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Some Fossil Insects from the Tedori Group (Upper Jurassic-Lower Cretaceous), Japan.

By

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Introduction and Acknowledgments

Some Lower Cretaceous fossil insects were found by Prof. Dr. H. MATSUO of Kanazawa University during the fossil research of Kaseki-kabe at Kuwajima in 1975. Kaseki-kabe ("fossil cliff"), a famous plant fossil site, is to be submerged within a few years owing to the progressing Tedorigawa-dam construction. The excavation at Kaseki-kabe were carried out in 1975–1977 by the research group led by Prof. MATSUO, under the sponsorship of the Board of Education of Ishikawa Prefecture and the Electric Power Development Company, Ltd.

This is the first record of insect fossils from the Lower Jurassic to the Upper Cretaceous in Japan. The preliminary report in Japanese on these fossils was published being included in the research report of the geology of the region surrounding the Tedorigawa-dam, edited by the Board of Education of Ishikawa Prefecture (1978). In addition to these insects, some fossil beetles obtained at the other localities of the Tedori Group to which the fossil-bearing strata at Kuwajima are referred, are dealt with in this paper.

First, the author expresses his cordial thanks to Dr. Hidekuni MATSUO for offering these precious materials for study and allowing the author to join the excavations at Kaseki-kabe in 1976 and 1977. He is, also, indebted to the Board of Education of Ishikawa Prefecture and the staff, especially to Mr. Akito TAJIMA, and the Electric Power Development Company. Ltd. The material from Ôkurodani was offered for study by Mr. Mitsuo KUWAYAMA of Tsushima, Aichi Prefecture, for which the author is grateful.

Geologic Note

The Tedori (=Tetori) Group is a representative of Mesozoic strata deposited in the inner side of Southwest Japan. As the result of crustal movement and erosion, the group is exposed in several areas isolated within 160 km in the direction NE–SW. Three fossil insects described herein are from the Tedori district, the original area of the group, along the Tedori River of Ishikawa Prefecture. Other two localities of beetles are situated in the Asuwa area in Fukui Prefecture and the Makido area in

Gifu Prefecture. The standard succession of the Tedori Group has been established by MAEDA (1961, etc.), viz. the Kuzuryû, the Itoshiro and the Akaiwa Subgroups in ascending order.

The Kuzuryû Subgroup, the lowest one, is mostly of marine origin, bearing fossils of pelecypods, ammonites, etc. indicating Callovian to Kimmeridgian Stages. However, partially being of land origin, some fossil plant beds are intercalated, from which a fossil elytron of beetle was found at Kowashimizu (Kowashôzu), a famous fossil plant locality. Recently, some geologists, attaching importance to the unconformity between the Kuzuryû and the Itoshiro Subgroups, have separated the Kuzuryû Subgroup from the upper subgroups and raised it to a group. As a consequence the Tedori Group has come to comprise the Itoshiro and the Akaiwa Subgroups only. Nevertheless, the Tedori Group in a broad sense has been still used (e.g., TANAKA & NOZAWA, 1977), and is adopted in this paper, also.

The Itoshiro Subgroup consists mostly of non-marine sediments. The Kuwajima (=Kuwashima) Sandstone and Shale Alternation in the Itoshiro Subgroup is intercalated with rich plant and fresh-water molluscan beds, from which the insect fossils described herein were found at Kuwajima. The horizon of the locality of fossil beetle at Ôkurodani in the Makido area may be correlated with the horizon at Kuwajima. The geologic age of the subgroup has been considered as Upper Jurassic-Lower Cretaceous (MATSUO & OMURA, 1966, and others), whereas KIMURA (1975, etc.) has confined the age of the subgroup to the early Neocomian. In any case, the geologic horizon of fossil site at Kuwajima, situated at the upper part of the subgroup, may be assigned to Upper Cretaceous, although a few possibility to Uppermost Jurassic remains. KIMURA (1975, etc.) has asserted that the flora in the Itoshiro Subgroup corresponds with those in the Siberian Paleofloristic Province of VAKRAMEEV (1964, etc.), not but with the Indo-European Province.

The Akaiwa Subgroup is characterized by thick sandstone, in which some plant beds are intercalated, also. An opinion that the Akaiwa Subgroup is a contemporaneous heterotopic facies of the Itoshiro Subgroup has proposed (OMURA, 1973).

Insect Fauna of the Tedori Group

Three new species from Kuwajima, two of which are under new genera, are described here: *Nipponohagla kaga, Fulgoridium? matsuoi, Kagapsychops aranea.* Their geologic age is assigned to Lowermost Cretaceous, whereas we can find their relatives rather in Jurassic insect faunas than in Cretaceous ones, although the latter is internationally less known than that of the former. They all belong to the stocks which flourished during the middle of Mesozoic Era (RIEK, 1955; SHAROV, 1968; TILLYARD, 1917, 1919; ZEUNER, 1939, etc.), and a small number of their descendants or relatives persisted to the present time, for example: *Prophalangopsis obscura*, a living species in India, is a survivor of Haglidae (ZEUNER, 1935); the family Psychopsidae with only about 20 species in the world is a more advanced relative of Osmylopsychopidae.

The rich Neocomian insect faunas have been known in Zabaikal of USSR and Mongolia (formerly they had been considered Upper Jurassic in age, but were later assigned to Neocomian (YAKOVLEV, 1965)). So far as the published insect faunas of Zabaikal and Mongolia are compared, there is no common or close relative species between them. However, the study of the enormous fossil collection from Zabaikal and Mongolia have carried on by the Paleontological Institute of the Science Academy of USSR.

Other two fossil beetles from the Upper Jurassic and Lower Cretaceous are represented by elytron/a, so that they are not available for faunal comparison.

Description of Species

Order Orthoptera
Family Haglidae
Subfamily Prophalangopsinae
Genus *Nipponohagla*, nov.

Type species: *Nipponohagla kaga* FUJIYAMA, sp. nov.

Generic diagnosis: Moderately large Gryllidea. Forewing of female: Anterior margin almost straight; posterior margin slightly curved. C thin, running obliquely, ending at one-third of anterior margin, across proximal branches of Sc (although indistinct due to ill-preservation of this part). Precostal area with several fan-like veins. Sc slightly bent upward at middle, with anterior branches. R furcate early, Rs parallel with R_1; R_1 with several branches; Rs posteriorly with several branches. MA bifurcate early (earlier than furcation of R) into MA_1 and MA_2, both veins not forking again. $MP+CuA_1$ branching off twice. Distal branch of CuA_2 arising at the point where MP and CuA join. Basal part of CuP coming close to CuA. Four anal veins slightly curved at basal part. Many remarkable cross veins in proximal half of wing except subcostal area. Intercalary veins in the distal half of radial and median areas. No network veins. Without marking.

Hind wing of female: R early forking into R_1 and Rs; R_1 and Rs with some

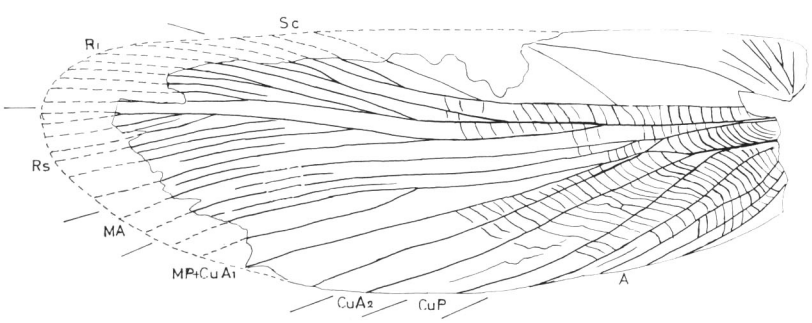

Fig. 1. *Nipponohagla kaga* sp. nov., forewing. ×2.2
Holotype, NSM-PA12002. Kuwajima, Lower Cretaceous.

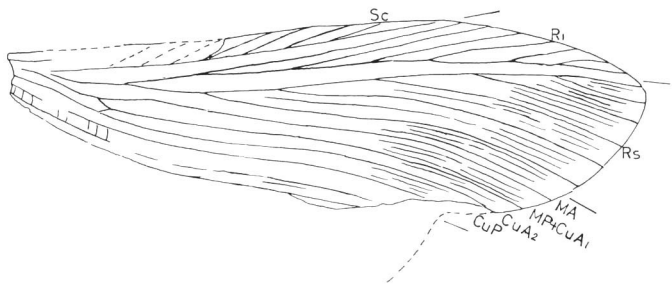

Fig. 2. *Nipponohagla kaga* sp. nov., hind wing. ×2.2
Holotype, NSM-PA12003. Kuwajima, Lower Cretaceous.

anterior and posterior branches respectively. M furcate much earlier than R; MA and MP+CuA_1 not forking. Three or two intercalated vein-like ridges between branches of Rs, M and Cu instead of cross veins or polygonal veins.

Comparison and remarks: Unless the author errored in recognition of veins in the humeral area owing to poor preservation, the costa obliquely crossing the humarel area suggests the subfamily Prophalangopsinae CAUDELL, 1911 (=Prophalangopseinae, SHAROV, 1962, 1968). Of this subfamily, only one genus of Lower Cretaceous, *Prophalangopseides* SHAROV, 1968, represented by a male specimen, has been known hitherto. This genus seems not to be allied to the new genus so far as the venational manner is concerned, although a precise comparison between wings of different sexes is difficult. A relative of the new genus is found among Jurassic genera; *Aboilus* MARTYNOV, 1925 from USSR which is a representative archaic Orthopteroid with 6–7 dark-colored cross bands on wings. Though the new genus possesses no such remarkable bands, it is essentially allied to *Aboilus* in venational manner, especially in CuP basally close to CuA. *Nipponohagla* is distinguishable from *Aboilus* in the following points; the earlier forking of R into R_1 and Rs in both wings, the distal branches of CuA_2 of forewing arising at the junction of MP and CuA instead of just a little proximally in female of *Aboilus*, less forking MP+CuA of forewing, intercalary veins instead of polygonal veins in both wings, and without dark-colored cross bands.

Nipponohagla kaga, sp. nov.

Pl. 1, figs. 1a, b, c, 2a, b, c; Figs. 1, 2

Holotype: Female fore- and hind wings, hindwing lacking anal lobe. NSM-PA12002 (forewing) and PA12003 (hind wing), collected by H. MATSUO, stored at the National Science Museum, Tokyo, with counterparts. Fore- and hind wings are preserved on a piece of greyish shale together with a forewing of *Kagapsychops aranea* described in this paper (Pl. 2, figs. 7a, b). The wings are 8 mm apart from each other and in the opposite direction, but it seems more natural to regard that these

two wings came from one individual rather than they were derived from two different individuals. There is no obstruction to regard as the wings of the same species, viewing their venational manner. Kuwajima, Lower Cretaceous.

Description: Forewing of female: Moderately large, not elongate; remaining part 43 mm long, 19 mm wide; estimated total length about 47 mm, width about 22 mm. Costal margin almost straight, hind margin curved. Costal field broad; costa oblique, ending at 1/3 of anterior margin, meeting with proximal branches of Sc (though only one branch visible due to ill-preservation). Precostal field with several fan-like veins which are rather thick but faint due to ill-preservation. Sc running slightly upward in distal half; with a series of anterior branches. R furcate at proximal one quarter; Rs parallel with R_1, R_1 with a series of anterior branches and Rs with posterior branches in distal two-thirds. M forking to MA and MP; MA soon furcate into MA_1 and MA_2 which do not fork. MP+CuA_1 early forking once, and again at about middle. Distal branches of CuA_2 arising at junction of MP and CuA. CuP running close to CuA in basal part. 4 anal veins; space between 1A and 2A in basal part a little expanded. Cross veins running close to each other in proximal part of radial, median, cubial and anal fields. Intercalated veins between radial and median branches in distal part of wing. Without markings.

Hind wing of female: Length of preserved part about 37.5 mm, total length estimated about 40 mm. A short veins appearing at basal part of the specimen may be a part of costa. Sc terminating at 3/4 of anterior margin, with about 7–8 anterior branches oblique at low angles; subcostal area rather wide. R early forking; R_1 with 5 anterior branches, Rs with 5 posterior ones; radial branches occupying about a half of wing excluding anal lobe. M far earlier forking into MA and MP than R; MA not bifurcate. Junction of MP and CuA_1 observable indistinctly because of ill-preservation. MP+CuA_1 not forking; CuA_2, CuP also. Branches of Rs, M and Cu running parallel and slightly undulate; with 3 or 2 vein-like ridges between them. Cross veins not observed except in proximal small part of cubital and anal fields. Without polygonal veins. No marking.

Comparison and remarks: The present species is allied to *Aboilus columnatus* MARTYNOV in the form of forewing, and to *A. aulietus* SHAROV in the early forkings of MA and R. However, the forewing of the present species is distinguished from the species of *Aboilus* in the venational manner of MP+CuA_1 less forking (twice only) than *Aboilus*, and having no polygonal network nor dark-colored cross bands. Nevertheless, *Nipponohagla* must be a descendent branch of Jurassic *Aboilus*.

Only four species of fossil Haglidae, represented by their hind wings, have been illustralated. Compared with the hind wing of *Aboilus columnatus*, the new species is characteristic in a little broader subcostal field, more oblique branches of Sc, earlier forking R and M, the intercalary ridges between the branches of Rs, M, Cu instead of polygonal veins or cross veins, and without dark bands.

One male wing of *Prophalangopseides vitimicum* SHAROV and none of female has been known hitherto as species of Cretaceous Prophalangopsinae. SHAROV (1968)

stated "among the Cretaceous Prophalangopsinae, there are forms which resemble the Jurassic *Aboilus* or forms intermediate between *Aboilus* and the recent *Prophalangopsis*". The second Cretaceous species of this subfamily and the first material of female is the present species, which supports SHAROV's statement because of the close affinity to *Aboilus*.

SHAROV, also, pointed out that in some Upper Jurassic Prophalangopsinae (*Pseudohagla pospelovi* (MARTYNOVA) (1949a)), the anterior branch of CuA_2 in forewing has moved distally beyond the point where MP joins CuA. In female of *Aboilus*, according to the figures by SHAROV (1968), this branch arises a little proximally from the junction of MP and CuA. In the *Nipponohagla*, it starts at a point where MP joins CuA, further proximally than *Pseudohagla*.

"kaga" of the specific name is after the name of the province where the specimen was found.

Geological distribution: Kuwajima, Shiramine-mura, Ishikawa Prefecture. Kuwajima Alternation, Itoshiro Subgroup, Tedori Group, Lower Cretaceous.

Order Hemiptera
Suborder Homoptera
Family ?Fulgoridae
Genus ?*Fulgoridium* HANDLIRSCH, 1908.
Fulgoridium? *matsuoi*, sp. nov.

Pl. 2, fig. 6a, b; Fig. 3

Holotype: Hindwing lacking proximal half. NSM-PA12005, collected by I. FUJIYAMA, stored at the National Science Museum, Tokyo. Kuwajima, Lower Cretaceous.

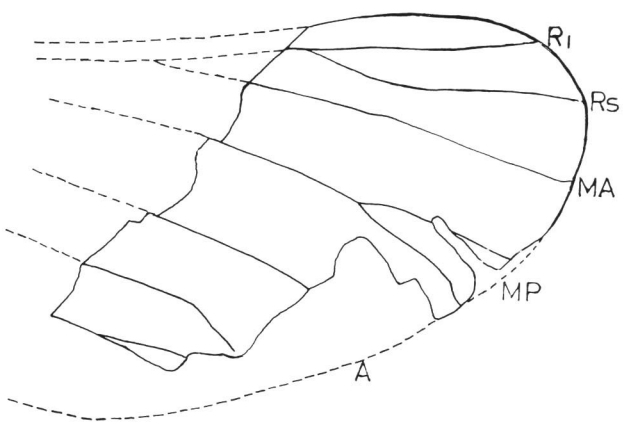

Fig. 3. *Fulgoridium*? *matsuoi* sp. nov., hind wing. ×8
Holotype, NSM-PA12005. Kuwajima, Lower Cretaceous.

Description: Hind wing: Proximal half unknown due to incomplete specimen. Maximum length of remaining part about 6.1 mm, width about 5.0 mm. R subparallel with costal margin; branching off Rs at about 2/3. Rs without branch, ending at a little anteriority of apex. M probably arising from R at middle, not furcate. Cu distally bifurcate. Cu_1 straight, without branch. No connecting veins along outer margin.

Comparison and remarks: This wing fossil of leaf-hopper lacking proximal half is possibly a hind one judging from its shape, of which the apex is situated anteriorly. Although the incomplete hind wing is insufficient to establish a new species, the new name is given herein because of its characteristic venation which is extremely reduced, expecting it will be repaired by finding another specimen.

Fossil wings bearing such much reduced veins have never been illustrated (BECKER-MIGDISOVA, 1960, 1961; EVANS, 1956; and others). It is difficult to decide its belonging to the family due to the lack of knowledge of the venation in the proximal half and its veins extremely reduced. It is possible to lead the venation of some species of *Fulgoridium* (e.g., *F. liadis* HANDLIRSCH 1908 (Fig. 4), *F. dubium* GEINITZ 1884, *F. infuscatum* BODE 1953, etc.) to the present one by simplification, although it is dangerous to draw a conclusion that the new fossil species was derived from the genus *Fulgoridium* of Jurassic. Besides *Fulgoridium*, some older leaf-

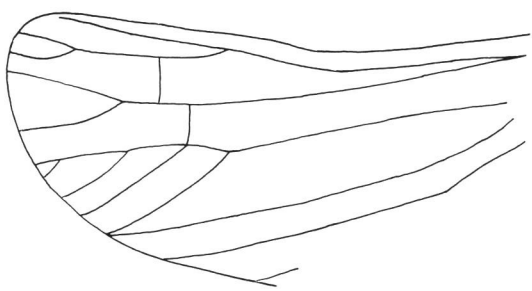

Fig. 4. *Fulgoridium liadis* HANDLIRSCH, hind wing.
Dobbertin, Liassic. (After HANDLIRSCH, 1908.)

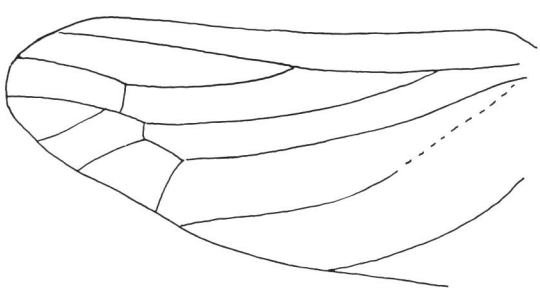

Fig. 5. *Scytinoptera kaltanica* BECKER-MIGDISOVA, hind wing.
Kuznetzk Basin, Permian. (After BECKER-MIGDISOVA, 1961 & 1962.)

hoppers seem to have alliance to the new species in venation of hind wing; for example, the venation of *Scytinoptera* (*S. kaltanica* BECKER-MIGDISOVA, 1961 (Fig. 5), *S. reducta* (MARTYNOV, 1928), etc.) which have reduced venation, may be led to the present species by further reduction. Species of *Scytinoptera* which flourished during the Permian Period and survived until Triassic, and most of species are smaller than 10 mm in length of wing. Hind wing of *Achilus* of living fulgorid also is somewhat allied to the new material.

It may be reasonable that the new species belongs to a new genus because of its having only standard veins with scarce brances. However, the recognizable features are insufficient to establish a new genus due to incompleteness of the specimen, so that the new species is described herein under the genus *Fulgoridium* with an interrogation mark since there is a possibility of its having been derived from another group of leaf-hopper by simplifying wing venation.

Geological distribution: Kuwajima, Shiramine-mura, Ishikawa Prefecture, Kuwajima Alternation, Itoshiro Subgroup, Tedori Group. Lower Cretaceous.

Order Neuroptera
Family Osmylopsychopidae
Genus *Kagapsychops*, nov.

Type species: *Kagapsychops aranea*, sp. nov. Kuwajima, Lower Cretaceous.

Generic diagnosis and comparison: Forewing: Large, broad-triangular. Costal area moderately expanded. Basal structure of Sc, R, M and Cu unknown as they are missing in the specimen. Sc, R_1 and stem of Rs straight and nearly parallel; Sc fused to R_1 apically and not forming distinct "vena triplica". R_1 and CuA strongly convex. A large number of branches of Rs, M and CuA radiating toward lateral margin.

This new genus is allied to the genus *Petropsychops* RIEK, 1956 from the Australian Upper Triassic in the comparable features except the basal part of main stems missing in the specimen. The shape of forewing with a larg angle of about 45° between R_1 and CuA, the straight and strong Sc, R_1 and Rs, the fusion of Sc to R_1 in apical part, many branches from Rs and M forking several times, are common in both genera. M in *Petropsychops* forms a pectinate series of many anterior branches, which recalls that seen in the Jurassic *Kalligramma* (RIEK, 1956), are alike in the new genus, but these branches are less in number, about 4–5, instead of more than 10 in *Petropsychops*. In *Kagapsychops*, these pectinate veins arise from the last but one main branch instead of the most posterior one in *Petropsychops*. CuA of *Petropsychops* gives off posteriorly many pectinate branches towards anal part of wing, but CuA of *Kagapsychops* only a few times forking towards the lateral margin in the distal half.

Of Jurassic and Cretaceous genera, *Angaropsychops* (MARTYNOVA, 1949b) from the Upper Jurassic of Zabaikal (recently Russian geologists (YAKOVLEV, 1965 and others) have assigned the age to Lower Cretaceous) seems to be the only one similar to this

Fig. 6. *Kagapsychops aranea* sp. nov., forewing. ×2.2
Holotype, NSM-PA12004. Kuwajima, Lower Cretaceous.

genus. However, *Kagapsychops* differs from *Angaropsychops* having Sc, R_1 and the stem of Rs slightly arched posteriorly, the broader costal field and the branches from Sc and Rs arising at higher angles. The manner of M in both genera does not seem to correspond with one another. The areas of Cu and A cannot be compared as they are missing in *Angaropsychops*. Nevertheless, the new genus is undoubtedly a close relative to *Angaropsychops*.

Kagapsychops aranea, sp. nov.

Pl. 2, fig. 3a, b; Fig. 6

Holotype: A well-preserved left wing, lacking basal part and costal and hind margins. Stored at the National Science Museum, Tokyo, reg. no. NSM-PA12004, collected by H. MATSUO. Kuwajima, Lower Cretaceous.

Description: Forewing: Large nearly isosceles right-angled triangular. Maximum length of remaining part along costal margin 40.5 mm and height 38 mm; estimated total length and height about 48 mm and 42 mm respectively. Costal area

moderately expanded judging from remaining part. Sc sending off numerous branches towards costal margin at an angle of 45°. Sc, R and the stem of Rs strong and straight, coming slightly close apically and finally Sc fused to R_1 at apex. R_1 strongly convex; the stem of Rs giving off about 15 pectinate branches at a low angle to the stem, which still retain the dichotomous nature at their bases. Most posterior two stems of M running parallel with CuA, connected by many cross veins; anterior one of which giving off more than five branches which run parallel with those of Rs. CuA strong and convex, forking several times over its distal half. Main stems of CuP and A not well-preserved; cubital and anal fields broader than costal area. Branches of Rs, M and Cu forking several times, finally to numerous fine veins. Cross veins distrubuted in areas of R, M and Cu, showing a slight tendency of partially concentric arrangement though each vein never joined another.

The species is named *"aranea"* because of numerous "cobweb-like" veins.

Geological distribution: Kuwajima, Shiramine-mura, Ishikawa Prefecture. Kuwajima Alternation, Itoshiro Subgroup, Tedori Group. Lower Cretaceous.

Order Coleoptera
Family ?Carabidae
Subfamily ?Harpalinae
Gen. et sp. indet.
Pl. 2, fig. 5a, b

Specimen examined: A pair of elytron obliquely extending; without head and thorax. Ôkurodani, Lower Cretaceous. Stored in the Kuwayama's Fossil Collection, no. 19770010300, collected by M. KUWAYAMA.

Description: Elytra: Rather elongate, length about 9.0 mm, maximum width about 3.6 mm at near middle. Not strongly convex, rather flat. Shoulder round; base not emarginate; scutellary corner of base not obliquely truncate, so scutellum probably small. Outer border extremely broad; inner border moderate. With about 13 striae on surface; interstices not strongly convex. Apex not truncate.

Comparison and remarks: The elytra of the present fossil are elongate as much as common living round beetles. Among living Harpalinae of Carabidae, the group of *Colpodes* seems to be closely related. However, the author feel hesitant to determine its belonging on the basis of the incomplete specimen lacking head and thorax.

Geological Distribution: Ôkurodani, Shôkawa-mura, Gifu Prefecture. Ôkurodani Alternation, Itoshiro Subgroup, Tedori Group. Lower Cretaceous.

Family ?Curculionidae
Gen. et sp. indet.
Pl. 2, fig. 4a, b

Specimen examined: A left elytron preserved except scutellary corner. Stored

at the National Science Museum, Tokyo, reg. no. NSM-PA11272, collected by I. FUJIYAMA, Asuwa, Fukui, Upper Jurassic.

Description: Medium size, 7.2 mm in length, 2.8 mm in maximum width, broadest at base, narrowing distally. Base of elytron slightly convex anteriorly. Humeral corner subangular. Lateral margin gently curved; apex not sharply pointed. Sutural margin marginated with a narrow carina, undulate at basal one-third probably by accident, basal part of sutural margin broken off in the specimen. With ten broad costae (except sutural carina); 9th vanishing at middle, inner seven costae ending near apex, outer two ending on distal part of lateral margin. Costae broad and rugose.

Comparison and remarks: The present elytron is characteristic in its shape and rugose costae. The appearance suggests some species of weevils. However, it is risky to identify the family and genus of the beetle based on a few characters in a single elytron, so that the present species should be left indetermined.

Geological distribution: Kowashimizu (Kowashôzu), Miyama-mura, Asuwa, Fukui Prefecture. Sakaidera Alternation, Kuzuryû Subgroup, Tedori Group. Upper Jurassic.

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Explanation of Plates

Plate 1

Fig. 1. *Nipponohagla kaga* sp. nov., forewing. Kuwajima. Holotype, NSM-PA12002a and b. a: ×2.5, b: ×1, c: couterpart, ×1.

Fig. 2. *Nipponohagla kaga* sp. nov., hind wing. Kuwajima. Holotype, NSM-PA12003a and b. a: ×2.5, b: ×1, c: counterpart, ×1.

Plate 2

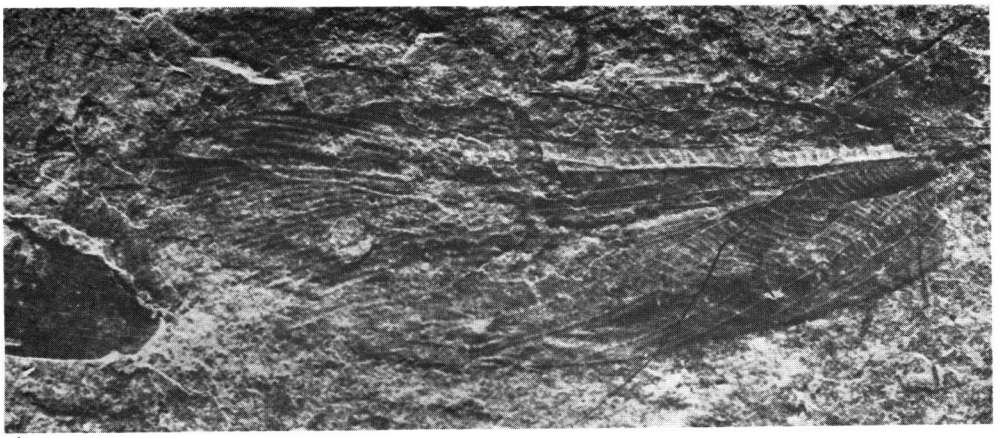
Fig. 1. *Kagapsychops aranea* sp. nov., forewing. Kuwajima. Holotype, NSM-PA12004. a: ×1, b: ×2.5.

Fig. 2. Curculionidae?, gen. et sp. indet., elytron. Kowashimizu. NSM-PA11272. a: ×1, b: ×5.

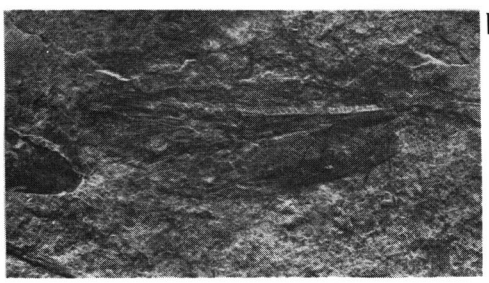
Fig. 3. Carabidae?, gen. et sp. indet., elytra. Ôkurodani. KFC-19770010300. a: ×1, b: ×4.

Fig. 4. *Fulgoridium*? *matsuoi* sp. nov., hindwing. Kuwajima. Holotype, NSM-PA12005. a: ×1, b: ×4.

Fig. 5. A piece of shale containing fossil insects. Kuwajima. ×0.4. 5a: counterpart of 5b.
a: *Kagapsychops aranea*, forewing.
f: *Nipponohagla kaga*, forewing.
h: *Nipponohagla kaga*, hind wing.



1a



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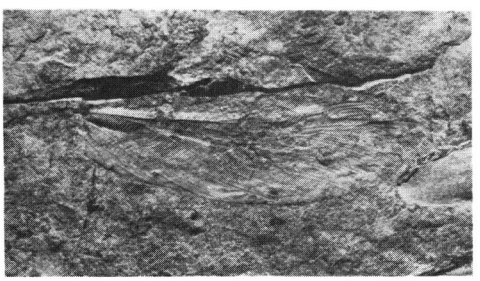
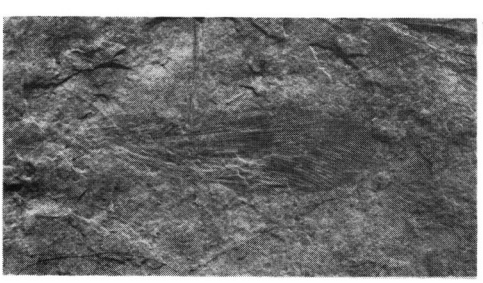


c

2a



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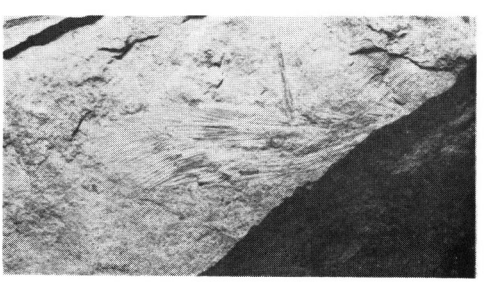

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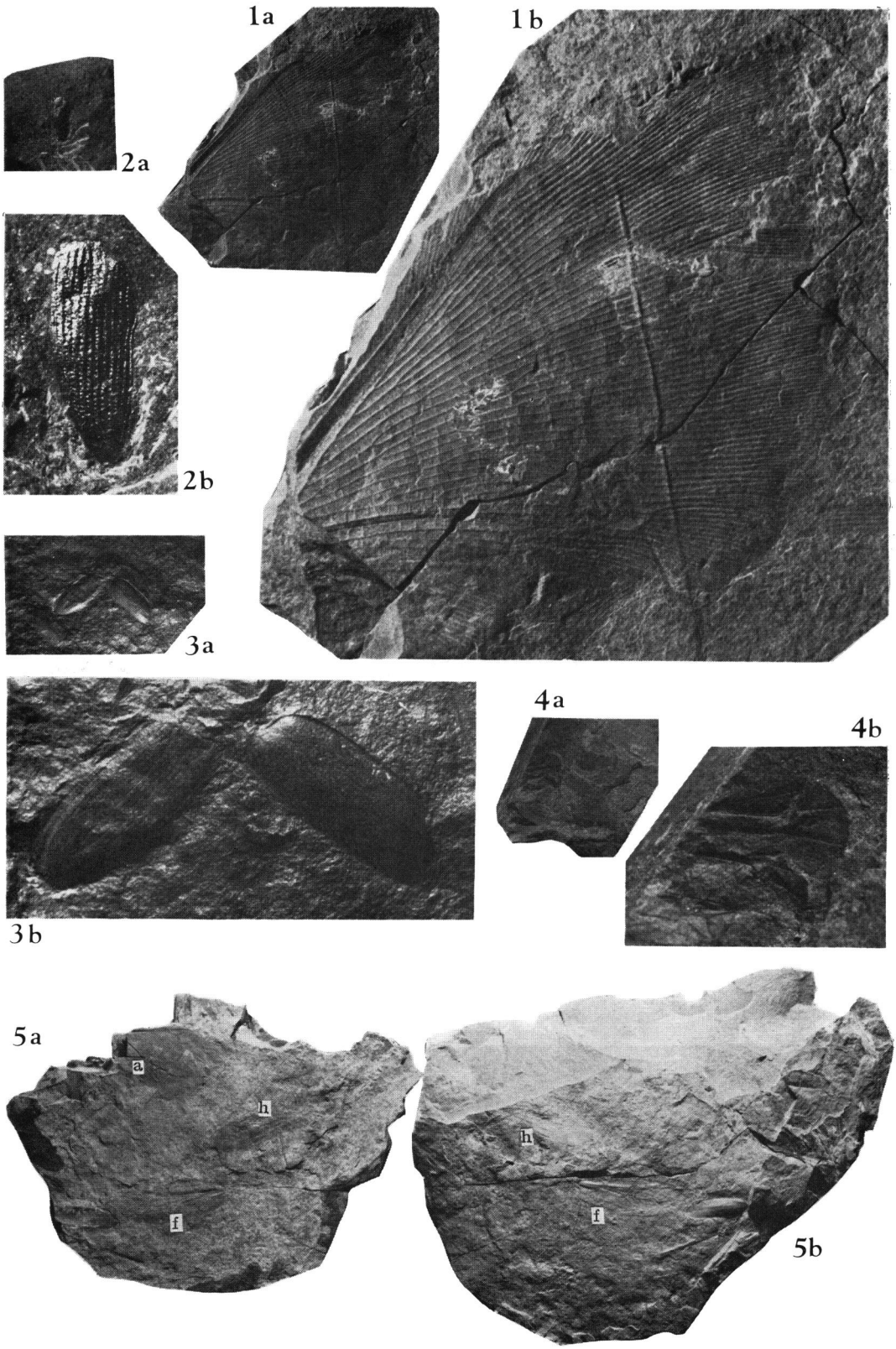
1a
1b
2a
2b
3a
3b
4a
4b
5a
a
h
f
h
f
5b