At the beginning of the 20th century R. Holden and E.W. Sinnott described five new genera of fossil coniferous woods, *Metacedroxylon* Holden, *Paracedroxylon* Holden, *Paracupressinoxylon* Sinnott, *Paraphyllocladoxylon* Holden and *Protobrachyoxylon* Holden. Since 1933 these five generic names have been consistently overlooked, and junior synonyms regularly used, including the relatively well-known genera *Protocupressinoxylon* Eckhold 1921 and *Protophyllocladoxylon* Kräusel 1939. The surviving type material of these five genera has been re-examined. According to this reappraisal: *Metacedroxylon* is an illegitimate nomenclatural synonym of *Protocedroxylon* Gothan, and its type material is heterogeneous; *Paracedroxylon* Sinnott and *Paracupressinoxylon* Holden are both junior taxonomical synonyms of *Brachyoxylon* Hollick et Jeffrey; the lectotype of *Paraphyllocladoxylon* is unfortunately lost, as is the one of *Protobrachyoxylon* Holden, the legitimate name for *Protocupressinoxylon*.

**Key words:** Fossil wood, nomenclature, taxonomy, *Brachyoxylon*, *Metacedroxylon*, *Paracedroxylon*, *Paracupressinoxylon*, *Paraphyllocladoxylon*, *Protobrachyoxylon*, *Protocupressinoxylon*.

**INTRODUCTION**

At the beginning of the 20th century fossil wood anatomy was actively studied, and several important papers about Mesozoic coniferous woods were published during this time (e.g., Gothan 1905, 1906, 1907; Hollick & Jeffrey 1909; Jeffrey 1907, 1910, 1913; Lignier 1907; Stopes 1914, 1915). In the U.S.A., especially at Harvard University, an ‘American school’ developed, led by researchers such as Sinnott, Jeffrey, Holden and, later, Torrey. These authors had original views about softwood evolution, views that they usually formalized etymologically while publishing several new generic names (e.g., *Metacedroxylon* Holden 1913, *Paracedroxylon* Sinnott 1909, *Protobrachyoxylon* Holden 1913). Among these, the most prolific author of new generic names was Ruth Holden, “a loyal adherent to the views of her teacher, Professor Jeffrey” (Seward 1917).

These ‘American’ generic names have been little used in Europe, where most authors have followed the taxonomy and nomenclature devised by Gothan (1905), Kräusel
(1919) and Eckhold (1923). Later, Bailey (1933) stated that he considered most of these ‘American’ genera as useless, and this helped plunge them into total oblivion. Nevertheless, the International Code of Botanical Nomenclature (Greuter et al. 2000) does not allow us to ignore validly published generic names. Thus the several names that Holden published in 1913 must be considered for priority (Bamford & Philippe 2001). The present work deals with the taxonomical and nomenclatural implications that have resulted from my examination of Holden’s and Sinnott’s type material.

BACKGROUND AND MATERIAL

Ruth Holden began to study plant anatomy during her B.A. at Radcliffe College (1910), under the direction of Professor Jeffrey. In 1913 she moved to England where she worked with Professor Seward until December 1915. In January 1916 she left England to serve as a volunteer nurse in a Russian hospital and she died in 1917 in Kazan. During her short but brilliant scientific life Holden produced 15 papers, seven of which dealt with fossil wood anatomy. She validly published (ICBN, art. 29–45) the following generic names in a 1913 paper: Metacedroxylon, Paracupressinoxylon, Paraphyllocladoxylon and Protobrachyoxylon. All of these names are based on fossil woods from Yorkshire (UK), some of which Holden collected at various Jurassic localities during a visit she paid to England in 1912, and some of which were sold to Professor Jeffrey by Mr. James Lomax. The latter was a professional slide-maker and fossil dealer who had a workshop in Bolton (Lancashire) and who was a shareholder in a company that mainly sold Carboniferous material. The original material for the wood slides sold by Lomax is said to be Jurassic in age (Holden 1913); however, there is absolutely no indication of locality on Lomax’s slides. Holden wrote (1913: 533) “All the sections from Mr. Lomax and representative ones of the lignitic material [i.e. the material she collected] are now at the University Museum, Harvard College, Cambridge, Massachusetts.” The repository is today the Botanical Museum of Harvard University. The palaeobotanical collection in this museum has been thoroughly searched and 39 pertinent slides were found. The labels on most of them are in Holden’s handwriting. To confirm this I compared these with the handwriting in her letters, kept at the Schlesinger Library, Radcliffe College, Cambridge, MA, and found that they are similar. During the same search the type material for Paracedroxylon Sinnott 1909 was rediscovered and is also included in this review. All of the slides have been carefully examined using a light microscope in order to locate the structures illustrated in Holden’s (1913) and Sinnott’s (1909) papers. A taxonomical and nomenclatural reappraisal of the material, unambiguously the basis of Holden’s and Sinnott’s generic names, has been performed.

RESULTS

Listed below in alphabetical order are the taxa of Holden and Sinnott, together with a discussion of the state of the slide collections. The term tracheidoxyl (Creber 1972) is used to designate a detached portion of secondary xylem characteristically composed of tracheids with only a minor proportion of other cell types.
**Metacedroxylon araucarioides** (Gothan) Holden

Number of samples investigated by Holden unknown, but they came from at least four localities (Lias of Robin Hood’s Bay, Oolite of Whitby and Scarborough, and an unknown place). Material attributed to this taxon in Harvard’s collection:

* set 53786 (1) slides #3 and #4; set 53786 (2) slides #2 et #7; no indication of locality on the labels. I have not been able to locate on these slides any feature shown on Holden’s figures. A tracheidoxyl (Creber 1972) with araucarian radial pitting, mainly uniseriate, sometimes biseriate or even triseriate, alternate; rare pairs of sub-opposite radial pits and occasional isolated radial pits (less than 5% of the pits of the abietinean type); ray cell walls thin and smooth, araucarian cross-fields; sparse axial parenchyma, with smooth transverse walls; primary structures (protoxylem and pith) are not well preserved.

* set 53787, two slides, a radial and a transverse section, labeled “the Lias of Whitby”. Features shown in figs. 17, 18 and 19 in Holden (1913) found on these slides. A resiniferous tracheidoxyl with mixed radial pitting; 50% uniseriate pits (of which 60% are araucarian), 40% biseriate pits which are mainly in opposite pairs, sometimes separated by rims of Sanio, and 10% araucarian triseriate pits; numerous oblique and transverse thickenings, 1 to 2 yew-like spiral thickenings; ray cell walls thin and smooth, cross-fields with 2 to 5 cupressoid pits disposed without order or in the cupressoid way; axial parenchyma common, with smooth transverse walls.

* set 53794, slides #1 and #2, originally label of “Metacedroxylon araucarioides” crossed out and marked “Cedroxylon sp.”; no indication of locality on the labels. I have not been able to locate any of the structures on these slides in the figures published by Holden. A tracheidoxyl similar to set 53787.

* set B with two slides. According to the printed labels W. Harold Tomlinson prepared these slides. They are labeled “Whitby” in Holden’s handwriting. There is no attribution to a wood taxon on the label. Because this material did not come from Lomax and because Holden (1913) indicated that Whitby was the source of only *Metacedroxylon araucarioides*, the hypothesis that she assigned this set to this taxon seems reasonable. I have not been able to match any of Holden’s figures to structures visible in these slides. A tracheidoxyl with mixed type radial pitting, araucarian pits being predominant; ray cell walls thin and smooth, cross-field pits not well preserved, probably 1 (locally 2) large oopore, no axial parenchyma observed.

* set C with six slides prepared by W. Harold Tomlinson and handwritten “Robin Hood’s Bay”. Holden only mentions one sample of *Xenoxylon latiporosum* (Cramer) Gothan from this locality (= set A in Harvard’s collection, see below) and *Metacedroxylon araucarioides*. Thus, set C probably represents the latter. I have not been able to match any illustrations to the structures visible on these slides. A poorly preserved tracheidoxyl that looks much the same as the material in set B.

**Metacedroxylon latiporosum** Holden

Number of samples studied by Holden and their source unknown. Material attributed to this taxon in Harvard’s collection:
* set 53790, slides #1 and #2; no indication of origin on the labels. Structures illustrated in fig. 24 in Holden (1913) found on slide #2. A homoxylous angiosperm-like wood, with a *Sahnioxylon* Bose et Sah 1954 type of radial pitting, thickened and pitted ray-cell walls and low uniseriate rays, no axial parenchyma observed, strikingly similar to the Carboniferous taxon *Protopitys* Göppert 1850 (Galtier in litt.).

* set 53791, slides #1 and #2; no indication of origin on the labels. I have not been able to locate any published figures to structures on these slides. The same wood as set 53790, but much less well preserved.

**Paracedroxylon scituatense** Sinnott

Exact number of specimens studied by Sinnott unknown (1909: 165, “several good-sized pieces”), Cretaceous clays of Second Cliff, Scituate (just south of Boston), Massachusetts. Material attributed to this taxon in Harvard’s collection:

* Eight slides marked “*Paracedroxylon*” in a box labeled “Prof. E.W. Sinnott slides”. Structures shown in figs. 4 and 5 in Sinnott (1909) found. A tracheidoxyl with mixed type of radial pitting (predominantly abietinean and uniseriate); ray-cell walls thin and smooth, araucarioid cross-fields with 1 to 5 cupressoid oculipores, no axial parenchyma observed.

**Paracupressinoxylon cedroides** Holden

Number of specimen studied and their source unknown. Material attributed to this taxon in Harvard’s collection:

* set 53785 (2), slides #1, #2, #3, #4; set 53785, slide #5; no indication of source on the labels. Structures in figs. 12 and 13 of Holden (1913) found on slide #4, those in fig. 11 found on slide #5. A resiniferous tracheidoxyl with radial pitting of the mixed type, predominantly araucarian uniseriate, ray cell walls thin and smooth, araucarian cross-fields, occasional traumatic resin canals, no axial parenchyma observed. Slide #5 displays primary structures (pith and protoxylem) and phloem.

**Paracupressinoxylon cupressoides** Holden

Number of samples investigated by Holden unknown, source unknown. Material attributed to this taxon in Harvard’s collection:

* set 53793, slides #1 and #2. The slides are labeled in Holden’s handwriting; no indication of source on the labels. None of the structures in figs. 15 and 16 have been found in the slides, but these figures have no distinguishing features. A resiniferous tracheidoxyl with podocarpoid radial pitting, smooth and thin ray cell walls, and araucarian cross-fields (few pits), no axial parenchyma observed.

**Paraphyllocladoxylon eboracense** Holden

One sample investigated by Holden, originates from the Scarborough Oolite. I have not been able to locate anything that could be assigned to this taxon in the Harvard collection.
Paraphyllocladoxylon araucarioides Holden

One sample investigated by Holden, source unknown. Material attributed to this taxon in the Harvard collection:

* set 53792 slide #1 and #2. Structures shown in fig. 10 of Holden (1913) found on slide #1. A tracheedoxyl with uniseriate araucarian radial pitting, pits being flattened; ray cell walls thin and smooth; phyllocladoid cross fields, no axial parenchyma observed.

Protobrachyoxylon eboracense Holden

One sample from the Scarborough Oolite was studied by Holden. I have not been able to locate anything that could be related to this taxon in Harvard’s collection.

In the Harvard collection there is also a set of slides labeled “A”, and another labeled “D” that look very much like sets B and C mentioned above. Just like sets B and C, sets A and D have printed labels indicating that they were prepared by W. Harold Tomlinson. On one slide of set A the structures shown in fig. 6 illustrating Xenoxyylon latiporosum in Holden’s paper (1913) were found. Set D most probably also belongs to Holden’s collection but the wood is poorly preserved, and I have not been able to relate it to any of the taxa described by her. This set came from Scarborough, a place that was the source of several taxa that Holden described.

DISCUSSION

In the Botanical Museum of Harvard University there are, according to this survey, seven slide sets for Metacedroxylon, one for Paracessedroxylon, two for Paracupressinoxylon, one for Paraphyllocladoxylon and none for Protobrachyoxylon. The material labeled Metacedroxylon actually represents several wood taxa. Obviously, a complete taxonomical and nomenclatural review of these taxa is necessary.

Metacedroxylon

Andrews (1955) chose M. araucarioides (Gothan) Holden as the lectotype of this genus. Consequently, the type material for Metacedroxylon is in Gothan’s material (in Nathorst’s collection stored in Stockholm, not yet reviewed). Furthermore, this generic name is illegitimate, because an earlier name (Protocedroxylon Gothan 1910) was available (ICBN, art. 11 and 12) in 1913. The latter itself is a taxonomical synonym of Araucariopitys Jeffrey in Hollick et Jeffrey 1909 (Bamford & Philippe 2001). None of the material assigned to Metacedroxylon by Holden that I have reviewed represents Araucariopitys. Instead her material should be assigned to Agathoxylon Hartig 1848, Protelicoxylon Philippe 1995, Protocircoporoxylon Vogellehner 1967, and Protopitys. Some of these generic names were published after Metacedroxylon 1913. However, I do not think that they should be put in synonymy with Protocedroxylon, according to ICBN art. 14 (limitation of the principle of priority for the stability of nomenclature) and as the syntypes for Metacedroxylon are xylologically disparate.
Paracedroxylon

Sinnott (1909) described only one species. Therefore *P. scituatense* is the type species and the eight slides of Harvard’s collection are the type material for the genus (ICBN art. 9.4). As there is no indication that the eight slides were made from a single specimen, I consider them as syntypes. The features observed on the slides indicate that *Paracedroxylon* is a taxonomical synonym of *Brachyoxylon* Jeffrey 1909. Both generic names were published in 1909, but the latter appeared in May and the former in September. Thus there is no need to change the name of the now well-established genus *Brachyoxylon* Hollick et Jeffrey.

Paracupressinoxylon

Andrews (1955) choose *P. cedroides* as the lectotype of this genus. Although Holden stated that she had studied “a considerable amount of material” of this species, she did not give an exact number of samples. She indicated that all the sections she received from Lomax and studied were preserved in Harvard’s collection. I think, therefore, that the five slides of set 53785 should be considered the holotype of *P. cedroides*. The anatomical features of this sample show that *Paracupressinoxylon* is also a junior taxonomical synonym of *Brachyoxylon*.

Paraphyllocladoxylon

*Paraphyllocladoxylon eboracense* was chosen to be the lectotype of this genus by Andrews (1955). Material and slides of this taxon are lost. *Paraphyllocladoxylon araucarioides* belongs to what is now usually called *Protophyllocladoxylon* Kräusel 1939. This species could be considered as a neotype and *Protophyllocladoxylon* a junior taxonomical synonym of *Paraphyllocladoxylon*. However, Holden stated that *Paraphyllocladoxylon araucarioides* is clearly differentiated from *Paraphyllocladoxylon eboracense* (“the tracheary pits, on the other hand, are quite different, …”, 1913: 536–537). I think that *Paraphyllocladoxylon* should be considered as a nomen dubium and not considered for priority, at least until the type material for *P. eboracense* is found and examined.

Protobrachyoxylon

As only *Protobrachyoxylon eboracense* was assigned to this genus by Holden, it is automatically the type species (art. 42.1). Furthermore, *Protobrachyoxylon* is the legitimate name for the otherwise well-known genus *Protocupressinoxylon* Eckhold 1921 (Bamford & Philippe 2001). It is thus very unfortunate that type material of this species has not been found. Although cross-field pitting was not described in the original article, a close examination of Holden’s fig. 29 shows at least two araucarioid cross-fields. With its mixed radial pitting *P. eboracense* is probably also a *Brachyoxylon*. I think however that until actual type material is found *Protobrachyoxylon* should not be considered for taxonomical synonymy.

In conclusion, all of the five generic names considered here are clearly either taxonomical synonyms or represent dubious taxa. Although they can return to ob-
livion, the ICBN makes this type of review absolutely necessary, and several other commonly used generic names are still badly in need of similar treatment. Palaeoxylologists cannot assign generic names to fossil coniferous woods only on the basis of Kräusel’s (1949) and Vogellehner’s (1967, 1968) publications as those authors did not review the type material and often did not follow ICBN rules. Furthermore, one can only regret that several collections throughout the world that include types have apparently been lost. Since natural history collection management has been experiencing a continuous crisis (lack of funding and staff) for several decades, palaeoxylologists are urged to review what is still available and to take all possible measures to secure types against loss, damage or ignominy.

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