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Author(s)	Huzioka, Kazuo
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# Notes on Some Tertiary Plants from Tyôsen. I\*

By

Kazuo HUZIOKA

*With 5 Plates*

(Contribution from the Department of Geology and Mineralogy, Faculty of Science, Hokkaidô Imperial University, Sapporo, No. 314).

The material which form the subject of the present note was collected some years ago by Professor S. ÔISHI from Meisen and

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\* A few years ago when I visited Tyôsen for the purpose of collecting fossil plants, Mr. R. KODAIRA kindly entrusted to me for study and description of some Tertiary plants from Kokangen district, N. Kankyô Dô and from the environs of Geizitu Bay, N. Keisyô Dô, which were mostly collected by Mr. N. UOTANI, and I gladly accepted the responsibility. My undertaking on the synthetic study of the Mesozoic floras of Japan compelled me temporarily to neglect the study of the Tertiary plants until now. However, the recent progress of the study of the Cenozoic plants of Hokkaidô and Karahuto now carrying on with the collaboration of Mr. K. HUZIOKA lead me to think of again the fossil plants from Tyôsen which show very similar assemblage with certain Cenozoic flora of Hokkaidô and Karahuto. Thus in order to avoid unnecessary delay, I suggested to Mr. HUZIOKA to study on one side the collection of Messrs. KODAIRA and UOTANI together with my own collection of Tertiary plants from some other localities in Tyôsen on the other. This seems to be pretty helpful to the study of the Tertiary plants of Hokkaidô and Karahuto, and papers will appear hereafter according to the progress of the study of the fossil plants from Tyôsen. Here I wish to express my cordial thanks to Mr. KODAIRA who kindly offered me the valuable specimens for study. Lastly, although Dr. S. ENDÔ of the Tôhoku Imperial University is also undertaking the study of the Tertiary plants of Tyôsen which he collected, HUZIOKA's study is rather independently carrying on in our Department. But I must appreciate to Dr. ENDÔ who always so much generous to give helpful suggestions to our study. Acknowledgment is also due to the Tôsyôgû Sambyakunen-sai Kinen-kai for a grant-in-aid devoted to me which has made possible the trips to Tyôsen. S. ÔISHI.

Kissyû districts of northeastern Tyôsen to which were added some specimens collected by Messers R. KODAIRA and N. UOTANI from the *Engelhardtia* Bed of Kokangen in northeastern Tyôsen and from the environs of Geizitu Bay in southeastern Tyôsen. Prof. ÔISHI first intended to study and describe them by himself, but recently he kindly submitted me the whole material for study.

The specimens are all impressions mostly of leaves but are usually very well preserved so as to show minute morphological characters. Their localities enumerated from north to south and geological horizons are as follows:

1. Ryûhokudô,<sup>1)</sup> Kokangen coal-mine, N. Kankyô Dô. *Engelhardtia* Bed (Miocene). Colls. R. KODAIRA and N. UOTANI.
2. Kissyû-Town,<sup>2)</sup> Kissyû-gun, N. Kankyô Dô. White Shale in the Kissyû Formation (Miocene). Coll. S. ÔISHI.
3. Yûtendô,<sup>3)</sup> Meisen-gun, N. Kankyô Dô. Ryûdô Formation. (Miocene; Palaeogene after TATEIWA). Coll. S. ÔISHI.
4. Kantindô,<sup>4)</sup> Meisen-gun, N. Kankyô Dô. Kantindô Formation (Miocene). Coll. S. ÔISHI.
5. Nanseki,<sup>5)</sup> Meisen-gun, N. Kankyô Dô. Hyôrokudô Formation (Miocene). Coll. S. ÔISHI.
6. Kinkôdô, Usen-men,<sup>6)</sup> N. Keisyô Dô. Enniti Series. (Miocene). Colls. R. KODAIRA and N. UOTANI.

As to the precise stratigraphical positions among the Miocene age, of each *Engelhardtia* Bed, White Shale, Ryûdô Formation Kantindô Formation, Hyôrokudô Formation and Enniti Series, there is diverse opinions from the view point of stratigraphy and Palaeozoology. In the present note, however, they have been all included in the Miocene as a whole as such is rather convenient in the present

1) 咸境北道古乾原炭礦龍北洞 (*Engelhardtia* 層) S. ENDÔ: Cenozoic Plants from Tyôsen (Korea). Journ. Geol. Soc. Japan, Vol. XLV, Nos. 532, 534, 1938.

2) 咸境北道吉州郡吉州邑 (吉州層白色頁岩) F. YAMANARI: Geological Maps of Tyôsen. No. 3. Kanyohô-Kissyû-Sihô and Kimmel Sheets; 1/75000, 1925.

3) 咸境北道明川郡雋店洞 (龍洞層) I. TATEIWA: Geological Maps of Tyôsen. No. 4. Kyokudô-Meisen-Sitihôsan and Katendô Sheets; 1/75000, 1925.

4) 咸境北道明川郡咸鎮洞 (咸鎮洞層) I. TATEIWA: Op. cit.

5) 咸境北道明 郡南夕 (坪六洞層) I. TATEIWA: Op. cit.

6) 慶尙北道迎日郡烏川面金光洞 (延日統) K. KANEHARA: Geology of the Northern Part of Geizitu District, N. Keisyôdô, Korea. Journ. Geol. Soc. Japan, Vol. XLIII, No. 509, 1936.

scope of Palaeobotany. As to the stratigraphy of each fossil locality, the readers will be requested to refer the original papers to which references are made in the foot-note.

In the present note are described some selected genera such as *Salvinia*, *Tilia*, *Acer* and *Platanus*, as they have already been treated also in the study of the Cenozoic plants of Hokkaidô and Karahuto printed in this Journal as joint work with Professor ÔISHI. Other genera will be described by the present writer hereafter according to the progress of the study.

At this place the writer wishes to express his cordial thanks to Professor S. ÔISHI who has given him an opportunity of studying this interesting material and giving valuable suggestions in all ways during the course of the present study, and who has given him permission to use freely his private library.

### Genus *Salvinia* ALLIONI

In eastern Asia, *Salvinia* is one of the most interesting fossil plants geologically widely distributing through the Cenozoic. The oldest representative of the genus in the world is an undeniable *Salvinia* from the Honkeiko Group (Upper Jurassic or Lower Cretaceous) in southern Manchoukuo that has been briefly described by YABE and ENDÔ<sup>1)</sup> as *Salvinia* sp. Besides this, *Salvinia* from the continental part of the eastern Asia has been known from the following places: *S. formosa* by ZEILLER<sup>2)</sup> from the Miocene of Tongking, Indo-China, *S. sp.* by ONUKI<sup>3)</sup> from the Fushun coal-field, Manchoukuo, and *S. formosa* by KRYSHTOFOVICH<sup>4)</sup> from the Changi flora and *S. sp.* by KANEHARA<sup>5)</sup> from the Enniti Series, both of South-eastern Tyôsen.

- 1) H. YABE and S. ENDÔ: *Salvinia* from the Honkeiko Group of the Honkeiko Coal-Field, South Manchuria. Jap. Journ. Geol. Geogr., vol. V, no. 3, 1927, p. 113.
- 2) R. ZEILLER: Flore fossile de gîtes de charbon du Tonkin, 1903, p. 269; pl. LI, figs. 2, 3. It seems to the present writer that ZEILLER's specimens from Tongking are a type similar to *S. pseudoformosa* ÔISHI and HUZIOKA.
- 3) Y. ONUKI: Fossils of the Fu-shun Coal-Fields (Picture Cards), 1932.
- 4) A. KRYSHTOFOVICH: To the Tertiary Flora of Changi in Korea. Rec. Geol. Comm. Russ. Far East, no. 18, p. 14 (list only).
- 5) K. KANEHARA: The Geology of the Northern Part of Geizitu District, North Kankyôdô, Korea. Journ. Geol. Soc. Japan, vol. LXIII, no. 509, 1936, p. 82 (list only).

The *Salvinia* which the present writer wishes to describe at this place is a single specimen, derived from the *Engelhardtia* Bed of Kokangen, N. Kankyô Dô, which, though not in satisfactory preservation, is closely allied to *S. pseudoformosa* ÔISHI and HUZIOKA than to any other known species of this genus. The description follows:

*Salvinia pseudoformosa* ÔISHI and HUZIOKA

Pl. XXII(II), Fig. 1.

1941. *Salvinia formosa* ÔISHI and HUZIOKA: Studies on the Cenozoic Plants of Hokkaidô and Karahuto. II, *Salvinia natans* ALLIONI *fossilis* subsp. nov. from Karahuto and *S. formosa* HEER from Hokkaidô. This Journal, Vol. VI, No. 2, p. 197, pl. XLIV, figs. 5, 5a, 6, 6a, 7, 7a, 8, 8a, 9, 9a.
1943. *Salvinia pseudoformosa* ÔISHI and HUZIOKA: A Supplementary Note on *Salvinia formosa* HEER. This number of this Journal. p. 68, text-figs. 1, 1a, 1b, 2-4.

Pl. XXII(II), fig. 1 shows three floating leaves in close association two of which bear water leaves. As all of the floating leaves are half folded upwards, each leaf shows semi-orbicular in outline and we see here impression of the lower surface. The mesh is the same as is shown in the case of *S. pseudoformosa* ÔISHI and HUZIOKA (= *S. formosa* in ÔISHI and HUZIOKA, 1941, op. cit., p. 197, text-fig. 3) and the tubercles appear to be arranged in a single row. Also the marginal loop appears to be absent, the lateral nerves ending direct at the margin of the leaf. The water leaf is slender and about 13 mm. long.

\* ENDÔ<sup>1)</sup> listed *Salvinia* sp. from the *Engelhardtia* Bed of Kokangen. KRYSHTOFOVICH<sup>2)</sup> and KANEHARA<sup>3)</sup> also listed *S. formosa* from the Japan Sea coastal region of southeastern Tyôsen, but all of these are accompanied with neither figure nor description.

*Occurrence:*

*Engelhardtia* Bed of the Kokangen coal-field, N. Kankyô Dô.

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- 1) S. ÔISHI and K. HUZIOKA: A Supplementary Note on *Salvinia formosa* HEER. This number of this Journal, p. 68, text-figs. 1, 1a, 1b, 2-4.
  - 2) S. ENDÔ: Cenozoic Plants from Tyôsen (Korea). I. Journ. Geol. Soc. Japan, vol. XLV, no. 532, 1938, p. 89.
  - 3) A. KRYSHTOFOVICH: Op. cit.
  - 4) K. KANEHARA: Op. cit.

Genus *Tilia* (TOURNEFORT) LINNE

ÔISHI and HUZIOKA<sup>1)</sup> recently described three different types of fossil *Tilia* from the Cenozoic rocks of Hokkaidô and Karahuto, of these two were new species while the remaining one was specifically indeterminable. The fossil occurrence of this genus is also not common even in the whole area of the Japanese Islands, but seems to have been rather common in Tyôsen in the Tertiary time.<sup>2)</sup> Tertiary *Tilia* which the present writer discriminated and described in this note are as follows:

*T. japonica* SIMK.

*T. distans* NATHORST

*T. remotiserrata* ÔISHI and HUZIOKA

*T. meisenensis* sp. nov.

*T. subnobilis* sp. nov.

*T. japonica* is widely distributed in the modern forest in Hokkaidô, Honsyû, Sikoku and Kyûsyû, and it distributes also in Central China. As fossil, it has been recorded only from the Siobara Lake Deposits (Pleistocene). *T. distans* has been known from the Neogene beds of Mogi, Amakusa and Omi. Thus it is very interesting that the geographical distribution of these species were now far extended as far as Tyôsen. The remaining three species are new (*T. remotiserrata* has recently been named for leaves from Karahuto), but are highly interesting that their allied forms being found among the living *Tilia* in Central China but not among fossils.

*Tilia distans* NATHORST

Pl. XXI(I), Figs. 1-4, 7 and 8.

1883. *Tilia distans* NATHORST: Contributions à la flore fossiles du Japon. Kgl. Svensk. Vet. Akad. Handl., Bd. XX, No. 2, p. 65, pl. VI, figs. 5-13.

1920. *Tilia distans* FLORIN: Zur Kenntnis der jungtertiären Pflanzenwelt Japans. Ibid., Bd. LXI, No. 1, p. 25, pl. II, fig. 9.

- 1) S. ÔISHI and K. HUZIOKA: Studies on the Cenozoic Plants of Hokkaidô and Karahuto. V. Tertiary *Tilia* from Hokkaidô and Karahuto. This number of this Journal.
- 2) Lists of fossil and living species of the genus *Tilia* from Japan (incl. Tyôsen) are given in the paper by ÔISHI and HUZIOKA referred to above.

*Description of specimens:* Pl. XXI (I), fig. 3 shows a basal part of a leaf with petiole about 3 cm. long. The base is slightly cordate and asymmetrical. The midvein is well-defined. So far as can be seen, the lateral primary veins are also well-defined and straight. About 5 lateral secondary veins are given off abaxially from the basal pair of the primaries, slightly curving and end in marginal teeth. Another leaf in fig. 1 is imperfect in its distal and petiolar portion. The blade is 5 cm. broad and more than 7 cm. long. The marginal serration is clearly seen in the figure. The midvein is straight, while the lateral secondary veins which are about 4 in number on each side are slightly curved. In fig. 7 is shown an imperfect floral bract occurred in close association with the leaf in fig. 3 but not in organic connection. It is more than 5.5 cm. long and 2 cm. broad traversed by a thick midvein and the margin is broadly wavy. The vein system is clearly seen in the figure.

*Remarks:* Although the specimens here referred to NATHORST's species are all fragmentary, they resemble most this species among known species of this genus. The bract is not in organic connection with the leaves, but has provisionally been referred to this species. Similar bracts are associated with *Tilia distans* at Mogi where NATHORST<sup>1)</sup> described this species. Later FLORIN<sup>2)</sup> described a leaf of this species from Amakusa.

*Comparison:* There are several allied forms among living and fossil *Tilia*. The modern species, leaves of which have similar morphological characters with *T. distans* are *T. breviradiata* HU and CHUNG,<sup>3)</sup> *T. Miqueliana* MAXIM.<sup>4)</sup>, *T. laetevilens* REHDER and WILSON,<sup>5)</sup> *T. oblongifolia* REHDER,<sup>6)</sup> all living in China. But in *T. breviradiata* and *T. Miqueliana* the base is more strongly cordate, although marginal serration is similar, in *T. laetevilens* the marginal serration is finer, in *T. oblongifolia* the margin is almost entire though similar in basal character. The fossil bracts described above are too imperfect to admit of comparison with those of these living species.

1) A. G. NATHORST: Op. cit., 1883, p. 63, pl. I, fig. 12.

2) R. FLORIN: Zur Kenntnis der jungtertiären Pflanzenwelt Japans. Kgl. Svensk. Vet. Akad. Handl., Bd. LXI, no. 1, 1920, p. 25, pl. II, fig. 9.

3) Kiangsu.

4) Kiangsu (and in southern part of Kyûsyû, Japan).

5) Kansu, Honan and Shensi.

6) Anhwei.

Among the fossil leaves, there are three comparable species described from America. They are *T. populifolia* LESQ.,<sup>1)</sup> *T. aspera* (NEWBERRY)<sup>2)</sup> and *T. oregona* LAMOTTE.<sup>3)</sup> In these American species, however, the lateral nerves are decidedly more in number and the base of the leaves is markedly cordate. *T. sachalinensis* HEER<sup>4)</sup> from Sachalien resembles *T. distans* in the basal character, but is not known of the general outline of the leaf. KON'NO<sup>5)</sup> figured an imperfect leaf from the Omi flora of Sinano as *T. distans*, but without description.

**Occurrence:** Yûtendô, Meisen-gun, N. Kankyô Dô (Ryûdô Formation); Kissyû-Town, Kissyû-gun, N. Kankyô Dô (White Shale of the Kissyû Formation).

*Tilia japonica* SIMONKAI

Pl. XXI(I), Fig. 6.

1940. *Tilia japonica* ENDÔ: A Pleistocene Flora from Siobara, Japan. Sci. Rep. Tôhoku Imp. Univ., 2nd Ser., Vol. XXI, No. 1, p. 68, Pl. VIII, figs. 7, 19.

*Tilia japonica* is one of the commonest arborescent trees in the Japanese Islands and it grows also in central China. In Japan it distributes from Hokkaidô, Honsyû, Sikoku as far as Kyûsyû, and it grows on the mountain forest more than 300 m. above the sea level in central Japan and more than 400 m. in Kyûsyû. In China it grows in Kiangsu, Anhwei and Chekiang, but not in Tyôsen.<sup>6)</sup>

- 1) L. LESQUIREUX: Contributions to the Fossil Flora of the Western Territories. III. The Cretaceous and Tertiary Floras. U.S.G.S. Terr. Rep., vol. VIII, 1883, p. 179, pl. XXXIV, figs. 8, 9.
- 2) J. S. NEWBERRY: The Later Extinct Floras of North America. U.S. G.S. Mon., vol. XXXV, 1898, p. 102, pl. XLII, figs. 1 and 2 (non fig. 3 and pl. LIX, fig. 3), described as *Platanus aspera*. R. S. LAMOTTE: The Miocene *Tilias* of Western America. p. 45, pl. I, figs. 1-3; pl. II, figs. 1, 2.
- 3) R. S. LAMOTTE: Op. cit., p. 47, pl. III, figs. 1-6.
- 4) O. HEER: Flora Fossilis Arctica, Bd. V, Abth. 3, 1878, p. 47, pl. XII, figs. 6, 7.
- 5) E. KON'NO: Cenozoic Flora from the Central Sinano, in HOMMA: Geology of the Central Sinano. 1931, pl. XIV, fig. 4.
- 6) Although LAMOTTE (R. S. LAMOTTE: The Miocene *Tilias* of Western America. Carnegie Instit. Washington, Publ. no. 455, pt. 3, 1936, p. 46), wrote that *T. japonica* is now living in Tyôsen, Manchuria and North China, she is obviously mistaken as it is restricted in its distribution only in Hokkaidô, Honsyû and Central China.



The fossil leaf figured in fig. 6 on Pl. XXI(I), has been derived from the Kantindô Formation of the Meisen Group of Miocene age, and shows a striking morphological agreement with the modern leaves of *T. japonica*. Imperfect specimens figured by SCHMALHAUSEN<sup>1)</sup> from Altai as *T. cordata* are very similar to *T. japonica*.

*Occurrence:* Yûtendô, Meisen-gun, N. Kankyô Dô (Ryûdô Formation).

### *Tilia remotiserrata* ÔISHI and HUZIOKA

Pl. XXI(I), Fig. 5.

This species<sup>2)</sup> recently described from the Esutoru coal-bearing Bed (Kawabataian) of Karahuto is now found to occur also in the nearly equivalent rocks (The Enniti Series) of southeastern Tyôsen. As it is shown in Pl. XXI(I), fig. 5, the leaf is petiolate, ovately oblong, more than 7 cm. long and 4.4 cm. broad, and the base is markedly cordate and asymmetrical. The margin is slightly undulate or with remote short teeth at the end of lateral primary and lateral secondary veins. Venation is distinct. The midvein is the thickest and straight, lateral primary veins are camptodromous, about 6 on one side, at an angle of about 30° to the midvein and nearly straight. Lateral secondaries given off abaxially from the basal pair of the primaries are about 6 in each, the lowest one curving strongly. The tertiaries are rather coarse and percurrent.

*Remarks:* As was already mentioned by ÔISHI and HUZIOKA,<sup>3)</sup> the present species bears rather closer similarity with some of living species in Central China, namely, *T. lepidota* REHDER in Chekiang and *T. oblongifolia* REHDER in Anhwei. However, in the former the leaves are less cordate and the lateral primaries are curving and more markedly camptodromous; in the latter the lateral primaries are also strongly curved and markedly ascend along the margin.

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- 1) J. SCHMALHAUSEN: Über Tertiär Pflanzen aus dem Thale des Flusses Buchtorma am Fusse des Altaigebirges. Palaeontogr., vol. XXXIII, 1887, p. 211, pl. XXII, figs. 1-4.
  - 2) S. ÔISHI and K. HUZIOKA: Studies on the Cenozoic Plants of Hokkaidô and Karahuto. IV. Tertiary *Tilia* from Hokkaidô and Karahuto. This number of this Journal, p. 77, pl. VIII(I), figs. 2, 2a.
  - 3) S. ÔISHI and K. HUZIOKA: Ibid.

Among the fossil species, *T. speciosissima* KNOWLTON<sup>1)</sup> from the Raton Formation of North America is one closely allied to the present species except the base where in that coarsely serrate.

*Occurrence*: Kinkôdô, Usen-men, Geizitu-gun, N. Keisyô Dô (Enniti Series).

*Tilia meisenensis* sp. nov.

Pl. XXII(II), Fig. 5 (type-specimen).

A single specimen examined; its description follows:

*Description*. Leaf petiolate, ovate-oblong, about 9 cm. long, 5.5 cm. long, slightly cordate and asymmetrical; margin coarsely serrate, teeth acuminate; veins palmate at the base, of which the median one forms the midvein and reaches the top of the leaf; lateral secondaries about 5 on each side, at an angle of about 45° to the midvein then curving upwards and probably end in marginal teeth; lateral tertiaries obscure.

*Remarks*: Though this new species was named based on a single leaf impression, yet it does not agree with none of the living and fossil species. This species is certainly a type of *T. distans* NATHORST in the leaf form and venation, but in this the base is usually more markedly and obliquely inequilateral. This species may be a type of leaves of living *T. japonica* SIMK. There is also a certain resemblance to *T. Miqueliana* MAXIM. in marginal teeth, but in this the leaves are broader.

*Occurrence*: Yûtendô, Meisen-gun, N. Kankyô Dô (Ryûdô Formation).

*Tilia subnobilis* sp. nov.

Pl. XXII(II), Figs. 2, 3 (type-specimen), ?4.

*Description*: Leaf petiolate, considerably large, deeply cordate, asymmetrical at the base. Margin serrate, teeth acuminate and upwarded. Nervation palmate in the origin, 5 plinervous, of which the median one (midvein) thick and straight; lateral primary veins 5

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1) F. H. KNOWLTON: Fossil Floras of the Vermejo and Raton Formations of Colorado and New Mexico. In W. T. LEE and F. H. KNOWLTON: Geology and Palaeontology of the Raton Mesa and other Regions in Colorado and New Mexico. U.S.G.S., Prof. Paper 101, p. 336, pl. LXVII.

or 6 on each side,  $45^{\circ}$ – $50^{\circ}$  to the midvein, craspedodromous; tertiaries percurrent; finer veins form fine meshes.

*Remarks:* There is a floral bract occurred in association with the leaves; it is shown in Pl. XXII (II), fig. 3. It is considerably large, being more than 8 cm. long and 2 cm. broad, widening gradually towards the distal end and suddenly round off there.\* The well-marked midvein sends off lateral veins at an oblique angle as is clearly shown in the figures. As there is no organic connection with the leaves among the specimens now at my disposal, it is only provisionally that the bract is described at this place.

As is shown in the figures 2 and 3, the leaves of the species attain a considerable dimension in its complete state. Even the imperfect specimen in Pl. XXII (II), fig. 3 shows that the breadth is at least 10 cm.

*Comparison:* Similar leaves are found in *T. nobilis* REHDER and WILSON in Szechuan, Central China, *T. Miyabei* JACK in northern Japan, and *T. japonica* SIMK. from the Japanese Islands and Central China. Especially the leaves in *T. nobilis* seem to be almost indistinguishable from the present fossil leaves except that the base is very deeply cordate. Bracts are also very large (fig. 4). The present fossil leaves resemble also large leaves of *T. japonica*, but in the living species the lateral primary veins are generally less in number (in *subnobilis*  $\pm 7$ , in *japonica*  $\pm 5$ ).

Among fossils, leaves named by HEER<sup>1)</sup> as *T. Malmgreni* from the Arctic region is somewhat comparable to the present fossil, but in that the marginal serration is finer than this. A more allied form is *T. miohenryana* HU and CHANEY<sup>2)</sup> from the Shanwang flora of Shantung prov., China, but it slightly differs from ours in the basal and marginal characters of leaf.

*Occurrence:* Yûtendô, Meisen-gun, N. Kankyô Dô (Ryûdô Formation).

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1) O. HEER: *Flora Fossilis Arctica*, Bd. I, Abth. 5, 1868, p. 160, pl. XXXIII.

2) H. H. HU and R. W. CHANEY: *A Miocene Flora from Shantung Province, China*. Carnegie Inst. Washington, Bull. No. 507, 1940, p. 69, pl. XXXIII, fig. 3a; pl. XLIV, figs. 1, 2; pl. XLV, fig. 3.

Genus *Acer* L.<sup>1)</sup>

*Acers* form one of the most common forest trees in Tyôsen. So far as *Acers* concerned, it is interesting to note that they have closer relationship to the Manchurian forest flora than to that of the Japanese Islands; this can be understood from the fact that 8 species among 13 species of Tyôsenian *Acers* are growing in Manchuria, while only 4 species are common with *Acers* in the Japanese Islands. Moreover, 5 species among 8 common between Tyôsen and Manchuria are common only between these two floral districts, while remaining three species are common all over the Japanese Islands, Tyôsen and Manchuria. Therefore, 3 species among 4 which are common between Tyôsen and the Japanese Islands are cosmopolitan ones widely distributing in Eastern Asia, and only one remaining species is common between Tyôsen and the Japanese Islands. These common species between Tyôsen and Manchuria are *A. mandshuricum* MAXIM., *A. triflorum* KOM., *A. tegmentosum* MAXIM., *A. Tschonoskii* MAXIM. var. *rubripes* KOM., and *A. barbinerve* MAXIM. var. *glabrescens* NAKAI, while remaining three species come on all over the Japanese Islands, Tyôsen and Manchuria are *A. ukrunduense* TRAUTY. et MEY., *A. mono* MAXIM. and *A. ginnala* MAXIM.

While on the contrary, the similarity of the Miocene *Acers* between the Japanese Islands (especially Hokkaidô and Karahuto), Tyôsen and Manchuria is quite reverse.

Following is the list of the fossil *Acers* described in the present note:<sup>2)</sup>

- 1) Prof. ÔISHI and the present writer recently summarized the fossil *Acers* from Hokkaidô and Karahuto (S. ÔISHI and K. HUZIOKA: Studies on the Cenozoic Plants of Hokkaidô and Karahuto. V. Tertiary *Acers* from Hokkaidô and Karahuto. This number of this Journal). The note contains the description of the fossil *Acers* from the named two islands together with brief discussion concerning the phytogeographical problems of the *Acers*.
- 2) Some fossil *Acers* have already been reported from the Tertiary rocks of Tyôsen, however, they are neither described nor accompanied with illustrations. They are as follows:
  - A. palmatum* THUNB. (Kantindô Formation, TATEIWA 1925 and ENDÔ 1938; Tûsen, ENDÔ 1938).
  - A. palmatum* THUNB. (Kantindô Formation, TATEIWA 1925).
  - A. Nordenskiöldi* NATH. (Tûsen, ENDÔ 1938; Enniti Series, KANEHARA 1937).
  - A. platanoides* L. (Kantindô Formation, ENDÔ 1938).
  - A. trilobatum* AL. BRAUN (Kantindô Formation, ENDÔ 1938; *Engelhardtia* Beds of Kokangen, ENDÔ 1938; Tûsen, ENDÔ 1938).
  - A. sp. nov.* (Tûsen, ENDÔ 1938).
  - A. sp.* (Kantindô Formation, TATEIWA 1925, ENDÔ 1938; *Engelhardtia* Beds of Kokangen, ENDÔ 1938; Ryûdô Formation, TATEIWA 1925).

- A. rotundatum* sp. nov. (Kinkôdô, Geizitu-gun, N. Keisyô Dô; Enniti Series; Yûtendô, Meisen-gun, N. Kankyô Dô, Ryûdô Formation).
- A. subpictum* SAPORTA (Kantindô, Meisen-gun, N. Kankyô Dô, Kantindô Formation; Yûtendô, Meisen-gun, N. Kankyô Dô, Ryûdô Formation; Kissyû-Town, Kissyû-gun, N. Kankyô Dô, White Shale in the Kissyû Formation; Kinkôdô, Usen-men, Geizitu-gun, N. Keisyô Dô, Enniti Series).
- A. ezouanum* ÔISHI and HUZIOKA (Kantindô, Meisen-gun, N. Kankyô Dô, Kantindô Formation).
- A. fatsiaefolia* sp. nov. (Kinkôdô, Usen-men Geizitu-gun, N. Keisyô Dô, Enniti Series).
- A. trilobatum* (STERNB.) var. *productum* AL. BRAUN (Kantindô, N. Kankyô Dô, Kantindô Formation).
- A. ornatum* CARR. (Kinkôdô, Usen-men, Geizitu-gun, N. Keisyô Dô, Enniti Series).
- A. japonicum* THUNB. (Kantindô, Meisen-gun, N. Kankyô Dô, Kantindô Formation).
- A.* sp. indet. (Yûtendô, Meisen-gun, N. Kankyô Dô, Ryûdô Formation).
- A.* spp. (samarae) (Each locality and formation enumerated above).

Of these fossil *Acers*, there is no common species with the Manchurian Miocene flora; this is possibly because of the scantiness of our knowledge on the Cenozoic flora of the country. While on the contrary, it has become clear that the recent study of the Cenozoic plants of Hokkaidô and Karahuto now carrying on by Prof. ÔISHI and the present writer has revealed that there is a considerable number of common species in the Miocene plants of these districts geographically so remote. It is also the case in the genus *Acer*, and the four species among the fossil species enumerated above, are common with the Kawabataian *Acers* of Hokkaidô and Karahuto; these common species are *A. rotundatum* sp. nov., *A. subpictum* SAPORTA, *A. ezouanum* ÔISHI and HUZIOKA and *A. ornatum* CARR.

Further it must be noted that the Miocene species from Tyôsen described in this note have their morphological similarity with the living species now growing in the Japanese Islands, instead of having the similarity with those in Manchuria with which the living species

of Tyôsen have very close similarity, as mentioned above. This may roughly suggest the former existence of closer physiographical relationship between Tyôsen and Japanese Islands than it is in the present day.

*Acer rotundatum* sp. nov.

Pl. XXIV (IV), Figs. 1-3; Pl. XXV (V), fig. 2' (all the type-specimens).

*Description*: Leaf petiolate; petiole thin, 4.2 cm. long; lamina semi-orbicular in outline, about 8 cm. high and 10 cm. broad, palmately 5-lobed; base rounded, slightly cordate; lobe lanceolate, with caudate acuminate apex; margin entire all around; sinus broadly trigonal, obtuse or round at the bottom; primary veins 5 in number, straight, at an angle of  $30^{\circ}$ - $45^{\circ}$  (mostly  $30^{\circ}$ ) to each other; finer veins of *A. mono* type.

*Remarks*: There is no fossil leaves which are identical with the present species. It is characterised by rounded base of the leaf and caudato-acuminate apices of lobes. The general feature of the specimens may remind one of *A. Nordenskiöldi* NATH., but in the latter, the leaves are rather of *A. ornatum* (= *A. palmatum*) type.

The present species is rather comparable to certain living species, for instance, *A. mono* MAXIM. (= *A. pictum* THUNB.) widely distributed in Japan, Manchoukuo and China and *A. angustifolium* HU in Southern China. In the former, however, the base of the lamina is usually straight or broadly cordate and very rarely rounded or narrowly rounded as in the present species. While in the latter, the anterior margin of lobes is minutely serrated, though in other characters the two are similar. Therefore, the writer believes that the present fossil type represents in itself a type specifically distinct from neither of these living species.

*Occurrences*: Kinkô-dô, Usen men, Geizitu-gun, N. Keisyô Dô (Enniti Series); Yûtendô, Meisen-gun, N. Kankyô Dô (Ryûdô Formation).

*Acer subpictum* SAPORTA

Pl. XXIV (IV), Figs. 4-6; Pl. XXV (V), Fig. 3.

1943. *Acer subpictum* ÔISHI and HUZIOKA: Studies on the Cenozoic Plants of Hokkaidô and Karahuto. V. Tertiary *Acers* from Hokkaidô and Karahuto. This Number of this Journal. p. 93, pl. XIII (V), figs. 1-4; pl. XIV (VI), figs. 3, 4.

This well known type is represented in Tyôsen by four specimens of which two are nearly complete. One in Pl. XXIV (IV), fig. 5 shows a leaf with petiole about 3 cm. long; lamina displays typical form of this species, cordate at the base, 5 veined, shallowly 5 lobed, each lobe being trigonal and provided with pointed apex; the margin is entire. This is a type closely allied to *A. mono* var. *Savatieri* MURAI living in Japan. The specimen in Pl. XXIV (IV), fig. 4 is a form similar to the preceding differing only in the smaller size and somewhat deeper sinus of the lamina. This specimen shows a close resemblance to *A. pictum* var. *parviflorum* SCHNEIDER now growing in North and Central China. Other specimens in Pl. XXIV (IV), fig. 6 and Pl. XXV (V), fig. 3 are very imperfect leaves, but are almost doubtless that they also belong to the same specific type as the precedings.

*A. subpictum* has already been described by ÔISHI and HUZIOKA from Hokkaidô with criticism bearing on the relation to the living *A. mono* to which this fossil type is exceedingly similar. In Tyôsen, *Acer* of *mono* type distributes widely throughout the peninsula under several varieties, namely, var. *Pavii* NAKAI, var. *rubripes* NAKAI and var. *Savatieri* MURAI.

*Occurrences*: Kantindô, Meisen-gun, N. Kankyô Dô (Kantindô Formation); Yûtendô, Meisen-gun, N. Kankyô Dô (Ryûdô Formation); Kissyû-Town, Kissyû-gun, N. Kankyô Dô (White Shale in the Kissyû Formation); Kinkôdô, Usen-men, Geizitu-gun, N. Keisyô Dô (Enniti Series).

### *Acer ezoanum* ÔISHI and HUZIOKA

Pl. XXIII (III), Fig. 6.

1943. *Acer ezoanum* ÔISHI and HUZIOKA: Studies on the Cenozoic Plants of Hokkaidô and Karahuto. V. Tertiary *Acers* from Hokkaidô and Karahuto. This number of this Journal, p. 89, pl. X (II), figs. 1, 2, 3; pl. XI (III), figs. 1, 2, 3, 4; pl. XII (IV), figs. 1, 2.

Although it is represented by a single imperfect leaf, the specimen shown in Pl. XXIII (III), fig. 6 may probably represent the species above referred to. As was already discussed by ÔISHI and HUZIOKA this species is characterised by the presence of a pair of prominent dents in the median lobe and also one or more dents at the lower basal margin of the lateral lobes. The figured specimen in the present note is indeed very fragmentary, but the lobation of the lamina, the presence

of peculiar dent on the median lobe and on the lower margin of the lateral lobe verify the most probable agreement of the present specimen with *A. ezanum* from Hokkaidō and Karahuto.

The present fossil is a type very similar to *A. Miyabei*, *A. diabolicum* and *A. sacchalinum*. Comparable fossil types are *A. sub-Miyabei* (including *A. subcampestre*) from Europe, *A. Osmonti*, *A. Merriami*, *A. Chaneyi*, all from North America.

*Occurrence*: Kantindō, Meisen-gun, N. Kankyō Dō (Kantindō Formation).

*Acer fatsiaefolia* sp. nov.

Pl. XXIII (III), Fig. 7 (type-specimen).

Lamina about 10 cm. high and 14 cm. broad, deeply cut into lobes, being separated from one another by narrow sinus; the lowest pair of the lobes triangular in outline, smaller than the median one, with a lobule at the basal part, and with acuminate apex; margin roughly dentate with sharply pointed teeth directed forwards and numbering about three on one side of each lobe; primary veins five in number, straight, basal pair nearly straight extending approximately an angle of 180°; lateral veins about 6 in number, oblique to the primaries, curving slightly forwards, some entering into the marginal dents, while other curve strongly forwards close to the margin.

*Remarks*: Among fossil leaves heretofore described, the present specimen may be comparable to *Acer Osmonti* KNOWLTON<sup>1)</sup> from the Miocene of North America and *A. sub-Miyabei* MÄDLER<sup>2)</sup> from Germany; from both of these, however, the present specimen can be distinguishable in the general feature of the lamina, especially in the nature of marginal dents, those in ours being sharply acuminate, while in *A. Osmonti* they are double serrated and in *A. sub-Miyabei* crenato-dentate. Another allied species is *A. ezanum* ŌISHI and HUZIOKA<sup>3)</sup> recently described from Hokkaidō and Karahuto, but in this species the primary veins are three in number, while in ours

- 1) F. H. KNOWLTON: Fossil Flora of the John Day Basin, Oregon. U.S. G.S., Bull. 204, 1902, p. 72, pl. XIII, fig. 3.
- 2) K. MÄDLER: Die pliocäne Flora von Frankfurt am Main. Abh. Senk. Nat. Gesell., Abh. 446, 1939, p. 117, pl. IX, figs. 15-17.
- 3) S. ŌISHI and K. HUZIOKA: Studies on the Cenozoic Plants of Hokkaidō and Karahuto. V. Tertiary *Acers* from Hokkaidō and Karahuto. This Number of this Journal.



they are five; there is also a certain distinction in the marginal serration.

As described above the present species is certainly very close in several points to the species above referred to, and belong certainly to the same group in respect to the morphological characters of the lamina. But as ours is in nearly complete and so much characterised in the marginal serration, it may be appropriate, the writer believes, to distinguish it specifically from the species above compared with.

Among the living *Acers*, *A. Miyabei* MAXIM., *A. diabolicum* BLUME and *A. sacchalinum* PARSH are similar to the present fossil, but differ in marginal serration. *A. Giraldui* PAX of Szechuan and Tibet is another living type somewhat similar to our species.

New specific name, *fatsiaefolia*, is named as it resembles superficially 5 lobed leaves of *Fatsia japonica* DEC. et PL.

*Occurrence*: Kinkôdô, Usen-men, Geizitu-gun, N. Keisyô Dô (Enniti Series).

*Acer trilobatum* (STERNBERG) var. *productum* AL. BRAUN

Pl. XXIII(III), Fig. 8.

The lamina is small, 4 cm. high, 2 cm. broad, 5 lobed, the median lobe being exceedingly larger than the lateral ones which are on the rather proximal portion of the lamina. Apex of each lobe is acuminate. The margin of the lamina is roughly serrate. The lowest lobes are exceedingly smaller than the median and appear likely to be mere dents of the lateral lobe. The nervation clearly seen in the figure.

This fossil type was first described by AL. BRAUN<sup>1)</sup> for the specimens from the Miocene rocks of Oeningen in Switzerland as *Acer productum*, but later HEER<sup>2)</sup> considered it as a variety of *A. trilobatum* (STERNBERG). HEER's specimens show that this fossil displays a considerable variation in respect to the size and manner of dissection of the lamina, but on the other hand, it is deniable that it is certainly a type which may, in a wide sense, be grouped in *A. trilobatum* group. Although the present specimen is represented by

1) AL. BRAUN: Die tertiär Flora von Oeningen. N. Jahrb. f. Min. etc., 1845, p. 172.

2) O. HEER: Flora Tertiaria Helvetiae. III, 1859, p. 50, pl. CXIV, figs. 1, 4-8.

a single lamina, it is almost identical with one of the figures of *A. productum* figured by UNGER<sup>1)</sup> and HEER. Therefore it may be the best way, in the present time, to treat such specimen as ours as a variety of *A. trilobatum*, following HEER.

*Occurrence*: Kantindô, Meisen-gun, N. Kankyô-Dô (Kantindô Formation).

*Acer ornatum* CARR.

Pl. XIII (III), Fig. 9.

The specimen shown in Pl. XXIII (III), fig. 9 is, though it is somewhat imperfect, identical with the well-known and widely distributed species, *A. ornatum* CARR. (= *A. palmatum* THUNB.), in Eastern Asia. As is shown in the figure, the specimen is deeply cordate at the base and 7 lobed, each lobe being somewhat long acuminate, with distinct marginal serration similar to the living leaves.

Living *A. ornatum* is now divided into too many varieties and subvarieties with minute difference in morphology of the leaves so as to make it almost impossible to identify the present specimen to any one of them. But the identification of our specimen to *A. ornatum* may be almost unquestionable.

In Japan, this species was described by FLORIN<sup>2)</sup> from Amakusa, by KON'NO<sup>3)</sup> from Sinano and by MIKI<sup>4)</sup> from Aiti prefecture, all under the name *A. palmatum*. ENDÔ further listed this species from the Nenosirosi Plant Beds<sup>5)</sup> near Sendai and from Siobara<sup>6)</sup> under

- 1) F. UNGER: *Chloris Protogaea*, 1847, p. 131, pl. XLII, figs. 1-9.
- 2) R. FLORIN: *Zur Kenntnis der jungtertiären Pflanzenwelt Japans*. K. Sv. Vet. Akad. Handl., Bd. 61, no. 1, 1920, p. 23, pl. IV, figs. 1-4.
- 3) E. KON'NO: *Cenozoic Flora from the Central Sinano* in HOMMA's *Geology of the Central Sinano*, 1931, Pl. IV, fig. 9; pl. XIII, fig. 8.
- 4) S. MIKI: *On the Change of Flora in Eastern Asia since Tertiary Period (I). The Clay or Lignite Beds Flora in Japan with Special Reference to the *Pinus trifolia* Beds in Central Hondo*. Jap. Journ. Botany, vol. XI, 1941, p. 283, fig. 17B-Cd.
- 5) S. ENDÔ: *On Fossil Plants from the Environs of Sendai*. Journ. Geol. Soc. Japan, vol. XLV, no. 538, 1938, p. 619 (*A. eupalmatum*).
- 6) S. ENDÔ: *Some Japanese Cenozoic Plants. I. On the Fossil *Acer* from the Siobara Pleistocene Plant Beds*. Jap. Journ. Geol. Geogr., vol. XI, nos. 3-4, 1934, p. 340, XXIX, 5; XXXIV, fig. 4; pl. XXXV, figs. 6, 7, 8, 19 (*A. eupalmatum*); p. 241, pl. XXXII, figs. 7, 8; pl. XXXV, fig. 11 (*A. euseptenlobum*).

the name *A. eupalmatum* KOIDZ. or *A. euseptenlobum* KOIDZ. Recently CHANEY and HU<sup>1)</sup> figured and described leaves of *ornatum* type under the name *A. Nordenskiöldi* NATH.

*Occurrence:* Kinkôdô, Usen-men, Geizitu-gun, N. Keisyô Dô (Enniti Series).

*Acer japonicum* THUNB.

Pl. XIV (IV), Fig. 7.

1934. *Acer japonicum* ENDÔ: Some Japanese Cenozoic Plants. I. On the Fossil *Acer* from the Shiobara Pleistocene Plant Beds. Jap. Journ. Geol. and Geogr., Vol. XI, Nos. 3-4, p. 241, pl. XXX, figs. 1, 6; pl. XXXII, fig. 5; pl. XXXV, figs. 3, 9, 10, 12, 16, 17.

Leaf almost orbicular in outline, nearly 6 cm. in diameter, shallowly 11 lobed, with corresponding number of primary veins palmately radiating from the bottom of cordate base; margin of each lobe with rough serration.

Living species of *Acer* with more or less 11 lobes are as follows<sup>2)</sup>:

- Acer pseudosieboldianum* (PAX)
- A. Sieboldianum* MIQ. var. *typicum* MAXIM.
- A. ornatum* var. *Matsumurae* KOIDZ. forma *miyazimense* NEMOTO
- A. kobakoense* NAKAI
- A. dissectum* THUNB. var. *tenuifolium* KOIDZ.
- A. japonicum* THUNB.
- A. japonicum* THUNB. var. *villosum* KOIDZ.
- A. japonicum* THUNB. var. *macrophyllum* KOIDZ.
- A. japonicum* THUNB. var. *microphyllum* KOIDZ.
- A. nudicarpum* NAKAI
- A. Shirasawanum* KOIDZ.
- A. circumlobatum* MAXIM.
- A. Ishidoyanum* NAKAI
- A. Okamotoi* NAKAI

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- 1) R. CHANEY and H. H. HU: A Miocene Flora from Shantung province, China. Carnegie Inst. Washington, Publ. no. 507, 1940, p. 60, pl. XXXIV, figs. 1, 6.
  - 2) As it is clear from this list, multilobate types are dominant in the Japanese *Acers*.

Among Tertiary species of *Acer* heretofore described from the world, there is none which has so many lobes as the present specimen. Therefore ours shows a leaf which has the greatest number of lobes among the fossil specimens belonging to the genus *Acer*.

Almost all of these living species display a considerable resemblance to the present fossil type, but among them *A. japonicum* and *A. circumlobatum* show the greatest resemblance to the present fossil type, and the present writer are quite at a loss which specific name should be selected for the present fossil. But the former name was selected simply on the ground that the former is more common species than the latter in the Japanese Islands.

*Occurrence:* Kantindô, Meisen-gun, N. Kankyô Dô (Kantindô Formation).

#### *Acer* sp.

Pl. XXV (IV), Fig. 1.

Leaf petiolate, large, more than 10 cm. high, 7 shallowly lobed, with broad sinus, base cordate, margin simply serrate.

Unfortunately the present specimen is represented by a single imperfect leaf, although it is characterised by the large size of the leaf which is 7 lobed. Apical nature of the lobes is not known.

Among the fossil species, one from Mgratch in Russian Karahuto figured and described by HEER<sup>1)</sup> as *A. ambiguum* HR. is most comparable to the present specimen, especially in size and form of the leaf and in the number of lobes, except that in HEER's species the marginal serration is coarser than in ours, otherwise the two being almost indistinguishable.

Among the living species, there is none comparable to the present fossil. More or less allied species are *A. Siebodianum* MIQ. var. *tsusimense* KOIDZ. and *A. japonicum* BL., but in the former the leaves are generally smaller, and in the latter the lobes are usually more in number.

There is a probability that the present specimen represents a new type comparable to neither of living and fossil species, but the specimen is too imperfect to give a new name for it.

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1) O. HEER: Flora Fossilis Arctica, Bd. V, Abth. 3, 1878, p. 50, pl. XIII, figs. 5-7.

*Occurrence:* Yûtendô, Meisen-gun, N. Kankyô Dô. Ryûdô Formation.

*Acer* spp. (SAMARAE)

Pl. XXII (II), Figs. 6, 7; Pl. XXIII (III), Figs. 1-5; Pl. XXIV (IV), Fig. 8; Pl. XXV (IV), Fig. 4.

Fossil samarae are conveniently grouped at this place. They are represented by several types possibly including more than two different species. But their specific determination on the basis of the present material is difficult. Therefore they are described here to each specimen.

1. (Pl. XXIII (III), fig. 5). Part of the wing is broken. Seed is large, about 8 mm. broad. Two wings are nearly horizontal. This is the type of living *Acer Miyabei*. A similar fossil samara is known also from Abura in Hokkaidô<sup>1)</sup>. Loc. Yûtendô, Meisen-gun, N. Kankyô Dô. Ryûdô Formation.

2. (Pl. XXV (V), fig. 4). A samara larger than the former, being 1.2 mm. broad near the seed and widening distally, the maximum breadth being 1.5 cm., and more than 3.5 cm. long. Two wings are almost horizontal. The size of seed 9×12 mm. This is also the type of *A. Miyabei* and very similar to the preceding specimen differing only in size. Samarae figured by LUDWIG<sup>2)</sup> as *A. trilobatum tricuspidatum* var. IIa and IIb resemble most. Loc. Ditto.

3. (Pl. XXIII (III), fig. 2). Somewhat long and narrow samara. It is longer than 1.8 cm. and 7 mm. broad near the seed. Seed is oblong, being 1.3 cm. long and 0.5 cm. broad. Splitting surface is oblique, two wings extending an angle of approximately 100°. This samara is characterised by having oblong seed.

Comparable species is *A. carpinifolium* S. et Z. In the size and form of the samara especially in the character of seed, the present fossil is closely allied to this living species. Loc. Ditto.

4. (Pl. XXII (II), fig. 6). A samara nearly completely preserved. It is 2 cm. long, and 6 mm. broad in its broadest portion of the wing.

- 1) S. ÔISHI and K. HUZIOKA: Studies on the Cenozoic Plants of Hokkaidô and Karahuto. V. Tertiary *Acers* from Hokkaidô and Karahuto. This Number of this Journal.
- 2) R. LUDWIG: Die fossilen Pflanzen aus der ältesten Abtheilung der rheinisch-wetterauer Tertiärformation. Palaeontogr., Bd. VIII, 1860, p. 129, pl. LI, fig. 10 (IIb); pl. LII, fig. 7 (IIb).

Seed is  $5 \times 7$  mm. As the splitting surface of the seed is parallel to the longitudinal axis of the wing, the two wings may arrange almost in parallel to each other. In the modern *Acer*, *A. ginnala* MAXIM., *A. cissifolium* C. KOCH, *A. ukrunduense* TRAUTY. et MEY. have samarae similar to the present fossil. Loc. Kantindô, Meisen-gun, N. Kankyô Dô, Kantindô Formation.

5. (Pl. XXIV(IV), fig. 8). A samara somewhat imperfect at the distal portion of the wing, it is more than 3 cm. long, about 1 cm. broad near the distal end and narrows rapidly towards the seed. Seed is  $6 \times 6$  mm. The splitting surface are oblique to the general axis of the wing and the two wings make approximately an angle of  $60^\circ$ . Loc. Kantindô, Meisen-gun, N. Kankyô Dô, Kantindô Formation.

6. (Pl. XXIII(III), fig. 3). A large samara longer than 4.5 cm. and 9 mm. broad near the seed thence widening gradually toward the distal portion. Seed is roundish,  $1.5 \times 1$  cm. Angle between two wings is approximately  $120^\circ$ . Loc. Ditto.

7. (Pl. XXII(II), fig. 7). A samara similar to one in Pl. XXIII(III), fig. 5. The seed is very small, being  $6 \times 3$  mm., part of the wing is imperfect. Two wings are almost horizontal. Loc. Kissyû-Town, Kissyû-gun, N. Kankyô Dô. White Shale in the Kissyû Formation.

8. (Pl. XXIII(III), fig. 1). An imperfect samara, the distal portion of the wing being missing. Seed is roundish, 8 mm. across. The splitting surface is oblique and the wings make an angle of approximately  $70^\circ$ . The present samara is *A. mono* type, especially *A. mono* MAXIM. var. *glauca* HONDA living in northern part of Honsyû. Loc. Ditto.

9. (Pl. XXIII(III), fig. 4). A samara imperfect on both ends. The seed is elongated towards the wing along its upper margin and acuminate distally. This specimen is too imperfect to compare with the known types, both fossil and living. Loc. Ditto.

### *Platanus* L.

*Platanus* is one of the interesting Tertiary plants more or less widely known from the northern hemisphere. Recently ÔISHI and the present writer<sup>1)</sup> summerised the Tertiary *Platanus* from Hok-

1) S. ÔISHI and K. HUZIOKA: Studies on the Cenozoic Plants of Hokkaidô and Karahuto. VI. Tertiary *Platanus* from Hokkaidô and Karahuto. This number of this Journal.

kaidô and Karahuto and arrived at the conclusion that *Platanus* flourished most in the Upper Isikarian and the Urahoroian, this genus being represented by four species. It was also noted that this genus diminished greatly at the end of the Urahoroian and only a single species was represented in the next younger Kawabataian deposits. The specimens from the Kawabataian were collected from the Kayanuma coal-mine in Hokkaidô and from the *Engelhardtia* Beds of Kokangen in northeastern Tyôsen, the two having been determined as cfr. *Platanus Guillelmae* GOEPPERT.

ENDÔ<sup>1)</sup> once reported an occurrence of *Platanus Guillelmae* from Agoti, N. Kankyô Dô. The specimen of *Platanus* dealt with in this paper is that from the *Engelhardtia* Bed mentioned above, and ENDÔ<sup>2)</sup> already discriminated following species from this bed: *Acer pictum* THUNB., *A. trilobatum* HEER, *A. sp.*, *Alnus* cfr. *prerhombifolia* BERRY, *A. sp.*, *Betula sp.*, *Carpinus sp.*, *Carpolithes sp.*, *Castanea atavia* UNGER, *C. Kubinyi* KOVATS, *C. castanaefolia* KNOWLT., *Ceratophyllum sp.*, *Cercidiphyllum japonicum* S. et Z., *Cercis ? sp.*, *Dryophyllum spp.*, *Equisetum ? sp.*, *Engelhardtia koreanica* ÔISHI, *Fagus crenata* BLUME, *F. japonica* MAXIM., *F. multinervis* NAKAI, *F. sp.*, *Ficus tiliaefolia* HR., *Glyptostrobus europaeus* HR., *Laurus sp.*, *Leguminosites sp.*, *Libocedrus ? sp.*, *Malus sp.*, *Myrica ? cfr. langeana* HR., *Populus tremula* L., *Porana kokangenensis* ENDÔ, *Quercus drymeja* UNG., *Q. Jhonstrupi* HR. ?, *Q. simulata* KNOWLTON, *Q. furcinervis* ROSSM., *Q. intermedia* FRIEDR., *Q. spp.*, *Rhus sagoriana* ETT., *Salvinia sp.*, *Sequoia japonica* ENDÔ, *Sparganium ? sp.*, *Taxodium* cfr. *tinajorum* HR., *Vitis sp.*, *Zelkova Ungerii* KOVATS.

The age of this plant bed is Miocene.

#### Cfr. *Platanus Guillelmae* GOEPPERT

Pl. XXV(V), Fig. 5.

1855. *Platanus Guillelmae* GOEPPERT: Die tertiäre Flora von Schosnitz in Schlesien. p. 21, pl. XI, figs. 1, 2; pl. XXII, fig. 5.

- 1) S. ENDÔ: Fossil *Platanus* from Eastern Asia (in Japanese). Tôkyô Hakubutugaku-zasshi, vol. XXXV, no. 60, 1937, p. 388 (list only).
- 2) S. ENDÔ: Some New and Interesting Miocene Plants from Tyôsen (Korea). Jub. Publ. Commem. Prof. H. YABE's 60th Birthday. 1939, pp. 534-335.

1943. *Platanus Guillelmæ*, ÔISHI and HUZIOKA: Studies on the Cenozoic Plants of Hokkaidô and Karahuto. V. Tertiary *Platanus* from Hokkaidô and Karahuto. This Number of this Journ., p. 110, pl. XVII(III), figs. 2, 3; pl. XVIII(IV), figs. 2, 3.

For further references, see ÔISHI and HUZIOKA: 1942, op. cit.

*Description:* Leaf broad, more than 9 cm. in breadth; margin not lobed, but roughly dentate; dents trigonal, obtuse in apex; base unknown, but probably cuneate judging from the nervation; lateral veins 3 or 4 in number on each side of midvein which is straight persisting to the apex.

*Remarks:* The figured specimen is unfortunately imperfect at the basal part which is important in the generic determination of *Platanus*. But the general features of the leaf shows that the specimen is *Platanus* type and moreover most closely related to *P. Guillelmæ*. Specimens figured by HEER<sup>1)</sup> from Simonowa in Siberia under this specific name resemble the most.

*Occurrence:* Kokangen, N. Kankyô Dô; *Engelhardtia* Bed.

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1) O. HEER: Flora Fossilis Arctica. Bd. IV, Abth. 2. Fossilen Flora Sibiriens und des Amurlandes. VI. Tertiäre Pflanzen aus dem Amurlandes und der Mandschurei, 1878, p. 40, pl. IX, figs. 14-16; pl. X, figs. 1-4a; pl. XI, fig. 1; pl. XIII, figs. 5b, 6.



## EXPLANATION OF THE PLATES

(The figures are of natural size)

The specimens are in the Department of Geology and Mineralogy, Faculty of Science, Hokkaidô Imperial University, Sapporo.

## Plate XXI(I)

- Figs. 1, 2, 4. *Tilia distans* NATHORST. Loc. Kissyû-Town, Kissyû-gun, N. Kankyô Dô; White Shale of the Kissyû Formation.  
 Fig. 3. *Tilia distans* NATHORST. Loc. Yûtendô, Meisen-gun, N. Kankyô Dô; Ryûdô Formation.  
 Fig. 5. *Tilia remotiserrata* ÔISHI and HUZIOKA. Loc. Kinkôdô, Geizitu-gun, N. Keisyô Dô; Enniti Series.  
 Fig. 6. *Tilia japonica* SIMK. Loc. Yûtendô, Meisen-gun, N. Kankyô Dô; Ryûdô Formation.  
 Fig. 7. *Tilia* sp. (bract). Loc. Ditto.  
 Fig. 8. *Tilia* sp. (bract). Loc. Ditto.

## Plate XXII(II)

- Fig. 1. *Salvinia pseudoformosa* ÔISHI and HUZIOKA. Loc. Kokangen, N. Kankyô Dô; *Engelhardtia* Bed.  
 Figs. 2, 3. *Tilia subnobilis* sp. nov. Loc. Yûtendô, Meisen-gun, N. Kankyô Dô; Ryûdô Formation.  
 Fig. 4. *Tilia* sp. (bract). Loc. Ditto.  
 Fig. 5. *Tilia meisenensis* sp. nov. Loc. Yûtendô, Meisen-gun, N. Kankyô Dô; Ryûdô Formation.  
 Fig. 6. *Acer* sp. (samara). Loc. Kantindô, Meisen-gun, N. Kankyô Dô; Kantindô Formation.  
 Fig. 7. *Acer* sp. (samara). Loc. Kissyû-Town, Kissyû-gun, N. Kankyô Dô; White Shale of the Kissyû Formation.

## Plate XXIII(III)

- Fig. 1. *Acer* sp. (samara). Loc. Kissyû-Town, Kissyû-gun, N. Kankyô Dô; White Shale of the Kissyû Formation.  
 Fig. 2. *Acer* sp. (samara). Loc. Yûtendô, Meisen-gun, N. Kankyô Dô; Ryûdô Formation.  
 Fig. 3. *Acer* sp. (samara). Loc. Kantindô, Meisen-gun, N. Kankyô Dô; Kantindô Formation.  
 Fig. 4. *Acer* sp. (samara). Loc. Kissyû-Town, Kissyû-gun, N. Kankyô Dô; White Shale of the Kissyû Formation.

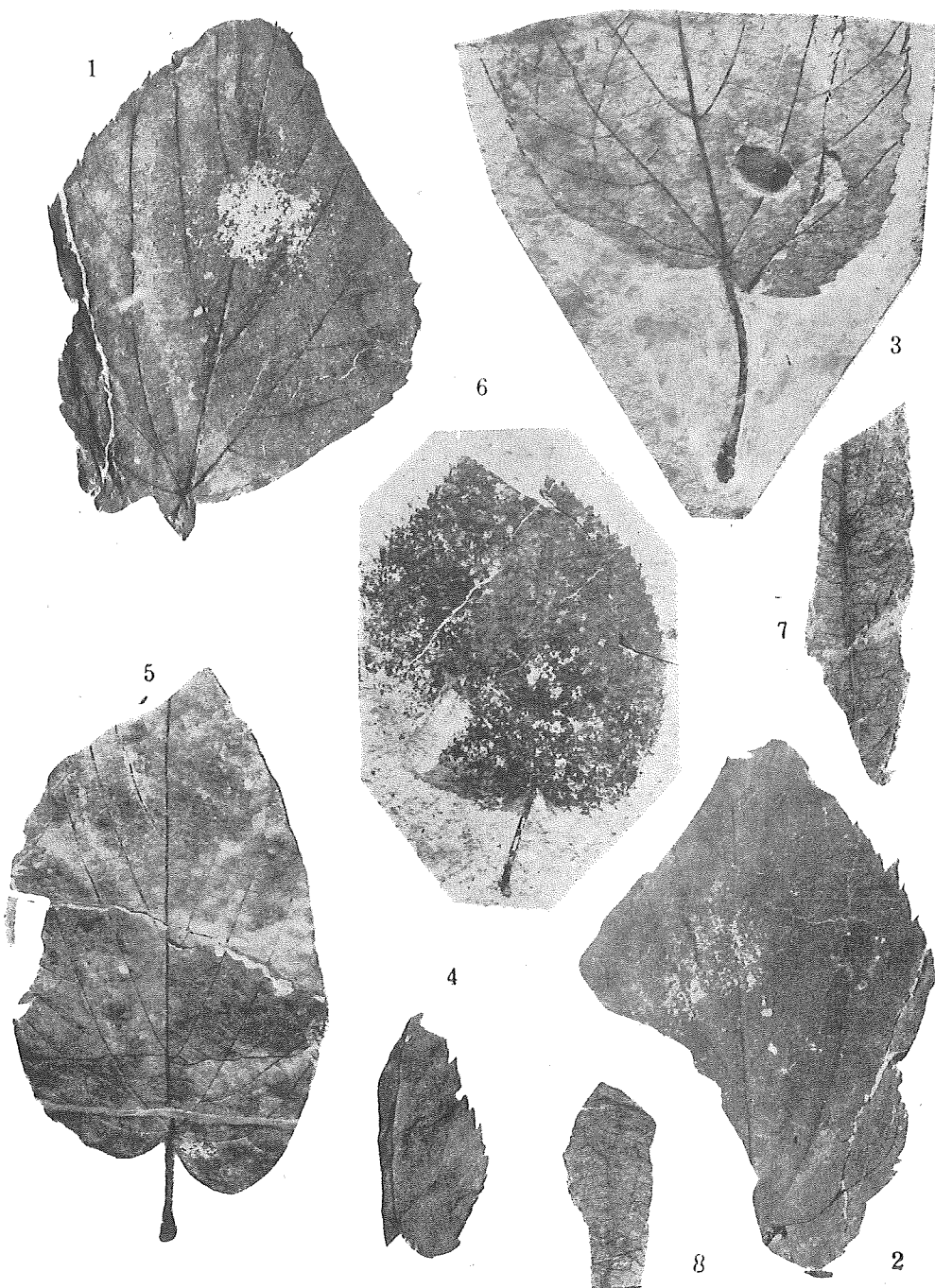
- Fig. 5. *Acer* sp. (samara). Loc. Yûtendô, Meisen-gun, N. Kankyô Dô; Ryûdô Formation.
- Fig. 6. *Acer ezoanum* ÔISHI and HUZIOKA. Loc. Kantindô, Meisen-gun, N. Kankyô Dô; Kantindô Formation.
- Fig. 7. *Acer fatsiaefolia* sp. nov. Loc. Kinkôdô, Geizitu-gun, N. Keisyô Dô; Enniti Series.
- Fig. 8. *Acer trilobatum* (STERNB.) var. *productum* AL. BR.. Loc. Kissyû-Town, Kissyû-gun, N. Kankyô Dô; White Shale of the Kissyû Formation.
- Fig. 9. *Acer ornatum* CARR. Loc. Kinkôdô, Geizitu-gun, N. Keisyô Dô; Enniti Series.

## Plate XXIV(IV)

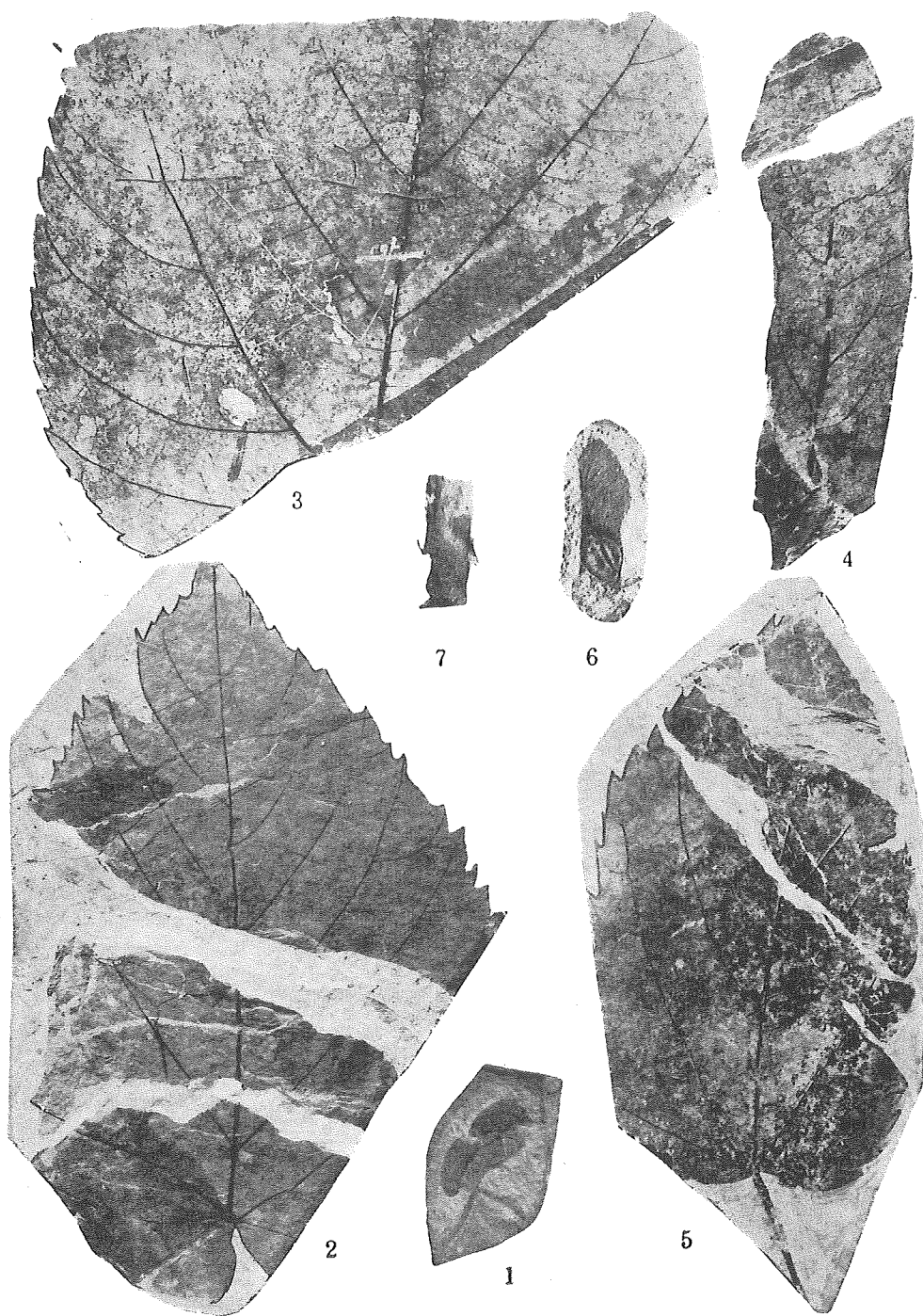
- Fig. 1. *Acer rotundatum* sp. nov. Loc. Kinkôdô, Geizitu-gun, N. Keisyô Dô; Enniti Series.
- Figs. 2, 3. *Acer rotundatum* sp. nov. Loc. Yûtendô, Meisen-gun, N. Kankyô Dô; Ryûdô Formation.
- Fig. 4. *Acer subpictum* SAPORTA. Loc. Yûtendô, Meisen-gun, N. Kankyô Dô; Ryûdô Formation.
- Fig. 5. *Acer subpictum* SAPORTA. Loc. Yûtendô, Meisen-gun, N. Kankyô Dô; Kantindô Formation.
- Fig. 6. *Acer subpictum* SAPORTA. Kissyû-Town, Kissyû-gun, N. Kankyô Dô; White Shale of the Kissyû Formation.
- Fig. 7. *Acer japonicum* THUNB. Loc. Kantindô, Meisen-gun, N. Kankyô Dô; Kantindô Formation.
- Fig. 8. *Acer* sp. (samara). Loc. Ditto.

## Plate XXV(V)

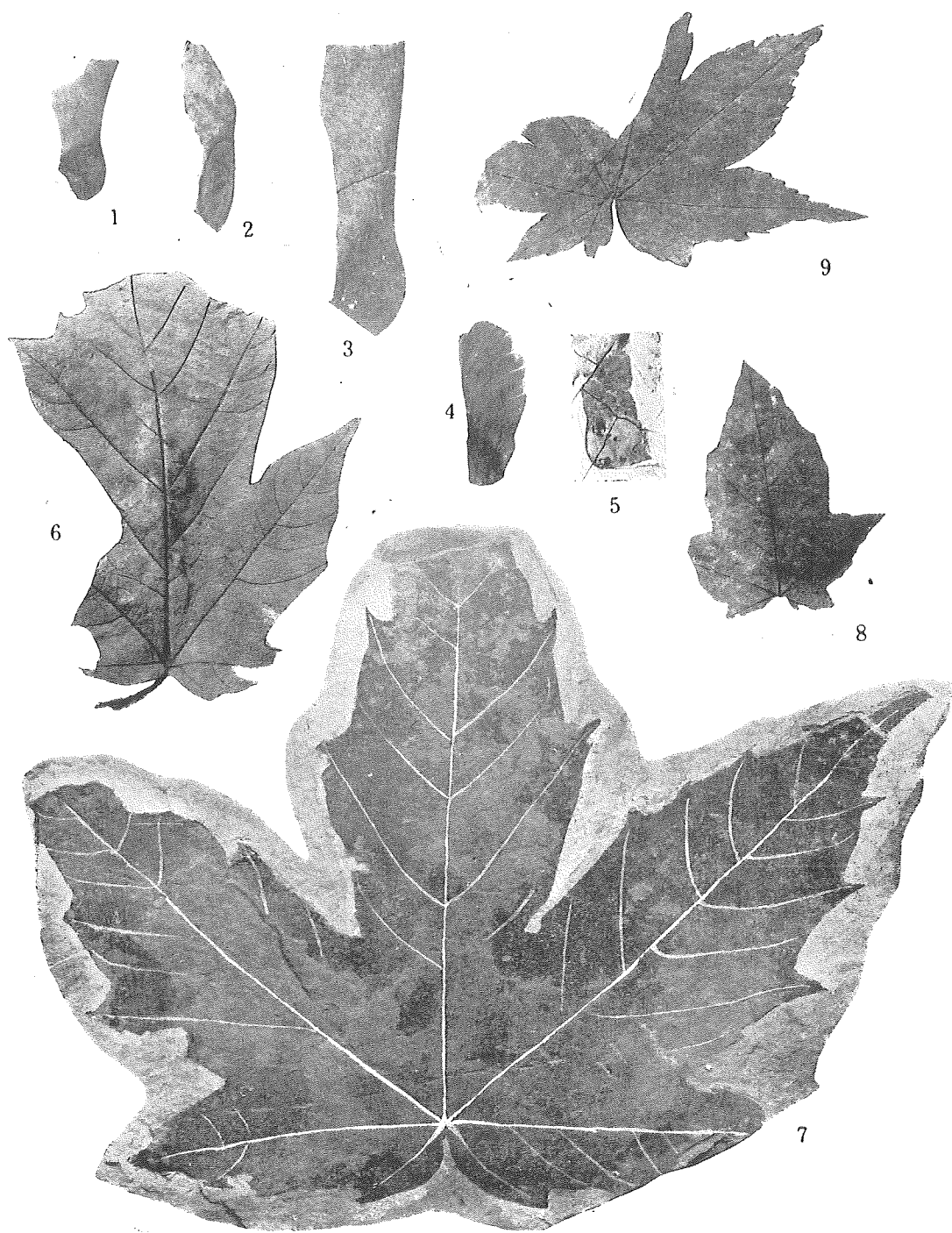
- Fig. 1. *Acer* sp. Loc. Yûtendô, Meisen-gun, N. Kankyô Dô; Ryûdô Formation.
- Fig. 2. *Acer rotundatum* sp. nov. Loc. Kinkôdô, Geizitu-gun, N. Keisyô Dô; Enniti Series.
- Fig. 3. *Acer subpictum* SAPORTA. Loc. Kantindô, Meisen-gun, N. Kankyô Dô; Kantindô Formation.
- Fig. 4. *Acer* sp. (samara). Loc. Yûtendô, Meisen-gun, N. Kankyô Dô; Ryûdô Formation.
- Fig. 5. Cfr. *Platanus Guillelmae* GOEPPERT. Loc. Kokangen, N. Kankyô Dô; Engelhardtia Bed.



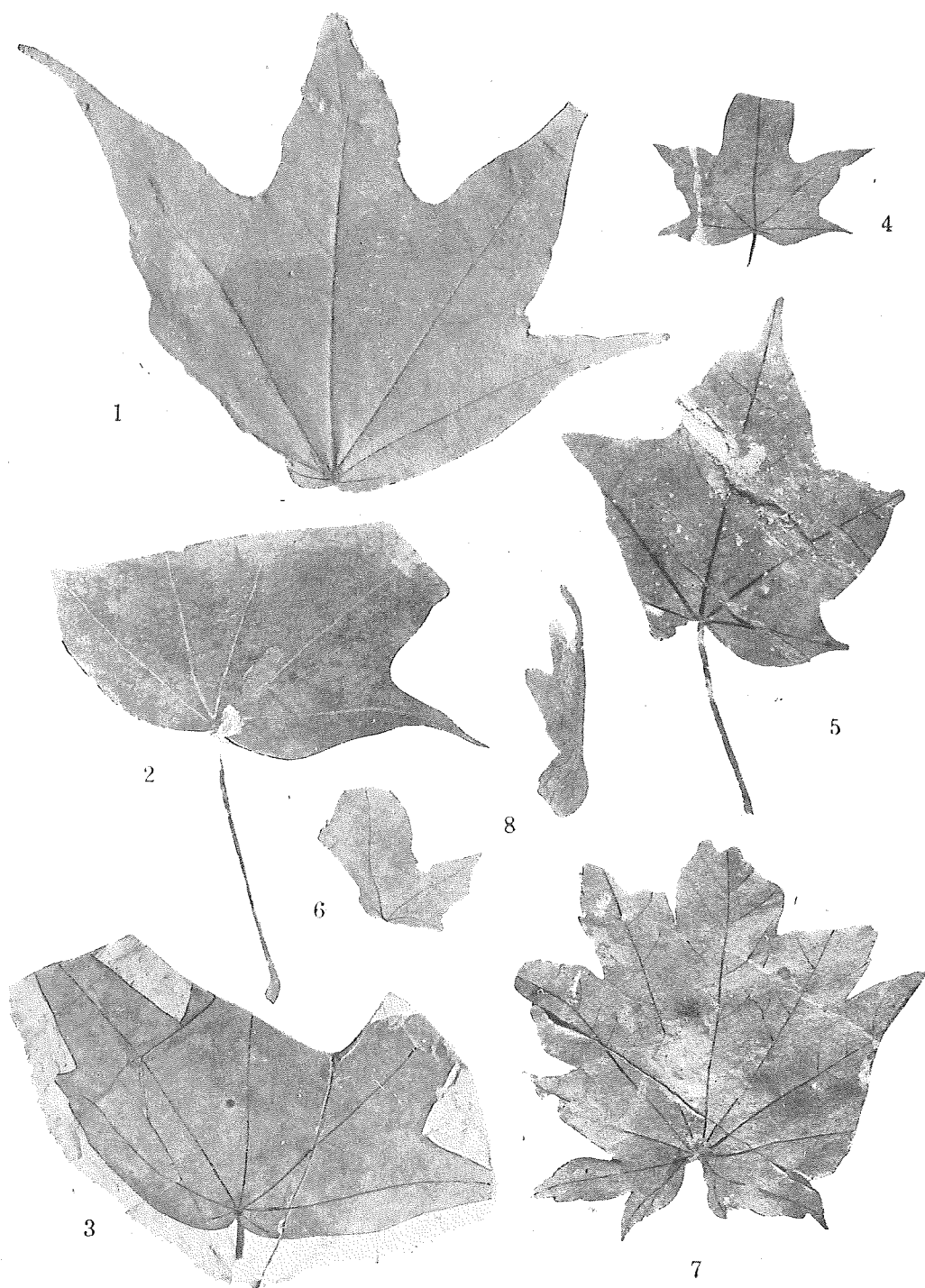
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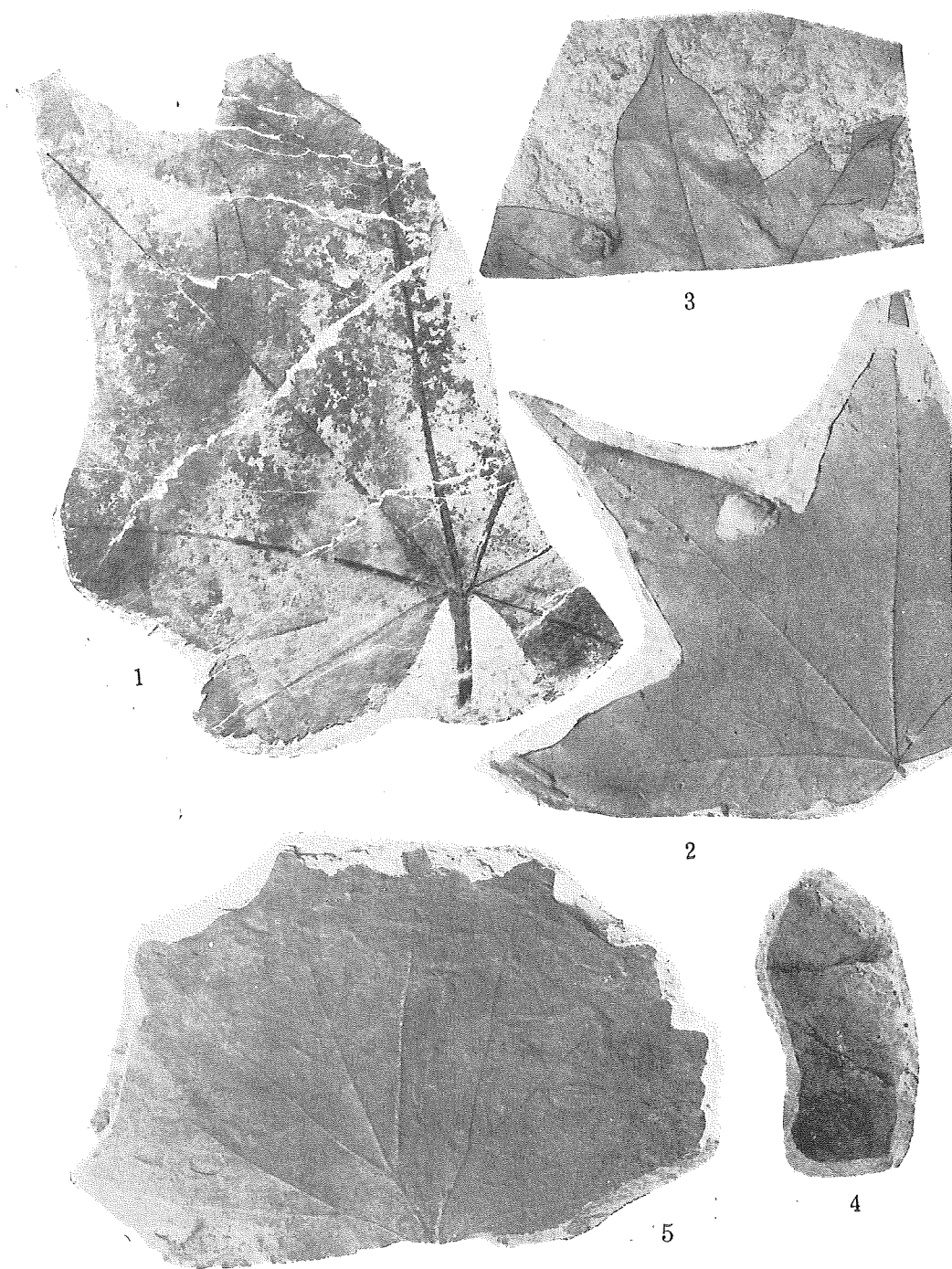


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