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# Art. X.—*Fossil Wood from Upper Devonian Rocks at Mansfield, Victoria.*

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## Introduction.

Amongst a collection of plant-fragments made by Mr. H. B. Hauser, M.Sc., from sediments of the South Blue Range, Mansfield, Victoria, is a well-preserved sample of fossil wood. Since nothing is known of the secondary woods of the precarboniferous rocks of Australia, a brief description of the structure of this specimen appears to be justified. My thanks are due to Mr. Hauser for the opportunity of examining and describing his specimen.

The following note as to the age of the plant-containing beds was kindly provided by Mr. Hauser. "About 2 miles to the south of Mansfield, a line of hills stretches in a south-easterly direction for about 6 miles to the Delatite River. This range of hills, called the South Blue Range, was originally marked on the Geological Survey maps as Lower Carboniferous and was thought to be the western limit of the Lower Carboniferous basin at Mansfield.

"The rocks in the range consist of shales, sandstones, breccias, and conglomerates, dipping in a north-easterly direction at an angle of about 45°, thus forming a hogback with a north-west and south-west trend. The sedimentary series is accompanied by a suite of acid volcanic rocks.

"The dips given by the survey officers was 5° to the north-east, and this conforms to the dips of the Lower Carboniferous in the Mansfield district, but investigation has proved that the rocks have a much higher dip, and the igneous rocks are not pre-Lower Carboniferous.

"At the northern end of the range the sediments are fossiliferous. The heavy conglomerates which are the highest beds in the area, rest on a series of shales which contain plant remains which are too fragmental for determination. These clays in turn rest on the igneous rocks. Immediately underneath the igneous rocks is a series of clayey breccias and sandstones which contain plant and fish remains. The fish remains have been determined by Dr. Hills as *Bothriolepis* and *Phyllolepis*, thus proving the sediments to be of an age not later than Upper Devonian. The plant remains provided were found under the sandstone bearing fish remains."

The specimen (M.U.G.D. No. 1630) is in a coarse-grained sandstone. It represents portion only of a woody cylinder and no tissues external to the wood are preserved. The greater part of the central area including the region of the primary wood is missing. It is preserved as a partial petrifaction, the walls of the elements composing it having more or less retained their original character while their cavities are filled with a fine matrix. The result is a petrified wood which is soft and extremely porous. The diameter of the sample is 2.5 cm. and its length is 5 cm.

The study of its structure has been made entirely from film-pulls obtained from ground and slightly polished surfaces. It was advantageous to give a transverse surface a short preliminary treatment with a dilute solution of hydrochloric acid, before the application of the cellulose acetate solution. With a longitudinal surface either radial or tangential, the pull usually removed sufficient organic material without previous etching. The film-pulls were subsequently treated with hydrofluoric acid to remove the matrix, and after washing in water and alcohol were dehydrated in turpineol and mounted in Canada Balsam.

## Description of Specimen.

Pulls taken from transversely ground surfaces (Plate XI., fig. 1) show that the wood consists of narrow wedges of radially arranged tracheides which are separated by medullary rays. The tracheides are usually rectangular with their greater extension in the radial direction, but may be square. Frequently they are five or six sided but some are almost triangular, and when situated on the edge of the tracheidal wedge the base abuts on a medullary ray cell. The radial walls of the tracheides vary in length from 24-76$\mu$ and the tangential from 24-56$\mu$. The tracheidal walls are from 6-12$\mu$ in thickness. Often they are incompletely preserved, the middle lamella being most generally affected by the processes of decay. The secondary wall also may be partially or completely decomposed, leaving only the tertiary layer to show the cell outlines. The tracheides are pitted on all walls (Plate XI., fig. 3), but structural details of the pits cannot be determined from transverse pulls. The medullary rays are prominent and extend across the pull. They are composed of 1-4 rows of radially elongated parenchymatous cells. There is no evidence of the occurrence of annual rings.

A portion of a pull from a surface ground in the radial longitudinal plane is shown in Plate XI., fig. 2. The radial walls seen in surface view are completely and uniformly covered with bordered pits. These are arranged in three to five alternating rows and, owing to their crowded position, have an hexagonal outline. The pits are elongated at right angles to the length of the tracheides, and have a width of from 12-16$\mu$ and a depth of from 8-10$\mu$. The pores of the pits are elongated in the

same direction and are more or less obliquely placed. In the majority of cases the complete wall between two tracheides is not preserved so that the relationship of the pit openings of adjacent tracheides to one another cannot be determined. Such a wall shows in surface view a number of oval pores all inclined in the same direction. More rarely, a complete wall is similarly viewed when the pores are seen to cross one another (Plate XI., fig. 7). The complete length of an individual tracheide has not been determined but as shown in Plate XI., fig. 2, the ends of the tracheides of one radial row all reach the same level. The medullary rays run at right angles to the tracheides and have a considerable depth. The individual ray cells are brick-shaped and fairly thin walled. They measure from 120-224$\mu$ in a radial direction and a single cell covers from 2-6 tracheides. As far as can be ascertained there is no distinct structural differentiation of any particular region of a medullary ray. The end walls are either curved, oblique, or quite straight. The pitting of the ray cells in relationship to the tracheides has not been seen.

A small area of a pull taken from a surface ground in the tangential plane is shown in Plate XI., fig. 4. The tangential walls of the tracheides are here seen in surface view, and appear to be similarly pitted to the radial walls. The critical evidence on this point is shown in Plate XI., fig. 5, where portion of a tangential wall of a tracheide which is adjacent to a medullary ray viewed in true cross section is enlarged 400 diameters. The wall is uniformly covered with oval pits which are indistinguishable from those of the radial walls. The medullary rays vary both in depth and width. They range from 1-5 cells in width and from 1-32 cells in depth. The preservation of the wood is extremely unequal, and for this reason the deeper medullary rays are almost always incompletely shown on the pull. The vertical depth given is therefore only approximate, and it is probable that some rays have an even greater depth than it suggests. The majority of rays are from 2-3 cells wide.

Brown spherical thin-walled vesicles which range in diameter from 12.5-55$\mu$ are frequently associated with the cells of the medullary rays (Plate XI., figs. 8, 9). They are seen in pulls taken from all planes, but have been most abundant in the tangential pulls. They mainly appear to lie in the cavities of the cells. In one instance (Plate XI., fig. 8), delicate brown hyphae, 2.5$\mu$ broad, occur in the same cell as a number of small vesicles, but their actual attachment to any of the vesicles cannot be seen. In both size and form the latter approximate closely to some of the fungal vesicles or thin-walled resting spores of *Palaeomyces* sp. (Kidston and Lang, 1921) found in the Rhynie chert. The association of hyphae and vesicles in the present sample suggests that the vesicles were possibly organs of a fungus which was perhaps responsible for the decay of the wood before fossilization.

## Conclusion.

The sample of wood from Upper Devonian rocks at Mansfield consists of tracheides unmixed with parenchyma other than the medullary rays; its tracheides are uniformly pitted on all walls, the pits being hexagonal in form with apertures tangentially extended and obliquely placed. The medullary rays are numerous, usually 2-3 cells broad and often attain a considerable depth.

In the absence of any information regarding the position and nature of the primary wood not even generic identification of the specimen is possible. Only generalized comparisons with other examples of secondary woods from rocks of closely approximating geological periods can be made.

The occurrence of pits on all the tracheidal walls is a characteristic feature of only a few types of wood, and it is these which naturally suggest themselves for comparison. The most clearly known stem with wood of this type is *Palaeopitys Milleri,* McNab (Kidston and Lang, 1923) from the Middle Old Red Sandstone of Scotland. In this species the wood is composed of tracheides with multiseriate bordered pits on all walls, the pits being oval with transversely extended pores which coincide with one another. In two of these features there is close agreement with the tracheides of the Mansfield specimen, but these can be distinguished by the more oblique position of the pits and the crossing of their apertures. The medullary rays of *P. Milleri* are not as closely comparable as are the tracheides. They are distinctly broader in the Victorian wood, the majority being 2-3 cells broad, whereas in *P. Milleri* they are usually one cell broad except possibly in the outer zones where, according to Kidston and Lang, there "are indications but not conclusive evidence that some of the rays in the outer part of the wood were 2-4 cells broad." In spite of the more parenchymatous composition of the Victorian sample it can be considered as of the same general type of wood as that of *P. Milleri.*

An almost equally close comparison can be made with the wood of *Aneurophyton germanicum* from the Middle Devonian of Germany which has been described by Krausel and Weyland (1923, 1926). The tracheides of this wood have multiseriate bordered pits on all their walls and the medullary rays are uniseriate becoming biseriate in the outer zones of the wood. Here, as in the case of *Palaeopitys,* it is the size of the medullary rays which chiefly distinguishes the wood of *Aneurophyton* from the Victorian wood.

An interesting comparison can be made with the "secondary" wood of *Schizopodium Davidi* Harris (1929) an Australian genus from the Middle Devonian of Queensland. In *Schizopodium* the tracheides composing the so-called "secondary" wood agree with those of the Mansfield specimen in having multiseriate bordered pits with obliquely placed crossed pits on

both radial and tangential walls. The medullary rays, however, are quite distinct for in *Schizopodium* they are tracheidal whereas in the Victorian specimen they are purely parenchymatous.

A specimen of secondary wood which is very similar to the Mansfield wood has been described by Walkom (1928) from the Lower Carboniferous (Kuttung series) of New South Wales under the name *Pitys? Sussmilchi.* The medullary rays agree in being numerous and 1-4 seriate and the relative proportions of parenchymatous to tracheidal tissue appear practically identical in both forms. The chief distinction between them is the typical restriction of the pits to the radial walls in *Pitys?* although Walkom mentions their occasional occurrence on the tangential walls. Since Walkom does not specify the position of the pit openings it appears likely that the elongated pores of adjacent pits coincided with one another. If this is so, it provides another variance between the two types of tracheides.

In the possession of crossed pits the Upper Devonian wood from Mansfield agrees with the wood of *Dadoxylon,* species of which have been recorded from the Upper and Middle Devonian of America (Penhallow, 1900) as well as the Middle Devonian of Britain (Lang, 1929). In *Dadoxylon* however, the pits are definitely restricted to the radial walls of the tracheides and the shorter and narrower medullary rays are an additional distinction.

It will be seen from the above comparisons that the Victorian wood does not agree exactly with any of the more closely comparable types of secondary wood. In the absence of complete stems any further speculations as to its affinities will be unprofitable. Until such examples are available Mr. Hauser's specimen must remain simply a piece of secondary wood of rather distinctive character.

In conclusion, I wish to thank Professor W. H. Lang, F.R.S., for his interest in this investigation and to acknowledge my indebtedness to Mr. E. Ashby of the Barker Cryptogamic Laboratory, University of Manchester, for his assistance in the making of film-pulls and with the photographic illustrations of the paper.

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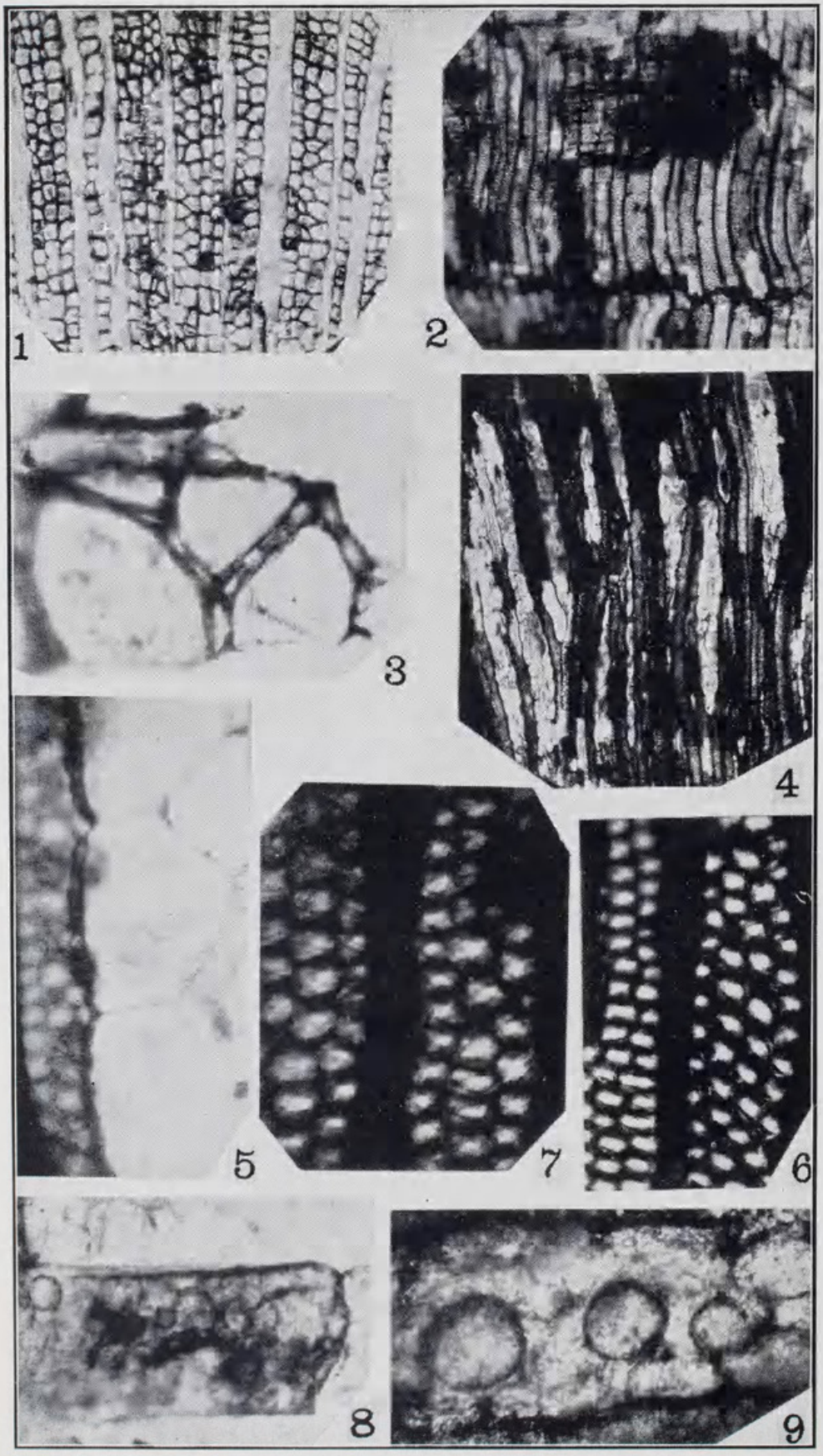
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## Explanation of Plate XI.

All figures are from untouched negatives.

C. before a number denotes author's collection.

Fig. 1.—Portion of a transverse pull showing radial rows of tracheides and medullary rays. × 50. C.15.

Fig. 2.—Secondary xylem in a radial longitudinal plane. × 50. C.16.

Fig. 3.—Tangential pull showing tracheides and numerous medullary rays. × 50. C.24.

Fig. 4.—Tracheides from a transverse pull showing pits on all walls. × 400. C.17.

Fig. 5.—Pitted tangential wall of tracheide adjacent to medullary ray. × 400. C.18.

Fig. 6.—Portion of two tracheides showing transversely elongated pits on radial wall. × 400. C.20.

Fig. 7.—A tracheide with crossed pits on radial wall. × 530. C.21.

Fig. 8.—Radial view of medullary ray cell containing fungal hyphae and vesicles. × 300. C.23.

Fig. 9.—Tangential view of medullary showing 3 vesicles. × 430. C.22.