A New Miocene *Sassafras* from Shimane Prefecture, Japan

By

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with 2 Plates and 3 Text-figures

ABSTRACT. Fossil *Sassafras* hitherto reported from several formations of Lower Cretaceous to Pliocene in Japan and adjacent land seems to show the most extensive development in Miocene deposits.

Fukui plant bed newly discovered at Fukui, Nagahama-chô, Hamada City, Shimane Prefecture belongs to the lower-most part of the Kokubu group, the lowest division of the Hamada Tertiary.

The plant bed must be, stratigraphically and paleontologically, of pre-Daijiman, namely early Middle to Early Miocene.

A new species of Fukui flora, *Sassafras Yamanei* IMAMURA, will be described below.

CONTENTS

I. GEOGRAPHICAL AND GEOLOGICAL DISTRIBUTION OF FOSSIL *Sassafras* IN JAPAN AND ADJACENT LAND

The genus *Sassafras* is one of the most ancient dicotyledonous plants belonging to the Family Lauraceae. Its fossil records have been found dating back to the Early Cretaceous in age like those of *Sassafras chinensis* (MS) reported by S. ENDÔ from the southeastern Manchuria in 1957 and *S. cretaceum* Newberry by D. P. PENHALLOW from British Columbia, Canda in 1902. The Upper Cretaceous shows an extensive development of *Sassafras*-like forms in North America, Greenland, South America, Europe and New Caledonia, especially a large number of the species flourished in North America. Although more or less reduced in variety of forms the genus remains are still cosmopolitan throughout the Tertiary period. At present, however, only three modern species are known to us as follows:

1. *Sassafras officinale* NEES et EBERMANN: Massachusetts, Ontario, Michigan, Florida and Texas, U.S.A.
2. *S. Tsumu* HEMSLEY: Sechuan, Hupeh and Chekian, China

3. *S. randaiense* (HAYATA) REHDER: Central ranges, Formosa

In and around Japan, no fossil remains of *Sassafras* were known till S. Endô and H. Okutsu described the first occurrence of *Sassafras* (*S. Yabei* E. et O.) from the Upper Miocene near Sendai, Japan.

Since then, new occurrences of 9 species have been reported from the following localities as shown in Text-fig. 1.

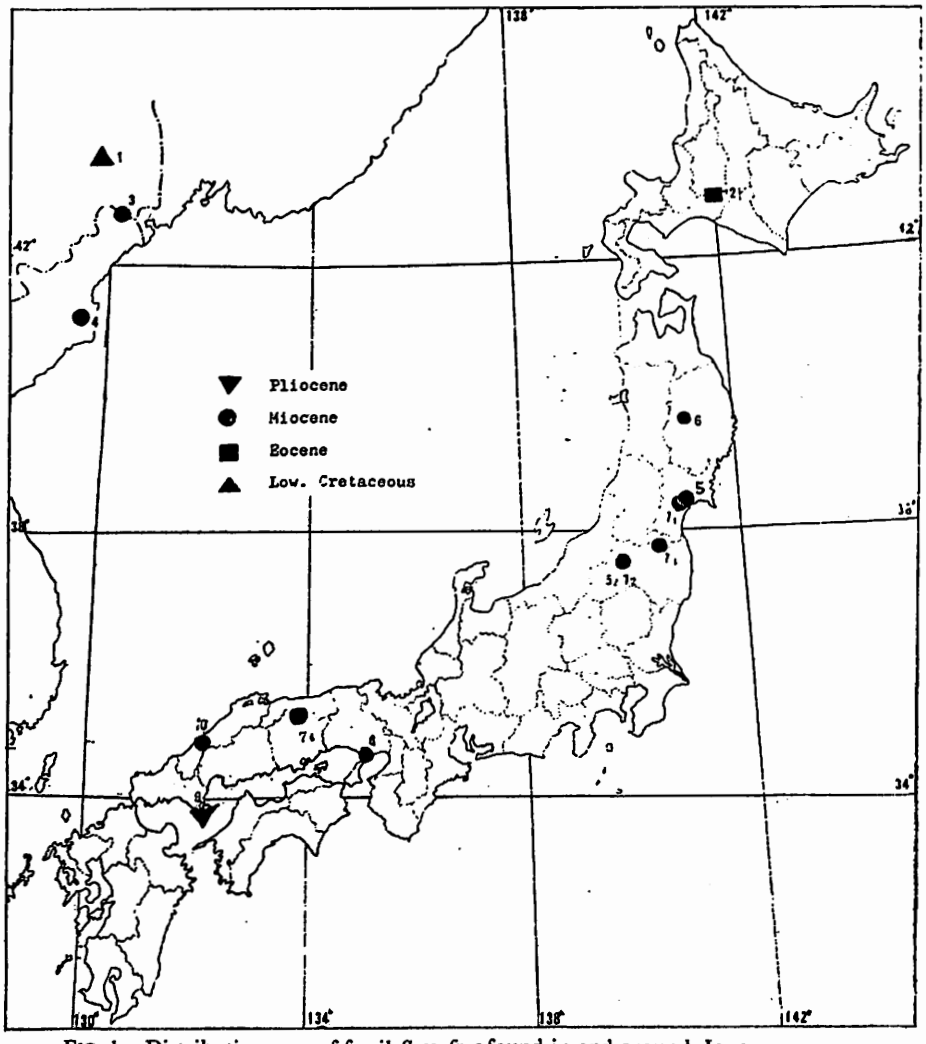

FIG. 1, Distribution map of fossil *Sassafras* found in and around Japan

1. *Sassafras chinensis* ENDÔ (MS): (1957) Che-Chang-yu-kou, * Lo-tzu-kou, Prov. Chientao. Manchuria, Lower Cretaceous Lo-tzu-kou formation.
2. *S. alaskanum* HOLLICK: (1943) Ishikari Coal Field, Shimizusawa, Yubari-gun, Hokkaidô, Upper Eocene *Woodwardia* zone of Ishikari gruop.

3. *S.* sp. : (1943) Kyushin * * Coal Mine near Kainei district, Kankyô-Hokudô (North Mam-Gyŏng-dô), Korea, Middle Miocene Kanchindô formation.
4. *S.* ? sp. : (1939) Meisen district, Kankyô-Hokudô. Korea, Middle Miocene Kanchindô formation.
5. *S. Yabei* ENDÔ et OKUTSU : 1) (1936) Ôsawa-mura, Miyagi-gun, Miyagi Prefecture, Upper Miocene Shirasawa formation.
   2) Fuji-tôge, Yanagizu-chô, Kanuma-gun Fukushima Prefecture, Upper Miocene Shirasawa formation.
6. *S.* cf. *Yabei* E. et O. : (1956) Shizukushi Basin, Gosho-mura, Iwate-gun, Iwate Prefecture, Upper Miocene Masuzawa (or Yunokuchi) formation.
7. *S. Oishii* OKUTSU*** : 1) (1952) Shirasaka-tôge, Akyu-mura, Natori-gun, Miyagi Prefecture, Upper Miocene Shirasawa formation.
   2) (1957) Fuji-tôge, Yanagizu-chô, Kanuma-gun, Fukushima Prefecture, Upper Miocene lower Fuji-tôge formation.
   3) (1957) Aka-gawa, Iisaka-chô, Shinobu-gun, Fukushima Prefecture, Upper Miocene Ten-nôji formation.
   4) (1957) Onbara, Kamisaihara-mura, Tomata-gun, Okayama Prefecture, Upper Miocene orLower Pliocene Onbara formation.
8. *S. offiicinale* NEES et EBERMANN : (1938) Takasô-yama, near Kôbe City, Hyôgo Prefecture, Upper Miocene Shirakawa formation.
9. *S. Endoi* HUZIOKA : (1938) Heigun Island, Setouchi Inland Sea, Yamaguchi Prefecture, Upper Pliocene Heigun Plant bed.
10. *S. Yamanei* IMAMURA n. sp. : (1957) Fukui, **** Nagahama-chô, Hamada City, Shimane Prefecture, Lower～Middle Miocene Kokubu group.

TABLE 1. RANGE CHART OF FOSSIL *Sassafras* FROM JAPAN, KOREA AND MANCHURIA.

Geological Occurrence / Fossil species *	Low Cretaceous	Up. Cretaceous	Paleocene	Eocene	Oligocene	Miocene	Pliocene
1. *Sassafras chinensis* ENDO (MS)	———						
2. *S. alaskanum* HOLLICK				———			
3. *S.* sp.						———	
4. *S.* ? sp.						———	
5. *S. Yabei* ENDO et OKUTSU						———	
6. *S.* cf. *Yabei* E.et O.						———	
7. *S. Oishii* OKUTSU						———	—
8. *S. officinale* N. et E.						———	
9. *S. Endoi* HUZIOKA							———
10. *S. Yamanei* IMAMURA n. sp.						———	

* Numbers correspond to those given in Text-fig. 1.

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*** According to the latest personal information from. K. SUZUKI to me, he has an opinion that *Lindera subtrilobum* KON'NO of the Ômi flora (fossil locality : Kabauchi, Ôoka-mura, Sarashina-gun, Nagano Prefecture, Middle Miocene Ogawa formation) may be similar to *Sassafras Oishii* OKUTSU.

Considering on the above-mentioned data, fossil *Sassafras*, the earliest form of which appeared in Early Cretaceous of the southeastern Manchuria, seems to show the most extensive development in Miocene of Japan and adjacent land, but no later records are known except but one from Japan.

II. NEW FOSSIL LOCALITY AND ITS GEOLOGICAL HORIZON

The present materials described here were recently collected by me at Fukui, Nagahama-chô, Hamada City, Shimane Prefecture, from the tuffaceous sandstone bed intercalated in two-pyroxene-basaltic andesite and its agglomerate of Tertiary age which overlie the black schist of Upper Palaeozoic Sangun metamorphics with unconformity.

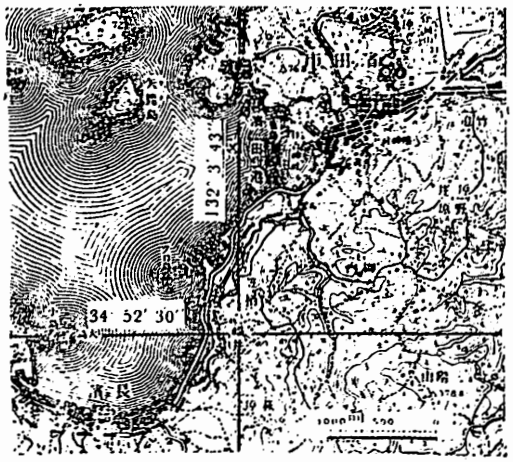

FIG. 2, Map showing the locality of *Sassafras Yamanei* IMAMURA n. sp.

The stratigraphical succession of the Tertiary fomations near Hamada (IMAMURA, S. and M. MUKAE, 1956) is tabulated below.

The Kokubu group, the lowest division of Hamada Tertiary, underlies the Middle Miocene Tôgane* formation unconformably, which contains abundant molluscan fossils described by Y.Otuka in 1937, and it is divisible into two parts; the upper Yatadani** formation and the lower Kokubu*** volcanics.

The latter overlying unconformably late Paleozoic Sangun metamorphics are composed, in upward succession, of two-pyroxene-basaltic andesites, two-pyroxene-leucoandesites, dacites, quartz-liparite, plagioliparite, and hornblende-andesite including their tuff-breccias and tuffs besides lava flows.

From the stratigraphical and the lithological points of view, the tuffaceous lower part of the Yatadani formation which contains rich "*Comptoniphyllum-Liquidambar*" flora of Daijima type (early Middle Miocene) is certainly contemporaneous with hornblende-andesite~liparites memders of the Kokubu volcanics.

Accordingly the lower andesite members of the Kokubu volcanics must be of early Middle Miocene age or even of the earlier.

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TABLE 2

Age		Formation (thickness)		Rocks	Fossils
Pleistocene		Kokubunji f. (25m)		quartz sand with gravel	
		Hamada Nepheline-basalt			
		unconf.			
Late Pliocene		Tsunozu f. (20-50m)		alt. of loose sandstone, conglomerate, clay, mudstone and tuffaceous silt	*Stegodon*? sp. *Sequoia semperivirens* *Metasequoia japonica* *Liquidambar* sp., etc.
		unconf.			
Miocene	Middle	Tôgane f. (70m)		sandstone conglomerate	.....Tôgane fauna *Siratoria siratoriensis* *Dosinia nagaii, D. nomurai,* *Turritella kadonosawaensis.* *Aturia* sp., etc.
		disconf.			
		Kokubu group	Yatadani f. (120m)	sandstone conglomerate alt. sandstone, shale, tuff, and conglomerate	.....Yatadani flora *Liquidambar formosana* *Comptoniphyllum Naumanni* *Castanea Kubinyi*, etc.
	Early ?		Kokubu volcanics	hornblende-andesite plagioliparite & quartz-liparite dacites two-pyroxene-leucoandesites two-pyroxene-basaltic andesites	.....Fukui flora *Sequoia Langsdorfii* *Sassafras Yamanei*, etc.
		unconf.			
Late Paleozoic		Sangun metamorphics		black-schist green-schist quartz-schist, etc.	

III. FUKUI FLORA AND ITS GEOLOGICAL AGE

The Fukui fossil plants comprise the following species*

Coniferales

Taxodiaceae

° 1. *Sequoia Langsdorfii* BRONGNIART

Dicotyledonae

* Fossil species except 12 determined by S. Endô

Fagaceae
2. *Fagus* sp. (Cupla)
3. *Fagophyllum* ? sp.
+4. *Castana Kubinyi* KOVATS
5. C. sp ?
6. *Quercus* sp.
7. Q. sp. ?
Betulaceae
+ 8. *Betula* cf. *Brongniarti* ETTINGSHAUSEN
Moraceae
+ 9. *Ficus* cf. *tiliaefolia* HEER
Lauraceae
10. *Cinnamomum Scheuchzeri* HEER
11. C. cf. *camphora* NEES et EBERMANN
° 12. *Sassafras Yamanei* n. sp.
Cormaceae
13. *Cornus* ? sp.
Cyperaceae
14. *Cyperites* sp.

° Exotic genus + Extinct species

Of the above-listed species, *Sequoia Langsdorfii* BRONGNIART, *Betula Brongniarti* ETTING., *Ficus tiliaefolia* HEER and *Cinnamomum Scheuchzeri* HEER are well-known Miocene and Palaeogene species in Japan, Korea and South Manchuria while *Castanea Kubinyi* KOVATS is mostly found in Middle Miocene of the former two. Furthermore, *Cinnamomum camphora* NEES et EBERMANN known as fossil from the Upper Miocene Nenoshiroishi plant beds near Sendai and others is still living in Japan, Ryukyu, Formosa, Central and Southern China.

For the above-stated paleontological and stratigraphical reasons I am inclined to believe that the geological age of the Fukui flora is not older than Early Miocene nor younger than the early stage of Middle Miocene.

IV. ACKNOWLEDGEMENTS

Finally I wish to express my cordial thanks to Dr. S. Endô for his valuable advices and helps in determining the fossil species and in preparing this note. Thanks are also due to Mr. M. Mukae, subprofessor of the Hiroshima University and Mr. Chu Santo, teacher of the Hamada High School, for their assistances in collecting the present materials, Dr. Y. Horikawa, Prof. of the Botanical Institute of the same university, Mr. K. Suzuki, subprofessor of the Fukushima University for their valuable suggestions, and Mr. K. Sada, a graduate student of the Hiroshima University for his help in preparing the figures.

DESCRIPTION

Genus *Sassafras* NEES

Sassafras Yamanei IMAMURA n. sp.

Pl. 5, Figs. 1-5, Text-fig. 3

Leaves rather large, very variable in size and outline, lower half cuneate with a decurrent base, or more or less narrowly rounded below, upper half palmately three-lobed, divided by narrow and acute sinus. Length 12 cm. up to 24 cm, (restored), width from the tips of the lateral lobes ranging 6.5 cm. to 17 cm. (restored). Central lobe more or less longer and broader than the lateral ones, each lobe lanceolate, apex acute. Marging entire throughout. Midrib stout and prominent, lateral primaries almost of the same size as the midrib, opposite, sub-opposite diverging from it at a considerable distance above the base as in European Pliocene *S. ferrettianum* MASSALONGO and modern *Sassafras* leaves, and extending to tips of lateral lobes. Their angle of divergence from the midrib varies from about 35° to 20,° averaging 30° to 26.° In the lobes, secondary veins thin, numerous, springing up from primary ones at an angle 40°–50,° gently upward curving, comptodromous at the margin. Basal secondaries of midrib very stout, nearly straight, running somewhat parallel with the lateral primaries or curving slightly upward to be nearly parallel with the lower margins. Petiole unknown.

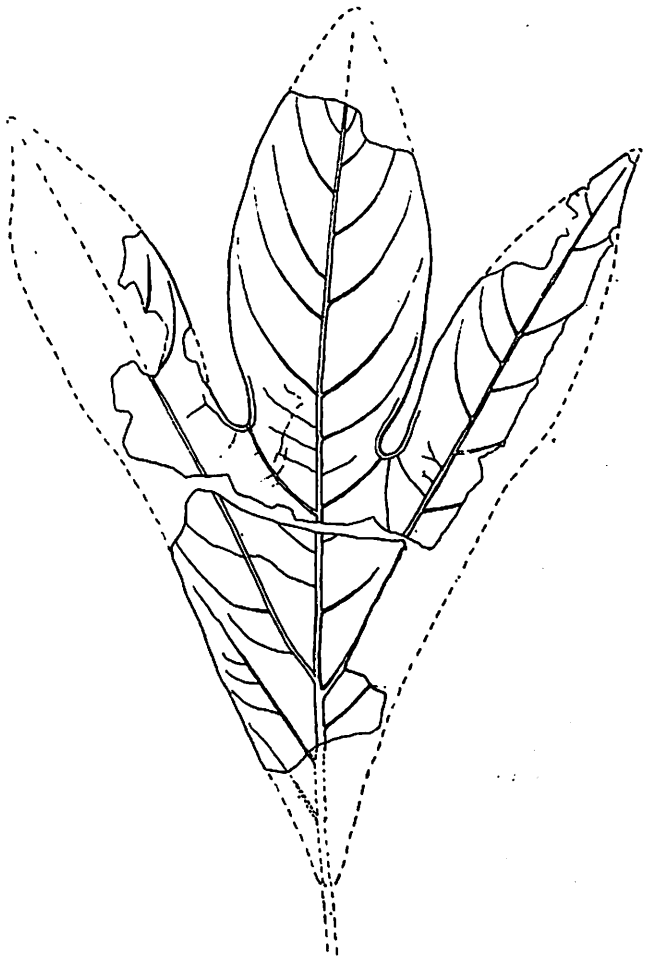

FIG. 3. A restoration of *S. Yamanei* n. sp. $\times 1/2$

Remarks:—It is easy to distinguish the present new species from the similar three-

lobed living Lauracean plants in Japan; *Porabenzoin trilobum* NAKAI and *Lindera obtusiloba* BLUME, by the prominent features of its lower cuneate form with a decurrent base and its lanceolate lobes with the deeper sinuses. Comparable species are *S. Yabei* ENDO et OKUTSU, *S. Oishii* OKUTSU, both from the Upper Miocene Shirasaka shale bed near Sendai, *S. officinale* N. et E. from the Upper Miocene Shirakawa formation near Kobe but now living in North America. The present materials, however, can be easily distinguished from them by the lanceolate lobes and the cuneate lower half of the leaf.

Another comparable species is *S. Endoi* HUZIOKA from the Upper Pliocene Heigun plant bed, Yamaguchi Prefecture, but the present species differs from it by the larger size, the nervation and the characteristic cuneate lower half of the leaf.

The specific name is dedicated to Dr. Shinji YAMANE, President of the Shimane University who first published on the areal geology near Hamada in 1911.

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EXPLANATION OF PLATE

PLATE 7

All figures are in natural size.

The specimens are in the Institute of Geology, Facalty of Science, Hiroshima University, Hiroshima.

Sassafras Yamanei IMAMURA n. sp.

FIG. 1. The under surface impression of a comparatively complete leaf.

FIG. 2. A specimen of a variform with shallow sinuses.

FIGS. 2,3,4,5 Each the upper surface impression of an imperfect leaf.

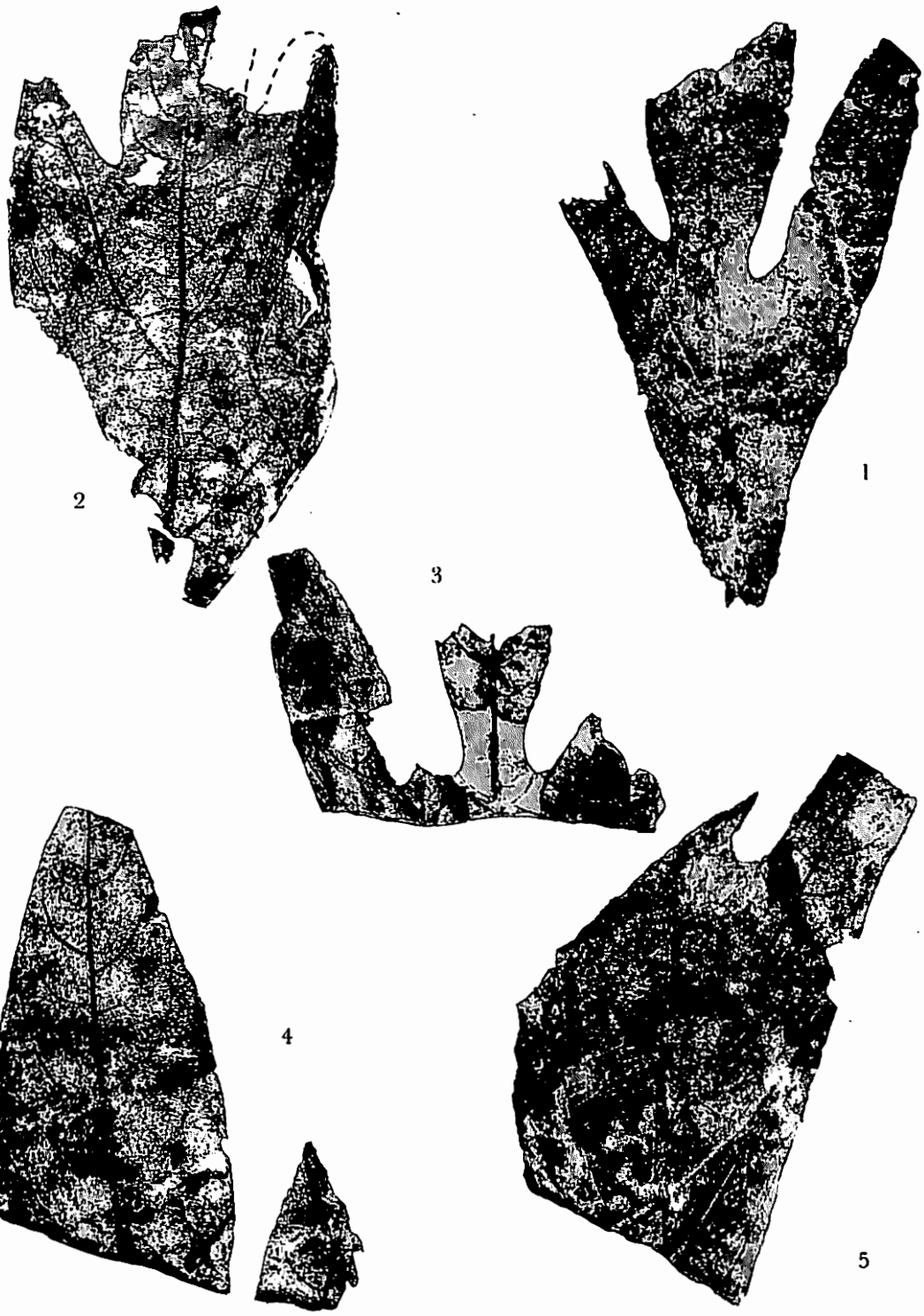

Photo. by K. Sata.

EXPLANATION OF PLATE

PLATE 8

All figures are in natural size.

The specimens are in the Institute of Geology, Faculty of Science, Hiroshima University, Hiroshima.

Sassafras Yamanei IMAMURA n. sp.

FIG. 1. The under surface impression of an upper half specimen, the largest of the kind at hand.

FIG. 2. The upper surface impression of a lower part specimen, cuneate, nearly complementary to FIG. 1 in size.

Photo by K. Sata.