Xenoxylon Fossil Woods from the Lower Cretaceous Akaiwa Subgroup of Shiramine, Central Japan

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Mitsuo SUZUKI* and Kazuo TERADA* : *Xenoxylon* Fossil Woods from the Lower Cretaceous Akaiwa Subgroup of Shiramine, Central Japan

鈴木三男*・寺田和雄*：石川県白峰村の下部白亜系赤岩亜層群産のザイシツフメイ属の材化石

Abstract

Seven fossil woods collected from the strata of Lower Cretaceous Akaiwa Subgroup in Shiramine-mura, Ishikawa County, Ishikawa Prefecture, were studied anatomically, and identified as *Xenoxylon latiporosum* (CRAMER) GOTHAN. In this connection, all of the fossil woods collected from the village and its surrounding area and studied previously by several authors were re-examined. As a result, all of the fossil woods are the same species, *Xenoxylon latiporosum*, and the one specimen obtained from North Korea and described by SHIMAKURA is recognized as a representative of *Xenoxylon japonicum* VOGELLEHNER. Lectotypification of this species is based on the re-observation of the original materials.

Key Words : Lower Cretaceous—Shiramine—Tetori Series—*Xenoxylon japonicum*—*Xenoxylon latiporosum*

Fossil woods are sometimes found in the strata of the Upper Jurassic-Lower Cretaceous Tetori Group in Shiramine-mura, Ishikawa Prefecture. This occurrence has been well known since the early part of this century (TAŇAKA, 1926) and they have been studied both geologically and palaeobotanically. SHIMAKURA (1934) identified a fossil piece (registered number 44490 in Tohoku University) collected by S. NAGAO from a farmer's garden in Kuwajima, Shiramine-mura in 1932 as *Xenoxylon latiporosum* (CRAMER) GOTHAN based on its anatomical features. SHIMAKURA (1936) again studied the Kuwajima specimen and also some additional Jurassic fossil woods from the Korean Peninsula and northeast China, and identified them as the same species, *X. latiporosum*. After that, a comprehensive study on the occurrence of the fossil woods by OGURA *et al*. (1951) found many fossil woods containing some erect stumps from the Upper Jurassic-Lower Cretaceous strata of 19 sites distributing wide areas of Ishikawa and Gifu Prefectures around Mt. Hakusan. They identified all of those fossil woods as the same species with SHIMAKURA. On the other hand, VOGELLEHNER (1968) recognized a new species, *Xenoxylon japonicum*, basing on the description of SHIMAKURA (1936).

In 1988 and 1989, we had a chance to collect seven fossil woods, including four erect stumps, at three sites in Shiramine-mura. This collecting by a fossil research group was sponsored by the Educatorial Committee of Shiramine-mura. In this paper, the anatomy of those newly collected fossil woods was presented and identifications provided.

We would like to express our thanks to the Educatorial Committee of Shiramine-mura, Ishikawa Prefecture, for the opportunity to study these fossils; to the curator of the Fossil Collection, Institute of Geology and Paleontology, Faculty of Science, Tohoku University for the permission to inspect the specimens studied by SHIMAKURA (1934, 1936); and to the curator of University Museum, the University of Tokyo for the permission to inspect the specimens studied by both OGURA *et al*. (1951) and WATARI (1960).

Collection sites, Materials and Horizon

Shiramine-mura (about 36°10'N, 136°37'E), Ishik-

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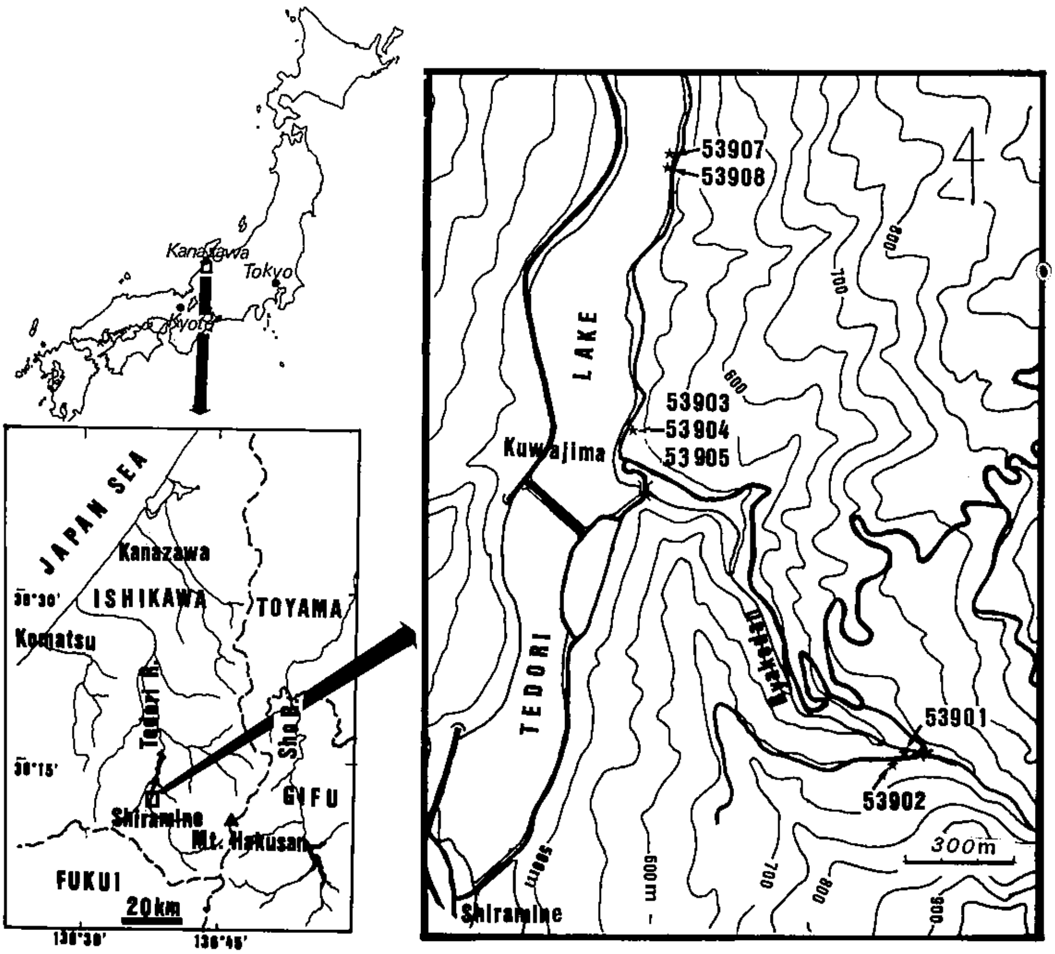
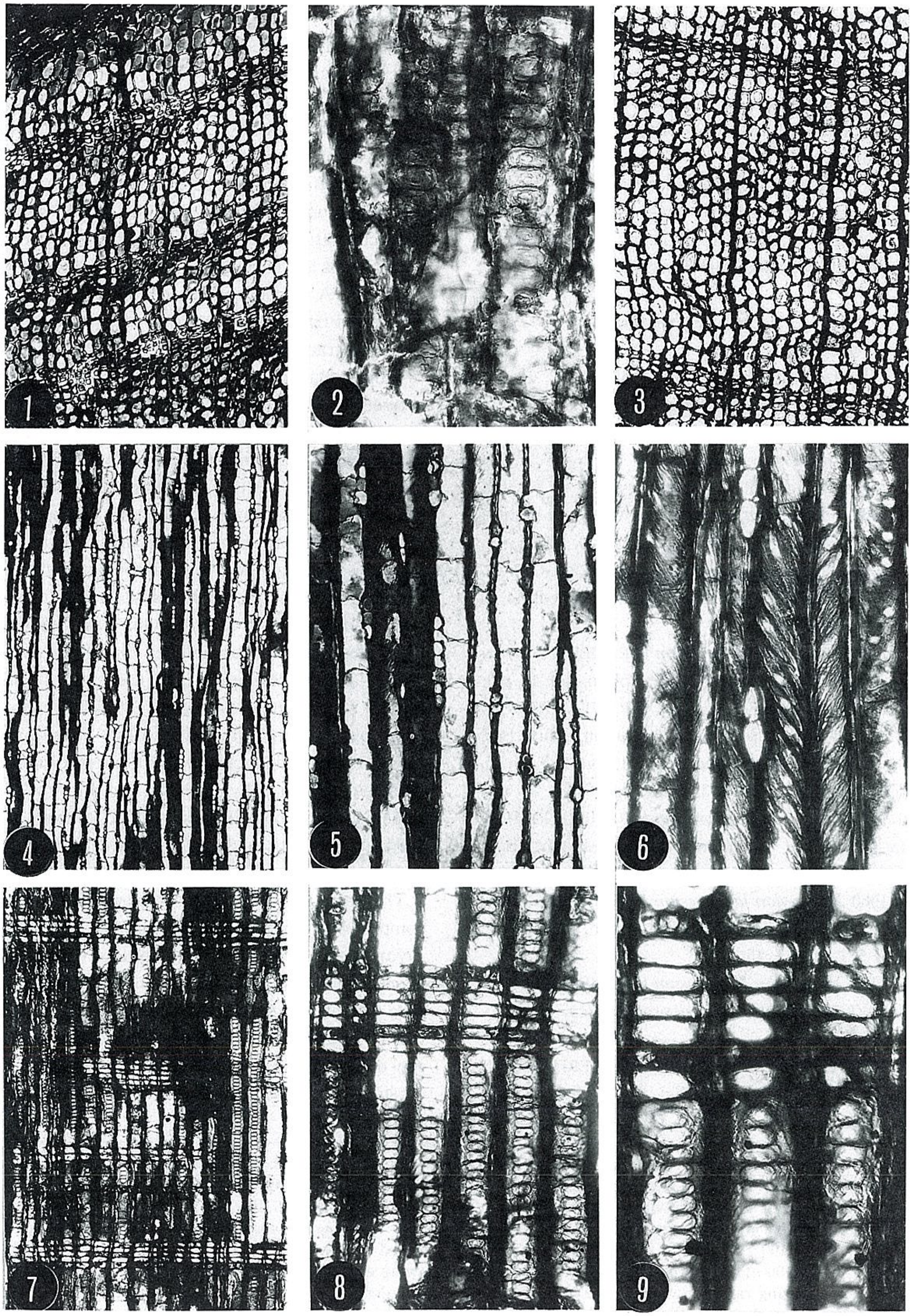


Fig. 1. Locality maps showing study areas of *Xenoxylon* fossil woods.

awa County, Ishikawa Prefecture, is located about 45 km south from Kanazawa, central Japan (Fig. 1). In and around this village, including Mt. Hakusan (2702 m high), the Upper Jurassic-Lower Cretaceous Tetori Group is widely distributed and many fossil woods of *Xenoxylon* have been known from the strata since 1926. During a comprehensive research on fossils of woods, macro-plants, molluscs and dinosaurs conducted by the Educatorial Committee of Shiramine-mura from 1988 to 1989, seven fossil woods were newly discovered. The seven specimens are from three sites, two are on the east shore of Tedori Lake and the other is along a small valley, Byakodan, of Tedori River near Kuwajima in Shiramine-mura (Fig. 1). Four of the seven, Nos. 53901, 53902, 53907 and 53908, are erect stumps and the other three, 53903, 53904 and 53905, are laid trunks. The diameter of these specimens varies between 15-60 cm; the biggest (No. 93901) is 60

Fig. 2. Microphtographs of *Xenoxylon latiporosum*, 1-9. 1-2: No. 53901. 1: Cross section showing four growth rings with narrow latewood, ×40. 2: Radial section showing elliptical and contiguous bordered pits on radial walls of tracheids, ×400. 3-9: No. 63907. 3: Cross section showing a little wider growth ring with very narrow latewood, ×40. 4: Tangential section with many septa of tylosoids in tracheids, ×40. 5: Magnified tangential section showing uniseriate and low, 1-7 cells height rays, and tylosoids in tracheids, ×100. 6: Higher magnified tangential section at the border of growth rings showing small tangential wall bordered pits with slit-like apertures and uniseriate rays, ×200. 7: Radial section showing long group of elliptical bordered pits on radial walls of tracheids and radial view of rays, ×40. 8: Magnified radial section showing long group of elliptical bordered pits, ×200. 9: Higher magnified radial section showing window-like cross field pitting, ×400.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cm in diameter and 185 cm tall and the smallest (No. 93904) is 15 cm in diameter. These fossil trunks are preserved as Natural Monuments *in suite*. Small pieces obtained from them for thin microscopic slide preparation are preserved in the Department of Biology, College of Liberal Arts, Kanazawa University.

All of these fossil woods were from the Akaiwa Subgroup, which is the uppermost of the three subgroups of the Tetori Group and its age is generally considered as Early Cretaceous.

Systematic Treatment

Coniferales

Protopinaceae KRÄUSEL 1949

Xenoxylon GOTHAN 1905

Xenoxylon latiporosum (CRAMER) GOTHAN Fig. 2: 1-9 and Fig. 3: 10-15.

Selected taxonomical treatments:

1868 *Pinites latiporosum* CRAMER *in* HEER, Flora Foss. Arct., vol. 1, p. 176, pl. 40, figs. 1-8.

1905 *Xenoxylon latiporosum* (CRAMER) GOTHAN *in* Abh. Kön. Preuss. Geol. Landesanst., vol. 44, p. 38 (not inspected).

1934 *Xenoxylon latiporosum* (CRAMER) GOTHAN *in* SHIMAKURA, J. Geol. Soc. Tokyo, vol. 41, p.9.

1936 *Xenoxylon latiporosum* (CRAMER) GOTHAN *in* SHIMAKURA, Sci. Rep. Tohoku Imp. Univ., Ser. 2, vol. 18, p. 278, text-fig. 4, pl. 14, figs. 7-8, pl. 15, figs. 1-8, pl. 16, figs. 1-3, pl. 17, figs. 6-7.

1951 *Xenoxylon latiporosum* (CRAMER) GOTHAN *in* OGURA *et al.*, Trans. Proc. Palaeont. Soc. Japan, n.s.no.4, p. 113, pl. 9, figs. 1-4.

1960 *Xenoxylon latiporosum* (CRAMER) GOTHAN *in* WATARI, J. Fac. Sci. Univ. Tokyo, sect.III, vol. 7, p. 511, figs. 1-15.

1968 *Xenoxylon latiporosum* (CRAMER) GOTHAN *in* VOGELLEHNER, Palaeontographica, B121, p. 144.

1982 *Xenoxylon latiporosum* (CRAMER) GOTHAN *in* SUZUKI *et al.*, Ann. Sci. Coll. Liberal Arts, Kanazawa Univ., vol. 19, p. 47, pl. 2, figs. 7-8, pl. 3, figs. 9-12, pl. 4, figs. 13-16.

Description

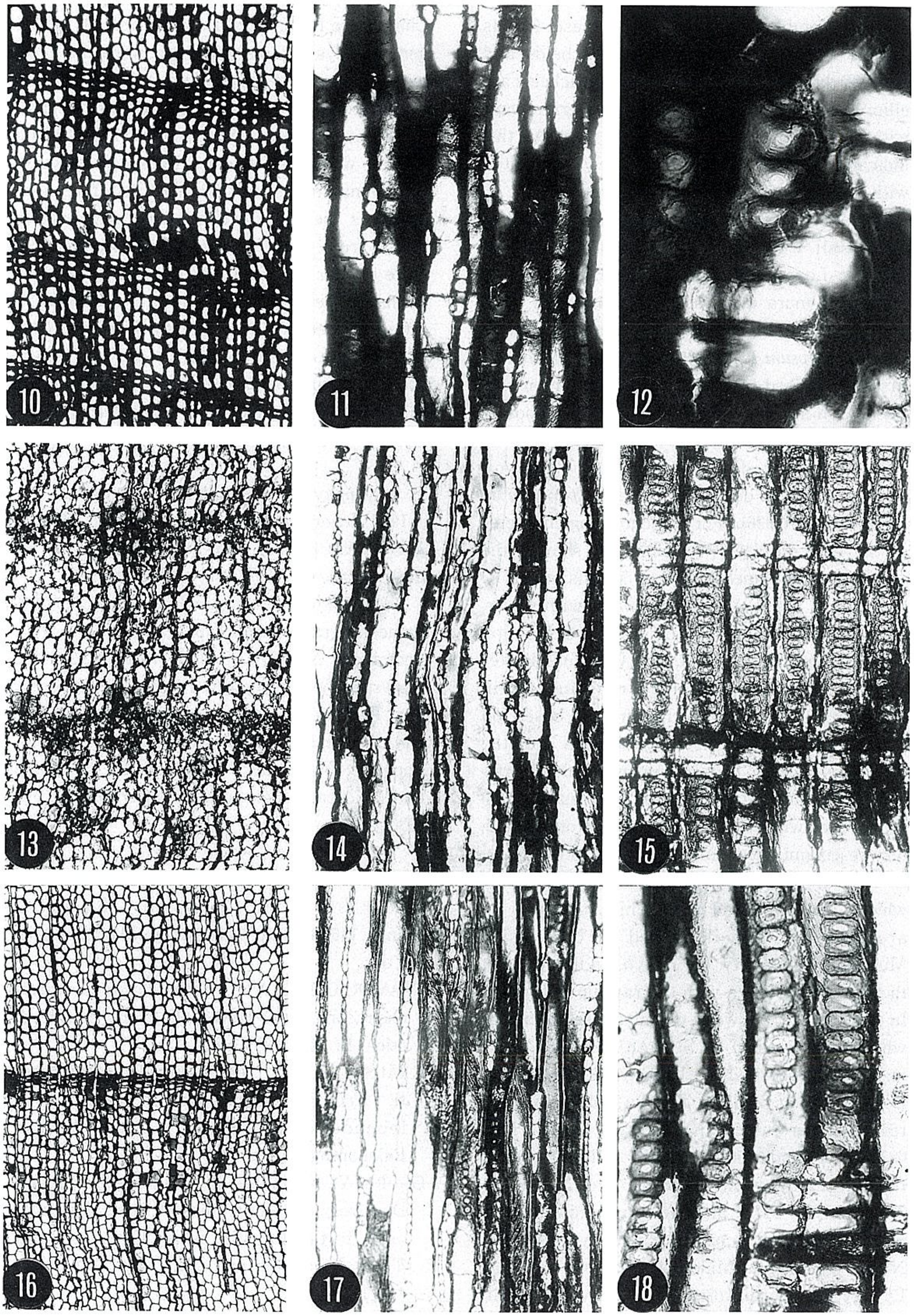
The internal structure of most of the seven specimens was not in a good state of preservation. Therefore, the following description is based mainly on specimen No. 53907 which is the best preserved of the group.

Wood is coniferous type characterized by tracheids and uniseriate rays, and the lack of axial parenchymatous cells. Growth rings are distinct; width bands are narrow and fairly uniform, 0.25-1.35 mm. A ring is composed of many rows of earlywood tracheids and two to several rows of latewood tracheids.

Tangential diameters of tracheids vary between 40-80 μm. Radial diameters vary between 60-80 μm in the earlywood tracheids and 20-30 μm in the latewood tracheids. Bordered pits on the radial walls of the earlywood tracheids are long elliptical, 25-30 × 15-20 μm in horizontal × vertical diameters; with round aperture of about 5 μm in diameter; several to many pits are arranged contiguously and in a scalariform pattern. Bordered pits on the radial walls of the latewood tracheids are small and circular; arranged in a scattered pattern. Tracheids at the growth ring boundaries have small circular bordered pits on their tangential walls. Those pits are 10-15 μm in diameter, with slit-like apertures. Tracheids are usually occluded by thin-walled tylosoids and look-like as septate tracheids. Spiral thickenings and crystals were not observed.

The rays are entirely uniseriate. They are composed of ray parenchyma and are devoid of ray tracheids. The rays are rather low, usually 1-10 cells high and rarely exceed 10 cells. Cross-field pits are large and window-like. There are usually one or rarely two pits per field. Ray cells are often occluded by dark substances, but no crystals were observed.

Fig. 3. Microphtographs of *Xenoxylon latiporosum*, 10-18. 10-12: No. 53908. 10: Cross section showing four growth rings, ×40. 11: Tangential section showing rather low uniseriate rays and tracheids with tylosoids, ×200. 12: Radial section showing large window-like cross field pits, ×400. 13-15: No. 53904. 13: Cross section showing three growth rings, ×40. 14: Tangential section showing uniseriate rays and tracheids with tylosoids, ×100. 15: Radial section showing elliptical bordered pits and window-like cross field pits, ×200. 16-18: No. 44490 of Shimakura, 1936. 16: Cross section showing a growth ring boundary, ×40. 17: Tangential section showing rather low uniseriate rays and tangential bordered pits of the latewood tracheids, ×100. 18: Radial section showing elliptical and contiguous bordered pits and window-like cross field pits, ×200.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Affinity and Discussion

The prominent characters of these fossils include (1) wood constituted by tracheids and rays, (2) bordered pits of earlywood tracheids are elliptical and contiguous, and (3) uniseriate rays with large, window-like cross-field pits. All this indicates that the fossils are surely associated with *Xenoxylon* of the Protopinaceae.

As described in the paper's introduction, all of the fossil woods obtained from the Upper Jurassic-Lower Cretaceous Tetori Group in Shiramine-mura and its sorrounding area have the same anatomy and are comparable to *Xenoxylon latiporosum* (CRAMER) GOTHAN, which was firstly described from the Jurassic of Greenland. Basing on a systematic study on fossil woods of the Mesozoic Protopinaceae, VOGELLEHNER (1968) recognized a new species, *Xenoxylon japonicum*, in the description of *X. latiporosum* by SHIMAKURA (1936). For distinguishing character of the new species, VOGELLEHNER showed the very tall rays, sometimes up to 50 cells tall, in *X. japonicum*, while *X. latiporosum* is with lower, about 10 cells tall, rays. Actually, the description and photographs by SHIMAKURA (1936) indicates the occurrence of such high rays in certain specimen(s), but his description was based on eight specimens, one from Kuwajima and the other seven from Korean Peninsula and Northeast China, and did not indicate which specimen(s) is provided with such tall rays. On the other hand, our re-examination on specimens studied by OGURA *et al.* (1951) and WATARI (1960), all of which were collected from Shiramine and its around area, and deposited in University Museum, University of Tokyo, indicates that there is no specimen with tall rays up to 50 cells. In this connection, we re-examined the specimens which were studied by SHIMAKURA (1934, 1936) and were deposited in the Fossil Collection of Department of Geology, Tohoku University. The result of our re-examination is as follow: Nos. 6870, 44490 and 57601 are fairly well preserved in their anatomy, while the other five, Nos. 30558, 30559, 51721, 51722 and 57602 are quite poor in preservation and to observe minutely is difficult. No. 6870 from the Middle Jurassic of Botandai, Pyongyang, North Korea, has taller, up to 40 cells or more, rays, while No. 44490 from Kuwajima of Shiramine, Japan and No. 57601 from Northeast China have lower rays, less than 15 cells tall. In general, rays become taller according the age of wood in juvenile stage, but it become stable within several ten years (CARLQUIST, 1961). Therefore, from comparisons of ray height among mature woods, it is generally accepted among wood anatomists that distinctly different ray height is the specific character. Although the fossils from North Korea and Shiramine show quite similar anatomical features, the difference of the ray height is much enough to recognize as different species as treated by VOGELLEHNER. Because VOGELLEHNER did not chose a holotype specimen for *Xenoxylon japonicum* based on SHIMAKURA's description, we would like to here lectotypify the species.

Xenoxylon japonicum VOGELLEHNER

1936 *Xenoxylon latiporosum* (CRAMER) GOTHAN *in* SHIMAKURA, Sci. Rep. Tohoku Imp. Univ., Ser. 2 (Geology), vol. 18, p. 278, pl. 15, figs. 1-6.

1968 *Xenoxylon japonicum in* VOGELLEHNEM, Palaeontographica B121, p. 145.

Lectotype: No. 6870 of SHIMAKURA, 1936. The type specimen is deposited in the Fossil Collection, Institute of Geology and Paleontology, Faculty of Science, Tohoku University.

Locality: The quarry of Botandai, Pyongyang, North Korea, Middle Jurassic (after SHIMAKURA, 1936).

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摘　要

石川県白峰村の国指定特別天然記念物「手取川流域の珪化木産地」調査委員会による調査で手取統赤岩亜層群（下部白亜紀）から新たに見つかった直立樹幹4本を含む7点の材化石についてその材構造を調べ，同定を行った。その結果，いずれもが CRAMER がグリーンランドのジュラ紀層から記載した針葉樹類原マツ科ザイシツフメイ属の *Xenoxylon latiporosum* であることが分かった。嶋倉巳三郎が 1934 と 1936 年にこの地で見つかった材化石を上述の種に同定して以来，1951 年に小倉ら，1960 年に亘理がやはりこの地の材化石を同定して嶋倉と同じ結論に達していた。ところが 1968 年に中生代の針葉樹材化石をまとめた VOGELLEHNER は嶋倉の 1936 年の記載に基づいて *X. japonicum* という新種を立てた。この嶋倉の記載には白峰村桑島の材化石とともに韓半島北部の平壌産のものなどが含まれており，どれとどれが *X. japonicum* に該当し，それ以外のものは *X. latiporosum* のままであるのかが不明のままであった。筆者らは東北大学理学部地質古生物教室及び東京大学総合研究資料館に所蔵してある嶋倉，小倉ら，亘理の用いた標本を再観察し，*X. japonicum* に該当するのは嶋倉の平壌産の1点のみであること，また白峰村及び白山周辺から得られた材化石は全て *X. latiporosum* であることを確かめた。

(Recieved August 25, 1992)

○ Mitsuo SUZUKI* and Shuichi NOSHIRO** : **Further Occurrence of *Hemiptelea mikii* Fossil Woods from the Pleistocene of Japan** 化石種ヒメハリゲヤキの材化石の新産地（鈴木三男*・能城修一**）

Hemiptelea mikii MINAKI is a fossil species of the Ulmaceae, of which fruits were found from the Early to the Late Pleistocene strata of several localities in Japan, and of which woods were from Kitaegota Site of Tokyo (MINAKI *et al.* 1988). The extant *Hemiptelea* is monotypic and *H. davidii* (HANCE) PLANCH. is distributed in Korea and northern and central China. During our further researches on Pleistocene fossil woods, we found two new localities of the species in Saitama and Ishikawa Prefectures as follows: **Locality 1:** Specimen No. W14-727 which was collected at Oiseyama Site, Mikashima, Tokorozawa, Saitama Prefecture (Tsuzurairi Formation) (NOSHIRO and SUZUKI, 1991). **Locality 2:** Specimen No. Saigawa-1, which was collected by Mr. Yuzuru ONO in 1988 on the river bed of Saigawa between two bridges of Saigawa-Ohashi and Sakurabashi, Kanazawa, Ishikawa Prefecture (Utatsuyama Formation).

These fossils have prominent anatomical features as follows: distinct ring porosity (Figs. 1, 2, 6), abrupt transition from early- to late-wood (Figs. 1, 6), sporadic larger pores in the late-wood (Figs. 1, 2, 6), large and low multiseriate rays with sheath cells (Figs. 5, 7), small vessel with simple perforations and spiral thickenings (Fig. 3), and storied fusiform elements (Fig. 4). All of these and other characters agree with the original specimen of this fossil species. The exact age of Tsuzurairi and Utatsuyama Formations is not clear. But it may be said that the age is the Middle or Early Pleistocene, because the former is roughly estimated as about 0.3 Ma (Million years ago) (TSUJI, 1991), and that of latter is considered between 0.59 and 0.83 Ma (SHIMIZU, 1987MS; TAKAYAMA *et al.* 1988). Although the fruit fossil is not yet found in these two new localities, the occurrence of fossil woods will indicated the more wide distribution of this species in the Pleistocene age of Japan.

ヒメハリゲヤキ *Hemiptelea mikii* MINAKI はニレ科の絶滅種で，関東と近畿の更新統から出土した果実と材化石を元に記載されたものである（MINAKI *et al.* 1988)。筆者らのその後の化石研究の過程において埼玉県所