

Late Triassic Insects from Miné, Yamaguchi, Japan, Part 1. Odonata

By

Ienori FUJIYAMA

Shirako 3-19-6, Wako-shi, Saitama

Abstract Among the numerous Carnian (Late Triassic) insect fossils newly found in Miné, Yamaguchi, Japan, three odonates are described. One is referred to the genus *Triassoneura*, and the others are to *Triassothemis*, known from South Africa and Argentina respectively. They have incipient nodus, and are considered to be primitive representatives of the order Odonata. The discoidal cell of the genus *Triassoneura* has not been closed, but closed in the genus *Triassothemis*.

Introduction and Acknowledgment

Thirteen species of the Late Triassic insects from Ominé Coal Field, Miné, Yamaguchi Prefecture, Japan, were described by the author (FUJIYAMA, 1973). They were found at the Ominé and Hazegatani Coal Mines accompanied with abundant plant fossils. This fossiliferous bed lies near the Fujiyahawachi-sô, one of six coal seams in Ominé Coal Field (FUJIYAMA, 1973).

Afterwards, the finding of a great number of fossil insects had become improbable because of the closing of all the collieries, though some wings of cockroaches and beetles have been found from various horizons. A small mine, Miné Coal Mine, opened in 1979. At an outcrop near the mine, Mr. Kenro HIRONAKA found an insect fossil bearing bed, which was composed of black shale accompanied with scarce plant fossils. This bed was situated at the horizon about 20 m above the Jô-sô (uppermost coal seam). From 1988 to 1990 some hills in Okubata 2 km SW of the Miné Coal Mine were cut off for the construction of a new road. The staff of the Miné City Museum of History and Folklore had expected the appearance of the extent of the insect fossil bearing bed and succeeded in discovery of the bed. As the result of their efforts of nearly two years' work, about six thousand insect fossils were excavated.

More than a half of the fossils from Okubata are the wings of Coleoptera and Blattodea though for the most part fragmentary. Homoptera is subordinate (about 20%) in amount, followed by Mecoptera, Orthoptera, Hymenoptera, Neuroptera, Ephemeroptera, Plecoptera, Paraplecoptera, Trichoptera, Diptera and Odonata. The author intends to publish the studies on every order or smaller group successively.

The author would like to express his appreciation to the staff and museum-asociates of the Miné City Museum of History and Folklore, Messrs. Fumio TAKA-

HASHI, Hideo ISHIDA, Eiji DOI, OSAMU Ito, Masanori NOHARA, Shunji TANIGUCHI, Takumitsu UTAMURA, and Shinjiro KUNIKIDA who have made serious efforts for collecting the precious fossil materials and offered them for this study. He is also indebt to Mr. Takayoshi HARADA of Kitakyushu for providing an odonate fossil. He expresses his cordial thanks to the former directors Mr. Sakaé ANO and Mr. Kazuo IWANO and Mrs. Yoshié OKAFUJI of the museum for providing the facilities to study these materials. He is grateful to Dr. Ikuwo OBATA, Dr. Yukimitsu TOMIDA and Ms. Shuko FUNAKI of the National Science Museum, Tokyo for their various help to the author.

Fossil localities and geology

Fossil insects described in the present paper were collected from the Momonoki Formation exposed at the road cutting in Okubata, Ominé-chô, Miné, Yamaguchi Prefecture, Japan.

Ominé district has been famous as an anthracitic coal field in Japan, but all the mines have been closed except a small one. The plant fossils from the district have contributed for the advancement of Mesozoic paleobotany of Japan. The geology of this area has been clarified by geologists of coal mines and universities, as summarized in the previous work of the author (FUJIYAMA, 1973). The insect fossil bearing bed lies in the Momonoki Formation of the Miné Group. Geological age of the formation is assigned to the Carnian stage, Late Triassic, based on the marine molluscs included in the Hirabara and the Asô Formations under- and overlying the Momonohi Formation.

Description

Order Odonata

Family Triassoneuridae, RIEK 1976

Genus *Triassoneura*, RIEK 1976

Type species: *Triassoneura andersoni* RIEK 1976. Molteno Formation, South Africa. Late Triassic.

Triassoneura okafujii, sp. nov.

(Figs. 1 & 8)

Etymology: The specific name is dedicated to the late Mr. Gorô OKAFUJI, who was a pioneer of fossil study in the Ominé district and found the occurrence of fossil insects for the first time.

Holotype: MMHF3-00006, stored in the Miné City Museum of History and Folklore. Okubata, Miné, Momonoki Formation, Carnian. Collected by Masanori NOHARA.

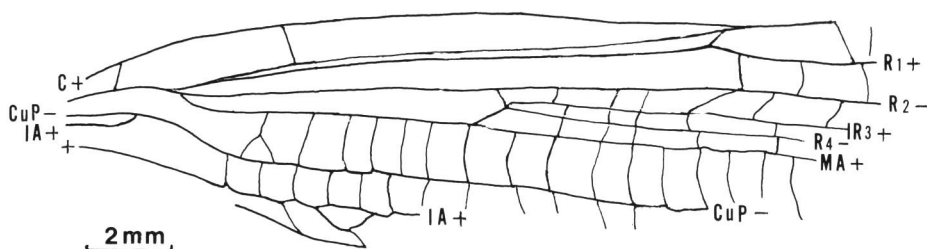


Fig. 1. *Triassoneura okafujii*, sp. nov., $\times 5.2$. Holotype, MMHF3-00006, Okubata, Miné, Carnian.

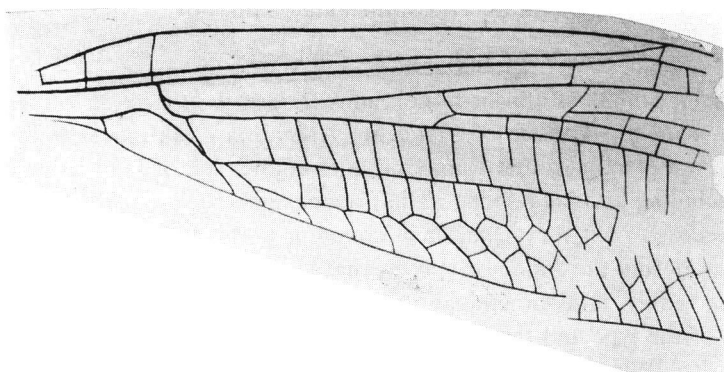


Fig. 2. *Triassoneura andersoni* RIEK, $\times 2.6$. South Africa, Late Triassic. (after RIEK, 1976)

Description: Type specimen is the proximal half of fore(?) wing. Slender. Preserved part of specimen 20.7 mm long, 6.2 mm wide, estimated total length more than 33 mm. Sc extending probably near middle of costal margin, ending on costal margin without costal indentation. Nodus not developed, except for appearance of a short and proximally slant cross vein between Sc and R_1 at near terminus of Sc, and slightly bent forward R_1 . Without subnodus. Arculus at low angle to R_1 . R_4 forking at a little distal point of middle between of arculus and end of Sc. Discoidal field broad; formed by a row of rectangular cells. Discoidal cell open. IA independent from CuP at base, once joining to CuP and again leaving CuP. Anal field not broad, with a row of rectangular cells along CuP.

Comparison: The present species is closely allied to the type species *Triassoneura andersoni* (fig. 2) in the venation except for the basal part. *T. okafujii* is distinguished from the type species in smaller size, less developed arculus, not strongly curved CuP at the basal part and independent IA from CuP at the basal part. The new species somewhat resembles *Liassophlebia* of Anisogygoptera in venation but the latter has the complete nodus.

Remarks: The genus *Triassoneura* is characterized by the incipient nodus, not

formed subnodus, not closed discoidal cell. These features indicate the incipient stage of development to modern odonates. RIEK (1976) referred the family Triassoneuridae to the suborder Protogygoptera composed mainly of Permian species. Although PRITYKINA (1981) placed *Triassoneura* in Triassolestidae with uncertainty and Triassolestidae to the superfamily Heterophlebioidea, the infraorder Heterophlebiomorpha, the above-mentioned features support that the *Triassoneura* belongs to Protogygoptera, but Triassoneuridae are different from Permian protogygopteran species in the extending Sc, the developed arculus, no remnant of CuA and other benational nature. Supposing this family belongs to Protogygoptera, Triassoneuridae should be a progressive and peculiar group in the suborder.

Family Triassothemidae, fam. nov.

Type genus: *Triassothemis* CARPENTER, 1960.

CARPENTER (1960) established the genus *Triassothemis* based on *Triassothemis mendozensis* from the Triassic of Mendoza, Argentina. He placed it in Family Incertae Sedis, not erecting a new family because of the lack of knowledge of the proximal part including arculus region. The present new species is very similar to *Triassothemis mendozensis* in the venation in common parts, especially in the incomplete nodus. Considering the Japanese species that should be referred to the genus *Triassothemis*, the family Triassothemidae are established and diagnosed as follows from the features of the type and the Japanese species described below.

Diagnosis: Wing slender, but more or less expanded in anal region, especially in hind wing. Base of wing not narrow petiolate. Nodus incipient, with a cross vein between Sc and R_1 , without costal indentation at junction of Sc with costal margin. R_1 slightly bent forward at the back of terminus of Sc. Without subnodus. Sc extending to about one-third of costal margin. Pterostigma well formed, elongate. A few antenodals, several postnodals. Arculus complete. Discoidal cell closed, but rather long trapezoid than rectangular. Anal area rather broad.

Genus *Triassothemis* CARPENTER, 1960

Type species: *Triassothemis mendozensis* CARPENTER, 1960. Mendoza, Argentina, Late Triassic.

Triassothemis nipponensis, sp. nov.

(Figs. 3 & 6)

Holotype: MMHF3-00007, stored in the Miné City Museum of History and Folklore. Okubata, Miné, Momonoki Formation, Carnian. Collected by Eiji DOI.

Description: Forewing. Type specimen missing apical part. Remained part 31.3 mm long, 8.5 mm wide, estimated total length about 36 mm. Slender, but postero-proximal part a little expanding due to broad anal field. Sc extending beyond

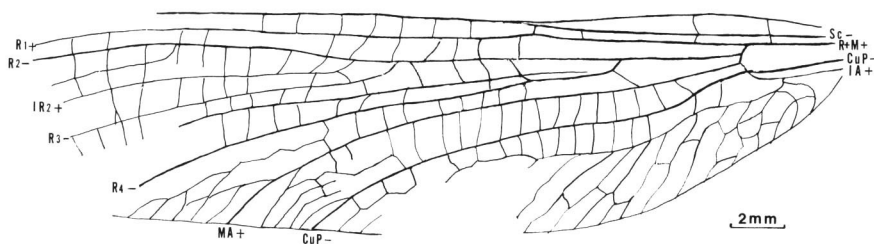


Fig. 3. *Triassothemis nipponensis*, sp. nov., $\times 3.5$. Holotype, MMHF3-0007, Okubata, Miné, Carnian.

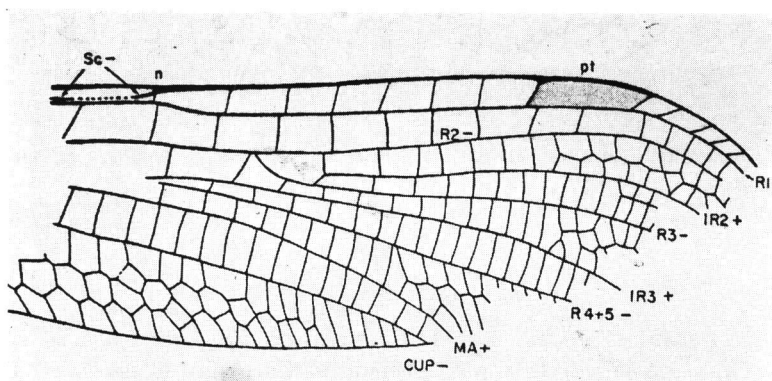


Fig. 4. *Triassothemis mendozensis* CARPENTER, $\times 4$. Mendoza, Argentina, Late Triassic. (after CARPENTER, 1960)

one-third of costal margin. Nodus incomplete, with short and weak cross vein between Sc and R_1 . R_1 having weakly bending forward at the back of end of Sc. Sub-nodus not appeared. 2 antenodals, 7 postnodals. Pterostigma not well preserved in the specimen. Arculus completely formed. R_2 shooting R_4 at middle between arculus and terminus of Sc. Discoidal field rather broad, forming a row of rectangular cells by subparallel cross veins. Discoidal cell closed, forming elongate trapezoid quadrilateral instead of rectangular one. 1A having a small branch ending at postero-proximal corner of quadrilateral. Anal field formed by a row of sub-rectangular cells along CuP and oblique cells in posterior part.

Comparison: The present species is closely allied to *Triassothemis mendozensis* (fig. 4) in the venation as far as comparable. In *T. nipponensis* the short cross vein between Sc and R_1 is far from the cross veins between R_1 and R_{2+3} , but these cross veins are almost aligned in *T. mendozensis*. The discoidal field is distally narrowed and is formed by rectangular cells in *T. mendozensis*, but distally widened and occupied by polygonal cells in the distal part of *T. nipponensis*.

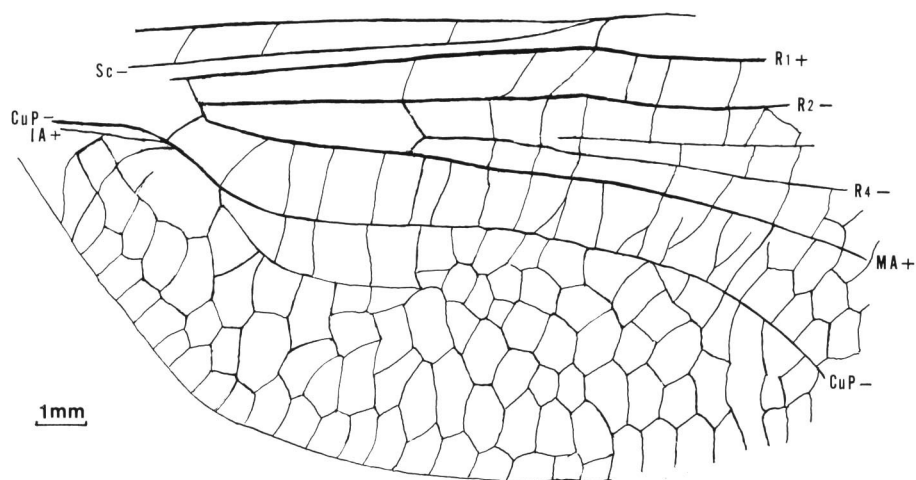


Fig. 5. *Triassothemis minensis*, sp. nov., $\times 6.5$. Holotype, MMHF3-00008, Okubata, Miné, Carnian.

Triassothemis minensis, sp. nov.

(Figs. 5 & 8)

Holotype: MMHF3-0008, stored in the Miné City Museum of History and Folklore. Ohubata, Miné, Momonoki Formation, Carnian. Collected by Takayoshi HARADA.

Description: Probably hind wing; distal half and base of wing missing. Preserved part 17.1 mm long, 9.2 mm wide, estimated total length about 26 mm. With three or four antenodals. Nodus incomplete, with a cross vein between Sc and R_1 distally from terminus of Sc, without costal indentation. No information on pterostigma in the specimen. Arculus completely formed. R_4 arising from R_{2+3} at almost middle between arculus and end of Sc. Discoidal field in proximal part formed by a row of subrectangular cells by subparallel cross veins. Discoidal cell closed, quadrilateral rather trapezoid than rectangular, formed by not straight but weakly curved veins. 1A joining with CuP at anterior corner of discoidal cell and leaving at posterior corner. Anal field broad, formed many polygonal cells except some rectangular or triangular ones.

Comparison: *Triassothemis minensis* differs from *T. nipponensis* in the broader wing. Consequently, the spaces between every longitudinal veins are broader. The discoidal cell of *T. minensis* is shorter trapezoid than that of *T. nipponensis*. The venations of 1A differ each other. The anal field of *T. minensis* is more or less swollen and consists of polygonal cells instead of obliquely elongate cells in *T. nipponensis*. However, the possibility that the two specimens may be of the same species and the differences are due to fore- or hind wings, may be left. *Cyclothemis sogjutensis* de-

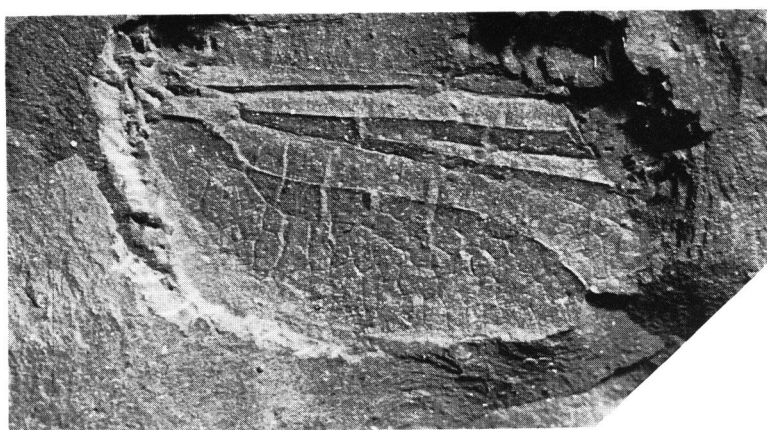


Fig. 6. *Triassothemis nipponensis*, sp. nov., $\times 4$. Holotype, MMHF3-00007, Okubata, Miné, Carnian.

Fig. 7. *Triassothemis minensis*, sp. nov., $\times 4$. Holotype, MMHF3-00008, Okubata, Miné, Carnian.

Fig. 8. *Triassoneura okafujii*, sp. nov., $\times 4$. Holotype, MMHF3-00006, Okubata, Miné, Carnian.

scribed by PRITYKINA (1980) from Lower Jurassic from Sogjut, U. S. R., somewhat resembles *Triassothemis minensis* in the venation in the basal part, especially arculus, discoidal cell and veins in discoidal and anal fields. However, it differs from *T. minensis* in the developed nodus.

Remarks: Triassic fossil genus *Triassothemis* shows a more progressive stage than *Triassoneura* because of the closed discoidal cell. Nevertheless, *Triassothemis* retains the incipient nodus. These genera seem to be some representatives of Triassic odonates in the transitional stages from the Permian incipient odonates to modern ones flourishing since the Jurassic period.

It is interesting that the Triassic odonates from Japan are much more closely related to those from South Africa and Argentina situated on the Gondwanaland in that time than to those from Central Asia (PRITYKINA, 1981). Five odonates in different taxonomic positions were described by TILLYARD (1916, 1918, 1922) from the Late Triassic in Australia, but no common genus is found in the Japanese odonate fauna.

References

- CARPENTER, F. M., 1960. A Triassic Odonata from Argentina. *Psyche*, 67: 71–75.
- FUJIYAMA, I., 1973. Mesozoic insect fauna of East Asia. Part 1, Introduction and Upper Triassic faunas. *Bull. Natn. Sci. Mus., Tokyo*, 16(2): 331–386, pls. 1–5.
- PRITYKINA, L. N., 1980. New dragonflies of the Lower Jurassic period in Central Asia. In *Fossil insects of Mesozoic*. 119–134, pls. 19–21. (in Russian)
- , 1981. New Triassic dragonflies of Central Asia. *Trudy Pal. Inst. Akad. nauk SSSR*, (183): 5–42, pls. 1–13. (in Russian)
- RIEK, E. F., 1976. A new collection of insects from the Upper Triassic of South Africa. *Ann. Natal Mus.*, 22(3): 791–820.
- TILLYARD, R. J., 1916. Mesozoic and Tertiary insects of Queensland and New South Wales. Description of the fossil insects. *Qld. Geol. Surv., Publ.*, (253): 11–49.
- , 1918. Mesozoic insects of Queensland. No. 3 Odonata and Protodonata. *Proc. Linn. Soc. N. S. W.*, 43(171): 417–436.
- , 1922. Do. No. 9 Orthoptera, and additions to the Protorthoptera, Odonata, Hemiptera and Planipennia. *Ibid.* 47: 447–470.