

DET KONGELIGE DEPARTEMENT
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MEDDELELSE Nr. 14

THE FOSSIL WOOD FROM
THE TERTIARY AT MYGGBUKTA,
EAST GREENLAND

BY
OVE ARBO HØEG

A FOSSIL RIVER BED
IN EAST-GREENLAND

BY
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Reprinted from Norsk geologisk tidsskrift. B. XII

OSLO
I KOMMISJON HOS JACOB DYBWAD
1932

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6 TEXTFIGS. AND 8 PLATES

Previous investigations. In many Arctic regions there is a very striking abundance of fossil wood, usually silicified and of Tertiary age. We still lack a critical summary on the subject, in connection with a detailed examination of all the collections available; but quite a number of contributions have already been published in the course of time, dealing with the occurrences in various parts. One may mention:

From Spitsbergen (Tertiary and older): CRAMER 1868 p. 175, SCHROETER 1880, SCHENK 1890, GOTHAN 1910, WALTON 1927.

From King Charles Land (Upper Jurassic): SCHROETER 1880 p. 3, NATHORST 1901, GOTHAN 1907, EDWARDS 1925.

From Franz Josef Land (Upper Jurassic): NEWTON & TEALL 1897 p. 508, KOETTLITZ 1898 p. 636, HORN 1930 p. 10.

From New Siberian Islands (Tertiary): SCHMALHAUSEN 1890.

From Iceland (Tertiary): WINDISCH 1886.

From Greenland: CRAMER 1868, BEUST 1884, NATHORST 1885 p. 279, SCHENK 1888 p. 19 (a short note), NEWTON & TEALL 1897 p. 510 (the same), WALTON 1927, MATHIESEN (in KOCH 1929).

From the Arctic Canada (Tertiary), at Mackenzie River: SCHROETER 1880 p. 16 and 1881, and on Banks Land: CRAMER 1868 p. 170.

It is very probable that the fossilization of all this wood has some causal connection with the eruptions of basalt, at least in many cases; this possibility has been mentioned by various authors previously. It is not, however, of the same age in all places. As will be seen from the short indications of the list above, most of the occurrences date from the Tertiary or from the end of the Cretaceous; but some of them probably even go back to the upper part of the Jurassic.

As to the records of fossil wood from Greenland, particularly, a brief summary of the results may be useful.

CRAMER (1868 p. 167) described a few specimens, poorly preserved, out of a more extensive material sent him for examination; he identified *Cupressinoxylon Breverni*, MERCKLIN, from Disko, a specimen so damaged, however, that the important details of the medullary rays could not be observed; further *C. ucranicum*, GÖPPERT, (?) from 70° N and 51° 45' W, which does not seem to have been much better. BEUST (1884) gave an account of some specimens collected by K. J. V. STEENSTRUP in the Tertiary of the West coast of Greenland (occurrence also mentioned by NATHORST in NORDENSKIÖLD 1885 p. 279 and by other visitors to these places); the samples comprised *Araucarioxylon Heerii*, BEUST, from Atanikerdluk and from Hare Island, and from the latter locality another sample of wood which the author called *Libocedrus Sabiniana*, HEER, combining it with the twigs and leaves which had been found as impressions in great numbers in the same strata. This material must also have been rather poorly preserved.

In his extensive account of the fossil flora of Scoresby Sound, HARRIS (1926) mentioned the occurrence of numerous splits of carbonised wood; being, however, of Rhaetic age they are of no special interest in this connection. WALTON (1927) described *Cupressinoxylon diskoense*, WALTON, from Disko, *C. cf. vectense*, BARBER, from the Nûgssuak Peninsula, both probably of Cretaceous age, and *Cedroxylon greenlandicum*, WALTON, from the Tertiary (?) of Hare Island; some of these forms are further mentioned below (p. 383).

Finally, a collection of fossil plants from East Greenland, including wood fragments, has been examined by Professor FR. J. MATHIESEN; as will be seen from a preliminary report published by KOCH (1929 p. 203), it contains some highly interesting forms, but it has no species in common with the collection described in this paper.

Apart from some of WALTON's specimens most of the wood that has been described from Greenland has been in such a poor state of preservation that our knowledge of the anatomy is very inadequate, and the names used often only serve to increase the confusion of synonymy.

New collections. — In 1930, during the expedition sent out by "Norges Svalbard- og Ishavs-undersøkelser", leader Mr ADOLF

HOEL, a geological party under the command of Mr ANDERS K. ORVIN discovered an occurrence of fossil wood at Myggbukta, East Greenland. It was a very interesting occurrence, not hitherto described; an account of the geological conditions is given elsewhere in this volume by the finder.

Mr ORVIN made an extensive collection of samples; besides, the expedition also brought home some specimens picked up by Mr FINN DEVOLD. The whole material was left to me for examination. I am very glad to have got the opportunity to see this interesting collection, and I beg to express my sincere thanks to Mr HOEL and Mr ORVIN for this favour.

The wood is silicified, and, upon the whole, the preservation is excellent. Some specimens have not been silicified all through, and it also happens that pressure has damaged the original structure rather badly; in some cases it was very difficult to grind satisfactory cross-sections, the wood splitting up before the section was thin enough. But as is evident, I hope, from the photographs, other ones gave the most beautiful sections, where the details of the structure could be studied without any difficulty.

The examination has only been carried out by means of ordinary ground sections and no other preparations. — The collection belongs to the Paleontological Museum of the University, Oslo.

The specimens could be sorted into groups, probably representing different species, as far as species can be spoken of in connection with fossil wood. — As will be seen, they have been described as new, in spite of a strong resemblance to some other species previously instituted. Perhaps they will turn out to be identical, and the new names have to be dropped, but well-defined synonyms are preferable to heterogeneous species and dubious combinations.

It has also been preferred, in this paper, to describe with full details only the best specimen of each species (the holotype), and then only make shorter notes on the other specimens (paratypes) referable to the same species, as far as they deserve mention. This has been found safer than combining all the specimens in question, as the latter way, particularly on account of the varying quality of the preservation, might lead to confusion.

Piceoxylon laricinoides, n. sp.

Pl. I—III; Pl. IV, figs. 1—4, 6—7; text-figs. 1 & 6.

Description of the holotype. The specimen which has been chosen as the holotype (text-fig. 1) is a piece of a stem, about 30 cm long, giving off a branch about 2.5 cm in diameter.

The anatomy of the stem will be described first.

The wood is in a good state of preservation, although rather badly pressed. In each annual ring, the very first spring wood is well preserved, and so is the broad summer wood, while the middle zone between them is very much compressed and folded (Pl. I, fig. 1). It is, therefore, impossible to give the exact thickness of the annual ring; it may be estimated at about 0.7—1.6 mm, of which the summer wood will make up from one sixth to one third. The limit between the three parts is rather fluent. Vertical resin canals are found regularly in the summer wood.

The radial rows of tracheids vary in breadth; the broader ones measure 50 μ across, or even slightly more, but between them there are also narrower ones. In the earliest spring wood the cells have a more or less quadrangular outline in the cross-section, or they are even longer in the radial direction. The tracheids are very long; one has been found measuring 4.9 mm.

On the spring tracheids there are bordered pits in great number, equally distributed along their radial walls. In many instances they form a single row, but it is not uncommon, in the more vigorously developed parts, that there is a double series; if so, they are strictly opposite or approximately so (Pl. II, fig. 1). In the middle part of the year-ring there are pits in great numbers, but details of their distribution cannot be ascertained on account of the compression. In the first tracheids of the summer wood there are also pits, but usually in single rows only. The pits are circular, sometimes slightly flattened horizontally, but never angular. Rims of Sanio are well developed above and below each pit, or, in the double rows, each pair of pits. In cross-sections and tangential sections the structural details of the bordered pits may be studied (Pl. II, fig. 2); the torus, for instance, is often distinctly visible.

On the tangential walls bordered pits have not been observed at all.

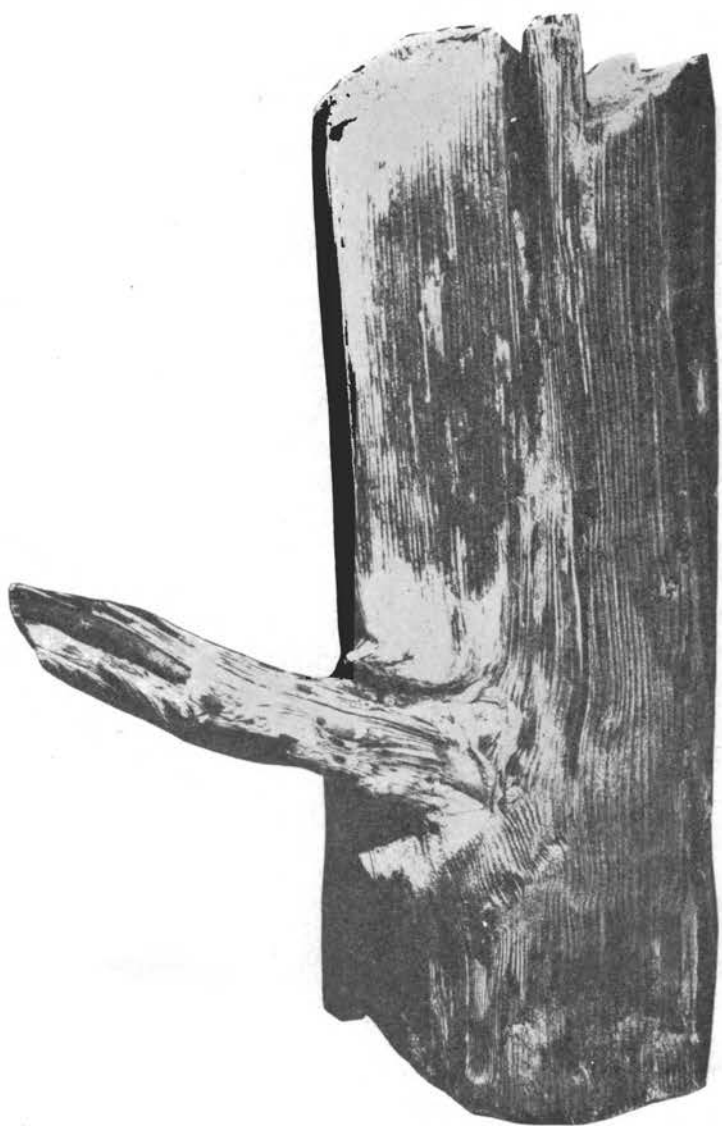


Fig. 1. *Piceoxylon laricinooides*, n. sp. Holotype PA 159.
Half nat. size.

The walls of tracheids have a very delicate striation in dense, steep spirals; but real thickenings have not been observed (see below, particularly p. 371).

Medullary rays are present in great numbers; some of them contain a resin canal, but most of them do not.

The non-resiniferous rays, corresponding to the uniseriate rays of other *Piceoxyla*, do not always correspond to this name here, being biseriate in a number of cases. These latter ones are always uniseriate in their upper and lower ends, while for a distance of 1—4—6 cells they are double.

In the tangential sections, these biseriate rays form quite a conspicuous element; but a statistical examination shows that they are only a small percentage of the whole number: Out of 250 rays examined, there were 228 simple rays, 9 biseriate ones, and 13 multi-seriate ones, each with a resin canal.

The height of the non-resiniferous medullary rays is not very great. Usually there are less than 20 cells, and only quite exceptionally there are 25 or 30.

The parenchymatous cells, forming by far the major part of the rays, are some 20 μ in height, varying from about 15 μ to about long in the spring wood, and short in the summer wood, where they may measure only 45 μ . The abietinean pitting is abundant and distinct on all walls; in the crossings with the tracheids there are from one of four pits in each field. In the tangential walls the pits are crowded.

Beside these normal pits, there are often, in the radial walls, some wider pores, usually about 10 μ wide, and occurring on the same walls as small pits of the usual type. They look like open holes through the wall, and they probably represent the effect of some corrosion or decay; but their regular, round shape and well-defined outline make them very remarkable, and they might be mistaken for oöpores of the *Pinus* type, so much the more as they are present in several of the specimens of this species (*cf.* Pl. II, fig. 6). The parenchymatous cells are very uniform, all of them resembling each other, except in the size.

The tracheidal cells of the medullary rays are few, forming, as a rule, one row in each end. The outer wall is thin and much

curved, and it is not dentate on the inside. The wall between the tracheidal elements themselves is somewhat curved and inclined, and it sometimes shows a slight dentation; in relation to the parenchymatous cells it forms an angle opening towards the surface of the wood (*cf.*, *e. g.*, Pl. II, fig. 9). In the spring wood, the tracheidal cells are long, and the angle mentioned is acute, while towards the periphery of the annual ring the dividing walls are nearly vertical, and with so short distances between them that the cells are nearly quadrangular, or they are even higher than broad. Bordered pits are sometimes visible on the radial walls (Pl. I, fig. 6); they are small, often only half the size of those between the wood tracheids, and they must be rather scarce; on the tangential walls, however, there are often a couple of such pits, closely together, well developed and excellently preserved (*cf.* Pl. I, figs. 6 & 6 and Pl. II, figs. 6 & 9).

The tracheidal cells are, as a rule, confined to the margin of the medullary ray; only quite exceptionally they may be found between the parenchymatous cells. Then there are usually two or more rows of them, and the appearance is as if there were originally two neighbouring medullary rays, one above the other, which had happened to get such a short vertical distance between them that they united into one.

The multiseriate medullary rays are usually fusiform in the tangential section, with the resin canal in the middle. More exceptionally, in the very high medullary rays, the canal is placed in one end, and the other part resembles a usual uniseriate medullary ray. Rarely there are two canals.

The resin canals, vertical and horizontal, are bordered by thick-walled cells, and consequently they are very well preserved. The abietinean pitting of these thick-walled cells is distinctly visible, in transversal sections as well as in longitudinal ones.

Wood parenchyma occurs regularly at the periphery of the year-ring, but only as scattered cells, not forming a continuous layer. They are particularly well recognizable in the radial section, where they may be found between the summer wood and next year's spring wood. The cross-walls between the parenchymatous cells are horizontal or nearly so; the size of the cell varies rather much, those in the row figured (Pl. I, figs. 8 & 9) measuring, say, from $120\ \mu$ to $185\ \mu$ by a width of about $20\ \mu$. In other places they are

shorter, even only 85 μ . Small simple pits are observable in many cases, but not always.

The twig is excellently preserved and not pressed at all. The annual rings are narrow, the average of 13 being 0.16 mm. The spring tracheids are square in the cross-section, and they keep the same shape and size out to the sharp limit against the summer wood; the latter forms from one fourth to one half of the entire zone. The resin canals are rather scanty, but they are equally distributed throughout the wood. Bordered pits are abundant on the radial walls of the spring tracheids, but, with few exceptions, they occur only in single rows; they have also been observed on the tangential walls.

As to the two most important specific characters of the wood, there is no essential difference between the twig and the stem:

The medullary rays have the same structure as those of the stem, but they are not so high (Pl. I, figs. 4 & 5); about 5 is the common number of cells, and the highest ones have 8 cells, or rarely more. Biseriate medullary rays occur; they are perhaps less frequent than in the stem, but as well developed. Multiseriate rays with resin canals are also less numerous than in the stem.

Xylem parenchyma is present in a considerably larger quantity in the twig than in the trunk. Upon the whole, their shape is the same; they may be narrower (as are most cells in the twig), but not always shorter.

Paratypes. The collection comprises a large number of other specimens referable to the same species, but showing a great deal of variation. It is so much the more valuable to be able to compare these specimens, as they are of all sizes, from twigs a centimetre in diameter and up to pieces of thick stems.

There are particularly two characters of importance in this connection, *viz.* (1) the biseriate medullary rays, and (2) the xylem parenchyma.

All these specimens possess the parenchyma at the end of the year-ring, but the quantity varies between very wide limits. As in the holotype, there is always quite an abundance of it in the twigs and thin branches (as in PA 142, 146, 153); there is rather more of it here than in the wood of the stem. Otherwise it is, however, very difficult to give any general rule as to its occurrence: In some samples (as PA 156), evidently fragments of stems, there is very

much of the parenchyma, as, upon the whole, all elements of the wood are vigorously developed. In other ones, it may be very scarce, although the wood is otherwise quite typical and well developed; in some cases it has only been found after considerable searching.

The medullary rays are also subject to some variation, but, upon the whole, in a more regular way. In the twigs, they are as numerous as in the stems, but they are never so high, and there are not so many multiseriate ones. Of the non-resiniferous rays, the number of biseriate ones is less in the twigs, and it has sometimes taken a long search to find any (particularly in PA 153). In the stems medullary rays of this kind are usually present about in the same percentage as in the holotype (p. 368), although there is some variation in the frequency. No specimen has been found to miss them entirely. In a class of its own stands a flat piece of wood, No. PA 134; to judge from its size it might be a fragment of a stem or at least quite a big bough, but the narrow year-rings have the anatomy usually characteristic of twigs or branches. Here, the parenchyma is very scanty, and the biseriate medullary rays are so scarce that they would have been overlooked if not searched for very carefully by means of the cross-board.

The walls of the tracheids are often badly striated, but sometimes, as mentioned in the description of the holotype, there are indications of original inner thickenings of the membrane. This is distinctly observable in a certain specimen, PA 165 (Pl. II, figs. 3 & 4). The specimen now consists of eight small fragments; possibly they have belonged to one of the other specimens, but it cannot be said which. The wood is rather badly pressed and no transversal section has been prepared. No xylem parenchyma has been found, but still, there is scarcely any reason to doubt the identity with the species described above; there is a complete agreement in other details, the structure and distribution of the resin canals, the presence of biseriate medullary rays, &c. In the summer tracheids, which are well preserved, this specimen shows very distinct annular thickenings; as visible in the photographs, they are horizontal or very nearly so, and they are very dense.

The pith is present in a number of branches, and in some of the sections several details of the structure are observable (PA 142, 146 & 147). There is no doubt as to the specific identity of these specimens: they show all the essential characters mentioned above, although the biseriate medullary rays are scanty, as is usually the

case in branches. The pith is (in PA 146) about 0.7 mm wide, consisting of very thick-walled cells with distinct simple pores and dark contents.

They are rather varying in size, but usually about 35—40 μ across. In the cross-section they are rounded or angular; usually they are closely packed together, but, according to their shape, there are often considerable intercellular spaces between them (Pl. III, fig. 3), in other cases not (Pl. III, fig. 5). In the longitudinal sections they are seen to be irregularly elongated, the length being up to four times the breadth.

The protoxylem consisting of spiral tracheids lies close to the pith; in exactly transversal sections these cells are not always easily recognizable, but when cut obliquely they show their spiral thickening, and in more longitudinal sections they are also sometimes visible (Pl. III, figs. 5 & 6). They are rather uniform in size, measuring about 20 μ across. In size and in the structure of the wall they are like those of *Larix decidua* and *Picea excelsa*.

Leaf-traces are radiating in all directions (Pl. III, fig. 2). Each of them contains a small group of a few spiral tracheids, surrounded by thick-walled cells resembling those of the pith. Bundles like that may also be found further out, in the secondary wood (Pl. III, figs. 5 & 7).

Of the cortex there are a few detached pieces, which do not, however, show the anatomical structure any longer; but this may be studied in another specimen, where it is still connected with the wood; this specimen (PA 146) is one of those in which the pith is also preserved.

In a longitudinal section of it there are, in the inner part of the cortex, some thick-walled, narrow fibres alternating with other prosenchymatous cells, badly pressed (Pl. IV, figs. 1 & 2); probably the former represent sclerenchyma, but details are not observable. A cross-section, further out in the cortex, is shown in the photographs Pl. IV, figs. 3 & 4; there are alternating zones of cells with different thickness of their walls. The best preserved ones are very thick-walled and angular, leaving only small intercellular spaces at the corners; they are a few times as long as broad, and, as is seen when they are cut obliquely or longitudinally, they have often rather irregular outlines. They have well preserved pits; usually there is not much left of the contents of the cells.

Affinity. As mentioned above, there is a good deal of variation between the various specimens. Subject to such variation are, first, many non-essential characters: The size of the cells, absolute and relative; the width and composition of the annual rings; &c. But it also affects some characters which have to be regarded as more important from a taxonomic point of view, *viz.*, above all, the xylem parenchyma and the biseriate medullary rays. Thanks to the great number of specimens of different kinds in this collection there are, however, all transitional stages between the extremes, and there is no essential gap between the holotype and the paratypes suggesting the presence of more than one species. A certain amount of parenchyma and a certain percentage, however small, of medullary rays of the said type, are always present and have to be regarded as characteristic to the species.

Some of the generic characters also vary, *e. g.*, the pitting of the tracheids and that of the cells in the medullary rays, the number of resin ducts, &c.; but it is not possible to ascribe any systematic importance to this variation, which is more quantitative than qualitative; on the other hand it is not easy to see what kind of external influences might have been the cause in the various cases.

The wood is a typical *Piceoxylon*, as evident from the description above.

It is of some interest to compare it with the living genera corresponding to that fossil one, *viz.* *Larix*, *Picea*, and *Pseudotsuga*. The wood parenchyma, and the biseriate medullary rays, give it a very close resemblance to *Larix* (*cf.* KLEEBERG 1885, GOTHAN 1905). On the other hand, the cortex is more like that of *Picea*, the zones of stone cells in the fossil corresponding to similar ones in *Picea excelsa*; but if this character can really serve to distinguish between the two genera (as has been suggested) can scarcely be decided without a more extensive research, which, as far as I know, has not yet been carried out in this field. The pith is rather different from that of *Picea excelsa* and *Larix decidua* (the two only species with which I have had the opportunity to compare it). Both of them consist chiefly, or entirely, of rather thin-walled parenchyma; beside that, *Picea* has incomplete diaphragms, formed by sclerified cells (*cf.* KUBART 1924), and these cells have some resemblance to those of our Greenland species. However, there are strong differences, too, particularly that in the recent *Picea* they make up only a small

portion of the pith, while in the fossil they form a more or less uniform tissue.

The possibility of a relationship to *Pseudotsuga* presents itself on account of the distinct spiral thickenings of the tracheids in one specimen (PA 165, see p. 371). As mentioned above, this specimen resembles the holotype very closely (as far as the pressed state of the specimen allows it to be observed), so that there should not be any reasonable room for doubt about the specific identity. On the other hand it is surprising that these thickenings, so distinctly visible in this specimen, should not also be present in other ones, where the tracheids are as well preserved. It is probably most safe not to base any further conclusions upon this character.

Among the fossil *Piceoxyla*, our species has undoubtedly the closest resemblance to *P. laricinum*, KRÄUSEL (1919 a). The spiral thickenings form a dubious character, and the pith and the cortex are not known in the case of *P. laricinum*, so none of these can be taken into consideration. The only difference is that in our Greenland species the biseriate medullary rays are of constant occurrence, while they are not recorded from the other one at all. Therefore, it may be correct to regard the species described here as a new one. If the medullary rays of the said type should be found in the German species, too (as is rather likely), the new name may probably be dropped again, provided that there are no differences in the anatomy of the pith and the cortex.

Pinites mosquensis, MERCKL., is worth mentioning in this connection. The drawings given by MERCKLIN (1855, Pl. X, particularly fig. 4) show resin canals surrounded by thin-walled cells giving a strong resemblance to *Pinuxylon*, the poor preservation of most of the resin canals pointing in the same direction. But on the other hand, the medullary rays are drawn with abietinean pits (fig. 5), and this structure is also explicitly mentioned in his description (p. 52), so that it is most probable that the species in question is a *Piceoxylon*. This fact, together with the occurrence of biseriate medullary rays (*l. c.* figs. 2 B & 3) make a comparison with our Greenland *Piceoxylon* possible. But xylem parenchyma is not recorded, and at all events, the preservation seems to be so poor that it should be unnecessary to pay any more attention to this species, at least not without a re-examination of the type specimen, if existing.

Pinites Pachtanus, MERCKL., should perhaps also be taken into consideration, although its nature is somewhat dubious. In the original drawings (MERCKLIN 1855, Pl. IX) the resin canals are surrounded by thin-walled cells, more or less obliterated, very much resembling those of *Pinus*. Further, the parenchymatous cells of the medullary rays seem to have pores of the *Pinus* type; but this is explained by the author as an error, the structures being no pores, but inclusions in the cells. If this is so, the medullary rays give the species its place in the genus *Piceoxylon*.

The specific characters seem, however, to be different from those of our species. In his Pl. IX, fig. 8 B, MERCKLIN figures some parenchymatous cells, which KRÄUSEL (1919 b, p. 223) regards as "scheinbar Harzparenchym" and consequently as indicating a relationship to *Larix*. The figure is, however, explicitly said to represent the longitudinal section of a resin canal, and it can scarcely be regarded as any proof of the existence of wood parenchyma. As to medullary rays, there are no biseriate ones without any resin canal between those figured, and neither is this type mentioned in the description. Consequently, *P. Pachtanus* is in all probability not identical with our species from Greenland.

D i a g n o s i s.—*Piceoxylon laricinoides*, n. sp. Coniferous wood with distinct annual rings and vertical and horizontal resin canals. Bordered pits on the radial walls of the spring tracheids, in one row, more rarely in two rows; tangential pits very scarce. Medullary rays fusiform, with resin ducts, or linear; of the latter, a small percentage is biseriate. Parenchyma of the medullary rays with abietinean pits; tracheidal elements constantly present, but few. Epithelial lining of the resin canals thick-walled. Wood parenchyma present along the periphery of the annual rings. Pith consisting of thick-walled, short cells with numerous pits and rounded or angular in outline. Protoxylem with spiral tracheids. Leaf traces numerous, containing the same kind of tracheids. Cortex with layers of stone cells.

Age: Tertiary.

Locality: East Greenland: Myggbukta.

Holotype: PA 159, Paleontological Museum of the University, Oslo.

Cfr. Piceoxylon laricinoides, m.

Pl. V, figs. 1—5.

There are two specimens resembling the previous species in nearly all characters, but differing in a certain detail in the medullary rays, as described further below. One of them (PA 133) consists of two small fragments of a twig, and the other one (PA 137) is a somewhat large piece; both of them have a very tight structure, like agate, and the preservation is not bad. In the cross-sections the annual rings are indistinct, probably only as a secondary phenomenon due to the fossilization.

The resin ducts as well as the pitting of the tracheids are as typical in *Piceoxylon*. There is a fair amount of wood parenchyma in both specimens, and the identity with *P. laricinoides* is probable, although it has not been possible to find any biseriate medullary rays in the sections at hand, but this may be due to the fact that they are twigs.

The medullary rays consist of parenchymatous cells, and tracheids; as usually the latter, with bordered pits, are found only in the upper and lower end, and not, as a rule, between the parenchymatous cells.

So far, the structure is in complete agreement with that of the typical *P. laricinoides*.

The parenchymatous cells, however, show a peculiarity not seen in other specimens, being of two kinds: There are always one or two of them in each ray containing an abundance of dark resin, and having thick walls in which the pits are exceptionally numerous and prominent. These cells are surrounded by, or separated by, other parenchymatous cells without any contents; their walls are thinner, at least apparently, and they do not have so many pits (but those which are found are of the abietinean type).

The contrast between these two kinds of cells is very prominent in the radial section, but it is also well visible in the tangential section, where the dark contents and bigger size make the former type well visible (Pl. V, figs. 1 & 3—4).

This differentiation seems to be quite constant, and it puts these specimens in a position of their own. But it is scarcely necessary to create any new specific name before it has been studied in a larger material.

Cedroxylon Orvini, n. sp.

Pl. IV, fig. 5; Pl. V, figs. 6–8; Pl. VI–VIII; text-figs. 2–5.

Description of the holotype. The specimen chosen as a holotype, PA 152, is a piece of wood about 35 cm long and 16 by 12 cm thick. It is somewhat pressed, but otherwise the preservation is good.

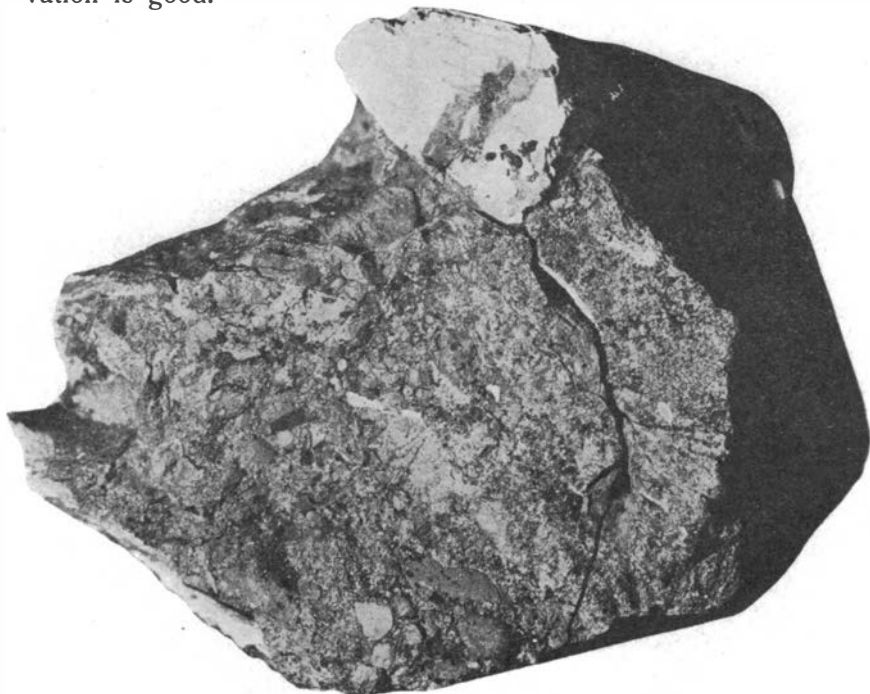


Fig. 2. *Cedroxylon Orvini*, n. sp. PA 160. Branch still imbedded in matrix. Nat. size.

Each annual ring contains a layer of one or two spring tracheids, which are very wide; then a broad middle part, occupying about one half of the whole growth ring, but badly pressed; and finally, a zone of summer tracheids. On account of the compression the exact width of the annual ring cannot be measured; it may have been from about 0.3 mm to 0.7 mm. There are no resin canals, neither normal nor traumatic in the holotype (*cf.* below, No. PA 131, p. 382).

The tracheids are about 20–30 μ broad (tangentially). Their whole length could not be measured, but sometimes at least it is

more than 2 mm. The walls have delicate spirals, forming a left-screw at an angle of about 45° ; it is not always visible, but it seems to be of a general occurrence. Bordered pits occur on the radial walls of the tracheids in nearly all parts of the wood, even in the summer tracheids, although not in the very last ones. They have only been found in single series, and often with some distance between each other, except in the earliest spring tracheids where they may be more crowded; they are circular, and often rather small in relation to the width of the tracheid. The inner pores may be fusiform, crossing each other at right angles. The presence of rims of Sanio has not been ascertained beyond doubt. There are sometimes pits in the tangential walls in the summer wood.

The medullary rays are numerous, but rather small, and they never contain any resin duct; they are always uniseriate. The number of cells usually vary between 5 and 8, and rarely as many as 15 or even 22 have been observed. There are chiefly parenchymatous ray cells, 16—20 μ high; they are short in the summer wood, and very long in the spring wood. Usually they contain a considerable amount of some dark matter. The wall is thick, 4—6 μ or more, and abundantly pitted, with pits of the abietinean type (Pl. VI, fig. 2); in the horizontal and tangential walls these pits are very well developed, while on the radial walls against the tracheids, there are only a few ones in each crossing field, and they are usually difficult to discover; often they are not observable at all.

The medullary ray is sometimes bordered above and below by a tracheidal cell, but in most instances this is not so. The tracheidal cells are often low, but much varying in size; the wall is thin, and bordered pits are sometimes distinguishable.

Xylem parenchyma is present in a small quantity along the periphery of the summer wood. In the cross-section (Pl. VII, fig. 7), these cells have about the same size as the tracheids, but the wall is darker brown; the dark cell contents are often visible, sometimes also the pitting of the longitudinal wall, and even the pitted cross-wall. The length, as seen in the longitudinal sections (Pl. VI, fig. 3), is often about 150 μ , sometimes considerably more.

Beside this parenchyma of the ordinary type there is a considerable amount of other parenchyma, which is looking most extraordinary and perhaps should be regarded as traumatic. It

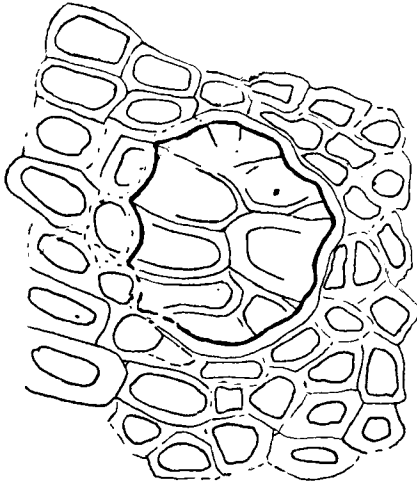


Fig. 3.



Fig. 5.

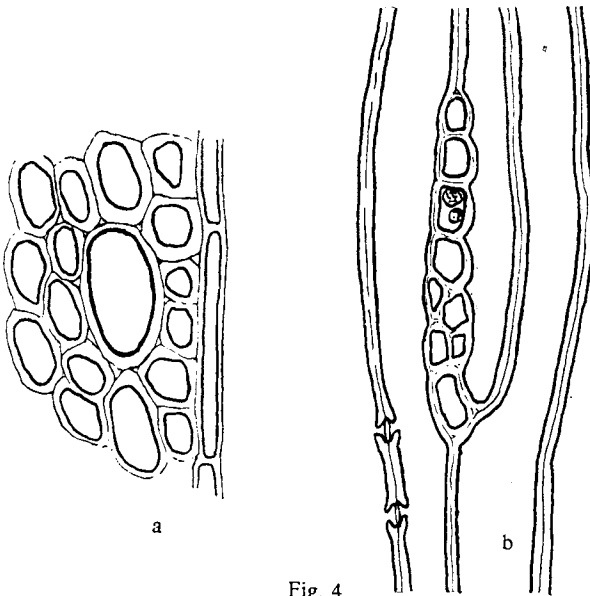


Fig. 4.

Fig. 3. *Cedroxylon Orvini*, n. sp. PA 135. Cross-section with a very wide tracheid, cf. Pl. VIII, figs. 2 & 3. — $\times 360$.

Fig. 4. *Cedroxylon Orvini*, n. sp. PA 160. a: Very wide tracheid in a cross-section. b: Tangential section; medullary ray with two cells on the same level. — $\times 360$.

Fig. 5. *Cedroxylon Orvini*, n. sp. PA 129. Tangential section. Medullary ray with exceptionally wide cell, probably a widened tracheid curving along the margin of the ray. — $\times 360$.

consists of groups of very large cells, irregularly formed and very thick-walled.

These cells (Pl. VI, fig. 4; Pl. VII) are usually found in the earliest spring wood, starting from the surface of the preceding year-ring; more rarely they are found further out. They are nearly always in connection with the medullary rays, and usually it looks as if it were the ray cells themselves, which had multiplied and swollen. The cells are angular and in close connection with each other, leaving but small intercellular spaces open at some of the corners. The wall is brownish and very thick; when two cells of this kind are neighbours the separating wall between them may be 8—10 μ or even 14 μ thick. There are simple pits in varying number, sometimes very numerous. Most frequently there is rather much of dark cell contents. — In the longitudinal sections these cells are always very irregular and variable. Sometimes such abnormal tissue is but very slightly developed, as, *e. g.*, when all the cells of a medullary ray have extraordinarily thick walls and somewhat larger size, while the proportions in other respects are as usual. In other cases these thick-walled cells are seen as very conspicuous groups, which may extend widely in the longitudinal direction, the cells being quite irregular and often very big, the length sometimes exceeding 110 μ .

Paratypes. One of the best ones among the other specimens is a fragment (PA 135) probably from a big stem. The annual rings are wide, 1.3—1.5 mm; the middle part of each of them is very thick and remarkably well preserved, even better than the summer wood itself. The specimen resembles the one described above, having the same kind of the ray cells, wood parenchyma, no resin canals, &c. The medullary rays are low, usually from one to six or eight cells high, twelve being the maximum number observed; it is surprising, because in a stem wood, vigorously grown as this, one might have expected higher medullary rays than in a wood like that described above as the holotype. The parenchymatous cells very frequently contain a lump, most certainly of fossilized resin (Pl. VIII, fig. 7).

This specimen contains the same kind of abnormal parenchyma as that mentioned above. It is seen in a radial section, where it may at first be mistaken for a resin duct.

The delicate spirals of the tracheid walls are well observable in many places. They have not been found in the very first spring tracheids, but otherwise they seem to occur in all parts of the annual rings. Bordered pits are usually rather small in relation to the width of the tracheid; they are also found on the tangential walls of the summer wood. The inner opening of the pore canal is often formed as a fusiform split, parallel to the spiral of the wall, and the two splits, in both ends of the same pore, may be seen to cross each other at a right angle, or approximately so (Pl. VIII, fig. 6).

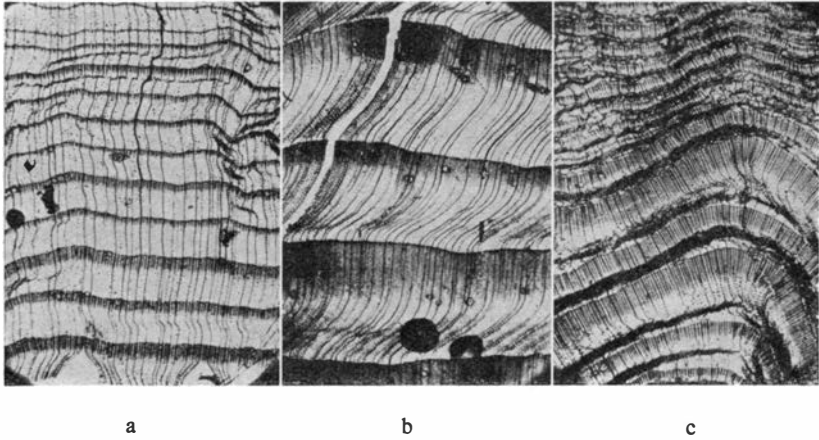


Fig. 6. *Piceoxylon laricinoides*, n. sp. Three cross-sections showing the variation in the thickness of the annual rings. a: PA 149, from a twig. b: PA 144, a large piece of a stem. c: PA 143, probably part of a stem. — $\times 8$.

The tracheids are rather curved and twisted. At the ends, particularly when bordering a medullary ray (Pl. IV, fig. 5), they are often swollen, and this gives rise to a peculiarity which is also found in the holotype, although less pronounced; good illustrations of it are found in the other paratypes, too:

These very wide ends of tracheids (*cf.* Pl. VIII, fig. 8) have a very varying appearance, according to the direction of the section. In the radial sections it may be seen how the ends of tracheids curve along the medullary ray. In the tangential section, a portion of such a widened tracheid end may be cut off from the rest of the cell, on account of the curve, and appear as a separate short cell (*cf.* text-fig. 5). In the cross-sections, they are sometimes

visible as very large cells, and, when they are extraordinarily much enlarged, they may disturb the whole regularity of the wood structure (Pl. VIII, fig. 4). In a cross-section of PA 135 there is a cell of this kind (text-fig. 3; Pl. VIII, figs. 2 & 3) measuring no less than about 85μ across, that is 3—4 times the diameter of the ordinary tracheids in that part of the xylem; it might easily be misinterpreted as a resin duct, but it is surrounded by usual tracheids, not by parenchyma, and, if focusing down, one may see how the neighbouring cells approach each other, closing the opening; the proper wall of the cell itself is also visible.

PA 131 is a small branch fragment. In the cross-section, the annual rings are strikingly uniform, the difference between the spring wood and the summer wood being but slight (Pl. V, fig. 6). In one place, there is a layer of thick-walled parenchyma, extending along the periphery of a year-ring for a distance of very nearly 0.5 mm, the radial thickness being scarcely 75μ (Pl. V, fig. 7). The cells have some resemblance to those of the abnormal parenchyma mentioned above, although the cells are smaller and not quite so irregular. There are, in a few places, intercellular spaces open between them, and in all probability these openings have to be regarded as traumatic resin canals. This supposition is proved in a radial section of the same specimen (Pl. V, fig. 8); there is a long line of parenchyma, with thick walls abundantly pitted, and between these cells there is a long intercellular space doubtlessly corresponding to a resin duct.

PA 160 is a branch, still imbedded in the basaltic matrix (text-fig. 2). The cross-section shows the same uniformity within the growth-rings, making the zonation rather indistinct. There are no resin ducts of any kind. Widened tracheids occur (text-fig. 4a). The medullary rays are low; there is one in which there are two cells on the same level (text-fig. 4b), but as the whole medullary ray is rather irregular, too much importance should probably not be attributed to it. The parenchymatous cells on the border between the annual rings are long and narrow. Tracheidal cells in the medullary rays occur, but are scarce.

PA 129 is a small sample like No. 131. The widened ends of some tracheids are well visible (Pl. VIII, figs. 8 & 9; text-fig. 5).

Affinity. All the specimens described above most probably belong to one and the same species, the variations being of slight systematic value. The chief difference between them is found in the composition of the annual rings, some of which are strikingly uniform throughout, and consequently not very distinct, while others, as in the holotype, are well marked.

It is a typical *Cedroxylon*, and there is a very strong resemblance to *C. greenlandicum*, WALT. The resemblance even goes so far as to the presence of traumatic (?) parenchyma. There are some differences: (1) *C. greenlandicum* sometimes has biseriate pits, a feature never observed in our species (with a single exception in PA 160, p. 382); further (2), the former may perhaps have a better developed regular parenchyma. The description reads: "The last elements of the late wood regularly consist of thick-walled parenchyma", while in the species described here, these cells are rather scattered and scarce, never forming any continuous tissue. Finally (3) tracheidal ray cells are not mentioned from *C. greenlandicum*. On account of these characters, and particularly the third one, it is preferable to keep these species apart.

For comparison with other forms it may suffice to refer to the paper by WALTON (1927).

Diagnosis. — *Cedroxylon Orvini*, n. sp. Coniferous wood with annual rings. Tracheids often very much dilated, chiefly when ending against a medullary ray. Bordered pits circular, uniseriate on the radial walls and sometimes on the tangential walls in the summer wood. Medullary rays linear, usually low, chiefly consisting of parenchymatous cells with abietinean pitting and resinous contents; tracheidal cells occur, but are scarce. Wood parenchyma often present at the periphery of the annual ring. Traumatic resin canals occur rarely; besides, there is frequently a development of (traumatic?) parenchyma with exceptionally large cells, irregularly formed and very thick-walled.

Age: Tertiary.

Locality: East Greenland: Myggbukta.

Holotype: PA 152, Paleontological Museum of the University, Oslo.

General Remarks.

The collection comprises samples of stems and branches, while roots have not been identified with certainty. Taken as a whole, the preservation is excellent, and the fossilization must have taken place rapidly and under favourable circumstances.

The annual rings are very well marked. The width is highly varying (*cf.* text-fig. 6); but that is only what may be expected in a collection comprising samples of wood from stems and branches of all dimensions. The average width is rather considerable, but, as far as it can be stated without any statistical proof, it does not seem to be essentially different from that of coniferous wood from, *e. g.*, the northern temperate zone of to-day.

By far the major part of the specimens belong to two species only, and it is uncertain if there is a third one at all. Both species are conifers, belonging to the genera *Piceoxylon* and *Cedroxylon*.

These two genera have been recorded already from the Cretaceous, but they are much more common in the Tertiary. Although regarded as new, the two species in question show a close resemblance to other ones previously established, namely, respectively, to *P. laricinum*, KRÄUSEL, and *C. greenlandicum*, WALT., both of a Tertiary age, a fact giving support to the supposition that the occurrence at Myggbukta dates from the Tertiary. But as both of the new species are of a very modern type, they do not give any clue for the fixing of the upper time limit.

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Explanation of the Plates.

The photographs are not retouched, except Pl. III fig. 3 a and Pl. IV fig. 6.

Pl. I.

Piceoxylon laricinoides, n. sp. Holotype, PA 159.

- Fig. 1. Cross-section of the stem. — $\times 10$.
„ 2. Cross-section of the branch. — $\times 10$.
„ 3. As fig. 2. — $\times 40$.
„ 4. Tangential section of the stem, with bisériate medullary rays. — $\times 100$.
„ 5. Tangential section of the branch. The medullary rays are shorter than in the stem wood. As in fig. 4, no resiniferous medullary rays are visible in the photograph, but one of them is biseriata. — $\times 100$.
„ 6. A medullary ray in a radial section of the stem. Parenchymatous cells with pores of the abietinean type; one series of tracheidal cells with bordered pits. — $\times 400$.
„ 7. As fig. 6. — $\times 200$.
„ 8. Radial section of the stem, showing xylem parenchyma between the summer wood (right) and the next year's spring wood. — $\times 100$.
„ 9. As fig. 8. — $\times 200$.

Pl. II.

Piceoxylon laricinoides, n. sp.

- Fig. 1. Holotype (PA 159). Stem wood. Double series of bordered pits on the radial wall of a spring tracheid, with rims of Sanio. — $\times 200$.
„ 2. The same. Bordered pits in a tangential section. — $\times 400$.
„ 3. PA 165. Radial section. — $\times 40$.
„ 4. Detail of fig. 3, showing more distinctly the thickenings of the tracheids. — $\times 200$.
„ 5. Holotype (PA 159). Tangential section of the stem. A multi-seriate medullary ray with a resin canal, showing the thick-walled epithelial lining. Of the other medullary rays, one is biseriata. — $\times 100$.
„ 6. PA 165. A medullary ray in a radial section. In the parenchymatous cells, the abietinean pitting is visible. Besides, note the circular markings in the wall (*cf.* p. 368). There are two

- rows of tracheidal cells. In the upper left corner, there are bordered pits in the horizontal wall of the upper one; they have not been exactly in focus. — $\times 350$.
- Fig. 7. PA 143. Radial section along a resin canal. In the centre of the figure is seen a long, thick-walled cell, showing very distinctly its "abietinean" pitting; the next cell above it has been cut more superficially, and the pits appear as circular markings. On the right-hand side are shorter cells (best visible in the lower corner), forming the thick-walled lining of the resin duct. To the left, a medullary ray. — $\times 350$.
- „ 8. PA 165. Tangential section, showing a medullary ray. In the centre, a vertical wall with numerous pits. — $\times 350$.
- „ 9. PA 147. Radial section, with a medullary ray, near the border of an annual ring; the surface of the stem has been to the left. In the centre, three rows of parenchymatous cells; above and below them one series of tracheidal cells, with tangential walls inclined towards the periphery of the stem. In the summer wood, the tracheidal cells are much shorter than in the spring wood, and prolonged in the vertical direction. Some of the bordered pits of these cells are visible. — $\times 200$.
- „ 10. Holotype (PA 159). Cross-section from the branch, with a resin canal in the outer part of the summer wood. — $\times 100$.
- „ 11. PA 144. Cross-section, with a resin canal in the summer wood, between two medullary rays. Note the pits in the thick-walled cell to the right. Cf. fig. 7. — $\times 200$.

Pl. III.

Piceoxylon laricinoides, n. sp. PA 146.

- Fig. 1. Oblique cross-section with pith. — $\times 10$.
- „ 2. Detail of fig. 1. — $\times 40$.
- „ 3. Detail of fig. 1, from the other half of the pith (the upper half in fig 1). Bundles of protoxylem, as marked in fig. 3 a. Some of the thick-walled cells of the pith are isolated and circular in outline, other ones are angular and closely connected. — $\times 100$.
- „ 4. Detail of fig. 2, showing a strand of annular tracheids in a leaf-trace. — $\times 200$.
- „ 5. Another section, cutting the pith in an oblique direction. The sclerotic cells angular, with thick, pitted walls and no intercellular spaces. Protoxylem with annular thickenings indistinctly visible, particularly to the left of the pith. To the right, in the upper half of the figure, there is a leaf-trace. — $\times 40$.
- „ 6. Detail of fig. 5. — $\times 200$.
- „ 7. The leaf-trace of fig. 5. — $\times 200$.

Pl. IV.

- Fig. 1. *Piceoxylon laricinoides*, n. sp. PA 146. Longitudinal section showing fragments of the cortex (left) in connection with the xylem. — $\times 10$.
- „ 2. Detail of fig. 1. — $\times 100$.
- „ 3. The same specimen. Cross-section of the cortex, showing the curved and pressed zones of sclerotic cells. — $\times 10$.
- „ 4. Detail of fig. 3. — $\times 100$.
- „ 5. *Cedroxylon Orvini*, n. sp. PA 135. Radial section. Tracheids ending against a medullary ray consisting of a single cell. Bordered pits small and isolated. — $\times 300$.
- „ 6. *P. laricinoides*, n. sp. PA 153. Tangential section. The darker parts in the centre and to the left are summer wood, with spring wood to the right — *xp*: Rows of xylem parenchyma; note the tapering ends. — $\times 40$.
- „ 7. The same preparation. To the left: Summer wood with parenchyma. To the right: Spring wood; bordered pits, cut across, are indistinctly seen in the radial walls. — $\times 100$.

Pl. V.

- Fig. 1. *Cf. Piceoxylon laricinoides*, n. sp. PA 137. Radial section, showing the resiniferous cells of the medullary rays. — $\times 100$.
- „ 2. The same. Cross-section. — $\times 40$.
- „ 3. The same. Tangential section. In the upper left corner a medullary ray with a resin canal. To the right some irregular parenchyma from a longitudinal section of a resin canal. — $\times 100$.
- „ 4. The same. Tangential section. A medullary ray; two of the cells have thick, dark walls with pores. — $\times 400$.
- „ 5. The same. Radial section. Tracheids curving along a medullary ray. — $\times 100$.
- „ 6. *Cedroxylon Orvini*, n. sp. PA 131. Cross-section, showing the comparatively slight difference between the various parts of the annual ring in this specimen. — $\times 40$.
- „ 7. The same section. Group of parenchyma at the end of an annual ring; intercellular spaces representing traumatic resin ducts. — $\times 200$.
- „ 8. The same specimen, in radial section. Traumatic resin canal. — $\times 200$.

Pl. VI.

Cedroxylon Orvini, n. sp. Holotype, PA 152.

- Fig. 1. Cross-section. — $\times 10$.
- „ 2. Medullary ray in a radial section, showing the abietinean pitting. Note the dark contents abundant in the parenchymatous cells in.

this section and in figs. 3 and 5. In the lower right corner some bordered pits. — $\times 200$.

- Fig. 3. Tangential section, with xylem parenchyma. Tracheids with secondary spiral striation. — $\times 200$.
 „ 4. Abnormal parenchyma at the end of an annual ring, in cross-section. — $\times 40$.
 „ 5. Tangential section. — $\times 100$.

Pl. VII.

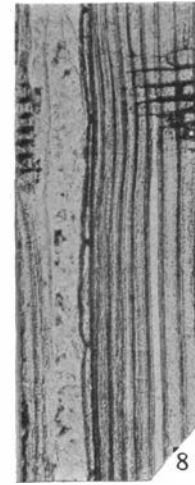
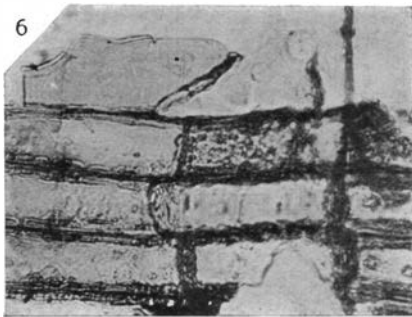
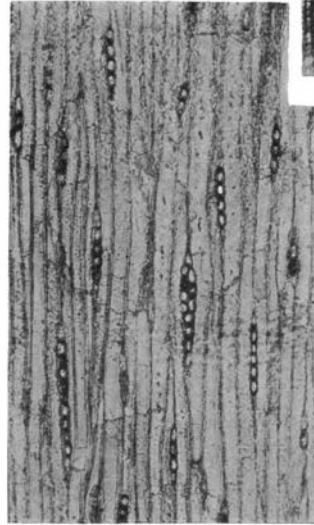
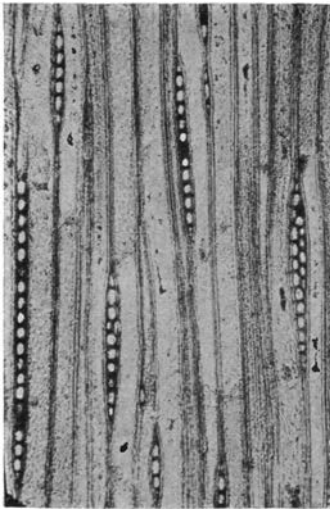
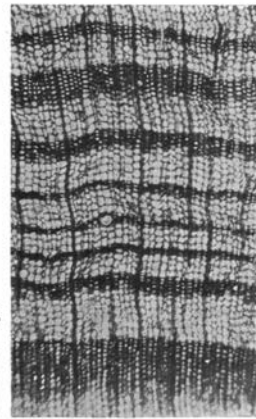
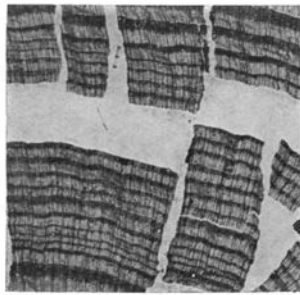
Cross-sections of *Cedroxylon Orvini*, n. sp. Holotype, PA 152.

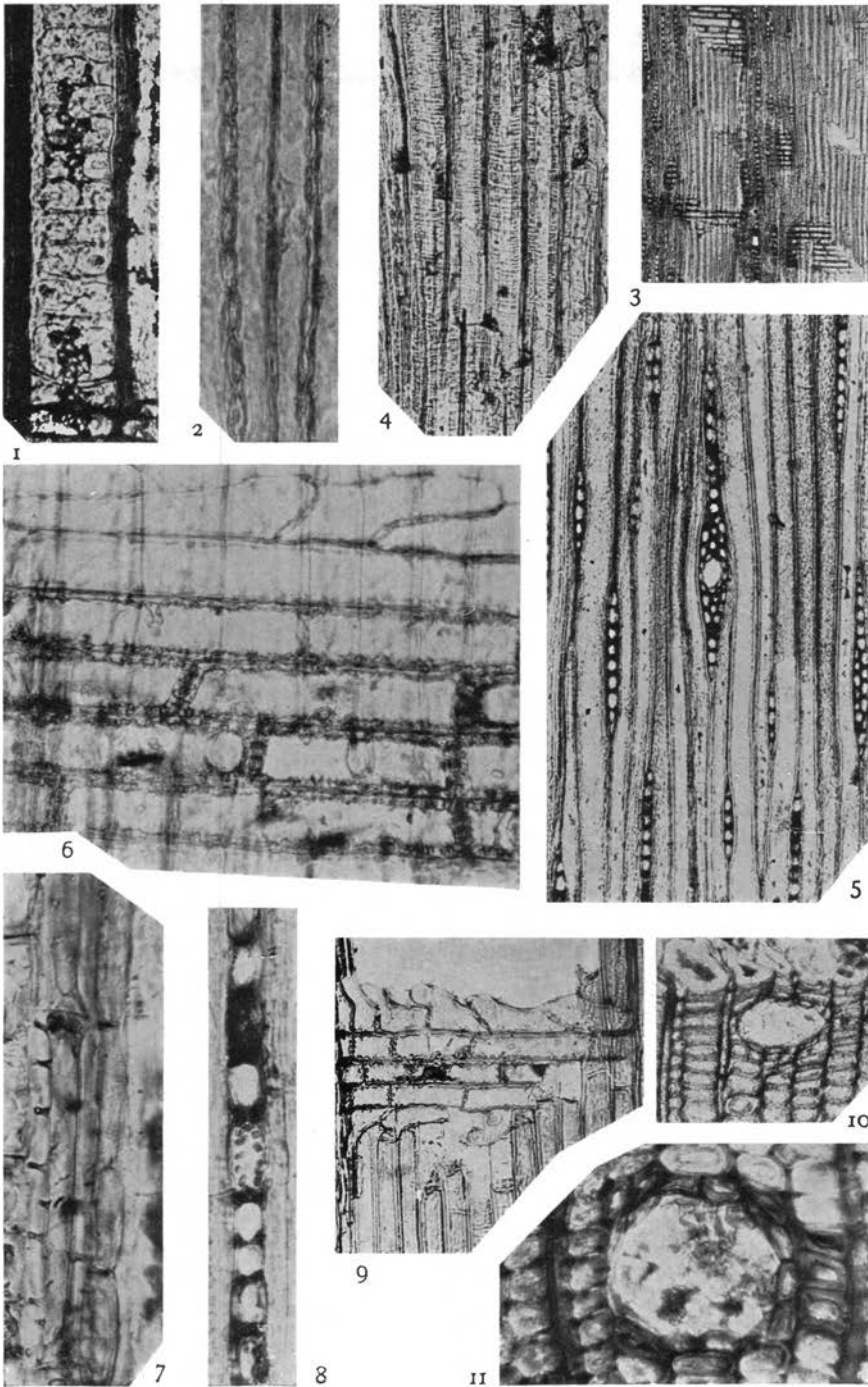
- Fig. 1. Abnormal parenchyma, developed from a medullary ray in the outer part of the spring wood. — $\times 200$.
 „ 2. Detail of Pl. VI fig. 4. — $\times 200$.
 „ 3. An abnormal parenchymatous cell in the middle of an annual ring, without any connection with the medullary rays. — $\times 100$.
 „ 4. An exceptionally wide cell, probably a dilated spring tracheid. — $\times 200$.
 „ 5. Abnormal parenchyma, forming a bridge from one medullary ray to another, in the spring wood. — $\times 200$.
 „ 6. Medullary rays, starting from the periphery of the summer wood with abnormally wide cells, which are very thick-walled. — $\times 200$.
 „ 7. A normal cell of xylem parenchyma, on the limit between two annual rings. — $\times 200$.

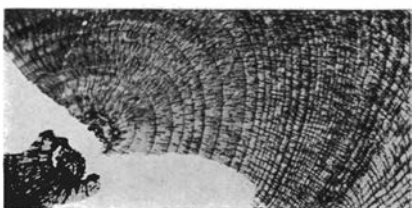
Pl. VIII.

Cedroxylon Orvini, n. sp.

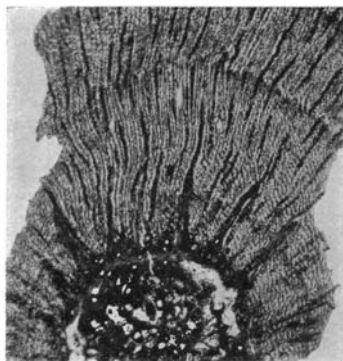
- Fig. 1. Cross-section of PA 135. Note the wide middle part of the annual ring, scarcely compressed at all. — $\times 10$.
 „ 2. From the same section. A very wide cell, most probably the dilated end of a tracheid. — $\times 200$.
 „ 3. The same structure as in fig. 2, but focused down to show the surrounding cells closing the opening, *cf.* text-fig. 3. — $\times 200$.
 „ 4. As fig. 2. — $\times 100$.
 „ 5. Tangential section of PA 135. The curved and undulating shape of the tracheids is characteristic. — $\times 100$.
 „ 6. The same in radial section, to show the distribution and shape of the bordered pits. — $\times 200$.
 „ 7. The same, with a medullary ray. The darker parts to the right are the summer wood, with short parenchymatous cells in the medullary ray. Note the lump of resin in most of the cells. — $\times 200$.
 „ 8. Radial section of PA 129, with the dilated end of a tracheid. — $\times 200$.
 „ 9. From the same section. — $\times 100$.







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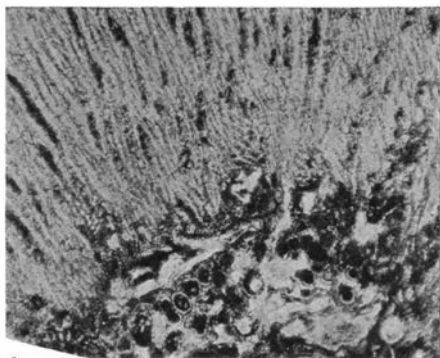
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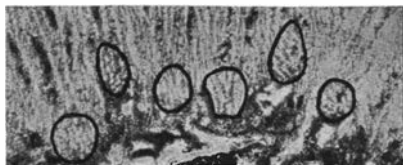
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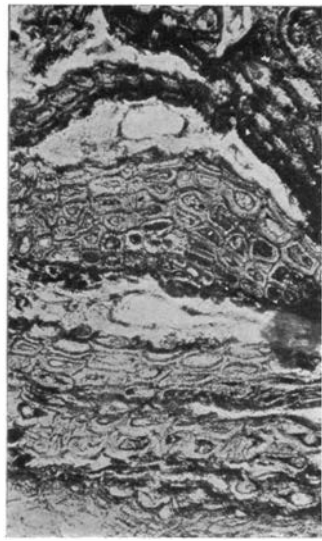
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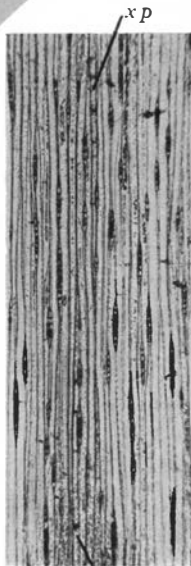
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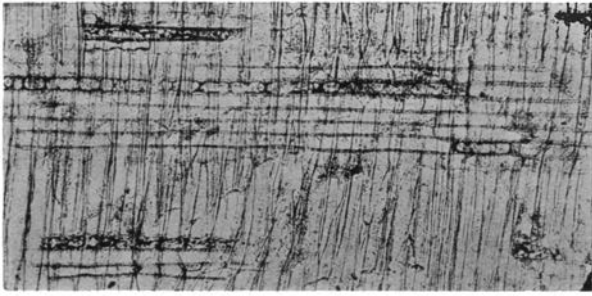


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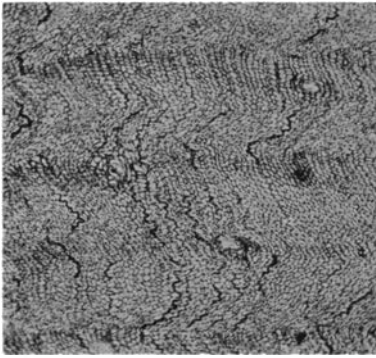
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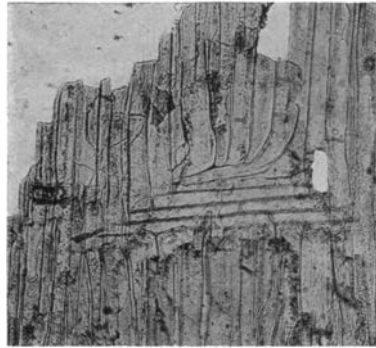
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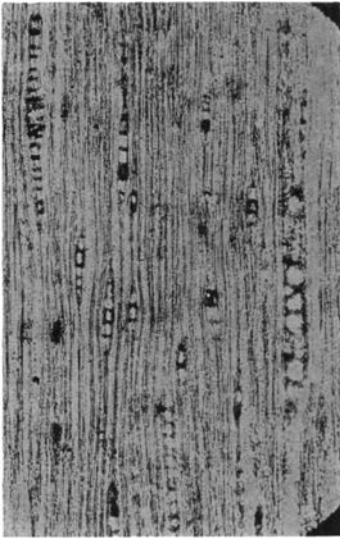
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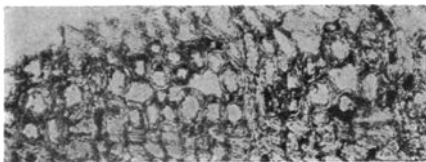


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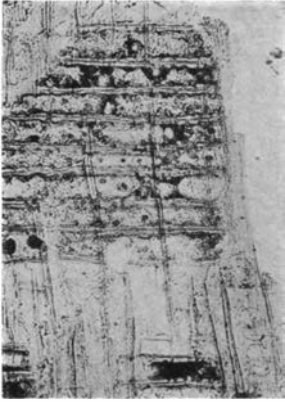


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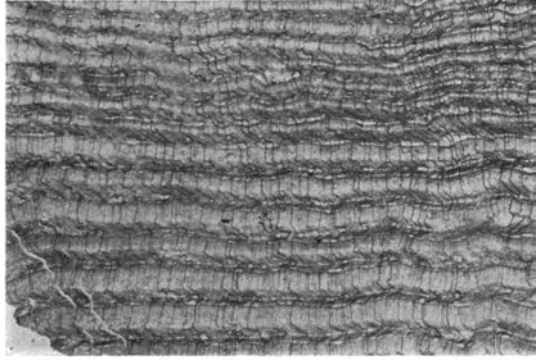
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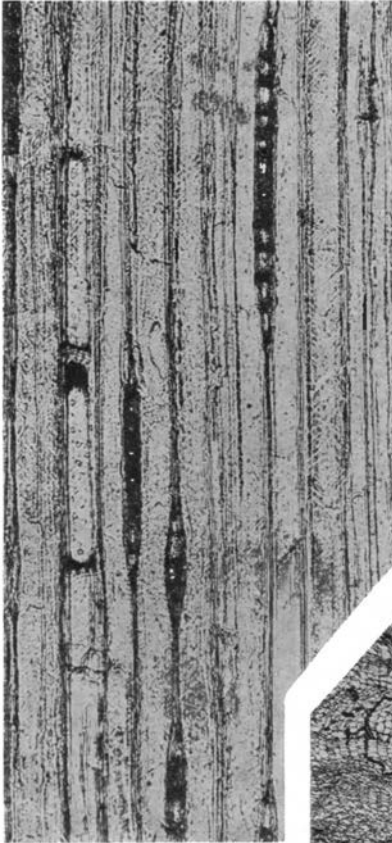
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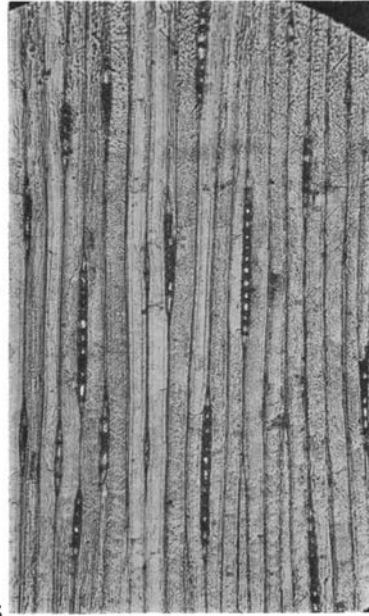
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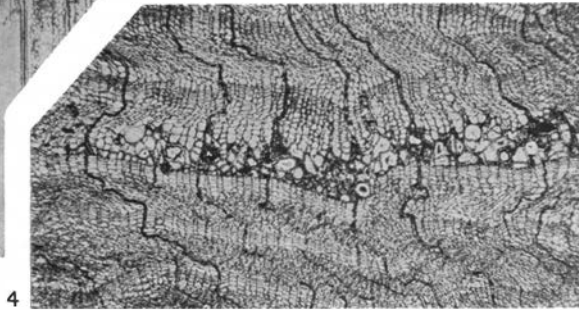
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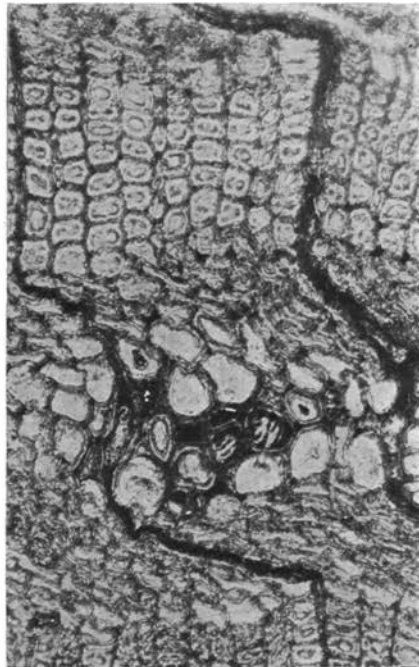
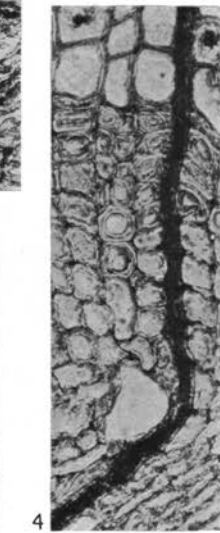
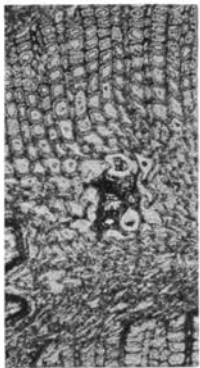
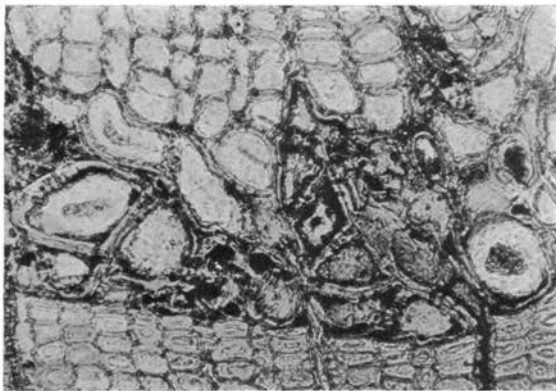
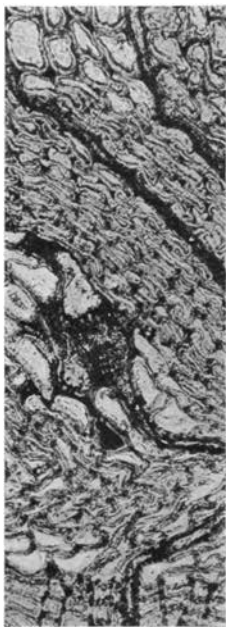
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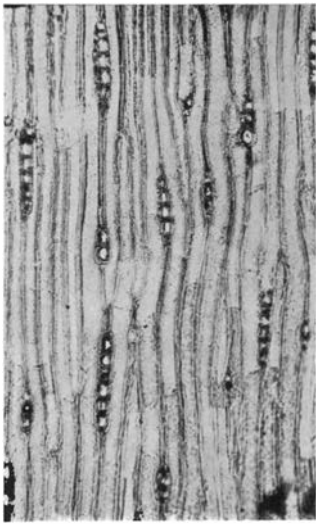


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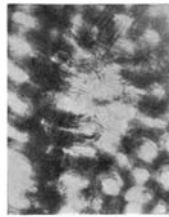


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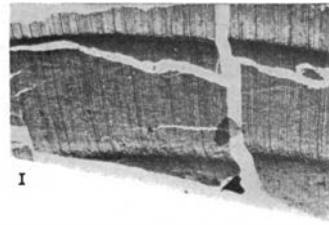




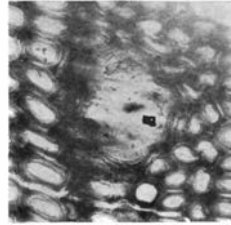
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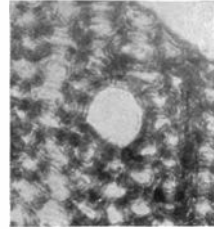
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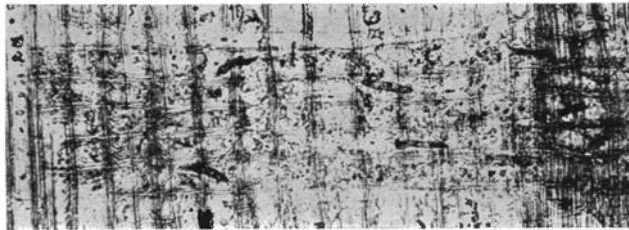
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A FOSSIL RIVER BED IN EAST-GREENLAND

BY

ANDERS K. ORVIN

3 TEXTFIGURES

During the expedition to East-Greenland in 1930, sent out by *Norges Svalbard- og Ishavs-undersøkelser*, I brought home amongst other fossil collections about 65 pieces of fossilized wood from a locality near Myggbukta in East-Greenland. OVE ARBOE HÖEG, conservator at the *Kongelige Norske Videnskabers Selskab*, Trondheim, has been kind enough to examine this material and has in the paper: "The Fossil Wood from the Tertiary at Myggbukta, East-Greenland" (published in this volume, pp. 363—390), given a detailed description of it. In connection with his paper, I shall in the following give a short description of the finding point of the wood.

The fossil-bearing layer was discovered in the following way: FINN DEVOLD, the leader of a hunting expedition, showed me some pieces of fossil wood, which he had found in the second river valley east of the wireless station at Myggbukta. The pieces brought down to the station by him were all rounded, and their appearance clearly indicated that they had been subject to water action either in a river bed or on a beach. He could not say from where they originated. It was most likely that the fossils were to be found in Tertiary sediments somewhere in the neighbourhood. The previous year, however, I had seen no such sediments in this tract, which only seemed to be made up of Tertiary basalts and other volcanic rocks.

On July 31 I went up the valley, which I have named *Wood Valley*. It is developed as a canyon with high and steep walls. I soon found more of these fossilized trunk-remains in the gravel on the river bottom, the rocks of which were nearly entirely of volcanic origin. About 150 metres above sea-level I observed some sediments consisting of fine-grained sandstone, calcareous sandstone and silt-

stone, which had been pierced by the volcanic rocks, in which they are now enclosed as irregular patches. In these sediments no fossils could be found, but I think it is most likely that they are remnants of Tertiary rocks. The absence of fossils, however, makes it impossible to fix the age, and they may also belong to an older period.

The following day I searched the ground east of the valley, but did not find any sedimentary rocks or fossils, although I went right up to the mountains. If the fossil-bearing sediments still existed they

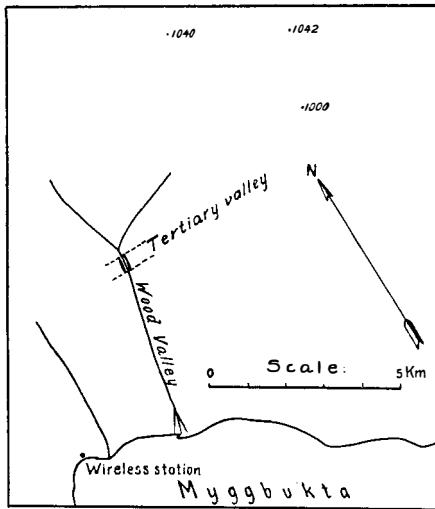


Fig. 1. Sketch-map of Wood Valley.

must thus be situated somewhere in the upper course of the river. I consequently went down the westernmost of the upper river branches. I first noticed some remnants of light coloured sedimentary rocks without fossils, and a short distance farther down I stumbled on the fossil source. In the steep eastern river wall a great many light spots were visible in a dark rock. In the rock wall before me was exposed a 15—20 metres thick bed of a dark conglomerate interbedded between basaltic rocks, and from the conglomerate projected a

great many fossilized chunks of wood. The rock waste below also contained a good deal of this material.

The fossil locality was situated about 200 metres above the sea-level.

The conglomerate was dark brown, and resembled from the distance the over- and underlying basaltic rocks. The pebbles and cobbles consisted of more or less rounded stones of a dark siltstone, and the matrix was made up of sand, and was partly calcareous. The conglomerate was porous in parts and rich in iron oxides. In some places I noticed vugs and other small cavities covered with small rhombic crystals of brownspar. The conglomerate rested upon a dense basaltic rock, which under the microscope was found to be a plagioclase-basalt, and it was overlain by a porphyritic olivine-basalt, both belonging to two different eruptions. I collected as many fossil

specimens as I was able to carry, and took a photograph of one of the greatest trunks being about 3 metres long and 0.5 metres thick (fig. 2).

As will be seen a twig is still attached to it, and it looks exactly like the wood one finds in recent streams. The greater part of the fossil wood was to be found in the upper part of the conglomerate.

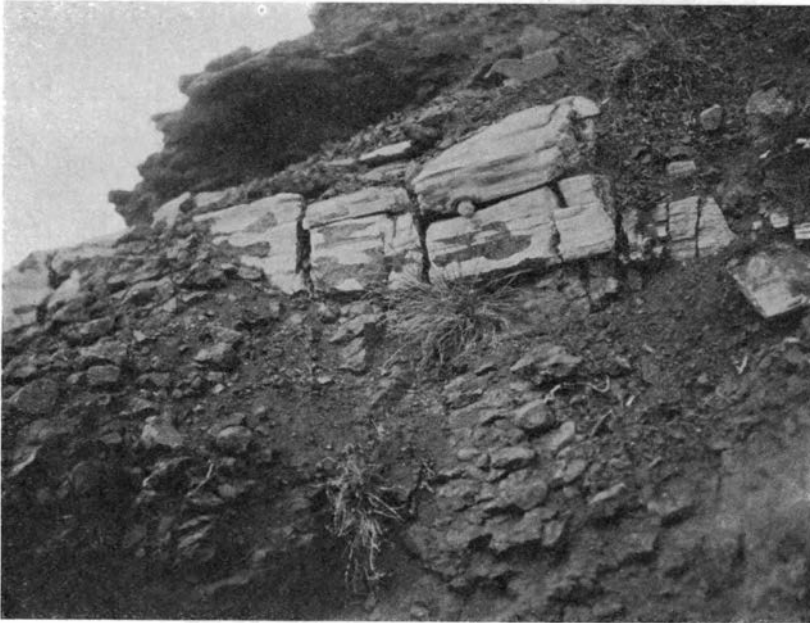


Fig. 2. Trunk, about 0.5 metres thick, of *Piceoxylon laricinoides* n. sp. according to determination by Ove Arbo Höeg. From the Tertiary conglomerate, Wood Valley at Myggbukta. A. K. Orvin phot. 1—8—1930.

I also tried to find other fossils, which might give a hint as to the exact age of the deposit, but without success.

By closer examination the conglomerate was found to wedge out against the slopes of the underlying basalt, both to the north and the south, clearly indicating that the conglomerate belongs to an ancient river bed, which seems to have had its trend at about right angles to the present Wood Valley (fig. 3). In the western side of the river bed the conglomerate could also be noticed, but it was here much covered with débris and only little could be seen. In the débris I noticed many pieces of fossil wood.

Whereas the trend of the ancient river must have run in an east-westerly direction, I could not fix the direction of the current. It is, however, possible that this may be ascertained by a closer examination of the arrangement of the sand and gravel around the greater stones and pieces of wood.

The conglomerate could not be observed in other places in the neighbourhood, but it may perhaps be exposed in other localities at some distance, and the course of the river bed may then be better known in the future.

On the slope of the western side of Wood Valley small pieces of coal and black shale were also found. I had no tools wherewith to get these rocks exposed, but as the soil here obviously had been formed through disintegration of the underlying rock it could not be doubted that the coal and shale would be found *in situ* between the two basalt streams. They scarcely belong to the river bed. The coal and shale must either belong to a series older than the ancient valley, or they originate from peat covered with clay situated on the ancient river bank. The latter is the most reasonable explanation. The coal shows some lamination, but seems macroscopically to consist chiefly of vitrite (bright coal). An old coal-seam close under the covering lava-stream would certainly have become coked, and living wood on the then existing surface would have burnt, leaving some charcoal (fusite) only.

I also observed a few streaks of coal (vitrite) in the conglomerate on the east side of Wood River. The coals have not been examined under the microscope, but macroscopically I could observe neither coke nor charcoal. The reason why coal-streaks have been formed in one instance and silicified wood in another is difficult to say. A possible explanation is that the material from which coal has been formed was not suitable for the process of silicification. It is doubtful at what time these wooden trunks and pieces have been silicified. It is possible that this process took place already before the eruption of the olivine-basalt, but I should think it more reasonable that they have been silicified by percolating silicious water and gases emanating from the overlying lava.

The fossils consist of trunks, twigs, and pieces of cortex all strongly silicified. They contain, however, still some humic substance imparting to them a dark brown colour. On the surface this humic content has been dissolved and carried away, and the

weathering has formed on the surface a film of greyish-white colour, consisting of nearly pure silica. In small pieces and twigs the humic content is now quite insignificant, and these pieces have a light colour throughout. When the dark brown fossil wood is heated to redness the humic substance will burn and the colour will turn into nearly white, without the fossil piece changing in volume or form.

This ancient Tertiary valley is scarcely unique in East-Greenland. On Jackson Island one of the members of our first expedition in 1929 found a piece of fossil wood exactly of the same appearance as those found at Myggbukta.

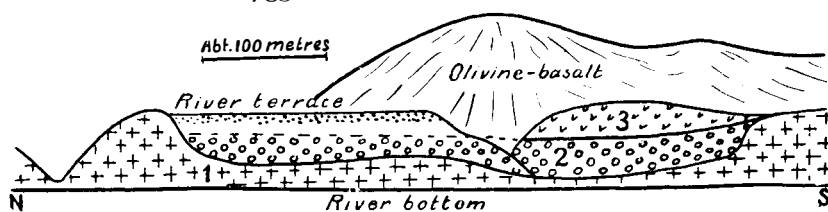


Fig. 3. Section through the Tertiary valley exposed in the canyon of Wood Valley at Myggbukta. 1. Plagioclase-basalt in the foot wall. 2. Tertiary conglomerate with fossil wood. 3. Hanging layer of olivine-basalt.

As to the age of this conglomerate we know very little. From the wood species may only be concluded that it must be of Tertiary age or younger. The sediments found at other points in Wood Valley were all older than the basaltic rocks and they may therefore as well belong to an older formation. Concerning the fossil valley one can only conclude with certainty that it is of Tertiary age, younger than the underlying basalt and older than the overlying olivine-basalt.

The two genera *Piceoxylon* and *Cedroxylon*, found by OVE ARBOE HÖEG in the material collected at this point, belong to a modern type and confirm the Tertiary age. A closer determination of the age cannot be done from the material available.

It must be regarded as quite certain that the wood found in the conglomerate has grown on Greenland in the intervolcanic period represented by the fossil valley, and the growing site cannot have been situated very far from the spot where the wood is now found. At the time when the olivine-basalt, now covering the wood-bearing conglomerate, had its eruption, the surface was probably rather barren, made up of basaltic hills and depressions, and valleys with

a rather thin cover of residual soil. This ancient surface has certainly been very uneven, and is difficult to trace now. However, future geological investigations of this tract, combined with an accurate geological mapping, may give us some hints as to the exact age of the valley and the different volcanic eruptions.

It is generally agreed that the basaltic rocks in Greenland are of old Tertiary age, and that the olivine-basalt of Jan Mayen is of Quaternary age. It seems, however, not probable that the olivine-basalt of East-Greenland should also be of this age. The wood found in the conglomerate, is according to HÖEG, very similar to Tertiary wood found in other places in Greenland.

According to LAUGE KOCH¹ the Tertiary beds of Sabine Island is of Eocene age, and on Cape Dalton, south of the entrance to Scoresby Sound, lower or middle Eocene marine sediments have been found, containing trunks of trees and pebbles of basalt. Thus the conditions here also show that these sediments were formed in an intervallic period, and it seems very probable that the sediments here and the Tertiary valley at Myggbukta have been formed contemporaneously. If this be the case the valley is of Eocene age. In any case it is not older. Where good sections of the volcanic rocks are exposed, it is seen that they are built up of different layers representing a series of eruptions. Tertiary remnants as described above may thus be expected to have been deposited in any of the intervallic periods.

¹ KOCH, LAUGE: The Geology of East Greenland, Med. om Grönland, B. LXXIII, 2. afd. 1929.

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