larix Potanini*, Batalin

● -·-·-· " *Mastersiana*, Rehd. & Wils.

The first material was discovered by Armand David at Shensi, and was described by Franchet in 1884 as

Larix spec. POTANIN found the material for BATALIN's type in the neighbourhood af Ta-tsien-lu in 1893, and the majority of the subsequent finds originate from this locality. Specimens were found by PURDOM in 1910—1911 in Kansu and Shensi, and by ROCK in 1922 and 1924 as far south as the mountains around Yangtsze in the north-west of Yunnan (Journ. Arnold Arb. VII. 1926, p. 46). Several other finds had already been made in the north-west of Yunnan by HANDEL-MAZZETTI in 1914—18, but they were first reported in 1929 (HANDEL-MAZZETTI; Symbolae Sinicae, VII, 1, 1929). HANDEL-MAZZETTI also reports its occurrence from the south of Szechuan, and as far west as the mountains between Salween and the Irrawady in the extreme north-east of Burma. It is found in the greatest abundance, forming forests, at an altitude of about 3000 and 3400 m. above sea-level, and in scattered groups down to 2700 m. above sea-level.

The material for BEISSNER's *L. chinensis* was found in 1893—94 by Father GIUSEPPE GIRALDI at Tai-pei-shan in Shensi, and PURDOM's discovery originates from the same locality. This, together with the fact that the original material of *L. Potanini* agrees with BEISSNER's illustration (Fig. 70 in Nadelholzk. 1909), proves that the two species are identical. FRANCHET's *L. tibetica*, which was found by Prince Henry d'Orleans near Ta-tsien-lu, where so many finds of *L. Potanini* have subsequently been made, also coincides in every respect with the latter.

The length of the cone varies from 2,5—7,5 cms. Two cones from the already-mentioned highest known locality, north-east of Ta-tsien-lu, 3300 to 4800 m. above sea-level (WILSON No. 903) measure 2,5—3 cms. Two other cones from WILSON's material collected from about the same district,

west and south-west of Ta-tsien-lu, from 3300—4000 m. above sea-level, are 3,5—3,7 cms. long. William Purdom's No. 760 from the south of Kansu, 3000—3300 m. above sea-level, should be mentioned as representing material from a northern locality; six cones from this collection vary from 3 to 3,5 cms. in length. Rehder & Wilson estimate the average length of the cones taken from the intermediate and most northern localities to be 3—4,5 cms. (Pl. Wils. 1916, p. 19), but specimens from more southerly regions show that it can be considerably greater. Among George Forrest's material from the Likiang Range in the extreme north of Yunnan (George Forrest: No. 6745, 1910, lat. 27° 35′ N.), there are cones up to 5 cms. in length (Kew Herb.), and Rock's specimens from the same neighbourhood (1922—24) are, according to Rehder, 6—7 cms. long (Journ. Arnold Arb. VII, 1926, p. 46. See also f. *australis* Henry apud Handel-Mazzetti, 1929, l. c.). In this connection it should be stated, that Franchet had already described this species from Yunnan, and this accounts for his quoting a length as great as 5 cms. for ordinary cones (R. P. Delaway). The large cones, which demonstrably exist, give it a point of similarity with *L. Griffithiana*, and explain the reason for Masters and Patschke attributing this species to Szechuan on the

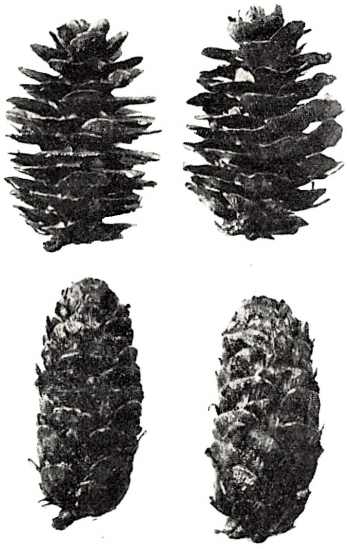


Fig. 4. *L. Potanini* Batal. Cones from China, Northern part. (W. Purdom No. 760). (Nat. size, upper row dry, lower row wet, the same two cones).

basis of PRATT's discovery (Journ. Linn. Soc. Bot. XXVI. 1902, p. 558; Engl. Bot. Jahrb. XLVIII, 1913 p. 746). FRANCHET, however (Journ. de Bot. XIII, 1899, p. 262), correctly identified PRATT's discovery with *L. tibetica* (= *L. Potanini* Bat.).

The distinguishing characteristics of *L. Potanini* from *L. Griffithiana* and *L. Mastersiana* are best demonstrated by an examination of the cones. In the case of the former, the bracts of the mature cone are not more than 2 mms. longer than the cone-scales, and are straight, while, in the case of the other two latter species, they are relatively longer, and strongly reflexed. The cone is violet with red bracts, that of *L. Mastersiana* being brown with red bracts.

The first-year's shoots are of a deep reddish-brown colour (WILSON, No. 903), or orange-brown (WILSON, No. 910), with prominent, lighter-coloured stigmata. The leaves are placed in bundles of up to fifty on the dwarf branchlets, 1,5—3 cms. in length, and are similar to *L. Mastersiana* in being distinctly keeled on the under-side, the keel on the upper-side being only noticeable at the base.

All three south-asiatic larches (*L. Griffithiana, L. Mastersiana* and *L. Potanini*) have a prominent keel on the under-side of the leaf, and are also partly keeled on the upper-side; but none of them can be compared to *L. Lyallii,* the leaves of which are prominently keeled on both sides.

The leaves of *L. Potanini* have been described as four-sided when seen in tranverse section, being keeled on the upper as well as the under-side (DALLIMORE & JACKSON: Handb. Conif. 1923, p. 297); but we have been unable to observe this dissimilarity from *L. Mastersiana* and *L. Griffithiana* in the specimens we have examined.

In the localities where the tree attains its best growth,

it reaches a height of 25—30 m., according to Rehder & Wilson, but A. E. Pratt observed specimens west of Tatsien-lu as high as 40 m. (Engl. Bot. Jahrb. XLVIII, 1913, p. 746). The crown is more slender in shape than that of *L. Griffithiana*, the branches of the first order being described as rather short. Branches of the second order are, on the contrary, pendulous in both species.

Single individuals of the species attain their best growth in the fertile, lower-lying, forest districts, but it only occurs scattered among other conifers and deciduous-leaved trees, and is more specially found along the sides of watercourses. It becomes more and more common as the ground rises, and in the highest-lying districts whole forests are composed of it.

It was introduced into Germany in 1899 under the name of *L. chinensis*. Seeds of it were sent to Beissner, and plants were successfully raised (Beissner: Nadelholzk. 1909, p. 305; vide Elwes & Henry: Trees Gr. Brit. and Irel. II, 1907, pp. 346—347). It was subsequently introduced into England, when Wilson in 1904 sent seeds from Szechuan to Veitch's Nursery Gardens. It is not found under cultivation in Denmark.

Herb. Mat. examined:

W. Szechuan, No. 910, E. H. Wilson 1908 (Arn. Arb.; U. S. Nat. Mus.; Kew.; Brit. Mus.; Hort. Bot. Haun.). — Lichiang Range lat. 27° 35′, 1910, Forrest No. 6745 (Brit. Mus.; Kew). — W. China, Hung-Sha, No. 3009, E. H. Wilson, 1904 (Brit. Mus.; Kew). — N. China, No. 760, Arn. Arb. Exp. Wm. Purdom (Kew; Brit. Mus.; U. S. Nat. Mus.; Arn. Arb.; Hort. Bot. Haun.). — Cam. Schneider, Iter chinense 1914, Szechuan austr., Kapala-Linku, 3800—4000 m. (Kew). — Kansu, T'ao River basin, 10—11000 ft. I. F. Rock, 1925, No. 12803. — Shensi sept., monte Kuon-tan-san 1894, ded. Beissner (Part of Type collection of *L. chinensis;* Kew). —

4. **L. occidentalis,** Nuttall: North Am. Silv. III, *1849*, p. 143, t. 120. —

SARGENT: Silv. N. Am. XII, 1898, . 11, t. DXCIV. — REHDER: Man. Trees and Shrubs, 1927, p. 51. —

Syn:
Pinus Nuttallii, PARLATORE in De Candolle, Prodr. XVI, 2. part, 1868, p. 412.

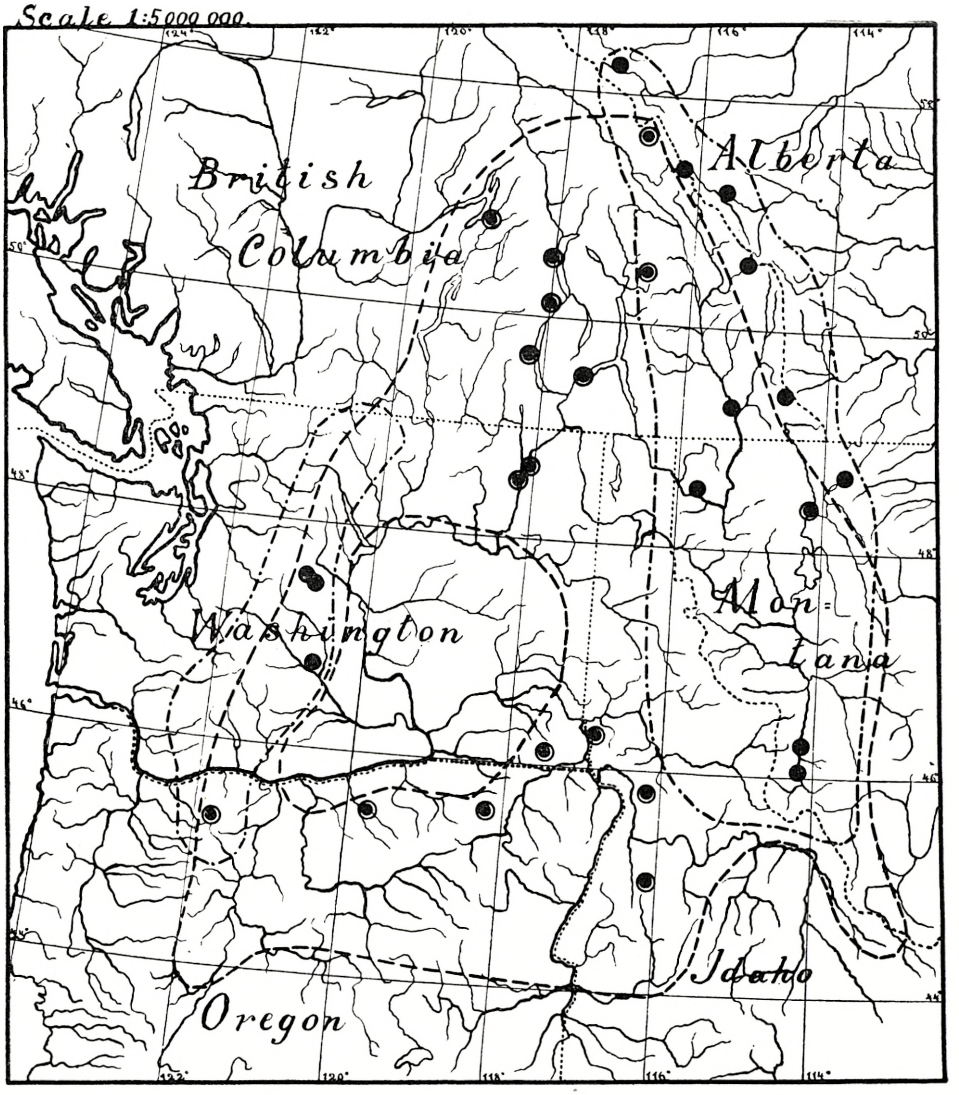
L. occidentalis together with *L. Lyallii* are representatives in North America of the type of larch characterised by possessing cones, the bracts of which are longer than the cone-scales, even when the cones attain maturity. Both species are indigenous to the most westerly parts of North America, where they are vicarious, *L. occidentalis* being a native of the mountains at an altitude of between 600 and 2100 meters, while *L. Lyallii* is an alpine tree, holding itself to the neighbourhood of the forest line between 1200 and 2400 m. above sea-level.

L. occidentalis is a valuable tree, which can attain very considerable dimensions under suitable conditions, namely, on fertile, deep soil in vallies. It occurs in Western Canada (British Columbia), and reaches its highest pitch of development in a section of the most north-easterly part of the State of Washington, the extreme west of Montana, and the northern parts of Idaho, where whole forests of it are often to be met with; while it is often found growing among *Thuja plicata, Pseudotsuga mucronata, Tsuga Albertiana, Picea Engelmanii*, and *Abies grandis*. In the most suitable localities, it can attain a height of 50—80 m. (SARGENT: Silv. N. Am. XII, 1898, p. 11; REHDER, 1927, p. 51), but as a rule it is less than 50 m. high. The girth may also be considerable, and trunks are mentioned having a diameter of up to 2 m. (HENRY & ELWES: 1907, p. 394), and about 2,5 m. (SARGENT: 1898, p. 11). Such girths are, of course, considerable, but not so enormous in relation

to the great height, and *L. occidentalis* in its habitat also grows slender, regular trunks with short lateral branches, and slender, pyramid-shaped crowns.

In April 1826, David Douglas made a journey up the Columbia River, and in the district lying in the fork made by the junction of the River Spokon and the Columbia, on his way to Fort Colville, he entered the great, fertile pine-forests, where *L. occidentalis* attains its greatest development. He did not differentiate it from *L. decidua*, which is later described, but he admired its imposing dimensions and the excellence of its timber, writing in his journal: »I measured some thirty feet in circumference; and several which had been levelled to the ground by the late storms, were one hundred and forty-five feet long, with wood perfectly clean and strong«, and he also states that they were the commonest conifers met with in the district (Companion to the Bot. Mag. II, 1836, p. 109). The tree is a splendid one, surpassing all the other species of larch in height and girth where it attains its best development, and possesses a shape and timber as valuable as the best of the other species.

Its area of distribution lies like a ring around the lowland, formed by the central part of Washington and the northern of the Oregon up to the northern side of the Blue Mountains. This is the Great Plain of the Columbia River. It is most extensively distributed towards the north-east in the Rocky Mountains; the line then takes a north-westerly direction towards the Cascade Mountains, which it follows southwards until a little south of the Columbia River, where it bends eastwards and continues — in somewhat straggling groups, it must be confessed — until it again reaches the Rockies.



Map. III.

● ---- *Larix occidentalis, Nutt.*

● ----- *Larix Lyallii, Parl.*

Its cone is 2,5—3,5 cms. in length, and the open form with the long, visible bracts, which are straight or only slightly recurved, make it easily recognisable. The scales

Fig. 5. *L. occidentalis* Nutt. Branch and cone from Montana, Glacier National Park, Lake Mac Donald, ca. 1000 m (leg. I. G. Jack, Sept. 1921). (Nat. size, left wet, right dry, the same branch).

are thin, and their free tips are straight, or slightly recurved. The basal portion of the outer side is finely pilose. The female inflorescence are deep red with green mid-rib and mucro (U. S. Nat. Herb.), and the male flowers are rather long. The young shoots are brown and pilose, becoming smooth at a later period, the leaves 2,5—4,5 cms. long; they are green, and not blueish-green. Vigorous

shoots of young trees are provided with particularly long leaves, giving them the characteristic appearance, which by itself alone renders them distinguishable from the other

Fig. 6. *L. occidentalis* Nutt. Cones from cultivated trees. Botanical Gardens, Copenhagen 1928. (Nat. size, upper row dry, lower row wet, the same two cones).

cultivated species. It was introduced into Europe (Kew) in 1881, and thrives well under cultivation in Great Britain, developing the same fine form of growth as when found in its native surroundings, but is attacked by *Dasyscypha Willkommi*, with which it has also been badly beset in Denmark (Hæsede Nursery at Gisselfeld, Dr. BØRGESEN's garden in Hellebæk, the Nurseries of the Danish Experi-

mental Forestry Service at Egelund; vide A. OPPERMANN: Cultivation of the Larch in Denmark in Det forstlige Forsøgsvæsen i Danmark, VII, p. 276). In forests and gardens its occurrence is as yet rare.

Herb. Mat. examined:

Brit. Columbia.: Deer Park, Lower Arrow Lake, 1890, MACOUN (Gray Herb.). — Upper Arrow Lakes, 1889, DAWSON (Ottawa Herb.). — Between Lower and Upper Arrow Lakes, 1890, MACOUN (Ottawa Herb.) — Sicamous, 1889, MACOUN (Ottawa Herb.). — Colombia Slope, 1834, Herb. Nuttall, Type collection (Brit. Mus.). — Columbia River from lat. 48°—49° N., several specimens, Dr. LYALL, 1860 (Kew; Gray Herb.), — Columbia River 1890, JOHN MACOUN, (Brit. Mus.). — Selkirk Flora, 1905. CHAS H. SHAW, a) Wood W. of Nelson, b) Hills near Howser Lake (Brit. Mus.; U. S. Nat. Herb.; Gray Herb.). — Washington: Blue Mts. Columbia Co. 1897 (Gray Herb.). — Swank River, 750—1800 m., SHARPLES, 1913, (Gray Herb.). — Near Kettle Falls and in the Rocky Mountains, 1826, DAVID DOUGLAS (Kew). — Cascade Mts., T. S. BRANDEGEE, 1882, Ex Herb. Univ. Calif. (Hort. Bot. Haun.). — Suksdorf, Fl. of Washington, Mt. Paddo, ADAMS 1883 (Brit. Mus.; Gray Herb.).— Oregon: Union, Col. CASICK 1882 (Kew). — Petty's Canon, 1880, S. WATSON (Gray Herb.). — Big Fork, 1908, J. CLEMENTS (Gray Herb.). — Clear water (Gray Herb.). — Near Mt. Hood, WALPOLE, 1898 (U. S. Nat. Herb.). — Montana: Columbia Falls, 1893, WILLIAMS (U. S. Nat. Herb.). — Lower valley of Clarks Fork, 650 m. J. B. LEIBERG, 1895 (Gray Herb.; U. S. Nat. Herb.). — Fl. of Idaho, Craig Mts. near Lake Waka, 1892 (Brit. Mus.; Gray Herb.). — Fl. of Idaho, Payette Lake, 1899. Marcus Gray Jones (Brit. Mus.). —

5. L. Lyallii, Parlatore, in Enum. Sem. Hort. Reg. Mus. Flor. *1863.*

Journ. Bot. I, 1863, B. 35, and, in Gard. Chron. 1863, p. 916. — SARGENT: Silv. N. Am. XII, p. 15, t. DXCV. — REHDER: Man. Trees and Shrubs, 1927, p. 51.

Syn:

Pinus Lyallii, PARLATORE in De Candolle Prodr. XVI. 2. 1868, p. 412.

L. Lyallii, has for its area of distribution two regions divided from one another, one towards the east in the Rockies, and one to the west in the Cascade Mountains.

Within both areas, it goes southwards to about lat. 45° N., that is to say, as regards the western area, a trifle south of the Columbia River, and north again to about the

Fig. 7. Group of *L. Lyallii*, forming forest line above Lake Louise, Alberta, Canada. Ca. 2000 m. (Aug. 1924. C. H. Ostf. phot.).

boundary line between Washington and British Columbia; in the eastern area, it follows the boundary between British Columbia and Alberta northwards to the neighbourhood of Mount Hooker. On the west, it runs a little nearer to the coast than, and on the north-east, a little beyond the

limits of, *L. occidentalis*. This area of distribution corresponds with the more alpine character of *L. Lyallii*, which is therefore found at higher altitudes than the latter on the great mountain chains bounding their mutual domains. (See Maps III & VIII).

L. Lyallii, in contrast to *L. occidentalis*, is of very small importance as a forest tree. Under favourable conditions, it succeeds in reaching a height of 20—25 m., but is frequently lower. It grows but slowly in the harsh climate of the upper forest-line, where it has its home; Brandegee counted as many as 562 annual rings in a trunk about 50 cms. in diameter.

From the taxonomic point of view, *L. Lyallii* and *L. occidentalis* resemble one another closely, and it is also probable that their characteristics can vary to such an extent, that they overlap. Even so, they are, nevertheless, so dissimilar, that they must be regarded as two different species.

The cone is larger than that of *L. occidentalis* (3,5—5 cms. in length), but has the same open form, and the long, visible bracts which characterise the latter. The scales are more pilose, and become a little more recurved at maturity. The cone at the flowering-stage has dark red, rarely green, scales, while the bracts are of more pronounced red shade. The long mucro of the bract is also deep red, in contrast with *L. occidentalis* (U. S. Nat. Mus.). The male flower is long, the young shoots are strongly pilose, the hairs light brown; the leaves are 2,5—4 cms. in length, and blueish-green; the transverse section shows them to be rhomboid, and considerably thicker than those of *L. occidentalis*. The leaves, which may be as long as those of *L. occidentalis*, are more quadrangular than those af any other species, which fact, together with the densely pilose young shoots,

makes *L. Lyallii* easily recognisable, even without the cones. The wings of the seeds are stated to be of a faint red colour in contradistinction to those of *L. occidentalis*,

Fig. 8. *L. Lyallii* Parl. One year's shoot showing dense pilosity. Montana, Glacier National Park, Piegan Purs, 2100 m. No. 2204 (leg. J. G. Jack, Sept. 1921).

Fig. 9. *L. Lyallii* Parl. Cone from British Columbia, Tecamores (leg. John Macoun, July 1889). (Nat. size, upper dry, lower wet)

where they are brown; but the material of *L. Lyallii* from Glacier National Park (2100 m. above sea-level) in Montana, and from Tecamores in British Columbia, presents this difference to a slight degree only, and it can, no doubt, be entirely absent.

In recent times (1893 and later), trials have been made

in England with the cultivation of *L. Lyallii*, but it thrives very poorly; the attempts have only resulted in raising a few isolated specimens, which, however, only grew for a short time. In Denmarks no attempts at cultivation have been made.

Herb. Mat. examined:

Alberta: Silver City 1885, JOHN MACOUN (Brit. Mus.). — Near Banff, W. C. CALLA, 1899 (Kew). — Selkirk Mt. 1904, Summit of Burgess Trail, H. PETERSEN (Brit. Mus.; Gray Herb.). — Lake Louise, 1905, EDITH M. FARR (Brit. Mus.; Gray Herb.). — Above Lake Louise, 1924, C. H. OSTENFELD (Hort. Bot. Haun.). — Lake Agnes & Mt. Piron, FRANCES C. PRINCES 1900 (Gray Herb.). — Lake Agnes, 6800 ft., C. S. SARGENT, 1897 (Gray Herb.; U. S. Nat. Herb.). — Near Lake Agnes, 7400 ft., MACOUN, 1904 (Ottawa Herb.). — Pipestone Valley S. of Summit, Headwaters of the Saskatchewan and Athabasca River, STEWART & BROWN, 1908 (Gray Herb.). — Sheep Mt., MACOUN, 1895 (Ottawa Herb.). — Brit. Columbia, Tecamores, JOHN MACOUN, 1889, Ex. Herb. Geol. & Nat. Hist. Surv. Canada (Hort. Bot. Haun.). — Kicking Horse Lake, JOHN MACOUN, 1890 (Brit. Mus.). — Kootanie Pass., DAWSON AUG. 1881, and MACOUN 1890 (Ottawa Herb.). Kootanie Valley, DAWSON July (Gray Herb.). — Kanashir Summit, R. M., 7000 ft. DAWSON, July, 1884 (Ottawa Herb.). — Washington: Cascade Mt. to Fort Colville, Dr. LYALL, 1860 Type collection (Kew, also in Gray Herb.). — Fort Colville to Rocky Mountains, Galton Range, Dr. LYALL 1861, (Kew). — Near Mt. Stewart, T. S. BRANDEGEE, 1883, Ex. Herb. Univ. Calif.; (Hort. Bot. Haun.; Kew; Brit. Mus.; Gray Herb.), — Yokima Region, 6200 ft. 1883. — Forest Reserve, 5700—5800 ft., 1897. Mt. Stuart, 1898; Wanalschee Mt. 1901 (U. S. Nat. Herb.). — Fl. of Montana, MARCUS E. JONES: a) Hamilton, Bitter Root Valley 1905 (U. S. Nat. Herb.); b) Darby 1909 (Brit. Mus.). — Glacier Nat. Park, 2100 m., Arn. Arb. Journey to Montana, No. 2204 (Hort. Bot. Haun.). — Horse Pass, Montana, 200 m. (U. S. Nat. Herb.). —

6. **Larix Kaempferi,** (LAMBERT, *1824*), SARGENT: Silv. N. Am. XII, *1898*, p. 2. Note.

WILSON: Conif. and Tax. Jap. 1916, p. 30. — REHDER: Man. Trees and Shrubs, 1927. p. 51. —

Syn:

Larix conifera nucleis pyramidatis, foliis deciduis, Engelbertus, Kaempferus: Amoenitarum exoticarum, 1712, p. 883. —

Pinus Larix, CAROLUS PETRUS THUNBERG: Flora Japonica, 1784, p. 275. — Non L. 1753. —

Pinus Kaempferi, LAMBERT: Genus Pinus, II, 1824, p. V. —

Abies leptolepis, SIEBOLD & ZUCCARINI: Fl. Jap. II, 1842, p. 12, t. 105. —

Larix japonica, CARRIÈRE: Traît. Conif. 1855, p. 272. — Non MURRAY, 1863. —

L. leptolepis, GORDON: Pinetum, 1858, p. 128. — MURRAY: Pines and Firs, Jap. 1863, p. 89. — BEISSNER: Nadelholzk, 1909, p. 307. — O. G. PETERSEN: Forstb. 1920, p. 247. — A. OPPERMANN, in Det forstl. Forsøgsv. i Danmark, VII, 1923, p. 266. — DALLIMORE & JACKSON: Handb. Conif. 1923, p. 288. —

The Japanese Larch is only found in the wild state in the interior of Hondo at about the same latitude as Tokio, while it is cultivated in the north and south, and also upon the large islands of Hokkaido, Schikoku, and Kiuschiu. Its area of distribution runs roughly east and west across Hondo from the province of Kaga in the west, through Shinano to the district around Nikko in the province of Shimotsuke, where it reaches its most easterly and most northerly point of occurrence. The area forms a belt 80—100 km. wide, and 250—300 km. long (see Map V). It is common within these limits, and grows at an altitude of between 500 and 2300 m. above sea-level, keeping to the volcanic soil. On Fuji-Yama it occurs right up to an altitude of 2900 m., but, at the extreme limit, only as a stunted bush hardly 1 m. high (MURRAY: 1863, p. 97). I. G. VEITCH was the first to draw attention to this form, which MURRAY in 1863 described as a separate species, *L. japonica* (non Carrière). After its subsequent introduction to the Arnold Arboretum in 1892, it has been demonstrated that it does not retain its dwarf growth, and does not deviate from the species in any important characteristic.

WILSON has given a detailed description of its occurrence

upon the basis of his own observations (Wilson: 1916, pp. 30—31), and he states that is has a tendency to form pure growths of considerable extent, otherwise occurring only in company with other conifers such as *Pinus densiflora, Abies homolepis, A. Veitchii, Picea jezoensis, Tsuga diversifolia*, and deciduous foliage trees, such as oak, birch, hornbeam and beech. Sirasawa, however, states that it most frequently occurs in mixed forests (Sirasawa: 1910, p. 307). As a rule, it attains a height of 25—26 m. with a girth of 2—3 m.; but it can, under exceptional circumstances, reach 33 m. with a girth of 4 m. In speaking of its occurrence upon Fuji-Yama, Wilson remarks, that *Pinus pumila* as a rule is not found here, and consequently the light-loving *L. Kaempferi* is allowed to dominate in these greater altitudes, where otherwise *Pinus pumila* is the only ruling tree or shrub.

The recurved cone-scales, which are generally very distinctive, make *L. Kaempferi* an easily recognisable larch. It varies in size, and large cones are common in cultivated specimens. Mayr, who may be supposed to have been intimately acquainted with the species in its native country, states that the cones only attain a length of 1,5—3 cms. in their natural habitat, becoming as long as 3,5 cms. under cultivation (Mayr: 1890, p. 65). He mentions the illustrations in Siebold & Zuccharini: Fl. Jap. II, 1842 (Plate 105), which reproduce two cones 3,5 cms. in length, as an example of a cultivated specimen with large cones. Under culture in Denmark, this tree has produced cones as long as 4 cms. (Strødam near Hillerød, and Tinning Forest near Friijsenborg).

The female cone in the flowering stage is violet; the bracts have a green mid-rib; the species seems to vary

very little. Pale flowers are not mentioned, and flowers only a trifle lighter in shade are found in cultivated spec-

Fig. 10. *Larix Kaempferi* (Lamb.) Sargent. (From E. H. Wilson, Conifers and Taxads of Japan, 1916).

imens (Egelund Nurseries under the Danish Experimental Forestry Service). The first-year's shoots are stout, yellow

to reddish-brown, most frequently a fresh chestnut-brown, and may be smooth or pilose. The leaves are 3—3,5 cms. long, blueish green in colour, with stomata on both sides, and have a prominent keel on the under-side.

Wilson describes the crown as narrow and somewhat pyramidal, the branches numerous, thin, and short. Usually

Fig. 11. *L. Kaempferi* (Lamb.) Sarg. Cones from cultivated trees. Denmark, the Garden of Forest Botany, Charlottenlund, 1922 ($^3/_4$ nat. size, upper row dry, lower row wet).

they project horizontally from the trunk, but are sometimes bent upwards or downwards; this description is confirmed by an illustration of a group of older trees (Wilson: 1916, Plate XV). (Fig 10). Under culture in Europe, *L. Kaempferi* seems to have a tendency towards developing a broader crown with stouter, longer branches, than those of *L. decidua*, but as there are at present only young trees up to 60 years of age in culture, there is some hope that, as time goes on, they will adopt a — from the forestry point of view — more satisfactory form, and one more in keeping

with WILSON's description of them from their home. Although the Japanese Larch was mentioned by KAEMPFER already in 1712, it was first described by LAMBERT in 1824, and first introduced into Europe in 1861, when JOHN GOULD VEITCH sent seeds to the Nursery Gardens near London. It came to Denmark in 1889 (The Garden of Forest Botany at Charlottenlund), and is now, thanks to its vigorous early growth, and stout, picturesque appearance, a tree in common use in forests and gardens.

Herb. Mat. examined:

Yokohama, 1862, MAXIMOWICZ (Brit. Mus.). — Chinsenji, Nikko, BINET, 1877 (Brit. Mus.). — Nippon, Jizogatake 1903, FAURIE, No. 5344 (Brit. Mus.). — Nippon, Asamayana, 1904, FAURIE (Brit. Mus.). — Aomori, culta, 1905, FAURIE (Brit. Mus.). — Also seen in Kew etc. — Numerous cultivated specimens from Denmark, etc.

7. **Larix Gmelini** (RUPRECHT *1845*), GORDON: Pinetum *1858*, p. 123. —

Herb. Fl. Ross., Mus. Bot. Acad. Imp. Petropol. edit. 1912. — Conf. MIDDENDORFF in Middf. Reise, IV, 1. 1867 p. 527, Note. —

Syn:

Abies Gmelini, RUPRECHT, in Beitr. Pflanz. Russ. Reich. 2. Lief. 1845, p. 56. —

Abies kamtschatica, RUPRECHT 1845, l. c. p. 57. —

Pinus dahurica, FISCHER, in Schtschagl. Anz. f. Entd. in d. Phys. Chem. Natur. u. Techn. VIII, 3'. 1831 (nomen nudum). — TURCZANINOW, in Bull. de la Soc. Imp. Natur. de Mosc. XI, 1838, p. 101 (nomen nudum). — Id., Fl. Baical. Dahur. I. 1842—45. p. 14, (nomen nudum). — ENDLICHER: Syn: Conif. 1847, p. 128. — LEDEBOUR: Fl. Ross. III, 1846—51. — TRAUTVETTER in Act. Hort. Petrop. V, 1877, p. 111.

Pinus Kamtschatica, ENDLICHER: Syn: Conif. 1847, p. 135. (Species inquirenda). — LEDEBOUR: Fl. Ross. III, 1846—51, p. 673. —

Larix dahurica, TRAUTVETTER: Pl. Imag. Descrip. Fl. Russ. III. Fasc. 7, 1846. p. 48, Tab. 32. — TURCZANINOW, in Bull. de la Soc. Imp. des Natur. de Mosc. 1838, p. 101 (nomen nudum). — TRAUT-

vetter in Middf. Reise, I, II, 4′, 1847, p. 148. — Carrière: Trait. Conif. 1855, p. 270. — Trautvetter & Meyer in Middf. Reise, I, II′, 2′, 1856, p. 88. — Maxim.: Prim. Fl. Amur. 1859, p. 262. — Radde, in Baer & Helmersen: Beitr. Kennt. Russ. Reich. XXIII, 1861, p. 608, — Henkel & Hochstetter: Syn: Nadelh. 1865, p. 138. — Middendorff, in Middf. Reise, V, 1′, 1867, p. 527. — Fr. Schmidt, in Mém. Acad. Imp. Sci. St. Petersbourg, Sér. 7, XII, No. 2. 1868, p. 63. — Regel, in Gartenfl. XX, 1871, p. 104, et in Act. Hort. Petrop. I. 1871, p. 159. — K. Koch: Dendrol. 1873, p. 261. — Masters, in Journ. Linn. Soc. Bot. XVIII, 1880, p. 522. — Willkomm: Forst. Fl. 1887, P. 155. — Herder, in Act. Hort. Petrop. XII, 1892, p. 98. — Sargent: Silv. N. Am. XII, 1898, p. 4. Note. — Cajander, in Act. Soc. Sci. Fennicæ, XXXII, No. 3. 1904, p. 8. — Mayr: Fremdl. Wald- und Parkb. 1906, p. 299. — Elwes & Henry: Trees, Gr. Brit. and Ireland II, 1907, p. 379. — Beissner: Nadelholzk. 1906, p. 319. — Patschke, in Engl. Bot. Jahrb. XLVIII, 1913, p. 651. — A. Oppermann, in Det forstl. Forsøgsv. i Danmark VII, 1923, p. 271. — Okada, in Bot. Mag. Tokio XXXVIII, 1924. — Komarow, in Acad. Sci. Publ. Foederat. Soviet. Social. 1927, p. 101. — Hultén, in Kungl. Sv. Vetensk. Handl. Ser. 3, V. 1928, p. 68. —

Larix Kamtschatica, Carrière: Traît. Conif. 1855, p. 279. — Middendorff, in Middf. Reise, IV, 1. 1867, p. 529. — Elwes & Henry: Trees, Gr. Brit. and Irel. II, 1907, p. 343. —

L. sibirica, Maximowicz, apud Regel: Veget. Skitz. Amur. 1856, p. 495. — Id. in Bull. Acad. St. Petersbourg XV, 1857, p. 226. — Herder, in Act. Hort. Petrop. XII, 1892, p. 102 (p.p.). — Masters, in Bull. Herb. Boiss. VI, 1898, p. 272. — Patschke, in Engl. Bot. Jahrb. XLVIII, 1913, p. 651 (p.p.). — Non Ledebour. —

L. decidua var. rossica, Henkel & Hochstetter: Syn: Nadelh. 1865, p. 133, (p.p.). — Non Regel. —

L. dahurica var. japonica, Maxim., apud Regel, in Gartenfl. XX, 1871, p. 105, cum icon. — Miyabe, in Mem. Boston Soc. Nat. Hist. IV, 1890, p. 261. — Patschke, in Engl. Bot. Jahrb. XLVIII, 1913, p. 651. — Wilson: Conif. and Tax. Jap. 1916, p. 33. — Miyabe & Kudo: Icon. Ess. For. Hokkaido 1920, p. 23. — Rehder: Man. Trees and Shrubs, 1927. p. 52. —

L. intermedia, K. Koch: Dendrologie, 1873, p. 260 et 261 (pp.). —

L. kurilensis, Mayr: Monogr. Abiet. Jap. 1890, p. 66. Pl. V. — Elwes & Henry: Trees, Gr. Brit. and Irel. II. 1907, p. 383. — Beissner: Nadelholzk. 1906, p. 321. — Dall. & Jackson: Handb. Conif.

1923, p. 287. — A. OPPERMANN, in Det forstl. Forsøgsv. i Danmark VII, 1923, p. 275. —

L. dahurica var. kurilensis, SARGENT: Silv. N. Am. XII, 1898, p. 4, Note. —

L. Cajanderi, MAYR: Fremdl. Wald- und Parkb. 1906, p. 297. — ELWES & HENRY: Trees, Gr. Brit. and Irel. II, 1907, p. 346. — DALL. & JACKSON: Handb. Conif. 1923, p. 279. —

L. dahurica var. pubescens, PATSCHKE, in Engl. Bot. Jahrb. XLVIII, 1913, p. 651. —

L. dahurica var. kamtschatica, MIYABE & KUDO: Icon Ess. For. Hokkaido, 1920, p. 26. — KUDO, in Jap. Journ. Bot. II, 1925, p. 52 et 217. —

L. Gmelini (L. dahurica) is a very common tree throughout the entire forest-clad regions of Eastern Siberia, vast tracts being often entirely composed of it, especially in the north, where it alone forms the forest line (See Map V). Its most northerly point of occurrence is near the Chatanga and its tributary, the Novaja, at lat. 72°—72½° N. (Middf. Reise IV, 1867, pp. 595 and 604), and further eastwards, at the mouth of the Lena, it reaches nearly as far north as lat. 72°N. (CAJANDER in Act. Soc. Sci. Fennicae, XXXII, No. 3, 1904, p. 32). From these outposts in the extreme north, it extends southwards through the whole of Eastern Siberia, and reaches its most southerly point of occurrence at about the same latitude as Vladivostok, where it goes over to *var. olgensis,* which carries the area of occurrence further southwards. In the southern parts of the area of distribution, it goes westwards to Lake Baikal, the northerly part reaching as far west as the district around the mouth of the Jenisej. Near Lake Baikal, and along the banks of the Lena from Kirensk to Oleminsk, forms are found intermediate between the typical *L. Gmelini* and *L. sibirica;* the same phenomenon might also conceivably be observed

further north in a belt, where the two species meet one another (CAJANDER; ibid p. 8). Similar forms probably occur in the extreme north near the mouth of the Jenisej, contradictory reports existing regarding the larch species in these districts. SCHEUTZ states that *L. sibirica* is the only larch near the Jenisej, also attributing the most northerly, stunted specimens between Dudino (Lat. 69° N.) and the Arctic Sea to this species (Kgl. Sv. Vet. Handl. XXII, No. 10, p. 41). MIDDENDORFF, who devoted special attention to the relation between the two larches, and endeavoured to fix the boundary between them during his sojourn near the Jenisej, came, on the other hand, to the result, that the dividing line between *L. Gmelini* and *L. sibirica* must be looked for between lat. $67^1/_2°$ and lat. $68^1/_2°$ N., and that only *L. Gmelini* at any rate was to be found at lat. $69^1/_2°$ N. He also suggested the possibility of the existence of a transition belt with intermediate forms between the two species (l. c. pp. 530 and 595). MIDDENDORFF supposed that *L. Gmelini* formed the forest line as far west as about the spot where the Ob empties itself into the Arctic Sea (l. c. p. 538). His statements here are not based on personal observation, and *L. Gmelini* has never subsequently been found so far west; SCHEUTZ too (l. c. p. 47) only found *L. sibirica* there. The relation between the two species will be seen from the foregoing to be still insufficiently illuminated, but as already stated, it appears reasonable to suppose that a transitional zone lies in this district as well, and that in all probability the boundary lies somewhere in the neighbourhood of the mouth of the Jenisej.

Eastwards, *L. Gmelini* is found as far as the coast bordering the Sea of Ochot, the only localities where it does not occur being the coast of Kamtschatka and the northern

section of the gulf between Kamtschatka and the mainland. It extends further to the small islands along the coast, passes over to Sachalin and to the most southerly of the Kurile Islands, viz., Shikotan and Etorofu. On the north-east, it reaches its extreme limit near the Anadyr River, which, however, it only follows for a short distance south of lat. 65° N., never overstepping lat. 65° N. and long. 172° E. Finally to its area of distribution must be added the isolated occurrence in the interior of Kamtschatka.

The limit for its occurrence on the north-east towards the Sea of Ochot, as well as the northern boundary, is given on our map in accordance with MIDDENDORFF's detailed accounts (l. c. pp. 530—535). The occurrence in Kamtschatka is reproduced from the map of HULTÉN (Kgl. Sv. Vet. Handl. V, No. 1, p. 284), and KOMAROV (Acad. Sci. Phil. Foederat. Soviet Social., 1927, p. 101), and with regard to the localities on Sachalin and the southern Kurile Islands, several detailed notes exist, the most exhaustive of which has been supplied by MIDDENDORFF (1867), FR. SCHMIDT (1868), MAYR (1890), and MIYABE & KUDO (1920).

Within this extensive area of distribution, between lat. 43° N. and lat. 72½° N., and between long. 85° and 172° E., the species undergoes considerable variations in habit. It is found in every possible form, from low, stunted specimens in the most northerly localities, to shapely trees in the southern vallies 80 to 100 feet high. MIDDENDORFF, who has given the, hitherto, most detailed description of this species on the basis of his own observations, has supplied several sketches of types varying from the fine, single-trunked tree near the Aldan River at lat. 61½° N., to the century-and-a-half old stunted, zig-zag bent specimens from the River Novaja at lat. 72½° N. (Fig. 12).

A little to the south of the most northerly localities with the quite dwarf, stunted specimens, more or less open forest is found, becoming denser and better formed the further south it approaches. The growth everywhere in the northern localities is slow, and the average size small. Thus, the larch in the Arctic circle seldom exceeds 12 m. in height at the Lena, and the trees are all more or less stunted. The forest is so open, that the branches hardly touch one another, and rejuvenation is very slow. Cajander, who described the forest there also, examined a number of trees in the neighbourhood of Shigansk on the Lena, close to the Artic circle, and as the measurements give a good impression of the slowness of growth, they are given here: —

	Height	Girth	Age
I	190 cms.	—	about 85 years
II	295 —	26 cms.	90 —
III	310 —	—	95 —
IV	640 —	—	110 —
V	700 —	—	136 —
VI	710 —	—	130 —
VII	750 —	—	120 —
VIII	940 —	41 cms.	150 —
IX	990 —	—	160 —
X	1100 —	—	150 —

The following three younger trees, however, were measured at the same time and in the same locality:

	Height	Girth	Age
I	350 cms.	13 cms.	17 years
II	570 —	24 —	38 —
III	755 —	34 —	51 —

These three trees as well as those in the first table show that the rate of growth can vary considerably, even within the same area, but, taken as a whole, the figures indicate only a slow rate of growth, agreeing well with the descriptions (CAJANDER: 1904, l. c. p. 23).

MIDDENDORFF supplies information with regard to the appearance of the larch near the Aldan River and its tri-

Fig. 12. *L. Gmelini* (Rupr.) Gordon. very old, stunted specimen, from lat. 72½° N., river Novaja. From Middendorff, Reise, 4. Vol. p. 605.

butary, the Milja, from about lat. 60° N. His illustration (Vol. IV, 1867, p. 538 reproduced here as Fig. 13) of a tree near the Aldan River, bears witness to good shape, and his measurements of trees on the Milja at lat. 60° N. (l. c. p. 539) indicate considerable size as well. One of the tallest trees found was 80 ft. high, the girth of the trunk 3¾ ft. above the level of the ground being 6 ft. 4 inch., and at a height of 56 ft., 2 ft. 4 inch.; from the district around Jakutsk eastwards through the Stanowoj Range, the East-Siberian larch also develops into a valuable forest tree. The tallest trees mentioned by MIDDENDORFF were found on the west slope of the Stanowoj Range, and were 80—100 ft. high. In a more southerly direction, in the neighbourhood

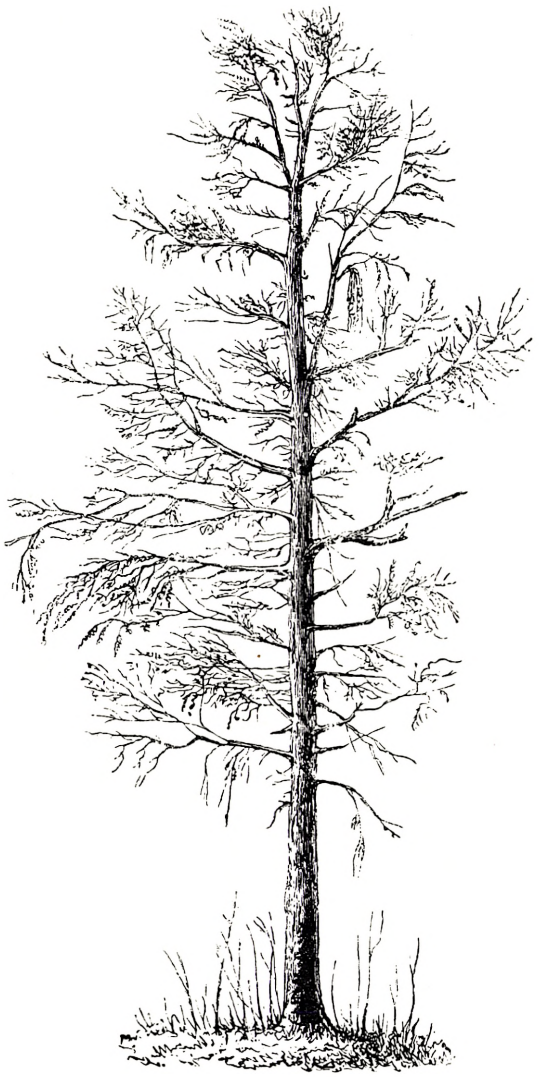


Fig. 13. *L. Gmelini* (Rupr.) Gordon. Tall tree at the river Aldan, lat. 60½° N. From Middendorff, Reise, vol. 4. p. 538 (Abt. 80 feet high).

of the Amur River and its tributaries, it probably attains an even greater height, both Fr. Schmidt and Maximowicz describing the occurrence of large, fine specimens with a diameter of up to 4 ft. (Maxim. 1859, pp. 393—394).

It appears to be an extremely common tree in all districts within its extensive area of distribution, and in the localities in the extreme north, it predominates over all other kinds of trees. Thus CAJANDER, on his journey down the Lena, noticed that the spruce disappeared a little to the north of Jakutsk, the fir being still found a few degrees further north, while the larch was supreme from about lat. 64° N. right up to the forest-line at the mouth of the Lena at lat. 72° N. (CAJANDER: 1904). A good impression of how dominating, nay, supreme, it becomes in comparison with other trees in wet, tundra-like districts, may be gained from OKADA's description of its occurrence on Sachalin (OKADA: 1914), where the larch is able to form whole forests on tracts that are so wet, that the undergrowth is composed, inter alia, of Ledum, Myrica, Vaccinium, Andromeda, and Oxycoccus. Finally, it is met with in the „high moor formation", although certainly only as small individuals (vide SCHMIDT, 1868, p. 14; BEISSNER, 1909, p. 320, and REGEL in Gartenfl. XX, 1871, p. 105).

We have seen that *L. Gmelini* reaches farther north and farther out on the flat, wet areas than other coniferous trees; it possesses also a marked propensity for withstanding the foggy, inclement climatic conditions prevailing in the regions abutting the Sea of Ochot, which it closely approaches on the Kurile Islands, as well as on Sachalin and the mainland, from about lat. 61° N.; further southwards, it goes out on the many small islands along the coast.

It not only contrives to exist under the inclement conditions, high winds and a cold, damp atmosphere, to which it is exposed, but can also develop into a tree of considerable dimensions. Thus WILSON gives its height on Sacha-

lin as being 20—30 m., while Mayr found it at its best on Etorofu in the Kurile Islands, and measured specimens as high as 22 m. with a girth up to 1 m. breast-high above the level of the ground; in the exposed localities on Shikotan it only occurred as small, stunted specimens, 10 ft. high. While its growth and outward form suffer under exposure, the influence of the damp atmosphere endows it with fine, luxuriant foliage, and the transition between the normal, well-developed larch forest, and the stunted, wind-swept, but luxuriantly green shrub of the coast localities, may be exceedingly abrupt (Middendorff: 1867, p. 606).

Departing from the coastal districts inland into the mountain ranges, *L. Gmelini* is again found growing in the most inaccessible spots and in the very highest tree-clad regions. In the north this fact is very pronounced, the only other tree accompanying it to its highest points of growth being the low, creeping *Pinus pumila;* Middendorff has supplied an exhaustive description of this circumstance in the Stanowoj Range, especially in the district around the source of the little Ujan River, 1200 m. above sea-level (l. c. 1867, p. 616).

Further south, indeed, the larch contrives to force its way high up among the mountains, but only occurs scattered among *Abies sibirica* and *Pinus cembra* var. *sibirica* at the extreme limit, which, on Sokondo, south-east of Lake Baikal, reaches 2000 m. above sea-level (Radde in Baer & Helmersen: Beitr. Kennt. Russ. Reich. XXIII, 1861, pp. 468—472. Vide Middf. 1867, p. 622).

L. Gmelini is thus the dominant tree, outnumbering all others far northwards out upon the flat, wet tracts, and in part also, upon the upper tree-clad mountain regions, and, finally, outwards to the coast, but it by no means

attains its best development in these localities. The protected spots on the slopes of vallies with the fresh, well-drained soil are those where the finest examples are found, even though they appear to demand a greater degree of humidity on the more southerly than the more northerly situated localities (MAXIM. 1859, pp. 393—394, and MIDDF. 1867, p. 540). The fact that *L. Gmelini* is most common in localities shunned by other trees, is in agreement with its light-loving characteristic. It may be expressed as follows: it is excluded from richer soil by coniferous trees more tolerant of shadow (*Abies sibirica, A. sachalinensis, Picea obovata, P. jezoensis, P. Glehnii, Pinus silvestris, P. cembra var. sibirica,* and *P. pumila*), and is only deserted by them under the most unfavourable growing conditions, which the larch has greater capabilities of withstanding than the other species. *Pinus pumila* is its closest competitor, and may perhaps even be said to surpass it with regard to the elevations at which it can exist.

TRAUTVETTER's first detailed description of *L. Gmelini* with illustrations is based upon specimens collected by MIDDENDORFF near Novaja at lat. 72½° N., and thus originates from „Die an der äussersten Baumgränse stehende Lärche des Taimyrlandes", as MIDDENDORFF himself expresses it (l. c. p. 748, Note), that is to say, from the same region as MIDDENDORFF's illustration (reproduced here) of the most stunted specimen. A just estimation of *L. Gmelini* as a valuable forest tree widely distributed in Eastern Siberia, and not merely as a dwarf growth on the forest-line towards the Polar Sea, as MAYR still regarded it when he described the larch on the Kurile Islands (MAYR: 1890, p. 99), has been arrived at from the descriptions given by MIDDENDORFF himself, and from the accounts of

Maximowicz, Fr. Schmidt, Wilson, Miyabe & Kudo, Okada, and others. Beyond varying in its form of growth, *L. Gmelini* evinces certain modifications in other particulars, but never to such an extent as to warrant their not being included under one species within the limits adopted in the present paper; it must, nevertheless, be regarded as one of the most variable species of the genus Larix.

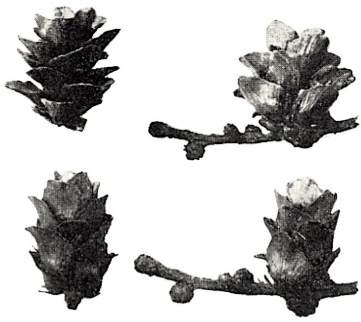


Fig. 14. *L. Gmelini.* (Rupr.) Gordon, small coned (so-called *L. kurilensis* Mayr). Cones from cultivated tree. Denmark, Egelund plantation 1923. (Nat. size, upper row dry, lower row wet.)

The cones may vary in size from quite short (1 cm. or less Fig. 14—15) to almost double the size (2 cms.), but all possess the characteristic straight cone-scales, not incurved, but rather sligthly recurved, truncate or emarginate at the free edge. The straight cone-scales give the cone a characteristic appearance of lightness, specially pronounced in the case of dried specimens.

The one-year's shoots vary from reddish-brown to light coloured, and their degree of pilosity, often very pronounced, varies likewise, and may be completely absent. Reddish-brown and distinctly pilose shoots are stated by Mayr as being characteristic for the larch on the Kurile Islands, and this was generally accepted, until the exhaustive investigations of Miyabe & Kudo (1920, p. 24) showed that this fact alone did not warrant the differentiation between the larch on the Kurile Islands an that on Sachalin. Mayr also described the larch on the Kurile Islands as possessing purple-red female cones when flowering, but Miyabe & Kudo, in common with Wilson, have shown that the flowers of

the Larix on the Kurile Islands and Sachalin were not constant in colour, but that the bright, green colour could also occur (MIYABE & KUDO: Plate 7; and *f. ochrocarpa*; WILSON 1916). It is possible that the one-year's shoots of the larch in Kamtschatka, the Kurile Islands, Sachalin,

Fig. 15. *L. Gmelini* (Rupr.) Gordon. Cones from cultivated specimens. Denmark, Forestry Botanical Gardens, Charlottenlund, 1922. (3/4 nat. size, upper row dry, lower row wet).

Skantar, other lesser islands, and tracts of coast of the mainland, are rather more reddish-brown, and that the colour of the female cone is more often red there than in other localities, but there is not sufficient basis to warrant this larch being classed as a separate variety, and still less for the retention of a distinct species, viz., *L. kurilensis* MAYR.

There is likewise no reason for separating MAYR's *L. Cajanderi* from *L. Gmelini*. The "dichter weissgelber, lockiger Haarschopf", which appears simultaneously with the new leaves, has the same form as that described for the cone-scales of *L. Gmelini*, and there is no deviation in other particulars. MAYR stated that is was found scattered among *L. Gmelini*, along the course of the Lena, from the outlet

of its tributary, the Aldan River, and still farther northwards, *L. Gmelini* occurring alone to the south of it. Mayr based his opinion upon material collected by Cajander in the course of his journey along the Lena from its source to its estuary; but Cajander himself described all the larches along the lower course of the Lena as *L. Gmelini*. Comparing Mayr's illustration of *L. Cajanderi* (Fremdl. Wald und Parkb. 1906, Fig. 88) with Trautvetter's *L. dahurica* (Pl. Imag. Descrip. Fl. Russ. Ill. Fasc. 7, 1846, Plate 32), one may well go so far as to say that Mayr's specimens represent a very typical *L. Gmelini*; it originates, moreover, from a northerly locality (North of lat. 63° N.) similar to that from which Trautvetter derived his material (lat. 72½° N.).

L. Gmelini is stated to have been introduced into Europe in 1827, and put into culture in Denmark in 1889 (or earlier), where attempts have been made to utilise it in the forests (A. Oppermann: 1923, p. 271). To judge by its occurrence on the cold, foggy coasts of the sea of Ochot, it is reasonable to suppose that it possesses forest-forming capabilities in other unfavourable localities, of which we have a pronounced example in the Faeroe Islands.

Besides the variations which we do not think are worth keeping as special varieties (*L. kurilensis* and *L. Cajanderi*), the species-complex *L. Gmelini* has two geographical varieties of more systematic value, viz., *var. olgensis* and *var. Principis Rupprechtii*, both of which occur south of the area of occurrence of the real *L. Gmelini*.

Herb. Mat. examined:

Ad. fluv. Boganida 72½°, Middendorff (Hort. Bot. Haun.); type collection to *L. dahurica*. — Sib. Orient. Udskoi, Exp. Acad. 1844 (Kew). — Ochotsk Sea, C. Wright, Coll. U. S. Explor. Exp. 1853—56 (Kew). — Amur, Maximowicz, ex Herb. Hort. Petropol. — Maximowicz, Iter secund, 1860. Manchuria austro-orient. ad. fontes fluv. Fundim (Kew). — Manschur.

austr. orient. ad Usuri sup., c. 1860, MAXIMOWICZ (Brit. Mus.). — Jap. Hakodate, cult. MAXIMOWICZ, Iter secund. 1861. — (Kew) Dr. ALBRECHT, Jap. Ins. Jezo circa Hakodate, 1861 (Kew). — Sachalin, FR. SCHMIDT (Kew). — Ad. flum. Kolyma, leg. AUGUSTIMOWICZ (Kew). — Sibiria, SCHOCKLEY, 1900, a) Cape Suffein b) Turumcha Crest (Brit. Mus). — Kaborowsk, C. S. SARGENT, 1903 (Kew). — Border of swamps near Srychensk, C. S. SARGENT, Aug. 1903 (Arn. Arb.). — SACHALIN, 1907, FAURIE (Brit. Mus.; Arn. Arb.). — V. KOMAROW, Iter Kamtschatic. secund. leg. V. KOMAROW, No. 247, 1909 (Kew). — Kamtschatka, V. KOMAROW, Iter Kamtsch. secund. 1909 (Kew). — Prov. Transbaicalia, sept. lacus Baical. Herb. Fl. Ross. 1912 (Hort. Bot. Haun.). — Sachalin, 1914, E. H. WILSON, No. 7364 (Brit. Mus.). — Sachalin, 1914, E. H. WILSON No. 7331: *L. dahurica* var. *japonica* f. *ochrocarpa*, WILSON (Brit. Mus.). — Tschapina, Nikolki, Kamtschatka, leg. R. MALAISE, 1921, Svenska Kamtschatkaexp. No. 3468 (Hort. Bot. Haun). — Open country near Togoliara shrine, Sachalin, 1914, E. H. WILSON, No. 7333 (Arn. Arb.). — Cult. HEINRICH MAYR, Grafrath, Bayern, 1927, C. SYRACH LARSEN (Hort. Bot. Haun.). — Det forstlige Forsøgsvæsen, Egelund Planteskole, Denmark. — Copenhagen, Bot. Gardens. — Forestry Botan. Gardens, Charlottenlund, Denmark.

7 b. **Larix Gmelini, var. olgensis** (Henry *1915*) OSTF. & SYRACH L., in Pflanzenareale. II. 7. *1930.*

Syn.:

Larix sibirica, MAXIMOWICZ, 1860, in herb. et apud KOMAROW, in Act. Hort. Petrop. XX, 1901, p. 194. — PATSCHKE in Engl. Bot. Jahrb. XLVIII, 1913, p. 692. — Non LEDEB.

Larix dahurica, KOMAROW, in Act. Hort. Petrop. XX, 1901, p. 190. — NAKAI, in Journ. Coll. Sci. Imp. Tokio, 1911, p. 382. — Non TRAUTV. —

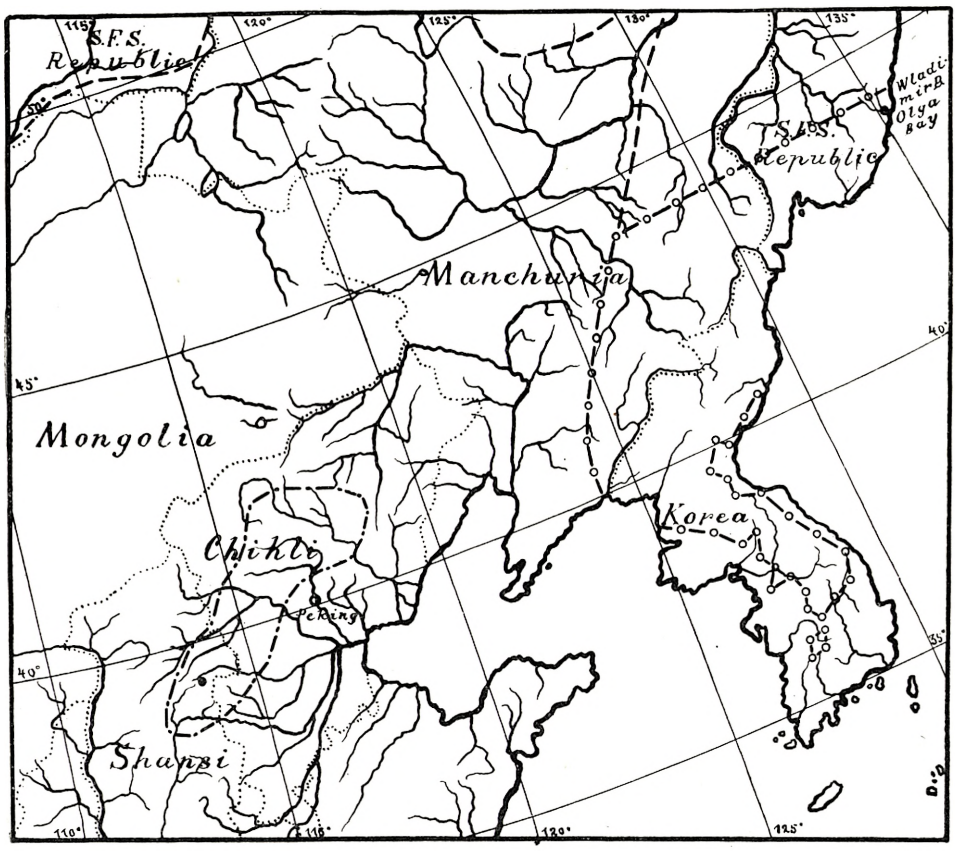
Larix olgensis, HENRY, in Gard. Chron. 27. Febr. 1915, and in Trans. Roy. Scot. Arb. Soc. 1915, p. 147. — KOMAROW, in Act. Hort. Petrop. XXXIX, 1923, p. 23 et 126. — DALLIMORE & JACKSON: Handb. Conif. 1923, p. 295. —

Larix koreensis, RAFN, nomen nudum, in Tidsk. f. Skovv. XXVII, 1915. — O. G. PETERSEN: Forstb. 1920, p. 247. — A. OPPERMANN in Det forstl. Forsøgsv. i Danmark, VII, 1923, p. 273. —

Larix dahurica, var. *koreana,* NAKAI, in TOZAWA & NAKAI, Atlas ill. geogr. Distrib. of Korean woody Plants & Bambo os. I. 1. 1929.

In 1860, MAXIMOWICZ found a larch near Olga Bay on the coast of the Amur district, which he classified as *L.*

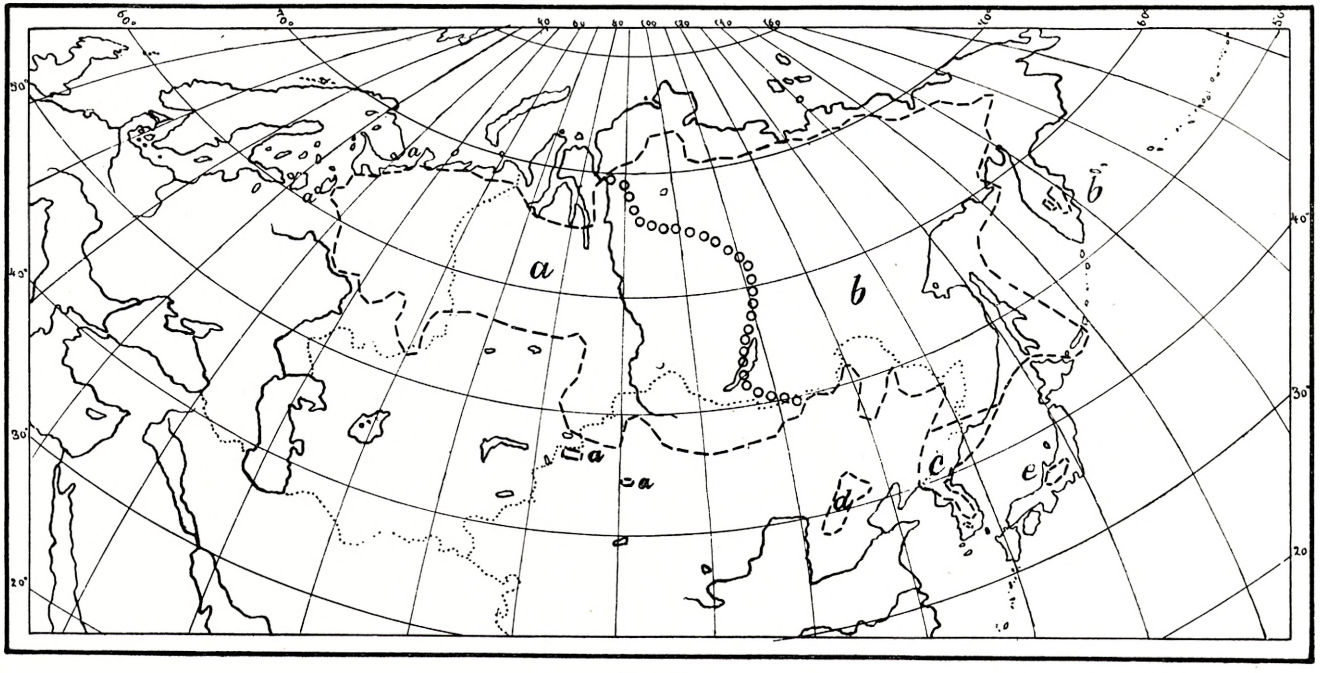
sibirica. It was subsequently described by Henry in 1915 on the basis of the same specimens together with fresh ones from Olga Bay as a new species, *L. olgensis*.



Map IV.

——— *Larix Gmelini (Rupr.) Gord.*
o—o—o—o—o *L. G. var. olgensis (Henry) nob.*
—·—·—·— „ „ „ *Principis Rupprechtii (Mayr) nob.*
o *Type Locality.*

When constituting the new species, Henry specially relied upon the strongly pilose one-year's shoots, and the shape of the cone. As regards the first character, Miyabe



Map V.

a. *Larix sibirica*, Ledb.

b. ,, *Gmelini*, (Rupr.) Gord.

ooooo ,, *Gmelini* x *sibirica*

C. *L. G.* var. *olgensis*, (Henry) nob.

d. ,, ,, ,, *Principis Rupprechtii* (May) nob.

e. ,, *Kaempferi*, (Lamb.) Sargent.

& Kudo have shown that this pilosity of the shoots cannot be used as characteristic for the larch at Olga Bay as opposed to *L. Gmelini*, having found on Etorofu examples of the latter just as pilose. The cone is long with well-rounded cone-scales, giving it a certain superficial resemblance to that of small-coned *L. decidua* or *L. sibirica*, also to *L. Kaempferi*; it deviates to such a marked extent from the hitherto-known type of *L. Gmelini*, that there is warrant for supposing it to be a variety of the latter. It is found over a tract of country extending from Olga Bay and Vladimir Bay southwards through Kirin and the north of Korea, continuing further on the peninsula, as shown on the map (Nakai, 1911, p. 382, Tozawa & Nakai, 1929). On the north it passes over to typical *L. Gmelini*, the transition zone presumably lying in the neighbourhood of Vladivostok, but in such a manner, that *L. Gmelini* extends furthest to the south inland, while *var. olgensis* reaches furthest north along the coast. There is even a possibility that some of the large-coned Larix found on the coast around the Bay de Castries and the mouth of the Amur by Maximowicz in 1854 ought to be classified under this variety. Maximowicz first classified it as *L. sibirica*, but subsequently altered his classification to *L. Gmelini* (Maximowicz: in Bull. Acad. St. Petersburg, XV, 1857, p. 226; Id., Prim. Fl. Amur., 1859, pp. 393—394).

Fig. 16. *Larix Gmelini*. Rupr. var. *olgensis* (Henry) Ostf. & Syrach L. Cone in natural size. (from Henry in The Gardener's Chronicle, Febr. 27, 1915).

L. G. var. olgensis has been cultivated in Denmark under the name of *L. koreensis*, Rafn, nom. nud., and has been shown to possess such good qualities, that the stock is being steadily increased (A. Oppermann, 1923, p. 273). The

cultivated trees show the same characteristic type of cone, the colour of the cone when flowering varying from tree to tree from red through pale pink to green; the shoots vary

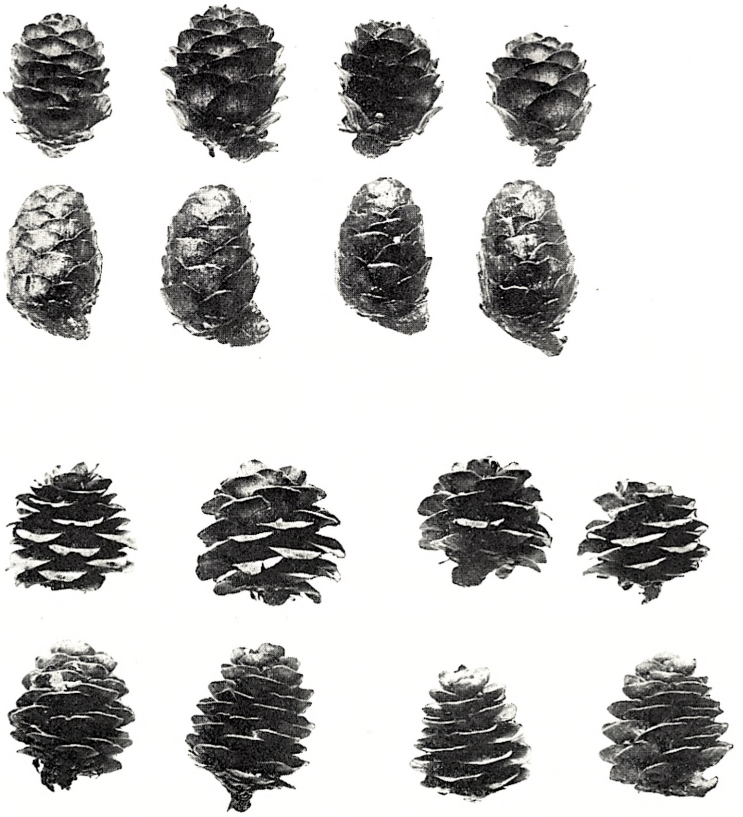


Fig. 17. *L. Gmelini* var. *olgensis* (Henry) Ostf. & Syrach L. Cones from cultivated specimens[1]. Roden forest in Denmark 1922 ($^3/_4$ nat. size, two upper rows wet, two lower rows dry).

from pale to a light chestnut-brown, the majority at all events appearing to be smooth. The oldest examples known in Denmark are to be found in a plantation, Roden Forest, near Aalholm (Lolland), already mentioned in the preface.

[1] The method of photography in this illustration differs from that adopted in most of the others, and the specimens are, therefore, not well suited for comparison with figs. 16 and 18.

They were planted out in 1902 as three-year-old plants, and can be traced back to a seed-merchant in Yokohama.

Herb. Mat. examined:

Manschuriæ austr.-orient. St. Olga, Maximowicz, 1860, Type (Kew); Co-type (Brit. Mus.). — V. Komarow: Fl. Manschuriæ, No. 80, 1897, Distr. Musang, trajectus Pzao-sieng, Korea sept. (Kew). — Korea, Ma-Mi-hint, F. N. Meyer, 1906, No. 169 (Kew). — Arnold Arb. Exp. 1917—18: Korea, Prov. N. Kankyo, 1917, Nos. 8948, 8962, 8977 and 9044 (Snow Mt.).

Fig. 18. *L. Gmelini* var. *olgensis* (Henry) Ostf. & Syrach L. Cultivated in Denmark, Egelund Plantation, 1923. (Nat. size, upper row dry, lower row wet).

Prov. S. Kankyo 1917, Nos. 9151 and 9152 (all in Kew and Brit. Mus.). Prov. N. Kankyo, No. 8893 and 9037 (Arn. Arb.) — Culta in Dania, ins. Lolland, Roden Skov (seeds sown 1899, plants coll. 1922); ins. Sjælland, Egelund (seeds sown 1914, plants coll. 1923).

7 c. **Larix Gmelini, var. Principis Rupprechtii** (Mayr *1906*) Ostf. & Syrach L., in Pflanzenareale II. 7. *1930.*

Syn:

L. dahurica, Hance, in Journ. Bot. IV, 1875, p. 138. — Bretschneider, in Peterm. Mittl. 1876, No. 46, p. 37—39. — Masters, in Journ. Linn. Soc. Bot. XVIII, p. 522. — Patschke, in Engl. Bot. Jarhb. XLVIII, 1913, p. 706. — Non: Trautvetter.

L. sibirica, Franchet: Pl. David I, 1884, p. 97. — Patschke, in Engl. Bot. Jahrb. XLVIII, 1913, p. 706. — Non: Ledebour.

L. Principis Rupprechtii, Mayr: Fremdl. Wald- und Parkb.

1906, p. 309. — ELWES & HENRY: Trees. Gr. Brit. and Irel. II, 1907, p. 346. — DALLIMORE & JACKSON: Handb. Conif. 1923, p. 298. —

L. dahurica var. Principis Rupprechtii, (MAYR) REHDER & WILSON, 1914, in SARGENT: Pl. WILSON II, p. 21 (p.p.). — REHDER, in Journ. Arnold Arb. IV, 1923, p. 121. — REHDER: Man. Trees and Shrubs, 1927, p. 52. — HSEN-HSU HU & WOON-YOUNG CHUN: Icon. Plant. Sinicarum, 1927, Pl. 1.

Inhabiting an area which is now completely separated from that of *L. Gmelini* and *var. olgensis*, another variety of *L. Gmelini* is found, namely, var. *Principis Rupprechtii*. Its area of distribution extends over the mountains west and north of Peking through the provinces of Shensi and Chili. No forest is found north of the Yellow Sea. (Maps IV og V).

The province of Shonking, north of the Yellow Sea, was once rich in forests, which in earlier times probably formed the link between the two now widely separated forest tracts, containing respectively *L. Gmelini var. olgensis* and *var. Principis Rupprechtii*. The separation has taken place partly in recent times, and has been caused by extensive afforestation, which in that district has produced a wide extent of country devoid of forest (W. PATSCHKE in Engl. Bot. Jahrb. XLVIII, 1913, p. 705).

In 1903, HEINRICH MAYR discovered in Wutaishan, one of the most southerly localities in its area of distribution, the material on the basis of which he put forward the species *L. Principis Rupprechtii*. MAYR's cones (Fig. 94 in Fremdl. Wald- und Parkb.) are very large, and present many points of difference from those of *L. Gmelini*. The larch which WM. PURDOM found in 1909 in the same district — near some temples in the village of Wutai — has rather smaller, or much smaller, cones (Arnold Arboretum Expedition to the north-west of China, 1909, No.

161 a and 161 b), and together with other specimens, shows modifications towards *var. olgensis.*

The types of the two varieties have been taken from localities lying as far apart as possible, and for this reason it is only natural that careful investigation within the

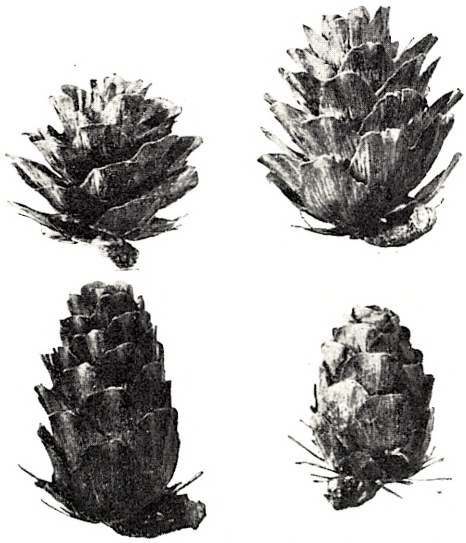


Fig. 19. *L. Gmelini* var. *Principis Rupprechtii* (Mayr) Ostf. & Syrach L. China, Shansi, Wutai village (leg. W. Purdon, 1909), (large-coned). (Nat. size, upper row dry, lower row wet).

radius of distribution has led to the discovery of material showing less pronounced differences than the types, but which, on the other hand, illustrate the transitional stages from the one to the other.

Breitschneider found *var. Principis Rupprechtii* during his ascent of the mountain Po-hua-shan on the west of Peking, where, apart from its having been planted near the temple on the summit of the mountain at a height of about 2200 m. above sea-level, it was also found scattered on the slopes of the mountain (Peterm. Mittl. 1876, No. 46, pp. 37—

39). MAYR's account of its occurrence in 1903 includes an isolated specimen near a temple, and some old trees on a slope of a neighbouring mountain. Together with these, the oldest, accounts, PURDOM's observations, showing that the tree has now become very rare on the mountains west of Peking (Pl. Wils. II, p. 21), give the impression of a rapidly declining tree, and one which, at any rate, is now found for the most part scattered in the higher mountain regions, 2000—3000 m. above sea-level.

Neither does it appear to be a particularly tall tree, the greatest dimensions given being 20—25 m. high with a girth of 2 m. The cone is cylindrical, being longer, and possessing considerably more cone-scales, than either *L. Gmelini* or *L. G. var. olgensis.* The shape and number of the cone-scales are reminiscent of *L. sibirica,* with which FRANCHET also classified it on the basis of DAVID's specimens. It differs, however, quite distinctly from *L. sibirica* in its smooth, thinner cone-scales, which are not incurved along the free margin, and are more openly arranged, thus giving the cone that appearance of lightness and openness characteristic of *L. Gmelini* and its varieties, and which is especially apparent when dry. MAYR's cones, which seem to be of unusual size, are 4,2—4,3 cms. in length; cones from 2400 m. above sea-level in Wutai-shan (PURDOM, No. 161 b) are 2—3 cms. long, while others from 2550 m. above sea-level in the same district are only $1^1/_2$—$2^1/_4$ cms. in length, but they are all more slender and narrower in comparison with the length than the cone of *L. Gmelini.* The, relatively, still larger size of the cone is the only point of difference between it and *var. olgensis.* The cone when flowering is red with a pale midrib in the bracts, according to WM. PURDOM's specimens in the U. S. National

Herbarium, but other information with respect to the colour is lacking. This larch is not found in cultivation in Denmark, where everything bearing a resemblance to it almost certainly has its origin in Korea, and belongs to *var. olgensis.*

Dallimore & Jackson (Handb. Conif. 1923, p. 298) are incorrect in citing Rehder & Wilson as the authors of the species *L. Principis Rupprechtii;* Rehder & Wilson were the first to classify it as a variety of *L. dahurica,* while Mayr must still be accounted the author of the species, if it is to be maintained as such.

On the occasion of the Arnold Arboretum Expedition to the East in 1917—1918, Wilson discovered a larch with a peculiar cone, which he has named *L. dahurica var. Principis Rupprechtii f. viridis.* Two trees of unknown origin have been planted near the monastery of Yutingi in Kongosan in the province of Kogan in Korea. The cones of the specimen lying before us (No. 10508) vary in length from 2,5 to 3,5 cms., and in breadth from 2,3 to 2,6 cms. (open and dry). The cone-scales are faintly emarginate, of a reddish-brown colour, with a distinct blue bloom. The bracts are blue-black, and are visible between the cone-scales. The light, open structure of the cone characteristic of *L. Gmelini* and its varieties is absent; in its place there is a close, solid structure which, together with the long, cylindrical cone, is reminiscent of *L. decidua.* It is impossible to come to any definite conclusion with regard to this form; further researches on the spot and cultivation are necessary.

Herb. Mat. examined:

Po hua shan, China bor. 1876, Bretschneider No. 14480 (Kew; Brit. Mus.). — Wutai shan, Wutai village, temple grounds, Shansi prov. 1909,

Wm. Purdom, Arn. Arb. Exp. N. China, No. 161 a and 161 b (Arn. Arb.; U. S. Nat. Mus.; Brit. Mus.; Hort. Bot. Haun.). — Hsiae, Wutai shan, Chili, China, 1913, F. N. Meyer (Kew). — Chili, Arn. Arb. Herb. J. Hers, Nos. 2018 and 2116 (Kew). — West-Weichang, North Chili, 1909, Wm. Purdom (Arn. Arb.).

8. **L. sibirica,** Ledebour, Flora Altaica, IV, *1833* p. 204.

Carrière: Trait. Conif. 1855, p. 274. — Trautvetter, in Middf. Reise ,I, 2'. 1. 1847, p. 170. — Trautvetter & Meyer, in Middf. Reise, I, 2'. 2. 1856, p. 88. — Herder, in Act. Hort. Petrop. XII, 1892, p. 101. — Sargent: Silv. N. Am. XII, 1898, p. 3. Note. — Köppen: Geogr. Verbr. Holzg. europ. Russl. II. 1889, p. 489. — Printz: Veget. Sib. Mong. Front. 1921, p. 112. — Elwes & Henry: Trees, Gr. Brit. and Irel. II, 1907, p. 374. — Rehder: Man. Trees and Shrubs, 1927, p. 51.

Syn:

Pinus Larix Europœæ, Pallas, Fl. Ross. I, 1784, p. 1, Tab. 1, Fig. A, B, & C. —

Pinus intermedia, Fischer, in Schtschagl. Anz. f. Entdeck. 1831 (nomen nudum). — Turczaninow, in Bull. Soc. Imp. Nat. Mosc. XI, 1838, p. 101 (nomen nudum). —

L. europaea var. sibirica, Loudon: Arb. & Frut. Brit. IV, 1838, p. 2352.

L. intermedia, Turczaninow, in Bull. Soc. Imp. Nat. Mosc. XI, 1838, p. 101. (nomen nudum). — K. Koch: Dendrol. 1873, p. 260. —

Abies Ledebourii, Ruprecht in Beitr. Pflanz. Russ. Reiches, 2' Lief. 1845, p. 56. —

Pinus Ledebourii, Endlicher: Syn. Conif. 1847, p. 131. —

L. decidua var. Rossica, Henkel & Hochstetter: Syn. Nadelh. 1865, p. 132. — Regel in Gartenfl. XX, 1871, p. 101, and in Act. Hort. Petrop. I, 1871, p. 157. —

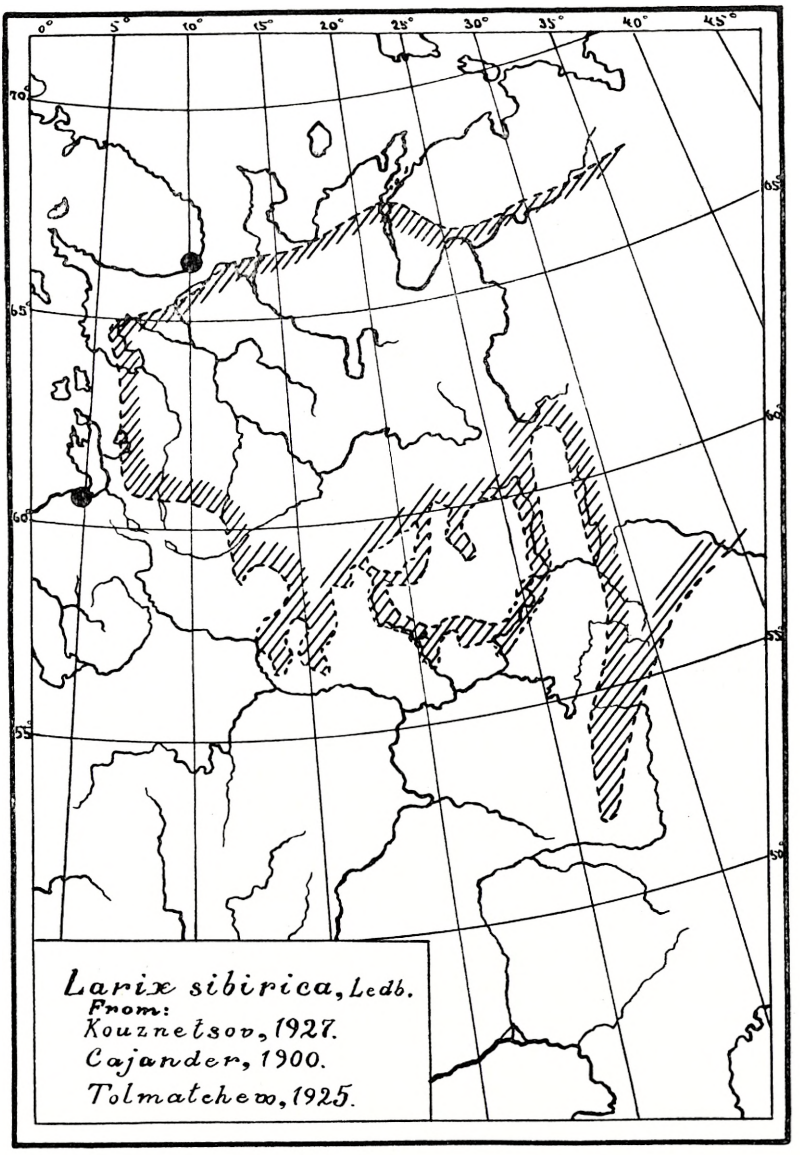
L. decidua, var. sibirica, Regel, in Gartenfl. XX, 1871, p. 101, and in Act. Hort. Petrop. I, 1871, p. 156. — Korshinsky, in Mém. Acad. Imp. Sci. Mosc. 8' Ser., VII, 1898, p. 493. —

L. Rossica, Trautvetter, in Act. Hort. Petrop. IX. 1884, p. 212.

We have seen the manner in which *L. Gmelini* occurs in Eastern Siberia; *L. sibirica* presents the parallel in Western Siberia and the north-east of Russia, where it is a common forest tree. Its area of distribution extends unbroken from Lake Baikal in the east to the White Sea,

terminating in the west quite near to Lake Onega (Cajander). Its most northerly point reaches Jenisej, where, according to Scheutz (1888, p. 41), it is to be found right up to the Arctic Sea (see under *L. Gmelini* in this paper, p. 40). From this point, lat. 69°—70° N., it may be found growing everywhere southwards to the Altai Mountains, and the area reaches its southern extremity in two isolated localities a little more to the south on the southern slopes of the Sair Mountains at lat. 46°—46½° N. and near lat. 45° N. (Price & Simpson in Journ. Linn. Soc. Bot. XLI, 1913, p. 444). On the south-east point of the Kola peninsula there is an isolated, presumably wild, specimen. It is about 3½ m. in height, and is supposed to be more than 150 years old. It is situated 3 km. from the sea, and 2 km. from Ssosnowka (Tolmatchew in Sv. Bot. Tidskrift, 1925, p. 523). (See Map V).

The border-line of its occurrence has been drawn on the map according to several different sources. In European Russia, Kouznetsov's revision of Köppen's map has been adhered to in the main (Köppen; Geogr. Verb. Holz. 1889, Map IV, and Kouznetsov in "vol. jubil. à I. P. Borodin" 1927) (see our Map VI), and also Blomqvist (Finsk Forstf. Medd. 1887, pp. 152 and 153). Towards the east, more particularly north of the Urals, the line has been extended farther out towards the Arctic Sea in agreement with Middendorff (Midd. Reise, IV, Part I, p. 531), who gives the most northerly point of occurrence in Europe as being about the source of the Kara in the extreme north of the Urals at lat. 68° N. Further eastwards, the boundary is likewise Middendorff's (l. c. pp. 531—532), and has only been moved close to lat. 70° N. near Jenisej, as already stated, in conformity with Scheutz, Middendorff having placed it a little more to the south, attributing the occur-



Map VI.

rences of larch in the extreme north to *L. Gmelini* (for which we refer to *L. Gmelini).* Towards the east, it is bounded by the belt of intermediate forms, also mentioned under

L. Gmelini (*L. Czekanowskii*, Szafer), and we find the reports of the most easterly occurrence of *L. sibirica* within this belt, where Cajander found it on the Lena almost as far east as Oleminsk (Act. Soc. Sci. Fen. XXXII, No. 3, p. 8). In a southerly direction, it has been collected in the forest east of Urga and north of the river Tola (C. W. Campbell, 1902, Kew Herb.). In determining the borderline towards the south, we have the exhaustive reports of Printz (Veget. Sib. Mong. Front. 1921), and the already-mentioned observations of Price & Simpson for the eastern section; but from this point, where we are without their observations in the south of Russian Siberia, and until we reach European Russia, special investigations regarding the larch are lacking. The most probable boundary is the one given here (according to Zon & Sparhawk: Forest Resources of the World, 1923, p. 286), as it undoubtedly everywhere constitutes one of the farthest-reaching forest outposts. Its occurrence in the Urals has been investigated by both Köppen and Korshinsky, and their observations, have been followed here. Their statement, that *L. sibirica* is not to be found on the western side of the Urals towards the north right up to the source of the Petschora, has, nevertheless, been somewhat modified, the boundary having been fixed at a rather less northerly point. Köppen also mentions a more southerly line than Korshinsky. The boundary line in the southern outposts of the Urals has been drawn according to Korshinsky's and Kouznetzov's maps, which are the most detailed; the two isolated occurrences on the south-east of the Urals are included in the general are of distribution.

In the north of Russia and in Siberia, the West-Siberian larch is, as a rule, only a small tree, but along the sides

of the rivers, where it is protected, and where the soil is fresher, it may develop better; in the extreme north, however, where it occurs on the forest-line, only stunted individuals are met with (MIDDF. l. c.; GOREDKOV, 1926, Ref. in Bot. Centralbl. XX, 1927, p. 246).

In northern European Russia, the larch does not reach the forest-line, which chiefly consists of *Picea obovata*, but the situation changes as it approaches the Urals, where it becomes the only tree among the forest outposts, and this continues to be the case farther east (RIKLI in Vierteljahrsschrift, Nat. Gesell. Zürich, XLIX, 1904, p. 132; vide CAJANDER, 1903).

The tree is of common occurrence and one of value in the entire southern area; it is seen at its best in the Urals and the mountains towards the south-east in the western part of Altai. KRASSNOFF (1886, Ref. in Engl. Bot. Jahrb. IX, 1888, pp. 53—67) has investigated the occurrence of the larch in the western part of Altai, and particularly discussed the problem of its natural regeneration, which only takes place with difficulty in these regions. Further towards the east in Altai, in Tannu-ola, and other portions of the extreme north-west of Mongolia, its occurrence has been described by PRICE & SIMPSON (l. c. pp. 391 – 398). The best and most recent description of the West-Siberian Larch in its natural surroundings is PRINTZ's detailed account of its occurrence and development in Tannu-ola and the Sajan Mountains and the adjacent steppes. The area is an interesting one, the larch being described in all its forms, from the highest development in the fertile, fresh mountain-soil, to its isolated, decrepit appearance on the steppes.

Under the most favourable circumstances, it may attain a height of over 40 m. with a diameter of about

1,5 m. A warm, fresh soil is especially favourable to its growth, and in such localities it forms more or less pure groups, while it is otherwise met with in forests scattered among *Pinus silvestris, Picea obovata, Abies sibirica,* and *Pinus cembra var. sibirica.*

On the forest steppes the larch is the dominating tree. On the steppe between the Sajan Mountains and Tannu-ola, small sporadic specimens of the larch are found along the upper course of the River Jenisej. West of the Sajan Mountains, on the Abakan steppes, it is found where the ground rises in low ridges, and it also occurs along the courses of the rivers and on the small islands lying in their beds. Here it is often mingled with *Pinus silvestris,* birch (*B. pendula*), and poplar (*P. laurifola, P. tremula,* and *P. nigra*) (Printz, 1921, p. 112). Good illustrations of *L. sibirica* are to be found in Printz's book, and in B. A. Keller's paper: Im Berg und Tal des Altai I, 1914, Plate 5 (see Fig. 20).

Of the other species of larch, *L. sibirica* most resembles *L. decidua,* of which it has sometimes been regarded as a variety (Loudon, Regel, and Korshinsky).

In the absence of flowers or cones, they are also difficult to distinguish; their leaves are similar, although those of *L. sibirica* are somewhat longer than those of the latter; the light-coloured bark is another point of resemblance.

Under cultivation, the young tree of *L. sibirica* is characterised by its crown, which is remarkably narrow, but the young tree is perhaps most easily recognised by the sweet, pleasant scent which becomes apparent under dry conditions, and which is not found in the European larch.

The cone of *L. sibirica* is, when flowering, green, or

faintly rose-coloured, varying to a deeper red, in which case the colour approaches that of *L. decidua*. Material taken from the province of Irkutsk (Herb. Fl. Russ, 1907,

Fig. 20. *Larix sibirica* Ledeb. Trees of good size from Altai. (From KELLER, Altai I. 1914).

No. 2545), and from a forest east of Urga and north of the river Tola in Manchuria (C. W. CAMPBELL, 1902, Brit. Mus.) shows flowering cones of just such a colour, but, as a rule, they are of a lighter red, or almost green. The cone is 3—4,5 cms. long, composed of numerous scales, 30—40 in number, and is in this particular reminiscent

of the cone of *L. decidua* or *L. Gmelini var. olgensis*. Its incurved cone-scales, with their inflexed free margins nevertheless constitute *L. sibirica* a well-defined species, and its characteristics do not appear to vary much,

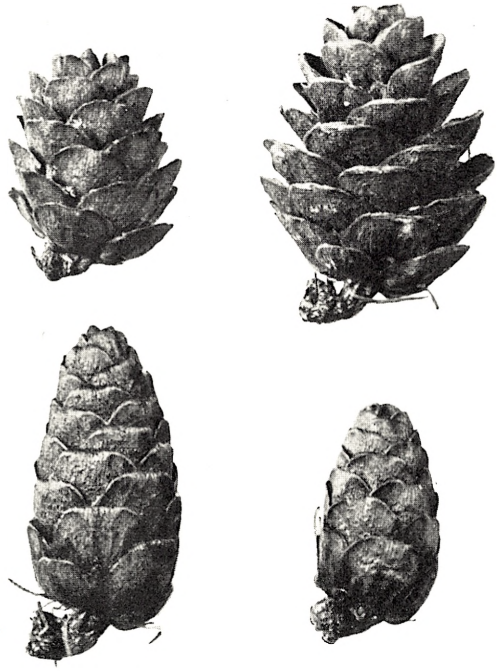


Fig. 21. *L. sibirica* Ledeb. Kuretj on the western side of Lake Baikal, in mixed forest, leg. Sukatschew, 1928. (Nat. size, upper row dry, lower row wet).

although it shows some transition into *L. decidua* in the most westerly area of occurrence, *L. decidua var. polonica* being a stage approaching *L. sibirica*. The outer-side of the cone-scale is, moreover, faintly pilose to closely matted, chiefly at the base. At maturity, the cone-scales open more than is the case with *L. decidua*, but not so much as *L. Gmelini*, and the wing of the seed does not reach quite as far as the free margin of the cone-scale.

L. sibirica was introduced into Denmark by SCHÄFFER, and it was planted in the Castle Garden at Hørsholm in 1796 (A. OPPERMANN, 1923, p. 257), but is has never become common, although it is to be found in several dendrological collections, and experiments are still being made with it in forestry, but on the whole it does not seem to grow well with us, and is usually strongly attacked by *Dasyscypha Wilkommi.*

Herb. Mat. examined:

Altai, LEDEBOUR (Kew). — Altai (Brit. Mus.). — Sasan Gebirge, Chonna Engate, STUBENDORFF 44. (Brit. Mus.). — Little Atlim and Jumbemjol, Siberia, c. 1880, CH. HAGE (Hort. Bot. Haun.). — East Mongolia, forest E. of Urga and N. of Tola River 1902, C. W. CAMPBELL (Brit. Mus.). — Prov. Irkutsk, distr. Balagansk, in insula fl. Angara pr. Sczerbaczewa, 1907, Herb. Fl. Ross., Mus. Bot. Acad. Imp. Petropol. edit. (Hort. Bot. Haun.). — Mongol & Turkestan Exp. 1910, M. P. PRICE, Gloucester. Kobdo River, Mongol.; several other specimens from the same Expedition without locality (Kew). — KASNEZKY, Alatau reg. flum. Tom. 1909, B. KLOPOTOV (Kew). — Pl. of Siberia, F. N. MEYER. Near Sajansk, S. W. Siberia, 1911 (Kew). — Pl. of Siberia, F. N. MEYER. Near Ak-selan, Altai 1911, (Kew). — St. Irkutsk, W. SUKATSCHEW, 1928 (Hort. Bot. Haun.). — The Bays Kurkut and Koty, Mt. Chargana and at the village Kuretj, all on the western side of Baikal lake, W. SUKATSCHEW, 1928 (Hort. Bot. Haun.).

9. **L. decidua,** MILLER: Gard. Dict. 8'. *1768.*

K. KOCH: Dendrol. 1873, p. 258. — KIRCHNER, LOEW & SCHRÖTER: Lebensgesch. Blütenpfl. Mitteleuropas I, 1906, p. 155. — REHDER: Man. Trees and Shrubs, 1927, p. 51. —

Syn:

Pinus Larix, LINNÉ: Spec. Pl. 1753, p. 1001. — LEDEBOUR: Fl. Ross. III, 1846—51, p. 672. —

Abies Larix, POIRET in LAMARCK: Dict. VI, 1804, p. 511. —

L. europœa, DE CANDOLLE in LAMARCK: Fl. Franc. III. 1805. p. 277[1]. — CARRIÈRE: Traît. Conif. 1855, p. 276. — ELWES & HENRY: Trees, Gr. Brit. and Irel. II, 1907, p. 349. — BEISSNER: Nadelholzk. 1909, p. 311. — DALLIMORE & JACKSON: Handb. Conif. 1923, p. 281.

[1] On the title page is given 1815, but it should be 1805; according to a note from A. DE CANDOLLE. Conf. ELWES & HENRY, II, 1907, p. 349. Note. —

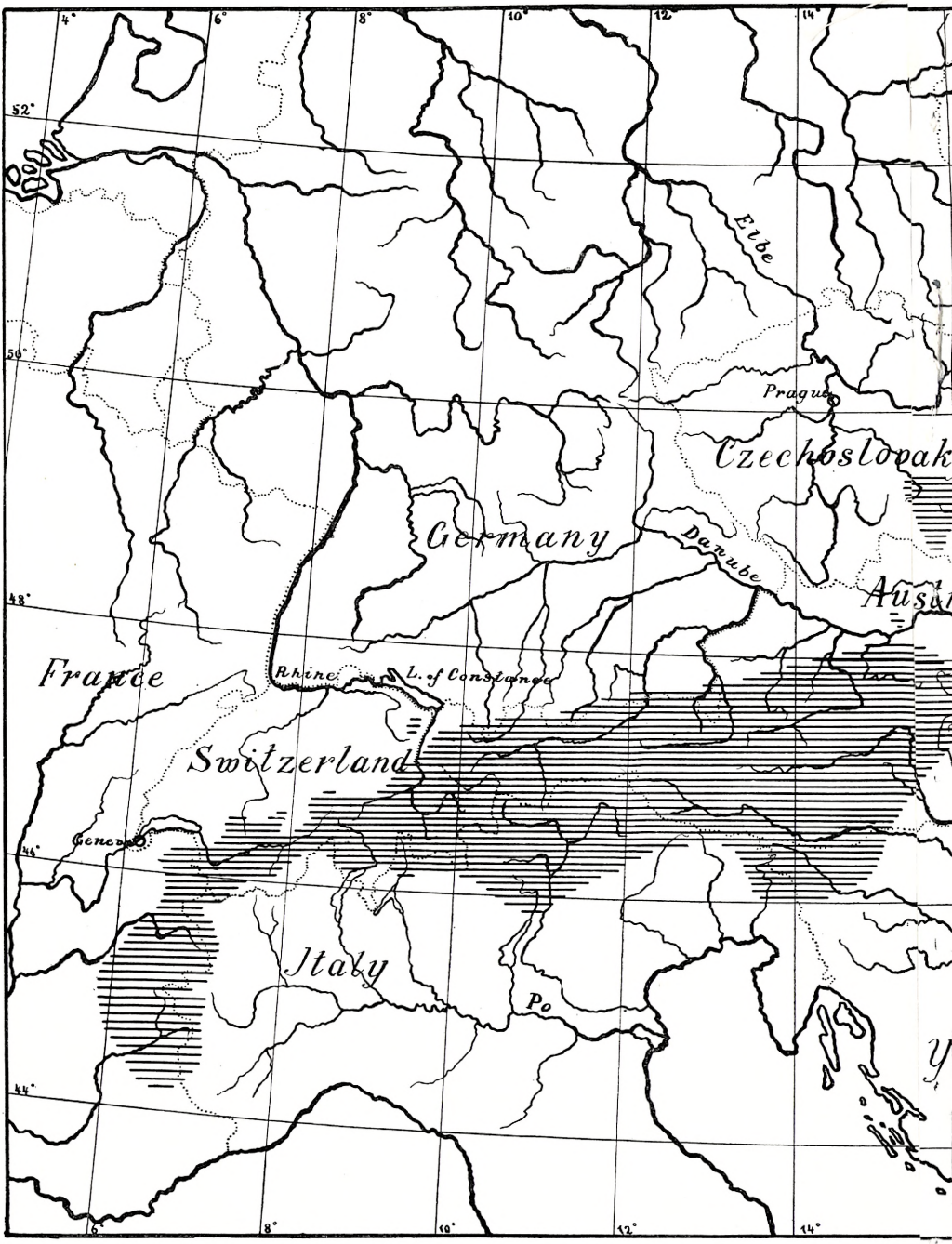
Larix larix, Karsten: Pharm. med. Bot. 1882, p. 326. — Sargent: Silv. N. Am. XII, 1898, p. 3. Note. — Ascherson & Graebner: Synop. 2'. I, 1913, p. 313.

The European Larch, *L. decidua*, extends from Dauphiné and Provence northwards and eastwards through the Alps to a point 40—50 km. south-west of Vienna, where its main area of occurrence reaches the most extreme northwesterly point. In the north-west corner of Yugo-Slavia and the north-east corner of Italy it reaches southwards to lat. 46° N., extending to lat. 44½° N. in the west (Willkomm: Forstliche Flora, 1887, p. 144), and probably even a trifle further southwards to between lat. 44½°—44° N. It also occurs spontaneously towards the north-east in the southern district of the Sudetic Mountains and Tatra, and there may be two isolated localities in the Transylvanian Alps.

The occurrence of the larch in the French Alps has been mentioned sufficiently frequently (Grenier & Godron: Fl. France, III, 1855, p. 156; Honoré Ardoine: Fl. Alp. Maritim, 1867, p. 346; Rouy: Fl. France, XIV, 1913, p. 359), but a detailed description, such as, for example, Christ's account of the species in Switzerland, is wanting. It is found in Savoy, Dauphiné, and in the Provincial Alps and no doubt extends somewhat into the Maritime Alps, its southern limit being probably, as already stated, between lat. 44° and 44½° N. Briquet's account of the larch in the French Alps which approach the Lake of Geneva (Briquet in Ann. Conserv. & Jard. Génève, III, 1889, pp. 46—146), indicates an occurrence in larger or smaller quantities at an elevation of 600—1800 m. above sea-level, and points to the fact that the natural forests have been greatly over-exploited, and finally, that it is

partly being superseded by other kinds of trees. In all probability, a similar state of affairs holds good for its distribution in a southerly direction, where it is nevertheless found growing higher up in the mountains. Thus it is found forming dense woods at an elevation of 2300 m., and can be seen in small groups as high as 2400—2500 m. above sea-level (FLAHAULT in COSTE: Fl. France, I, 1901, and in Rev. Eaux et Forêts, 1901).

The border-line of distribution in the present paper has been drawn in accordance with CHRIST's map of the occurrence of the larch in Switzerland (CHRIST: Pflanzenl. Schweiz, 1879, Map II), and is continued in an easterly direction in conformity with the statements of KERNER and CIESLAR (KERNER: Pflanz. Donauländer, 1863, and CIESLAR in Centralbl. Forstw. 1904, pp. 2—9). Of these the latter is one of the most recent and detailed descriptions of the geographical distribution of the European Larch, and is the work which has been most closely adhered to here. The small area of occurrence north of the Danube near Pöggstall and Jaurling has, nevertheless, been included on the authority of KERNERS' positive statement that it grows wild in this locality (KERNER: l. c. p. 158). The area of distribution in Czeko-Slovakia on the south-easterly frontier of Bohemia, and the south-easterly portion of the Sudetic Mountains, is drawn according to CIESLAR and HAYEK (HAYEK: Die Pflanzendecke Österr. Ung. I, 1916). HAYEK remarks, that it is hardly possible to define with any degree of certainty the area of distribution where the larch grows wild, and the same is undoubtedly the case with regard to the other area on the Bohemian frontier. There appears, however, to be no doubt that the larch exists in the wild



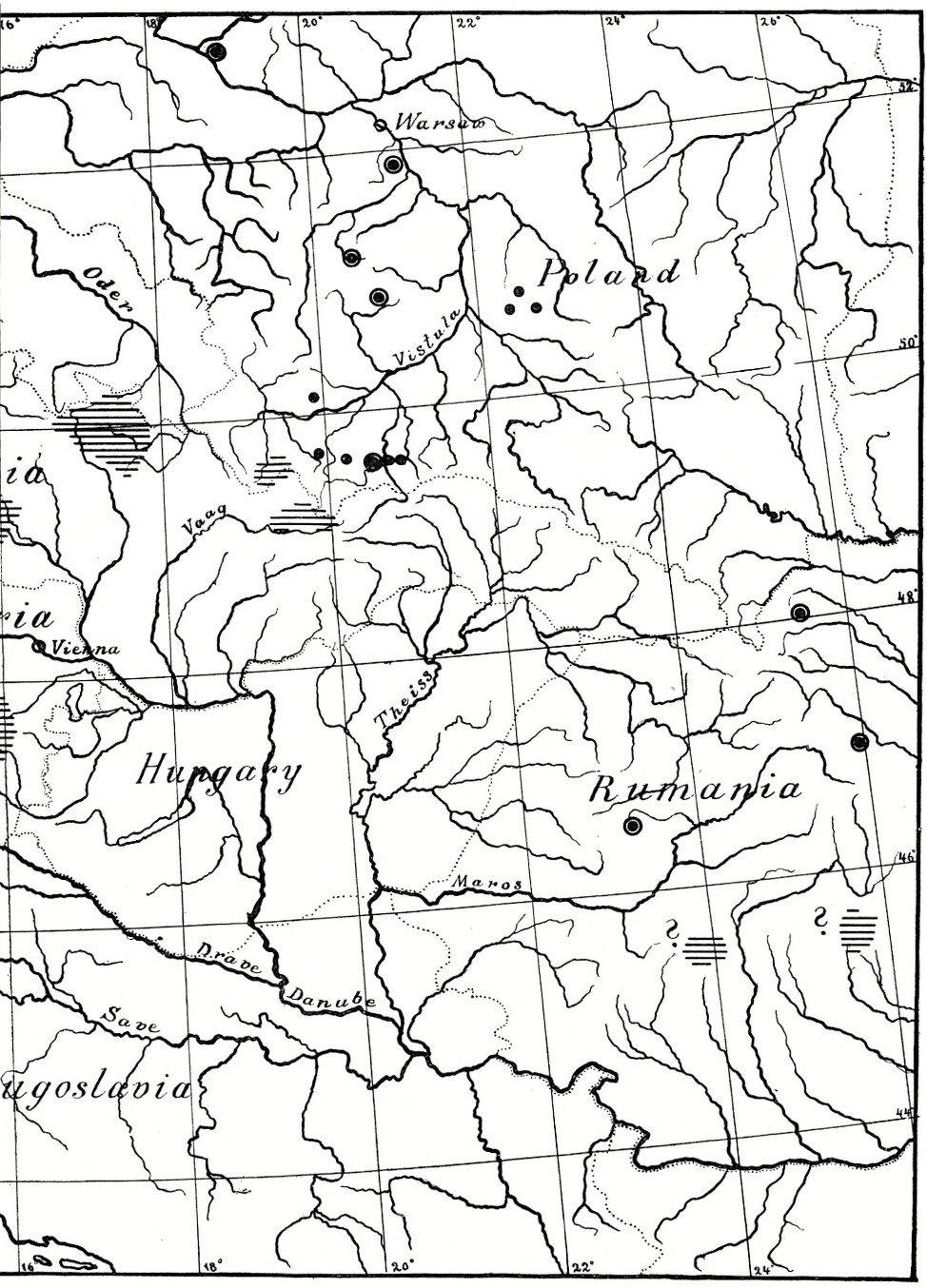
Larix deciduа, Mill.

L. d. var. polonica, (Racib.) nob.

Natural Forest.

Single Specimens.

Map


Warsaw
Poland
Oder
Vistula
Vaag
Vienna
Theiss
Hungary
Rumania
Maros
Drave
Danube
Save
ugoslavia
16°
18°
20°
22°
24°
26°
52°
50°
48°
46°
44°

VII.

state in both these areas; the only point of uncertainty is the extent of the two localities in question.

Of the two smaller localities still further eastwards, the most southerly lies in Tatra, where the larch occurs scattered on the slopes towards the valley of the Waag (Cieslar: l. c. p. 4; Hayek: l. c. pp 343 and 395; and Sagorski and Schneider: Fl. Centralkarpathen, I, 1891, p. 569). The forest-line here is formed of stunted larches, which in the highest parts grow at an elevation as high as 2000 m. above sea-level. The other locality north-west of Tatra lies in Babia góra on the frontier between Czeko-Slovakia and Poland (Vierhapper in Öster. Bot. Zeitschr. LXI, 1911, p. 229. Vide Cieslar in Centralb. ges. Forstw. XL, 1914. p. 182, Note).

Beyond the area of distribution mentioned here, *L. decidua* has also been reported far out towards the south-east in the Transsylvanian Alps, where Hayek cites two localities, one to the south (see Map VII), and the other to the west of Kronstadt, in the Cibin Mountains, where it is found in the neighbourhood of the Zood valley at an elevation of 1400 m. above sea-level and upwards. The first-mentioned locality has also been described by Maack (Zeitschr. Forst. Jagdw. XXXVI, 1904, p. 644), who gives a detailed account of forest remains, including specimens of considerable dimensions in the mountains, growing at altitudes from 1300—1600 m. above sea-level, and mentions that timber for the castle at Sinai was fetched from this spot. The larch in both these localities is undoubtedly the original species; the only point not decided being whether the tree is the typical *L. decidua*, as there seem to be reasonable grounds for believing that it may be *L. d. var. polonica*.

The colour of the young shoots and the colour of the

leaves is reminiscent of the West-Siberian Larch, which, in the coneless state, is most easily distinguishable from *L. decidua* by the scent of dried specimens, absent in the case of the latter, as mentioned under *L. sibirica*. The young shoots are smooth and yellowish, the leaves 2—3 cms. long, of a fresh, green colour. The bracts, which are of a deep purple-red are, during the flowering season, much longer than the green, or faintly red, cone-scales, which they entirely cover. This purple-red colour is absent from the bracts only in exceptional cases, the whole female cone being then green or whitish instead. The last-mentioned form (*flore albo*, Loudon, 1838) is found in Wallis, the Engadine, and in the neighbourhood of Flühelen in Switzerland (Christ: l. c. p. 225; Asch. & Graeb. l. c. p. 314). The cone is long and cylindrical, consisting of a large number of scales — 30 to 40 — and is generally 2,5—4 cms. long, but specimens as long as 6 cms. have been collected by Coaz in the Münster valley at Graubünden (Beissner: 1909, p. 312, Note). The cone-scales are straight and thin at the free margin, which is broad and rounded, or slightly incurved. The seed-wings are as long as the cone-scales, and reach their extreme edges, so that they are, relatively, a trifle longer than in the case of *L. sibirica*. The exterior of the cone-scales is smooth or pilose, but seldom so pronounced as in the case of *L. sibirica*, and the bracts of the mature cone are visible at the extreme base of the cone, being wholly covered on the other parts.

During the younger period of growth, the tree is pyramidal in shape, but the appearance becomes less pronounced the older it becomes. The bark of old trees becomes furrowed, and sheds in larger or smaller plates, thus exposing portions of the reddish-brown inner bark. The heart-wood is

handsome, strong, and of great durability; its value is further increased by the trunk being frequently straight,

Fig. 22. *L. decidua* Mill. Cones of cultivated specimens from Denmark, 8 different collections (3/4 nat. size, all wet).

and often attaining considerable dimensions. The greatest height observed is presumably 53,7 m., or perhaps a trifle higher (Oppermann: 1923, p. 216; vide Elwes & Henry: II, 1907, p. 349). The corresponding diameter was 1,1 m.,

which indicates a well-formed tree, but far greater girths combined with less height have been observed.

Fig. 23. *L. decidua* Mill. Cones of cultivated specimens from Denmark, 8 different collections. (3/4 nat. size, the same cones, all dry).

L. decidua often varies in its growth, and several well-pronounced forms have been found — pendulous, globular, and so on —. CIESLAR has differentiated the larch found in the Sudetics as a separate form with more slender trunk

and crown, thinner branches, later leafing, and earlier fall (Cieslar: l. c. 1914, pp. 171—174; vide Schreiber in Centralb. ges. Forstw. 1921, p.p. 1—30 and pp. 76—99), and the larch which has been grown in Scotch forests for the last two hundred years is also regarded as a separate form with good qualities from the forestry point of view (G. Schotte, 1917; A. Oppermann, 1923). The height of 53,7 m. with a corresponding diameter of 1,1 m. was found at Jägerndorf in the south of the Sudetic Range, which shows it to have been discovered within the area indicated by Cieslar as being the district for the good Sudetic Larch.

The European Larch is one which has been cultivated for a long period; it was introduced into Danish forests by v. Langen in 1763, or even perhaps in 1745, and is now a common forest tree. One of the finest plantations is to be found in Tinghus Plantation in Grib Forest. It originates from 1777, and in 1923 the largest tree had attained a height of 34,5 m. with a girth of 85,5 cms. 1,3 m. above the level of the ground, this and other trees in the plantation being of particularly good shape (A. Oppermann, 1923).

Herb. Mat. examined:

Numerous cultivated specimens from Denmark, Sweden, Norway, Scotland, North America etc., in different herbaria.

9 b. **L. decidua, var. polonica** (Raciborski *1890*) Ostf. & Syrach L., in Pflanzenareale II. 7 *1930*.

Syn: *L. polonica*, Raciborski: Kilka slow omdrzewiu w Polsce, (Einiges über die Lärche in Polen) 1890, and in Z. Woycicki: Obrazy reslinnosci Krolestwa Polskiego (Vegetationsbilder aus dem Königreich Polen) 1912. — Szafer, in Kosmos XXXVIII, 1913, p. 1298. — Sukatschew: Entwicklungsgeschichte der Gattung Larix in Lesnoje Djebo 1924 (Ref. in Bot. Centralb. V, 1925, p. 297).

L. europœa, Köppen, Geogr. Verb. Holzgw. europ. Rusl. II, 1889, p. 484—487. — Ascherson & Graebner: Synop. mitteleurop. Fl. 1, I, 1897, p. 203. — Elwes & Henry: Trees, Gr. Brit. and Irel. II, 1907, p 352—353. — Non D. C.

L. sibirica, CZIHAK & SZABO in Flora, 1863, p. 278. — JANKA, in Oestr. Bot. Zeitschr. 1868, p. 665. — KANITZ: Pl. Roman. 1879—81, p. 139. — BRANDZA: Prod. Fl. Roman 1879—83, p. 433. — GRECESCU: Consp. Fl. Roman. 1898, p. 539. — PANTU & PROCOPIANU-PROCOPOVICI, in Bull. Herb. Inst. Bot. Bucarest, 1901, p. 131. — HORNUZAKI, in Oestr. Bot. Zeitschr. LXI, 1911, p. 407. — VIERHAPPER, ibid, 1911, p. 228—231. — ASCHERSON & GRAEBNER: Synop. mitteleurop. Fl. 2'. I, 1913, p. 314. — PRODAN: Fl. Roman. I, 1923, p. 29. — Non Ledeb.

Fig. 24. *Larix decidua* Mill. var. *polonica* (Racib.) Ostf. & Syrach L. Cones of the typical form. Nat. size. (From Szafer 1913).

Outside the area of distribution hitherto treated of, the European Larch appears also in Poland as a special race. KÖPPEN has given a detailed description of its distribution (KÖPPEN: l. c. II, 1889, pp. 484—487), and has also cited some localities where fossil remains are found, north and east of the existing remnants of the primitive larch forests in Poland, thereby proving that the larch enjoyed a wider distribution in prehistoric as well as early historic times than it does at the present day. All these forests of wild larch, however, were classified by KÖPPEN as well as by all other botanists of an earlier date as *L. decidua*, unti RACIBORSKI in 1890 showed that the larch from the old Polish stock differed morphologically from the typical European Larch, and bore a close resemblance to *L sibirica*, for which reason he classified it as an independent species, *L. polonica*.

SZAFER in 1913 went closely into the question regarding the justification of its being regarded as an independent species, and gave the first detailed description of its characteristics, at the same time examining it on the spot. The result of his observations convinced him, that the classification was justified, and that its systematic characteristics

gave it a place between *L. decidua* and *L. sibirica*. With regard to its distribution, he showed that the larch in Tatra and Babia góra (West Beskiden) in reality is true *L. decidua*, while on the contrary, the larches found in the wild state on the north-east of this locality in Poland all belong to the Polish Larch. Its intermediate position between the other two European representatives of larch is clearly shown by material from its natural habitat, and from Szafer's analysis of the flowers and cones (Szafer: l. c. Plates I and III). The shape of the cone is strongly reminiscent of a small-coned specimen of *L. decidua*, but the cone-scales are more rounded, resembling those of *L. sibirica*, and less emarginate at the free margins than those of *L. decidua*. The cone is truncate like that of *L. sibirica*, and not so pointed as that of *L. decidua*. The reason for the cones being, as a rule, small, may possibly be, that they are taken from very old trees. It seems to be a fact that the cone of *var. polonica* is smaller than that of either *L. sibirica* or *L. decidua*. Szafer differentiates two types, *f. typica*, and *f. pienina*, the former of which has completely rounded cone-scales, those of the latter having a slight emargination, thus resembling *L. decidua*. He further differentiates between two forms according to the colour of the flowering cone, namely, *f. rubriflora* and *f. viridiflora*, so that both colours can occur here just as in the case of the European Larch: but the green colour, which is the exception with *L. decidua*, is described as common in the case of the Polish Larch.

As far as it is possible to judge from well preserved material and Szafer's detailed treatment, there do not appear, however, to be sufficient grounds for maintaining it as an independent species, as its close resemblance to

Fig. 25. *L. decidua* var. *polonica* (Racib.) Ostf. & Syrach L. A very old tree in Chedmowa Góra reservation in Poland (photo. by W. Szafer).

L. decidua makes it more natural to consider it as a variety of the latter.

L. d. var. polonica is only found in the remains of forests, and then as a rule only in small groves. Most of

the specimens are old individuals, and young trees are not common. The photographs kindly sent by Szafer certainly bear witness to trees of considerable size, but unattractive in shape (Figs. 25 and 26). The first plantations visited by Raciborski are said to have been very beautiful, and Cieslar was

Fig. 26. *L. decidua* var. *polonica* (Racib.) Ostf. & Syrach L. Natural forest, Chedmowa Góra reservation, Poland. (photo. by W. Szafer).

thus induced to suggest a trial with the Polish Larch in forest culture, as he thought it would prove to have the same valuable properties as the larch in the Sudetics (Cieslar l. c. 1914, pp. 182 and 183).

The systematic position of the Polish Larch having been demonstrated, as an intermediate form between the European Larch and the West-Siberian species, a possibility is obtained of being able to explain the systematic position of the larch in its spontaneous occurrences in Rumania, where it has been classified alternately as *L. decidua* and *L. sibirica*, but the question is still incapable of a full explanation.

In Rumania as it is at present, the larch is cited as occurring spontaneously in five different localities; WILLKOMM has mentioned a sixth near Bistritz (l. c. 1887, p. 144), but

Fig. 27. *Larix decidua* var. *polonica* (Racib.) Ostf. & Syrach L. Poland, Chelm at Nowa Slupia. (From Szafer 1913).

this has never subsequently been confirmed, and is therefore not taken into account here. WILLKOMM thought it probable that the European Larch reached its extreme south-easterly limit in the districts round Kronstadt, but CIESLAR did not consider that sufficiently reliable evidence of its occur-

rence east of Tatra had been produced. Our own opinion is that the five localities mentioned here can be relied upon.

As already mentioned (p. 74), the two most southerly localities are those cited by Hayek, and classified as *L. decidua*, namely, the Cibin Mountains and the mountains to the south of Kronstadt, and as we have no material at our disposal regarding these two localities, they must for the present be regarded as *L. decidua*, even though their geographical position renders it probable that they may belong to *L. decidua var. polonica;* the three localities in the north must, in fact, be classified with this variety (see Map VII).

The facts regarding these three localities are as follows: Czihak & Szabo make a reference to *L. sibirica* in Rumania in 1863 (Flora 1863, p. 278), and in 1868 Janka gave a detailed description of his discovery of *L. sibirica* at Ceahlau (Östr. Bot. Zeitschr. 1868, pp. 365, 366). These statements as well as others of still older date (1835 and 1842) are quoted by Kanitz in support of the discovery of *L. sibirica* in Moldavia (Kanitz: Plantas Romaniae, 1879—81, p. 139). Later Rumanian botanists as well as others are agreed that the tree is *L. sibirica* (Brandza, Grecescu, Pantu & Procopianu-Procopovici, Hornuzaki, Vierhapper, and Prodan).

Other botanists have had doubts as to its being *L. sibirica* (Aschs. & Graebn. 1897, and Elwes & Henry, 1907). Ascherson & Graebner, having in their first edition adopted a sceptical attitude, state in the second edition, that they are now satisfied that the tree in question was the true *L. sibirica.*

The light-coloured flowering cones and their pilosity have been specially quoted as being an indication that the tree found at Ceahlau in Moldavia (the most south-easterly

of the three Transylvanian localities where *var. polonica* occurs), and in Bukovina near Krasna-Ilska (the most north-easterly), is *L. sibirica*, but this is insufficient for classifying them as such. Specimens in the Fl. Roman. exsicc. No. 331 b (Kew.; Brit. Mus.; Hort. Bot. Haun.) show that the larch at Ceahlau belongs to the intermediate type between *L. decidua* and *L. sibirica*, and the same is the case with the specimens (No. 331 a) from the Transylvanian district, Turda-Aries, Trascau, 1924. The last-mentioned locality lies a little to the south-west of Klausenberg (the most south-westerly of the three Transylvanian localities for *var. polonica*).

The larches at Ceahlau and near Turda must accordingly be classified as *L. decidua var. polonica*, and the third locality just to the north of them in Bukovina should undoubtedly receive the same classification, while the classification of the two southern localities remains an open question until material comes to hand.

Herb. Mat. examined:

Fl. Roman. exsicc. Nos. 331 a and 331 b (Kew; Brit. Mus.; Hort. Bot. Haun.). — Forest of Maijouv, near Kielce, Poland, 1921, A. Henry (Herb. A. Henry, Dublin).

10. **L. laricina** (Du Roi, *1771*) K. Koch: Dendrol. *1873*, p. 263. —

Britton & Brown: Ill. Fl. U. S. & Canada, I, 1913, p. 60. — Sudworth in Bull. Agric. No. 680, 1918, p. 3. — Sargent: Man. Trees. N. Am. 2'ed. 1921, p. 31. — Rehder: Man. Trees and Shrubs, 1927, p. 52. —

Syn:

Pinus laricina, Du Roi, Observationes Botanicae, 1771, p. XLIX. — Wangenheim: Beytr. Nordam. Holz. 1787, p. 42, cum icon. —

P. Larix Americanæ, Pallas: Fl. Ross. I, 1784, p. 2. Tab. 1, Fig. E. —

P. intermedia, Du Roi: Harbk. Baumz. II, 1800, p. 114. —

Larix americana, Michaux: Fl. Bor. Am. II, 1803, p. 203. — Regel in Gartenfl. XX, 1871, p. 105 et in Act. Hort. Petrop. I, 1871, p. 160. — Sargent: Silv. N. Am. XII, 1898, p. 7, cum icon. —

Pinus microcarpa, Lambert: Genus Pinus, I, 1803, p. 58, cum icon. — Pursh: Fl. Am. Sept. II, 1814, p. 645. —

Larix microcarpa, Desfontaines: Hist. Arb. II, 1809, p. 597 — Carrière: Traît. Conif. 1855, p. 275. — Gordon: Pinetum, 1858, p. 129. —

Pinus pendula, Pursh: Fl. Am. Sept. 1814, II, p. 645. — Hooker: Fl. Bor. Am. II, 1840. — De Candolle: Prodr. 1848. — Non Solander. —

Larix pendula, Macnab, in Quart, Journ. Agric. V, 1834—35, p. 601. — Hooker: Fl. Bor. Am. II, 1840. — Non Salisbury. —

L. intermedia, Lawson & Son, in Agric. Man. 1836, p. 389. —

L. decidua var. americana, Henkel & Hochstetter: Syn. Nadelholzk. 1865, p. 133. —

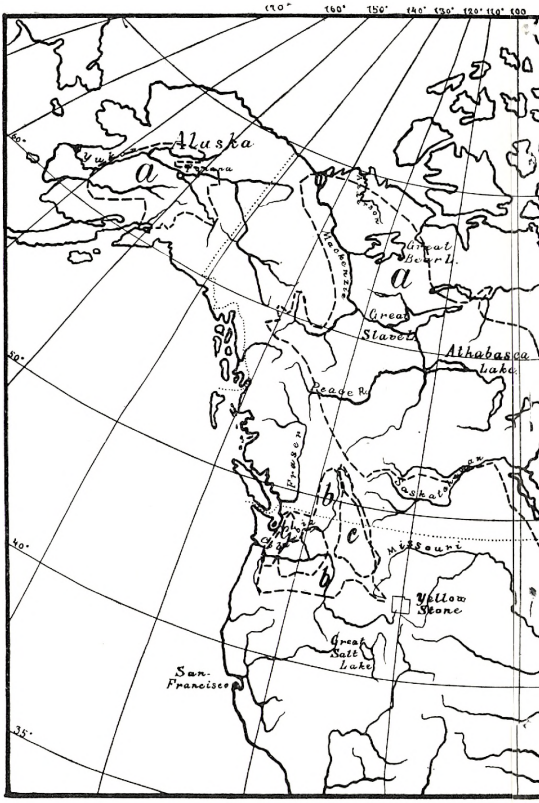
L. alaskensis, W. F. Wight, in Smiths. Misc. Coll. L. 1907, p. 174, Tab. XVII. —

The small-coned American Larch has a very wide area of distribution. The boundary-line extends unbroken from the extreme east of Newfoundland westwards over Canada and the northern U. S. A. to the Rockies, and north-west to the mouth of the Mackenzie River. From this point there is a gap in the line from the water-shed in the northern spur of the Rockies to the interior of Alaska, where it re-appears along the banks of the Yukon River, its tributaries, and lesser streams. The most northerly point is situated at the mouth of the Mackenzie, and a little to the east at the Anderson River; it nearly, buth never quite, reaches lat. 70° N. (see Map VIII). The most southerly localities lie to the south of the Great Lakes, reaching lat. 40° N. south of Lake Michigan, and a trifle more southerly nearer east (about lat. 39° N.). Sudworth's statements regarding its occurrence on the extreme north of the coast of Labrador right up to Baffin Land (U. S. Bull.

Agric. No. 680, 1918, Map 7) are very improbable, and we have been unable to discover any evidence in support of them, either in the shape of other records or specimens from Baffin Land.

Within such wide bounds, it is only natural that the tree should vary somewhat in growth from the good to the poor localities, and from south to north, but it seems otherwise to be a very uniform species, varying but little morphologically. It attains its best development on well-drained ground around the Great Lakes, but here, just as elsewhere within the wide bounds of its occurrence, it is not the dominating tree where the soil is richer and also appeals to other more shadow-enduring species. Most frequently it will be found relegated to low-lying, damp soil, where other trees cannot follow it, and also in the extreme north it becomes the dominating tree. It succeeds in thriving and forming extensive, dense forests even in the very damp areas. In the north it reaches the extreme forest-line together with *Picea mariana*, *P. canadensis*, and other species of trees, or it is found forming the forest-line alone. In the most northerly localities, where it grows together with others, it is the most vigorous species, succeeding in developing as a small tree when other kinds only manage to exist as creeping, stunted individuals. With regard to temperature and humidity, *L. laricina* is capable of growing under very widely differing conditions. HUTCHINSON states its powers of existing with or without water to be three times as great as those of *Alnus incana* (HUTCHINSON, 1918, p. 482).

On marshy ground and in the extreme north, it certainly does not grow as large as in the best localities, but on the marshes in the southern portion of the area it can still

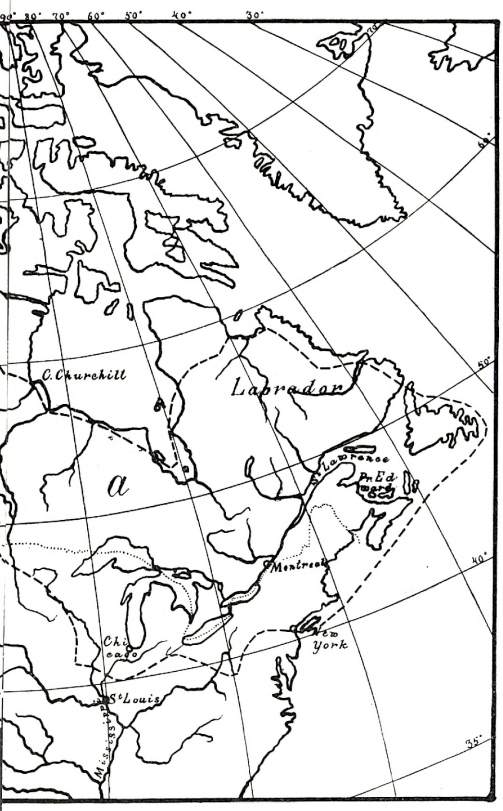


Map VI

a. *Larix laricina*,

b. ,, *occidental*

c. ,, *Lyallii*, *P*



II.

(Du Roi), K. Koch

is, Nutt.

arl.

attain a height of 12—15 m. (SARGENT: 1918, p. 9), and in Alaska a height of about 10 m. is reached (KELLOGG in Forest Serv. Bull. No. 81, 1910). Statements from Minnesota are extant of its attaining a height of 35—40 m. in the districts around the Great Lakes, where, as already stated, it grows best; HENRY has there measured a specimen 24,3 m. in height with a girth of about 1,4 m. (HENRY & ELWES, II, 1907, p. 393), but as a rule, its extreme height is given as being only 18—20 m. (SARGENT: 1921, p. 31; REHDER: 1927, p. 52).

The tree possesses both in its earlier and its later years a pyramidal crown, owing to the shortness of its lateral branches. Branches of the second order are generally pendulous, and contribute towards giving the tree its characteristic appearance. The bark presents a peculiarity in peeling off in small, thin flakes in a manner somewhat similar to that of *Picea abies*. The leaves are green, or a light blueish-green, narrow, and 2,5—3,5 cms. in length. The pronounced keel on the under-side gives them a triangular appearance, seen in transverse section. The young shoots are light-coloured, smooth, or with a slight down, the cones when flowering varying in colour from light red to green.

The mature cone presents the most pronounced characteristic of the species, and varies only to a very slight degree. The cone-scales are thick, bright, smooth, and distinctly arcuate, 12—15 of them together forming the 1,5 cms. long cone. The bracts are $^1/_4$—$^1/_2$ as long as the cone-scales, and vary somewhat in shape, the mucro being either rather shorter or rather longer, and the angle between it and the rest of the free margin of the bract more or less pronounced; the angle is often a distinct right-angle.

On the basis of specimens from Tanana on the Yukon River, WIGHT has distinguished the larch in Alaska as a separate species, *Larix alaskensis* (W. F. WIGHT: A new

Fig. 28. Marsh with *L. laricina* and some *Picea*. Canada, Ont. Holland River near Toronto. Aug 1924. (C. H. Ostf. phot.).

Larch from Alaska. SMITHSON. Misc. Coll. L., 1907, p. 174, Table XVII). Of the characteristics which are said to distinguish it from *L. laricina*, the following are the most important. The bracts are more evenly pointed than in the case of *L. laricina*, where they are described as „more

broad-shouldered" — alluding to the right-angle between the „mucro" and the remaining free margin of the bracts. The cone-scales are fewer in number, longer, and narrower in the case of the Alaskan Larch, and, finally, the shorter

Fig. 29. *L. laricina* (Du Roi) Koch. Cones from Canada, Ontario, Lake Superior (leg. K. Heimbürger, 1928). (Nat. size, upper row dry, lower row wet).

Fig. 30. *L. laricina* (Du Roi) Koch. Cones from cultivated tree; Denmark, Bellevue near Beldringe, Præstø. (Nat. size, upper row dry, lower row wet).

leaves and slower growth are stated to be characteristic for the latter.

An investigation of the material from Fort Gibbon (lat. 65° N., long. 152° W.) which lies on the Yukon River, and is very close to Tanana, from which Wight's type came, confirms Wight's description, and there is no doubt that it fits the larch in Alaska. But this is not sufficient to separate it from *L. laricina*. In a large collection of cones from Lake Superior kindly sent us by Mr. K. Heimbürger 1927, several cones are to be found which exactly correspond to those from Fort Gibbon, and this will probably always be the case whenever there is abundant

material to hand. It must finally be stated, that in the analysis of the cone-scales and bracts of *L. laricina*, as given by BRITTON & BROWN, the bracts have exactly the form described by WIGHT for *L. alaskensis* (BRITTON & BROWN: Ill. Fl. 2nd. Ed. I. 1913, p. 60). Therefore *L. alaskensis*, WIGHT, cannot be maintained, either as a species or variety; it can only be regarded as a form of growth, influenced by inclement external conditions; a similar form will presumably be found further eastwards on the extreme northerly limit for the area of *L. laricina*. We have material from Fort Churchill, Hudson Bay, which supports this supposition.

Fig. 31. *L. laricina* (Du Roi) Koch. Cones of *L. alaskensis* from Fort Gibbon, Alaska. U. S. Nat. Mus. No. 866498. (Nat. size, upper row dry, lower row wet.)

Finally, it should be adduced for the sake of completeness, that HENRY (Gard. Chron. LVIII, 1915, p. 179, Note) wrongly classifies *L. alaskensis*, with *L. Gmelini*, supposing that it does not deviate from the small-coned *L. Gmelini* from Eastern Asia.

Larix laricina is found in a few old Arborets in England, where it has long been cultivated, but has never become common. In Denmark it is stated as planted in the Arboretum at Aalholm in 1832 (WEILBACH: Notes, Bibl. Hort. Bot. Haun.). A tree at Bellevue near Præstø which still exist probably dates from the same time and was in 1924 24,5 m. high with a girth of 1,5 m. (1,3 m. above the ground). The oldest mention of American Larch in forest culture in Denmark from about the year 1800 (OPPERMANN, 1923) we regard as not applying to *L. laricina*, but to

the supposed hybrid, *L. pendula*, our opinion being based upon still-existing specimens from that period. (See below under Hybrids).

Herb. Mat. examined:

In uligin. Am. Sept. (Brit. Mus.). — Labrador: Geol. & Nat. Surv. of Can. No. 24990, Fords Harbour, R. Bell, 1884 (Ottawa Herb.); Anatotak Secound 1928, 364 (Hort. Bot. Haun.). Ungava River, Fort Chino, Spreadborough, 1876 (red coned), (Ottawa Herb.), Ungava Bay, L. M. Turner, 1884 (Gray Herb.); Sandwich Bay, White Bear River, 29. July 1926 (red coned) (Gray Herb.); Fl. of the Labrador Peninsula, Saguenay Co.; Archipel Quapitagone, H. St. John, July 1915 (Ottawa Herb.). — Canada, Miss. Brenton (Kew). — Forêst ou nord du Fort Carlton, Bougeau, 28. Maj 1858 (Kew). — Brouagne, H. St. John, Aug. 1915 (red coned) (O. H.); also colls. from Labrador in U. S. Nat. Herb. — New Foundland: Bay of Islands, North Arm, Fogg, 1926 (Gray Herb.). — Strait of Belle Isle, 1924, Fernald etc. (Gray. Herb.). — In the Gray Herb. 8 other colls. of New Foundland. Colls. also seen in U. S. Nat. Herb. — Flora des Iles St. Pierre et Miguelon (Gray Herb.). Fl. of Newfoundland no. 157, St. Johns, 1894, Robinson & Schrenk (Ottawa Herb.; Kew; Hort. Bot. Haun.). — Fl. of W. Newfoundland, Bay of Island, 1910, Fernald & Wiegand, no. 2408 (Brit. Mus.). — Fl. of Newfoundland, Valley of Exploits River, Grand Falls, 1911, Fernald & Wiegand, no. 4417 (Kew; Hort. Bot. Haun.). — Interior Newfoundland, Ed. Brenton, 1912. (Kew). — Prince Edward Island, Brackley Point, Macoun, June 28, 1887 (Very small coned, the new cones red) (Ottawa Herb.). Magdalen Isles, Fr. Johansen, July 1917 (Ottawa Herb.). — Fl. of Prince Edward Island, Queens County, Brackley, Point Road, 1912, Fernald, Land & John (Ottawa Herb.; Brit. Mus.; Hort. Bot. Haun.). — Fl. of Magdalene Island, Quebec, 1912, Fernald & Wiegand, no. 6716, Grindstone Isl. — (Further Fragm. from N. B. Maine, Mass. Michigan), (Brit. Mus., Gray Herb. and U. S. Nat. Herb.). — New Brunswick, Campbellton, 1876 (Ottawa Herb.). — Gaspé Co., Mt. Albert, Fernald & Collins, July 1906 (red coned), (Ottawa Herb.). — Montmorency Falls, Macoun, June 1915 (red coned) (Ottawa Herb.). — 7 colls. from Quebec (Gray Herb.). — Quebec, Flamand, leg. K. Heimbürger, 1926, C. H. Ostenfeld: Canadian Plants, no. 626 (Hort. Bot. Haun.). — Ontario: 3 colls. in Ottawa Herb. — Massachusetts, 1 coll. (Gray Herb.). — Rhode Island: 1 coll. (Gray. Herb.). — Newport, Nova Scotia, June 18, 1918, J. G. Jack. (Arn. Arb.). — Arctic Canada, Churchill, Hudson Bay 16-7-1923., Hort. Bot. Haun.; Birket Smith (5. Thule Expedition 1921 —24, red cones). — St. Thomas, Ontario, 1906, Geo. L. Fischer (Arn. Arb.). — Churchill, Hudson Bay, 1910. J. M. Macoun (red coned, rather few scales in the cone). (Ottawa Herb.). — Manitoba, Near Branden, Macoun, 1896

(very small coned). (Ottawa Herb.). — Ohio: 1 coll. (Gray Herb.). — Buffalo, G. W. CLINTON (Brit. Mus.). — Maine, Dr. A. GRAY, 1877 (Kew). — Maine, J. BLAKE (Brit. Mus.). — BROWNVILLE, Maine, Aug. 29, 1895, J. G. JACK (Arn. Arb.). — New Hampshire, 5 colls. in Arn. Arb. at Gray Herb. — Adirondacks Mt. New York, T. S. BRANDEGEE, 1884, Ex. Herb. Univ. Calif. (Hort. Bot. Haun.). 1 other coll. of New York (Gray Herb.). — Near Port Huron, St. Claire Co. Michigan, C. K. DODGE, October 11, 1891 (Arn. Arb.). — North of College, Agricultural College, Michigan, 1898 (Arn. Arb.). — Roadside near Douglas Lake, Cheboygan Co., Michigan, J. H. EHLERS, July, 7, 1917. (Arn. Arb.). — Michigan, 3 colls. one red coned (Gray Herb.); also in U. S. Nat. Herb. — WISCONSIN: 3. colls. (Gray Herb.). — Illinois (Gray Herb.). — Maryland, Pennsylvania, New Jersey and Indiana (U. S. Nat. Herb.). — Saskatchewan, North of Prince Albert, MACOUN, 1896 (small coned) (Ottawa Herb.). — N. W. Ter., Lat. 61° Long. 104°, TYRELL, 1893 (Ottawa Herb.). — Lake Huron, Dr. TODD (Kew.). — Winnipeg Lake, 1884, Jas. M. MACOUN (Ottawa Herb.; Brit. Mus.). — Lake Superior, HEIMBÜRGER 1928 (Hort. Bot. Haun.). — Heron Bay, C. H. OSTENFELD, 1924 (Hort. Bot. Haun.). — Charlotte, Vermont, 1877, C. G. PRINGLE (Kew). — Mac. Cubbins Lake, Minnesota, E. P. SHELDON, May, 1895. Ex. Herb. Univ. Calif. (Hort. Bot. Haun.). — Swamps at Mineral Springs 1913, OVE PAULSEN (Hort. Bot. Haun.). Dease River, Northern Brit. Col., DAWSON, 1887 (Brit. Mus.; Ottawa Herb.). — Kokomo Creck, 40 ml. north of Fairbanks, Alaska, L. M. PRINGLE, Aug. 17, 1909. (U. S. Nat. Herb. et ex U. S. Nat. Herb. in Hort. Bot. Haun.). — Fort Gibbon Alaska, A. G. MADDREW, Ex. Herb. U. S. Nat. Herb. (Hort. Bot. Haun.). — Fort Gibbon along the Yukon River, A. S. HITCHCOCK, 1909 (U. S. Nat. Herb.). — E. KOEHNE: Herb. dendrologicum (Hort. Bot. Haun.).

IV. Hybrids.

There are three areas where two different species of larch meet in nature. In two cases, those of *L. Potanini—L. Mastersiana*, and *L. occidentalis—L. Lyallii*, the species are so little known and so closely related, that it has hitherto been impossible to distinguish hybrids between them. In the third case, however, where the question is one of two widely differing species, *L. sibirica—L. Gmelini*, it is evident that hybrids are produced in the areas where their respective boundaries meet.

Hybridisation has undoubtedly taken place several times under cultivation, when two or more species have been brought together, and it is probable that a considerable number of crossings might be made artificially, but deliberate experiments of this nature have not been mentioned hitherto in the literature extant upon the subject.

L. Gmelini × sibirica, Szafer in Kosmos, XXXVIII, *1913*, p. 1297.

Syn:

L. Czekanowskii, Szafer l. c.

This hybrid is probably found on a broad belt stretching from Lake Baikal northwards to about the mouth of the Jenisej. It has been described by Szafer, and investigated by Sukatschew in 1928 in the district round Lake Baikal, where it seems to grow extensively. He has kindly sent us abundant specimens of cones taken from a large number of trees, and these specimens give evidence of many different intermediate stages between the supposed parent species (see figs. 32—33 showing some of the cones).

Middendorff (Middf. Reise IV, I, Teil, pp. 530 and 595) and Cajander (Act. Soc. Sci. Fennicae. XXXII, No. 3, 1904, p. 8) have both previously stated that no well-defined difference existed between the two species, and this belt with its hybridogenous intermediary forms is the natural explanation of their assertions. The matter has been dealt with in greater detail under *L. Gmelini.*

Herb. Mat. examined:

Maretuj, Cape Ulan (3 samples); the village Listwenicznoja, and the bays Kurkut (5 samles), Koty (3 samples) and Krestowka (1 sample), — altogether 14 samples from 14 different trees, all from the western side of the Lake Baikal, W. Sukatschew, 1928 (Hort. Bot. Haun.). —

L. decidua × laricina, A. Henry, in Gard. Chron. Ser. 3. LVIII, *1915*, p. 178.

REHDER: Man. Trees and Shrubs, 1927, p. 52. —

Syn:

Pinus pendula, SOLANDER, in Aiton: Hort. Kew. III, 1789, p. 369. — Non Pursh. —

Larix pendula, SALISBURY, in Trans. Linn. Soc. VIII, 1807, p. 314. — Non McNab. —

L. dahurica, ELWES & HENRY: Trees, Gr. Brit. and Irel. II. 1907, p. 379—382, pro parte. Non Turcz. (Conf. HENRY, in Gard. Chron. Ser. 3. LVIII, 1915, p. 178, Note). —

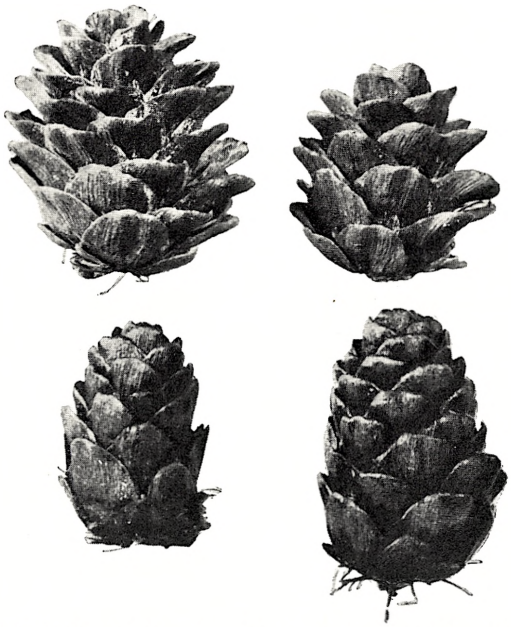


Fig. 32. *L. Gmelini* × *sibirica*. Kurkut on the west side of Lake Baikal. (Leg. Sukatschew, 1928). (Nat. size, upper row dry, lower row wet).

L. americana, forma, OPPERMANN, in Det forstl. Forsøgsv. VII, 1935. p. 190 and 278. (Cum icon.). — Non Michaux.

There has been a good deal of uncertainty with regard to the origin of this Larch. From the time when it was first described as *L. pendula* (1789) until 1915, it was always regarded as indigenous to North America, where the statements regarding it were certainly very diverse and

usually of a very summary character, usually based only on the accounts of others.

Of the many statements regarding its occurrence in North America, there are only two authors who could

Fig. 33. *L. Gmelini* × *sibirica*. Kurkut on the west side of Lake Baikal, (leg. Sukatschew, 1928). (Nat. size, upper row dry, lower row wet).

have based their records on personal observations. The one Macnab (in the Quart. Journ. Agric. V, 1834—35, pp. 594—605), simply mentions one species of larch (*Larix pendula*) observed by him in the neighbourhood of Lake Ontario, and his description coincides entirely with *L. laricina*, thus being of no value as regards the present question. The other description, which strikes one as more convincing, is given by Pursh (Flora Americae Septentrionalis, II, 1814,

p. 645). According to the title-page, he relies upon "twelve years travels and residence in that country", and, describing *L. pendula*, Lambert, and *L. microcarpa*, Lambert, jointly, he says positively that MICHAUX is mistaken in including them under one species, adding: "I never saw them both growing in the same place, or even near one another." We have, nevertheless, no doubt at all, that this is wrong, and that his remark considers only *L. laricina*, the occurrence of which in two forms is due in the main to the different characters of the growth localities. The description of the two "species", as far as it concerns their habitats, sounds extremely improbable. *L. pendula* is said to be "a beautiful tree, resembling the European Larch"; and grows "in low cedar swamps", while *L. microcarpa*, which certainly "resembles the preceding *L. pendula*" has its home "on high mountains". Finally, *L. pendula* — which must, at any rate have been less common than the other, as no subsequent attempts to find it in North America have been successful — has been provided with American popular names (Tamarack, Hackmatack), no American name being given to *L. microcarpa (laricina)*, which otherwise is known under these names. As already mentioned, we have no doubt that there is only one species of larch of that group in North America, and that PURSH's description is clearly influenced by LAMBERT's account (in Genus Pinus, 1803), in which two "species" are mentioned, but which, in part at all events, is based upon material from specimens cultivated in England.

In SOLANDER's Notes (Brit. Mus., unpublished), its habitat is given as follows: — „Habitat in New Foundland insula Amer. septentr. Latitud. 48 gr. ubi hiems perquam aspera", but in SOLANDER's description in AITON: Hort. Kew., there

only stands "Nat. of North America. — cult. 1739 by Peter Collinson". Thus it appears from the oldest descriptions that the tree was to be found in Newfoundland as well as in culture. Fernald in 1915 answered an enquiry from the British Museum with regard to *L. pendula* in Newfoundland, by sending herbarium specimens (Herb. Brit. Mus.) from various localities on the island, but all of them distinctly belong to *L. laricina*, and he knows only one species.

The tree as cultivated in England (Collinson, Mill Hill), which has been described as *Pinus pendula*, is positively stated as having come from America. We do not, however, think that any proof exists of its having been found in North America in the wild state.

Morphologically, it occupies an intermediate position between *L. decidua*, and *L. laricina*. The type specimen in the British Museum gives the length of a cone as 25 mm., and two still immature cones are 23 mm. and 19 mm. respectively. The immature cones are distinctly reddish-mauve, and in this point they resemble *L. decidua*. The lowest cone-scales are larger than those of *L. decidua*, and in this point they show a decided approach to the type of *L. laricina*, as well as in the fact of the cone-scales being thicker and brighter than those of the European Larch. Lambert reproduces material from Collinson's tree at Mill Hill (Genus Pinus, 1803, Pl. 36).

On account of its intermediate position between the European Larch and the American Larch and also of the fact that it is found in culture, we agree with Henry's explanation, wherein he describes it as a hybrid, produced in cultivation, between *L. decidua* and *L. laricina* (Gard. Chron. LVIII, 1915, p. 178).

A. OPPERMANN has shown, that a group of peculiar-looking larches about 125 years old is to be found in Denmark (Folehave), and he classifies them as "a kind of *L. americana* which has larger cones than the pronounced *L. microcarpa*" (A. OPPERMANN: Cultivation of Larch in Denmark, 1923, p. 319). We regard them as being *L. pendula*,

Fig. 34. *L. decidua* × *laricina*? *(L. „pendula").* Cultivated, Denmark Folehave, 1922. (3/4 nat size, upper row wet, lower row dry.)

viz., hybrids between *L. decidua* and *L. laricina*, but have to add, that it is extremely difficult to decide whether such trees, which are found in culture among many forms of *L. decidua*, really are *L. pendula*, it being possible to find among *L. decidua* specimens of great similarity, but it is at least evident that the said specimens are not *L. laricina*.

Herb. Mat. examined:

Culta; SOLANDER, Type specimens, no locality, no year (Brit. Mus.) — Woburn Abbey, Bedfordsh., England, Oct. 1928, C. SYRACH LARSEN (Hort. Bot. Haun.). — ? Denmark, Folehave on Sjælland (1922).

L. Kaempferi × decidua, COAZ, in Schw. Zeitschr. Forstw. LXVIII, *1917*, p. 12.

L. leptolepis × *decidua*, Henry, in Irish Times, June 24, 1919. — Henry & Flood, in Proc. Roy. Irish Acad. XXXV, B, 1919, p. 55. — Rehder, in Journ. Arn. Arb. I. 1919, p. 52. — Dallimore & Jackson: Handb. Conif. 1923, p. 280. — Rehder: Man. Trees and Shrubs. 1927, p. 51. —

Syn:

L. Marschlinsi, Coaz: l. c. 1917.

L. eurolepis, Henry: l. c. 1919. — Henry & Flood: l. c. 1919. — Dallimore & Jackson: l. c. 1925. — Rehder: l. c. 1927. —

L. Henryana, Rehder: l. c. 1919. —

Coaz can only be understood to mean, that he believes he has observed the cross *L. Kaempferi* × *decidua;* but others are of the opinion that it is *L. Kaempferi* × *sibirica* (Henry & Flood: l. c. p. 57; vide Henry's notes: ibid. p. 66; Dallimore & Jackson: l. c. p. 292). Coaz's observations are based upon specimens of seed from a *L. Kaempferi* in the neighbourhood of Morat in Switzerland. *L. decidua* and *L. sibirica* were both found close by, but, as already stated, Coaz believes the European Larch to be the male parent in the supposed cross; it seems, nevertheless, as though there might be some doubt as to whether it was the one or the other. If, however, any regard is to be paid to his observations, it can only be in the present shape; perhaps it would be best to neglect them entirely.

The oldest specimens of the hybrid *L. Kaempferi* × *decidua* recognised with certainty originated about 1900 upon the estates of Dunkeld and Murthly in Perthshire, Scotland, and the first detailed report by Henry & Flood in 1919 was based upon material derived from this source.

It is an easily recognisable form, intermediate between the two widely different parent trees. The cone is more cylindrical than that of *L. Kaempferi*, the cone-scales being at the same time less recurved. The one-year shoots are

something between the reddish-brown, stout shoots of the Japanese Larch, and the light-coloured, slender shoots of the European species.

In the seed-bed, one-year plants of *L. Kaempferi* are distinguishable by being considerably smaller than those of *L. decidua*, and in this particular too the one-year hybrid plants occupy an intermediate position.

From the forestry point of view, the European Larch has a better shape, but is, upon the other hand, extremely susceptible to the attacks of *Dasycypha Willkommii*, which the Japanese Larch is not. The hybrid combines the good shape of the one and the powers of resistance against canker of the other, and is therefore now the subject for larger experiments in forests. The second and third hybrid generation has also been raised, and is now being experimented with.

In Denmark, one specimen is known from Dr. BØRGESEN's garden at Hellebæk, and young plants of *L. Kaempferi* from various Danish forests show signs of being hybrids with *L. decidua*.

Herb. Mat. examined:

Buffalo Park, Murthly, Scotland, 1923, J. M. MURRAY (2 samples). — Scotland, 1923, J. M. MURRAY. — Dunkeld, Scotland, September 1926, C. SYRACH LARSEN. — Denmark, the Garden of Dr. BØRGESEN at Hellebæk 1925, C. H. OSTENFELD. — Denmark, Strødam, near Hillerød (specimens sent from Scotland).

The reciprocal cross, *Larix decidua* × *Kaempferi*, has been observed in the Frijsenborg Forest District, where the first hybrid generation was planted as one-year plants in 1925. The seed was collected from a 90—100-year-old *L. decidua* in »Frijsenborg Lystskov«, where the Japanese Larch stands a little to the west and south-west of the former. The seed yielded only a minimum of hybrids, the

Fig. 35. *L.* "*pendula*" Soland. Cultivated trees about 125 years old, from Folehave, Denmark. From A. Oppermann Forstl. Forsøgsvæsen 1923.

majority of plants being pure *L. decidua*. This seems to indicate that crossing *L. decidua* × *Kaempferi* is attended with more difficulty than the reverse hybridisation.

V. Summary.

1. In the present paper the areas of distribution of the various species of larch are dealt with in detail, but only as far as the distribution concerns the wild-growing plants; the cultivation of the larches, which in many regions is of rather considerable economic interest, has mostly been omitted.
2. The authors recognise 10 species of larch and three geographical varieties. According to the international rules of nomenclature, the following names are valid: *L. Griffithiana*, *L. Mastersiana*, *L. Potanini*, *L. occidentalis*, and *L. Lyallii*, which five species constitute a natural sub-genus, characterised by the bracts of the cone being longer than, and reaching out of, the cone scales. All these species have restricted areas of distribution, being mountain trees from the great mountain regions of western N. America and south-eastern Asia respectively. Of these, only *L. occidentalis* has any considerable economic value, but none of them have hitherto been taken into culture on a large scale.
3. The five other species are *L. Kaempferi* (*L. leptolepis*) *L. Gmelini* (*L. dahurica*) with the varieties *olgensis* and *Principis Rupprechtii*, *L. sibirica*, *L. decidua* (*L. europaea*) and *L. laricina* (*L. americana*). Of these, *L. Kaempferi* has a small area of occurrence on Hondo, Japan, while *L. decidua* has a medium-sized area. *L. Gmelini*, *L. sibirica*, and *L. laricina*, on the other hand, have very large areas, the last inhabiting the northern temperate and sub-arctic zones of N. America from Newfoundland to Alaska. *L. Gmelini* and *L. sibirica* divide Eurasia between them, *L. Gmelini* being found in Eastern Asia, and as

far west as from Lake Baikal northwards; *L. sibirica* in the area west of *L. Gmelini* as far west as N. E. Europe.

4. The differences between the species and their variability have been considered under each species, and their synonymy and the records of specimens upon which our conclusions are based are cited in full. The geographical varieties of *L. Gmelini*, namely *L. olgensis* and *L. Principis Rupprechtii*, form a kind of transition to the first-named sub-genus, and their areas of occurrence also cause them to approach the Chinese species of that sub-genus.
5. The variety of *L. decidua, var. polonica*, is a link between that species and *L. sibirica*, and is a form which appears to be not far from extinction.
6. The species of the second sub-genus are of importance as forest trees, and several of them are objects of extensive cultivation.
7. Between the species which meet in nature, hybrids are found as regards the combination *L. Gmelini* × *sibirica*, while the combinations *L. Lyallii* × *occidentalis* and *L. Mastersiana* × *Potanini* have not yet been recognised. When cultivation brings two species together, hybrids also arise. *L. decidua* × *laricina* has been known for a very long time, but is usually misinterpreted; *L. Kaempferi* × *decidua* is much more recent, but seems to be of economic value, and will probably become much commoner; *L. Kaempferi* × *sibirica* has been reported, but is not definite.
8. When *L. Gmelini* becomes more used in cultivation, this most valuable species will no doubt hybridise with several of the other species.

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Færdig fra Trykkeriet den 30. Juni 1930.

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DET KGL. DANSKE VIDENSKABERNES SELSKAB

6. BIND (Kr. 18,10):

Kr. Ø.

1. Lundblad, O.: Zur Kenntnis der Quellenhydracarinen auf Møens Klint nebst einigen Bemerkungen über die Hydracarinen der dortigen stehenden Gewässer. Mit 7 Tafeln und 5 Textfiguren. 1926 ..... 5.00
2. Børgesen, F.: Marine Algæ from the Canary Islands, especially from Teneriffe and Gran Canaria. II. Phæophyceæ. 1926 ... 6.00
3. Ostenfeld, C. H.: The Flora of Greenland and its Origin. 1926 ..... 3.35
4. Fibiger, Johannes and Møller, Poul: Investigations upon Immunisation against Metastasis Formation in Experimental Cancer. With 5 plates. 1927 ..... 2.75
5. Lind, J.: The Geographical Distribution of some Arctic Micromycetes. 1927 ..... 1.50
6. Børgesen, F.: Marine Algæ from the Canary Islands, especially from Teneriffe and Gran Canaria. III. Rhodophyceæ. Part 1. Bangiales and Nemalionales. 1927 ..... 4.50
7. Lindhard, J.: Nogle Undersøgelser over den respiratoriske Kvotient under kortvarigt Muskelarbejde. 1927 ..... 1.00

7. BIND (Kr. 14,85):

1. Raunkiær, C.: Dominansareal, Artstæthed og Formationsdominanter. 1928 ..... 1.75
2. Petersen, C. G. Joh.: On some Biological Principles. 1928 ... 2.00
3. Vimtrup, Bj.: Undersøgelser over Antal, Form, Bygning og Overflade af Glomeruli i Nyren hos Mennesker og nogle Pattedyr. 1928 ..... 1.30
4. Bensley R. R. og Vimtrup, Bj.: Undersøgelser over de Rouget'ske Cellers Funktion og Struktur. En Metode til elektiv Farvning af Myofibriller. 1928 ..... 1.00
5. Thomsen, Oluf: Die Erblichkeit der vier Blutgruppen des Menschen, beleuchtet durch 275 Nachkommenschaftsindividuen in 100 AB (IV)-Ehen (nebst 78 Kindern, von denen nur der eine (AB)-Elter bekannt ist). 1928 ..... 1.00
6. Krogh, A. and Hemmingsen, A. M.: The Assay of Insulin on Rabbits and Mice. 1928 ..... 0.70
7. Johnsson, J. W. S.: L'Anatomie mandchoue et les Figures de Th. Bartholin, étude d'iconographie comparée. 1928 ..... 2.00
8. Kemp, Tage: Om Kromosomernes Forhold i Menneskets somatiske Celler. 1929 ..... 1.75
9. Weis, Fr.: Fysiske og kemiske Undersøgelser over danske Hedejorder. Med særligt Henblik paa deres Indhold af Kolloider og Kvælstof. With a Resumé in English. 1929 ..... 8.25

Kr. Ø.

8. BIND (Kr. 14,95):

1. Børgesen, F.: Marine Algæ from the Canary Islands, especially from Teneriffe and Gran Canaria. III. Rhodophyceæ. Part II. Cryptonemiales, Gigartinales and Rhodymeniales. Les Mélobésiées par M^me^ Paul Lemoine. Avec 4 planches. 1929. . 4.50
2. Thomsen, Oluf og Kettel, Karsten: De menneskelige Isoagglutininers og tilsvarende Blodlegemereceptorers Styrke i forskellige Levealdre. Med 1 Tavle. 1929 ..... 1.60
3. Krabbe, Knud H.: Recherches sur l'existence d'un œil pariétal rudimentaire (le corpuscule pariétal) chez les mammifères. Avec 11 planches (22 figures). 1929 ..... 2.80
4. Rosenvinge, L. Kolderup: Phyllophora Brodiæi and Actinococcus subcutaneus. With one plate. 1929 ..... 2.40
5. Thomsen, Oluf og Kettel, Karsten: Kvantitative Undersøgelser over de menneskelige Isoagglutininer Anti-*A* og Anti-*B*. 1929 ..... 0.65
6. Madsen, Th. et Schmidt, S.: Toxine et antitoxine diphtériques. 1930 ..... 2.00
7. Lundblad, O.: Die Hydracarinen der Insel Bornholm. Mit 9 Tafeln und 1 Textfigur. 1930 ..... 5.00
8. Lindhard, J. and Möller, Jens P.: On the Origin of the Initial Heat in Muscular Contraction. 1930 ..... 1.00

9. BIND (under Pressen):

1. Børgesen, F.: Marine Algæ from the Canary Islands, especially from Teneriffe and Gran Canaria. III. Rhodophyceæ. Part III. Ceramiales. 1930 ..... 7.50
2. Ostenfeld, C. H. and Syrach Larsen, C: The species of the Genus Larix and their geographical distribution. With 35 illustrations and 8 maps. 1930 ..... 5.00