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Typification of *Pinus benthamiana* HARTW. (Pinaceae), a taxon deserving renewed botanical examination.

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Abstract

Pinus benthamiana HARTW., a taxon coined during mid-nineteenth century exploration of California and currently one of the many synonyms of the polymorphic *Pinus ponderosa* DOUGLAS ex C.LAWSON, is lectotypified with authentic material (mainly ovuliferous cones) found in a historical carpological collection surviving at the Natural History Museum in Vienna [W]. By reviewing the literature, the synonymy, and other historical particulars pertaining to this taxon, it is suggested that a renewed botanical study in situ and now based on a type could well result in new conclusions concerning the taxonomic status of HARTWEG's *Pinus*.

Key words: Flora of North America; Pinaceae, *Pinus*, Ponderosae, ponderosa complex, *Pinus ponderosa, Pinus benthamiana*; taxonomy, typification, botanical history.

Zusammenfassung

Pinus benthamiana HARTW., ein anläßlich der botanischen Erforschung Kaliforniens in der Mitte des 19. Jahrhunderts beschriebenes Taxon und derzeit eines der vielen Synonyme der polymorphen *Pinus ponderosa* DOUGLAS ex C.LAWSON, wird mit authentischem Material lektotypifiziert. Dieses Typus-Material (in der Hauptsache weibliche Zapfen) wurde in einer historischen karpologischen Sammlung am Naturhistorischen Museum in Wien [W] wiederentdeckt. Eine durch das Auffinden dieses Typus' ermöglichte Neubewertung aller für HARTWEG's Taxon verfügbaren Daten und der relevanten historischen Literatur könnte - nach einer profunden, noch ausstehenden botanischen in situ Studie - auch zu neuen Schlußfolgerungen hinsichtlich des weiteren taxonomischen Status von *Pinus benthamiana* HARTW. führen.

Introduction

Work in progress towards a revision of the 'ponderosa complex' of western North America (LAURIA 1991) has brought to light a suite of specific or varietal names today commonly considered to be synonyms of *Pinus ponderosa* DOUGLAS ex C.LAWSON (1836) in the strict sense [and exclusive of synonyms of the varietal, subspecific or closely related specific pine taxa *arizonica* ENGELM. (1879b), *engelmannii* CARRIÈRE (1854), *jeffreyi* BALF. in A.MURRAY (1853), or *scopulorum* ENGELM. (1879a)]:

P. beardsleyi A.MURRAY (1855)
P. benthamiana HARTW. (1847)
P. craigana A.MURRAY (1855)
P. engelmannii TORR. (1857, non CARRIÈRE)
P. jeffreyi var. *ambigua* LEMMON (1889)
P. jeffreyi var. *montana* LEMMON (1895)
P. macrophylla TORR. (1853, non LINDL. nor ENGELM.)
P. parryana GORDON (1858, non ENGELM. nor VOSS)
P. ponderosa var. *nigricans* LEMMON (1889)
P. resinosa L. in TORR. (1828, nec alii auctores)[1]
P. resinosa HOOK. (1838, nec alii auctores)[1]
P. sinclairii HOOK. & ARN. (1840)
and the cultivars:
P. malletii MOTTET (1902)
P. nootkatensis MANETTI (1844)
P. ponderosa f. *crispata* SCHWER. (1919)
P. ponderosa var. *pendula* H.W.SARG. (1878)
P. ponderosa var. *tortuosa* CARRIÈRE (1867)

[1] Apart from *Pinus resinosa* SOL. in AITON the Index Kewensis (JACKSON 1893 ff.) alone lists four later homonyms (exclusive of *P. resinosa* HOOK. also listed above).

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Even *Pinus washoensis* H.MASON & STOCKW. (1945) now turns out to be identical to and, therefore, no more than another synonym of *Pinus ponderosa* s.str. (CALLAHAM, in prep., pers. comm. 1995; LAURIA, in press). Almost none of the synonymous taxa listed above are typified or have ever been subjected to any botanical study in situ. Since even *P. ponderosa* DOUGLAS ex C.LAWSON itself so far remains untypified (LAURIA, in press), the taxonomic status of these other synonymous taxa must also remain open until a full taxonomic revision of the ponderosa complex is completed.

One purpose of the present study is to typify one of these synonyms, *Pinus benthamiana* HARTW. This pine clearly appertains to the ponderosa complex. But, despite its renewed rejection (CALLAHAM, in prep.; pers. comm. 1995), the combined examination of all available data suggests that a new botanical study in situ, and based on the type material brought to light and designated here, may well result in new conclusions concerning the taxonomic status of HARTWEG's *Pinus benthamiana*. The data pertaining to this taxon is presented. Another purpose of the present study is to identify those among the names listed above that would eventually have to be placed synonymous with HARTWEG's pine, rather than with *P. ponderosa* s.str.

The case of *Pinus benthamiana* HARTW.

Having travelled Mexico, Central and South America for seven years gathering plants and seeds on behalf of the Horticultural Society of London, Carl Theodore Hartweg spent two more years (1846 and 1847) in Alta California, collecting mainly around Monterey, San Diego and also in the upper Sacramento river valley (MCKELVEY 1955). Among other plants he also collected, named (in honour of his patron at the Horticultural Society, the eminent botanist George Bentham), and described *Pinus benthamiana* (HARTWEG 1847, p. 189).

GEORGE BENTHAM (1839 - 1857) undertook to publish a comprehensive list of Hartweg's collections (MCVAUGH 1970). Hartweg's Californian pines however, were almost all subject of another paper issued earlier by GEORGE GORDON (1849), one of the leading European conifer experts of the time (only a specimen of *Pinus contorta* doubtfully identified as a variety of *P. virginiana* is listed among the other Californian plants [on page 337 issued 1857] in BENTHAM 1839 - 1857).

Although HARTWEG's authorship is always acknowledged, and though his account of *Pinus benthamiana* was published without delay (HARTWEG 1847), it is mainly the figure and the more detailed technical description of the taxon by GORDON (1849, p. 212 - 214) to which other European scientific or horticultural writers of the time often refer in their own publications (e.g. CARRIÈRE 1855; HENKEL & HOCHSTETTER 1865; HOGG 1857; LOUDON 1850; VAN HOUTTE 1850). The enthusiasm for *Pinus benthamiana* and other recently described pines (e.g. *Pinus beardsleyi* and *P. craigana* of A. MURRAY 1855) was not to last long, though; it vanished when NEWBERRY's (1858) eyewitness report of the forest trees of California became known in Europe.

John Strong Newberry (paleontologist, geologist and botanist) accompanied Lieut. R.S. Williamson as surgeon-naturalist on the expedition exploring routes in California and Oregon for the Pacific Railroad Surveys in 1855 (EWAN & EWAN 1981). The route

followed by Williamson's party is detailed in WARREN (1859, p. 81 - 82). The resulting reports were the first scientific accounts of the botany of the Far West and as such greatly influenced the leading botanists in the East and in Europe (GOETZMANN 1959).

In this way, Newberry's account not only affected the taxonomic status of *Pinus benthamiana* and other new pines of the West. His enthusiastic portrayal of *Pinus ponderosa* ("as it grows in these sterile regions, it is a noble tree; and though never rivalling the gigantic sugar pine in its dimensions, it claims among western pines the second place. .... we saw many of this species six, and even seven, feet in diameter, three feet from the ground") accounts for the fact that ponderosa pine, which had been a species typical of the Columbia Basin ever since David Douglas' explorations, was now declared to be one of the most genuinely 'Californian' conifers. It was the Californian ponderosa pine which was forthwith generally considered to be the botanical archetype of *Pinus ponderosa*, with populations farther north remaining mainly overlooked in later botanical studies.

Although Hartweg's specimens were probably not available for him to study, Newberry had at least full access to all the important publications of the time, including those from Europe. In his account, Newberry reduced *P. benthamiana* and other recent pine discoveries to synonyms of *Pinus ponderosa* by stating: "I can only explain the confusion which exists in reference to [*Pinus ponderosa*] in the notes on the botany of the far west ..., by the supposition that its favorite habitat, though immensely extended, lying so far inland, has scarcely been entered by the botanists who have visited the inhabited portions of California and Oregon" (NEWBERRY 1858, p. 36 - 39).

John Torrey was obviously well supplied with data on, and with specimens of, *Pinus ponderosa* and its relatives, sent to him by a suite of explorers and collectors gathering in different parts the West; his contribution to the cluttered synonymy of *P. ponderosa* s.l. is quite extensive: *Pinus resinosa* TORR., *P. engelmannii* TORR., *P. macrophylla* TORR. (see introduction), and also *Pinus deflexa* TORR. (one of the synonyms of *P. jeffreyi*) well testify to this. However, as much impressed by Newberry's account as were most other contemporary professional botanists, John TORREY (1859) nonetheless soon thereafter acknowledged: "Dr. Newberry, who had abundant opportunity of studying the forest trees of New Mexico, California, and Oregon, in their native place of growth, has clearly shown (as we think) that *P. brachyptera*, ENGELM., is identical with the earlier published *P. ponderosa*, DOUGLAS, to which species he also refers *P. Benthami*, HARTW., and *P. Beardsleyi*, MURR. ...".

What surprises today is the fact that NEWBERRY's ovuliferous cone of *Pinus ponderosa*, as figured at natural size in his report (1858: p. 36), has so little in common with Hartweg's cone of *P. benthamiana*, as it is figured, for example, in GORDON (1849). Nevertheless, *Pinus benthamiana* was no longer conceded specific status. Before it was dropped altogether, it persisted for some time in European horticultural circles only.

With the travels of William Lobb and John Jeffrey in the decade from 1850 to 1860, the era of European botanical exploration of California expired and a new era of investigation by resident botanists set in. Several of them studied the forest flora of the West and also published on it (among them A. Kellogg, H.N. Bolander, S.B. Parish, E.L. Greene and many more to come: see EWAN 1953). In their publications Hartweg's pine is either

never mentioned again (e.g. in EASTWOOD 1905; JEPSON 1923; THOMAS 1961b), or referred to only as being synonymous with ponderosa pine (e.g. JEPSON 1910; ABRAMS 1923). However, there are some noteworthy exceptions: LEMMON consistently (1888; 1889; 1892; 1895), and also VASEY (1876), retained it at the varietal rank. In building up a collection of woods (and good botanical specimens for exhibition) of all American forest trees for the Centennial Exposition in Philadelphia (CANBY & ROSE 1893), Vasey, like Lemmon, who for some time was botanist to the California State Board of Forestry, also had a first hand knowledge of the trees of California. Diagnostic characters given for *Pinus ponderosa* var. *benthamiana* are not very helpful though: 'Sappy pine' growing in damp valley bottoms (VASEY), or 'Foothills Yellow pine' of low altitudes and (comparatively) more medium size, with dark bark, and long, narrow cones (LEMMON). In 1888 (p. 99) LEMMON described a mature tree (150 ft. [45 m] high, 4 ft. [120 cm] diameter at breast height [dbh]) of var. *benthamiana* in more detail, stating the deeply fissured bark to be dark-brown and reddish within, and the cones 4 - 5.5 in. [10 - 14 cm] long.

In 1889 LEMMON described trunks of another of his creations, *Pinus ponderosa* var. *nigricans*, a tree 120 to 150 ft. [35 - 45 m] high (with no indication as to dbh), and trunks of var. *benthamiana* of between 2 and 5 feet in diameter (LEMMON 1888), as both exhibiting dark bark (dark brown to almost black, or genuinely black). CALLAHAM (in prep., pers. comm. 1995) may be correct with respect to var. *nigricans* in surmising that Lemmon only mistook 'black Jacks' (a name given by loggers to young, dark bark *Pinus ponderosa* of 10 to 30 in. [25 - 75 cm] dbh; see WILLITS 1994, for a good characterisation of these low grade 'dark bark' juvenile 'black Jacks') for a separate taxon. However, this cannot apply to Lemmon's var. *benthamiana*: Trees of up to 5 ft. dbh have long outgrown the 'black Jack' stage. MUNGER (1924) also characterises var. *benthamiana* as having a more greyish bark than the type (see further down). MITCHELL (1973) gives a good impression of the variability of bark colour in mature trees of ponderosa pine.

SUDWORTH (1908; 1917), who followed Vasey as Forest Service botanist, and also SHAW (1914), both denied separate taxonomic rank for any of the different forms of ponderosa pine, lumping them all into one extremely polymorphic entity only.

However, foresters, often in areas away from the natural range of the pine, repeatedly noted the striking ecological, morphological and physiological differences between the various provenances of ponderosa pine. Hartweg's pine and other forms of *Pinus ponderosa* s.l. remained a subject of repeated inquiry (e.g. LINDSAY 1932; MOORE 1942 - 1944 [including appended comment by A.N. Pernham]; ELORRIETA Y ARTAZA 1964). One of the most persuasive arguments for the re-examination of *P. benthamiana* is to be found in the reply to one such inquiry: the comments more or less casually advanced by MUNGER (1924) to the queries of the editor of the Australian Forestry Journal. Munger, an officer of the United States Forest Service stationed at Portland, Oregon, was experienced with ponderosa pine throughout the Pacific Northwest (see his bibliography in ROE & BOE 1950, and AXELTON 1967). He stated:

"The true *Pinus ponderosa*, as growing throughout Eastern Washington and Eastern Oregon, also spills over the Cascades in Southern Oregon into the Willamette valley. Unexpectedly *Pinus ponderosa* (or, the variety named *benthamiana*) also occurs in a few places in Western Oregon, at low elevations in Willamette Valley on moist soils [!] in the very heart of the Douglas fir region [!]. It has quite long needles, and a more greyish

bark than the type form. It would be desirable in any reforestation work to recognise the difference between the type form of this tree found in Eastern Oregon from the variety - if it is such - found in the humid foothills of Western Oregon which, however, would likely be less hardy" (abridged from MUNGER 1924). In another paper, although still tentatively, MUNGER holds on to var. *benthamiana* as late as 1947.

In conclusion, while the present writer is d'accord with Munger not to aspire to any possibly still premature conclusions concerning the taxonomic status of Hartweg's pine, it is pointed out that *Pinus benthamiana* deserves a renewed examination in situ, in particular in conjunction with reference type material (cones) originating from Hartweg's collection and designated further down. This conclusion is further corroborated by MIROV (1961, p. 90 and 130), who sampled one single Santa Cruz mountain area provenance of purported ponderosa pine (at or near the supposed type locality of *P. benthamiana*) and found it yielding turpentine of a very unusual composition, strikingly different from that of any other of the many sampled provenances of the widely distributed *Pinus ponderosa* s.l.

Type locality

As to the type locality, HARTWEG stated the following: Leaving Monterey, Calif., on 24 August, 1846, "I took advantage [of a delay at Santa Cruz] and made an excursion to the mountains, in a different direction from that visited before" (HARTWEG 1847, p. 189). Here HARTWEG alluded to a first excursion to Santa Cruz on 22 June, 1846, then visiting a site 'well wooded with *Taxodium* [*Sequoia*] *sempervirens* and *Abies douglasii* [*Pseudotsuga menziesii*] thinly scattered among the redwood trees' (HARTWEG 1847: p. 124). On the occasion of this second visit HARTWEG described his *Pinus benthamiana*, giving the necessary botanical details but omitting place names (l.c., page 189). Later, he again saw trees of it 'a few days after [17 April, 1847] near Pine creek, a little mountain rivulet' above Sacramento valley, and again in early June, 1847, near Bear creek (and Chuba river) and in Bear valley, Sierra Nevada foothills (HARTWEG 1848, p. 221 and 223; see MCVAUGH 1970, for modern names of places). Finally, on 6 September, 1847, he "went again over to Santa Cruz in quest of pine-cones [cones of *Pinus benthamiana* explicitly included] which were now ripening. ... The cones [of *Pinus benthamiana*] were unusually scarce this season ... [and] were smaller than those of the preceding year ..." (l.c., p. 225).

There is no doubt that the type locality for *P. benthamiana* is in the Santa Cruz mountain area. The details given by Hartweg, including those given for his other plant collections in this general area, are however insufficient to determine the locus classicus of his specimens with greater precision. Neither JEPSON (1897), nor EASTWOOD (1911; 1939), MCVAUGH (1970, see p. 97 for comments on Santa Cruz), nor THOMAS (1961a; 1961b) were able to indicate place names for Hartweg's discoveries in the Santa Cruz area.

CALLAHAM (in prep., pers. comm. 1995), while working on his taxonomic review of *Pinus ponderosa* (with the intention of splitting it into several sub-taxa), concluded that the site in the Santa Cruz mountains today named 'Bonny Doon' probably corresponds to Hartweg's type locality, because it is the only (undisturbed, old growth ?) ponderosa pine forest in this area today. According to CALLAHAM (l.c.), these Bonny Doon ponderosa

pines were "found to be indistinguishable taxonomically from ponderosa pines growing from southern California northward through western Oregon to Puget Sound", prompting him to also dispose of *Pinus benthamiana* as a mere synonym of Pacific ponderosa pine.

However, GRIFFIN (1964) well points out that as late as in the 1960's "several large chaparral stands still contained remains of pine stumps [and that] the older, less disturbed communities [with Santa Cruz ponderosa pines were those] near Felton, California [Zayante valley, Santa Cruz County]", but obviously not the stand at Bonny Doon. As GRIFFIN (l.c.) continues, "nearly all the [sandy] Laguna- and large portions of the Arnold soils [distributed all over the Santa Cruz mountain area] have at least scattered trees [of *Pinus ponderosa*]". This scattered mode of distribution and invasive behaviour of ponderosa pine into sandy tracts in the Santa Cruz mountain area is also confirmed by MORGAN (1995, p. 10).

It may also be appropriate here to add another detail stated by GRIFFIN (1964): "Winter precipitation is abundant and summer fogs are frequent near Felton [mean annual precipitation 44 in. with a range from 19 - 101 in.] and near Ben Lomond [mean 56 in. and similar range of precipitation]. The higher elevation Bonny Doon stand has less fog". This again is reminiscent of Munger and his var. *benthamiana* alluded to above, which grows in a wetter climate than the type. GRIFFIN continues: "This combination of ... soil ... and relatively humid, coastal climate is ... probably the only such situation supporting this [ponderosa] pine [in California]".

All considered, it would seem preferable not to decide on the taxonomic status of *Pinus benthamiana* before having studied all populations of ponderosa pine now growing in the Santa Cruz area. Since CALLAHAM (in prep., pers. comm. 1995) was also unable to locate any type material (in particular ovuliferous cones), his notion of HARTWEG's *Pinus benthamiana* is, in my opinion, quite likely to be incorrect and his conclusion seems premature. One of the basic requirements of any revisionary work is to firmly establish the identity and to (neo-)typify all the (purportedly synonymous) names affiliated to any taxon about to be revised.

Hartweg's pine (as well detailed and figured in e.g. GORDON 1849) may be uncommon and/or not the only ponderosa morphotype present in the area, and ponderosa pines growing in the Santa Cruz mountain area today are not necessarily a priori identical to HARTWEG's *Pinus benthamiana*. The topotype method (the assumption that whatever [related pine] grows today at the presumable type locality must be [in the present case] Hartweg's taxon) can be quite misleading (see FARJON 1995, for another example of a similar confusing procedure as applied by other workers in Mexico).

Type material

With the exception of the doubtful *Pinus washoensis*, types for the taxa listed in the introduction are practically always either missing, or none were ever collected. Other original material for typification appears to be present for only a few of these synonyms.

Concerning *Pinus benthamiana* it seems certain that HARTWEG (1848, p. 225) collected specimens and that they were deposited in the herbarium of the Horticultural Society of London (GORDON 1849, p. 211). On pages 212 - 214, GORDON (l.c.) obviously described

specimens and did not merely repeat Hartweg's account, but neither HARTWEG (1847) nor Gordon designated a type. The herbarium of the Horticultural Society was sold at auction in 1856. A copy of the auction catalogue (STEVENS 1856) at the Lindley Library of the Royal Horticultural Society bears Lindley's annotations of the buyers of the various lots. The notes indicate that all (!) of Hartweg's specimens were bought by Bentham, whose herbarium is now at Kew [K] (STAFLEU & MENNEGA 1993), as is that of Hartweg (STAFLEU & COWAN 1979) and Gordon (STAFLEU & COWAN 1976).

The Botanical Museum and Herbarium Lund [LD], said to possess Hartweg's original herbarium (LANJOUW & STAFLEU 1957), only holds one sheet of his pine specimens (*Pinus contorta*, as listed as *P. inops* in BENTHAM 1839 - 1857, p. 337). Searches by the author at Kew [K] have been unsuccessful, as have been searches in other herbaria [BM, CGE, E and OXF]. CLOKIE (1964) mentions about 200 California specimens of Hartweg kept at OXF, although not specifying any *Pinus*. Of *Pinus benthamiana*, DÜMMER (1913) only acknowledges pen-and-ink sketch(es) in Lindley's herbarium at CGE.

George Engelmann toured through European herbaria in 1868 and 1869 (WHITE 1902). On that occasion, as is evidenced by specimens today present in his collections at MO (and dated 1869), he obviously received fragments of genuine type material (needles) of several pine taxa (e.g. *P. beardsleyi* and *P. craigana*) for comparative studies at home. However, of the three sheets determined as *Pinus benthamiana* and present in his collections today, the authenticity is either not clear (a sterile twig, MO 899036, labels indicating: "P. Benthamiana California 1847" and "Herbarium of Joseph Tarrigan Monell presented 1915"), or they originate from a later date (2 sterile specimens, Nos. MO 3574050 and MO 3574067, LEMMON 1879).

Sets of Hartweg's plants were distributed to many herbaria (LANJOUW & STAFLEU 1957), including the herbarium of the Museum of Natural History in Vienna [W]. According to a card catalogue of acquisitions its holdings include:

873 specimens of Plantae Mexicanae, bought 1840, 1843 and 1846,
400 specimens of Plantae Californiae, obtained 1851, and
400 specimens of Plantae Columbiae, bought 1852.

If this collection of Hartweg's Mexican or Californian plants at W ever comprised any pine specimens, these would not survive today. Vienna's main conifer herbarium was destroyed in a fire accident in 1945 (PETRAK 1948). Only a historical carpological collection remains that also includes an old collection of conifer cones. This was assembled independently of the conifer herbarium, probably by S. Endlicher in the 1840's, but there have been more recent additions. The collection is mainly in a pristine, unrevised state. The labels appended to the various specimens leave no doubt as to their age (actually stated on some; see also FARJON 1995) and often indicate names of various little-known historical collectors (which are, however, well listed in BARNHART 1965). There also is a cone of *Pinus montezumae* in the collection, with an attached label stating: 'From this Cone Mr. Lambert made his figure'. Labels on other specimens of pines, not readily available from the wild in Endlicher's time, indicate sources like 'Jardin des Plantes, Paris', or 'Bayford Bury, 1849', at that time an emerging English reference-pinetum.
As to material of *Pinus benthamiana* and a number of other cones, the source is indicated as 'Hort. Soc.'. Some Labels from this source are evidently in Lindley's hand (Candollea 31: 337 - 338, 1976, and archival resources, Kew), e.g. the 'B' in 'Benthamiana' appears

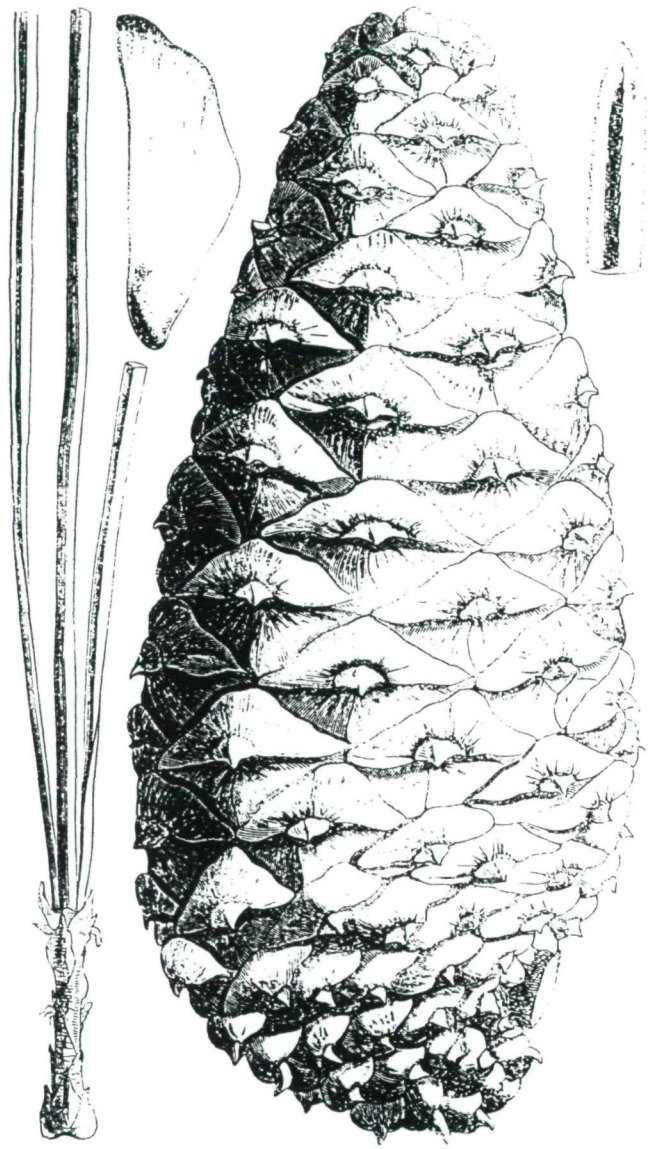

Fig. 1: *Pinus benthamiana*, cone in GORDON (1849).

to be very characteristic. Lindley was the Assistant-Secretary, later Vice-Secretary and Secretary to the Society from 1822 to 1863 and took a very active part in most of the Society's affairs during these 41 years (FLETCHER 1969). The authentic material of *Pinus benthamiana* present at [W] consists of the following:

1) A cone 14.3 x 8.0 cm, partly half open and partly still tied up to keep the cone closed (fig. 2). The appended label in John Lindley's hand states: 'P. Benthamiana Hartweg'. This cone is likely to be identical with the cone (15 cm, see fig. 1) shown by GORDON

Fig. 2: *Pinus benthamiana*, lectotype cone [W], and corresponding labels. Bar = 2 cm.

(1849). The two seem to match in shape and size. This cone and the corresponding specimen seeds (from large cone) listed below are here designated as the lectotype of *Pinus benthamiana* HARTW.

2) Another cone (fig. 3), fully open and measuring 14.4 x 9.8 cm, with similar label. It gives a good impression of a mature cone of *P. benthamiana* and is here termed an isolectotype.

Fig. 3: *Pinus benthamiana*, isolectotype cone [W]. Bar = 2 cm

3) Two more cones (10.2 x 5.6 [fig. 4] and 9.0 x 6.5 cm), on close inspection slightly abnormal, each with a label: 'Pinus Benthamiana Hartweg small cone'. These cones obviously correspond to those mentioned by HARTWEG in his account (1848, p. 225). These small cones and the corresponding seeds listed below (collected on 6 September, 1847 - HARTWEG 1848: p. 225) were clearly not part of the original collection (24 August, 1846 - HARTWEG 1847: p. 189) and, therefore, only constitute additional contemporary material.

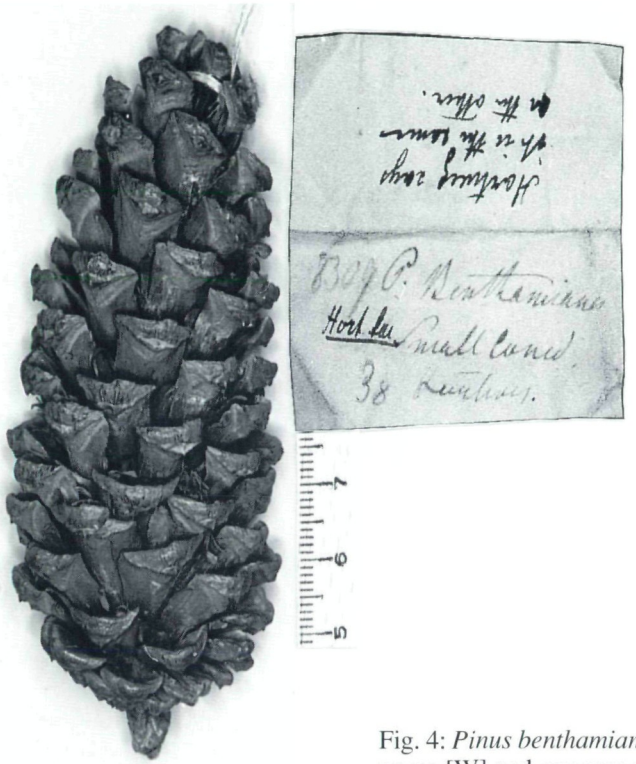

Fig. 4: *Pinus benthamiana*, one of Hartweg's small cones [W] and corresponding label. Bar = 2 cm

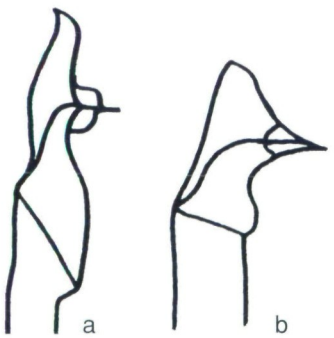

Fig. 5: Side view of cone scales. a) *Pinus benthamiana*, b) Bigelow's cone of *P. ponderosa* from Sonora, California

4) Three vials containing seeds, with labels stating as follows: "Specimen Seeds of Pinus Benthamiana large cone. Hort. Soc" (fig. 2); "P. Benthamiana Hartweg Small Cone Hort. Soc. Hartweg says it is the same as the other" (fig. 4); the label of the third vial only states: "P. Benthamiana Hartweg small cones".

Potential distinguishing characteristics and distribution

Ovuliferous cone characteristics distinctive of *Pinus benthamiana* are as follows: Sizes for closed cones range from 5 x 2.5 inches (12.7 x 6.3 cm, HARTWEG [1847, p. 189]) to

6 x 2.5 in. (15.2 x 6.3 cm, GORDON [1849]), or from 3 to 6 in. (7.6 x 15.2 cm) in length (LEMMON 1889); sizes of open cones seen by the writer range from 11.7 x 9.0 cm (smallest) to 16.5 x 9.5 cm (largest, from a cultivated tree). This range seems only to begin where the already broad range of sizes for Pacific ponderosa pine ends (6.4 - 12.2 x 5.6 - 8.9 cm, CALLAHAM in prep., pers. comm. 1995).

Mature, open cones are comparatively light, in over-all appearance somewhat resembling those of *Pinus palustris*. They are normally ovate in shape (strikingly contrasting the slimness of closed cones, LEMMON 1888, 1889; the writer's own observation), with relatively few, thin and brittle scales, indicating a cone-density appreciably less than that of other forms of the polymorphic *Pinus ponderosa* s.l., or that of *P. jeffreyi* cones which are usually more massive and heavier.

The distinctly russet colour of scales of normally matured *Pinus benthamiana* cones closely matches the russet of cones of *Pinus ponderosa* s.str. and indicates that immature cone coloration could be purple in both (as seen by the writer in cultivation). Purple immature cone colour is one of the more conspicuous characters distinguishing *P. ponderosa* s.str. from Pacific ponderosa pine (CALLAHAM, in prep., pers. comm. 1995; CRITCHFIELD 1984).

Apophyses of *Pinus benthamiana* cones are normally of large size (up to 25 mm broad in lectotype cone, 24 mm in isolectotype), quite thin and flat (upper part scarcely or only slightly elevated, also on abaxial side of asymmetric cones), transversely keeled and with a well-rounded upper margin. On abaxial side of cone the umbo is projecting from the (centre of the) apophysis and is well differentiated (see fig. 5) from the slim, but prominent mucro (centromucronate sensu KLAUS 1980). Contrary to this, the umbo can be depressed on the adaxial side (depending on symmetry of cone) with a very minute mucro. In other Pacific *P. ponderosa* morphotypes the entire upper part of the apophysis is thickly projecting (as in Bigelow's specimen mentioned further down), and gradually blending into a robust, pyramidal mucro. Umbo and mucro are not at all, or only scarcely differentiated (fig.5). Apophyses of *Pinus jeffreyi* cones are also much harder and often distinctly rhombic in shape.

Ovuliferous cones matching Hartweg's specimens are rarely seen in collections: The writer has seen several cones (and/or photographs thereof) in the private collection of M. Frankis, Newcastle upon Tyne, Great Britain (e.g. the sources "west of Eugene, Oregon" [cone about 10 cm long], and "Yosemite, California" [15 cm long]). The Chicago Natural History Museum [F] keeps at least one such specimen (Cat.No. 455581, mature open cone, 11.7 x 9.0 cm), collected by Elihu Hall (No 476) at the Dalles of the Columbia in 1871, and which was, obviously in view of the place of collection on the Columbia, erroneously coined by Engelmann to be "The genuine original Douglasian form" of *Pinus ponderosa* (ENGELMANN 1873). However, since a Douglasian reference specimen never existed as such for *Pinus ponderosa* (LAURIA, in press), Engelmann cannot really have had a correct notion of the genuine Douglasian form of it, nor does he appear ever to have seen Hartweg's specimens of *Pinus benthamiana*. Cones of the genuine Douglasian form of *Pinus ponderosa* s.str. are small and ovate (physically comparable to those that have been named *Pinus washoensis* H.MASON & STOCKW. (1945), see introduction to this paper).

Another specimen that is quite typical of *Pinus benthamiana* is Farjon 287 [W]. This specimen (sub *P. ponderosa*) was collected in Stanislaus National Forest in 1992, at an

altitude of c. 900 m NN. The open cone measures 12.5 x 9.2 cm (apophyses up to 23 mm broad) and is also very different in external morphology from cones of other *Pinus ponderosa* s.l. from the Pacific Slope as, for example, that figured in NEWBERRY (1858, p. 36, apophyses vaulted, 16 mm broad), or that collected by J.M. Bigelow at a comparable altitude in the same area (hillsides, Sonora [Calif.], May 1854, an open, egg-shaped cone of higher density [9.0 x 7.4 cm] also having smaller [up to 19 mm broad] and thickly vaulted apophyses, see fig. 5). Incidentally, Bigelow's specimen (*Pinus brachyptera* Engelm., Torrey Herbarium [NY], s.n.) typifies *Pinus engelmannii* TORREY (1857, non Carrière).

Some characters of bark have already been mentioned. Most sources agree that leaves (in fascicles of 3) are 'quite long' (MUNGER 1924), 'usually' 11 in. (28 cm) long (HARTWEG 1847; GORDON 1849). Although ranging only from 24.5 to 26.5 cm, the needles of Hall's specimen of 1871 (the northernmost source) well exemplify the extraordinary dimensions the foliage of *Pinus benthamiana* can attain. Contrary to this the needles of Farjon's specimen from Stanislaus National Forest only range from 13 to 20 cm. According to CALLAHAM (in prep.; pers. comm. 1995), leaves of Pacific ponderosa pine range from 14.4 to 24.3 cm.

Young plants grown from seed extracted from mature and indubitable '*benthamiana*' - cones of undetermined seed source, unexpectedly exhibited glaucous (bloomed) shoots, although perhaps less intense than those of *Pinus jeffreyi*. In an as yet unreplicated experiment (MIROV 1961, p. 90 and 130) the gum turpentine of purported *Pinus ponderosa* from the Santa Cruz mountain area was unexpectedly found to yield aldehydes and certain alkanes, components indicating affinity with *P. coulteri* D.DON. But neither Jeffrey pine nor Coulter pine are native to the Santa Cruz mountain area (GRIFFIN & CRITCHFIELD 1972). The constancy and discriminative power of all the other characters discussed in this section also yet remain to be surveyed.

The geographical locations given by HARTWEG (1847), MUNGER (1924), or evidenced by the places of collection of the specimens named above, all indicate that *Pinus benthamiana* may have (or may have had) a wide distribution. However, since it has escaped the notice of most botanists and foresters, it may, at the same time, perhaps also be uncommon, a taxon narrowly restricted to some particular (comparatively humid) habitats, to some extreme soil types (e.g. marine sands in the Santa Cruz mountains, or serpentine outcrops (e.g. in the Klamath region), or to a combination of both.

Taxonomy

Pending a renewed thorough botanical study and revision of *Pinus benthamiana*, the synonymy is tentatively given as follows:

Pinus benthamiana HARTW., J. Hort. Soc. London 2: 189 (1847); descr. & icon. in GORDON, J. Hort. Soc. London 4: 212 - 214 (1849).

≡ *Pinus ponderosa* var. *benthamiana* (HARTW.) VASEY, (Ann.) Rep. U.S. Commiss. Agric. 1875: 178 (1876).

≡ *Pinus ponderosa* var. *benthamiana* (HARTW.) LEMMON, 2nd Bienn. Rep. Calif. State Board Forest.: 97 (1888). - comb. superfl.

Lectotype, here designated [W]: "United States, California, Santa Cruz mountain area", C.T. Hartweg s.n. One ovuliferous cone (fig. 2) and corresponding seeds with appended labels: "P. Benthamiana Hartweg" in John Lindley's hand.
Isolectotype [W]: A second large ovuliferous cone (fig. 3), with similar label.

Of the taxa listed in the introduction, *Pinus ponderosa* var. *nigricans* LEMMON could be identical with *Pinus benthamiana* HARTW.; and if not merely another synonym, *Pinus parryana* GORDON seems at least closely related to it. Having at various times been treated as synonyms *of Pinus benthamiana* HARTW., the taxa *Pinus sinclairii* HOOK. & ARN., *Pinus malletii* MOTTET, and the data pertaining to them, are also discussed in this section.

Pinus ponderosa* var. *nigricans (LEMMON) LEMMON, Revision of broken-cone pines. Calif. State Board Forest. Bull. 7: 8 (1889). - [The basyonym is not explicitly cited, but the intention of the author is made evident in the text.]
≡ *Pinus jeffreyi* var. *nigricans* LEMMON, 2nd Bienn. Rep. Calif. State Board Forest.: 74, 100, 101 (1888).
Type: "United States, California, In the Sierra at low altitudes, often in wet localities" (LEMMON 1888, p. 74); "near Beckworth", "near Sierra Valley", "near Sardine Valley", and "near Sisson" (all California; LEMMON 1888, p. 101). According to Index Herbariorum, Lemmon's types are supposed to be at UC. However, apart from a "back-log" where they still might be hidden, inquiries to locate type material of this taxon have been unsuccessful to date.

From the characteristics given for var. *nigricans* by LEMMON, either as a variety of *Pinus jeffreyi*, or later of *P. ponderosa*, it seems that there is much overlap between this taxon and his var. *benthamiana*. A renewed thorough botanical investigation in situ, which so far has never been carried out, might perhaps result in placing var. *nigricans* as a synonym of *P. benthamiana*.

Pinus parryana GORDON, Pinetum: 202 (1858).
≡ *Pinus ponderosa* var. *parryana* (GORDON) ROB., Fl. & Sylva 3: 104 (1905). - Basionym not explicitly cited, but obviously referring to the same taxon, as the tree planted at Highnam Court (see below) is cited.
Type: "United States, Upper California, on the Sierra Nevada" (GORDON 1858), collected by Lobb and Bridges (GORDON 1875) at 3000 to 3300 m NN (SÉNÉCLAUZE 1867: The altitude should probably read 3000 to 3300 feet, which corresponds to an actual altitude of c. 900 to 1000 m). Although original material obviously existed in GORDON's (1858) time, so far all recent searches for it have been unsuccessful.

Callaham (pers. comm. 1995) concluded from the description by Gordon that the author must have mistaken this pine for *P. attenuata* (in Gordon's time *P. tuberculata*). As one reason out of several for concluding this, Callaham points to the fact that cones of ponderosa pine never attain six inches in length, as Gordon stated for *Pinus parryana*. However, GORDON (1849, see also his figure) well knew his *P. tuberculata*. And indeed, also cones of *Pinus benthamiana* attain such a size, and have very broad scales like those of *P. parryana* which, according to GORDON, were almost an inch (25 mm) broad. On the other hand, considering Gordon's involvement with *Pinus benthamiana*, it is hard to believe that he could have mistaken his *P. parryana* for it. GORDON explicitly described cones of *P. parryana* to be of a bright, glossy, yellow colour, very different from any other Californian pine so far known.

Additional information to shed light on this matter is available in the Mss of the Scottish Oregon Botanical Association, 1850 - 1859 (Mss kept at E). From original letters and transcripts of letters in these Mss it becomes clear that Gordon had named his *Pinus* after a conifer enthusiast of the time, T. Gambier-Parry of Highnam Court near Gloucester (see bibliography in DESMOND 1984), and that a tree of *P. parryana* had been planted on this estate. In a letter to Andrew Murray dated Oct. 25th 1857, Gambier-Parry (who in other letters gives evidence of being well acquainted with *Pinus tuberculata*) added the following postscript: "I believe the *Pinus Parryana* [named by my name, letter Jan. 22nd 1857, see also VEITCH 1881, p. 168] to be nothing but ponderosa, or Benthamiana or Beardsley's. I should like to get at a cone. You shall know them by their fruits". Several subsequent writers on conifers have treated *Pinus parryana* GORDON either as synonymous with *Pinus benthamiana* HARTW. (e.g. SENILIS 1866), or much more often with *Pinus ponderosa* DOUGLAS (e.g. PARLATORE 1868), but never with *Pinus attenuata* LEMMON.

In the Spring of 1992 the author had an opportunity to visit Highnam Court and its present proprietor. Three large trees of *Pinus ponderosa* s.l. were found on the grounds, two of which (130 and 115 cm dbh, respectively) are remembered to have been planted at about the appropriate time. One of them is a *Pinus ponderosa* s.str. Despite the fact that only a quite weathered cone could be secured from the other tree (available from the writer at W), it appears to be identifiable as *P. benthamiana*, a tree of which is also actually documented to have been planted at Highnam Court (Anonymous 1855). Therefore, the tree surviving today is not necessarily identical with GORDON's *P. parryana* planted in 1857.

Whatever the case, the identity of *P. parryana* does not seem to be resolvable in the absence of genuinely authentic type material, or without further information which may still turn up.

Pinus sinclairii HOOK. & ARN., Bot. Beechey Voy.: 392, table 93 (1840). - Sometimes termed "sinclaireana" or "sinclairiana".

≡ *Pinus sinclairiana* HOOK. & ARN., in CARRIÈRE, Traité gén. conif.: 355 (1855).

≡ *Pinus ponderosa* var. *sinclairiana* (HOOK. & ARN) ROB., Fl. & Sylva 3: 104 (1905). - Basionym not cited, but the choice of the adaptation of the name proposed by CARRIÈRE implies that the same taxon is meant.

Type: "United States, California, hills from Monterey to Carmelo and to Punta Pinos. Collector Dr. (Andrew) Sinclair".

Lectotype (designated here): The cone (exclusive of foliage) figured in HOOK. & ARN. (l.c.), table 93.

Note: A holotype is documented to have existed at Kew as late as 1869 (see further down), but is now obviously missing. So far all searches for it have been unsuccessful. In order to again formally establish the identity of this taxon, a lectotype is designated here. An epitype - cone typical of *Pinus montezumae* from the vicinity of Tepic, Mexico (see account further down), ought to be collected (and deposited, preferably at [K], the repository of most of J.W. Hooker's types).

Pinus sinclairii was a dubious taxon right from the beginning, as it was based on specimens of only poor quality. LINDLEY & GORDON (1850) soon reduced it to a synonym of *Pinus benthamiana*; and when this species was in turn reduced to synonymy (NEWBERRY 1858), it was affiliated to *Pinus ponderosa* (e.g. PARLATORE 1868).

Engelmann studied these specimens in more detail while touring through Europe and visiting its main herbaria in 1868 and 1869 (WHITE 1902). A short notice indicating the dubious nature of *Pinus sinclairii* was published soon thereafter (Anonymous 1871), prompting MURRAY (1871) to insist in affiliating it with *Pinus benthamiana*. However, HOOKER & ARNOTT's (1830 - 1841) description of the cone and its scales (narrow, the apex much thickened and hard, forming a four-sided pyramid) should have warned him that the two taxa cannot be identical.

The main body of the Botany of Captain Beechey's Voyage (l.c.) is an enumeration of plants collected by G.T. Lay and A. Collie between 1825 and 1828, when H.M.S. 'Blossom', commanded by F.W. Beechey, sailed the western coasts of the Americas, anchoring in California in 1827 and again in 1828 (EWAN 1953). This collection is said to have reached London in a disorderly state with many specimens having been mixed to some extent (SEEMANN 1857, p. 257).

Andrew Sinclair and G. Barclay, on the other hand, both assisted R.B. Hinds as naturalists on H.M.S. 'Sulphur', at first again commanded by Capt. Beechey (1835 - 1836), and after his retirement, by Capt. E. Belcher (1836 - 1842). The 'Sulphur' anchored in California ports in 1836 and 1839 (EWAN 1953). The plants collected on this expedition were the subject of another publication (R.B. Hinds & G. Bentham, The Botany of the Voyage of H.M.S. Sulphur, 1844 - 1846); but, at least parts of this collection must have come to the hands of Hooker and Arnott, who formed on the basis of these plants a Supplement (to the Botany of Captain Beechey's Voyage) entirely devoted to plants from California and collected by Douglas (his last journey to western America), by Sinclair and the other naturalists of the 'Sulphur' named above, and perhaps by others. Contrary to the plants collected by Lay and Collie, Sinclair's collection ought to have reached London in good state. There are no reports to cast doubt on such an assumption.

In 1869, Engelmann nonetheless found *Pinus sinclairii* to be "a factitious species founded upon a cone of *P. Montezumae* (from Tepic) and the foliage of *P. insignis*, while *P. radiata* of the same authors, l.c. 392 and 443, is made up of foliage of the former species and cone of the latter, as is proven by the specimens in Herb. Kew." (ENGELMANN 1879a, p. 128). Incidentally, HOOKER & ARNOTT (l.c.) had already stated earlier that the cone of *Pinus sinclairii* "in its form and scales approaches that of *P. Montezumae*", as figured in LAMBERT (1832).

Pinus malletii MOTTET, Conifères & Taxacées: 186 (1902); Rev. Hort. n.s. 13: 263 - 266 (1913).

≡ *Pinus ponderosa* [var.] *malletii* (MOTTET) BEISSN., Mitt. Deutsch. Dendrol. Ges. 1907: 105 (1907). - Basionym not cited, but obviously referring to the same single tree growing near Paris.

≡ *Pinus ponderosa* var. *mallettii* (CROUX) GAUSSEN, Trav. Lab. Forest. Toulouse t. 2, vol. 1, chap. 11: 128, 281 (1960). - Superfluous and incorrect author.

Type: A cultivar grown on the estate of Baronet Mallet, near Paris, France, from cuttings rooted by M.G. Croux, horticulturist, and originating from a tree of unknown seed source that succumbed to the severe winter of 1879/1880. Type material does not appear to exist; so far, all searches for it have been unsuccessful.

= Pinus malletii BEISSN., Mitt. Deutsch. Dendrol. Ges. 1900: 113 (1900). - Nomen nudum, referring to the same tree described in MOTTET (l.c.).

According to PARDÉ (1937) trees of *P. malletii* still existed in the 1930's. These trees have been characterised as a particularly luxuriant form of *Pinus ponderosa* (BEISSNER 1900; 1907), or having affinity with *Pinus benthamiana* (CROUX in MOTTET l.c.).

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