

Chinese Species of *Tsuga*.

BY

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With Plate CXCIV.

THE following paper is an attempt to arrange and classify the Chinese specimens of *Tsuga* in the herbarium of the Royal Botanic Garden, Edinburgh. The material was collected in the south-west provinces of China, chiefly Yunnan, Szechuan and Western Hupeh.

Up to the present, species and varieties known are the following :—

Tsuga chinensis, Pritz. *Abies chinensis*, Franchet.

Tsuga yunnanensis, Masters. *Abies yunnanensis*, Franchet.

Tsuga Brunoniana, Carr., var. *chinensis*, Masters.

Abies dumosa, Loud., var. *chinensis*, Franchet.

Tsuga Mairei, Lemée et Lévillé.

In an enumeration* of Chinese *Tsugas*, Masters refers certain collections to *T. Sieboldii*. I have seen no specimen from China which can be referred to this species. In a later work† Masters enumerates under *T. yunnanensis* collections which in his previous paper he had included under *T. Sieboldii*. Henry 7156—one of the specimens so treated by Masters—I have, after comparison with the type in Paris, referred to *T. chinensis*. Probably some of the other specimens which, so far, I have had no opportunity of examining, may have been wrongly included under *T. yunnanensis* by Masters.

Diagnostic characters. The condition of the leaf margin, generally employed in dividing the genus, was not a constant factor here and a division based on the character of the leaf apex was adopted. The utility of this feature as a diagnostic character was strengthened on finding that all plants with an entire leaf apex bore strictly sessile cones, while those with the leaf apex emarginate had shortly stalked cones. In all cases where the

* Journ. Linn. Soc. vol. xxvi, p. 556 (1902).

† Journ. Linn. Soc. vol. xxxvii, p. 421 (1906).

attachment of cones could be observed the combination of characters held. Of the described species* *T. yunnanensis* comes under the first group (i.e., leaf apex entire) and *T. chinensis* under the second. As the cone stalk of the plants of the *Chinensis* group is in all cases very short, the criterion used was the condition of the bud scales at the base of the cone. In stalked forms the scales retain the erect condition of an opening bud above which the stalk may or may not appear, while in the sessile forms the bud scales are flattened out against the base of the cone.

Yunnanensis Group. (i.e. leaf apex entire, cones sessile). Of the four collections thus placed in the *Yunnanensis* group, three, Ward 1666, Wilson 2098, and 2099, I believe to be the same as *T. yunnanensis*. The remaining one, Forrest 6747, differs so markedly in the type of cone that I believe it to be a distinct species. The cone scales of *T. yunnanensis* are finely striate, thin and fibrous, whereas those of Forrest 6747 are smooth, thick and woody in texture.

Chinensis Group. (i.e. leaf apex emarginate, cones stipitate). In this group one specimen, Wilson 2096, stood out very distinctly in the character of the mature cone. The cone scales thick, woody, polished and with truncate apices, open wide at maturity, spreading at an angle little less than 90° to the axis. All other cones in this group and in the previous one, have the scales erecto-patent at maturity.

Although the serration on the leaf margins was variable, one or two specimens in this group were found with persistently entire margins. To this sub-division belong Henry 7156, Wilson 2100 and 2097, all of which I believe to be the same as *T. chinensis*, and also Forrest 17,169. The latter has a long narrow needle often 25 mm. in length, in contrast to the short broad needle, rarely exceeding 18 mm. of *T. chinensis*. This together with differences in the cone scale and the colour and indumentum of the twig led me to believe that it was a distinct species.

Leaves of Ward 257 and Maire 203 were generally serrulate on the margin, but there was a marked difference in cone outline and in the size and shape of the cone scale. In Ward 257 the cone is obovate, the cone scales few in number (about 25) measure 14×13 mm. while in Maire 203 the oblong-ovate cone is composed of a larger number of smaller scales (about 35) 10×7 mm. and therefore I believe them to be distinct species.

The young twigs of all the Chinese Tsugas I have examined are more or less pubescent, the indumentum occasionally confined to the grooves between the pulvini, more often scattered in the grooves and on the lower part of the pulvini. The leaves, flat

* Excluding *T. Mairei* which, ex descr., is probably incorrectly referred to *Tsuga*.

and grooved on the upper surface are either white underneath or concolorous. The one year twigs vary from a distinct yellow to a red-brown colour, the apex of the pulvinus invariably being redder or darker than the rest of the twig.

The anatomy of the leaf did not help very much in the systematic placing of the species. What differences I have found merely substantiate the formation of the two main groups. A difference in outline is maintained in a general way throughout the groups. In the Yunnanensis group there is a deep groove on the upper surface and a slight midrib on the lower surface, while the angles of the leaf are sharp. In the Chinensis group the groove on the upper surface is very slight and there is no midrib on the lower surface while the angles of the leaf are rounded. Exceptions, however, occur. The deep groove on the upper surface is absent in some leaf sections of Ward 1666, belonging to the Yunnanensis group (all sections were taken near the middle of the leaf) and sharp angles were observed in serrated species of the Chinensis group, so that variability in outline must be expected. The distribution of the hypodermal cells on the other hand has proved quite a constant factor. In both groups the arrangement on the lower surface is the same, a few cells beneath the resin canal and a few in scattered groups or continuous between the angle of the leaf and the beginning of the stomatic area. The difference is found on the upper surface. In the Yunnanensis group hypodermal cells are practically absent, a few cells subtend the deep groove only. In the Chinensis group all species show a large development of hypodermal cells in groups all along the upper surface or forming a continuous layer beneath the epidermis.

Key to the Species.

- A. Leaf apex entire; cones strictly sessile; leaf margin serrulate; branchlets pubescent; hypodermis on upper surface restricted to groove.
 - I. Cone scale woody in texture, smooth. 1. *Tsuga dura*.
 - II. Cone scale fibrous in texture, finely longitudinally striate. 2. *T. yunnanensis*.
- B. Leaf apex emarginate; cones shortly stalked; leaf margin serrulate or entire; branchlets pubescent; hypodermis scattered all along upper surface.
 - I. Cone scales patent at maturity. 3. *T. patens*.
 - II. Cone scales erecto-patent at maturity.
 - a. Leaves generally serrulate on margin.
 - i. Scales up to 14×13 mm. about 25 per cone. 4. *T. Wardii*.

pliato. Folia 7-21 mm. longa, 2.5 mm. lata, apice rotundata vel truncata, emarginata, ima basi angustata, breviora integra, longiora parte triente superiore serrulata, supra sulcata, subtus saepissime subalbida, fasciebus stomatiferis duabus e lineis 7-9 constitutis. Strobili iuventute luteo-brunnei, maturi lutei vel castaneo-lutei, ambitu oblongo-ovati vel oblongi, 25-30 mm. longi, breviter sed distincte stipitati; squamae maturae patentes, bractea obovata apice conspicue bilobata 5 mm. longa irregulariter serrulata dorso puberula, squama seminifera subquadrata margine truncata vel truncato-rotundata 12 mm. longa 10 mm. lata auguste marginata fere integra parte exserta breviuscula et latiuscula nitida irregulariter distantius longitudinaliter striata, parte oblecta dense puberula; semina ambitu triangularia, 3.5 mm. longa, 2.5 mm. lata, ala 9 mm. longa 4 mm. lata.

Western Hupeh. Wilson, 2096. Type. (Arnold Arb. Exped.) July 1907, and Nov. 1907.

4. *Tsuga Wardii*, Downie, sp. n. Arbor 80-100-pedalis trunco saepe 10-40-ped. supra basem aequaliter bifurcato (ex Ward); ramuli novelli pallide brunnei, indumento brevi subdenso, pulvino rubro-brunneo subconspicue rimoso alabastro axillari dimidio brevior, haud conspicue sulcati, mox supra cinereo-brunnei, infra fusco-brunnei, pulvino per annos 3-4 persistente. Folia omnia immatura, 10-20 mm. longa, 1.5 mm. lata, apice rotundata vel subtruncata, emarginata, basi in petiolum brevem angustata, margine praesertim apicem versus serrata, supra sulcata, subtus alba, fasciebus stomatiferis duabus e lineis 5-7 constitutis. Inflorescentia ♂ distincte stipitata. Strobili iuventute rubro-purpurei, maturi erecto-patentes, ambitu oblongo-obovati, 21 mm. longi, stipite brevi squamis persistentibus oblecto suffulti, bracteis apice bifidis; squamae seminiferae obovatae vel rotundato-obovatae, apice truncatae vel subtruncato-rotundatae, 14 mm. longae, 13 mm. latae, anguste et haud conspicue marginatae, fere integrae, parte exserta maiuscula luteo-brunnea nitida longitudinaliter irregulariter corrugata, parte oblecta dense puberula sulcata.

N.W. Yunnan and E. Tibet. Chung valley, 9-10,000 ft. also in mixed forests of Doker-la, Mekong-Salween Divide. Lat. 28°. Ward, 257, May 1913.

5. *Tsuga calcarea*, Downie, sp. n. Ramuli iuventute pallide rubro-brunnei, indumento brevi pallido subdenso, pulvino apice rubro-brunneo, annotini haud conspicue sulcati, mox fusco-grisei vel griseo-brunnei. Folia 6-20 mm. longa, 2 mm. lata, apice truncata vel subtruncata, emarginata, apud basem angustata, breviora integra, longiora saepissime serrulata, pagina

utraqe concoloria vel inferiore subalbida superiore sulcata, fasciebus stomatiferis duabus e lineis 7-9 constitutis, breviter petiolata. Strobili maturi erecto-patentes, pallide brunnei, ambitu oblongo-ovati, 21 mm. longi; squamae seminiferae oblongae, apice rotundatae vel subtruncatae, angustissime marginatae, haud recurvae, fere integrae, parte exserta brevi lata pallide brunnea nitida irregulariter longitudinaliter sulcata.

Yunnan. Mi-monts arides, calcaires à Tché-hay, altitude 2600 m. Grand et superbe résineux à aubier rose, fruits très petits, dressés-rameaux tendant à la verticale (rare). Maire, 203. Octobre.

6. *Tsuga chinensis*, Pritz. in Engler's Bot. Jahrb. vol. xxix, p. 217 (1900); Masters in Journ. Linn. Soc. vol. xxvi, p. 556 (1902) et vol. xxxvii, p. 421 (1906).

T. Sieboldii, Masters, l.c. vol. xxvi, p. 556, saltem pro parte, non Carr.

T. yunnanensis, Masters, l.c. vol. xxxvii, p. 421, saltem pro parte, non Carr.

Abies chinensis, Franchet in Journ. de Bot. xiii, p. 259 (1899). Szechuan, near Tchen keou tin, altitude 2500 m. Farges 808! (type).

Szechuan. Henry 7156.

Western Szechuan. Wilson 2097, 2100.

7. *Tsuga Forrestii*, Downie, sp. n. Arbor 30-80-pedalis (ex Forrest); ramuli primo brunnei vel rubro-brunnei, indumento brevi pallido, pulvino rubro-brunneo nitido inferne gradatim pallescente ramulis annotinis subprominente infra apicem marginatum ampliato, mox supra griseo-brunnei, infra rubro-brunnei, cortice transverse fissio pulvino subconspicuo. Folia 10-25 mm. longa, 2 mm. lata, apice rotundata, emarginata, ima basi in petiolum angustata, integra, concoloria, supra sulcata, subtus fasciebus stomatiferis duabus e lineis 6-8 compositis instructa, breviter petiolata. Strobili lutei vel pallide luteo-brunnei, ambitu ovati vel oblongo-ovati, 25-30 mm. longi, breviter stipitati; bractee ovatae, apice breviter bilobatae, 4 mm. longae, irregulariter denticulatae, breviter petiolatae, dorso puberulae, inferne margine ciliatae; squamae seminiferae truncato-rotundatae, dorso convexae, basi auriculatae, 12 mm. longae, 13 mm. latae, longitudinaliter subregulariter striatae, marginatae, integrae, parte exserta nitida glabra luteo-brunnea, parte inclusa dense puberula. Semina 3 mm. longa, ala 10 mm. longa.

Yunnan, Lichiang range. Lat. 27° 30' N. Tree of 30-80 ft. in pure and mixed forests 10-13,000 ft. Forrest, 17,169. Nov. 1918.

NOTE.—Very similar to this species is Maire 692, 1914.

Grand et superbe résineux (rare). Fl. jeunes. Coteaux arides à Siao-ou-long. Alti. 2550 m., Juin.

Species Exclusae vel Dubiae.

Tsuga Brunoniana, Masters in Journ. Linn. Soc. vol. xxxvii, p. 421 (1906), an Carr.?

Tsuga Brunoniana, Carr., var. *chinensis*, Masters in Journ. Linn. Soc. vol. xxvi, p. 556 (1902). *Abies dumosa*, Loud., var. *chinensis*, Franchet in Journ. de Bot. xiii, p. 258 (1899).

Tsuga Sieboldii, Masters in Journ. Linn. Soc. vol. xxxvii, p. 421 (1906), an Carr.?

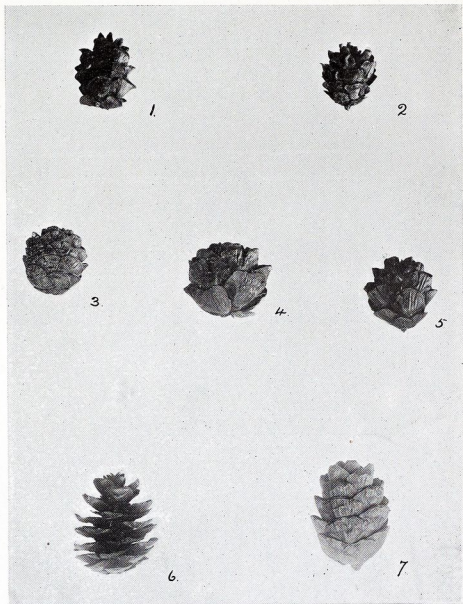
Tsuga Mairei, Lemée et Lévillé in Le Monde des Plantes, vol. xvi, p. 20 (1914). Ex descr. this species is probably incorrectly referred to *Tsuga*. There is no specimen in the Lévillé herbarium in Edinburgh.

In conclusion I wish to thank Professor W. G. Craib at whose suggestion the study was undertaken and to whom I am indebted for helpful criticism throughout the work and in the preparation of the manuscript. Acknowledgment is also made to the officials of the herbarium of the Paris Museum for permission to examine type specimens and to Professor W. Wright Smith for the preparation of the plate. I should also like to express my indebtedness to the late Professor Sir I. Bayley Balfour for the use of the Edinburgh herbarium material.

EXPLANATION OF PLATE CXCIV.

Illustrating Miss Downie's Paper on Chinese Species of *Tsuga*.

1. Cone of *Tsuga yunnanensis*, Masters—Wilson, 2098.
2. Cone of *Tsuga dura*, Downie—Forrest, 6747.
3. Cone of *Tsuga calcarea*, Downie—Maire, 203.
4. Cone of *Tsuga Wardii*, Downie—Ward, 257.
5. Cone of *Tsuga chinensis*, Pritz.—Wilson, 2097.
6. Cone of *Tsuga patens*, Downie—Wilson, 2096.
7. Cone of *Tsuga Forrestii*, Downie—Forrest, 17,169.



Chinese Species of *Tsuga*—Cones.