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Studies on *Populus tomentosa* Carr.¹

INTRODUCTION AND LITERATURE REVIEW

The Peking poplar, *Populus tomentosa* Carr., can be included among the common trees of the landscape of central China. It gives some of the villages in the valley of Wei-ho a tributary of Huang-ho, a characteristic appearance and is cultivated there together with other poplar species.

In China it is considered as both a decorative species and a timber producer. Its wood according to Chinese authors is economically very important, since it is used as construction timber, for pulp and paper production, in match industry, and for ship building. For these reasons it is commonly cultivated in some parts of China.

The determination of the taxonomic position of *Populus tomentosa* within section *Leuce* of the genus *Populus* has troubled dendrologists for many years. This is evident from the large number of synonyms for the species and the abundance of critical statements on the subject of its specificity made by several dendrologists.

Carrière was the first to give a short diagnosis of *P. tomentosa* in *Revue Horticole* 1867. Next, Maximowicz (21) in the *Bulletin de la Société Impériale des Naturalistes*, 1879, when describing *P. alba* L. forma *denudata* Hartig from the vicinity of Peking mentions that the tree is similar to *P. tomentosa* Carr. In this diagnosis he describes long shoots and leaves and the nature of their indumentum. In 1887 Wesmael (25) in *Bull. Soc. Bot. Belg.* describes *P. tomentosa* Carr. as *P. alba* var. *tomentosa*. Burkill (25) in the *Journal of the Linnean Society of London*, 1899, describes this poplar as *P. alba* Burkill. The most detailed description of the species made to date has been published by L. Henry in *Revue Horticole*, 1903 (13) however he has changed the species name to *P. pekinensis* L. Henry. In this work he describes the morphological characteristics of shoots, leaves and buds, based on material coming from young individuals only. Thus the description does not fully characterise the species. In *Extraits d' une monographie inédite du genre „Populus”* Dode, 1905 (7) includes a de-

¹ The help of Mr S. Bartkowiak in the preparation of graphs is gratefully acknowledged

scription of *P. tomentosa* and *P. glabrata* Dode, which according to Rehder (25) is identical with *P. tomentosa*. Many valuable notes on the subject of this species were made by Schneider (28) in 1904. They will be discussed further on.

A very comprehensive diagnosis of *P. tomentosa* Carr. is to be found in the work of Gombocz, 1908 (11). There the author characterises such morphological features as colour of branches, long shoots, buds, leaves of long and short shoots, their pubescence and the shape and depth of bract incisions. Detailed descriptions of *P. tomentosa* Carr. are also given by Henry (10) in 1913, Shun-Ching Lee (29) 1935, Schenck (27) in 1934 and more recently by the authors of the Dendrology of Manchuria (8). It is remarkable that the authors of the basic work on the trees and shrubs of the USSR (23) and of the the Flora of USSR (18) have not mentioned the Peking poplar which has been described in 1879 and 1903 by Russian botanists in botanical works published in Russia.

Many interesting and thought provoking remarks on the subject of *Populus tomentosa* have been made by Schneider (28). From his critical discussions of this poplar it appears that Schneider has doubts whether the Peking poplar deserves the rank of species, and he recommends that it be further studied. He also suspects the existence of two species, *P. tomentosa* Carr. and *P. pekinensis* L. Henry.

Schneider is not inclined to consider *P. tomentosa* as a form of white poplar. He has seen in the Berlin herbarium material from a female specimen of this poplar collected by Giral di (no 1155, march) in the north part of Shensi province near Tunjan-fan and another from the same region also collected by Giral di (no 5352, august). He describes them as *P. tomentosa*, but says that it is „Interesante noch zu erprobende und klarzustellende Art”.

Schenck (27), when describing the Peking poplar, points out that *P. tomentosa* has larger leaves than *P. × canescens*. In this description he compares *P. tomentosa* to *P. alba*, *P. tremula* and *P. × canescens*. This method of describing the plant indicates that *P. tomentosa* lacks distinctive morphological features. Bretschneider (5) stresses the existence of great variability in leaf shape, and quotes Maximowicz as having included it with the white poplars. On the basis of the information supplied by Handel-Mazzetti (12) that there is in the Nanking University herbarium a specimen of *P. adenopoda* Maxim. which was described by Merrill as *P. tomentosa*, it is reasonable suppose that some forms of the Peking poplar are difficult to tell from *P. adenopoda* Maxim.

Henry (13) informs that Dode considered *P. tomentosa* and *P. adenopoda* as very similar, but points out that some of their morphological features are somewhat distinctive. From the description of the Peking poplar made by Henry (13) it appears that he had at his disposal only juvenile material.

Koch (20) when writing in 1872 about the white poplar and its geographic races, makes an interesting remark about *P. tomentosa*, which at the time was widely distributed by commercial nurseries. He claims that old specimens of this poplar are usually mistaken with *P. × canescens* Sm., which is a hybrid between



Phot. S. Białobok

Poplar cultivation nr. Yingtou-koi, valley of Wei-ho

the white poplar and the trembling aspen. Houtzagers (14) describes the Peking poplar as a Chinese species of the white poplars.

The somewhat archaic view that *P. × canescens* and *P. tomentosa* are good species, related in some morphological characters to the white poplar is expressed by Rehder (24). When describing the Peking poplar Henry (10) mentions that Diels, the famous student of Central Chinese flora, sometimes referred to *P. tomentosa* as *P. tremula*, where as in reality Henry (10) thinks that it was *P. wutaica* Mayer. that Diels came across. *Populus wutaica?* is a synonym for *P. tremula* var. *Davidiana* Schn., and it occurs in a large part of the East Asian continent. As can be seen from this note some botanists had difficulties in identifying not only the forms but also the species of some Chinese poplars.

In the more recent dendrological literature, the subject of the Peking poplar has become topical again. Bartkowiak (2, 3) in connection with his studies of the variation in bracts of *P. alba* in Poland, including some geographical races, of *P. tremula* and *P. tremula* var. *Davidiana* from several localities within its range, and of the natural and artificial hybrids *P. × canescens*, has also considered this feature in *P. tomentosa*. As a result of these studies Bartkowiak points out that the bract morphology in *P. tomentosa* is intermediate between that of a white poplar and an aspen and close in shape to the bracts of *P. × canescens*, thereby suggesting hybrid origin. When comparing the bract shape, nature of its lobes and indumentum of *P. × canescens* with these features in *P. tomentosa* Bartkowiak does not see significant differences. Also Bugała (6) seems to

agree with Bartkowiak about the hybrid nature of *P. tomentosa*. Bartkowiak has also shown (3) that the bract characteristics of *P. × canescens* from artificial crosses do not differ from those of natural hybrids of *P. alba* and *P. tremula*.

THE DISTRIBUTION OF CULTIVATED *P. TOMENTOSA*

Many students of Chinese flora report the occurrence of this species in China. Bretschneider (5) reports it from the vicinity of Peking. Komarov (19) also reports it from around Peking and Chefoo (prov. Shantung), as well as from the southern part of the Liaotung province, from parks in Ryojun and Talien. Willimson (Sargent-26) considers it as common in North China and Macgregor has seen it in the parks of Shanghai. Schneider (28) reports it from the vicinity of Peking and from the mountains of the Shensi province. Gombocz (11) has seen it there too as well as in Kweichow and Shantung.



Phot. S. Białobok

P. tomentosa Carr. from the valley of Wei-ho

Shun-Ching Lee (29) draws up a much wider area of occurrence for the tree including the provinces Hopeh, Honan, Shansi, Kansu, Shantung and Kiangsi. The southernmost occurrence of *P. tomentosa* in China is reported by Handel-Mazzetti (12). The authors of the work (8) report it also from the vicinity of Chêng-têh in the Hopeh province and in Liaotung near the towns Talien and Ryojun as well as in North and North-west China.

Steward (30) lists the stands of *P. tomentosa* in southern China from the



Phot. S. Bialobok

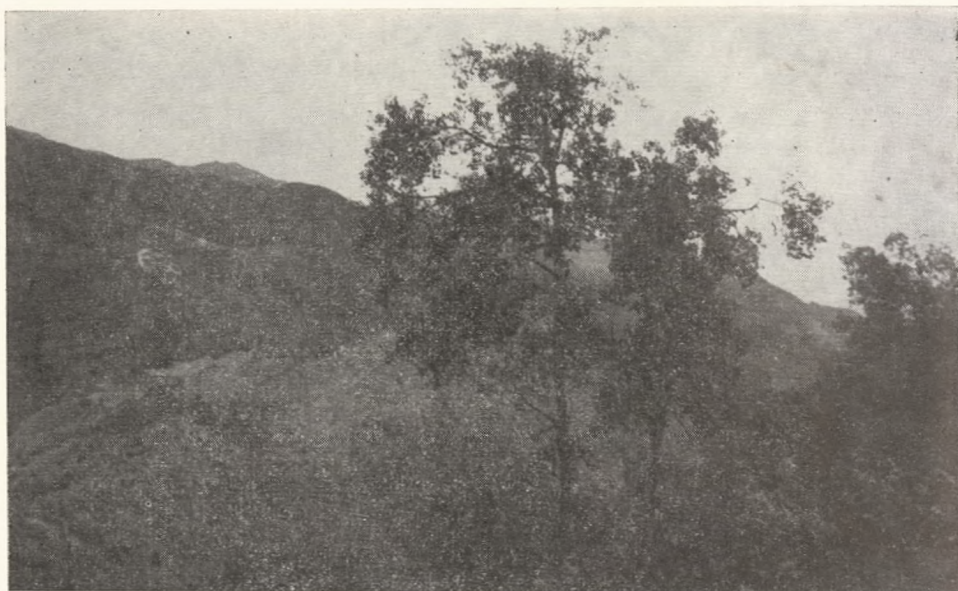
P. tomentosa Carr. — trunk from the valley of Wei-ho

provinces Anhwei, Kiangsu and Kiangsi, and Wu Chung-lwon and Hwang Tung-shen (34) report it from the high flatlands of North China and from the valley of the lower Yangtze kiang.

As can be seen from the above review this poplar is a tree widely distributed over the Chinese Peoples Republic. It is however difficult to establish whether *P. tomentosa* is only a cultivated species or whether it occurs also in natural plant associations. Schneider (28), Komarov (19), Elwes (10), Sargent (26), Macgregor (26), Steward (30) and the author of this paper report *P. tomentosa* from cultivation. Wu Chung-lwon and Hwang Tung-shen (34) write about *P. tomentosa* "It is interesting to mention that there is no authentic record of natural growth of this aspen". Other botanists like Shun-Ching Lee (29), Gombocz (11) and Handel-Mazzetti (12) do not express any definite view on the subject.

THE HISTORY OF *P. TOMENTOSA* DISCOVERY

It is not unusual in the case of some Chinese trees or species that they are only to be found in cultivation to-day and not at all in natural stands. Several millennia of man's activity on the colossal area of China has changed the plant communities so much, that now it is difficult to delimitate the natural ranges of many trees and shrubs used by man.



Phot. S. Białobok

P. tremula var. *Davidiana* Schn. in the mountains of Tai-paishan

Bretschneider (5) on page 118 of his work describes *P. tomentosa* as having large, roundish leaves on a long thin petiole. These leaves according to Bretschneider tremble during windless weather giving like *P. tremula*, a murmuring sound comparable to a copious shower. The Chinese call this poplar pai-yang (white poplar) or else ta ye yang (a poplar with large leaves). According to Henry (10) pay-yang is the name given by the Chinese to *P. tomentosa*. In the work *Ku Kin chu* written in the 4th century A.D. by Tsui Pao from Peking the differences between Chinese poplars and willows are discussed.

Wu Chung-lwon and Hwang Tung-shen (34) mention that the cultivation of poplars in China has a long history. In the work *Chi Ming Yao Shi*, written by Chia Shu-hsia in about 534—543 A.D. there is a description of poplar cultivation. In another work entitled *Chung Fan Pu* written in 1624 there are considerably more details about poplar cultivation than in the previous works.

Populus tomentosa was (10) introduced into modern dendrological literature thanks to its "discovery" by Simon in Siwan, north-west of Peking.

From Peking to Europe young transplants of *P. tomentosa* were brought in 1897 by Provost in 1897, of which two individuals he gave to the Museum in Paris and the third to M.M. Vilmorin, who transferred it later to be planted in a collection together with the other two. Of these three individuals two have died later, and from the remaining tree many ramets were distributed over France and other countries. Much later, in 1905 Jack brought this species from China to the Arnold Arboretum. French nurserymen appreciated its high decorative

value and promoted its cultivation, but as has been pointed out by Henry (10) *P. bogueana* Dode has often been sold as *P. tomentosa*. According to Henry (10, page 1781) *P. bogueana* is a vigorous form of *P. × canescens* with very large leaves on long shoots, 12,5 cm long or more and wide. At the turn of the present century it was distributed by French nurseries Simon Louis and Barbier, which is indicative of its popularity as a decorative tree. Henry (10) reports having found it growing wild in a wood near Orlean, where it evidently grew as a sucker from a typical grey poplar growing beside it. The fact of selling grey poplars with larger leaves as *P. tomentosa* indicates great similarity of these two poplars within section *Leuce*.

To Kórnik the Peking poplar was introduced from Jardin des Plants in Paris in 1930, and it was registered as catalogue number 4770. This individual is still growing in the Arboretum. On my return from the Chinese Peoples Republic I compared the Kórnik specimen with those I have seen in the native country of *P. tomentosa*, and came to the conclusion that it was erroneously described, and that it represents some form of *P. × canescens*. We do not have any confirmed data on the occurrence of the Peking poplar under cultivation in other arboreta or parks in Poland.

MATERIALS AND METHODS

As can be seen from the above review much contradictory evidence about the systematic value of *P. tomentosa* has accumulated, which requires clarification. As a result, in some European herbaria this poplar is often found incorrectly described. Sometimes it is described as *P. alba* L. or *P. adenopoda* Maxim.

When making a description of *P. tomentosa* I could not rely on the diagnosis of Carrière or Dode, since they are too general. According to Dode the Peking poplar was adequately described by Henry (13), who worked with botanical material received from Carrière.

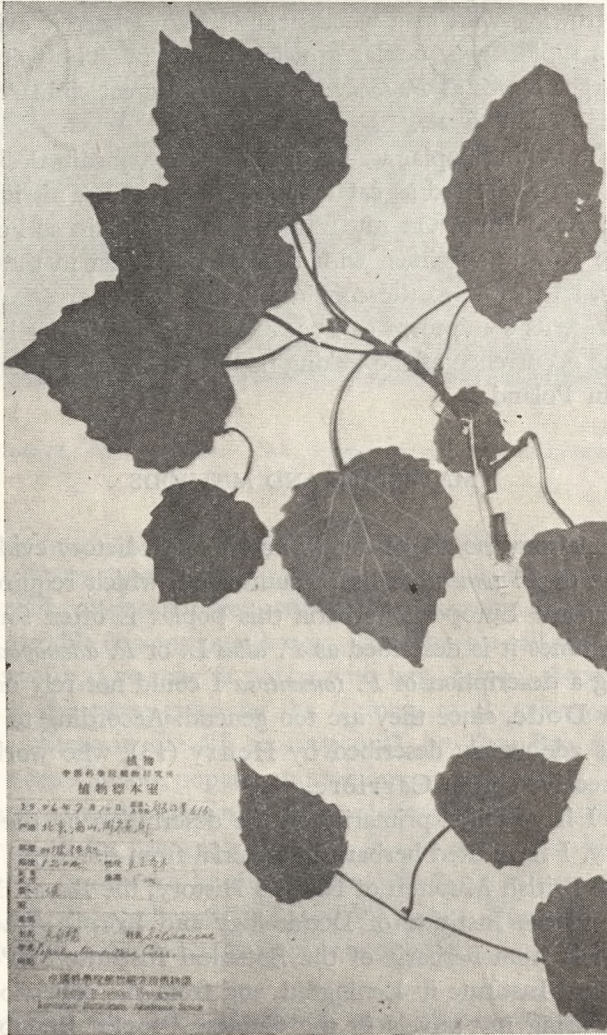
In this work I have relied primarily on the description of the Peking poplar made by Henry. I have used herbarium material from the Royal Botanical Garden at Kew, the British Museum of Natural History, the Royal Botanic Garden in Edinburgh and the Institute of Dendrology and Kórnik Arboretum, where there are materials from herbaria of the Botanical Institute in Peking, and the Komarov Botanical Institute in Leningrad, and from the collection of Browicz and my own. During my travels in the Chinese Peoples Republic I was able to see the close similarity between *P. tomentosa* and *P. × canescens*. Thus I decided that it would be of interest to analyse the morphological characters of *P. tomentosa* in order to clarify its systematic position.

In this work I have used the following herbarium sheets:

Populus tomentosa Carr.

China P. R.: Shantung prov., Meng shan Fei Hsien, trees very common on temple sites, alt. 200, 1936, T. Y. Cheo and L. Yen (BM); Mount. West of Peking, summer 1881, Bretschneider, (BM); Mount. West of Peking, summer 1881, Bretschneider, 1964 (BM); Herb. of Monbeigneur

Léveille, (E); Ta Yang?, Herb. L. Léveille (E); Eastern China, 1910, I. B. Balfour (E) Chihli prov. Tientsin, M. Strong Clemens, 1758 (E); Cent. Manchuria, 1869, Revd—Alex Wiliamson (E); Plant from the vicinity of Yun Nan sen, Nov. 1906, Maire, 2474 (E); Ta-Yang (Tche-Ly)? March 1906, L. L. Chanel, 163 (E); Shansi prov. by Tsien lin shan, 11. IX. 1959, Białobok, 933 (Kór 1); Shansi prov., Wei-ho valley, 11. IX. 1959, Białobok, 933 a (Kór); USSR, Tashkent, Dendro-park, 17. X. 1957, Browicz (Kór)².



Phot. W. Bugała

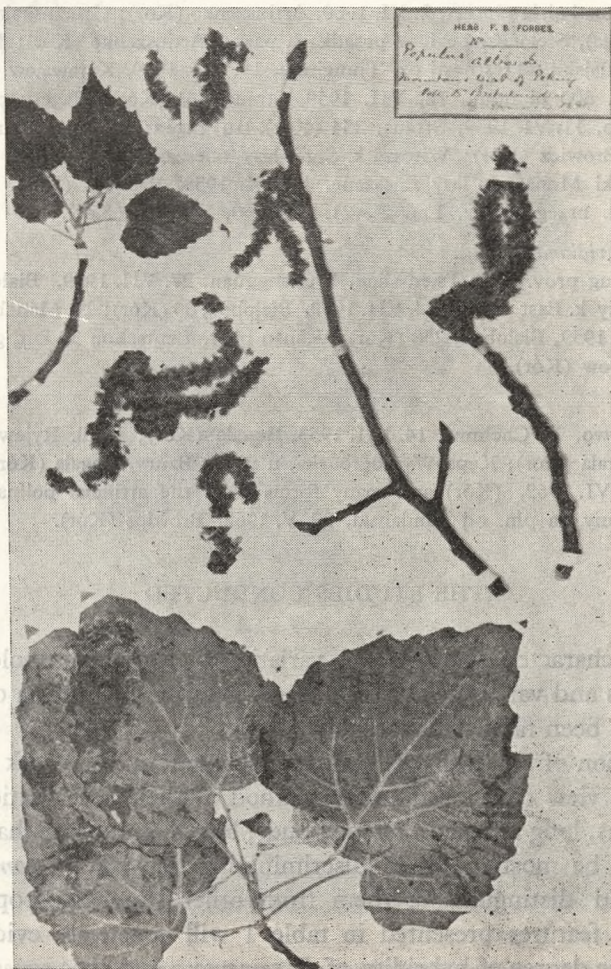
P. tomentosa Carr. specimen from Institutum Botanicum, Academia Sinica, short shoot with leaves

Populus alba L.

Poland: Stare Miasto k. Leżajska, lewy brzeg Sanu, 14. VII. 1961, Browicz, Gostyńska, 2820 (Kór); Nadl. Ryjewo, Leśn. Maławy, 16. VII. 1953, Bugała, 584 (Kór); Nadl. Czeszewo,

² The abbreviation (Kór) refers to herbarium sheets at the Institute of Dendrology and Kórnik Arboretum of the Polish Academy of Sciences.

Leśn. Warta, 3. VII. 1953, Bugała, 583 (Kór); Arciechów n. Wisłą, 15. VII. 1954, Bugała, 332 (Kór); Toruń, 27. V. 1954, Bugała (Kór); Kępa Wyszogrodzka, Bugała, 52 (Kór); Dęblin, Bugała, 79 (Kór); Kępa Kaliszańska k. Józefowa, Bugała, 105 (Kór); Kępa k. Sandomierza, Bugała, 113 (Kór); Kępa k. Sandomierza, Bugała, 106 (Kór); Kępa k. Sandomierza, Bugała, 109 (Kór).
 Bulgaria: Balczyk n. Morzem Czarnym, na ulicach, Browicz (Kór); Ahtopol n. Morzem Czarnym, na ulicach, 1. X. 1958, Browicz (Kór).



Phot. K. Jakusz

P. tomentosa Carr. specimen from the British Museum, Natural

History, short shoot with leaves

Populus alba var. *genuina* Wesm.

Bulgaria: Balczyk n. Morzem Czarnym, na kredowych zboczach, 5. X. 1958 (Kór).

P. alba var. *Bachofenii* Hartig.

USSR: West Tien Shan., pod górą Czingan, „Mielowyj pieriewal”, 16. X. 1958, Browicz (Kór). Many specimen.

P. alba var. *Bolleana* Lauche.

Poland Kórnik Arboretum, Bugała (Kór).

P. tremula L.

Poland: Kórnik Arboretum (Kór); Białowieża, Białowiecki Park Narodowy (Kór). USSR: Azerbajdżańska SSR, Zakatał, Zakatajskij zapowiednik, pojas bukowo liesa, 13. V. 1960. Artju-szenko, 354 (Kór); Siew. Kawkaz, Bokszańskoje uszczielie, skłony G. Krugozor, u podnożia Elbrusa, 15. VI. 1960, Artju-szenko (Kór); Gruzinskaja SSR, Gergetskeje uszczielie (Wojenno Gruzinskaja doroga), O. Krestnosti sieła Gerget, 2. VI. 1960, Artju-szenko (Kór); Gruzinskaja SSR (Wojenno-Gruzinskaja doroga), Sieło Kazbegi, w posadkach parka, Artju-szenko (Kór); Jakutskaja ASSR, raj. Megino-Kangałajskij, okrestnosti oz. Tjungjulju, 13. VII. 1949. Karawajew (Kór). Sweden: Abisko-Nudja, alt. 600 m n.p.m., 12. VII. 1959, Straus, 361 (Kór); Hagesköp, okolice Ängelholm, wrzosowisko, 11. VI. 1959, Straus, 254 (Kór). Bulgaria: Strandža Planina, lasy k. Kosti, 29. IX. 1958, Browicz (Kór); Witosza k. Sofii, lasy mieszane, 18. X. 1858, Browicz (Kór); Riła Planina, Rilski Monastyr, lasy mieszane, 17. IX. 1958, Browicz (Kór). USSR: Wyspy Wałaaam, przy pół. brzegach jez. Ładoga, 21. IX. 1960, Browicz (Kór).

P. tremula var. *Davidiana* Scheid.

China: Liaotung prov. góry Tsien-shan, Wuliangguan, 27. VII. 1959, Białobok, 166 (Kór); Liaotung prov. lasy k. East Tomb, 24. VII. 1959, Białobok, 83 (Kór); N. Manchuria, Liangshui-gon, lasy, 8. VIII. 1959, Białobok, 258 (Kór); Kansu prov. Lantschou 30 km, góra Iszkłunmań, 23. VI. 1957, Pietrow (Kór).

P. × canescens Sm.

Poland: Plutowo k. Chelмна, 14. VII. 1953, Bugała (Kór); Nadl. Ryjewo, Leś. Mątawy, 16. VII. 1953, Bugała (Kór); Kępa Wyszogrodzka, u ujścia Bzury, Bugała (Kór); Nadl. Kórnik, las mieszany, 15. VI. 1962, (Kór) and many forms from the artificial polination. Bulgaria: Dolina rzeki Strumy na płn. od Sandanski, 22. V. 1962, Browicz (Kór).

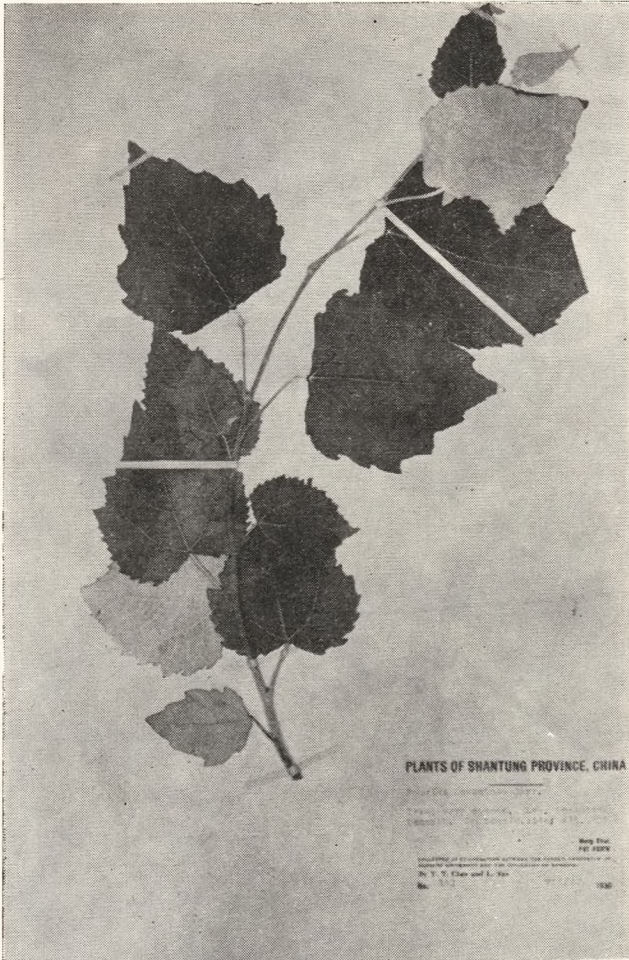
THE STUDIES CONDUCTED

In order to characterise clearly the variation of some morphological features between species and varieties of section *Leuce* growing in Eurasia or in East Asia only, they have been tabulated in table 1.

The description of some of the features discussed in this work is of necessity very general in view of the tabulatory method of their presentation. Only such features of stems, long and short shoots, buds, leaves, and bracts have been included which can be most useful in discriminating between *P. tomentosa* and *P. × canescens* and distinguishing them from other Eurasiatic poplars. Some of the descriptive features presented in table 1 will constitute evidence for the estimation of the degree of hybridity of *P. tomentosa* and *P. × canescens*, thus the descriptions were made in such way as to be able to characterise generally their range of the features variation and degree of their intensity. Besides the very variable features of the studied poplars, such as leaf shape and size, one can distinguish features that vary little and therefore are characteristic for a particular species such as pubescence of one year old shoots, the luster of the ventral leaf surface, and others.

Particular difficulty was encountered in characterising *P. × canescens* due to a great variability of some of its morphological features and the varying degree of its hybridity.

When discussing the morphology of *P. tomentosa* it will be compared with that of *P. × canescens*, which as is known is a hybrid between the white poplar and the trembling aspen. This is done because *P. tomentosa* represents a similar type of hybrid between the Asiatic white poplar and an aspen of that region.



Phot. K. Jakusz

P. tomentosa Carr. specimen from the Royal Botanical Garden, Edinburgh, long shoot with leaves

Some taxonomists describe *P. tomentosa* as a "Chinese white poplar". This name does not have as precise a systematic meaning as "white poplar". The Peking poplar is not a geographical race of a white poplar, since it differs from it in important morphological characters discussed below.

The bark of upper parts of the trunk of the Peking poplar is not as intensively white as that of the white poplars of Central Asia, *P. alba* var. *Bachofenii* and *P. alba* var. *Bolleana*, and not as greenish-grey as that of the East Asiatic aspens.

It has a definitely intermediate colour comparable to *P. × canescens*. The next characteristic feature of *P. tomentosa* is the pubescence of long shoots and sprouts, which is not as intensive as that of the Central Asiatic white poplars, and comparable to, though considerably more intense than the pubescence of *P. × canescens*.



Phot. K. Jakusz

P. tomentosa Carr. specimen from the Royal Botanical Garden,
Edinburgh, long shoot with leaves

One of the most characteristic of the morphological features of East Asiatic white poplars is the lobing of leaves on long shoots and sprouts. On the other hand the leaves of aspens of this region are not lobed, oval or ovate and the leaf margin is irregularly dentate, hook-like dentate or finely serrate. On the other hand the leaves of long shoots and sprouts of *P. tomentosa* and *P. × canescens* are not lobed but deeply sinuate or finely irregularly serrate, with the teeth of *P. tomentosa* leaves curving towards the margin like in *P. tremula* var. *Davidiana*.

Table 1

Description of some poplar species from section *Leuce*

Morphological characters		<i>Populus alba</i> L.	<i>P. alba</i> var. <i>Bachofenii</i> Hartig	<i>P. alba</i> var. <i>Bolleana</i> Lauche	<i>P. tremula</i> L.	<i>P. tremula</i> var. <i>Davidiana</i> Schneider	<i>P. × canescens</i> Sm.	<i>P. tomentosa</i> Carr.
I. Trunk	1. Bark colour of upper stem	white, greyish — white greenish, smooth	chalk white or bright greyish white	bright greyish green	greenish yellow	light greyish green	greenish-grey, olive	whitish — grey green
II. Long shoots and sprouts	1. Colour of shoots	olive green	light brown	olive green	brownish green	brownish red	olive brown	olive brown
	2. Pubescence of young shoots	silvery indumentum	dense silvery indumentum	dense silvery indumentum	medium or absent	medium, or no indumentum	weak or glabrous	strong on top, weak or glabrous lower down
III. Leaves of long shoots and sprouts	1. Shape	cordate, lobed	cordate, sharply lobed	cordate, lobed	oval, suborbicular	oval, suborbicular	oval-cordate	oval-cordate
	2. Lustre of ventral surface	distinct	strong	very distinct	absent	absent	distinct	strong
	3. Colour of dorsal surface	silvery white	silvery white	silvery white	dull green	dull green	grey	silvery
	4. Pubescence of ventral surface	slight or only along veins	only along veins	slight or only along veins	medium or only along veins	medium glabrescent	medium in spring, in summer along veins only	medium in spring, in summer along veins only
	5. Pubescence of dorsal surface	compact silvery indumentum	dense indumentum	dense indumentum or weak pubescence	dense in spring poor in summer	dense in spring weak in summer	medium to glabrous	strong
	6. Margin	coarsely dentate, lobed	coarse, sharp dentation, lobed	coarsely dentate, lobed	irregularly dentate	hook-like dentate	coarsely irregularly dentate	finely, irregularly hook-like dentate
	7. Glands at leaf base	absent	absent or occasional on short shoot lvs	absent	sporadic	always, but sporadic	rare	frequent
IV. Foliage buds on long shoots	1. Shape	obtusely tapering, blunt	sharply tapering	obtusely tapering blunt	narrowly tapering, pointed	narrowly tapering, pointed	obtusely acute, blunt	acutely tapering
	2. Pubescence	present	weak at the base	present	absent	absent	absent	absent
	3. Lustre	absent	absent	absent	shiny	shiny	absent	absent
V. Short shoots a) leaves	1. Shape	orbicular, oval or elliptic	cordate, suborbicular rather variable	cordate, suborbicular	suborbicular, oval	suborbicular, widely oval	oval suborbicular	oval cordate
	2. Colour of dorsal surface	silvery grey	silvery, silvery grey	silvery or greyish	light earthy green	light greyish green	earthy green	earthy green
	3. Apex	blunt	blunt	subacute, pointed	blunt, or slightly pointed	pointed	pointed	pointed
	4. Margin	sinusoidly dentate	sinusoidly — dentate	sinusoidly dentate	irregularly coarse dentate	irregularly hook-like dentate	irregularly, deeply or shallowly dentate	coarsely dentate
b) petiole	1. Pubescence	medium, mainly near base	strong	medium	absent or rare	absent	glabrous	glabrous
	2. Length	medium short	medium	medium	long, medium	long	long	long
	3. Cross section	flattened	flattened	flattened	very flattened	very flattened	very flattened	very flattened
c) foliage buds	1. Shape	obtusely tapering, blunt, small	sharply tapering	obtusely tapering, blunt, small	narrowly tapering	obtusely tapering pointed	globular, blunt	globular, blunt
	2. Pubescence	present	regularity at base	present	absent	absent	absent	absent
VI. Bracts	3. Lustre	absent	absent	absent	present	present	absent	absent
	1. Shape	elongate	elongate	elongate	spathulate	spathulate	spathulate	spathulate
	2. Incisions	absent or indistinct	absent or indistinct	absent or indistinct	very deep	very deep	medium	medium

The ventral leaf surface on both long and short shoots of the white poplar and its geographical varieties from Central Asia is dark shining green while the leaves of aspens coming from these areas are dull green. The leaves of *P. tomentosa* are on the ventral side dark green, shining. Less intensively coloured is the ventral side of *P. × canescens* leaves which have also a much weaker lustre.



Phot. W. Bugala

P. alba var. *Bachofenii* Hartig from Tien-Shan

The dorsal surface of *P. tomentosa* leaves from the long shoots is covered with a dense and finely tangled indumentum gradually disappearing and exposing a silvery-grey colouration. Leaves from the long shoots of the Siberian white poplar are intensively silvery on the dorsal side, and from the aspens of that region are dull green covered in the early stage of development with silvery hairs.

The dorsal side of *P. × canescens* leaves is at first covered with a dense silvery pubescence and later becomes grey. Young unfolding leaves of *P. tremula* and other East Asiatic aspens are red. This feature can also be observed to a limited extent in *P. tomentosa* and *P. × canescens*.



Phot. W. Bugala

P. × canescens Sm., valley of the Warta, Mechlin

The shape of leaves from the short shoots of *P. tomentosa* is more akin to the leaves of Asiatic aspens than to those of white poplars. Similarly the type of teeth on the leaf margin is reminiscent of aspen leaves. The leaves from *P. × canescens* short shoots are rather variable in shape, in some individuals they are more related to the leaves of aspen and in others to the leaves of white poplars.

There are no glands on the leaf bases of East Asiatic white poplars. On the other hand in *P. tremula*, and its variety *Davidiana*, they occur sometimes and

in *P. adenopoda* they are to be observed as one of the stable diagnostic features. In *P. tomentosa* glands are common on the leaf bases. The petiole cross section of white poplars is slightly flattened and in the aspens of East Asia, in *P. × canescens* and in *P. tomentosa* it is very flattened and the petioles are much longer than in the white poplars.

Considerable differences are also to be observed in bud morphology. Leaf buds on long and short shoots of *P. alba* and *P. alba* var. *Bolleana* are obtusely conical, in *P. alba* var. *Bachofenii* they are subacutely conical and pubescent, and in the aspens they are narrow conical and acuminate. *P. tomentosa* and *P. × canescens* have buds on long shoots obtusely conical and pubescent, and on short shoots globular and sparsely pubescent.

Very characteristic differences occur in the bract morphology of the studied poplars, and particularly in their shape, depth of lobing and density of pubescence. For comparative studies of bracts from male and female flowers of species and varieties of Eurasian poplars the following materials were used:

P. tomentosa Carr.

China: Nanking, Pekin, Tschifu, Herb. Inst. Bot. Leningrad; Kiang-su, Herb. Leveille (E); Nanking, Chiao, Tschifu, Herb. Gł. Bot. Sad. Moskwa; Pekin, Herb. Forbes (BM).

P. alba I.

Poland: *P. alba* from Dęblin (Kór); USSR: Uralsk. *P. alba* var. *Bachofenii* Hartig, Herb. Gł. Bot. Sad, Moskwa;; Poland: *P. alba* var. *Bolleana*, Poznań.

P. tremula L.

Poland: Nadl. Kąty; USSR: Altai, Herb. Gł. Bot. Sad, Moskwa.

P. tremula var. *Davidiana* Schneid.

China. Innern Mongolia, Herb. Inst. Bot. Leningrad and from Japan; Poland: Arboretum Kórnik.

P. × canescens Sm.

Poland: Nadl. Wolsztyn; forest near Bnin.

The photographs of many bracts included with this paper characterise much better some of their morphological features than any description could, in particular their shape, depth of their incisions and nature of their pubescence. Bracts of *P. alba*, *P. alba* var. *Bachofenii* and *P. alba* var. *Bolleana* are of similar shape, elliptically elongated with countless minute serrations or devoid of any incisions. On the other hand *P. tremula* and *P. tremula* var. *Davidiana* have bracts spatulate in shape, with very deep incisions reaching almost their bases, and covered with a copious indumentum. The bracts of *P. tomentosa* are irregular in shape, pubescent, usually roundish less frequently oval, with much shallower incisions than in the aspens. When comparing the bract characteristics of *P. tomentosa* with those of *P. × canescens* their resemblance is very striking.

A clear picture of the similarities and differences of some of the morphological features of male flower bracts of the various poplar species and varieties is to be seen from fig. 1 and table 2. There, in a graphical way some features of the bracts (mean of 70 per individual) are presented. The following bract characteristics were covered by the investigation: a) depth of incisions, b) ratio of inci-

sion depth to bract length, c) ratio of incision depth to bract width. For the comparison the following species and varieties were used: *P. tremula*, Kały, Poland, *P. tremula* var. *Davidiana* Japan and Mongolia, *P. × canescens*, Wolsztyn, Poland, and *P. tomentosa* from Nanking, Tschi-fu and Peking.

Table 2

Morphology of bracts from species and varieties of poplars from the section *Leuce* Duby in comparison with *P. × canescens* the values for which are taken as unity

Species or hybrids	Depth of incisions	Ratio of incision depths to bract length	Ratio of incision depths to bract width
1. <i>P. tremula</i> Forest Distr. Kały, Poland	2.26	2.50	2.02
2. <i>P. tremula</i> var. <i>Davidiana</i> Japan	2.36	2.50	1.51
3. <i>P. tremula</i> var. <i>Davidiana</i> Mongolia	2.93	2.75	1.46
4. <i>P. × canescens</i> Forest Distr. Wolsztyn, Poland	1.23	1.15	1.17
5. <i>P. tomentosa</i> Nanking	2.33	1.65	1.12
6. <i>P. tomentosa</i> Tschi-fu	2.00	1.55	1.05
7. <i>P. tomentosa</i> Peking	2.03	1.57	1.03

As a standart for comparison when preparing the graphs for fig. 1, the average values for bracts of *P. × canescens* from Poland was taken as one and represented as a straight line on the left side of the diagram. The studied bract features of other poplars are represented by graphs right of this line. The use of *P. × canescens* for comparison has enabled the confrontation of its hybrid characteristics with those of *P. tomentosa* (Szaferowa — 31).

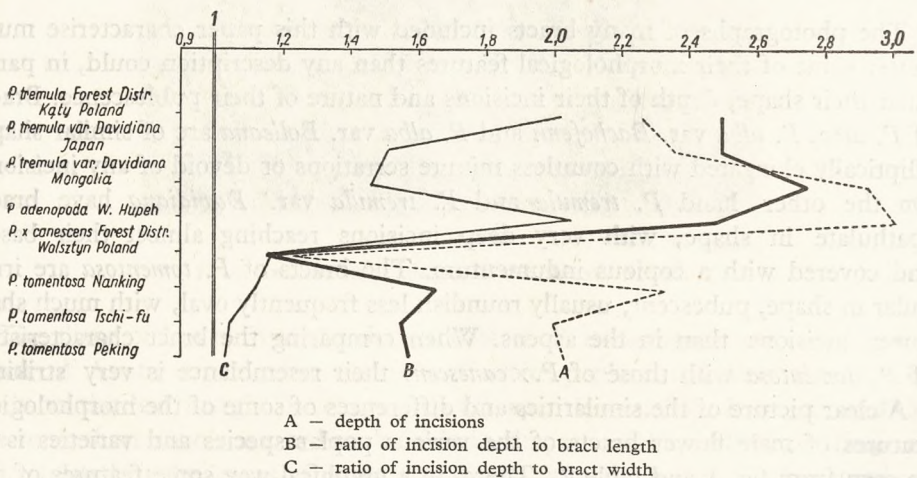


Fig. 1. A graphical comparison of three bract characters for eight poplar species from the section *Leuce*



a



b



c



d



e



f

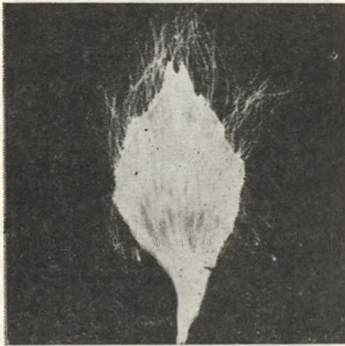
Male flower bracts of *P. tomentosa* from: a) Nanking, b) Tschifu, c) Kiang-su, d) Peking; and of *P. x canescens* from: e) Wolsztyn Forest Distr., Poland and f) a forest near Bnin, Poland



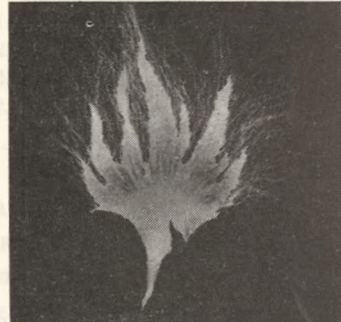
a



b



c



d



e



f

Male flower bracts of a) *P. alba* from Dęblin, Poland; b) *P. alba* var. *Bachofenii* from Uralsk, USSR; c) *P. alba* var. *Bolleana* from Poznań; d) *P. tremula* from Kórnik, Poland; e) *P. tremula* var. *Davidiana* from Inner Mongolia; and f) *P. adenopoda* from W. Hupei China.

The most characteristic bract feature of the Asiatic poplars is the depth of incisions. As can be seen from the curve *a*, deepest incisions of the bract are be found in *P. tremula* and *P. tremula* var. *Davidiana*. The incisions in the bracts of *P. tomentosa* are much shallower. The *P. tomentosa* specimens from Peking and Tschifu have an equal depth of bract incisions but the specimen from Nanking has somewhat deeper incisions.

The curve *b* represents the ratio of the incision depth to the bract length. A high value of this ratio is characteristic of *P. tremula* and its geographical varieties *P. tremula* var. *Davidiana*, whereas it is much smaller in *P. tomentosa*. The ratio of incision depth to bract width is a less significant characteristic for diagnostic purposes, however it does clearly indicate the difference between the East Asiatic aspens and *P. tomentosa*, which in respect of this characteristic is nearer to *P. × canescens*.

In order to characterise the degree of hybridity of *P. tomentosa* on the basis of some morphological features, and to compare it with the features of *P. × canescens* the Anderson (1) method for delimiting hybrids was employed. Also for this purpose the studies of Natho (22) were used.

Some of the morphological characters listed in table 1 were selected for their value as indicators of *P. tomentosa* and *P. × canescens* hybridity and presented in table 3. They are given estimates from 0–5.

Table 3

Key to character estimates for species and hybrids of poplars from section *Leuce*

Estimate 0 = *P. alba*, *P. alba* var. *Bachofenii*, *P. alba* var. *Bolleana*

5 = *P. tremula*, *P. tremula* var. *Davidiana*

- | | |
|---|--|
| <p>1. Bark colour of upper stem</p> <p>0 = chalk white</p> <p>1 = white</p> <p>2 = whitish—greyish—green</p> <p>3 = greenish—greyish—olive</p> <p>4 = greyish—green</p> <p>5 = bright greyish olive</p> | <p>4. Leaf shape on long shoots or sprouts</p> <p>0 = cordate, distinctly lobed</p> <p>1 = cordate, lobed</p> <p>2 = cordate—ovate</p> <p>3 = ovate cordate</p> <p>4 = cordate</p> <p>5 = ovate—orbicular</p> |
| <p>2. Colour of long shoots and sprouts</p> <p>0 = olive green</p> <p>1 = bright brown</p> <p>2 = olive brown</p> <p>3 = brownish—green</p> <p>4 = brown</p> <p>5 = brownish—red</p> | <p>5. Lustre of ventral leaf surface on long shoots or sprouts</p> <p>0 = very strong lustre</p> <p>1 = strong lustre</p> <p>2 = distinct lustre</p> <p>3 = poor lustre</p> <p>4 = indistinct lustre</p> <p>5 = dull</p> |
| <p>3. Pubescence of young long shoots or sprouts</p> <p>0 = copious, silvery indumentum</p> <p>1 = silvery indumentum</p> <p>2 = moderate pubescence</p> <p>3 = pubescence poor</p> <p>4 = pubescence poor or nil</p> <p>5 = glabrous</p> | <p>6. Colour of dorsal leaf surface on long shoots and sprouts</p> <p>0 = silvery white</p> <p>1 = silvery</p> <p>2 = grey</p> <p>3 = greenish</p> |

Table 3

- 4 = dullish green
5 = dull green
7. Pubescens of dorsal leaf surface on long shoots and sprouts
0 = puberulous silvery indumentum
1 = puberulous indumentum
2 = glabrescent except along the nerves
3 = glabrescent
4 = strong in the spring, weak in the summer
5 = very weak
8. Leaf margin on long shoots and sprouts
0 = sharp coarse dentation and lobing
1 = coarse dentation and lobing
2 = coarse irregular dentation
3 = coarse irregular dentation with hooked teeth
4 = hooked teeth
5 = serrate
9. Glands at leaf base on long shoots and sprouts
0 = absent
1 = absent or traces visible
2 = very rare
3 = rare
4 = frequent
5 = regular occurrence
10. Colour of dorsal leaf surface on short shoots
0 = silvery
1 = silvery—grey
2 = greyish
3 = dull—green
4 = bright greyish green
5 = bright dull—green
11. Petiole pubescence on short shoots
0 = strong
1 = medium
2 = poor
3 = poor or absent
4 = very poor
5 = absent
12. Foliage bud shape on long shoots
0 = very obtusely tapering
1 = obtusely tapering
2 = tapering, blunt
3 = tapering, sharp
4 = acutely tapering
5 = very acutely tapering
13. Foliage bud pubescence on long shoots
0 = present
1 = present at the base
2 = weak at the base
3 = rare
4 = very rare
5 = absent
14. Lustre of foliage buds on long shoots
0 = absent
1 = very weak
2 = weak
3 = visible
4 = conspicuous
5 = strong
15. Foliage bud shape on short shoots
0 = very obtusely tapering
1 = obtusely tapering
2 = tapering, blunt
3 = tapering, sharp
4 = acutely tapering
5 = very acutely tapering
16. Foliage bud pubescence on short shoots
0 = present
1 = present at the base
2 = weak at the base
3 = rare
4 = very rare
5 = absent
17. Lustre of foliage buds on short shoots
0 = absent
1 = very weak
2 = weak
3 = visible
4 = conspicuous
5 = strong
18. Bract shape
0 = elongate
1 = elliptic
2 = oval
3 = suborbicular
4 = round
5 = spatulate
19. Bract incisions
0 = absent
1 = slight
2 = definite
3 = medium
4 = deep
5 = very deep

The morphological characters of the studied poplars were so arranged that the low values of the estimates relate to *P. alba*, *P. alba* var. *Bachofenii* and *P. alba* var. *Bolleana*, and the high values to *P. tremula*, *P. tremula* var. *Davidiana*.

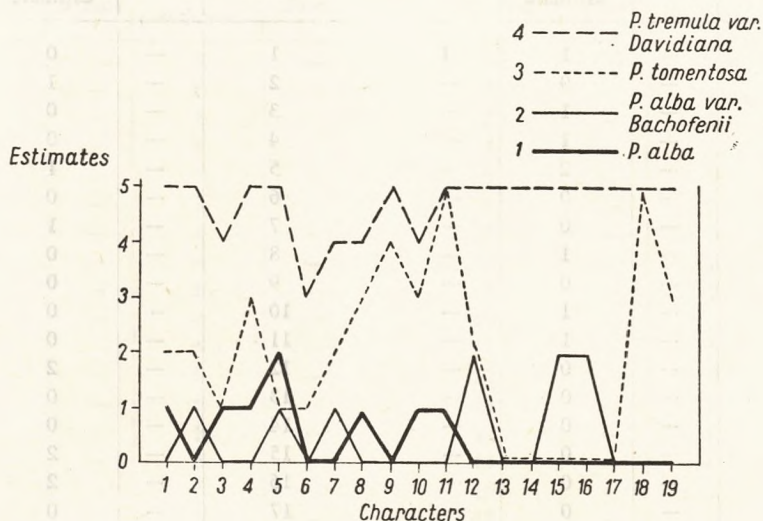


Fig. 2. Distribution of character estimates for *P. alba*, *P. alba* var. *Bachofenii*, *P. tomentosa* and *P. tremula* var. *Davidiana*

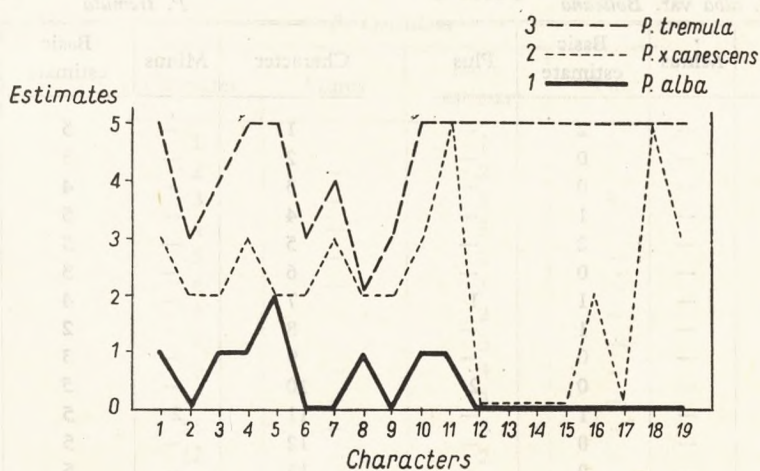


Fig. 3. Distribution of character estimates for *P. alba*, *P. x canescens* and *P. tremula*

The values of the estimates of the studied features are presented in tables 4, 5, 6, 7, 8, 9 and 10. The total values of the estimates for *P. alba*, *P. alba* var. *Bachofenii* and *P. alba* var. *Bolleana* are very close to each other and are respectively 9, 8 and 9. The variation in this case is not great. Also the total values of the

Character estimates (0–5), with deviations where applicable, for various poplars

P. alba

Table 4

Character	Minus	Basic estimate	Plus
1	—	1	1
2	—	0	—
3	—	1	—
4	—	1	—
5	—	2	—
6	—	0	—
7	—	0	—
8	—	1	—
9	—	0	—
10	—	1	—
11	—	1	—
12	—	0	—
13	—	0	—
14	—	0	—
15	—	0	—
16	—	0	—
17	—	0	—
18	—	0	—
19	—	0	—
		8	9

P. alba var. *Bachofenii*

Table 5

Character	Minus	Basic estimate	Plus
1	—	0	1
2	—	1	—
3	—	0	—
4	—	0	—
5	—	1	—
6	—	0	—
7	—	1	—
8	—	0	—
9	—	0	—
10	—	0	1
11	—	0	—
12	—	2	—
13	—	0	—
14	—	0	—
15	—	2	—
16	—	2	—
17	—	0	—
18	—	0	—
19	—	0	—
		9	11

P. alba var. *Bolleana*

Table 6

Character	Minus	Basic estimate	Plus
1	—	2	—
2	—	0	—
3	—	0	—
4	—	1	—
5	—	2	—
6	—	0	—
7	—	1	1
8	—	1	—
9	—	0	—
10	—	0	2
11	—	1	—
12	—	0	—
13	—	0	—
14	—	0	—
15	—	0	—
16	—	0	—
17	—	0	—
18	—	0	—
19	—	0	—
		8	11

P. tremula

Table 7

Character	Minus	Basic estimate	Plus
1	—	5	—
2	—	3	—
3	—	4	—
4	—	5	—
5	—	5	—
6	—	3	—
7	—	4	—
8	—	2	—
9	—	3	—
10	—	5	—
11	2	5	—
12	—	5	—
13	—	5	—
14	—	5	—
15	—	5	—
16	—	5	—
17	—	5	—
18	—	5	—
19	—	5	—
	2	84	

Character estimates (0-5), with deviations where applicable, for various poplars

Table 8

Table 9

<i>P. tremula</i> var. <i>Davidiana</i>				<i>P. × canescens</i>			
Character	Minus	Basic estimate	Plus	Character	Minus	Basic estimate	Plus
1	—	5	—	1	—	3	—
2	—	5	—	2	—	2	—
3	—	4	—	3	—	2	—
4	—	5	—	4	—	3	—
5	—	5	—	5	—	2	—
6	—	3	—	6	—	2	—
7	—	4	—	7	—	3	—
8	—	4	—	8	—	2	—
9	—	5	—	9	—	2	—
10	—	4	—	10	—	3	—
11	—	5	—	11	—	5	—
12	—	5	—	12	—	0	3
13	—	5	—	13	—	0	—
14	—	5	—	14	—	0	—
15	—	5	—	15	—	0	—
16	—	5	—	16	—	2	—
17	—	5	—	17	—	0	—
18	—	5	—	18	—	5	—
19	—	5	—	19	—	3	—
		84				39	42

Table 10

<i>P. tomentosa</i>			
Character	Minus	Basic estimate	Plus
1	—	2	—
2	—	2	—
3	—	1	3
4	—	3	—
5	—	1	—
6	—	1	—
7	—	2	—
8	—	3	—
9	—	4	—
10	—	3	—
11	—	5	—
12	—	2	—
13	—	0	—
14	—	0	—
15	—	0	—
16	—	0	—
17	—	0	—
18	—	5	—
19	—	3	—
		37	40

estimates for *P. tremula*, and *P. tremula* var. *Davidiana*, are close to each other 84, and 84 respectively. Thus they also indicate a low variability of the total estimate. *P. tomentosa* and *P. × canescens* have intermediate values of the summed estimates, and their variability is also somewhat greater. They vary from 39–42 for *P. × canescens* and from 37–40 for *P. tomentosa*.

The hybrid nature of both *P. tomentosa* and *P. × canescens* is clearly evident from the morfograms in figs. 2 and 3, which were made on the basis of estimates compiled in tables 3, 4, 5, 6, 7, 8, 9 and 10. In the morphogram on fig. 2 the estimates for *P. alba*, *P. alba* var. *Bachofenii*, *P. tremula* var. *Davidiana* and *P. tomentosa* are presented. Both *P. alba* and *P. alba* var. *Bachofenii* are presented because it is difficult to decide which of the varieties took part in formation of the hybrid *P. tomentosa*. Some of the characters distinguishing *P. alba* and *P. alba* var. *Bachofenii* are quantitative in nature, and not qualitative, thus in the analysis of this morphogram it is not possible to establish which of the two was a parent of *P. tomentosa*. This problem will be discussed in the latter part of this paper. I believe that *P. tremula* var. *Davidiana* was one of the parents of *P. tomentosa*.

The morphological features of *P. tomentosa* are usually intermediate between *P. alba* and *P. alba* var. *Bachofenii* on the one hand and *P. tremula* var. *Davidiana* on the other, or else are similar to the features of the suspected poplar species. The intermediate characteristics are: colour of the bark on the upper parts of the stem, nature of pubescence of the tips of one year old or sprout shoots, the pubescence of the lower leaf surface, morphology of the leaf margin, colour of the dorsal side of short shoot leaves, and the depth of incisions in the bracts. The *P. tomentosa* characters similar to those of *P. tremula* var. *Davidiana* are glabrous petiole and bract shape. Also the presence of glands at the leaf base and shape of leaves of the long shoots are common characteristics for the two poplars. Many more features of *P. tomentosa* are akin to those of *P. alba* or *P. alba* var. *Bachofenii*. They have almost identical estimates for the features; lustre of ventral leaf surface, colour of dorsal leaf surface, shape of the foliage buds on long and short shoots and their pubescence and shininess.

The morphogram for *P. × canescens* (fig. 3) is very similar to that of *P. tomentosa*. *P. × canescens* has the following characters intermediate between *P. alba* and *P. tremula*; colour of bark of the upper stem, colour of one year old and sprout shoots, pubescence of one year old and sprout shoots, shape of long shoot and sprout leaves, colour of the dorsal leaf surface, the pubescence of the dorsal surface of long shoot and sprout leaves, sparse pubescence of short shoot buds, and the medium depth of the bract incisions. The nature of the margin of long shoot and sprout leaves, the pubescence of petiole and the bract shape of *P. × canescens* are comparable to the analogous features of *P. tremula*. Many more characters are common to *P. × canescens* and *P. alba*. They are; lustre of the ventral leaf surface, shape of foliage buds on long shoots and sprouts, their pubescence, and the shape of short shoot foliage buds.

The total estimates are presented in fig. 4. From these results it is obvious that the mean total estimates for *P. tomentosa* and *P. × canescens* are much closer

P. alba than *P. tremula*. Thus it is understandable why many taxonomists in China have described *P. tomentosa* as a white poplar.

P. × canescens as well as *P. tomentosa* are usually identical with respect to many features. This is common for the F_1 progeny of an interspecific crossing. The individuals of such a progeny are usually similar to each other like individuals within parental species. Man, has through years of *P. tomentosa* cultivation selected out of the natural hybrid population the individuals which are characterised by heterotic growth. Due to this selection the variability of the Peking poplar cultivated in China is not great.

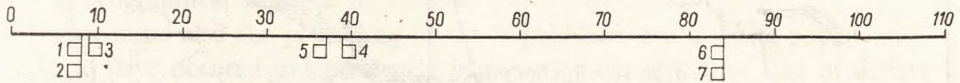


Fig. 4. Scatter of the sum of character estimates for some species and hybrids of poplars from section *Leuce*

Sum of characters: 1. *P. alba* — 8; 2. *P. alba* var. *Bolleana* — 8; 3. *P. alba* var. *Bachofenii* — 9; 4. *P. × canescens* — 39; 5. *P. tomentosa* — 37; 6. *P. tremula* — 84; 7. *P. tremula* var. *Davidiana* — 84

It remains to establish which species of East Asiatic poplars have produced *P. tomentosa*. As a basis for the following discussion an analysis was made of the morphological characters of the geographical varieties of poplars from the section *Leuce*. Also important for the considerations of the systematic position of *P. tomentosa* within the section *Leuce* is the information available about the geographic distribution of white poplars and aspens in Central and East Asia.

The eastern limit of *P. alba* and its varieties range in Asia is little known, nor do we have much information about the distribution of the various species and varieties of the white poplars in East and Central Asia. There is much contradictory data on the subject in the relevant literature.

In the east *P. alba* L. occurs also in western Siberia (18, 23) in the Ob, Upper Tobol, Irtysh and Altai regions, and in Central Asia it occurs in parts of the Pamiro-Altai and Jungaro-Tarbagatai regions. Sargent (26) believes that the range extends much further east and he states that "...this species seems to be wild and often planted in the north-western Himalaya, Tibet and Altai. I have seen no specimen from those regions and I do not know if Dode's species may really indicate any distinct form". In view of these data it is not clear what Shun-Ching Lee (29) meant when he reported the occurrence of *P. alba* in China with the eastern limit of its range reaching the Shantung and Liaotung provinces. This author does not specify whether the species there is endogenous or cultivated. Bugala on the basis of his studies of the East Asiatic poplar species in the Leningrad herbarium claims that the East Siberian forms of the white poplar are very akin to *P. alba* var. *europaea* Bug.

Within the eastern range of *P. alba* several authors discriminate between geographic varieties. Bogdanow (4), Bugala (6) and Komarow (17) describe for Central Asia *P. alba* var. *Bachofenii*, whose eastern limit reaches Kopet-Dag

and the Altai, and Browicz (6) collected herbarium specimens of this species in the western part of the Tien Shan mountains. Also *P. alba* var. *Bolleana* is widely planted in Central Asia, but it probably does not occur in the wild state.

P. tremula var. *Davidiana* occurs in East Asia on a large area from Manchuria to Yunan reaching in the west the Kansu province (18, 23, 33).

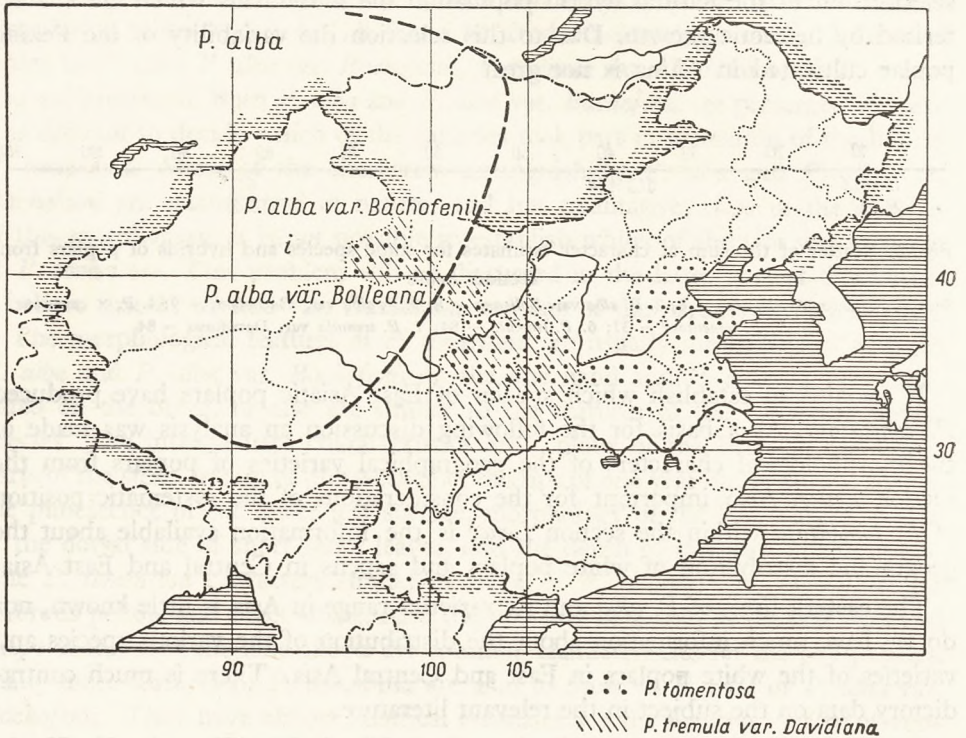


Fig. 5. Map of the eastern range of distribution of *P. alba* and its geographical varieties *P. alba* var. *Bachofenii* and *P. alba* var. *Bolleana*, the western part of *P. tremula* var. *Davidiana* range and the localities of *P. tomentosa* occurrence in China

If *P. tomentosa* first originated in China than one of the parents was most probably *P. tremula* var. *Davidiana*. As regards the other parent one can only suppose that it was one of the geographical varieties of the white poplars growing in Central Asia, which had a much more intensive silvery indumentum on the dorsal side of leaves growing on young shoots, than is the case for *P. alba* var. *europaea* Bug. It is rather unlikely that *P. tomentosa* occurred as a hybrid between *P. tremula* var. *Davidiana* and *P. alba* var. *Bolleana* since the latter species is not cultivated in China nowadays (29, 34), however it is not known whether it was not cultivated in West China in the remote past. The experiments conducted at Kórnik indicate that the hybrids between *P. alba* var. *Bolleana* and *P. alba* or *P. × canescens* var. *rogalinensis* have pyramidal or wide crowns. Thus there exists the theoretical possibility that *P. tomentosa* which has a wide crown

could have been a hybrid between *P. alba* var. *Bolleana* and *P. tremula* var. *Davidiana*. It is also possible that *P. tomentosa* originated outside China, in Central Asia. If this second possibility is considered then one of the parents of *P. tomentosa* could have also been *P. alba* var. *Bachofenii*.

This second possibility concerning the place of *P. tomentosa* origin seems less likely, since that species is not known in Central Asia, and as has been stated by Browicz, was only recently brought to Tashkent from China. Had it originated in Central Asia, and being a fast growing tree, it would have got into cultivation and stayed there until to-day. Thus it has to be assumed that *P. tomentosa* originated in China at the point of contact between *P. tremula* var. *Davidiana* and one of the geographical varieties of *P. alba*.

There exists also the possibility of the hybrid between a white poplar and an aspen to have occurred independently in several parts of China, and at different times.

SUMMARY

On the basis of a study made of some morphological features of stems, shoots, leaves and bracts of several species and geographical races of poplar, it was concluded that *P. tomentosa* is a hybrid between some geographical variety of *P. alba* from the inner parts of Central Asia and most probably *P. tremula* var. *Davidiana*, with the degree of hybridity very close to that of *P. × canescens*.

P. × tomentosa originated probably as a natural hybrid in the western part of Central China at the point of contact between *P. alba* (species in the wide sense) and *P. tremula* var. *Davidiana*. Interspecific hybrids between a white poplar and an aspen, with a comparable degree of hybridity could have also occurred in other parts of China and are presently utilized for production purposes.

On the basis of the presented evidence it is incorrect to consider *P. × tomentosa* as a proper species of a poplar within the section *Leuce*, but it has to be recognized as an interspecific hybrid comparable to *P. × canescens*.

Populus × tomentosa Carrière, in Rev. Hort. X, 340 (1867); Dode in Mem. Soc. Hist. Nat. Autun, XVIII, 27 (1905); Schneider in Laubgehölze, 1, 21 (1906); Gombocz in Monog. Generis Populi, 140 (1908); Elwes and Henry in The Trees of Great Brit. and Ireland, VII (1913); Shun-Ching Lee, Forest Bot. of China, 173 (1935); Schenck in Fremdl. Wald u. Parkbäume, II, 427 (1939); Bugała in Arb. Kórnickie, V, 19 (1960).

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Populus glabrata Dode in Bull. Soc. Hist. Nat. Autun; 18 : 185 (Extr. Monog. Populus 27 (1905).

Bark greyish—white, on the lower parts of old trunks grey, furrowed. Long shoots and sprouts olive—brown, sometimes reddish, in the upper part covered with a white pubescence, lower glabrous. Buds on long shoots conical, acute, pubescent; on short shoots globular, obtuse, glabrescent. Leaves on top of long shoots and sprouts large, suborbicular or triangular, with an even or cordate base, margin irregularly dentate and finely serrulate, usually hook-like dentate, apex cuspidate. Young leaves densely silvery tomentose below, less so above, more along the venation. Older leaves are dark green above, shiny, below finely pubescent, more so along the veins. Leaves of short shoots oval or ovate, cuspidate, dull green, margin irregularly dentate, often with hooklike teeth, blade glabrous on top, slightly pubescent below when young, later glabrous, rarely pubescent along the veins. Petiole flattened from the sides. Glands, 2—4, at the leaf base. Bracts tomentose, with incisions of medium depth, shallower than in the east Asiatic aspens.

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STEFAN BIAŁOBOK

Studia nad Populus tomentosa Carr.

Streszczenie

Na podstawie zamieszczonych w pracy danych charakteryzujących niektóre cechy morfologiczne pni, pędów, liści i przysadek kwiatowych kilku gatunków i odmian geograficznych topoli stwierdzono, że *P. tomentosa* jest mieszańcem jakiegoś odmiany geograficznej *P. alba* ze środkowej części Azji centralnej i najprawdopodobniej *P. tremula* var. *Davidiana* o stopniu mieszańcowości bardzo bliskim *P. × canescens*.

P. × tomentosa powstała prawdopodobnie jako mieszańiec naturalny w zachodniej części środkowych Chin na styku zasięgu zbiorowego gatunku *P. alba* oraz *P. tremula* var. *Davidiana*. Mieszańce międzygatunkowe między topolą białą i osiką o podobnym stopniu mieszańcowości mogły również powstać w innych częściach Chin i są obecnie wykorzystywane dla celów użytkowych.

Na podstawie przedstawionych dowodów w tej pracy nie jest słuszne traktowanie *P. × tomentosa* jako dobrego gatunku topoli występującej w Chinach przynależnego do sekcji *Leuce*, a należy ją uznać jako międzygatunkowy mieszańiec, tak jak *P. × canescens*.

Populus × tomentosa Carrière, in Rev. Hort. X, 340 (1867); Dode in Mem. Soc. Hist. Nat. Autun, XVIII, 27 (1905); Schneider in Laubgehölze, 1, 21 (1906); Gombocz in Monog. Generis Populi, 140 (1908); Elwes and Henry in The Trees of Great Brit. and Ireland, VII (1913); Shun-Ching Lee, Forest Bot. of China, 173 (1935); Schenck in Fremdl. Wald u. Parkbäume, II, 427 (1939); Bugała in Arb. Kórnickie, V, 19 (1960).

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Kora białawoszara, w dolnej części starych pni — szara, splekana. Długopędy i odrośla oliwkowo-brązowe, czasami zaczerwienione, w górnej części pokryte białym kutnerem, spodem nagie. Pączki

na długopędach stożkowate, zaostrome, owłosione, na krótkopędach, kulistawe, tępe, prawie gładkie. Liście szczytowe długopędów i odrośli duże, sercowate lub trójkątne, o równej lub sercowatej podstawie, nierównomiernie grubo i drobno ząbkowane, najczęściej haczykowato ząbkowane, o zaostrom wierzchołku. Młode liście silnie, srebrzysto kutnerowate, omszone od dołu, górą słabiej, mocniej na nerwach. Starsze od góry ciemnozielone, błyszczące, spodem słabo omszone, silniej tylko na nerwach. Liście krótkopędów jajowate lub jajowato-sercowate, zaostrome, matowo-zielone, nierównomiernie grubo ząbkowane, często haczykowato ząbkowane, od góry gładkie, spodem za młodu słabo omszone, później nagie, rzadko omszone na nerwach. Ogonek liściowy z boków spłaszczony. Gruczołki przy nasadzie ogonka u podstawy liścia w liczbie 2—4. Przysadki kwiatowe owłosione, o średnio głębokich wcięciach, płyszych jak u wschodnioazjatyckich osik.

СТЕФАН ВЯЛОВОК

Изучение *Populus tomentosa* Carr.

Резюме

На основании приведенных в работе данных, представляющих характеристику некоторых морфологических признаков стволов, побегов, листьев и цветных чешуй нескольких видов и географических разновидностей тополя установлено, что *P. tomentosa* является гибридом какой-то географической разновидности *P. alba*, происшедшим из средней части центральной Азии, а именно *P. tremula* var. *Davidiana*, степень гибридации которого очень близка *P. × canescens*.

P. × tomentosa образовался по всей вероятности как естественный гибрид в западной части центрального Китая на границе ареала *P. alba* и *P. tremula* var. *Davidiana*. Междувидовые гибриды между сереющим тополем и осиной со схожей степенью гибридации также могли образоваться и в других частях Китая и в настоящее время используются для хозяйственных целей.

На основании представленных в настоящей работе доказательств, необоснованной является трактовка *P. × tomentosa* как вида тополя, отличающегося хорошими качествами, выступающего в Китае, а принадлежащего к секции *Leuce*. Следует его считать междувидовым гибридом, таким же как *P. × canescens*.

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Кора бело-серая в нижней части старых стволов, серая, со значительным количеством трещин. Побеги и поросли маслично-коричневые, иногда краснеющие, в верхней части покрыты белой ворсинкой, а в нижней части лишены

ворсинок. Почки на длинных побегах конусообразные, заострённые, с ворсинкой. На коротких побегах шаровидные, тупые, почти гладкие. Верхние листья длинных побегов и порослей большие — сердцевидные или треугольные с ровным или сердцевидным основанием, а также неравномерно крупно и мелкозубчатые, чаще всего с крючкообразными зубцами, с заострённой верхушкой. Молодые листья в нижней части сильно покрыты серебристой ворсинкой, в верхней части слабее, только несколько сильнее на жилках. Старшие листья сверху темнозелёные, блестящие, в нижней части с очень слабой ворсинкой, только на жилках с несколько более сильной. Листья коротких побегов яйцевидные или яйцевидносердцевидные, заострённые, матово-зелёные, неравномерно крупно зубчатые, часто крючковато-зубчатые, сверху гладкие, снизу молодые со слабой ворсинкой, позже без ворсинки, редко с ворсинкой на жилках. Листовой черешок по бокам сплюснутый. Железков 2—4 при основании черешка у основания листа. Прицветные чешуи с ворсинкой со среднеглубокими надрезами более мелкими как у восточноазиатских осин.





Fot. K. Jakusz

Pinus Armandii Franch. — kwiaty męskie