**Tetracentron** Wood from the Miocene of Noto Peninsula, Central Japan, with a Short Revision of Homoxylic Fossil Woods

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A vesselless fossil wood was discovered in the Miocene Yanagida Formation in the Noto Peninsula, central Japan. This fossil has distinct growth rings with gradual transition from the early- to the latewood; tracheids, which are called ‘usual tracheids’ here, constitute the ground mass of the wood and have typical scalariform bordered pits on radial walls in the earlywood and circular sparse pits on those in the latewood; rays are 1-4 cells wide and heterogeneous with low to high uniseriate wings; axial parenchyma strands are scattered in the latewood. This wood has a peculiar feature; sporadic radial files of broad tracheids whose tangential walls have crowded alternate bordered pits. The radial walls have crowded half-bordered pits to ray cells, but no pits to the usual tracheids. Among all of the extant and extinct angiosperms and gymnosperms, these unusual tracheids occur only in *Tetracentron*. From these features, we refer the fossil to the extant genus *Tetracentron*, and name it *T. japonoxylum*. A revision of homoxylic woods is made for comparison with the present fossil. *Tetracentron japonoxylum* is the only fossil wood of *Tetracentron*.

Key words: Fossil wood — Homoxylic — Miocene — *Tetracentron* — Vesselless

While studying the fossil wood flora of the Yanagida Formation (Lower-Middle Miocene) in the Noto Peninsula facing the Japan Sea, we found a vesselless fossil wood in a cliff beside a road construction site at Yukinobe, Uchiuramachi, Ishikawa Prefecture (37°20′N, 137°13′E) (Suzuki and Joshi, 1990). In this paper, we describe this wood, compare it to other vesselless dicotyledons, and discuss the affinities of homoxylic fossil woods of the Palaeozoic through the Tertiary.

*Tetracentron japonoxylum* M. Suzuki, Joshi et Noshiro sp. nov. (TETRACENTRACEAE) Figs. 1–3, 5, 7–14.

**Materials**: No. 80084 (holotype) is a fairly large silicified trunk 31 cm in diameter with unknown length; a piece of about 15 cm diameter was obtained from the trunk; preservation of internal structure was not especially good. The microscopic slides and the remaining block are deposited in the Institute of Biology, College of Liberal Arts,
Kanazawa University.

**Description**: Wood consists of two kinds of tracheids, usual and unusual, axial parenchyma, and rays. Growth rings are distinct (Fig. 1), but the earlywood is compressed in most rings; width is 2.4–3.0 mm. Transition from the early- to the latewood is gradual.

The usual tracheids constitute the ground mass of the wood (Fig. 1). Those in the earlywood are square to rectangular in cross section, 30–50 (mean 40.8) \( \mu \text{m} \) and 45-68 (mean 54.9) \( \mu \text{m} \) in tangential and radial diameters respectively; thin-walled, about 1 \( \mu \text{m} \) in thickness. Those in the latewood are smaller, polygonal or tangentially elongated rectangular in cross section, 21-38 (mean 29.6) \( \mu \text{m} \) and 12-25 (mean 17.7) \( \mu \text{m} \) in tangential and radial diameters respectively; relatively thick-walled, about 1.9 \( \mu \text{m} \) in thickness. The radial walls of usual tracheids have scalariform bordered pits in the earlywood (Figs. 11 and 12), and sparse circular pits in the latewood; the scalariform pits are 20–33 \( \mu \text{m} \) wide and about 3.3 \( \mu \text{m} \) high with very narrow vertical intervals (about 1.7 \( \mu \text{m} \)) between the pits; the width of these pits decreases as the radial diameter of tracheids decreases. The usual tracheids have no pits on the tangential walls even at the growth ring boundaries. Spiral thickenings and tylosoidal structure are not observed.

Sporadic, long radial series of a different kind of tracheids are found in cross section (Fig. 2); these radial files are usually uniseriate and rarely biseriate and more conspicuous in the latewood; rectangular in cross section; a little larger than usual tracheids in tangential diameter (48 \( \mu \text{m} \) in average) and variable in radial diameter (38–63 \( \mu \text{m} \)). The radial diameter reduces in the latewood (12–20, mean 15.8 \( \mu \text{m} \)), but the tangential one does not (45 \( \mu \text{m} \) in average) except at the growth ring boundaries (25–30 \( \mu \text{m} \)). The walls are very thin both in the early- and the latewood (about 1 \( \mu \text{m} \)). Their occurrence is sporadic and their frequency varies from 0 to 11 (mean 3.9) cells per 25 square mm in tangential section; solitary or in vertical multiples of 2–6 cells or more (Figs. 5 and 7). When solitary, these unusual tracheids are swollen fusiform in tangential view and are much shorter than usual tracheids, 210–310 (mean 241) \( \mu \text{m} \). These unusual tracheids have crowded alternate pits on tangential walls (Fig. 10); pits are small (about 3 and 3.3–5 \( \mu \text{m} \) in vertical and horizontal diameters respectively) with elliptical apertures. Pits to ray cells are abundant, circular and half-bordered with oblique elliptical apertures. No pits to usual tracheids are observed.

Axial parenchyma is difficult to detect because of poor preservation. It is diffuse and scattered in the latewood; usually in pairs of cells in cross section (Fig. 3). More minute features are not observed.

Rays are 1–4 cells wide and heterogeneous; 25–65 (mean 44.5) \( \mu \text{m} \) in width and 200–1,100 (mean 652) \( \mu \text{m} \) or more in height; multiseriate rays have more or less high uniseriate wings. Rays are composed of procumbent and upright cells; the former are 10–20 and 15–25 \( \mu \text{m} \) in tangential and vertical diameters respectively; the latter are 10–20 and 20–37 \( \mu \text{m} \) in tangential and vertical diameters respectively; radial diameters of both are immeasurable due to poor preservation. Cross-field pits to the usual