bi-monthly research notes

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BOTANY

Postglacial Fossil Tamarack (*Larix laricina*) Wood from the Mackenzie Delta, N.W.T.—The identification of fossil wood presents certain difficulties because the wood may be discolored by groundwater containing various minerals or by weathering, or it may be deformed by pressure. Differentiation of fossil spruce (*Picea*) and larch (*Larix*) is particularly difficult, as illustrated by the identification of driftwood found on Arctic beaches (Blake, pages 77-104 *in* Proc., Symposium on climatic changes in Arctic areas during the last ten-thousand years, Univ. Oulu, Finland, 1972). Only half (14) of the samples were identified to genus (either *Picea* or *Larix*); the other half were undifferentiated between *Picea* and *Larix*.

A piece of wood was recovered, in the summer of 1977, from the base of a perennially frozen peat deposit, in the Pleistocene Mackenzie Delta. Radiocarbon analysis, performed by the Department of Geological Sciences, Brock University, yielded a date of 7510 ± 140 years before present (BGS-472). We identified the wood as *Larix laricina* on the basis of cell structure, after comparing it with tamarack and spruce wood from different parts of Canada.

The site is a thick peat deposit on the shores of a small lake about 20 km east of Swimming Point on the East Channel, Mackenzie River, and some 75 km north of Inuvik at 69° 05'N latitude and 133° 52'W longitude. The site is on the Pleistocene Coastlands of the Mackenzie Delta in the Tununuk Low Hills Section (Mackay, Geol. Surv. Can., Misc. Rep. 23, 1963), formed mainly by Pleistocene fluvial and deltaic deposits. Most of the area lies below 60 m above sea level, but the elevation at the peat section is approximately 80 m ASL.

The peat exposure is adjacent to a large actively thawing massive sheet of ground ice. Thawing has exposed a 4.5 m headwall in the massive ice and in the adjoining high-center peat polygons. The peat deposit under the polygon is 332 cm thick, consisting of 32 cm of well-decomposed peat at the top underlain by somewhat decomposed peat of *Sphagnum* and other mosses, with scattered wood between 185 and 305 cm. Between 305 and 332 cm, freshwater gastropod shells are abundant in the peat, including a 12 cm marl layer. This stratum rests on an organic-rich mineral soil to the 335 cm level, where sparingly stony mineral soil is found.

A tree stump 28 cm in diameter, consisting of lateral roots and the basal part of the stem, was found in growth position partially encased in perennially frozen peat at the 298 cm level. One lateral root with the attached basal stem was collected. Examination of growth rings showed 89 annual rings, but a small (est. 3 cm diameter) portion of the center was missing.

The site is in a treeless, shrubby tundra, dominated by shrub birch, alder, and dwarf heath shrubs. The nearest trees are spruce (*Picea glauca* [Moench] Voss and *P. mariana* [Mill.] B.S.P.) and balsam poplar (*Populus balsamifera* L.) growing on the modern Mackenzie Delta some 35 km to the southwest. The nearest known occurrence of tamarack (*Larix laricina* [Du Roi] K. Koch) is 80 km to the south, near Inuvik.

The surficial geology and depositional sequence at the site preclude the possibility of postglacial long-distance transport of any organic debris. The site was originally occupied by a shallow lake on a morainic upland, as shown by marl and freshwater gastropod shells. Infilling of the lake by peat provided habitat for mosses and trees, including the sampled fossil. Continued peat deposition buried the wood; later permafrost development helped to preserve it.

The wood sample was partially fossilized. The fine-textured wood was brash, superficially gray, powdery, and weathered when dry, light brown in the broad band of springwood, and darker brown in the narrow summerwood. The growth rings were up to 1 mm wide. The sample was in excellent condition for sectioning with a blade and for pulping.

Two methods were used to identify the fossil wood. Sections of wood were examined under a microscope, according to the technique of Panshin and de Zeeuw (Textbook of wood technology, vol. 1, third ed., McGraw-Hill, New York, 1970). In addition, macerated wood tissue was also examined to observe the cellular detail of wood tissue, because woody stems are often difficult to section by microtome and because the sections rarely convey an accurate conception of the real nature of the cells of which they are composed (Johanson, Plant microtechnique, first ed., McGraw-Hill, New York, 1940).

Radial and tangential sections of wood specimens were prepared

TABLE 1
Anatomical data of fossil wood and known wood of tamarack, spruce, and Douglas-fir

Species	Tracheids	Longitudinal parenchyma	Rays and resin canals
Fossil wood	Diameter up to 42 μm. Spiral thickenings in summerwood. Bordered pits in 1-2 rows on radial walls. Pits in ray crossings piciform, 1-8 in double rows.	Terminal	Uniseriate ray 1-16+ cells in height. Fusiform ray with resin canal, 2-3 seriate, up to 16+ cells high. Ray tracheid slightly dentate, mostly nondentate. Resin canals with thick-walled epithelium. Diameter of longitudinal canals up to 90 μm. Transverse canals 20 μm.
Tree-line tamarack (*Larix laricina*)	Diameter up to 42 μm. Spiral thickenings in summerwood. Bordered pits in 1-2 rows on radial walls. Pits in ray crossings piciform, 1-8 in double rows.	Terminal	Uniseriate ray 1-16+ cells high. Fusiform ray with resin canal, 2-3 seriate, up to 16+ cells high. Ray tracheids slightly dentate, mostly nondentate. Resin canals with thick-walled epithelium. Diameter of longitudinal canals up to 90 μm. Transverse canals 20 μm.
Southern latitude tamarack	As in tree-line tamarack, but has only occasional spiral thickenings.	Terminal	As in tree-line tamarack.
Tree-line white spruce (*Picea glauca*) and black spruce (*P. mariana*)	Diameter up to 30 μm. No spiral thickenings. Bordered pits in one row on radial walls. Pits in ray crossings piciform, 1-4 in 1-2 horizontal rows.	None	Uniseriate rays numerous, 1-16+ cells high. Fusiform ray with resin canal, 2-3 seriate, up to 16+ cells high. Ray tracheids nondentate. Resin canals with thick-walled epithelium. Diameter of longitudinal canals up to 60 μm. Transverse canals 20 μm.
Douglas-fir (*Pseudotsuga menziesii*)	Diameter up to 40 μm. Spiral thickenings in spring- and summerwood. Bordered pits in one row on radial walls. Pits in ray crossings piciform, 4 in 2 horizontal rows.	Terminal	Uniseriate ray up to 12+ cells high, biseriate sparse. Fusiform ray with resin canal, 3-4 seriate in central portion, up to 16+ cells high. Ray tracheids nondentate, with spirals. Resin canals with thick-walled epithelium. Diameter of longitudinal canals up to 60 μm. Transverse canals up to 30 μm.

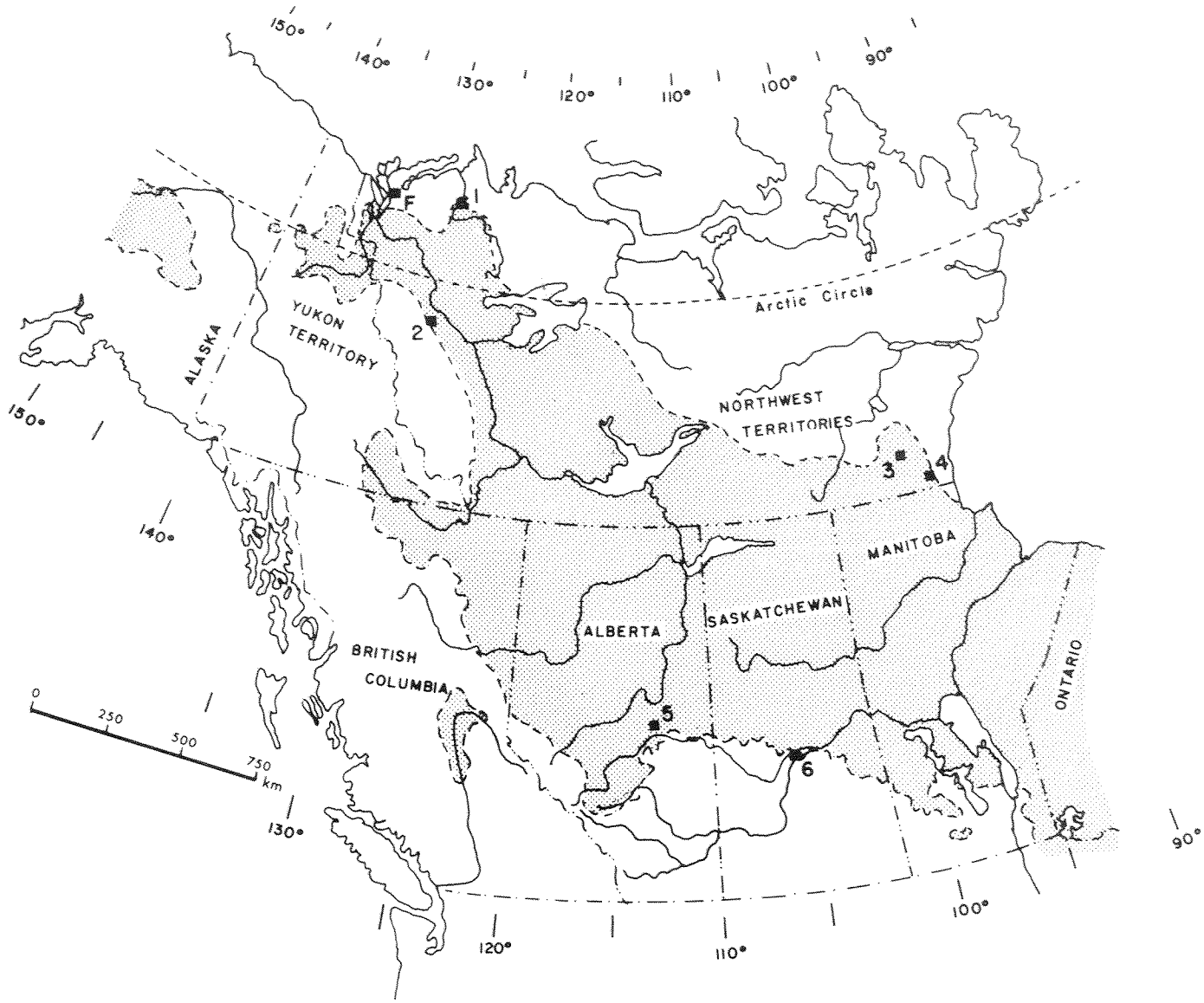

Figure 1. Map of western Canada showing the present range of tamarack (shaded), the location of the fossil tamarack find (F), and sites of modern tamarack wood collection (1-6).

with and without staining and mounted on glass slides. Pieces of wood were macerated by being cooked in an autoclave as outlined by Zalasky (Can. For. Serv. Bi-mon. Res. Notes 34:13-15, 1978). Both the sections and the macerated tissues were microscopically examined for vessels, which separate hardwoods from softwoods, and for markings on tracheids, rays, resin canals, and longitudinal parenchyma that are important in softwood genera and species identification (Panshin and de Zeeuw, 1970).

The initial examination of living *Larix* species wood showed that the fossil, because of its dimorphous summerwood tracheids, is *L. laricina* and not *L. occidentalis* Nutt. or *L. sibirica* Ldb. To verify this identification, the fossil wood sample was compared with *Larix laricina* specimens from near the northern tree line (Fig. 1, sites 1, 2, 3, 4) and from near the southern limit of their distribution (Fig. 1, sites 5, 6). Comparisons were also made with wood of white and black spruce from the vicinity of these areas and with wood samples of Douglas-fir (*Pseudotsuga menziesii* [Mirb.] Franco var. *glauca* [Beissn.] Franco) from the Banff and Jasper areas of Alberta. All wood samples were taken from the lowest portion of stems of mature (over 60 years old) trees to allow comparison with the fossil material.

The findings of cellular and tissue details are summarized in Table 1. The cellular and tissue details of the fossil wood are identical to those of *Larix laricina* samples from northern environments. This indicates that tamarack grew some 80 km north of its present range about 7,510 years ago.

Summerwood tracheids of fossil wood had two types of spiral thickenings described for tree-line tamarack (Zalasky, Can. For. Serv. Bi-mon. Res. Notes 34:38). The presence of spiral thickenings in the summerwood of tamarack appears to be influenced by extremes of summer temperatures, which are more generally prevalent in northern latitudes of the tree line than in southern latitudes. Therefore, it is advisable to compare any unknown wood material with living wood of known species in the vicinity, because some anatomical features may not be constant for the whole range of a temperate species.—S.C. Zoltai and H. Zalasky, Northern Forest Research Centre, Edmonton, Alta.

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