Tree of the Year : Chinese species of *Catalpa* Scop.

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Introduction

Catalpa is a genus of nine species of deciduous trees, found in eastern Asia, the eastern United States and the Caribbean. In horticulture the genus is most familiar in the form of the two American species, the Indian bean trees *C. bignonioides* and *C. speciosa*, although the latter is much less commonly grown than the former. Both are valued for their early summer displays of white flowers, bold foliage and, to some extent, their elongated fruits. The four Caribbean species are unfamiliar to temperate gardeners, but some, such as *C. longissima*, are valued flowering trees in tropical conditions.

The subjects of this article are a further three or four species from China. Botanical authorities differ in their delimitation; they are poorly known and understood in gardens and very much confused in the horticultural trade. The extremely beautiful *C. bungei* has barely a toehold in Europe and North American gardens: its name is frequently usurped by the least attractive of all, *C. ovata*, and a non-flowering clone of *C. bignonioides*; there are disputes over the delimitation of the *C. fargesii* group, and *C. tibetica* does not exist. These difficulties are discussed in full below.

Phylogeny and systematics

The family Bignoniaceae is widely distributed in the tropics and warmer temperate regions of the world, occurring as far north as the central United States and Japan, and southwards to Tasmania and northern New Zealand. Members of the family are almost all woody plants, with few herbaceous representatives (*Incarvillea* is a notable exception, though even some of these are shrubby), and are noted for their showy, usually two-lipped (bilabiate) flowers. Many fine ornamental plants are among their number, contributing notably to tropical gardens and landscapes. *Jacaranda mimosifolia* D. Don and *Spathodea campanulata* P. Beauv. are conspicuous and familiar trees in warm places, and there are numerous climbers, including golden showers *Pyrostegia venusta* (Ker-Gawler) Miers and the hardier *Campsis*.

As a rule it is quite easy to recognise members of the family, especially when they are in flower, though there is a notable exception in the deceptively similar *Paulownia* (see below). The bark usually has conspicuous lenticels, and the foliage is opposite and usually compound (sometimes with tendrils replacing leaflets in the climbers). *Catalpa* and its close relative *Chilopsis* are placed together in the tribe *Catalpeae* and are exceptional in the family in having simple leaves, but they share other characters, including very similar pollen of a shape unique in the family (Angiosperm Phylogeny Website 2012,

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Catalpa bungei growing at the United States National Arboretum in Washington DC.

Gentry & Tomb 1979, Li 2008). The monosymmetric flowers are usually distinctly 'bignoniaceous', being large and conspicuous, with a tubular corolla. This expands into upper and lower lips that are usually lobed. This basic model is elaborated into a diversity of different shapes and colours that are adaptive responses to different pollinators. All are pollinated by animals, whether it be insects, birds or bats (as in the Sausage-tree, *Kigelia africana* (Lam.) Benth.). Successful pollination results in the development of typically elongated fruits containing two series of flattened and often winged seeds. Further information on the morphology of the Bignoniaceae, its tribes and related families, is given in detail on the Angiosperm Phylogeny Website (2012) from which the above information has also been derived.

The distinctive fruits and seeds of ancestral Bignoniaceae have been discovered in fossils dated to 49.4 million years ago (mya) found in Washington State (Pigg & Wehr 2002) and it is believed that the family originated in the Americas before migrating, probably several times, to the rest of the world (Olmstead *et al*. 2009). *Catalpa* itself occurs in both Asia and the Americas, a well-known distribution pattern seen in many familiar genera including *Hydrangea* and *Magnolia*, for example, and usually indicative of a wide distribution during the Tertiary period (65-2.6 mya), prior to fragmentation

during subsequent periods of glaciation. Li (2008) makes the interesting point that of 90 genera with disjunct distributions shared between eastern Asia and North America only six also occur in the Caribbean. *Catalpa* is one of these. Other woody genera with this distribution include *Illicium* and *Pieris*: *Magnolia* is also found in these three areas, but extends widely into Central and South America as well.

The two North American species of *Catalpa*, *C. bignonioides* Walter (southern catalpa) and *C. speciosa* E. Y. Teas (northern catalpa) are by far the best known in cultivation outside China, being popular for their showy displays of white flowers in summer and the long, bean-like fruits persisting into winter. *Catalpa bignonioides* was introduced to cultivation in North America and Europe by Mark Catesby in 1726 from collections made during his travels in south-eastern United States the previous year. Catesby also first supplied the generic name in its current form, apparently as an adaptation from a local native American name for the tree, but not derived from the Catawba tribe (Olsen, in prep.) as often stated (as for example by Huxley *et al*. 1992). The species rapidly became popular in gardens on both sides of the Atlantic and possibly further afield too (Kirkbride & Olsen 2011a). Despite this popularity the early history of the discovery and introduction of this familiar plant is poorly known and will be the subject of a forthcoming article for *Arnoldia* by Richard Olsen. A similar exercise has recently been performed for *C. speciosa* (Kirkbride & Olsen 2011b), elucidating its early history and various taxonomic travails. Introduced in 1880, *C. speciosa* is the finer of the two North American species: "Much more attractive and hardy than *C. bignonioides* but less common in international garden culture" was Krüssmann's comment (1984), but it remains overshadowed in cultivation and the collective horticultural mind by *C. bignonioides*.

Catalpa bignonioides and *C. speciosa*, together with the Asian species, make up *Catalpa* Section *Catalpa*, though Li (2008) found that the section splits into two groups (clades). One clade contains *C. bignonioides*, *C. speciosa* and *C. ovata*, the other containing *C. bungei*, *C. fargesii* and *C. duclouxii* (which Li regards as distinct, but is treated here as of uncertain status).

The four Caribbean species in the genus (*C. brevipes* Urb., *C. longissima* (Jacq.) Dum.Cours., *C. macrocarpa* (A.Rich.) Ekman ex Urb. and *C. purpurea* Griseb.) are placed in Section *Macrocatalpa* Griseb; all are found as forest trees in the Antillean islands. This group has been shown by Li (2008) to be genetically as well as morphologically distinct from section *Catalpa*. They could be separated into two genera but are clearly closely-related sister groups and Li (2008) prefers to maintain the status quo of a single genus, *Catalpa*. They are too tender for temperate cultivation, and seem to be seldom recommended for use in the tropics, though *C. longissima* occasionally finds its way into standard reference works (e.g. Huxley *et al*. 1992) and seems to be an attractive species with horticultural merit, as well producing good timber (Francis 1990).

Table 1
Distinctions between Sects. *Catalpa* and *Macrocatalpa* (derived from Li 2008).

SECTION *Catalpa*	**SECTION *Macrocatalpa***
Leaves deciduous, broadly ovate	Leaves evergreen, elliptic
Foliar nectaries at basal junction of primary veins and along midrib	Foliar nectaries at junction of primary and secondary veins
Seeds fimbriate at end only	Seeds fimbriate all over

Catalpa is closely related to *Chilopsis* (Li 2008), a monospecific genus whose only species *C. linearis* (Cav.) Sweet, grows in seasonally dry riverbeds in the south-western United States and Mexico. An attractive, multi-stemmed shrub with pale pink flowers, it is known as the desert willow or desert catalpa, and is cultivated from Texas to California in the United States. Several cultivars have been named (see Dirr 2009): they vary in habit and flower colour. *Chilopsis* flourishes in areas with consistently high summer temperatures and low humidity, and is a useful garden plant in such places across the southern parts of the United States. It is probably not successful further north than North Carolina, however, and Europe is generally too cool, though it has potential as a drought-tolerant plant in the hottest parts of the Mediterranean basin and the desert parts of Central Asia. As with so many such plants, summer heat is the key to success, but good drainage is also essential.

Much the same can be said of the hybrid genus ×*Chitalpa* T. S. Elias & W. Wisura. This originated from deliberate crosses between *Catalpa* and *Chilopsis* made by Nikolai Rusanov in Tashkent, Uzbekistan, in the 1960s, with material of two clones reaching the USA in 1977. One has pink flowers and is known as 'Pink Dawn', while the other is white and is 'Morning Cloud'. Assuming that they were of the same parentage, the formal name ×*Chitalpa tashkentensis* T. S. Elias & W. Wisura was published in 1991, but Li *et al*. (2006) have shown that Rusanov in fact used two *Catalpa* parents, *C.* ×*galleana* (*C. ovata* × *C. speciosa*, see below) giving 'Pink Dawn' and *C. speciosa*, resulting in 'Morning Cloud'. This means that the name ×*C. tashkentensis* should be restricted to the pale-pink flowered clone 'Pink Dawn', which provided the specimen designated as the holotype of that name (R. Olsen, quoted in Grimshaw & Bayton 2009). Other clones are best attributed simply to the nothogenus ×*Chitalpa*. Both these clones, and a few later arrivals, make attractive small flowering trees, but do best in areas with hot summers and low humidity, as they are prone to powdery mildew (Olsen *et al*. 2006). They can look very unhappy and flower rather sparsely in cool maritime climates (Grimshaw & Bayton 2009).

In cultivation, *Catalpa* could only be confused with *Paulownia*, with which it shares large, opposite leaves and a terminal branched inflorescence

of showy bilabiate flowers. Despite this superficial similarity, they are not closely related, with *Catalpa* being placed in Bignoniaceae, and *Paulownia* in its own family, Paulowniaceae (formerly in Scrophulariaceae). The relationship between *Paulownia* and *Catalpa* and their respective families has been much-debated for many years as there is surprisingly little physical difference between them, though the lack of relationship is amply confirmed by DNA studies (Angiosperm Phylogeny Website 2012). The seeds of *Paulownia* have endosperm, which is absent in *Catalpa*, and there are differences in the anatomical structures of the fruit and seed as well. Convenient distinguishing features are that *Paulownia* always has a dense brown indumentum on the calyx (Angiosperm Phylogeny Website 2012), the flower buds are set on the previous year's growth, and flowering occurs before or as the leaves emerge in spring.

Family Bignoniaceae Jussieu
Tribe *Catalpeae* Meisner
CATALPA Scop.
Nine species of small to large deciduous or evergreen (Sect. *Macrocatalpa* only) trees, from China, the eastern United States and the Antilles. Trunks usually single and straight, bearing a rounded or dome-shaped crown; some species produce useful timber, in others the wood is weak. Branches typically stout and spreading, often rather brittle, with a thick pith; twigs somewhat stout, with raised, circular leaf-scars; buds small, rounded, with 2-4 reddish-brown scales, embedded in the bark, all axillary, with the apex of the shoot dying in summer leaving no terminal bud. Leaves opposite or occasionally in whorls of three, especially on vigorous shoots or seedlings, long-petiolate, simple, usually entire but occasionally lobed, usually ovate, often cordate at base, usually glabrous above, sometimes hairy below with extrafloral nectaries in the axils of veins below that are glossy green and glabrous. Inflorescences terminal, paniculate, corymbose, or racemose. Flowers few to many; pedicels short; calyx bilabiate or irregularly divided, rounded in bud; corolla campanulate, with a broad tube that becomes bilabiate, upper lip 2-lobed, lower lip 3-lobed; fertile stamens 2, included, inserted at base of corolla tube, staminodes 3, minute; nectary disc small; style elongate, with two stigmatic lobes at apex that are sensitive to touch; ovary 2-locular; ovules several. Capsule narrow and elongated, dehiscing loculicidally; valves thin; septum slender, terete. Seeds in two or four rows, rounded, thinly membranous, with hair tufts at both ends. Cotyledons epigeal, deeply bifid. (Henry 1912, Zhang & Santisuk 1998).

Catalpa ovata G. Don Chinese catalpa, yellow catalpa
Syn. *Bignonia catalpa* Thunberg; *Catalpa henryi* Dode;
C. kaempferi ovata (DC.) Siebold & Zuccarini.
Trees *c*. 15-20m tall, with wide-spreading branches; young shoots sparsely

pubescent, with sessile glands and scattered stiff glandular hairs. Leaves opposite or nearly so, sometimes whorled, not aromatic; petiole 6-18cm, purple-red to green, with glands and glandular hairs; lamina broadly ovate, *c*. 25 × 25cm, scabrous, minutely pubescent or glabrescent above, with sparse longer hairs on the veins, flushing purplish, becoming dark green, with veins remaining reddish; base cordate, margin entire or slightly waved, usually 3-lobed, apex shortly acuminate; lateral veins 4-6 on each side of midrib, palmately 5-7-veined basally. Inflorescences paniculate, terminal, 12-28cm long, peduncle sparsely pubescent. Flowers numerous: calyx bilabiate, 6-8mm, glabrous; corolla campanulate, creamy-white to pale yellow, with two conspicuous yellow or orange stripes and abundant fine purple spotting in the throat, *c*. 2.5 × 2cm; anthers divergent; style filiform, stigma 2-lobed. Capsule linear, pendulous, 20-30cm × 0.5-0.7cm. Seeds long ellipsoid, 6-8 × *c*. 3mm, villous at both ends. Flowering in early summer, fruiting in autumn. $2n = 40$. (Henry 1912, Zhang & Santisuk 1998).

Distribution CHINA: Anhui, Gansu, Hebei, Heilongjiang, Henan, Hubei, Jiangsu, Jilin, Liaoning, Nei Mongol, Ningxia, Qinghai, Shaanxi, Shandong, Shanxi, Sichuan, Xinjiang, introduced elsewhere. Naturalized in JAPAN, KOREA, USA. **Habitat** woodland and open places (500-)1900-2500m **USDA Hardiness Zone** 5. **RHS Hardiness Rating** H5. **Conservation Status** No IUCN assessment.

Catalpa ovata is the most commonly grown Asian member of the genus, and can be a fine tree, though it lacks the best ornamental qualities of both its compatriots and the American species. It is the parent of two horticulturally useful hybrids.

As a wild species it seems to be most abundant in the central provinces of China, especially Hubei, where it grows in open woodland and disturbed places: the *Flora of China* rather uninformatively gives 'slopes' as the sum description of its habitat (Zhang & Santisuk 1998). It may be a pioneer species on disturbed ground, as field notes often mention a presence by roadsides (e.g. notes for the Glasnevin Central China Expedition, pers. comm. S. O'Brien 2012) or the margin of woods and open areas (Rehder, 1913). Roy Lancaster (1989) records seeing it in Yunnan forming thickets of suckers from cut stumps, which suggests that in cultivation it could be stooled to produce an annual flush of new growth, as is frequently done with *Catalpa* cultivars grown for their coloured foliage. A suggestion that it is a somewhat 'weedy' pioneer species is also given by the fact that it flowers in two or three years from seed.

In China, *Catalpa ovata* has been cultivated since the middle of the third century BC (Wang 1988, in Valder 1999), being valued for timber as well as its ornamental and shade-giving qualities, and it sometimes features in Chinese artworks. Valder (1999) says that it and mulberry were universally planted

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The bark of *Catalpa ovata* at the Halle Botanical Garden in Germany.

around homesteads, enabling the manufacture of silk and the production of coffins made of *Catalpa* wood, which is particularly rot-resistant in damp soil. Valder quotes Li (1959) in giving the word *sangzi*, meaning both mulberry and catalpa, as a sentimental way of referring to 'home'. Its timber is also often used to make the flat undersides of the zither-like, seven-stringed musical instrument called *qin* or *guqin* (Yeung 2010): the flat surface symbolises the earth, while the rounded sounding-board (traditionally made of the wood of *Firmiana simplex* (L.) W. Wight) represents the heavens (Wikipedia 2012). In China the fruits are used medicinally for promoting diuresis (Zhang & Santisuk 1998). Recent researchers have extracted a chemical, dehydro-alpha-lapachone (DAL) from *C. ovata*, that has been shown to have useful antifungal properties (Cho *et al*. 2006) and can inhibit vascular activity in animals (Garkavtsev *et al*. 2011). Catalposide, another extract from *C. ovata*, seems to have some effective anti-inflammatory properties in mice (Kim *et al*. 2004).

Catalpa ovata became known to the West from trees cultivated or naturalized in Japan, where it had been introduced from China by Buddhist monks in the distant past, planting it around their temples. Interestingly, the first European to encounter the tree, the German Engelbert Kaempfer (1651-1716), recorded the Japanese name as *Ki-sasage*, meaning bean-tree, just as the American species have long been called in Europe. Kaempfer was a physician for the Dutch East India Company in the treaty port of Nagasaki between 1690 and 1692. On his return to Europe he published the first Western accounts of Japanese plants, covering them in his book on his travels in Asia, *Amoenitatum exoticarum*, published in Germany in 1712 (Stearn 1999). Among other notable first illustrations, including that of a *Camellia* and *Ginkgo* was a good image of *Catalpa ovata* (Henry 1912). The tree was first described by G. Don in 1837 as

The flower of *Catalpa ovata* 'Flavescens' growing at the US National Arboretum, Washington DC.

C. ovata (perhaps for the shape of the leaves), but this was overlooked by A-P. de Candolle when he published his name *C. bignonioides* var. *kaempferi* DC. in 1845. The epithet was used at specific rank by von Siebold and Zuccarini in 1846: the name *C. kaempferi* (DC.) Siebold & Zuccarini seems to have gained wide usage as plants were distributed from von Siebold's nursery. It remained in widespread use for decades (e.g. Hooker 1882, Henry 1912), despite Don's epithet *ovata* having 12 years' priority.

Kaempfer introduced *Ginkgo biloba* L. to Europe, as seed, but it took another 150 years for *Catalpa ovata* to arrive. Kaempfer's nineteenth century successor as physician at Nagasaki and equally keen plantsman, was Franz Philipp von Siebold. He worked in Japan from 1826 to 1829, and on his return to Europe established a nursery and society dedicated to the introduction of Japanese

plants. C. J. Textor was a collector for von Siebold in Japan beginning in 1843 (Thijsse 2004), so it was probably he who sent seeds of *C. ovata* to Belgium in 1849, an importation usually credited to von Siebold as the first introduction to Europe (e.g. Hooker 1882, Henry 1912, Bean 1976).

However, seeds of two species of catalpa arrived from China at the Muséum national d'Histoire naturelle in Paris in 1848 (Pépin 1856) which Decaisne (1851) attributed to *C. kaempferi* and *C. bungei,* using de Candolle's descriptions in the *Prodromus* (1845). Here lies the root of the confusion in cultivation between *C. ovata* and *C. bungei*, which persists to this day. Decaisne clearly states that seeds of these two species were received from China and young plants were growing in the museum's gardens by 1851, but since none had yet flowered, the original identifications were at best tentative. For *C. kaempferi* (= *C. ovata*), he recounts, as do von Siebold & Zuccarini (1846), Kaempfer's original description (1712) of terminal panicles of flowers and long thin fruits but was not aware of von Siebold's additional comment that the flowers are three times smaller than the American species (*C. bignonioides*).

Unfortunately, Decaisne, as well as subsequent French horticulturists, also included under *C. kaempferi* a new "dwarf catalpa" (which was what we now know as *C. bignonioides* 'Nana') received by Masson at the Muséum garden in 1847 (Pépin 1856), and which was also propagated and distributed erroneously as *C.* "*kaempferi*" (Carrière 1852; Pépin 1856). Decaisne assumed, as did Bossin (1850), that the dwarf catalpa also belonged to the newly imported species (*C.* "*kaempferi* "= *ovata*), which the Muséum was propagating and distributing (Carrière 1852; Pépin 1856). This error was compounded by Bossin, whose agricultural seed company in France had imported seeds (apparently still in the pods) from China, and was offering the resultant seedlings as the new "dwarf catalpa" (Bossin, 1850). Based on his description of the fruit he received from China, Bossin was actually distributing, like the Muséum, seedlings of *C. ovata*. In 1855 the first seedlings of "*C. bungei*" distributed by the Muséum came into flower in several French nurseries and gardens (Jacques 1855, Pépin 1856), producing terminal, branched panicles of small, green-yellow flowers, that "are smaller and less beautiful than the common catalpa" (Jacques 1855). Although the foliage, inflorescences, and flowers clearly did not fit Meyer's (1837) description of *C. bungei* which was widely disseminated through De Candolle's *Prodromus* (1845), the damage was done, as seedlings of *C. ovata,* under the name *"C. bungei*" were being distributed from Paris with great fanfare and growing and flowering well, even as Pépin (1856) lamented the poor performance of *C. "kaempferi*" (which in this case was actually *C. bignonioides* 'Nana') in Paris, as it had after nine years formed only a two metre, rounded bush and no flowers! At some unknown point, this dwarf also acquired the horticultural name *C. bungei*, which it has retained in many nurseries to the present day, thus further contributing to this muddle.

As a consequence of these importations *C. ovata* rapidly became widely

grown (whether or not correctly identified) in Europe, as it was considered hardier than *C. bignonioides* in continental Europe and the northeastern United States (Sargent, 1911, Henry 1912). At Segrez, France, a notable tree was recorded by Lavallée in the late 1800s (Lavallée 1885). In west London, a tree measured by H. J. Elwes in 1912 at Syon House was 19m tall, and approximately 48cm in diameter, comparing very favourably with the current British Champion at Sydney Gardens, Bath, measured at 19m, 70cm dbh, in 2002 (Johnson 2011). Henry (1912) recorded that the then oldest specimen at Kew had been received from the German nursery of van Volxem in 1879, and was then about 5m tall. A flowering specimen from it was used to prepare the plate used in *Curtis's Botanical Magazine* to accompany text by Joseph Hooker (Hooker 1882). Remarkably, it remains the oldest specimen at Kew today, being 13.9m tall when last measured in 1994 (Kew records). *Catalpa ovata* was not discovered as a wild plant in Central China until near the turn of the twentieth century: Augustine Henry (1912) had the satisfaction of being able to write that "It was found wild in China by myself and Wilson in western Hupeh, and by Giraldi in Shensi." Henry made three collections near Yichang: A. Henry 1391, 1391a, 1684 (S. O'Brien, pers. comm, 2012). A specimen collected by Henry was used as the type for *Catalpa henryi* Dode; published in 1907, the name was rapidly doomed to synonymy as it became evident that Chinese and Japanese material was identical–it was treated as a synonym by Henry himself in 1912.

In the US, nurseries were importing seed of *Catalpa ovata* from Japan as early as 1864 (Sargent 1889), but it may have arrived earlier. The Arnold Arboretum fell victim to the *Catalpa bungei* confusion, when C. S. Sargent received a packet of seed labelled *C. bungei* in 1892, but by 1900 he reported to Kew that the resulting plants were in fact *C. ovata* (Henry 1912); but the name *C. bungei* stuck (again!) to the yellow-flowered tree, even at the Arnold Arboretum (see below). A tree from this collection still grows at Kew, where it was received from the Arnold Arboretum in 1894, and was 13.4m tall in 1994 when last measured (Kew Records).

Wild seed from China would seem to have first been collected by Père Paul Farges (1844-1912), the French missionary and botanist whose achievements are so often overlooked by anglophonic authors. Botanically active in Sichuan in the 1890s, he was a prolific collector of herbarium specimens, but also sent seed to France, notably to Maurice de Vilmorin at Les Barres, Nogent-Vernisson, Loiret (Henry 1912, O'Brien 2011). Henry (1912) received material for comparison from Les Barres, so it had become established there from Farges's seed.

Ernest Wilson collected it at 'Paokang Hsien', Hubei, in June 1901 while employed by James Veitch & Sons, of Coombe Wood Nursery, Exeter, under the number *Veitch Expedition* 1631, which was presumably the source of the material Henry saw in cultivation while preparing his account for *The Trees of*

Great Britain and Ireland (vol 6, 1912). It is not however listed in *Hortus Veitchii*, the triumphant list of notable Veitch introductions, although it includes some Wilson plants from his first introduction, such as *Davidia involucrata* (Veitch 1906). Wilson collected it again in Hubei, for the Arnold Arboretum, in 1907 (seeds and specimens all under *Wilson* 2198, despite having been collected in different localities over a period of four months!), noting that it was common 'north and south of Ichang [now Yichang]' (Rehder 1913).

In more recent years *Catalpa ovata* has been collected by several expeditions to China and young trees from these gatherings are in cultivation. At Kilmacurragh Arboretum, Wicklow, Ireland, it is thriving from collections made in 2004 on the Glasnevin Central China Expedition, *GCCE* 461 and *GCCE* 630, both made in Hubei (pers. comm. S. O'Brien). Several plants from *CLD* 32, collected on the Chungtien, Lijiang and Dali Expedition of 1990 grow on the Chinese Hillside at the Royal Botanic Garden Edinburgh. In addition to collections made by expeditions, which represent the exciting edge of plant acquisition, other material has come from exchange with institutions. Thus Kew has a tree from Mt Heng, in Hunan, from seed provided by the Shanghai Botanical Garden, and the latter has also supplied seed collected in Gansu to the Morton Arboretum, Illinois. The Arnold Arboretum has two trees grown from wild origin seed supplied by the Yunnan Institute of Tropical Botany in 1987. Recently collected material from Japan is scarce, but the Morton Arboretum has an accession grown from seed collected at Sano City north of Tokyo, Tochigi Prefecture, Kanto Region, Japan, by the Laboratory of Floriculture and Ornamental Horticulture, Chiba University. Quarryhill Botanical Garden also has wild-origin material from Honshu. At the Arnold Arboretum is a tree grown from seed collected by Jhonju Arboretum, South Korea, from Mt Moack in that country: this represents an interesting extension of the known range of the species, although it is an introduced alien there along with *C. bignonioides* (Lee 2006). (All records from online databases of relevant institutions).

When growing well, as it seems to do over much of North America and Europe, *Catalpa ovata* can make a fine tree and some very large specimens have been reported. Jacobson (1996) mentions a tree in Paris, planted in 1852 and standing 32m tall with a trunk one metre in diameter when measured in 1982. In Belgium the current champion, though not measured since 1994, is recorded as being 21m, with a girth of 301cm (*c.* 95cm dbh) (pers. comm. Belgische Dendrolologie Belge). Such sizes are comparable with those of good specimens of *C. bignonioides* and *C. speciosa*, but in the opinion of Mark Flanagan (in Flanagan & Kirkham 2009), at least, it is the 'gem of the genus', preferring its shape and 'large but refined leaves' to *C. bignonioides*–'a rather coarse-leaved tree of ungainly habit.' In America, it was perhaps doomed from the beginning by Sargent's blunt statement, that aside from being the hardiest "as an ornamental tree it does not deserve much attention from the

lovers of handsome trees" (Sargent 1917). For many, however, it is edged into a lower position by its somewhat dingy creamy white or yellowish flowers (Dirr 2009, Jacobson 1996, Valder 1999) which lack the sparkle of the billowing white masses produced by the familiar American species. The flowers are certainly best seen close-up, when their scent may also be noticeable: "strawberries, with a hint of soap flakes' (Johnson 2004); 'faintly reminiscent of strawberry smoothies' (Flanagan, in Flanagan & Kirkham, 2009). Another demerit for some is its extremely free-fruiting habit: trees can look rather shaggy with the long pods, which persist on the tree over winter and can still be found while the next year's flowers are in bloom.

Despite its history in cultivation and potential for making a large tree, it is not widely planted, and is absent from many arboreta. In Belgium, where tree collections are particularly well-recorded, the BELTREES inventory of Belgian trees has only 24 specimens in the database (pers. comm. Belgische Dendrologie Belge).

The cultivar '**Flavescens**' seems to have more deeply yellow flowers than the normal cream-tint, but they are said to be smaller than normal (*c.* 19mm long) (Bean 1976). According to Paclt (1952) it was known at the Geneva botanic garden around 1863, being introduced to the trade in 1879. It remains in cultivation but is rare: there is one specimen at Kew and two are known in Belgium. The Arnold Arboretum first received a plant from England in 1925, but its current accession came from Kew in 1978. At the US National Arboretum, plants (originally from Hilliers) in the tree breeding program have a more compact habit, with smaller inflorescences but they are borne over a longer period (R. Olsen, pers. obs.). Along with the species, *C. ovata* 'Flavescens' is used in the breeding program as a source of cold-hardiness, powdery mildew resistance (Olsen *et al*. 2006), and for enhancing flower colours in hybrids.

'**Slender Silhouette**' is a selection with a narrow outline offered by a few European nurseries. It originated in the botanic garden at Mainz, Germany (Lombarts 2002), and has been known since before 1999, when it was described in the Dutch journal *Tuin en Landschap* (Anon. 1999). Young plants at the US National Arboretum obtained from The Netherlands have not shown this fastigiate growth form.

Hybrids involving *Catalpa ovata*

When *C. ovata* is grown in the vicinity of *C. bignonioides* or *C. speciosa* there is a chance that hybrids will be produced, despite the usual discrepancy in flowering times–*C. speciosa* flowers a couple weeks ahead of *C. bignonioides* and *C. ovata,* but there is occasional overlap, depending on weather and perhaps provenance of *C. ovata.* Determining the exact North American parent in purported hybrids is difficult and often just conjecture, as simply telling *C. speciosa* and *C. bignonioides* apart is confounding enough for many. How-

ever, *C. ovata* hybrids are easy to pick out, even from the foliage alone but flowers and fruit are better. The purple petiole and prominent purple extrafloral nectaries (glands on the lower leaf surface, where the veins meet the petiole) of *C. ovata,* are inherited in the hybrids. New foliage often displays a purple flush, but it usually fades quickly. Inflorescences are typically larger than either parent, with the branched panicles and smaller flower size of *C. ovata* predominating. The white flower colour of the North American species is dominant over yellow. Fruit thickness is intermediate between the parents, but they are often longer than those of either parent. The hybrids have arisen spontaneously in cultivation wherever the three species have been grown together, as *Catalpa* is typically out-crossing (Stephenson & Thomas 1977), although it appears *C. ovata* is somewhat self-fertile (R. Olsen, unpublished data). During the great catalpa craze of the late 1800s in the US (Del Tredici 1986), large plantations of *C. speciosa* were being planted as the next great agroforestry tree, and massive quantities of seed were being sold at premium prices to meet demand. Unscrupulous or ignorant seedsmen, not knowing the differences between *C. speciosa, C. bignonioides,* and *C. ovata,* collected and sold whatever they could find (Stone 1908).

***Catalpa* ×*erubescens* Carrière**

Syn. *C.* ×*hybrida* Späth, *C.* ×*teasii* Penhallow

C. ovata × *C. bignonioides*

This hybrid, which has characters intermediate between the parents, first arose in France prior to 1869, when it was described by Carrière, but this material has not persisted, it seems. Better documented is a secondary origin in about 1874 at the nursery of J. C. Teas, Baysville, Indiana, where *C. bignonioides, C. ovata* and *C. speciosa* grew in the same field: a 'peculiar single pod' was noted on a *Catalpa ovata* and its seed, gave rise to a hybrid seedling (Sargent 1889). John C. Teas first speculated that his hybrid catalpa was the result of a cross between *C. speciosa* and *C. ovata* (Teas 1879) but Sargent favoured *C. bignonioides* (Sargent 1889) and was later shown to be correct through wood anatomy (Penhallow 1905) and studies on the reciprocal cross by Hayes in 1911 (Jones & Filley 1920). This plant, now known as 'J. C. Teas', like most offspring of this parentage, had strongly purple-tinted new growth (the epithet *erubescens* is best translated as "blushing" in this case), making it a useful foliage plant in addition to its floral qualities, though Tripp & Raulston (1995) observe that the purple flush fades to green in the summer heat of the southern United States. It is more persistent in cooler climates. Controlled pollinations have been conducted (Jones & Filley 1920) and are ongoing at the US National Arboretum, but so far all named cultivars have arisen by chance. The following cultivars are known:

'Adina' originally described as a *forma* by Paclt (1948) from a tree in Plzen

(Czech Republic) that had double flowers, adding two additional specimens in Paris (Paclt 1952) and Trnava, Slovakia (Paclt 2005). In an enquiry to Jiře Paclt regarding the status of 'Adina' in cultivation in Europe, Richard Olsen received the following reply: "Cuttings from such an inhomogenous cultivar? Large quantity of flowers were found to be normal in all three specimens." (J. Paclt pers. comm. to R. Olsen, 12 March 2007).

In North America a tree with double flowers was found at Queen Victoria Park, Niagara Falls, Canada, and named 'Victoria' (Hatch 2007, Dirr 2009, and see below): Jacobson (1996) attributed it to 'Adina'. 'Victoria' was registered by S. Zalany in 1994 (Clemants 1995). Supposedly fully double, as opposed to 'Adina', since 'Adina' of Paclt included several different trees, that ranged from fully double and sterile to only partially double, the uniqueness of 'Victoria' is debatable. Queen Victoria Park staff had no knowledge of this plant when contacted (R. Olsen, unpublished notes). Aside from the registration, no other information pertaining to the distribution or sale of this cultivar has been found, and is doubtful if it was ever introduced to the nursery trade.

In the USNA *Catalpa* breeding programme, flowers of hybrids will occasionally have their rudimentary stamens become petaloid, as reported by Paclt (1948), most likely as the result of genetic incongruities between genomes interfering with control of floral meristem identity. It appears that 'Adina' has never been introduced into the trade (or even propagated) and the specimens attributed to this cultivar by Paclt (1948, 1952, 2005) and Jacobson (1996) are unrelated plants and represent occasional hybrid seedlings expressing this condition. It would therefore seem that these "doubles" are of dubious horticultural merit.

'Hybrida' released by the Späth nursery, Berlin in 1898. It has 'black-red new growth' but Krüssmann (1984) regards it as being identical to 'J. C. Teas'. Späth's plate (1454) accompanying his description in *Gartenflora* (1898) is a beautiful illustration of a typical *C.* ×*erubescens*, and therefore could just as well be another spontaneous hybrid that arose in Europe.

'Japonica' It appears that the clone in cultivation arose from seed sent from Japan to Simon-Louis Frères in 1886, and was described by Dode under his *C. japonica* (Dode 1907). Unfortunately for Dode, it is clear that Frères's plant was not a new species, but fell under the circumscription of *C.* ×*erubescens.* It has large glossy green leaves and large panicles of white flowers, not unlike the other named cultivars of this hybrid. The occurrence of this hybrid, from Japanese seed reinforces the long history of cultivation and global spread of *C. bignonioides.*

'J. C. Teas' the oldest surviving clone and the best for floral effect, originally stated as "producing up to 300 white, spotted flowers in a panicle" (Krüssmann 1984), but 150 is more usual (R. Olsen, pers. obs.). The leaves can be up to 60cm long on vigorous shoots, but 30cm is more normal; they are a good dark purple when young.

photograph © Richard Olsen

Opposite
Catalpa ×*galleana* (*C. ovata* × *C. speciosa*) growing at the United States National Arboretum, Washington DC.

Left
Catalpa ×*erubescens* (*C. ovata* × *C. bignonioides*) F_1 hybrids in a breeding programme at the United States National Arboretum, Washington DC.

'Purpurea' the most frequently seen clone, with an RHS Award of Garden Merit. It has very dark black-red new leaves and can be spectacular as a regular coppiced or pollarded foliage plant. It was distributed originally by Hosea Waterer, from Philadelphia, in 1886, where the plant originated from seed (Wawra von Fernsee & Abel 1886), although four years later the importer's name was changed to A. Waterer, but not the Philadelphia address (Wawra von Fernsee & Abel, 1890). Hosea was the son of Anthony Waterer of Knapp Hill, who opened his own seed and bulb nursery in Philadelphia (Desmond 1994), presumably staying after his father exhibited at the 1876 Centennial Exhibition in Philadelphia. Paclt (1952) assumed, since A. Waterer was in England that the plant originated with Thomas Meehan, the Philadelphia nurserymen; this has been repeated by Jacobson (1996) and Hatch (2007).

Catalpa* ×*galleana Dode
C. ovata × *C. speciosa*
Intermediate between the parents, but with the flowers and growth habit tending to resemble *C. speciosa* (Krüssmann 1984; R. Olsen, pers. obs.), this hybrid was first described by Dode, twice, using two different names, in the

photograph © Joseph Kirkbride

same publication (1907). Dode, citing Sargent (1889) agreed with Teas, and although he never saw the plant, described a new hybrid species: × *Catalpa teasiana* (*cordifolia? + ovata*) using the invalid *C. cordifolia* for *C. speciosa*. Dode followed this with a description of another hybrid species from a seedling grown by a Mr Galle: × *Catalpa galleana* (*? ovata* +) (Dode, 1907). Surprisingly, given the rest of Dode's masterful treatment of catalpa, he was not quite ready to commit to the parentage, although he states it was "reminiscent of *C. cordifolia*" (= *C. speciosa*) and "analogous to the ×*Catalpa teasiana*" (Dode, 1907). The taxonomic issues raised by this parallel publication have yet to be resolved: neither name is supported by a type specimen, so for now, at least, we retain the more familiar C. ×*galleana*.

What became of Mr Galle's hybrid is unknown. In the US the cross is not recorded until a mention of a specimen at the Arnold Arboretum, the result of a controlled pollination by Karl Sax, which set copious seed in 1940 (Smith, 1941). Plants in the US are exceedingly rare, and probably derived from this original plant. The cross has been recreated at the US National Arboretum, to increase the genetic base available in this hybrid species. The hybrid combines the hardiness of both species, with the larger flowers of *C. speciosa* and greater

mildew resistance of *C. ovata*. No cultivars are known.

Catalpa bungei C. A. Meyer Manchurian catalpa
Syn. *Catalpa syringifolia* Bunge, *C. bungei* f. *heterophylla* C. A. Meyer, *C. heterophylla* (C. A. Meyer) Dode.
Trees 8-12m tall; young shoots glabrous, with minute glands. Leaves opposite, unpleasantly scented; petiole 2-8cm, glabrous in northern China, slightly pubescent with simple hairs on the upper surfaces and petiole further south (Henry 1912); lamina variable in shape but usually triangular-ovate or ovate-oblong, 6-15cm × *c*. 8cm, glabrous below, dark green; base broadly cuneate or truncate to cordate, variably lobed and margins occasionally dentate, apex long-acuminate. Inflorescences corymbose-racemose, terminal, peduncle and pedicels glabrous or with a few simple hairs. Flowers 2-12 per inflorescence; calyx bilabiate, glabrous, pink above, green below, apex acutely 2-dentate; corolla whitish or appearing pale pink from dense fine stippling of pink spots, with two yellow stripes and dark purple spots in the throat, 3-3.5cm long. Capsule linear, 25-45cm × *c*. 0.6cm. Seeds narrowly ellipsoid, *c*. 10mm × 2mm, villous at both ends. Flowering in early summer, fruiting in autumn. $2n = 40$. (Henry 1912, Zhang & Santisuk 1998).

Distribution CHINA: Gansu, Hebei, Henan, Hunan, Jiangsu, Shaanxi, Shandong, Shanxi, Zhejiang; cultivated in Guangxi, Guizhou, and Yunnan. **Habitat** Upland forests, 800-2700m, widely planted elsewhere. **USDA Hardiness Zone** 5. **RHS Hardiness Rating** H5. **Conservation Status** No IUCN assessment.

Any consideration of *Catalpa bungei* raises two important questions; how come it is so poorly known in cultivation, and how did the name come to be so badly and persistently misapplied to at least two very different plants?

As a wild tree, *Catalpa bungei* has a wide distribution in upland areas of China, growing in Hubei, as observed by Augustine Henry (1912), in 'mixed forests of deciduous trees'. Henry says that Wilson saw it in the mountains of Sichuan, but no record of this is made in *Plantae Wilsonianae* (Rehder 1913). Henry (1912), writing with the experience of seeing it wild, reported that "The foliage of this tree is very variable–entire or two- to three-lobed leaves occurring on old trees; whilst those with a dentate margin are characteristic of branches ending in an inflorescence… As both forms occur on the same individual, var. *heterophylla* C. A. Meyer cannot be maintained as a distinct variety." The arch-splitter, Dode, who did so much to muddle the nomenclature of trees, went so far as to make a full species of this variation, as *C. heterophylla* (C. A. Meyer) Dode.

The species is said to be widely cultivated, especially in northern China (Valder 1999), and to be "much planted in temple grounds at Peking, Shanghai

and elsewhere" (Henry 1912). In 1905, Frank N. Meyer, plant explorer for the U.S. Department of Agriculture (USDA), collected the "real *Catalpa bungei.* A fine tree, said to be covered in spring with pink-white flowers; a favourite tree in old temple yards" just north of Beijing. Valder (1999) also says that "old trees of this species are quite common in Beijing", giving several sites in the city where they may be seen, and provides an illustration of a flowering specimen there. With its large white or pink flowers it is an attractive tree and, one might suppose, conspicuous, even when only the long fruits remain. It was no doubt in the vicinity of Beijing, where he was stationed with the Russian Ecclesiastical Mission in 1829-31 (Cox 1945), that it was discovered by Alexander Andrejewitsch von Bunge (1803-90). Of German extraction, he collected many new species that were later introduced by others, and he is commemorated by numerous plants, including *Clerodendrum bungei* Steud. and *Pinus bungeana* Zucc. ex Endl.

In his intelligently entertaining book *Landfalls*, Tim Mackintosh-Smith (2010) traces the adventures of the Moroccan traveller Ibn Battutah (1304-1368/9) around the fringes of the known world. One place both visited is the Chinese port city of Quanzhou in Fujian province, known in the past as Zaytun and once one of the greatest ports of the world. According to Mackintosh-Smith, the name Zaytun is derived from the name of a tree: "*citong*, a kind of catalpa planted in the city in large numbers; the name further mutated in English into that of the city's most famous export, 'satin'." While there Mackintosh-Smith observed "a line of dark trees with twisty trunks, their branches severely pollarded" and was told they were *citong*. The treatment seems apt for *Catalpa*, and it would seem most likely that it would be *C. bungei*, but it has been impossible to confirm their identity. The only online reference located suggests that the *citong* is a 'fiery red' *Paulownia* (Top China Travel 2012), though the source is not likely to be noted for botanical accuracy. The standard Mandarin name for *Catalpa bungei* is *qiu* (Zhang & Santisuk 1998) or *qiushu* (Valder 1999). Valder indicates that *qiushu* means that the leaves fall at the end of summer or early in autumn, and that during the Tang Dynasty (618-907AD) *Catalpa* leaves were "worn ceremonially at the time of the autumn equinox". As early as the third century AD, *C. bungei* (*qiu*) could be distinguished from *C. ovata* (*zi*), which alludes to 'son' or 'offspring', as it was known then that *C. ovata* produced copious fruit and seeds, while *C. bungei* did not, and was propagated by transplanting large trees (Zhao-hong 2007).

Despite this reputed abundance and importance a curious invisibility cloaks *Catalpa bungei*, as Olsen & Kirkbride (2010) have described. It simply does not feature in most modern travelogues of plant-hunting in China and it is incredibly rare in western gardens, notwithstanding Meyer's statement that "This tree is one of the finest flowering trees in the world" which accompanied his 1906 collection (PI 18267). The *name* has been in cultivation for a very long time, but genuine *C. bungei* is vanishingly rare: Olsen & Kirkbride

photograph © Philippe de Spoelberch

Impostor 1: *Catalpa bignonioides* 'Nana' is still frequently labelled *C. bungei*; it is seen here growing at the Jardin Botanique de la ville de Liège.

photograph © John Grimshaw

Bark of *Catalpa bungei* at the United States National Arboretum, Washington DC.

were able to find only three wild-collected accessions of the real thing in their survey of *Catalpa* in American collections: one of these is from the earliest documented introduction. This came in 1904, when wild-collected seeds from the vicinity of Beijing were sent to the Arnold Arboretum by the diplomat E. T. Williams. Material was distributed widely: a tree was sent to Kew by C. S. Sargent, for example, and was 2.4m tall in 1912 (Henry 1912), but most of this material has long since disappeared, with the exception of one small tree still growing in the Arnold Arboretum and flowering prolifically there (Olsen & Kirkbride 2010, Yih 2012). A plant propagated from this tree grows at the Highland

photograph © Richard Olsen

Impostor 2: *Catalpa ovata*, acquired as *C. bungei* from an American nursery (at the United States National Arboretum, Washington DC).

Park Arboretum, Rochester, New York (R. Olsen, pers. obs.). A search of the USDA National Plant Germplasm System Germplasm Resource Information Network (URL in references) for historical plant introductions (PIs), yielded nine records for *Catalpa bungei,* including five collections by Frank N. Meyer and three presented by Nanking University. The latter appears to have been a collection of *Catalpa bignonioides* from the Caucasus in 1914. At least three PIs have records for being made widely available for interested parties the year after introduction (44664 from Nanking in 1917; 52909 and 53989 also from Nanking in 1921), although these should not be taken as the only distributions made by the USDA. The Brooklyn Botanic Garden has a specimen labelled *C. bungei* var. *heterophylla* (340008), purchased in 1934 from a gentleman in Berlin (as *C. sutchuenensis*), and while it is true-to-type for the variety, the rank has no botanical merit.

The next successful introduction to the United States came in 1994, from seed and specimens collected on a NACPEC expedition to the Wudang Shan, Hubei, when a sceptical team was persuaded by Kevin Conrad of the United States National Arboretum to collect seed off a lone pollarded[1]

[1] Is it possible that the key to the mystery is found in the word 'pollarded' used to describe the tree from which *WD*009 was collected? If many specimens of *C. bungei* in similar situations are so-treated, it could be that flowering and fruiting are rather rare events, rendering the species 'invisible' to collectors, while obviously cultivated trees are usually passed-over in the quest for authentic wild-origin material (and may themselves be sparse-fruiting).

Catalpa tree growing in the middle of a cultivated field, under the number *WD*009 (Aniśko 2006, Olsen & Kirkbride 2010). The seed germinated and the species was – tenuously – reintroduced to cultivation, with one plant currently surviving at the Arnold Arboretum, two at the Morris Arboretum, Philadelphia, and three at the US National Arboretum, Washington DC. Including these, Richard Olsen knows of only nine specimens of *C. bungei* in the United States.

In Europe the identification of *C. bungei* is so confused that it is impossible to disentangle what's what in collections without physically verifying them all. True material has certainly been imported from time to time; Bureau (1894) was able to report on a small tree at Arboretum Segrez, which therefore predates the introductions to the United States, though nothing is known about its origins. At the National Botanic Gardens at Glasnevin, Dublin, there is a tree of *C. bungei* grown from a Purdom collection, accessioned in 1920 (NBG records, S. O'Brien, pers. comm. 2012), and Keith Rushforth (pers. comm. 2012) reports a possible specimen at Overton in Devon.

Despite this scarcity of true-to-name specimens in cultivation, trees bearing the name *C. bungei* are not infrequent in collections and nursery lists, but they are almost all something else. While gathering together the collection of *Catalpa* now grown at the US National Arboretum Richard Olsen was unable to find a single correctly named *C. bungei* in commerce. The main pretender has been and is *C. ovata*, but the name is often also usurped by *C. bignonioides* 'Nana', a seldom- or never-flowering dwarf clone that is usually top-worked onto standard stocks of its species to provide an inelegant and unattractive blob on a pole.

The *bungei* bungle can be traced directly to Paris in the 1850s when *C. ovata* was grown from a packet of seed labelled *C. bungei* (see p. 34 above), and *C. bignonioides* 'Nana' was known as *C. kaempferi*. It is not known how it came to be attributed to *C. bungei* (Sargent 1911), but it is still sold through nurseries on both sides of the Atlantic under that name, or with *C. bungei* as a synonym for *C. bignonioides* 'Nana', but in some nurseries it has become a cultivar name – as *Catalpa* 'Bungei' (e.g. Architectural Plants 2001-2012).

The persistence of the misidentification of this clone, and of *C. ovata* for *C. bungei* is remarkable in its own right. In 1882 Hooker remarked that '*C. kaempferi* [i.e. *C. ovata*] is often found under the name of *C. bungei*, a very different tree…' and Henry (1912) makes the same point. But nobody paid any attention! Those who should have known better did not help. Charles Sargent, as the author of a *Bulletin of Popular Information* for the Arnold Arboretum, which predated *Arnoldia,* repeatedly informed its readers that *C. bungei* had small yellow flowers (1911; 1917; 1920; 1923; 1926: see *Arnoldia* online): one feels that the same text was merely recycled every few years! The ironic thing is that true *C. bungei* was indeed established at the Arnold Arboretum from the 1904 introduction – had it not flowered [it can be slow to come into flower from seed (R. Olsen, pers. obs)], or had Sargent forgotten

his previous identification as reported to Kew in 1902 (Henry 1912, see above, p. 35) and, like so many before and since, just got completely confused (or simply hadn't looked at the trees?).

The consequence is that if they are not *C. bignonioides* 'Nana', most specimens in cultivation labelled *C. bungei* are still *C. ovata*, including a tree seen in the British National Plant Collection of *Catalpa* in 2011 (now corrected!). The conservatism and aversion to name-changes of many nurserymen is well-known, but this is an extraordinary situation. One also has to speculate that the material of *C. ovata* still being propagated under the name *C. bungei* is directly derived from those seeds received at Paris in a mislabelled packet in 1848, so it has a sort of perverse historical curiosity.

Unfortunately, though there is a wealth of publications on catalpa in Chinese agricultural and forestry journals, including many older articles recently scanned for the web, underlying its importance there, but it is frustratingly difficult to use and acknowledge. Botanical varieties other than *C. bungei* var. *heterophylla,* have been proposed, but their standing remains dubious. In at least one case (Anon., 1980), eight new "natural" varieties of *C. bungei* are described based on bark and foliage characteristics alone, and a key provided for their identification. Cultivars or clones appear in Chinese scientific literature as well. Unfortunately only the abstracts are translated, but these appear to be elite clones studied mostly for their wood qualities.

A photograph of a variegated *Catalpa*, captioned "*C. bungei* cv Variegata" is given by Ellison (1995): it is impossible to tell which species it belongs to but it has the long-acuminate leaf-tips associated with *C. bungei*, though the leaves are distinctly lobed. It is a marginal chimaera with a broad white margins flushed with pink, and a smallish central green patch. This does not tally with the description by Hatch (2007) of a *C. bungei* 'Variegata' with 'leaves heavily mottled and vein white up to 95% of surface', derived from a photograph in a Japanese source (Yokoi & Hirose 1978).

Catalpa fargesii Bureau
Syn. *C. vestita* Diels
Trees *c.* 25m tall; young shoots covered with stellate or branched hairs, also occurring on most parts of the tree. Leaves opposite; petiole 3-10cm, glabrous or pubescent; lamina ovate or triangular-cordate, 13-20 × 10-13cm, sometimes with one or two lateral lobes, thick and leathery, base truncate or slightly cordate, apex acuminate, tomentose below but only on veins above; lateral veins 4 or 5 on each side of midrib. Inflorescences corymbose-racemose, 7-15-flowered; calyx covered in small stellate hairs, divided nearly to base into 2 parts, lobes rounded; corolla campanulate, white or pinkish, purple spotted in the tube, *c.* 3.2cm; anthers divergent, 3-4mm; style filiform, *c.* 2.5cm; stigma 2-lobed. Capsule terete, pendulous, 55-80cm. Seeds terete, linear, thin membranous, filiform hairy at both ends with hairs

photograph © Koen Camelbeke

photograph © Gert Forgeus

5-6mm. Flowering in early summer, fruiting in autumn. (Henry 1912, Zhang & Santisuk 1998).

Distribution CHINA: Gansu, Guangdong, Guangxi, Guizhou, Hebei, Henan, Hubei, Hunan, Shaanxi, Shandong, Sichuan, Yunnan; often cultivated. **Habitat** Roadsides, slopes; 700-1300(-2500)m. **USDA Hardiness Zone** 5. **RHS Hardiness Rating** H5. **Conservation Status** No IUCN assessment.

As with so many Chinese plants, the credits for the early collections of *Catalpa fargesii* go to the extraordinary trio of Henry, Farges and Wilson, whose collective labours did so much to reveal the botanical riches of central China. It was first collected in the South Wushan, Sichuan, by Augustine Henry, in May 1888 under his number *A. Henry* 5856a (O'Brien, unpubl.) but was named from material collected by Farges in Sichuan a few years later. The confusion existing between the identities of *C. fargesii* and *C. duclouxii* (see below) make it somewhat difficult to trace the early introductions: Henry (1912) says *C. fargesii* was introduced by Wilson in 1901, but Rehder (1913) identified *Veitch Expedition 976* from 1901 as *C. duclouxii* and recorded that it had been sent out as *C. fargesii*. Wilson made further collections of *C. duclouxii* in 1904 (*Veitch*

Opposite left
The seed pods of *Catalpa fargesii* growing at Killerton in Devon, England.

Opposite right
The seed pods of *Catalpa fargesii* var. *duclouxii* growing at Trompenburg Arboretum in Rotterdam, the Netherlands.

photograph © Koen Camelbeke

Right
The inflorescence of *Catalpa fargesii* at the botanical garden of the University of Strasbourg, France.

Expedition 4289) and 1907 [*Wilson* 640, though this covered two collections made in Sichuan (May) and Hubei, both May and October (!)]. True *C. fargesii* was collected in Hubei in 1907 (*Wilson 636*, *748*), and again in 1910 (*Wilson 4556*), though, according to Rehder, some of this seed was distributed as *C. vestita* Diels, a form with hairier leaf undersides.

Two original plants of *Wilson 640* sent by the Arnold Arboretum in 1908 still grow at Kew, where they are regarded as *C. fargesii*: one of them growing near the Temperate House is the British and Irish Champion, being 18m tall (77cm dbh) in 2010 (Johnson 2011). Both have recently been propagated to ensure the continuation of this historic material (Kew records 2012). Material of *Wilson 640* from the Royal Botanic Garden Edinburgh now growing at Kew is, however, identified as *C. fargesii* f. *duclouxii* (Kew records).

More recent introductions of *C. fargesii* are rather sparse. At Wakehurst Place are plants of Maurice Foster's collection *93074*, collected from a roadside tree growing at 1980m by the Kunming-Xiaguan road, Yunnan, in 1993 (Kew records). It is also rare in North America, though a plant attributed to Frank Meyer from 1914 survives at the Arnold Arboretum. This plant has an uncertain provenance (no PI number), and given that Frank Meyer never collected a catalpa from China under this designation, it may indicate that his collections of *C. bungei* are a mixed lot that include *C. fargesii*. On the other hand Wilson never collected a catalpa under the name of *C. bungei*, but his herbarium specimens certainly include plants with that morphology (R. Olsen, unpublished notes). A second specimen, *C. fargesii* 75783 at the New York Botanical Garden, was grown from seed received in 1936 from the Arboretum des Barres, in Nogent-sur-Vernisson, France, and was measured at

31.4m tall, 55cm dbh and with a lateral spread of 14m in July 2011.

Identification of *Catalpa fargesii* is comparatively simple on account of the presence of stellate or branched hairs on most parts of the plant, which are easily visible with a hand-lens. Anyone growing trees with this name should confirm their identity by this method. There appears to be great variation in the amount of pubescence that needs further study. The inclusion of such divergent taxa as *Catalpa fargesii* f. *duclouxii*, as a glabrous form and *C. vestita* Diels, a heavily pubescent one, under *C. fargesii* is indicative of the confusion surrounding the whole range of pink-flowered Chinese taxa. For example, it is not clear how to differentiate a glabrous *C. fargesii* from the glabrous *C. bungei*: the only thing clear is that this group still needs a lot of work before they are properly understood. At least three natural varieties have been proposed for *C. fargesii*, with names such as "narrow-leaf", "dense-hair", and "thin bark" (Anon., 1980); a white flowered form, *Catalpa fargesii* Bur. f. *alba* Q. Q. Liu et H. Y. Ye was named from a single plant growing in Shanxi (Liu and Ye, 1993).

Opinions are mixed on the merits of *C. fargesii* as a garden plant: its beautiful pale pink flowers are exceptionally attractive and can be borne in large numbers, but as Bean (1976) says it is apt to be 'a rather gaunt, narrow-crowned tree'–though perhaps in a hot site on the rich soil he prescribes for the genus it may do rather better. A note from Nigel Muir (pers. comm. 2011) sums up the situation quite well:

> "The best forms of *Catalpa fargesii* could just be the finest June-flowering tree for temperate regions (though there is no accounting for taste). But it is quite a variable tree. Forty to 50 years ago there was an exceptionally beautiful specimen at Kew which was much superior to any other trees of the species growing there. The largest tree there… I never saw flower over many years.
>
> Like so many splendid trees it has been little used for any purpose, especially urban planting. It was rare half a century ago and it is still about as rare today. *Catalpa fargesii* could make a very good and interesting street tree. It has a fine upright habit for this use and the leaves are not too large to be at all oppressive... as those of the two North American species are."

Catalpa duclouxii Dode is another highly confused and poorly understood taxon, currently being studied at the US National Arboretum by Richard Olsen and Joseph Kirkbride. It was described by Dode in 1907 from material collected in Yunnan by three of the great French missionary-botanists: Delavay, sent to France in *Delavay* 3352, from 1888, cited as the holotype, *Ducloux 187* (1897), *Soulié 1422* (n.d.). The name commemorates François Ducloux (1864-1945), who spent much of his life teaching in Kunming, Yunnan. It has pink flowers, and on the basis of its weakly corymbose inflorescences Dode thought it was allied to *C. ovata* rather than *C. bungei*, which it otherwise closely

resembles. At the same time he published *C. sutchuenensis* Dode, which has a racemose inflorescence, citing the same type collection used by Bureau for *C. fargesii* (*Farges 495*, *pro parte*), but was placed as a relative of *C. bungei*. Rehder (1913), basing his observations on Wilson's specimens, found that there was no significant differences between the two taxa, as the inflorescence branching varied continuously between otherwise identical plants: he treated *C. duclouxii* as distinct, with *C. sutchuenensis* as a synonym. Henry (1912), however, in his discussion of *C. bungei*, says: 'Specimens with more numerous flowers in the corymb, which has one or two of the lateral axes branched, have been considered to be a different species, *C. duclouxii* Dode; but these are probably trees of greater vigour and not even a distinct variety.' These days it would seem rash to name a new species based on three specimens and a tenuous morphological character.

Joseph Rock, collecting for the USDA made two interesting collections under *C. duclouxii* from Yunnan in 1922. The first (PI 55931) was of cuttings from a tree growing at 9,400 feet (2,900m) in the Likiang Valley, where "at this altitude the trees do not bear seed." A second collection (PI 56084) was seed collected from trees at the "Likiang Plain at an altitude of 8,800 feet (2,700m): in large groves also south of Talifu on the Menghua Ting Plain. The pinkish lilac flowers are borne in large full panicles and make the tree very ornamental. It is a very valuable timber tree, and the wood is not attacked by insects. Seeds of this tree are exported from Tengyueh to other parts of Yunnan. Tengyueh being the centre of distribution." The cuttings probably failed, but seedlings from the second collection were distributed in 1923 as *Catalpa* sp., but no plants are known in cultivation. Additional *C. duclouxii* were received in the United States in the 1930s, including a George Forrest collection (*Forrest 324*) (PI 111349) presented by Major Lionel de Rothschild, and seeds from Wu-Han University, Wuchang, Hupeh in 1935 with plants distributed in 1937 through the USDA Glenn Dale Plant Introduction Station. Again, no plants from these accessions are known in cultivation in the US. A recent collection received by Jim Waddick from the vicinity of Dali, Yunnan has survived for over 20 years in his garden in Kansas City, Missouri, but has yet to flower and suffers in severe winters. It is glabrous throughout, and has a malodourous scent when a leaf is crushed (J. Waddick, pers. comm. 2012).

In 1936 the English botanist John Gilmour reduced it to a form of *C. fargesii* (*C. fargesii* f. *duclouxii* (Dode) Gilmour), viewing it and Dode's *C. sutchuenensis*, which he placed in synonymy, as simply a glabrous variant of that species, a treatment foreshadowed by Rehder (1913) who said that *C. duclouxii* agrees with *C. fargesii* 'in every character except in the pubescence and perhaps in the somewhat stouter capsules.' This has largely remained the status quo in horticultural literature ever since: Paclt (1952), Bean (1976), Krüssmann (1984), Huxley *et al*. (1992), Jacobson (1996), Hillier & Coombes (2002), Dirr (2009) have all called it *C. fargesii* f. *duclouxii*. The *Flora of China*, however, subsumes

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Catalpa fargesii duclouxii at the National Botanic Gardens, Glasnevin in Ireland.

it into *C. fargesii (*Zhang & Santisuk 1998), but the World Checklist of Selected Plant Families (2012) regards it as a full species, *C. duclouxii*.

In his recent DNA analysis and study of the relationships between *Catalpa* species, Li (2008) found that all the pink-flowered Chinese taxa formed a distinct clade separate from that containing *C. bignonioides*, *C. speciosa* and *C. ovata*. However, within the pink-flowered clade, *C. bungei* and *C. fargesii* were most closely related, while *C. duclouxii* formed a group sister to the other two, suggesting a distinct genetic division between them. The sample was extremely limited, however, and based on cultivated material. It would be valuable to explore the relationships of these three taxa more closely at the molecular level, as well as conducting a thorough review of their morphology across their range in China. It is interesting to note that European and American collectors (e.g. Wilson, Rock) in western China used *C. duclouxii* or *C. sutchuenensis* almost exclusively for pink-flowered, glabrous *Catalpa*, whereas in eastern China *C. bungei* was used for this phenotype (e.g. F. N. Meyer). Considering the long history of cultivation of *Catalpa* in China, could the ancestral home for *C. bungei* reside in western China, from where Western

photograph © Gert Forgeris

Flowers of *Catalpa fargesii duclouxii*.

botanists have collected it under the name *C. duclouxii*? A comprehensive study using both genetic and morphological characters is clearly very desirable to resolve these questions.

While the discussions concerning its identity rumble on, under the name *C. fargesii* f. *duclouxii* gardeners can enjoy a small tree with handsome, mostly pink flowers. As with *C. fargesii* its habit is apt to be somewhat gaunt, and Belgian growers find it susceptible to late spring frosts that on occasion have killed the tree (though when the wood is ripened the tree is winter hardy). It will probably do better in areas with hot summers and milder winters. A lone specimen at the US National Arboretum (NA 53522) grown from seed received from the Kunming Botanical Garden in 1984 has barely reached 8m tall with a sparse canopy.

In recent years a *Catalpa* has been distributed as seed from China as *C. szechuanica*, an unpublished name. At least some of this material has come from the Shanghai Botanical Garden, as received at the National Botanic Garden of Belgium, Meise, in 2003, which had been collected the previous season on Mt Maiji, Gansu. Plants with this name are also in circulation in the trade (e.g. Bulk 2010-11). Images available online are all of juvenile plants and their identity remains unknown, though they probably belong to this group.

The strange case of *Catalpa tibetica*

In 1919 George Forrest was based at Tengchong, Yunnan, but for most of the

year was too poorly to undertake fieldwork himself. Instead he organised teams of trained local collectors to visit areas of interest and gather specimens and seed. One of these parties, consisting of three men and two mules, was sent to Tsarong in Tibet for the season (McLean 2004). While there they collected two specimens of a *Catalpa*, later numbered *Forrest 18926* (fruiting material, August) and *Forrest 18950* (flowering specimen, June). They were used as the basis of a new species, *Catalpa tibetica* Forrest, published while he was back in Scotland in 1921 (though no type specimen was indicated). The description states that the flowers are 'creamy-yellow, flushed and marked pale purple and yellow' and compares the plant to *C. ovata*, finding many points of difference with that species. The collection data states that both specimens came from Tsarong on the Salween-Kiu-chiang divide, 28° 40′ N, 98° 15E, at an altitude of 4300m asl (Kirkbride & Olsen 2011a).

Catalpa tibetica has never been seen since. Despite this it is covered by Krüssmann (1984) and has an accepted place in the *Flora of China* (Zhang & Santisuk 1998), both sources describing it as a shrub or a small tree. Not surprisingly, it has been perceived of as a source of interesting new material for the garden and for breeding work (RTO in discussion with JMG, 2006; Kirkbride & Olsen 2011a). This interest inspired Richard Olsen and Joseph Kirkbride, both of the United States National Arboretum, to investigate *C. tibetica*. In 2009 Kirkbride visited herbaria in Edinburgh, Kew and Paris and studied the specimens of *Forrest 18926* and *18950*, leading to the conclusion that they are identical to *C. bignonioides* and that they must have been collected from a planted or naturalised tree of that species somewhere in Yunnan (Kirkbride & Olsen 2011a). With a long history of (especially French) missionary activity in China, during which seeds were exchanged in both directions, it is not improbable that such an attractive flowering tree as *C. bignonioides* should have been planted in mission gardens or elsewhere, even in some remote outpost. In fact, Sheng (1979) reminds Westerners that China, too, has had a long history of importing plants for economic benefit, with *Catalpa speciosa* having been introduced before the end of the nineteenth century (the identity should be interpreted loosely, given the often confused identities of *C. bignonioides* and *C. speciosa*). It is perhaps telling that the only other specimen purporting to be *C. tibetica*, *Qin Ren Chang 31019*, collected in Lijiang, Yunnan, in 1948, was identified as *C. bignonioides* in Flora Yunnanica (Kunming Institute of Botany, 1979) with the note "Obviously, this tree was introduced". Enquiries to three contemporary British plant explorers who have travelled in Yunnan and eastern Tibet (Tom Hudson, Keith Rushforth, Michael Wickenden) have revealed that they have seen no plants that could equate to *C. tibetica* (or *C. bignonioides*) in that area, though Tom Hudson has found what appears to be *C. ovata* growing in the Salween valley (*TH2505*).

Kirkbride and Olsen (2011a) went into the circumstances of Forrest's 1919 collections in some detail. They convincingly demonstrate that Forrest did not

see the plant himself and was entirely dependent on the information provided by his collectors, who were paid a bounty for every new species discovered and, it would seem, recognised this unfamiliar plant as a novelty, which, in Yunnan at that time, it was.

Thus *Catalpa tibetica* should be relegated to the synonymy of *C. bignonioides* [which has been done in the paper by Kirkbride & Olsen (2011a), in which the typification of *C. bignonioides* and its synonymy are also discussed].

Cultivation

Although most of the above species are capable, once established, of withstanding winter temperatures down to -25°C, or colder (USDA Zone 5), *Catalpa* is a member of a largely tropical family and will thrive best where summers are hot or at least warm. Writing for British gardeners, Bean (1976) recommended 'an open, sunny, but not a bleak spot', recognising the need for shelter from wind for the large leaves. A rich deep loamy soil is also advised for best success (Bean 1976), but they are quite tolerant of different soil types from sand to clay (Dirr 2009, Tripp & Raulston 1995). Compared to the North American species, whose native habitat includes alluvial flood plains and bottomland forests, the Asian species as a whole prefer better drainage.

Careful formative pruning is recommended to ensure that young plants develop a strong central trunk (Bean 1976, Tripp & Raulston 1995): this is especially important in marginal areas with cool summers, where growth may not be so vigorous.

Propagation is best from seed sown in spring in warm conditions: no special treatment is required. Softwood cuttings root readily, although the large foliage may be difficult to handle on the propagation bench. Hardwood cuttings in winter, provided with bottom heat, are also successful and alleviates the foliage issue. For production reasons, cultivars like *C. bignonioides* 'Nana' are often grafted onto stocks of *C. bignonioides* or *C. speciosa*, or they can be budded in August (Dirr & Heuser 2006).

The most serious disease to affect the genus is powdery mildew *Erysiphe elevata*, but this is mainly disfiguring to the foliage rather than seriously debilitating to the tree. Thus far, the Asian species and forms tested have been resistant, and this is inherited to some degree in their hybrids (Olsen *et al*. 2006). Likewise, there are a number of leaf spots that have been found on the North American species, but field observations suggest that the Asian species either escape or are resistant (but *C.* ×*erubescens* clones vary).

In the eastern United States all species of *Catalpa* are attacked by caterpillars of the Catalpa Sphinx moth *Ceratotomia catalpa*, a species of hawkmoth for which *Catalpa* is the only host plant. Although usually only disfiguring, heavy infestations can be damaging and lead to defoliation of the tree (Hyche 1994). It is of interest that the first use of an aeroplane for aerial spraying of pesticides was to control Catalpa Sphinx caterpillars on a *Catalpa* plantation

The Catalpa Sphinx is a species of hawkmoth for which *Catalpa* is the only host plant.

near Troy, Ohio, in 1921 (Johnson 2002). Lead arsenate was used to dust the trees! The positive aspect of Catalpa Sphinx caterpillars is that they are highly regarded as efficacious fish bait in the southeastern states, where they are known as 'Catawba worms' (Hyche 1994).

Conclusion

With the exception of *Catalpa ovata*, which is widely grown and easily recognised, the Chinese species of *Catalpa* are thoroughly confused in cultivation and literature: the expression 'clear as mud' is apt. As the subject of ongoing taxonomic research and breeding work at the United States National Arboretum it is hoped that this can be at least somewhat resolved in the next few years. It is also hoped that this work will result in a new series of *Catalpa* hybrids combining the best features of floral beauty, vigour and disease tolerance from across the genus.

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References

Angiosperm Phylogeny Website. Bignoniaceae. At <www.mobot.org/mobot/research/APweb/> (accessed 15 May 2012).

Aniśko, T. (2006). *Plant Exploration for Longwood Gardens*. Portland, Oregon: Timber Press.

Anon. (1980). On some varietal forms of *Catalpa bungei* C. A. Mey and *C. fargesii* Bur. in western Henan. Sci. Silvae Sin. 16:157-160.

Anon. (1999). Zuil- en bolbomen. *Tuin & Landschap Thema* 14 oktober 1999 21a. At <www.bontehoek.nl/media/Brochures/Zuil-%20en%20bolbomen%5B1%5D.pdf> (accessed 18 May 2012).

Architectural Plants 2001-2012. *Catalpa* 'Bungei'. At <www.architecturalplants.com/plant.html?code=CBIN> (accessed 18 May 2012).

Arnoldia is available online at http://arnoldia.arboretum.harvard.edu/

Bean, W. J. (1976). *Trees and Shrubs Hardy in the British Isles*. 8th edn (2nd revised impression), vol 1. D. L. Clarke (ed.). London: John Murray.
Bossin. (1850). Catalpa nain. *J. Hort. Prat. Belgique*. 7:186-188.
Bulk, M. (2010-2011). *Catalogus 2010-11*. Boskoop: Rein & Mark Bulk.
Bureau, L. É. (1894). Révision du genre *Catalpa*. *Nouv. Arch. Mus. Hist. Nat*., ser. 3 6:169-207, t. 3 & 4.
Carrière, E. A. (1852). Multiplication du *Catalpa kaempferi*, DC. *Rev. Hort.* 1:342-343
Carrière, E. A. (1869). *Catalpa erubescens*. *Rev. Hort*. 40:460
Cho, J. Y., Kim, H. Y, Choi, G. J., Jang, K. S., Lim, H. K., Lim, C. H., Cho, K. Y. & Kim, J. C. (2006). Dehydro-alpha-lapachone isolated from *Catalpa ovata* stems: Activity against plant pathogenic fungi. *Pest management science* 62 (5): 414–8.
Clemants, S. E. (1995). International registration of cultivar names for unassigned woody genera 1994. *Hortscience* 30:445.
Cox, E. H. M. (1945). *Plant-hunting in China*. Oxford: Oxford University Press.
Decaisne, J. (1851). Arbrisseaux de la Chine récemment introduits au Muséum. *Revue Horticole* 5:405-407.
de Candolle, A-P. (1845). *Prodromus systematis naturalis regni vegetabilis*. IX. Paris; Treuttel &Würtz.
Del Tredici, P. (1986). The great *Catalpa* craze. *Arnoldia* 46: 2-9.
Desmond, R. (1994). *Dictionary of British and Irish Botanists and Horticulturists*. London: Taylor & Francis.
Dirr, M.A. (2009). *Manual of Woody Landscape Plants*. Champaign, Illinois: Stipes Publishing LLC.
Dirr, M. A. & Heuser, C. W. (2006). *The Reference Manual of Woody Plant Propagation*. 2nd edn. Portland, Oregon: Timber Press.
Dode, L.-A. (1907). Notes dendrologiques. *Bull. Soc. Dendrol. France* 2:190-209.
Elias, T. S. & Wisura, W. (1991). ×*Chitalpa tashkentensis* (Bignoniaceae), an intergeneric hybrid of ornamental value. *Baileya* 23(3): 139-144.
Ellison, D. (1995). *Cultivated Plants of the World*. London, Cape Town, Sydney, Auckland, New Holland Publishers.
Flanagan, M. & Kirkham, T. (2009). *Wilson's China*. Kew: Kew Publishing.
Francis, J. K. (1990). *Catalpa longissima* (Jacq.) Dum. Cours. Yokewood. SO-ITF-SM-37.New Orleans, LA: U. S. Department of Agriculture, Forest Service, Southern Forest Experiment Station. Available in Spanish at <www.fs.fed.us/global/iitf/Catalpalongissima.pdf> (accessed 7 May 2012).
Garkavtsev, I., Chauhan, V.P., Wong, H.K., Mukhopadhyay, A., Glicksman, M. A., Peterson, R. T. & Jain, R. K. (2011). Dehydro-alpha-lapachone, a plant product with antivascular activity. *Proceedings of the National Academy of Science USA* 108(28):11596-601
Gentry, A. H., & Tomb, A. S. (1979). Taxonomic implications of Bignoniaceae palynology. A*nnals of the Missouri Botanical Garden* 66: 756-777.
Gilmour, J. S. L. (1936). *Catalpa fargesii* forma *duclouxii Curtis's Botanical Magazine* 159: tab. 9458.
Grimshaw, J. & Bayton, R. (2009). *New Trees Recent Introductions to Cultivation*. Kew: Kew Publishing.
Hatch, L. C. (2007). *Cultivars of Woody Plants*, Vol. 1 A-G. Ebook published by TCR Press. At http://members.tripod.com/hatch_1/woodyAG.pdf> (accessed 15 May 2012).
Henry, A. (1912) In Elwes, H. J. & Henry, A. *Trees of Great Britain & Ireland*, vol. 6. Edinburgh: privately printed.
Hooker, J. D. (1882). *Catalpa kaempferi*. *Curtis's Botanical Magazine* 108 (ser. 3 vol. 38) t6611.
Huxley, A., Griffiths, M. & Levy, M. (1992). *The New Royal Horticultural Society Dictionary of Gardening*. London, Macmillan.
Hillier, J. & Coombes, A. J. (2002). *The Hillier Manual of Trees and Shrubs*. Newton Abbot, Devon: David & Charles.
Hyche, L. L. (1994). The Catalpa Sphinx. At <www.ag.auburn.edu/enpl/bulletins/catalpasphinx/catalpasphinx.htm> (accessed 16 May 2012).

IUCN (2012). IUCN Red List of Threatened Species. Version 2011.2. At <www.iucnredlist.org> (accessed 16 May 2012).
Jacobson, A. L. (1996). *North American Landscape Trees*. Berkeley, California: Ten Speed Press.
Jacques, A. (1855). Première floraison du *Catalpa bungei*, DC. *Fl. Serres Jard. Eur*. 10:188.
Jones, D. F. & Filley, W. O. (1920). Teas hybrid catalpa. *J. Heredity* 11:16-24.
Johnson, O. (2004). *Collins Tree Guide*. London: HarperCollins Publishing Ltd.
Johnson, O. (2011). *Champion Trees of Britain and Ireland*. Kew: Kew Publishing.
Kim, S.W., Choi, S,C,, Choi, E. Y., Kim, K. S., Oh, J. M., Lee, H. J., Oh, H. M., Kim, S., Oh, B. S., Kimm, K. C., Lee, M. H., Seo, G. S., Kim, T. H., Oh, H. C., Woo, W. H., Kim, Y. S., Pae, H. O., Park, D.S., Chung, H. T., Jun, C. D. (2004). Catalposide, a compound isolated from *Catalpa ovata*, attenuates induction of intestinal epithelial proinflammatory gene expression and reduces the severity of trinitrobenzene sulfonic Acid-induced colitis in mice. *Inflammatory Bowel Disease* 10(5):564-72.
Kirkbride, J. H., Jr. and Olsen, R. T. (2011a). Identity of *Catalpa tibetica* (*Bignoniaceae*). *Journal of the Botanical Research Institute of Texas* 5(2): 625–631.
Kirkbride J. H., Jr. & Olsen, R. T. (2011b). Neotypification of *Catalpa speciosa* (*Bignoniaceae*). *Taxon* 60 (6): 1760-1763.
Krüssmann, G. (1984). *Manual of Cultivated Broadleaved Trees and Shrubs*, Vol 1, A-D. Portland, Oregon: Timber Press.
Kunming Institute of Botany. (1979). Flora *Yunnanica*, vol. 2. pp 703-706. Science Press, Beijing.
Lancaster, R. (1989). *Travels in China.* Woodbridge, Suffolk: Antique Collector's Club.
Lavallée, P. A. M. (1880-1885). *Arboretum Segrezianum. Icones selectae Arborum et Fruticum in Hortis Segrezianis collectorum*. Paris: J. B. Baillière et fils.
Lee, Y. N. (2006). *New Flora of Korea*. Seoul: Kyo Hak Sa.
Li, H-L. (1959). *The Garden Flowers of China*. New York: Ronald Press.
Li, J. (2008). Phylogeny of *Catalpa* (Bignoniaceae) inferred from sequences of chloroplast *ndhF* and nuclear ribosomal DNA. *Journal of Systematics and Evolution* 46 (3): 341–348.
Li, J., Shoup, S. &, Elias, T. S. (2006). Molecular confirmation of intergeneric hybrid ×*Chitalpa tashkentensis* (Bignoniaceae). *HortScience* 41: 1–3.
Liu, Q.-q. & Ye, H.-y. (1993). Rare and endangered trees newly discovered in Shanxi. Bull. Bot. Res. (China): 13:220-223.
Lombarts, P. (2002). Successvolle selecties. *Tuin en Landschap* 23:16-19. At <www.tuinenlandschap.nl/pdf/e907465dcfa3ffcb81d3d9a28b6f0911.pdf> (accessed 15 May 2012).
Mackintosh-Smith, T. (2010). *Landfalls*. London: John Murray.
McLean, B. (2004). *George Forrest Plant Hunter*. Woodbridge, Suffolk: Antique Collectors' Club in association with the Royal Botanic Garden Edinburgh.
O'Brien, S. D. (2011). *In the footsteps of Augustine Henry*. Woodbridge, Suffolk: Garden Art Press.
O'Brien, S. D. (unpubl.) *Plantae Henryanae*. (Personal database on plant colllections by Augus tine Henry).
Olsen, R. T. & Kirkbride, J. H. (2010). Manchurian catalpa *Catalpa bungei*. *Arnoldia* 68: 75-76.
Olsen, R. T., Ranney, T. G., Hodges, C. S. (2006). Susceptibility of *Catalpa*, *Chilopsis*, and hybrids to powdery mildew and catalpa sphinx larvae. *HortScience* 41:1629-1634.
Olsen, R. T. (in prep.). A Tale of Two Catalpas. For *Arnoldia*.
Olmstead, R. G., Zjhra, M. L., Lohmann, L. G., Grose, S. O., & Eckert, A. J. (2009). A molecular phylogeny and classification of Bignoniaceae. *American Journal of Botany* 96 : 1731-1743.
Paclt, J. (1948). Sur la métamorphose des étamines chez le *Catalpa ovata* × *C. bignonioides* (Bignoniaceae). *Ber. Schweiz. Bot. Ges*. 58:381-382.
Paclt, J. (1952). Synopsis of the genus *Catalpa* (Bignoniaceae) III. *Candollea* 13:241–288.
Paclt. J. (2005). Über zwei seltene cultivare in der gattung *Catalpa* (*Bignoniaceae*). *Mitt. Dtsch. Dendrol. Ges*. 90:149-151.
Penhallow, D.P. (1905). The anatomical changes in the structure of the vascular cylinder incident to the hybridization of catalpa. Amer. Naturalist 39:113-136.
Pépin, P. D. (1856). Sur le *Catalpa Bungei*, D. C. *Revue Horticole* ser. 4, 5:361-363.

Pigg, K. B., & Wehr, W. C. (2002). Tertiary flowers, fruits and seeds of Washington State and adjacent areas, part III. *Washington Geology.* 30: 3-20.
Rehder, A. (1913). Bignoniaceae. In Sargent, C. S. *Plantae Wilsonianae*, vol. 1, 303-305. Cambridge: Cambridge University Press.
Sargent, C. S. (1889). A hybrid catalpa. *Garden and Forest* 2:303-305.
Sargent, C. S. 1911. Bulletin no. 8. *Bull. Popular Inform. Arnold Arbor.* 8:1-3.
Sargent, C. S. 1917. Summer-flowering trees. *Bull. Popular Inform. Arnold Arbor. n.s.* 3:53-56.
Sargent, C. S. 1920. Catalpas. *Bull. Popular Inform. Arnold Arbor. n.s.* 6:49-50.
Sargent, C. S. 1923. Catalpas. *Bull. Popular Inform. Arnold Arbor. n.s.* 9:45-47.
Sargent, C. S. 1926. Catalpas. *Bull. Popular Inform. Arnold Arbor. n.s.* 12:50-51.
Sheng, C. K. 1979. Introduction of North American trees into China: a brief summary. *Arnoldia* 39:271-277.
Smith, E. C. 1941. Chromosome behavior in *Catalpa* hybrid Spaeth. *J. Arnold Arbor.* 22:219-221.
Späth, L. 1898. *Catalpa* hybrid Hrt. *Gartenflora* 47:481, t1454.
Stearn, W. T. 1999. Englebert Kaempfer (1651-1716): pioneer investigator of Japanese plants. *Curtis's Botanical Magazine* 16:103-115.
Stephenson, A.G., Thomas, W.W. (1977). Diurnal and nocturnal pollination of *Catalpa speciosa* (Bignoniaceae). *Syst. Bot*. 2: 191-198.
Stone, W.G.M. (1908). Some more catalpa talk and some object lessons. *Arboriculture* 7:144-148.
Teas, J. C. (1879). A month among the catalpa trees. *Trans. Indiana Hort. Soc.* 19:202-208.
Thijsse, G. (2004). *Von Siebold herbarium*. Leiden: Brill.
Top China Travel (2012). 5 Days Cultural Xiamen Experience. At <www.topchinatravel.com/china-tours/xiamen-tour/5-days-xiamen-extension-cultural-tour.htm> (accessed 15 May 2012).
Tripp, K. E. & Raulston, J. C. (1995). The Year in Trees. Portland, Oregon: Timber Press.
USDA National Plant Germplasm System Germplasm Resource Information Network At <www.ars-grin.gov/npgs/acc/acc_queries.html> (accessed 20 May 2012).
Valder, P. (1999). *The Garden Plants of China.* London, Weidenfeld & Nicolson.
Veitch, J. H. (1906). *Hortus Veitchii*. London: James Veitch & Sons Ltd.
Siebold, P. F. v. & Zuccarini, J. G. (1845-1846). *Florae Japonicae familiae naturales :adjectis generum et specierum exemplis selectis*. München: Akademie der Wissenschaften.
Wang, D. (1988). The history of ornamental plants in China. *Camellia News* 107: 14-16.
Wawra von Fernsee, H. R. & Abel, F. (1886). *Catalpa syringaefolia pupurea*. *Wiener Ill. Gart.-Zeitung* 11:40
Wawra von Fernsee, H. R. & Abel, F. (1890). Die gegenwärtig vohandenen formen trompetenbaumes. *Wiener Ill. Gart.-Zeitung* 15:314-318.
Wikipedia (2012). Quqin. At <http://en.wikipedia.org/wiki/Guqin> (accessed 15 May 2012).
World Checklist of Selected Plant Families (2012). At <www.kew.org/wcsp> (accessed 16 May 2012).
Yokoi, M. & Hirose, Y. (1978). Variegated Plants. Siebundo Shinkoshu Publishing Ltd.
Yeung, J. (2010). *Standards for the Guqin February 2010 Draft*. Toronto: Toronto Guqin Society.
Yih, D. (2012). Land Bridge Travelers of the Tertiary: The Eastern Asian–Eastern North American Floristic Disjunction. *Arnoldia* 69 (3): 14-23.
Zhang, Z. & Santisuk, T. 1(998). Bignoniaceae. In: Z. Wu and P. H. Raven, eds., *Flora of China*. Science Press, Beijing. Vol 18:213–225.
Zhao-hong, Li. 2007. Distinguishing *Catalpa ovata* and *Catalpa bungei* in ancient China. *J. Beijing For. Univ*. 6:20-24.

Tree of the Year 2012

Next year's Tree of the Year will be '*Heptacodium miconioides*'. Please send your comments, photographs and any other information to John Grimshaw, Castle Howard Arboretum Trust, c/o The Estate Office, Castle Howard, York YO60 7DA, but preferably by email to: oltarakwa@gmail.com.