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Some Fossil Cicadas from Neogene of Japan

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Introduction

Four specimens of cicada have been accumurated for study since the writer recorded several fossil cicadas from Japan (FUJIYAMA, 1969 and 1979). Of which one specimen is described in the present paper as a new species, and the remaining specimens are left indetermined at specific or generic level for their poor preservation.

The writer expresses his codial thanks to Mr. Shigehiro INOUÉ, Mr. Iwao YAMANA, Mr. Yoshio FUKUSHIMA and Mr. Kazuhiko UEMURA for giving him a chance to study these interesting fossils and to Dr. Masami HAYASHI for giving him useful suggestions and offering some specimens for comparison.

Description

Family Cicadidae WESTWOOD, 1840
Genus *Graptopsaltria* STÅL, 1886
Graptopsaltria inaba sp. nov.

Fig. 2A

Type: Holotype. A left forewing lacking its basal part and a part of right forewing in grey mudstone. Found at Tatsumi-tôgé, Tottori Prefecture by Yoshio Fukushima. Tochiwara Formation, Misasa Group. Late Miocene. Stored at the Tottori Prefectural Museum, reg. no. 649–072.

Description and comparison: Length of forewing at remaining part is 44 mm, width is approximately 16 mm. Outer margin of forewing is slightly curved, so the forewing is rather subtriangular than fusiform. Wings are opaque and their veins and cross veins are marginated in dark brown. Feather-like peculiar markings are seen in each cell though faintly. These features infer to belong the species to the genus *Graptopsaltria*. The pattern of wing venation is similar to that of *Graptopsaltria nigrofuscata* and other species of this genus.

Graptopsaltria is represented by three recent species: *G. nigrofuscata* (MOTSCHULSKY) (=*G. colorata* (STÅL)) (fig. 2B) from Japan, Korea and North and Central China, *G. bimaculata* KATO (Fig. 2C) from Ryûkyû Islands, and *G. tienta* KARSCH from Central and West China. *Graptopsaltria tienta* is smallest in size so far as the specimens from Fukien, Central China are examined, but these three living species are not greatly

Fig. 1. Localities of fossil cicadas in Japan. A: Tatsumi-tôgé. B: Umigami. C: Akakura. D: Nasu. E: Shiobara. F: Kazusa. G: Yoshida.

different in size each other, and the present fossil species also falls within the size range of these species. The shape of forewing considerably varies among the living and fossil species. The distance between the first forking of the M* and the apex (l_1) and that between the terminal of vein Cu_{1a}* and the costal margin (l_2) are measured instead of length and width as the fossil specimen lacks its basal and posterior parts. The ratio l_2/l_1 is calculated for indicating narrowness of the wing.

Regarding the above-noted ratio, the fossils are far apart from the living species. Comparing with the wings of *G. nigrofuscata*, every cell of the fossil is narrower, especially at the cells M and 1 M_2.

The fossil wing is also distinguishable in the following points other than narrowness. The apex is more pointed than living species. The outer margin is almost straight in the fossil species but it is somewhat concave in the middle in the living species as seen in *G. nigrofuscata*. The first cross vein slants outward, whereas that of the living species of the genus is arched outward without exception. Occasionally, there are found even individuals with the first cross veins weakely curved and seemingly slanting inward. The figure of *G. tienta* by DISTANT (1912), seems somewhat unnatural to the writer.

Graptopsaltria bimaculata, isolated in the Southwest Islands of Japan, has obvi-

Species	Number of individuals examined	l_1	l_2	l_2/l_1
G. nigrofuscata	23	35.0–40.3	14.0–16.5	2.43–2.66
G. bimaculata Amami Is.	6	34.1–40.2	14.0–15.8	2.43–2.54
Okinawa Is.	5	34.4–36.8	14.8–16.0	2.30–2.37
G. tienta Fukien	5	32.8–35.8	13.4–14.5	2.45–2.51
G. sp., aff. *G. nigrofuscata* (Pleistocene fossil)	1	36.2	13.2	2.74
G. inaba sp. nov.	1	40.4	14.9	2.72

* Nomenclature of the wing venation indicated on fig. 2C is tentatively adopted in this paper.

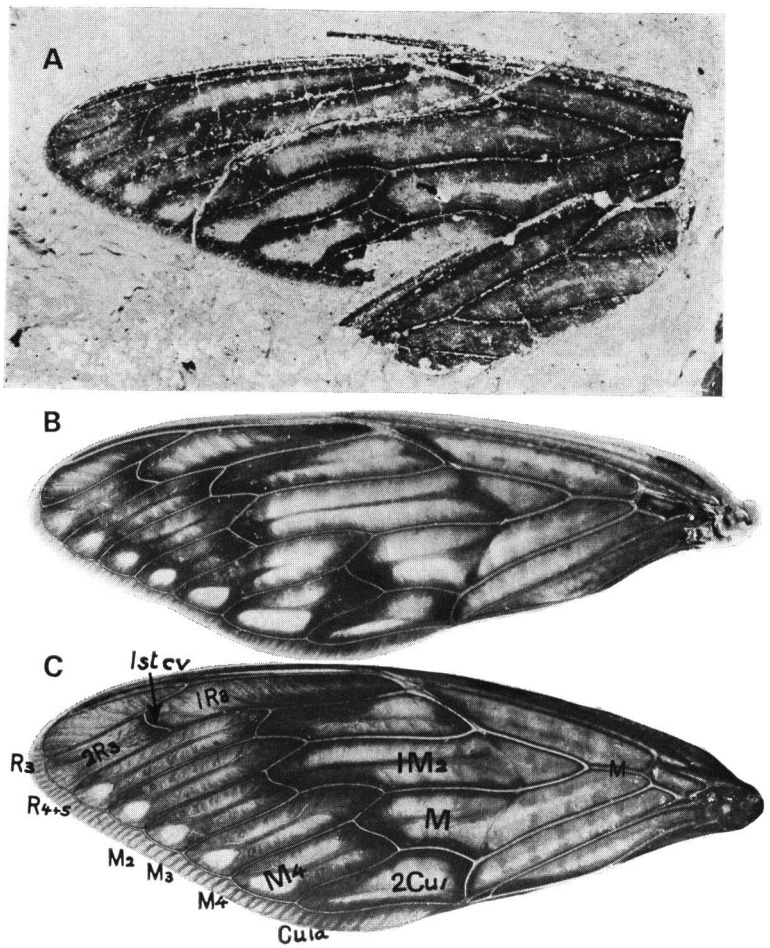

Fig. 2. A. *Graptopsaltria inaba* sp. nov. Tatsumi-tôgé, Tottori Pref., Japan. Late Miocene. Tottori Pref. Mus., 649–072.
B. *Graptopsaltria nigrofuscata*, Honshu, Japan.
C. *Graptopsaltria bimaculata*, Okinawa Is., Japan. ×2.

ously thicker forewings, especially in individuals from Okinawa Island. Another fossil specimen recorded as *G.* sp., aff. *G. nigrofuscata* by the writer from the Middle Pleistocene bed of Yoshida, Kagoshima (FUJIYAMA, 1979) bears narrower forewing than *G. nigrofuscata*, of which the ratio is comparable with that of the present fossil. However, it first cross vein seems to be arched outward as in *G. nigrofuscata*.

So far as the genus *Graptopsaltria* is concerned, the ancestral forms bore narrower wings and they seem to have increased their width. The arched first cross veins appear only in the genera *Graptopsaltria* and *Tanna* in the living cicadas of East Asia, but the

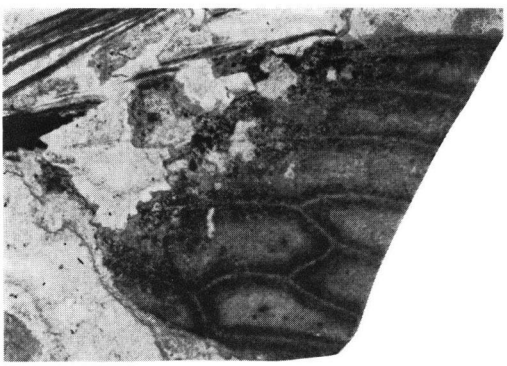

Fig. 3. *Graptopsaltria* sp. Umigami, Hyôgo Pref., Japan. Early Pliocene. Inoué's Coll., 811123–2. ×2.5.

ancsestral type, the present fossil, has a slant first cross vein alike most of cicada. It is probably a character lately acquired.

The specific name *inaba* is after "Inaba", the ancient provincial name of the fossil locality.

Graptopsaltria sp.

Fig. 3

Specimen examined: An incomplete forewing lacking distal one third and basal one fifth. Found at Umigami, Hyôgo Prefecture by Shigehiro INOUÉ. Haruki Formation, Teragi Group. Early Pliocene or Late Miocene. Stored at the INOUÉ's Fossil Collection, reg. no. 811123–2.

Comparison: Judging from the remaining part of opaque forewing, its dark colouration along veins and venartional manner suggest to belong to the genus *Graptopsaltria*. The width of the fossil is comparable with that of the largest individuals of *G. nigrofuscata*. Though the entire form of the fossil cannot be known, it seems to be more related to *G. nigrofuscata* than to *G. inaba* judging from the cells of remaining part.

Genus *Meimuna*, DISTANT, 1905

Meimuna sp.

Fig. 4A

Specimen examined: A left (?) forewing, lacking basal one third and a small part near apex. Found at Umigami, Hyôgo Prefecture. Haruki Formation, Teragi Group, Early Pliocene or Late Miocene. Collected by Shigehiro INOUÉ, Inoué's Fossil Collection, reg. no. 801111–16.

Description and comparison: The remaining part is measured 32.5 mm in maximum length and 13.2 mm in width. The forewing is slender in outline, and its veins are thin. The cell $1R_3$ is as long and as thin as that of *Meimuna opalifera* (fig. 4B). The vein R_3 terminates near the apex of wing as in the species of *Meimuna*. whereas it

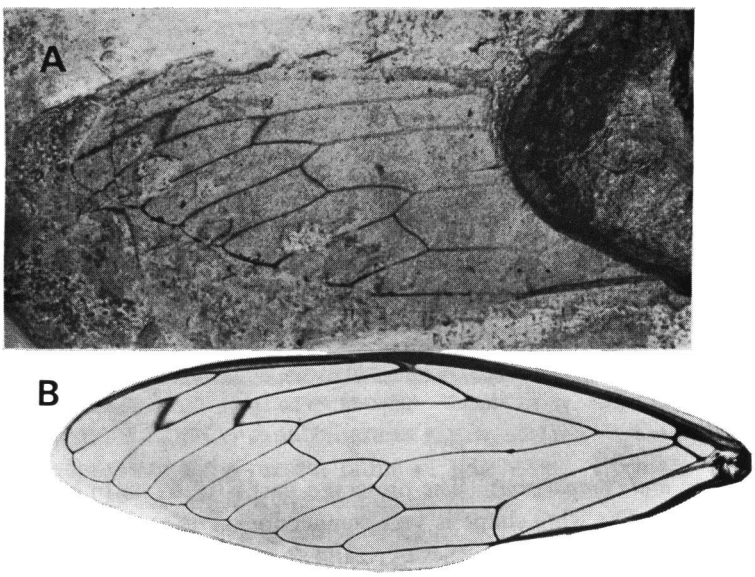

Fig. 4. A. *Meimuna* sp. Umigami, Hyôgo Pref., Japan. Early Pliocene. Inoué's Coll. 81111–16.
B. *Meimuna opalifera*, Honshu, Japan. ×2.5.

terminates a little posteriorly in *Terpnosia* and *Oncotympana*, anteriorly in *Tibicen*. The first cross vein slants outward, but it is curved in the species of *Tanna*. The cell M_4 is elongate and its veins at both sides (M_4 and Cu_{1a}) are parallel like *Meimuna* or *Oncotympana*. The cell $2Cu_1$ is as elongate as that of *Meimuna*. Fuscous spots are on the first, second and third cross veins and faintly on M_2 and M_3.

Comparing with the living species, the character of wing venation of the fossil well coincides with that of the genus *Meimuna*. The only species in the main islands of Japan, *Meimuna opalifera* WALKER, is smaller, and of which the range in size does not allow the fossil to belong to the species. In East and Souteast Asia south of Amami Islands, many species of *Meimuna* are distributed (DISTANT, 1906; ISHIHARA, 1968; HAYASHI, 1975), most of which are larger than *M. opalifera* of Japan. It is difficult to specifically distinguish the cicadas of *Meimuna* based only on wing venation, so specific identification is left until further well-preserved specimens are added in future.

Gen. et sp. indet.

Fig. 5

Specimen examined: Distal one third of forewing. Basal two-thirds are cutt off rectilinearlly. Found at a cliff of Akakura, Yamagata Prefecture by Kazuhiko UEMURA. Kannotaira Formation, Late Miocene. Stored at the National Science Museum, Tokyo, reg. no. NSM-PA12179.

Fig. 5. Cicadidae, gen. et sp. indet. Akakura, Yamagata Pref., Japan. Late Miocene. NSM-PA12179. ×5.

Description and comparison: The preserved part is 17.0 mm in length, 8.5 mm in maximum width. The wing shape is very slender for a cicada. The costal margin is less curved anteriorly than most species of cicada and its outer margin is near rectilineal, so the remaining part of wing is wedge-shaped. Each cell is narrow. The cell $1R_3$ is near 1.5 times of the apical cell being measuered at costal margin. The first cross vein (r_3–r_{4+5}) is at right angle to both R_3 and R_{4+5} veins. Outer part of each vein is little curved and nearly parallel, so the cell $2R_3$ is not extremely expanded outward. Total length of the forewing is estimated 38.0 mm or slightly less. The fossil forewing is extremely narrow.

The writer cannot find any genus in Japanese and East Asian cicadas, with combination of the above mentioned features: wedge-shaped distal one third of forewing, extremely narrow cells and right-angled first cross vein. The last feature is found only in the genus *Tanna* among East Asian living cicadas, though *Tanna*'s forewing is not thin. The wedge-shaped distal part of the wing appears in some species of the genus *Meimuna*, but *Meimuna*'s first cross vein slants outward and parallel with the second cross vein.

The generic determination of this interesting species is left hereafter, because too few characters are offered to identify the genus.

Consideration on Late Cenozoic fauna of cicada in Japan

Late Cenozoic fossil cicadas from Japan hitherto recorded are as follows:

Middle Miocene—Nasu, Tochigi Prefecture.

Meimuna protopalifera FUJIYAMA (closely allied to the living species *M. opalifera*.) (FUJIYAMA, 1969)

Late Miocene—Tatsumi-tôgé, Tottori Prefecture.

Graptopsaltria inaba sp. nov. (The present paper)

Tibicen sp., aff. *T. japonicus* (KATO) (KINUGASA & MIYATAKE, 1976)

Terpnosia sp., aff. *T. vacua* (OLIVIER) (KINUGASA & MIYATAKE, 1979)

Late Miocene—Akakura, Yamagata Prefecture.

Gen. et sp. indet. (The present paper)

Early Pliocene or Late Miocene—Umigami, Hyôgo Prefecture.

Graptopsaltria sp. (The present paper)

Meimuna sp. (The present paper)

Early Pleistocene—Kazusa, Nagasaki Prefecture.

Tanna (?) sp. (FUJIYAMA, 1979)

Middle Pleistocene—Yoshida, Kagoshima Prefecture.

Graptopsaltria sp., aff. *G. nigrofuscata* (MOTSCHULSKY) (FUJIYAMA, 1979)

Late Pleistocene—Shiobara, Tochgi Prefecture.

Tibicen bihamatus (MOTSCHULSKY) (FUJIYAMA, 1979)

Terpnosis nigricosta (MOTSCHULSKY) (FUJIYAMA, 1969, 1979)

1. The fauna of Late Cenozoic cicada in Japan, so far as known, consits mostly of the genera representing the present fauna of East Asia. Even the species of the Middle Miocene is closely allied to the living one.

2. The species of the Late Miocene of Akakura is the only species that does not have a close relative among the living genera.

3. Most of fossil cicada, even that of the Middle Pleistocene, never entirely correspond to the living species. Only Late Pleistocene species coincide with the living ones.

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