

# Pityoxylon Gillinghamense

## A New Species of Fossil Coniferous Wood

from

### South-Eastern England.

By

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## Introduction.

In a collection of fossils from the English cretaceous belonging to the Mineralogical and Geological Museum of the University of Copenhagen, there was a piece of silicified wood which excited my interest by its peculiar structural features. For this reason I resolved to subject it to a more detailed examination, the results of which form the basis of the present paper.

The specimen had been presented to the Museum with some other fossils, chiefly Echinodermata, from the English senonian; by senior surgeon in the Danish army Dr. phil. K. BRÜNNICH NIELSEN, in 1921. All the specimens had many years ago been purchased in England from Mr. GAMBLE, Luton. On the label Gillingham, Kent, was marked as the locality; other specimens in this collection from the same locality were *Conulus conicus* Ag. and *Echinocorys vulgaris* Lam. which were stated on the labels by Mr. GAMBLE to have been taken in the »Cor-anguinum zone«, (lower senonian); it is not, however, stated whether the wood was found in the same stratum as these fossils.

Even if we shall thus have to give up fixing an exact geological date for the wood in question, it must nevertheless be considered probable, from the locality indicated and the general nature of the collection in which it was incorporated, that the wood is cretaceous, and its anatomical structure, too, points decidedly in this direction.

The specimen was of a light yellowish brown colour, abt. 5 cm long, 2 cm broad, and 1.5 cm thick, there was thus very little material at hand and after the cutting of the necessary slides only a very small portion was left. The

specimen was bored by *Teredo*. The state of preservation was fairly good in so far as the greater part of the wood bore no marks of having been exposed to strong pressure before the petrification, and the cellular elements had not therefore, as is so often the case with fossil woods, been compressed or crushed, but the somewhat uniform light brown colour caused a less sharply defined differentiation of the cellular walls, which made it rather difficult to ascertain certain details, about which more below.

### Description of the Structure.

A diagram of a transverse section, moderately magnified, is shown in Fig. 1. The four heavy horizontal lines in the

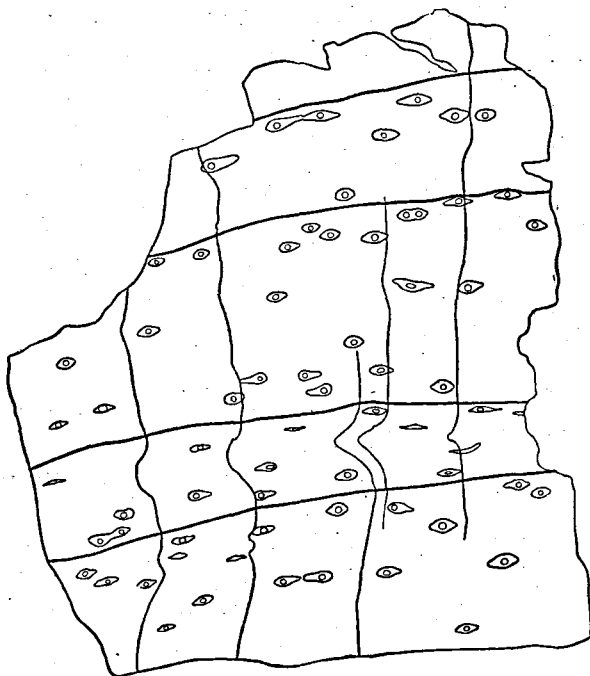


Fig. 1 *P. Gillinghamense*. Diagram of transverse section, showing growth-rings, some medullary rays and secretory ducts. ( $\times 6$ ).

figure denote limits of growth-rings, further some medullary rays have been marked which it has been possible to trace in the greater part of their course; in the second growth-ring at the bottom the medullary rays all show an almost uniform curve indicating that this part of the wood has been somewhat compressed.

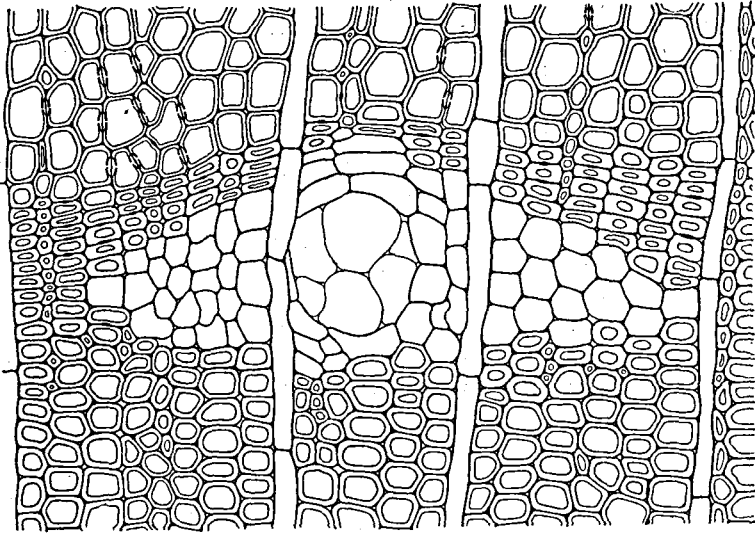


Fig. 2. *P. Gillinghamense*. Transverse section showing the limit of a growth-ring and a secretory duct with the enclosing parenchyma. ( $\times 110$ ).

The limits of the growth-rings are well marked; there is an even transition between the spring-wood and autumn-wood elements in one growth-ring, for which reason it is most likely that we have before us wood of a trunk or a branch. Numerous, more or less tangentially extended, areas of parenchyma are evenly distributed over the growth-rings, forming patches; each area encloses one schizogeous secretory duct, now and then two areas of parenchyma are seen to anastomose, (in Fig. 1 will be found marked the secretory ducts with surrounding parenchyma).

At one end of the specimen unquestionable traumatic resinous ducts had been formed; as is usually the case with such ducts, they were closely seriate near the limit of a growth-

ring, any further details about them could not be ascertained; they do not seem to have been jacketed by such large areas of parenchyma as is the case with the normal secretory ducts, which were present here in abundance besides the traumatic ducts.

Fig. 2 shows a secretory duct with surrounding parenchyma, higher magnified. The parenchyma cells are much more thin-walled than the tracheids, and I must observe that I regard the thickness given in the figure as corresponding relatively to the natural thickness and, on the whole, not as being caused by corrosion of the walls. Two medullary rays traverse the parenchyma. The secretory duct is filled with thyllen; this being so in all the cases examined, it seems to be the rule in this species. The walls of the thyllen were considerably thinner than those of the parenchyma cells enclosing the secretory duct.

In Fig. 2 is seen the limit of a growth-ring. The difference in the radial diameter between the tracheids of the spring-wood and autumn-wood is noticeable; the tracheids of the autumn-wood have bordered pits on their tangential walls, in the figure only shown as black thickenings of the middle lamella; in the spring wood the bordered pits are confined to the radial walls.

Fig. 3 shows a longitudinal tangential section of a secretory duct with its enclosing parenchyma. On the right and left are seen the tracheids that bound the parenchyma-column laterally; numerous medullary rays of different height traverse the parenchyma; thyllen fill up the duct in a compact mass. As could be observed in other sections where they were more perfectly preserved, the walls of the parenchyma cells are furnished with rather small elliptic simple pits; resinous tracheids proper (PENHALLOW p. 135) do not seem to occur in this species.

The parenchyma cells as well as the thyllen were always found devoid of resinous contents.

Longitudinal tangential sections of medullary rays are shown in Fig. 4, A—E. Fig. 4; A shows a simple linear ray,

17 cell-rows in height, with the enclosing tracheidal walls; it has not been possible to show ray pits in these in this

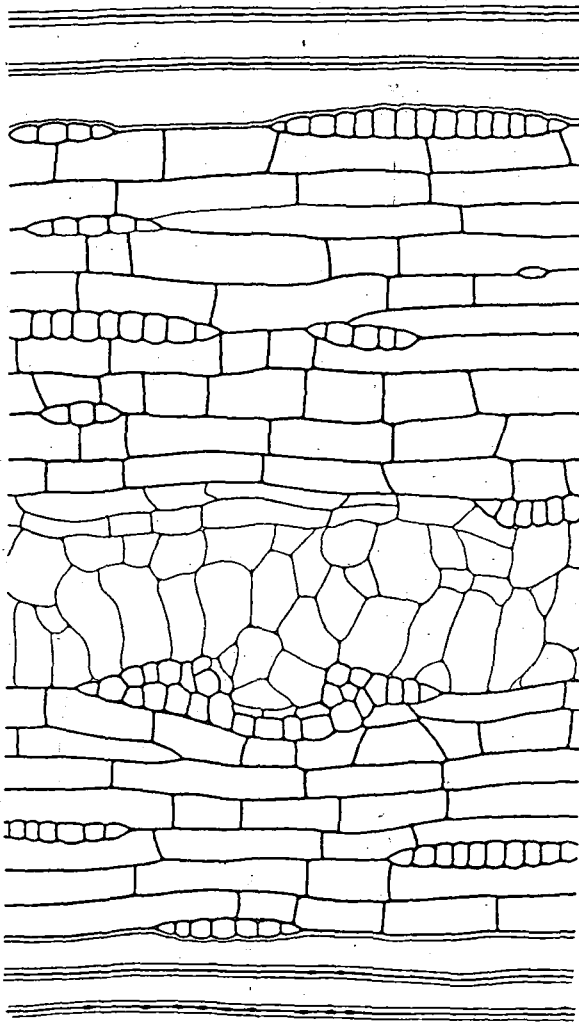


Fig. 3. *P. Gillinghamense*. Longitudinal tangential section of a secretory duct with enclosing parenchyma. ( $\times 110$ ).

figure, nor in the four other figures of the group, as, owing to the light colour of the material on account of which details are poorly differentiated, it is not possible to see

them with certainty in the tangential sections. The ray cells themselves seem to have been thin-walled and show no indication of pits on the horizontal or the tangential walls.

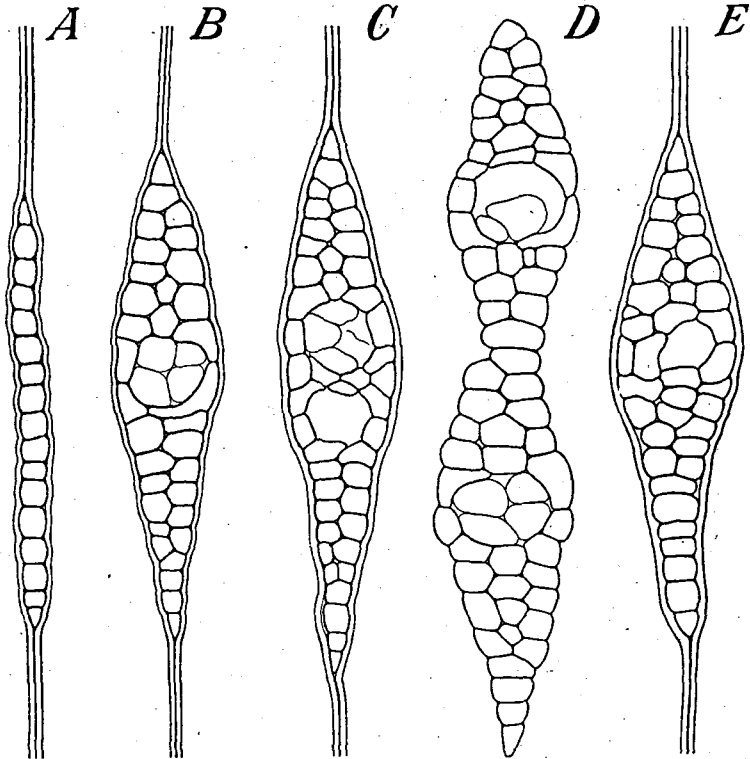


Fig. 4. *P. Gillinghamense*. Longitudinal tangential sections of a linear (A) and three fusiform rays (B, C and E); in Fig. 4, D are shown two anastomosing fusiform rays. ( $\times 130$ ).

Fig. 4, B, C and E show fusiform rays, they contain one or two secretory ducts, usually, filled up with thyllen — in a single case (Fig. 4, E) these seem to be lacking. Vertical fusions of two fusiform rays may take place as shown in Fig. 4, D; the surrounding tracheidal walls have been left out in this case as they could not be distinctly seen.

As it will appear from Fig. 3, anastomoses take place between the vertical and horizontal secretory ducts. This seems to be common in this species.



Two linear medullary rays are seen in radial longitudinal section in Fig. 5, A and B. At each crossfield between a ray-cell and a tracheid are found one or two (more rarely three or four — Fig. 5, B) large pits. In the spring wood they are very slightly bordered, («Eiporen» W. GOTHAN), in the autumn-wood the borders grow somewhat broader; yet most often the border is not unaffected by cor-

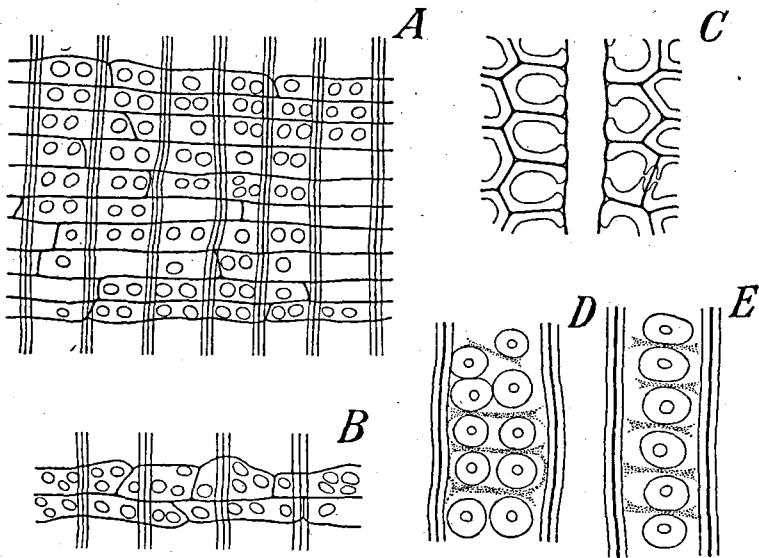


Fig. 5. *P. Gillinghamense*. A and B, radial sections of linear rays, showing pitting on the cross-fields of tracheids and ray-cells. ( $\times 130$ ). C, transverse section of ray, with enclosing tracheids (autumn-wood). D and E, radial walls of tracheids, showing bordered pits and rims of Sanio. (C, D and E  $\times 260$ ).

rosion and consequently more or less diminished, for that reason the porus will commonly appear larger in the fossil than it has really been in the wood that was intact. The outlines of the pits given in Fig. 5, A and B agree with the type found in the spring-wood; the relative size of the border of the ray pits in the autumn-wood can be imagined from Fig. 5, C, which shows a small selected part of a transverse section of a medullary ray with the surrounding tracheids higher magnified; here it has been possible to trace the pit in the tracheidal walls opposite the ray-cells.

We do not find marginal tracheids developed in this species, — the cells at the upper and lower edges of the medullary rays are found to be of the same nature as the other ray-cells.

Wood-parenchyma cells, scattered among the tracheids, could not be recognised.

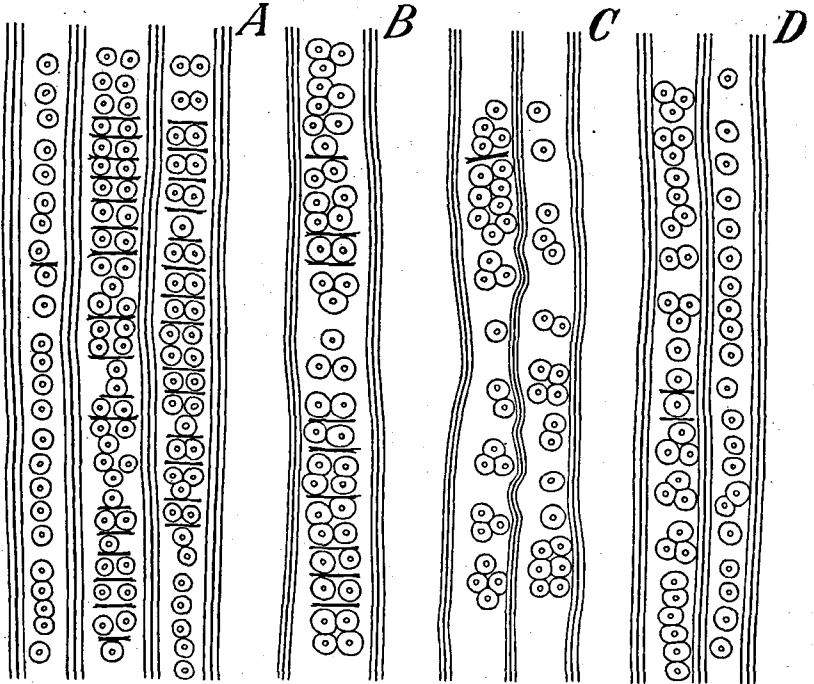


Fig. 6. *P. Gillinghamense*. A—D, radial sections of tracheids (spring-wood). (× 130).

The ray-cells were found devoid of the black or brown resinous contents otherwise so common a feature in these elements in fossil coniferous wood.

Fig. 6, A—D shows the arrangement of the bordered pits on the radial walls of the tracheids. As it will appear from these figures, the common arrangement in the greater part of the broader tracheids is typically abietinous, the pits are opposite, forming a double row, circular, most commonly not contiguous and flattened, the pairs separated by very

distinct rims of Sanio — in the narrower tracheids there is only a single row of bordered pits, mostly separated from each other. Groups of more closely disposed bordered pits, flattened by mutual pressure are, however, not at all uncommon. These groups may consist of several bordered pits arranged in a single row (Fig. 6, D, below), of three or four grouped in clusters, or finally of a greater number of alternating bordered pits (Fig. 6, B and C, above); this last mentioned type being the rule at the ends of the tracheids, where the pitting often presents a quite »araucarian« aspect.

Everywhere, where pectocellulosic material has predominated in the cell-walls, these now prove finely grained, thus the membranes of the pits of the ray-cells and those parts of the tracheidal walls that are occupied by the rims of Sanio; this may be seen in the higher magnified figures 5, D and 5, E.

### Diagnosis.

Secondary coniferous wood of the trunk-type. Growth-rings well marked, broad. Bordered pits on the radial walls of tracheids in spring-wood in single or double row — in this case rims of Sanio present —, or not uncommonly crowded and alternating, especially at the ends of the tracheids; in autumn-wood pits recognisable on the tangential walls of the tracheids. Normal secretory ducts, vertical and horizontal, abundant throughout the wood, freely anastomosing, constantly filled with thylosis; the vertical ducts are jacketed by a large mass of rather short parenchyma cells, thin-walled, simply pitted, and devoid of resinous content. A tangential row of apparently traumatic secretory ducts occurs in the specimen. Medullary rays are of two sorts: linear, uniseriate and fusiform, the latter always enclosing at least one secretory duct. The cells of the rays are thin-walled; the lateral pits are large, slightly bordered, one to four for each tracheidal zone.

Marginal tracheids are absent. The ray cells are found devoid of resinous content.

Type specimen: 1921. 15, and slides cut from it. The Mineralogical and Geological Museum of the University, Copenhagen.

### Affinities.

In the above-described wood, clusters and contiguous rows of alternating bordered pits are so commonly interspersed among the abietinous pitting that it forms a characteristic feature. It would therefore seem reasonable, when in search of related fossil types, to try first an examination of the forms mentioned by R. KRÄUSEL under the designation of »Hölzer mit teilweise opponierten, teils araucarioiden Hoftüpfeln« (1919, p. 225), even if from E. C. JEFFREY's statement (1917, p. 329) that »none of these transitional woods shows the presence of bars of Sanio«, we must suppose that these formations had not hitherto been observed in such forms. The only type within this group (*Protopinaceae* Kräusel, see also W. ECKHOLD, 1922, synoptic table, p. 498) with which we could think of comparing our wood, was *Pinites Ruffordi* Seward. On inspection of the type specimen, of which the British Museum had lent me a piece large enough to cut some slides from, it proved, however, that the above described wood could not be identical with *P. Ruffordi*, this species having a purer araucarioid pitting on the tracheidal walls and at any rate no rims of Sanio; it is conspicuous by having pits of greatly varying size on the radial walls of the ray-cells, which pits, where they were intact, were plainly enough not real »Eiporen« but approached more to the piceoid type.

Among the species included by R. KRÄUSEL in the group »Abietineenhölzer ohne Quertracheiden«, *Pinus scituatensisiformis* Bailey must have been placed by an error as it is ex-

pressly described as having marginal tracheids (J. W. BAILEY: A cretaceous *Pityoxylon* with marginal tracheids. Ann. of Bot. Vol. XXV, 1911). Of the other species *Pityoxylon foliosum* Holden and *Pityoxylon scituate* Jeffrey et Chrysler show resemblance to our wood by the considerable, tangentially extended areas of parenchyma, which in both these species surround the secretory ducts. In *Pityoxylon foliosum* we also find tangential pitting of the autumnal tracheids; but both species have the bordered pits on the radial walls of the tracheids in one row only, and they are scattered and by far not so numerous as in our species, besides their medullary rays showing piceoid characters. *Piceoxylon antiquus* Gothan is a still more markedly piceoid type and consequently quite out the question for comparison.

\*) *Pinus Nathorstii* Conwentz and *Pityoxylon infracretaceum* Fliche are regarded by R. KRÄUSEL — and no doubt with full justice — as being very closely related. The parenchyma-coating of the vertical secretory ducts is only a few cell-layers thick and does not form such large patches as in our species. The arrangement of the bordered pits seems to be wholly abietinous.

Further *Pityoxylon statenense* Jeffrey et Chrysler might come under consideration as a species related to the above described species, it is, however, quite distinct from ours in having »one or two layers of (rather thick-walled) epithelium enclosing the ducts, bordered pits in one row, and throughoutly piceoid structure of the cells of the medullary rays« (PENHALLOW 1907, p. 350).

From the above it will appear that the wood here described represents a new species which from the locality may suitably be given the specific name *Gillinghamense*.

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\*) During a stay at Stockholm last summer I had the opportunity of seeing CONWENTZ's original slides of this species in the phytopaleontological department of the Riksmuseum. I must remark that CONWENTZ's figures give an exceedingly good picture of the slides, and that there are hardly more details to be seen in the latter than the figures show.

In the case of geologically early abietinous wood it will often be impossible to refer it with certainty to recent types; nor is this possible in the case of the specimen under consideration. Though undoubtedly *Pinus*-like in essential features, it deviates unmistakably from the recent species, both by its entire lack of ray-tracheids, and by the partly crowded and alternating pits on the radial walls of the spring-wood tracheids, this being here a far more conspicuous feature than in any recent non-araucarian species known (v. A. C. SEWARD, 1919, p. 133); hence I have in this case given the more comprehensive generic name *Pityoxylon* the preference.

The generic diagnosis, as given by KRAUS, does not strictly demand the presence of ray-tracheids (»radiis medullaribus compositis ductumque resiniferum includentibus vel simplicibus, cellula eorum haud raro biformes«), but implies, it is true, a purely abietinous pitting on the tracheidal walls (»poris magnis, rotundis, uni — vel pluriserialibus, oppositis«), yet it seems to me the most reasonable, at least at the present time, to extend the genus *Pityoxylon* to include all types of fossil wood, showing undoubted affinities to *Pinus* and the other genera of the *Abietaceae* with horizontal and vertical secretory ducts normally developed.

In am indebted to Dr. SMITH WOODWARD (British Museum) for material of *Pinites Ruffordi*, and to Professor C. HALLE (Riksmuseet, Stockholm) for giving me an opportunity of studying the type specimen of *Pinus Nathorstii*. With Professor W. GOTHAN, Berlin, and Professor A. C. SEWARD, Cambridge, I have had the opportunity of discussing details, and I beg these gentlemen to accept my best thanks.

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