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Occurrence and Taxonomic Notes on Some Miocene Plants from Southern Sakhalin, Russia

By

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Abstract Plant megafossils from the Miocene coal-bearing formations in southern Sakhalin are examined on the basis of the collection by the senior author during 1938 to 1944. Eleven species belonging to the families Ulmaceae, Betulaceae, Juglandaceae and Salicaceae are recorded, of which *Betula oishii* Huzioka et Uemura is described as a new species. These plants are from the Esutoru and Naihoro formations which are nearly contemporaneous with the Upper Due Formation in northern Sakhalin. The occurrence of such species as *Ulmus drepanodonta* and *U. pseudolongifolia* suggests a floristic similarity to the Daijima-type floras of late Early to early Middle Miocene age in Hokkaido.

Introduction

During the past years from 1938 to 1944 the senior author collected a large amount of plant megafossils from the Miocene coal-bearing formations in southern Sakhalin. Based on these fossil specimens, OISHI and HUZIOKA published their taxonomic studies on *Salvinia*, *Tilia*, *Acer* and the Ulmaceae (OISHI & HUZIOKA, 1941, 1943a–c, 1954). Excepting the fossil specimens of the above-noted taxa, his collections have mostly been lost, possibly due to the disturbance after the World War II. However, a small amount of specimens are still stored in the Institute of Mining Geology, Akita University (AKMG).

The purpose of this paper is to record the Miocene plants of the families Ulmaceae, Betulaceae, Juglandaceae and Salicaceae based on the AKMG collection. As to the Miocene plants from Sakhalin, two comprehensive papers have been published by Russian authors after the World War II. One is by BAIKOVSKAJA (1974) who described the flora from the Upper Due Formation in northern Sakhalin, including the plants from classical localities of HEER (1878a, b). The other is by FOTJANOVA (1988) who described a number of plants from the "Upper Due Formation" in both of northern and southern Sakhalin, and discussed on the Oligo-Miocene floral transition. Comparing with the contributions by these Russian authors, taxonomic revisions are given for some species. A brief comparison with the contemporaneous Miocene floras of Japan is also made

on the basis of the species described in this paper.

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Fossil Localities

In the following lines, the geographic names follow the former Japanese ones before 1945, because Russian large-scale geographic maps are not available at present (see also OISHI & HUZIOKA (1954) for locality information). The stratigraphic units of plant-bearing beds are also indicated by the former Japanese usage.

Plant megafossils here described were collected from the Esutoru and Naihoro (coal-bearing) formations in southern Sakhalin (Fig. 1; Table 1). The localities, with Russian geographic names in parentheses, are as follows:—The Esutoru Formation (all localities are in the Uglegorsk region); Sarutsu (near the mouth of Riv. Goncharovka; probably the same as the locality Sertuny or Sartunay of HEER, 1871), Toyohata coal mine (north of Lesogorsk), Nayoshi (Lesogorsk), Kitakozawa (Tel'novskiy), Riv. Chio (Riv. Nadezhdinka), Toro coal mine near Esutoru (Shakhtersk near Uglegorsk), Taihei coal mine near Esutoru (Udarnyi near Uglegorsk), Kantazawa near Esutoru (? near Uglegorsk): The Naihoro Formation; Shiritori coal mine (Makarov, Makarov region), Odasu coal mine (Parusnoe, Tomari region), Naihoro coal mine (Gornozavodsk, Nevel'sk region).

The Esutoru Formation in the Esutoru coal producing area was believed to be contemporaneous with the Naihoro Formation (UWATOKO, 1939) or Upper Due Formation, (*s.l.*) (FOTJANOVA, 1988). However, the lower part of the Esutoru Formation includes parts correlative with the Noda Volcanic and Tokonbo formations which underlie the Naihoro Formation (OISHI & HUZIOKA, 1944).

All the plant fossils from the above localities are of impression-type in preservation. Well-preserved plants are found in sideritic concretions.

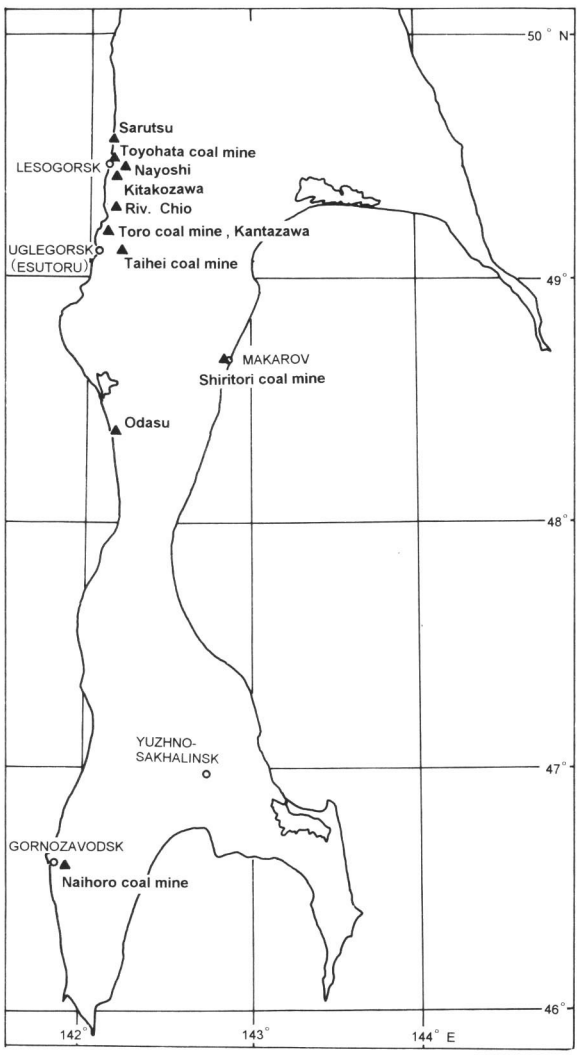


Fig. 1. Localities of plant fossils.

Description of Species

Family Ulmaceae

Ulmus drepanodonta GRUBOV

Ulmus drepanodonta GRUBOV in KRYSHOTOFOVICH, 1956, p. 109, pl. 29, fig. 1; pl. 34; pl. 36, figs. 1, 2, 4; pl. 37, figs. 1, 2, 3b–5; pl. 39, fig. 12; text-figs. 50–55. BAIKOVSKAJA, 1974, p. 64, pl. 11, figs. 1–8, 10–12; pl. 12, figs. 1, 2, 4–11; pl. 19, figs. 5, 9–11: p. 111, pl. 36, figs. 2–4; pl. 37, figs. 1, 2, 8, 10 (excluding pl.

Table 1. List of plants described in this paper.

	Sarutu	Toyohata coal mine	Nayoshi	Kitakozawa	Riv. Chio	Toro coal mine	Taihei coal mine	Kantazawa	Odasu	Shiritori coal mine	Naihoro coal mine
Ulmus drepanodonta	x	·	x	·	·	x	·	·	·	·	·
U. pseudolongifolia	·	·	·	·	·	x	·	·	·	·	·
Alnus miojaponica	x	·	·	·	·	·	·	·	·	x	·
A. protocordata	x	·	·	·	·	·	·	·	·	·	·
A. usyuensis	x	·	x	·	·	·	·	x	·	·	·
A. sp. cf. *A. adumbrata*	x	x	·	·	·	x	·	·	·	·	·
Betula oishii	x	x	·	x	x	x	x	·	x	x	·
B. palibinii	·	x	·	·	·	·	·	·	·	·	·
Cyclocarya sakhalinensis	x	x	·	·	·	·	·	·	·	·	·
Populus balsamoides	·	·	·	·	·	x	x	·	·	x	x
Salix varians	x	x	·	·	·	x	·	·	·	x	·

36, figs. 1, 5, 6; text-fig. 36). ILJINSKAJA, 1982, p. 9, pl. 1, figs. 1, 2; text-figs. 2–*1*–*4* (see synonymy). FOTJANOVA, 1988, p. 81, pl. 2, fig. 14; pl. 4, fig. 7; text-figs. 31-*6*, *11*.

Ulmus appendiculata auct. non HEER, HUZIOKA, 1952, p. 260, text-fig. 156. OISHI & HUZIOKA, 1954, p. 127, pl. 14, fig. 6; pl. 15, fig. 5; pl. 16, fig. 1. TANAI, 1961, p. 316, pl. 17, figs. 3, 6, 7. TANAI, 1971, p. 158, pl. 7, fig. 7; pl. 8, fig. 8.

Remarks: This species was established on the basis of the leaves from the Oligo-Miocene rocks of the Ashutas Mountains in Kazakhstan. Subsequently, many Russian authors reported this species from various localities in central and eastern Eurasia, including Sakhalin (ILJINSKAJA, 1982). As the epithet *drepanodonta* shows, this species is characterized by large sickle-shaped teeth (dents) which are apically curved and possess typically one or two subsidiary teeth on the basal side.

Ulmus appendiculata was originally described by HEER (1878a) on the basis of the leaves from Due in northern Sakhalin. Since the HEER's original specimens are fragmentary, OISHI and HUZIOKA (1954) gave the supplementary description of this species based on abundant well-preserved leaves from the Esutoru coal-bearing Formation in southern Sakhalin. However, the HEER's original specimens contain a heterogeneous assortment of species. The lectotype of *U. appendiculata* was chosen by BAIKOVSKAJA (1974) and subsequently illustrated by ILJINSKAJA (1982). Following this procedure, the leaves under the name of *U. appendiculata*, as listed in the synonymy, differ from the leaf of HEER's

U. appendiculata and are identical with those of this species in the teeth configuration, feature of the secondary venation and inequilateral leaf base.

This species is one of the common plants in the Esutoru and Naihoro formations, and is also known from the late Early to early Middle Miocene floras in Hokkaido.

Occurrence: Esutoru Formation; Sarutsu (OISHI & HUZIOKA, 1954; AKMG-5882d), Nayoshi (OISHI & HUZIOKA, 1954; AKMG-5841), Toro coal mine (OISHI & HUZIOKA, 1954; AKMG-5879a), Taihei coal mine, Ko-onnai, Onnai, and Nishisakutan (OISHI & HUZIOKA, 1954), Shakhtersk (FOTJANOVA, 1964, 1988). Naihoro Formation; Naihoro coal mine (OISHI & HUZIOKA, 1954). Upper Due Formation (BAIKOVSKJA, 1974).

Ulmus pseudolongifolia OISHI et HUZIOKA

Ulmus pseudolongifolia OISHI et HUZIOKA, 1954, p. 131, pl. 14, figs. 1–3; pl. 15, fig. 4. TANAI, 1971, p. 159, pl. 7, fig. 6a; pl. 8, fig. 1; pl. 11, fig. 2. FOTJANOVA, 1988, p. 82, pl. 3, figs. 7, 8; text-fig. 32-*8*, *9*.

Remarks: *Ulmus pseudolongifolia* was reported by OISHI and HUZIOKA (1954) from the Esutoru and Naihoro formations in Sakhalin and the Sakipenpetsu flora in central Hokkaido. This species is easily distinguished from other *Ulmus* species in its unique leaf features: inequilaterally cordate base, numerous and regularly-arranged secondary veins and obtusely toothed margin.

The affinity to the extant species is not certain, but some Chinese species such as *U. lanceaefolia* ROXB. et WALLICH and *U. castanaefolia* HEMSLEY show the slight resemblance to this species.

Occurrence: Esutoru Formation; Toro coal mine (OISHI & HUZIOKA, 1954; AKMG-5857), Nayoshi (OISHI & HUZIOKA, 1954). Naihoro Formation; Shiritori and Kashiho coal mines (OISHI & HUZIOKA, 1954).

Family Betulaceae

Alnus miojaponica TANAI

Alnus miojaponica TANAI, 1961, p. 280, pl. 6, fig. 8; pl. 9, fig. 5; pl. 10, fig. 10. BAIKOVSKAJA, 1974, p. 106, pl. 31, figs. 7, 8; pl. 32, fig. 7; pl. 33, fig. 7; pl. 35, fig. 7; text-fig. 7. FOTJANOVA, 1988, p. 89, pl. 9, fig. 7; text-fig. 39-*5*; text-fig. 40-*2*.

Remarks: This species is commonly known in the Miocene floras of Japan, and in the Oligo-Miocene floras of Sakhalin (FOTJANOVA, 1988). *A. duensis* (BAIKOVSKAJA) ILJINSKAJA, an another species related to the extant *A. japonica* (THUNB.) STEUD., was reported from the "Upper Due Formation" in northern and southern Sakhalin (FOTJANOVA, 1988). *A. miojaponica* is distinct from *A.*

duensis: in the latter species the marginal teeth and secondary veins are coarsely-arranged.

Occurrence: Esutoru Formation; Sarutsu (AKMG-5882a). Naihoro Formation; Shiritori coal mine (AKMG-5850), Gar and Novikovo (FOTJANOVA, 1988). Upper Due Formation (BAIKOVSKAJA, 1974).

Alnus protocordata FOTJANOVA
Fig. 9

Alnus protocordata FOTJANOVA, 1988, p. 90, pl. 11, figs. 3, 4; pl. 13, fig. 1; text-figs. 42-3, 4.

Remarks: A single leaf, having characteristic spinosely-pointed teeth without lobation, is identical with this species which was described by FOTJANOVA from Shakhtersk (Toro) in southern Sakhalin.

Occurrence: Esutoru Formation; Sarutsu (AKMG-5892), Shakhtersk (FOTJANOVA, 1988).

Alnus usyuensis HUZIOKA
Fig. 4

Alnus usyuensis HUZIOKA, 1964, p. 70, pl. 4, fig. 11; pl. 5, figs. 3–5. FOTJANOVA, 1988, p. 91, pl. 13, fig. 7; pl. 16, fig. 3; text-fig. 40-7.

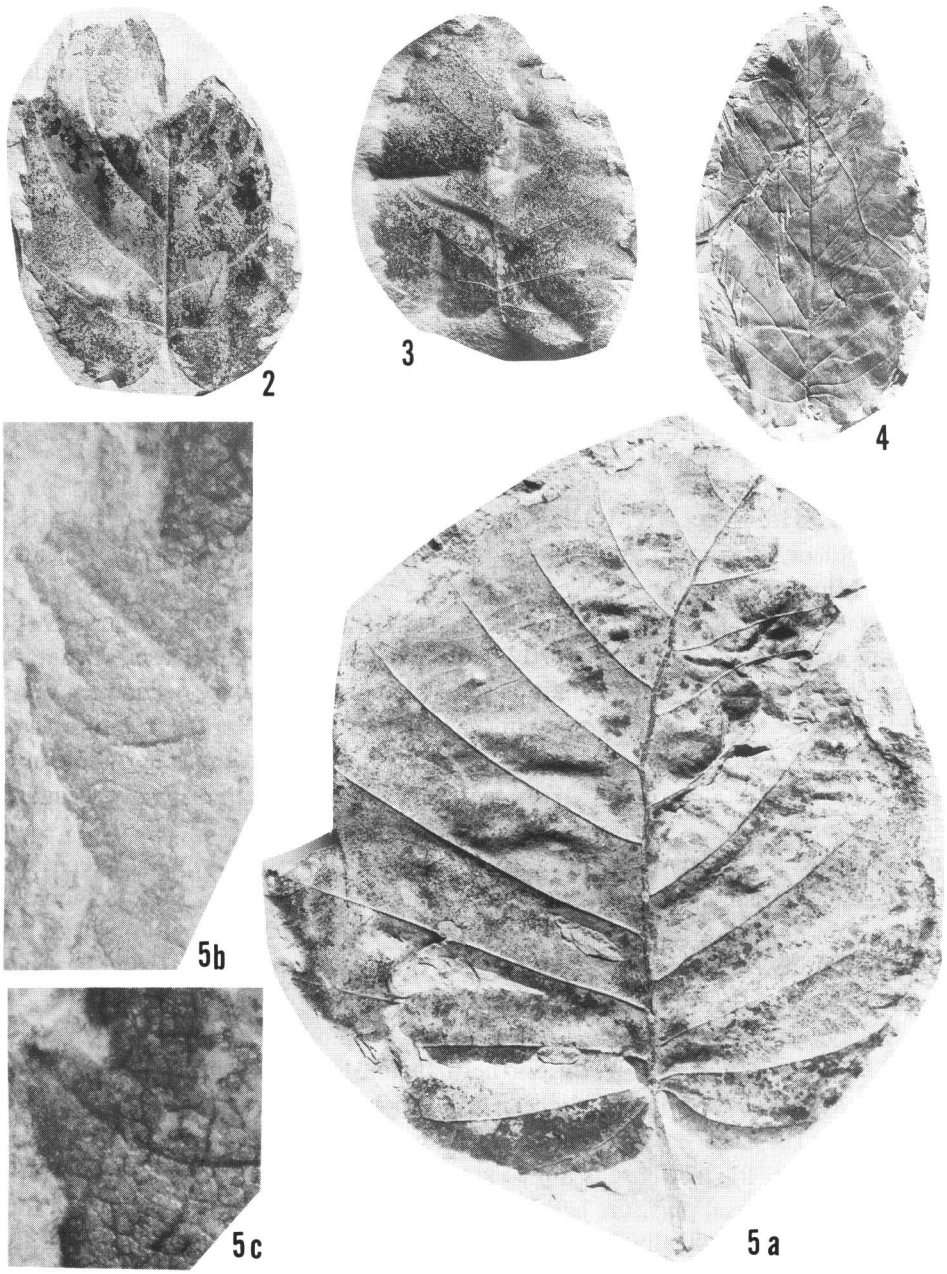
Remarks: The valid publication of *Alnus usyuensis* was in HUZIOKA (1964), though the name appeared in TANAI (1961, p. 283, pl. 6, figs. 1–3; pl. 7, figs. 2, 5, 6; pl. 9, fig. 8) and TANAI & N. SUZUKI (1963, p. 112, pl. 7, figs. 1, 2, 8).

This species is common in the early Early Miocene Aniai-type floras in Honshu and southwestern Hokkaido. The occurrence from the late Early to early Middle Miocene Daijima-type floras is only known in the Soya flora (TANAI, 1961) in northern Hokkaido. In Sakhalin, this species may be common in the Esutoru Formation, as FOTJANOVA (1988) also described it from Shakhtersk (Toro) and Riv. Nadezhdinka (Riv. Chio).

Occurrence: Esutoru Formation; Nayoshi (AKMG-5881a), Sarutsu (AKMG-5869), Kantazawa near Esutoru (AKMG-5837, 5893b), Shakhtersk and Riv. Nadezhdinka (FOTJANOVA, 1988).

Alnus sp. cf. *A. adumbrata* (HOLLICK) WOLFE
Figs. 2, 3, 8

Compare:
Alnus adumbrata (HOLLICK) WOLFE, 1966, p. 21, text-fig. 9.



Figs. 2–5. Betulaceous leaves–1. All figures ×1, except for figs. 5b & 5c. Figs. 2, 3, *Alnus* sp. cf. *A. adumbrata* (HOLLICK) WOLFE, loc. Sarutsu, AKMG-5891, 5890. Fig. 4, *Alnus usyuensis* HUZIOKA, loc. Kantazawa near Esutoru, AKMG-5893. Figs. 5a–5c, *Betula oishii* HUZIOKA et UEMURA, sp. nov., loc. Sarutsu, AKMG-5882c (holotype); figs. 5b & 5c show marginal configuration of fig. 5a, ×8.

Corylus adumbrata HOLLICK, 1936, p. 86, pl. 49, fig. 7. (not figs. 5, 6).

Remarks: These leaves from the Esutoru Formation are strongly cordate and asymmetric at the base, and slightly decurrent along the petiole. They are comparable with *Alnus adumbrata* which was described from the Middle Miocene (Homerian) rocks in Alaska.

Occurrence: Esutoru Formation; Sarutsu (AKMG-5838, 5842, 5867, 5872, 5876, 5878, 5883, 5890, 5891), Toyohata coal mine(AKMG-5885), Toro coal mine (AKMG-5888).

Betula oishii HUZIOKA et UEMURA, sp. nov.
Figs. 5a–c, 6

'*Betula miomaximowicziana* ENDO' [nom. nud.], FOTJANOVA, 1988, p. 92, pl. 15, fig. 7; text-fig. 46-*1*.

Type: Holotype AKMG-5882c (Sarutsu), paratypes AKMG-5889 (Sarutsu), 5884a (Toyohata coal mine); Esutoru Formation (late Early to early Middle Miocene).

Description: Leaves broadly ovate to nearly orbicular, generally large, 9–11 cm long and 5.5–9 cm broad, shortly acute at apex, cordate at base. Venation pinnate; primary vein thick, straight or somewhat zigzag to apex; secondary veins thick, 11 in pairs, alternate to subalternate, lowest pair diverged at more than right angles, gradually reducing angles upwardly, at 50–60 degrees in middle and upper parts of leaf, slightly up-curved, entering the main teeth centrally, branching some tertiary veins to smaller teeth, craspedodromous; intersecondary vein absent; tertiary veins distinct, straight-percurrent, 3–4 per cm; higher order veins thick, reticulate, highest order veins fifth; areoles quadrangular to polygonal, 0.4–0.6 mm across, with branching veinlets. Margin doubly serrate, not so conspicuous in upper part of leaf; acute teeth often curved apically, typically 4 per secondary veins. Texture thin. Petiole stout, 2–3 cm long.

Comparison and Remarks: These leaves are similar to those of the extant *Betula maximowicziana* REGEL in northern Japan, *B. miomaximowicziana* ENDO ex UEMURA (1988) from Mio-Pliocene floras in Japan, and *B. uotanii* K. SUZUKI (1961) from the early Early Miocene Shichiku flora in Northeast Honshu. In our leaves, however, the leaf-base is not so strongly cordate and reduced the breadth of lamina at the basal part, the basal pair of secondary veins is not so strong, and marginal teeth are typically acute and not so conspicuous. The leaf described by FOTJANOVA (1988) under the name of *B. miomaximowicziana* from the late Early Miocene Kavablya flora in Kamchatka is identical with this species in the above-noted features.

This species is named in recognition of the paleobotanical work of Saburo OISHI in Hokkaido and Sakhalin.

Figs. 6–9. Betulaceous leaves–2. All figures ×1. Fig. 6, *Betula oishii* HUZIOKA et UEMURA, sp. nov. loc. Toyohata coal mine, AKMG-5884a (paratype). Fig. 7, *Betula palibinii* AKHMETIEV, loc. Toyohata coal mine, AKMG-5852. Fig. 8, *Alnus* sp. cf. *A. adumbrata* (HOLLICK) WOLFE, loc. Sarutsu, AKMG-5878. Fig. 9, *Alnus protocordata* FOTJANOVA, loc. Sarutsu, AKMG-5892.

Occurrence: Esutoru Formation; Sarutsu (AKMG-5858,5880, 5882c 5889); Toyohata coal mine (AKMG-5884a, 5827, 5847b), Kitakozawa near Esutoru (AKMG-5832), Riv. Chio (AKMG-5866), Toro coal mine (AKMG-5879c, 5887), Taihei coal mine (AKMG-5829). Naihoro Formation; Odasu coal mine (AKMG-5844), Shiritori coal mine (AKMG-5828).

Betula palibinii AKHMETIEV
Fig. 7

Betula palibinii AKHMETIEV, 1973, p. 55, pl. 11, figs. 1, 5; pl. 13, fig. 1; pl. 15, fig. 3; pl. 16, fig. 4; pl. 27, fig. 5. BAIKOVSKAJA, 1974, p. 104, pl. 31, figs. 4, 5.

Remarks: *Betula palibinii* was established on the basis of the leaves from the Miocene floras of Sikhote-Alin, and reported by BAIKOVSKAJA (1974) from the Upper Due flora of northern Sakhalin. This species was compared by AKHMETIEV (1973) with the extant *B. albo-sinensis* BURK in China, *B. schmidtii* REGEL in northeastern Asia and *B. lenta* L. in North America.

Occurrence: Esutoru Formation; Toyohata coal mine (AKMG-5852). Upper Due Formation (BAIKOVSKAJA, 1974).

Family Juglandaceae

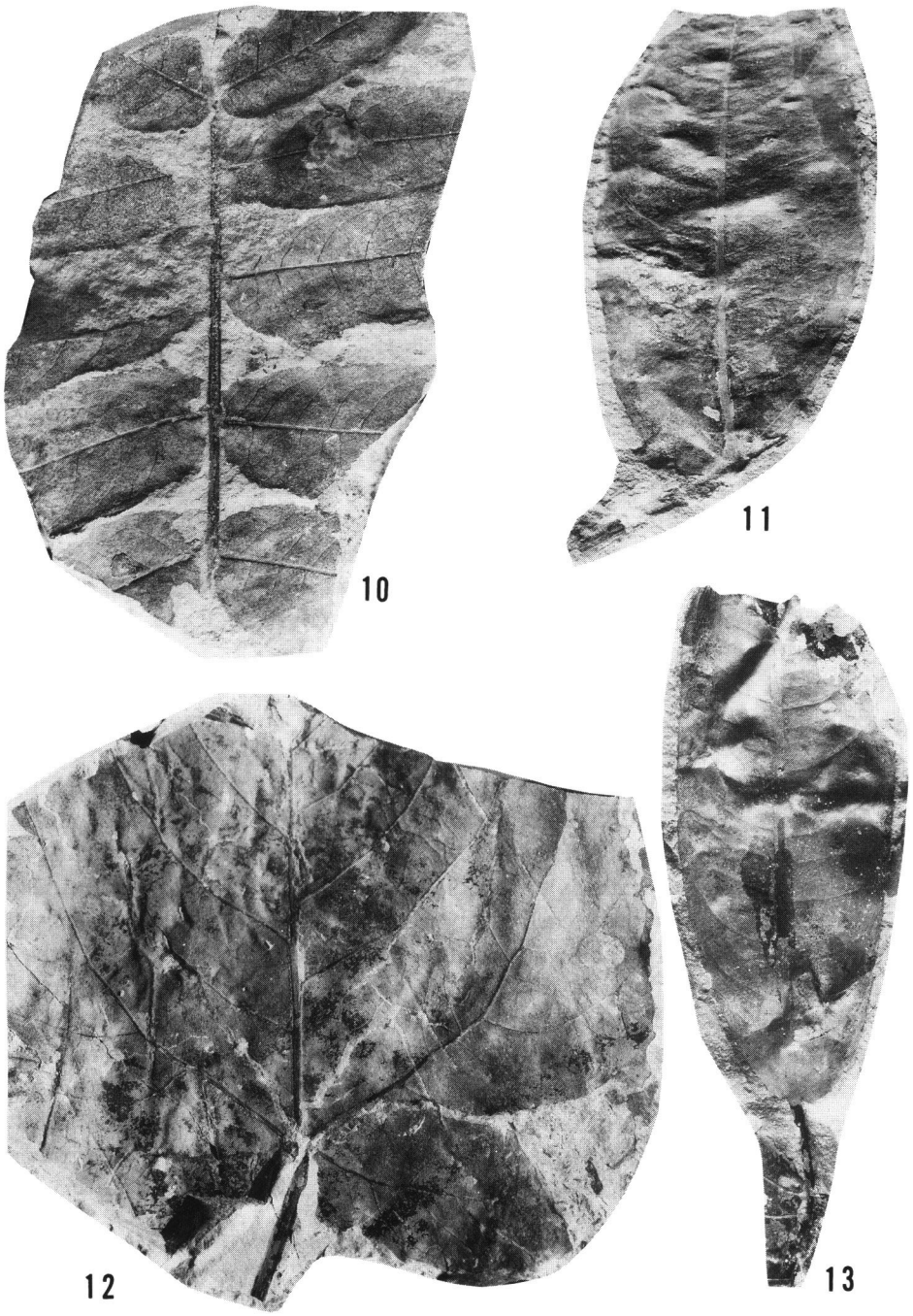
Cyclocarya sachalinensis BAIKOVSKAJA
Fig. 10

Cyclocarya sachalinensis BAIKOVSKAJA, 1974, p. 103, pl. 30, fig. 13; pl. 31, figs. 1–3; text-fig. 2. ILJINSKAJA, 1994, p. 43, pl. 7, fig. 7; text-fig. 34.

Remarks: *Cyclocarya sachalinensis* was described by BAIKOVSKAJA (1974) on the basis of the leaves and detached leaflets from the Upper Due flora of north Sakhalin. Very lately, ILJINSKAJA (1994) made a thorough revision of juglandaceous fossils, including *Cyclocarya*. According to her, a leaflet of *Pterocarya duensis* FOTJANOVA (FOTJANOVA, 1988, text-fig. 49-8) from Shakhtersk (Toro) is referred to this species.

Occurrence: Esutoru Formation; Sarutsu (AKMG-5851), Toyohata coal mine (AKMG-5845), Shakhtersk (FOTJANOVA, 1988). Upper Due Formation (BAIKOVSKAJA, 1974).

Figs. 10–13. Leaves of the Juglandaceae and Salicaceae. All figures ×1. Fig. 10, *Cyclocarya sachalinensis* BAIKOVSKAJA, loc. Toyohata coal mine, AKMG-5845. Fig. 11, *Salix varians* GOEPPERT, loc. Toro coal mine, AKMG-5826. Fig. 12. *Populus balsamoides* GOEPPERT, loc. Taihei coal mine, AKMG-5861. Fig. 13. *Salix varians* GOEPPERT, loc. Sarutsu, AKMG-5865.



Figs. 10–13.

Family Salicaceae

Populus balsamoides GOEPPERT

Fig. 12

Populus balsamoides GOEPPERT, 1855, p. 23, pl. 15, figs. 5, 6. HUZIOKA, 1952, p. 264, fig. 161. HUZIOKA, 1964, p. 65, pl. 3, fig. 4. TANAI, 1971, p. 154, pl. 8, fig. 8. AKHMETIEV, 1973, p. 49, pl. 7, fig. 5; pl. 8, fig. 5. BAIKOVSKAJA, 1974, p. 44, pl. 5, fig. 7; text-fig. 30. FOTJANOVA, 1988, p. 99, text-fig. 51-*1*.

Remarks: *Populus balsamoides* is widely distributed in Oligocene and Miocene floras of Eurasia. In Japan, this species has fossil records throughout the Miocene, but is more common in the earlier Miocene floras.

The leaves of this species are generally large in size and broadly truncate to cordate at the base, with a long petiole. The largest leaf in our disposal is from the Esutoru flora, being estimated over 20 cm in length and 13 cm in breadth.

Occurrence: Esutoru Formation; Toro coal mine (AKMG-5830, 5831, 5833, 5834, 5862), Taihei coal mine (AKMG-5860, 5861), Shakhtersk (FOTJANOVA, 1988). Naihoro Formation; Naihoro coal mine (AKMG-5859), Shiritori coal mine (AKMG-5863). Upper Due Formation (BAIKOVSKAJA, 1974).

Salix varians GOEPPERT

Figs. 11, 13

Salix varians GOEPPERT, 1855, p. 26, pl. 19, figs. 17, 18; pl. 20, figs. 1, 2. HEER, 1871, p. 2, pl. 8, fig. 3b. HUZIOKA, 1952, p. 261, figs. 158, 159. HUZIOKA, 1964, p. 66, pl. 3, fig. 8. TANAI, 1971, p. 155, pl. 4, figs. 5, 7, 8.

Remarks: *Salix varians* is widely distributed in Miocene floras of Eurasia. This species is common in the early Early Miocene Aniai-type floras of Honshu, while it is restricted in Hokkaido and northwardly in Sakhalin in the late Early to early Middle Miocene floras.

S. varians was compared by previous authors with the European extant *S. triandra* L. and *S. fagilis* L. *S. pet-susu* KIMURA now growing in northern Japan and *S. koreensis* ANDERSON in Korea are apparently related to *S. varians*.

Occurrence: Esutoru Formation; Sarutsu (AKMG-5840a, 5854, 5864, 5865; HEER, 1871, 1878a), Toyohata coal mine (AKMG-5849, 5884b), Toro coal mine (AKMG-5826, 5839, 5843, 5874, 5875). Naihoro Formation; Shiritori coal mine (AKMG-5847).

Concluding Remarks

Among the 11 species described in this paper, two ulmaceous species, *Ulmus*

drepanodonta and *U. pseudologofolia*, are noteworthy in comparison with Miocene floras in Japan. *U. drepanodonta* is known in the Soya flora (HUZIOKA, 1952; TANAI, 1961) in northern Hokkaido and Sakipenpetsu flora (HUZIOKA, 1952; TANAI, 1971) in central Hokkaido. *U. pseudolongifolia* has been recorded in the Sakipenpetsu flora (HUZIOKA, 1952, TANAI, 1971). Both floras are inclusive into the Daijima-type floras of late Early to early Middle Miocene age (TANAI & UEMURA, 1988). *Alnus usyuensis* is an element characteristic in the Aniai-type floras of early Early Miocene, but is also known in the Soya flora. *Populus balsamoides* and *Salix varians* are mostly confined to the Aniai- and Daijima-type floras in Japan, being more common in the former type: these two species are known in the Soya and Sakipenpetsu floras. Plant megafossil assemblages from the Esutoru and Naihoro formations have a close similarity in their floristic elements to the Daijima-type floras in central and northern Hokkaido.

The following species are also recognized in the AKMG collection (nos. 5826–5894) from the Esutoru and Naihoro formations: *Glyptostrobus europaeus* (BRONGNIART) HEER, *Metasequoia occidentalis* (NEWBERRY) CHANEY, *Liquidambar* sp., "*Castanea*" sp., *Alnus* sp., *Betula* sp., *Carpinus* sp., *Corylus* sp., *Acer tricuspidatum* BRONN, "*Alangium*" *aequalifolium* (GOEPPERT) KRYSHTOFOVICH et BORSUK, and *Tilia remotiserrata* OISHI et HUZIOKA. Although the fossil collection is small in size, plant megafossil assemblages from the Esutoru and Naihoro formations are characterized by the rich swamp-border or streamside elements, such as *Ulmus drepanodonta*, *Alnus usyuensis*, *Populus balsamoides*, *Salix varians*, and *Glyptostrobus europaeus*.

FOTJANOVA (1988) subdivided the Esutoru Formation (her Upper Duiskaya Suite, *s.l.*) on the basis of the floral composition and lithologic features: *i.e.*, the Shakhterskaya and Upper Duiskaya subsuites, in ascending order. She concluded that the flora from the Shakhterskaya Subsuite is correlated to the Aniai-type floras and that from the Upper Duiskaya Subsuite to the Daijima-type. Regarding this, our fossil material has no detailed stratigraphic data in the Esutoru Formation at present. However, so far as judged from the floristic list shown by FOTJANOVA (1988), difference in the floral composition between the two subsuites is not so conspicuous. Although more studies are necessary, both floras by FOTJANOVA (1988) in the Esutoru Formation may represent minor difference within the Daijima-type flora.

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