

## Studies on the Stoneflies of Japan.<sup>1)</sup>

By

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*With Plate XXIV and Twenty-six Text-figures.*

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Notwithstanding rather numerous records<sup>2)</sup> of Japanese stoneflies (Plecoptera), studies of their immature stages seem to have been completely neglected, the only description being a short article with three illustrations by KAWAMURA (1918, vol. i, pp. 264-266, figs. 370-372). In the present paper are chiefly recorded well-defined nymphs representing the fourteen known genera and a curious nymph of the new genus *Scopura*, in hope of making them available as early as possible for the ecological studies of this group, though I feel that my observations are still in many respects very imperfect. Beside these immature forms here recorded are added descriptions of six adult stoneflies which seem apparently to be of a new species.

I wish here to express my grateful thanks to Professor T. KAWAMURA for his kindness in allowing me to use the rich collection of the nymphs of the Plecoptera in the Otsu Hydrobiological Station. My sincere thanks are also due to Professor Dr. JAMES G. NEEDHAM of Cornell University who kindly gave me many helpful suggestions on his

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1) Contribution from the Zoological Institute and the Otsu Hydrobiological Station, Kyoto Imperial University.

2) Klapálek (1907, '09, '12, '13), Matsumura (1911), Navás (1912), Needham (1925), Okamoto (1912, '17, '21, '22), Šímal (1921), etc.

visit to our laboratory in June of 1928. For many interesting specimens I am much beholden to Mr. R. TAKAHASHI of the Government Research Institute of Formosa and to Mr. K. IMANISHI of the Entomological Laboratory of our university. In consulting the necessary literature for this study I must mention my great indebtedness to Professor Dr. H. YUASA of our university, Dr. H. OKAMOTO in Fukuyama, and Dr. C. HARUKAWA of the OHARA Institute for Agricultural Research.

#### GENERAL ASPECTS OF HABITATS AND DISTRIBUTION.

Generally speaking, the stonefly fauna of Japan is exceedingly rich, having a good many representatives of each family. Their nymphs are one of the important components of our brook-fauna and are commonly found everywhere in brooks and rapid streams that flow over stony beds, where they are to be found either clinging to the underside of submerged stones or creeping on the river-bottom. The larger ones, such as few forms of *Perla*, are also found on the rocky beds of larger rivers and the margins of lakes. Another type is seen in the Nemouridæ, some of which can be grubbed up from bottom sand in comparatively slowly flowing small brooks or found in the leaf drifts or organic débris in the wave-beaten margins of lakes and ponds. Some cold water forms of the Nemouridæ are collected in mountain torrents even as high as 2800 m. above sea level. A few of the small black capnids appear on the surface of the 'snow-couloir' in the alpine regions.

In the majority of our representatives, the emergence begins usually in April, lasting till July. Most species of the Perlidæ appear from May to the end of July in the lowlands in central Japan. The Capniidæ emerges also from the end of May to the beginning of June, while the Nemouridæ comprise the earlier species which are flying about mostly during the months from late winter to early spring. In the alpine regions in central Japan high up to between 1900-2800 m., however, some perlids, capnids and nemouras come out even in August. In the Kyoto region, *Teniopteryx* of the Nemouridæ is the earliest one, emerging

already at the beginning of February and are to be found creeping out abundantly on the snow; some other nemouras in this region are seen from March to May.

From the zoögeographical point of view, all Japanese genera are Holarctic, of which the Palæarctic elements are more than the Nearctic, and the majority of the species seems to be peculiar to Japan. The Perlidæ has the widest range of distribution in Japan, although such peculiar forms as *Typhogyge* Klapálek, *Formosina* Kl., *Mesoperla* Kl. or *Cerconychia* Kl. are limited to Formosa of lower latitudes. In this family, a few greenish forms, such as *Chloroperla* or *Alloperla*, ascend the highland cold waters in central Japan. The Nemouridæ comprise in general northern forms whose distribution extends to Saghalien of a higher latitude 45°50' N, and are also seen in the alpine regions in central Japan as high as 2800 m. above sea level, where the temperature of water sinks at midday in August to 3°C or thereabouts. Such an instance may be met with in the Capniidæ, some having been collected in the mountain regions of central Japan, though they live in the lowlands in Hokkaido. The occurrence of a striking nymph, *Scopura*, is, if that be really a form of a southern tropical family as mentioned later on, the most interesting fact from the zoögeographical standpoint.

***Key to the Genera of Nymphs found in Japan*<sup>1)</sup>.**

- 1. Mandibles weak, narrowed distally, molar reduced to lamina; palpi long, subuliform, its last joint successively more slender and often sharply pointed; glossæ of labium rudimentary, paraglossæ broadly rounded; last tarsal segment greatly elongated, but first and second very short; gills well developed or lacking ..... 2.
- Mandibles normal, broad, molar well developed; palpi relatively

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1) Keys to the families and genera of the adult forms are in Klapálek (1909), Needham and Classen (1925), Schoenemund (1927) and Tillyard (1921), especially Okamoto (1912 and '22). Keys to the European stonefly nymphs are in Klapálek (1909), Lestage (1921); a short key to the North American nymphs prepared by Classen is in: J. G. and P. R. Needham—Guide to the Study of Freshwater Biology, 1927, pp. 8-10.

- short, filiform, its last joint as thick as the others and not pointed; glossæ of labium well developed, generally as large as paraglossæ; tarsal segments as above or otherwise; gills present or lacking...7.
2. Gills present either on thorax or anal portion; paraglossæ broadly rounded; terminal portion of hypopharynx acicular and pointed; body strong and somewhat depressed.....3.
- No gills either on thorax or anal portion; paraglossæ narrowly rounded; body slender .....4.
3. Three ocelli; mandibles narrow, denticles small; usually with well-defined colour pattern .....*Perla*.
- Two ocelli; mandibles strong, with large denticles; without well-defined colour pattern .....*Neoperla*.
4. Last joint of maxillary palpus longer than the third, the former very slender and sharply pointed; tip of lacinia simple .....  
..... *Alloperla* and *Chloroperla*<sup>1)</sup>.
- Last joint of maxillary palpus as long as or a little shorter than the third, the former successively more slender than the latter; tip of lacinia bidentate.....5.
5. Maxillæ broad; abdomen without well-defined colour pattern .....6.
- Maxillæ moderate; abdomen with a pair of deep brown colour pattern .....*Isoperla*.
6. Pronotum slightly wider than head and quadrilateral .....*Isogenus*.
- Pronotum nearly as wide as head and elliptical .....*Perlodes*.
7. A unique rosette of gill-filaments present around anal portion; subanal lobes prolonged into tusk-like projections; pronotum prominent, with angles excised; glossæ as long as paraglossæ, but very small; body greatly elongated and cerci very short...*Scopura* gen. nov.
- Without such a type of gills as above.....8.
8. Gills present on coxæ of legs; body roach-like in form; head bent downward and thorax very broad; last tarsal segment longer than the first two together; cerci short.....*Peltoperla*.

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1) The distinction of these two genera is difficult with the nymphs only.

- Without coxal gills; head directed forward and thorax moderate; and last tarsal segment elongated.....9.
9. Palpi very short and thick, closely beset with short hairs; last tarsal segment nearly as long as the basal two together which are subequal; ninth abdominal sternite produced into a long tongue-shaped plate; cerci without fringes of long hairs; gills usually not developed, if present, single jointed filaments .....*Teniopteryx*.
- Second tarsal segment the shortest or often fused with first; ninth abdominal sternite not produced into a plate; cerci usually fringed; gills, if present, in tufts .....10.
10. Gills, if developed, in a few filaments attached to the underside of prothorax; last joint of maxillary palpus nearly as long as the third; last tarsal segment the longest; body comparatively stocky and hairy .....*Nemoura*.
- Gills not developed; last joint of maxillary palpus much longer than the others; body comparatively weak, smooth and slender...11.
11. Second tarsal segment fused with first; labium wider than long, last joint of labial palpus conic-shaped; body slender and elongated; antennæ and cerci sparingly fringed.....*Leuctra*.
- Second tarsal segment not fused with first, labium longer than wide; antennæ and cerci fringed; mostly small blackish forms.....  
.....*Takagrishopteryx* and *Capnia*<sup>1)</sup>.

DESCRIPTIONS.

*I. Family: Perlidæ.*

1. *Genus: Perlodes* BANKS, 1903<sup>2)</sup> (*Dictiopteryx* PICTET, 1841).

*Perlodes dispar* RAMBUR, 1842 (?).

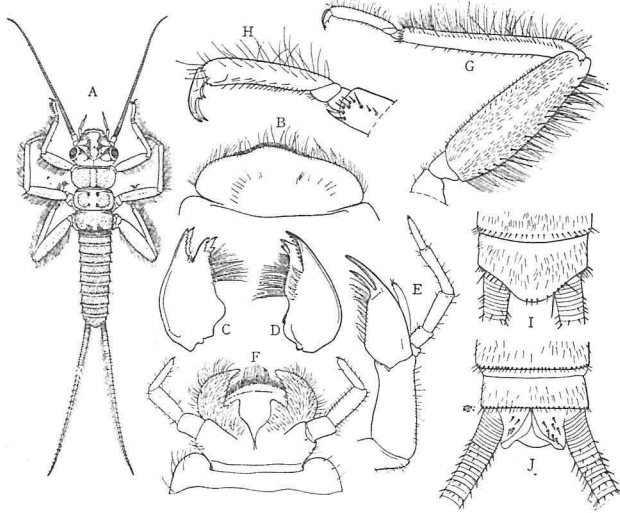
(*Text-figure 1*).

KLAPÁLEK (1909), p. 83, fig. 136-138; LESTAGE (1921), p. 286, fig. 77.

1) It is difficult to distinguish one from the other with the nymphs only. In the former, the first tarsal segment elongated, but in the latter the third tarsal segment in the hind-legs nearly twice as long as the first two together.

2) This genus does not appear in OKAMOTO's Monograph (1912).

*Nymph*.: Body (Fig. 1, A) delicate, cylindrical, widest across head and tapering toward the hind end. Head slightly wider than prothorax, widest across eyes and tapering toward front; with large eyes and three ocelli. Antennæ long, thick and bare. Pronotum oblong-elliptical (Fig. 1, A). Pro-, meso- and metanotum grayish green except a light



Text-figure 1. *Perlodes dispar* (?).

A. General view of nymph,  $\times 4$ . B. Labrum,  $\times 20$ . C and D, Mandibles,  $\times 20$ . E. Maxilla,  $\times 20$ . F. Labium,  $\times 20$ . G. Right hind-leg,  $\times 16$ . H. Distal portion of leg,  $\times 20$ . I and J, Anal portion in dorsal and ventral view,  $\times 16$ .

yellow mid-dorsal stripe and covered with minute hairs. Mouth-parts are shown in Fig. 1: B, C, D, E and F. In mandible (Fig. 1, C and D), the outer canine serrated internally, the inner margin fimbriated with a series of long setæ. Lacinia of maxilla (Fig. 1, E) armed with two large spines on the summit and galea nearly as long as lacinia; the third joint of maxillary palpus shorter than the fourth. Glossæ of labium (Fig. 1, F) very small and pointed, paraglossæ narrow and with pointed end. Hypopharynx rounded.

Legs (Fig. 1, G) rather slender and flattened dorso-ventrally, pale greenish yellow; the first two tarsal segments very short (Fig. 1, H); tarsal claws large, armed with a single lateral tooth near base. External

margins of femur, tibia as well as tarsus fringed both with long hairs and short setæ (Fig. 1, A and G); upper side of femur covered with minute spinules except along the narrow longitudinal median line.

Dorsum of each abdominal segment grayish green and covered with minute spinules. No gill-tufts are present either on thorax or on anal portion. Cerci long, strong, pale and fringed on inner sides.

Length of body 6-8 mm.; of antennæ 5.5-6 mm.; of cerci 5.5-7 mm.

*Locality*: 16 younger specimens were collected by Prof. K. AKATSUKA in August, 1925, in Lake Shikotsu (latitude 42°20'N), Prov. of Iburi in Hokkaidô.

2. *Genus*: **Isogenus** NEWMANN, 1833.

Seven species of adult *Isogenus* have been described from Japan, of which the following one nymphal form only was identified among our materials.

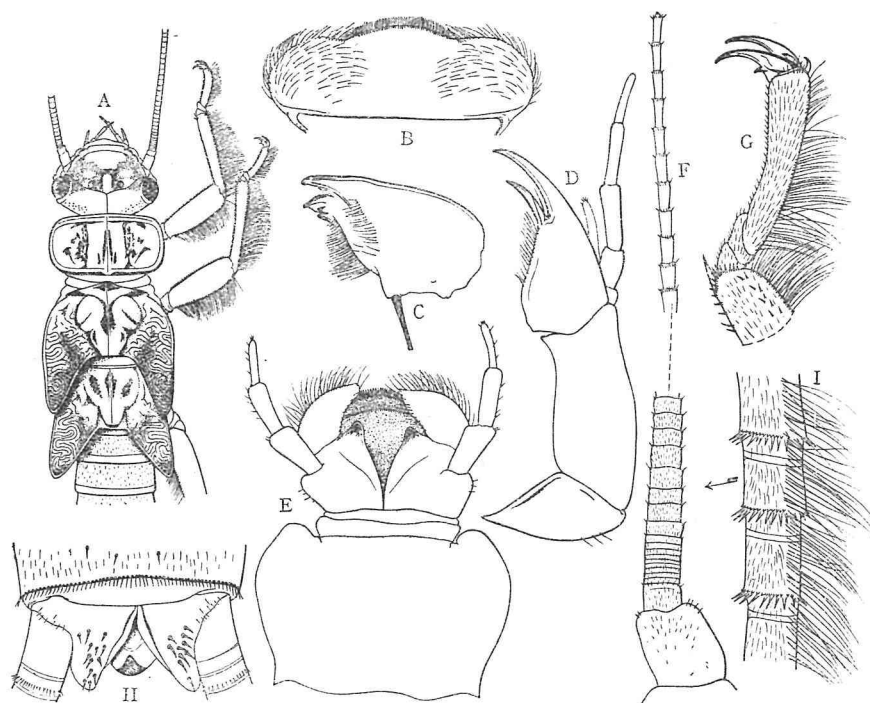
**Isogenus nubecula** NEWMANN, 1833 (?).

(*Text-figure 2*).

KLAPÁLEK (1909), p. 84, Fig. 139 A-D; E.-PETERSEN (1910), p. 109, Fig. 95; OKAMOTO (1912), p. 113 [imago]; LESTAGE (1921), p. 289, Fig. 78 a-c; SCHOENEMUND (1927), p. 15, Fig. 48.

*Nymph*: Body long and slender. Head almost as wide as pronotum (Fig. 2, A), tapering toward front, and with dark markings around the ocelli (Fig. 2, A). Antenna (Fig. 2, F) long and strong, provided with minute hairs, its basal joint extraordinary large and robust. Pronotum (Fig. 2, A) a little wider than head, quadrangular in dorsal view, with lateral margins round; brownish yellow and with a pair of symmetrical narrow dark irregular markings. Meso- and metanotum brown and with oval light areas.

Labium (Fig. 2, E) with small triangular glossæ; paraglossæ hairy; hypopharynx with round external margins. Mandible (Fig. 2, C) triangular, armed with two large and four small stout teeth on the apical portion, internal margin with a uniserial fine setæ. Maxilla (Fig. 2, D)

Text-figure 2. *Isogeus nubecula* (?).

A. Head and thorax of nymph,  $\times 6$ . B. Labrum,  $\times 20$ . C. Mandible,  $\times 20$ . D. Maxilla,  $\times 20$ . E. Labium,  $\times 20$ . F. Antenna,  $\times 20$ . G. Tarsus of right hind-leg,  $\times 20$ . H. Anal portion in ventral view,  $\times 20$ . I. A part of cercus,  $\times 25$ .

robust, lacinia armed with two long stout spines on its summit; galea small and scarcely reaching to the tip of lacinia; maxillary palpus slender, with the third joint nearly as long as the fourth.

Legs rather slender; the external margin of femur, tarsus and tibia fimbriated with a series of long hairs (Fig. 2, A and G); tibia armed with a sharp spine on infero-distal corner; the first two tarsal segments very short; tarsal claws strong, curved, provided near base with a small pointed lateral tooth (Fig. 2, G). Abdomen cylindrical but somewhat depressed, the posterior margin of each tergite armed with minute spines; subanal lobes situated in parallel. Cerci fringed with long hairs on inner sides (Fig. 2, I). No external gills present.

In alcoholic specimen, abdomen, legs and cerci are all brown-yellow.



Length of body 16.5 mm. ; of antennæ ca. 6.5 mm. ; cerci broken off.

*Locality:* A single well-grown nymph was taken by Mr. T. YAMANOUCHI on April 7, 1922, from the Iwakuni River, Prov. of Suo in western Japan.

3. *Genus:* *Perla* GEOFFROY, 1764.

Twelve species of adult *Perla* have been recorded from Japan. At present I am able to describe the following three immature stages only. These nymphs of *Perla* are one of the important components of our brook-fauna, together with some heptageniid-mayflies.

*Key to the Nymphs.*

1. Gills present on both thorax and anal portion ; without a paler area in front of the foremost ocellus ; abdominal dorsum with distinct light spots ; cerci without long fringes on inner sides ; more than 30 mm. long in full-grown nymph.....*Perla tinctipennis*.  
— Gills present on thorax only ; with a large light area in front of the foremost ocellus ; abdomen without distinct spots ; cerci with long fringes on inner sides of several basal joints.....2.
2. Femora with a narrow dark cross band on upper side .....*P. sp.*  
— Femora without any such cross band as above .....*P. tibialis*.

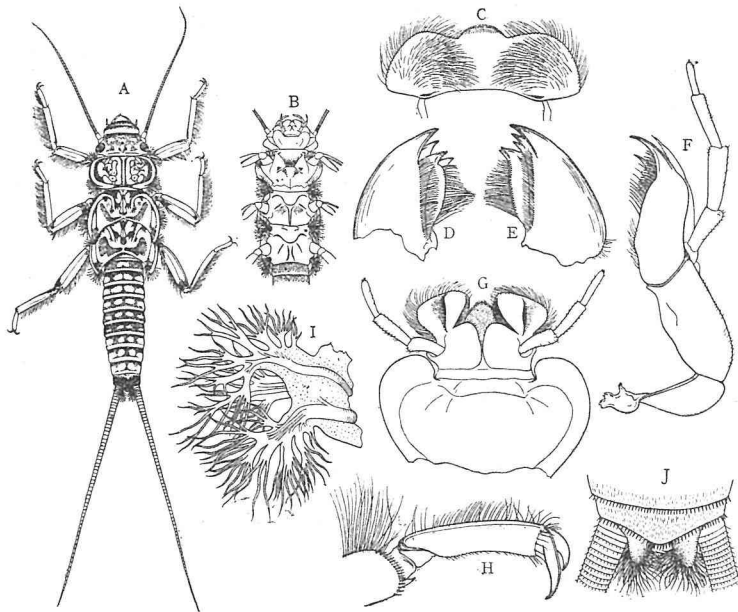
*Perla tinctipennis* McLACHLAN, 1875<sup>1)</sup>.

(*Plate XXIV, Fig. 5 and Text-figure 3*).

*Nymph:* Body broad and somewhat depressed (Fig. 3, A), light reddish brown in colour. Head broad, brownish yellow, with dark brown areas leaving six paler spots around the ocelli. Antennæ strong, tapering toward tip, reddish brown. Pronotum (Fig. 3, A) slightly wider than head, oblong-elliptical in dorsal view and with a pair of distinct dark regular markings as shown in Fig. 3, A. Similar regular markings are also present on the anterior portion of meso- and metanotum.

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1) For the record of the imago see OKAMOTO (1912), p. 123.

Text-figure 3. Nymph of *Perla tinctipennis*.

A. General view,  $\times 1\frac{1}{2}$ . B. Ventral view of thorax,  $\times 1\frac{1}{2}$ . C. Labrum,  $\times 12$ . D and E, Mandibles,  $\times 12$ . F. Maxilla,  $\times 12$ . G. Labium,  $\times 8$ . H. Tarsus of left fore-leg,  $\times 12$ . I, A thoracic gill,  $\times 8$ . J. Anal portion in ventral view,  $\times 2$ .

Mouth-parts are shown in Fig. 3: C, D, E, F and G. Paraglossæ of labium broadly rounded and with hairy external margins; glossæ rudimentary. Maxilla slender; denticles of lacinia large and spine-like, and more than fifteen spines present on inner side of them; galea longer than lacinia and sharply pointed; maxillary palpus nearly twice as long as lacinia (Fig. 3, F). Hypopharynx acicularly pointed. Mandibles triangular, with four large but narrow denticles, molar not developed; inner margin fimbriated with two series of stiff hairs (Fig. 3, D and E).

Legs long, flattened dorso-ventrally, fringed externally, yellowish, the terminal portion of each femur only blackish; the first two tarsal segment very short (Fig. 3, H).

Abdomen cylindrical, with somewhat flat ventral side; brown and marked with round light spots; subanal lobes narrow (Fig. 3, J); cerci long, fragile, minutely spinulated and without long fringes on inner sides;

several joints at base more robust and thence tapering rapidly.

Both thoracic and anal gills are present (Fig. 3, B, I and J).

Length of body 36 mm. in a full-grown nymph; of antennæ 19 mm.; of cerci 23 mm.

*Localities:* The materia's examined were collected from the following localities: The Ina River, near Osaka (UÉNO, April 1924, 4 specimens); the Muko River, at Takarazuka, near Osaka (UÉNO, Aug. 20, 1925, 8 specimens); the Séta River, an outlet of Lake Biwa, Prov. of Omi (KONDO, Dec., 1925?, 18 specimens); the Narai River at Kiso, Prov. of Shinano (YOKOUCHI, Aug. 15, 1926, 4 specimens); a small stream in Otsu (UÉNO, May 1926, a specimen); the Tenryu River, near Ina, Prov. of Shinano (KAWAMURA and UÉNO, Sept. 6, 1926, 14 specimens); a torrent at Kibune, north of Kyoto (UÉNO, May 1928); the Kiso River at Fukushima, Prov. of Shinano (UÉNO, July 1928, many specimens).

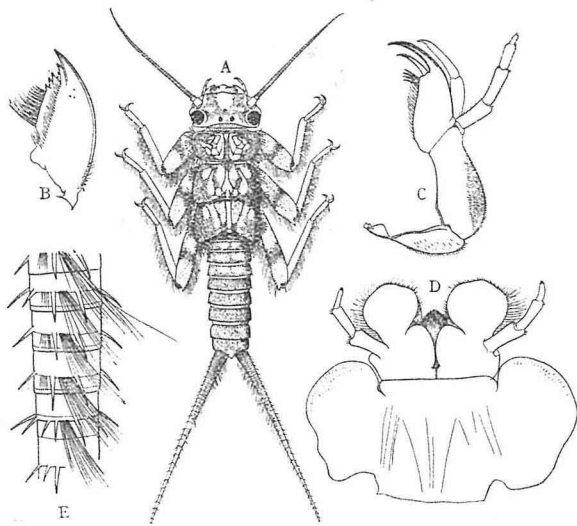
This nymph abounds in swift running large and small streams with stony beds, and its altitudinal distribution seems to be limited to about 1500 m. The emergence of this species begins in central Japan from the middle of July.

### **Perla sp.**

(*Plate XXIV, Fig. 5 and Text-figure 4*).

*Nymph:* Body flattened and broadest across head. Head large and rectangular; yellow, marked with dark brown areas leaving a spacious light part before the foremost ocellus; three ocelli beset on the hind margin of head. Antennæ strong, about  $2/3$  as long as body, brownish and bare.

Pronotum nearly as wide as head, yellow, with reddish brown areas on each side and with a pair of particular markings as in Fig. 4, A; front margin nearly straight, hind margin narrower than front and lateral margins round; dorsum armed with a series of stiff hairs in the median portion.

Text-figure 4. *Perla* sp., Nymph.

A. General view,  $\times 2\frac{1}{2}$ . B. Mandible,  $\times 12$ . C. Maxilla,  $\times 12$ . D. Labium,  $\times 12$ . E. A part of left cercus in dorsal view,  $\times 20$ .

Legs strong, flattened dorso-ventrally, covered with fine hairs on upper side; external margins fimbriated with long white hairs; each femur marked with a narrow dark cross band on the middle of upper side; claws strong.

Mandible slender, denticles smaller and more delicate than in the foregoing nymph and molar not developed; two series of long stiff hairs on the inner margin (Fig. 4, B). Lacinia of maxilla armed with two large apical spines and four small spines; distigalea slender and sharply pointed as those in the foregoing nymph and extending beyond tip of lacinia, disticardo closely covered with minute spinules; maxillary palpus rather short, with terminal joint vestigial (Fig. 4, C). Paraglossæ of labium very large and rounded, provided with long hairs and minute spinules; glossæ rudimentary and rounded at tip (Fig. 4, D); labial palpus hardly reaching to tip of paraglossæ.

Abdomen broad, cylindrical, ventral side somewhat flat; brown and marked with a pair of yellow but indistinct spots; dorsum covered with

fine white hairs as well as thorax. Cerci strong, corpulent, rapidly tapering, brown-yellow; all joints armed with minute spinules and provided with bundles of long stiff hairs which disappear from several joints at the middle (Fig. 5, E). There are present thoracic gills only and no anal gills at all<sup>1)</sup>.

Length of body 13.5-21 mm.; of antennæ 6.5-9 mm.; of cerci 8-14 mm.

This form is allied to the foregoing nymph of *P. tinctipennis*, but is very robust and hairy as shown in Fig. 4, A, and is destitute of anal gill-tufts.

*Localities:* Collected from the following localities: A small stream in Otsu (MOCHIZUKI, Feb. 26., 1916, 2 specimens); the Yoda River, Prov. of Shinano (MOCHIZUKI, Sept. 19., 1917, 17 specimens); the Seta River, Prov. of Omi (KAWAMURA, Jan. 24, 1918, 2 specimens); Yôbainotaki, a water fall at the eastern foot of Mt. Hira, Prov. of Omi (KAWAMURA, UÉNO and ONO, Aug. 2., 1925, 1 specimen); the Kiso River, Prov. of Shinano (KAWAMURA and UÉNO, Sept., 1926, 1 specimen).

This nymph is found in streams and rivers, usually under stones and sometimes creeping among organic débris on the bottom. I have failed in getting the imago of this species, because my explorations in the fields were in wrong seasons.

*Perla tibialis* PICTET, 1841<sup>2)</sup>.

(Text-figure 5).

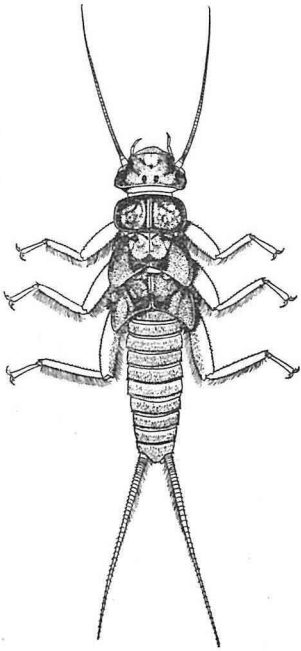
*Nymph:* Head slightly wider than pronotum. Pronotum quadrangular, with antero-lateral and postero-lateral angles rounded; yellow, marked with dark brown patterns on the marginal portions. Meso- and

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1) SEEMANN (1927, p. 53) writes that it is possible to distinguish the nymph of *Acroneuria* from that of *Perla* the absence of anal gills between the cerci, but, in my present view, the nymphs of *Perla* too, such as of the present nymph and the following *P. tibialis*, are without anal gills at all.

2) For the records of the imago see OKAMOTO (1912), p. 119. He treated this species as one of the subgenus *Kamimuria* KLAPÁLEK 1907, together with three other forms.

metanotum yellowish, both with dark brown markings near the mid-posterior margin. Abdomen cylindrical, somewhat flattened, widest across the sixth segment; grayish yellow, without markings and covered with fine spinules. Legs rather slender, flattened, yellowish; femur without



Text-figure 5.  
Nymph of *Perla tibialis*,  $\times 2$ .

any such cross dark colour band as in the preceding nymph of *Perla sp.*; femur and tibia fringed with uniserial long hairs, but tarsus without such fringes; tarsal claws armed with a basal tooth. Cerci long, fragile; each joint armed with fine spinules and several joints near the base with a bundle of hairs. Thoracic gills only present and no anal gills at all as in the foregoing nymph, *Perla sp.*

The mouth-parts show no remarkable distinction.

In full-grown nymph, length of body 20 mm.; of antennæ 11 mm., in another specimen: length of body 13 mm.; of antennæ 7.5 mm.; of cerci 10 mm.

This nymph seems to be closely allied to the preceding nymph *Perla sp.*, but differs from that in the following features: (i). Head with a narrow light area in front of the foremost ocellus as in Fig. 5. (ii). Femur without dark cross band on upper side as in the foregoing.

This is the commonest stonefly in our country being distributed in a wide range. The materials applied here were obtained in the Koto River, at Akiyoshi-mura, one of the well-known lime-districts in Japan, Prov. of Nagato. It was observed there that the emergence of this species occurs at the end of May and many imagines were flying among bushes in the vicinity of that river. In the Kyoto region, it emerges also from the middle of May. I once observed some imagines of this

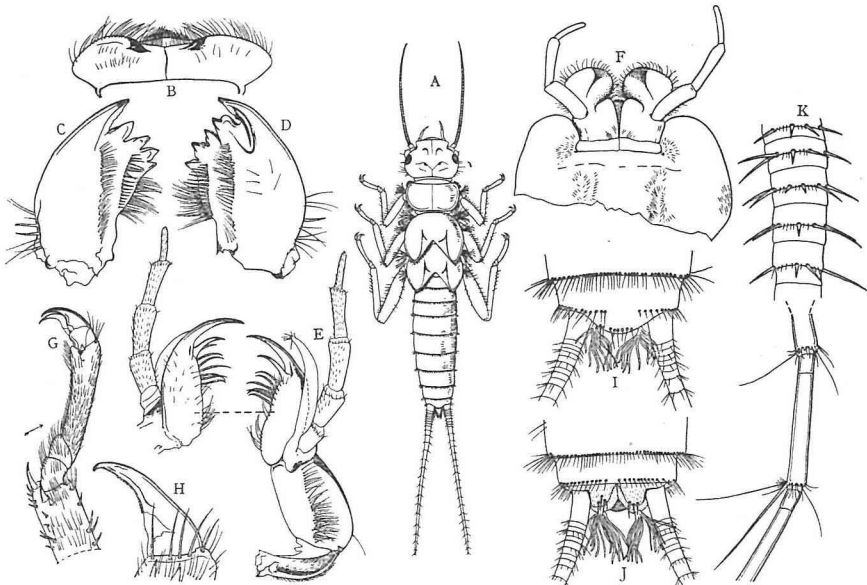
stonefly climbing up the trunk of pine-trees by the stream-side at Minoö, north of Osaka, as in the instance of *Acroneuria pacifica* observed in the Yellow-stone Canyon in the United States<sup>1)</sup>.

4. Genus: *Neoperla* NEEDHAM, 1905.

*Neoperla* sp.

(Text-figure 6).

*Nymph*: Red-brown and rather slender nymph. Body somewhat flattened. Head large, nearly  $\frac{2}{3}$  as long as wide; eyes small, situated on the lateral portions; two small ocelli, about half the distance from each other as from the eyes. Antennæ long, beset on antero-lateral corners of head; dark-red brown, distal part of each joint white. Pronotum nearly as wide as head, somewhat arched above, with its lateral and



Text-figure 6. *Neoperla* sp., Nymphal form.

- A. General view,  $\times 1\frac{1}{2}$ . B. Labrum,  $\times 12$ . C and D, Mandibles,  $\times 16$ .  
 E. Maxilla,  $\times 12$ . F. Labium,  $\times 8$ . G. Right hind-leg,  $\times 12$ . H. Claw,  $\times 40$ . I and J, Anal portion in dorsal and ventral view,  $\times 8$ . K. Cercus,  $\times 20$ .

1) NEEDHAM and CLASSEN (1925), p. 8.

posterior margins round and its antero-lateral angles armed with a series of fine spinules. Mouth-parts are shown in Text-fig. 6 : B, C, D, E and F. Mandibles strong and armed with five large teeth, but molar not developed as in those of the other nymphs of *Perla*. Lacinia of maxilla short, armed with two long curved spines, six curved spinules and a series of stiff hairs; galea longer than lacinia; maxillary palpus twice as long as lacinia and its last joint remarkably slender, all joints closely covered with fine spinules; lateral surface of stipe provided with a linear series of spines. Glossæ and paraglossæ of labium are similar to those in the other nymphs of *Perla*, but the labial palpi of this form are more slender than those in the others (Fig. 6, F).

Legs rather stout, sctaceous and without fringes; the second tarsal segment the shortest (Fig. 6, G); tarsal claws armed with fine spinules along the inner margin (Fig. 6, H). Abdomen broad, with ventral side somewhat flattened; hind margin of each abdominal tergite armed with a series of long spines (Fig. 6, I and J); the last tergite broadly rounded behind. Cerci strong, about three times as long as the width of the abdomen<sup>1)</sup>; each joint armed with a ring of minute spines and hairs (Fig. 6, K).

Thoracic and anal gill-tufts present, those on prothorax a pair and on meso- and metathorax each two pairs; anal gill-tufts composed of about ten white slender gill-filaments (Fig. 6, A, I and J).

Head, thorax, abdomen and legs are all light red-brown and each notum of the thorax is marked with indistinct colour patterns and covered with fine soft white hairs.

Length of body 24 mm.; of antennæ 9 mm.; of cerci 13 mm.

*Localities*: A nymph from Kurodaki, a waterfall at Yamauchimura, Prov. of Iga, nearly 50 km. SE of Kyoto (coll. by E. HATTORI, date unrecorded); a nymph from the Kiso River at Fukushima, Prov. of Shinano (UENO, July 1928).

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1) *Kiotina* KLAPÁLEK and *Nogiperla* OKAMOTO are distinguished from *Neoperla* with the cerci a little longer than the width of the abdomen (OKAMOTO, 1921, p. 115).



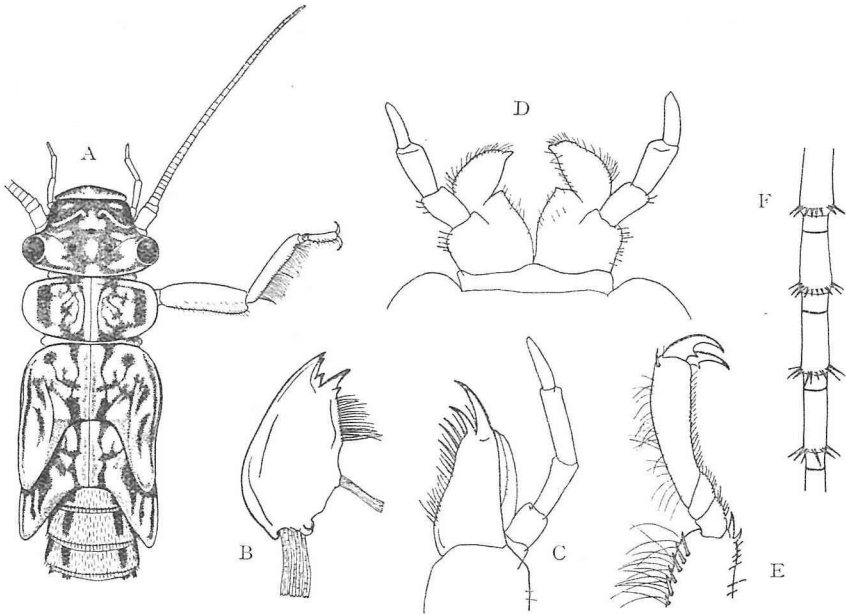
It is remarkable that in this form the body is very large, bright fulvous, smooth and glabrous.

5. *Genus*: *Isoperla* BANKS, 1906.

*Isoperla shibakawae* OKAMOTO<sup>1)</sup>.

(Text-figure 7).

*Nymph*: Body rather slender, grayish yellow in alcoholic specimens. Head as wide as pronotum; deep brown, with large pale areas between and besides the rear ocelli. Another paler large spot also before the middle ocellus and from this spot a row of pale narrow bands extend



Text-figure 7. *Isoperla shibakawae*.

- A. Head and thorax of nymph,  $\times 4$ . B. Mandible,  $\times 25$ . C. Maxilla,  $\times 25$ . D. Labium,  $\times 25$ . E. Tarsus of foreleg,  $\times 25$ . F. A part of cercus,  $\times 25$ .

each side to the base of antennæ; more pale small spots in a row before these bands. Antennæ brownish, composed of about 48 joints.

1) For the description of the imago see OKAMOTO (1912), p. 129, Fig. 18.

Pronotum half as long as wide, subquadrangular, with all angles rounded, somewhat arched above and marked with well-defined symmetrical deep-brown markings as shown in Fig. 7, A. Legs flattened dorso-ventrally, brownish yellow; tibia fimbriated closely with uniserial long hairs on its external margin; tarsus provided with uniserial short spines on internal margin, the first two tarsal segments very short.

Abdomen cylindrical, ventral side somewhat flattened and pale yellow; each tergite marked with a pair of deep blackish-brown longitudinal short markings and closely covered with minute spinules; the tenth tergite broadly rounded behind. Cerci long, composed of 20 rather long joints; posterior ring of each joint armed with minute spines.

Length of body 8.5 mm.; of antennæ 5 mm.; of cerci 4.5 mm. In full-grown nymph, length of body 12 mm.; of antennæ and cerci 5.5 mm. respectively.

*Locality*: Three nymphs were collected by Mr. S. KOIZUMI at the beginning of May, 1928, at Shioda, near UÉDA, Prov. of Shinano. OKAMOTO's type specimen was also taken near this locality (Oiwake, Shinano, 1911).

The emergence of this species occurs in this locality at the beginning of May. An imago which was brought with the nymph shows the typical wing-venation of the genus *Isoperla*.

#### 6. *Genus*: *Chloroperla* NEWMANN, 1836.

Under this genus seven species were described from Japan. I was able to examine a number of nymphs from ten places in mountain torrents, Prov. of Etchû and Hida (between 1600-1800 m. above sea level).

In alcohol, head and body brownish; antennæ, legs and cerci pale yellow. Antennæ  $1/2$  as long as body. Pronotum elliptical, with lateral margins round. Abdomen cylindrical; cerci short, less than half of the body. Mouth-parts are generally similar to those in the other *Pelra*-nymphs; the third joint of maxillary palpus about twice as long as the fourth which is exceedingly slender and sharply pointed; glossæ of

labium rudimentary, the last joint of labial palpus slender and pointed.

Length of body 10.5-12.5 mm.; of antennæ 5-5.5 mm.; of cerci 4-4.5 mm.

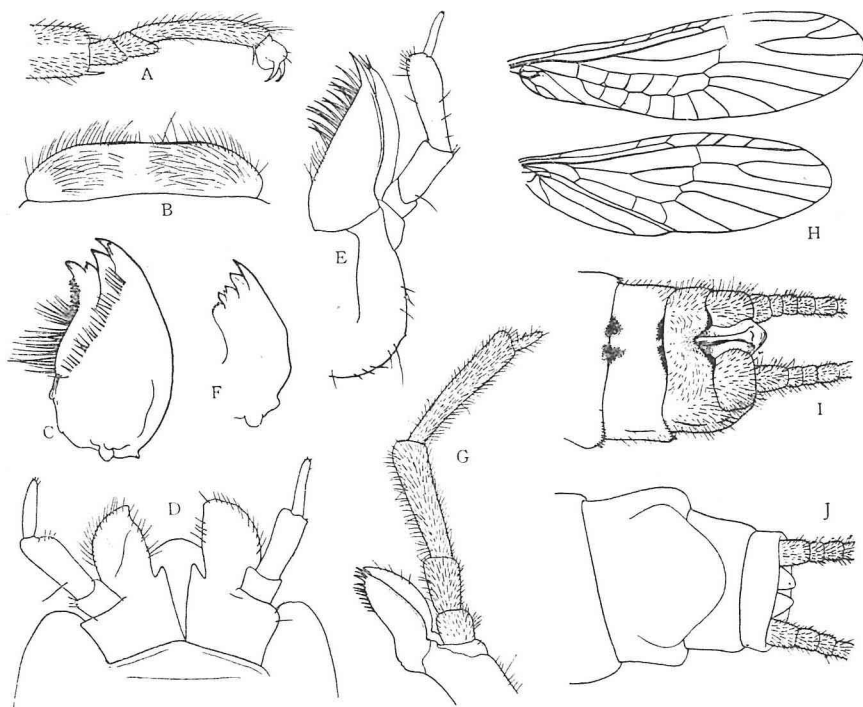
7. *Genus: Alloperla* BANKS, 1906.

*Alloperla shibakawae* (OKAMOTO).

(Plate XXIV, Fig. 3 and Text-figure 8).

*Chloroperla Shibakawae* OKAMOTO (1912), p. 159.

*Imago*: Small yellowish green species. Head nearly as wide as prothorax, slightly wider than long, yellowish green, with a blackish area surrounded by three ocelli and a brown marking in front of the foremost ocellus. This marking is darker in the female than in the



Text-figure 8. *Alloperla shibakawae*.

A, F-J, Imago; B-E, Nymph. A. Tarsus of right third leg,  $\times 25$ . F. Mandible,  $\times 60$ . G. Maxilla,  $\times 33$ . H. Wings. I. Male genital part, dorsal view,  $\times 15$ . J. Female genital part, ventral view,  $\times 15$ . B. Labrum,  $\times 33$ . C. Mandible,  $\times 60$ . D. Labium,  $\times 33$ . E. Maxilla,  $\times 33$ .

male. Antennæ yellow at base and darker toward tip, composed of ca. 40 joints. Maxillary palpi brownish, its last joint very short and slender. Prothorax wider than long, with angles broadly rounded, yellowish green, with a blackish median dorsal longitudinal band; a groove just inside the blackish margin. Meso- and metanotum with a distinct black U-shaped marking near the hind margin. Legs slender, yellowish, with a black narrow cross band at the distal end of femora; second tarsal segment very short (Fig. 8, A). Wings greenish hyaline and delicate; veins yellow; Sc ends before the cord; in fore-wing four costal cross-veins before the end of Sc and one beyond, in hind-wing one before and three beyond;  $Cu_2$  of fore-wing very short; 2A of fore-wing branched; anal field of hind-wing narrow, with two anal veins (Fig. 8, H). Abdomen slender, somewhat flattened, with a median dorsal broad dark stripe which extends to the eighth tergite; cerci nearly as long as body, yellowish, composed of 10 joints.

Male: Ninth tergite emarginate behind, in which the tip of the supra-anal process fits; tenth tergite broadly cleft and each side with long hairs; supra-anal process recurved, slender; subanal lobes unmodified; ninth abdominal sternite somewhat produced behind (Fig. 8, I).

Female: Eighth abdominal sternite produced into a broad subgenital plate which is rounded behind and covers fully half of the ninth sternite (Fig. 8, J).

Length to tip of wings 13 mm. in male, 14 mm. in female; of body, 9.5 mm. in male, 10.5 mm. in female; of antennæ, 6 mm. in male, 7.5 mm. in female; of cerci, 5 mm.

*Localities*: Bôgoya-zawa (1900 m. above sea level), on so-called "North Japanese Alps" (K. IMANISHI, August 6, 1928).

*Nymph*: Body depressed (Plate XXIV, Fig. 3). Head brown, nearly as wide as prothorax and with three ocelli; a black area among the ocelli and a square dark marking in front of the foremost ocellus as seen in the imago are also present. Antennæ brown and composed of less than 50 joints. Prothorax wider than long, angles rounded, with a median dorsal black stripe in full-grown nymph; front margin armed with long setæ. Meso-

and metathorax very broad, with rounded lateral margins; in full-grown nymph U-shaped marking as in the imago are present. Abdomen brown, ventral paler; with a median dorsal broad dark stripe on 1-7 segments; cerci brown and composed of 18 joints.

Mouth-parts both in the imago and the nymph are shown in Text-Fig. 8: B, C, D, E, F and G. Labrum short and broad, clothed with long hairs. Mandibles in the nymph small but with comparatively strong teeth, molar not developed; in the imago very small and weak. Glossæ of labium rudimentary, last joint of labial palpi very slender. Last maxillary palpus in the nymph very small and slender (Fig. 8, E), in the imago it is much slenderer and shorter (Fig. 8, G); tip of lacinia armed with a single denticle (Fig. 8, E).

Length of body in full-grown nymph 11 mm.; of antenna 5 mm.; of cerci 4 mm.

Seven nymphs were brought by Mr. K. IMANISHI together with the imagines above mentioned. According to him who studied carefully its ecology in that locality, the emergence occurs at the beginning of August. This species ascends the "North Japanese Alps" to 2000 m. above sea level, though it has not been caught in the lowlands.

8. *Genus*: **Peltoperla** NEEDHAM, 1905.

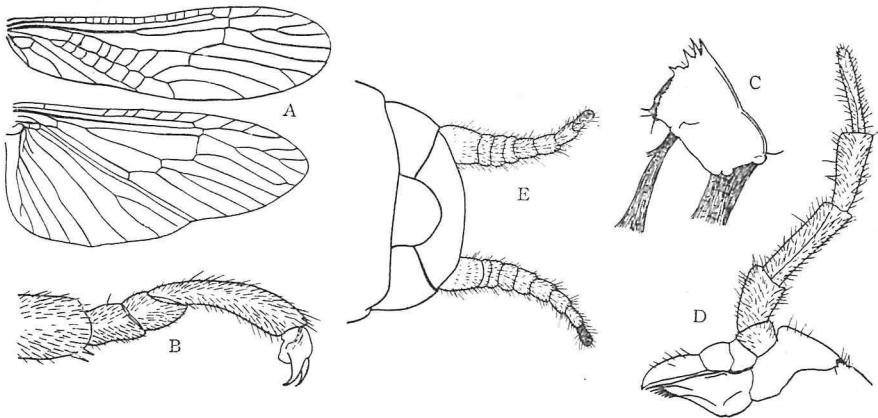
KLAPÁLEK (1912, p. 123) found a new form in H. SAUTER'S Formosan collections and named it *Peltoperla formosana*, as this genus has not yet been recorded from Japan proper. I describe here the following new *Peltoperla* and two nymphs both from Japan and Formosa, though yet nothing is clear about their life-histories. As for the habitat of the nymphs of *Peltoperla*, according to NEEDHAM (1905, p. 108), they are found in the United States "among dead leaves in a spring-fed brook" and "are of very unusual appearance". GARMAN (1912, p. 59) also mentions that his *Peltoperla*-nymph was "taken from a spring-fed rill". The nymphs described in the following pages were collected equally from such situations. The characteristics of the mouth-parts of the nymphs

of *Peltoperla* rather approach the Nemouridæ and Capniidæ than those of the other nymphs of the Perlidæ: mandible has well preserved molar, and the last palpal joint of both labium and maxilla is as thick as the proximal. The relative length of the three tarsal joints show the typical form of the Perlidæ. Gills are present on the coxæ of the legs only, and no thoracic nor anal gills at all. These important characteristics will be dealt with in more detail later on.

*Peltoperla japonica*, sp. nov.

(Text-figure 9).

Body stocky. Head narrower than prothorax, brownish, retracted under the front of prothorax; two large ocelli, as far from the eyes as from each other; antennæ longer than body, brownish and darker toward tip, composed of about 40 joints; palpi brownish. Prothorax much wider than long, quadrangular, with front and hind angles rounded, blackish brown, surface irregularly rugose. Legs brownish; tarsus darker, the



Text-figure 9. *Peltoperla japonica*, sp. nov.

A. Wings. B. Tarsus of right third leg,  $\times 25$ . C. Mandible,  $\times 60$ . D. Maxilla,  $\times 25$ . E. Female genital part and cerci, ventral view,  $\times 15$ .

first two joints very short, subequal, these two combined nearly  $1/2$  as long as the third (Fig. 9, B); femur with a black narrow band at the end. Wings sub-hyaline, somewhat brownish infuscated; venation

heavy, sepia-brown, Sc ends before the cord, with about 16 costal cross-veins in the fore-wings and 6 in the hind-wings; hind-wings with a large anal field (Fig. 9, A). Abdomen depressed, broad, blackish brown, the first three segments very short; cerci shorter than the width of prothorax, thick, yellow and composed of 10 hairy joints. Hind margin of the eighth abdominal sternite produced into a short narrow rounded subgenital plate as shown in Text-fig. 9, E.

Length to tip of wings 15 mm.; of body 8 mm.; of antennæ 9 mm. Holotype: a female. Male unknown.

*Locality:* A specimen was taken by Mr. K. IMANISHI on May 20, 1928, on a mountain at the frontier of Provs. of Mino and Omi (ca. 1000 m. above sea level).

It is to be noted that in this *Peltoperla* the prothorax is not much wider than the head, nor are the front angles so sharply or narrowly rounded as described in NEEDHAM's Monograph<sup>1)</sup>. The characteristics of the mouth-parts show more typical form of the Perlidæ (Fig. 9, C and D) than in those of the nymphs of *Peltoperla* which rather approach the types of the next family Nemouridæ as mentioned on later pages.

*Peltoperla* sp. *Nymph No. 1.*

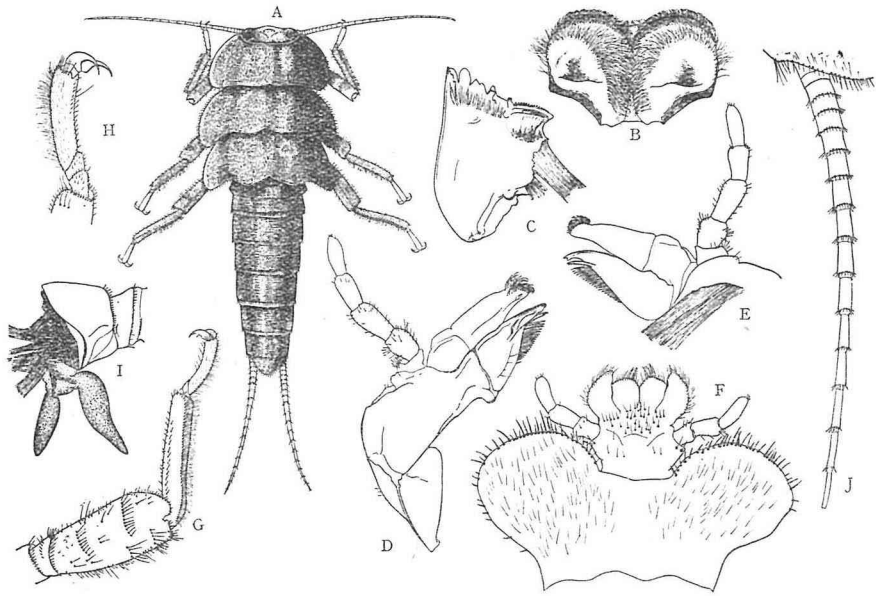
(Plate XXIV, Fig. 2 and Text-figure 10).

Remarkably broad and somewhat flattened nymph. Body roach-like in form and covered with soft sericeous hairs (Text-fig. 10, A). Head very short, nearly  $1/2$  as wide as pronotum, bent downward, blackish brown in colour. Eyes comparatively large; two small ocelli. Antennæ strong, nearly  $1/2$  as long as body, brown yellow, tapering distally and composed of about 40 joints. Pronotum deep blackish brown, marginal portion brown; front margin excavated, antero-lateral angles excised, lateral margins round, somewhat arched above and dorsal surface covered with minute yellow hairs and margins spinulated. Meso- and metanotum similar in form and colour as in pronotum, the former

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1) NEEDHAM and CLASSEN (1925) pp. 48 and 165.

slightly wider than pronotum and the latter remarkably excised at the postero-lateral angles. Abdomen long, somewhat cylindrical, ventral side flattened; each abdominal tergite arched above, its hind margin armed with uniserial short spinules. The tenth tergite is triangular and tongue-shaped in dorsal view.



Text-figure 10. *Peltoperla* sp. No. 1.

A. General view of nymph,  $\times 4$ . B. Labrum,  $\times 20$ . C. Mandible,  $\times 25$ .  
 D. and E. Maxilla,  $\times 20$ . F. Labium,  $\times 20$ . G. Right hind-leg,  $\times 8$ . H.  
 Tarsus,  $\times 16$ . I. Coxal gills on right fore-leg,  $\times 12$ . J. Cercus,  $\times 16$ .

Mouth-parts are shown in Text-fig. 10: B, C, D, E and F. Labrum hairy, quadrangular, distal margin round and excavated at the middle. Mandible broad, canines small, molar with well developed biting surface. Maxilla strong; lacinia triangular, armed with a large and a slender tubercle as well as a series of spines on the inner margin; distigalea broad, longer than lacinia, tip hairy; maxillary palpus a little longer than lacinia, its last joint nearly as thick as the others and minutely spinulated. Labium with large and broad mentum; glossæ slightly shorter than paraglossæ; labial palpus three-jointed, slightly shorter



than paraglossæ, its last joint as thick as the basal one and somewhat longer (Fig. 10, F).

Legs rather strong, blackish brown, tarsus only yellowish brown; each femur covered with a few series of fine spinules at  $\frac{2}{3}$  from the base (Fig. 10, G); tibiæ and tarsi slender and fimbriated with hairs on the external margin; the first two tarsal segments very short (Fig. 10, H); claws curved and pointed, without any teeth. Cerci short, about  $\frac{2}{3}$  as long as body, composed of less than 20-joints, several basal joints rather robust and tapering rapidly toward tip; each joint armed with a ring of minute spinules.

No thoracic nor anal gills at all. Two white pointed clavate gill-filaments present upon the coxa of each leg, but without any pleural gills on the metasternite<sup>1)</sup>.

Length of body 11.5 mm.; of antennæ ca. 5 mm.; of cerci 4 mm.

*Localities:* A nymph was found among mixed materials collected by KAWAMURA, YOKOUCHI and MIMURA on May 16, 1927, in a small torrent of about 2 m. wide on Mt. Kiso-Komagadake at about 1300 m. about sea level, Prov. of Shinano. Three young nymphs of the same form were collected by myself at the end of August, 1928, in a small brook at Dorogawa, Prov. of Yamato.

This nymph seems to belong to the preceding stonefly *Peltoperla japonica* from various features, though the time of emergence has not yet ascertained in the fields.

*Peltoperla* sp. *Nymph* No. 2.

(*Text-figures 11 and 12*).

UENO (1928), pp. 219-223, 1 fig.

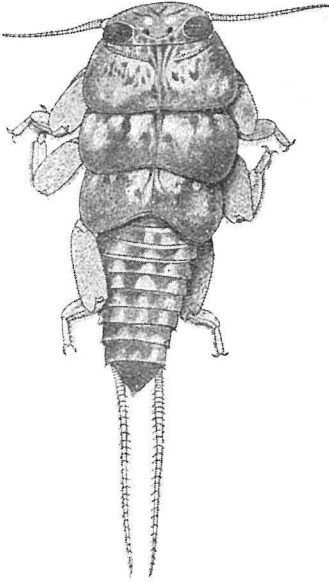
Very similar to the foregoing nymph in general form, but the body more flattened, broader, lateral margins of each notum rounder, and with only a single coxal gill. It is possible to say that this is a more

1) LESTAGE (1927), p. 89.

typical nymph of *Peltoperla* in form and structure than the preceding.

Body broad and roach-like in form. Head short and broad, bent downward, brown, marked with a pair of light round spots and of dark linear markings in front of the ocelli; eyes very large and round; two large ocelli. Antennæ rather strong, yellow, a little shorter than half the body, composed of about 50 joints; several basal joints rather robust and tapering abruptly.

Pronotum large, hind margin wider than front, lateral margins round, anterior margin slightly excavated, antero-lateral angles slightly

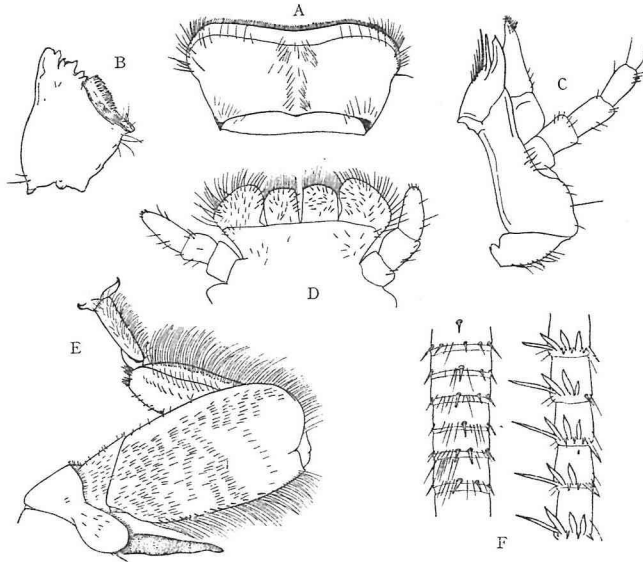


Text-figure 11.  
Nymph of *Peltoperla* sp.  
No. 2. X8.  
[UENO 1928].

excised, postero-lateral angles broadly rounded; paired series of spinules present near the anterior margin; grayish brown and marked with irregular dark markings as shown in Fig. 8. Meso- and metanotum almost similar in shape and colour as in pronotum, but with more excavated posterior margins. Abdomen short, broad and slightly arched above, somewhat flattened ventrally and broadest across the fifth segment, then gradually tapering behind; the tenth tergite triangular in dorsal view and pointed at the distal end as in the preceding *P. sp.* No. 1. Each abdominal tergite grayish brown in colour, marked with three large spots except the tenth and closely covered with fine hairs.

Legs very short, yellow, spinulated; femur exceedingly broad, flattened, fringed with uniserial long hairs on the external margin; tibia and tarsus more slender; tarsal claws comparatively small. Cerci  $\frac{2}{3}$  as long as body, grayish-yellow, composed of about 50 joints; each joint armed on the dorsal side with a ring of fine spinules and setæ, but on the ventral side these spinules are replaced with long flat scale-like ones.

No anal gills at all. The coxa of each leg has a white pointed clavate gill-filament, and there is no pleural gill on the metasternum as in the preceding Nymph No. 1.



Text-figure 12. The mouth-parts, leg and cercus of the same nymph in Fig. 11.  
A. Labrum,  $\times 25$ . B. Mandible,  $\times 42$ . C. Maxilla,  $\times 25$ . D. Labium,  $\times 60$ . E. Right mid leg,  $\times 8$ . F. Cercus,  $\times 60$ , left in dorsal and right in ventral view.

The mouth-parts in this nymph are more allied to the European form<sup>1)</sup> than to the foregoing Japanese one in many features as shown in Fig. 11: A, B, C and D. Labrum broad, narrower proximally, antero-lateral angles rounded and fimbriated with long setae, distal margin slightly excavated and fringed with a series of short setae. Mandibles small but robust, canines small, molar well developed. Lacinia of maxilla small, triangular, armed with two large denticles and about six spines on the inner margin; basigalea large, distigalea narrower distally and exceeds the tip of lacinia; maxillary palpus longer than lacinia and its last joint somewhat slenderer than the others. Labium short and broad; glossae slightly shorter than paraglossae which are oval in

1) LESTAGE, loc. cit., p. 89.

shape, both closely covered with fine spinules and fringed with long setæ on external margins; labial palpus scarcely reaching the distal end of paraglossæ, the last joint being the longest.

Length of body in mm. ....	6.0	7.0	7.5	8.5	9.0
Length of antennæ in mm.....	—	3.0	3.0	3.2	4.0
Length of cerci in mm. ....	4.0	—	5.0	4.5	—

*Locality*: I have examined five specimens which were collected by Mr. R. TAKAHASHI on October 17, 1927, in a rapid-flowing brook at Urai in Formosa.

The differences in the two nymphs of *Peltoperlæ* here described are shown in the following table.

Features	Localities	
	Kiso, Prov. of Shinano	Urai in Formosa
1. Tracheal gill	2 gill-filaments on coxa of each leg	1 gill-filament on coxa of each leg
2. Head	Very small, blackish brown	Comparatively large, grayish yellow
3. Thorax	broad, flat, enlarged in wing-shape, without markings	broad, margins rounded, with markings
4. Legs	rather long; femora not particularly broad	rather short; femora conspicuously broad
5. Abdomen	dorsum of each segment without markings	dorsum of each segment with 3 light spots
6. Cerci	composed of little joints	composed of as many as 50 joints

Appendix to I. Family: *Perlidae*.

9. Genus: *Scopura*,<sup>1)</sup> gen. nov.

This new genus is based upon a nymph of unique characters as described in the following pages.

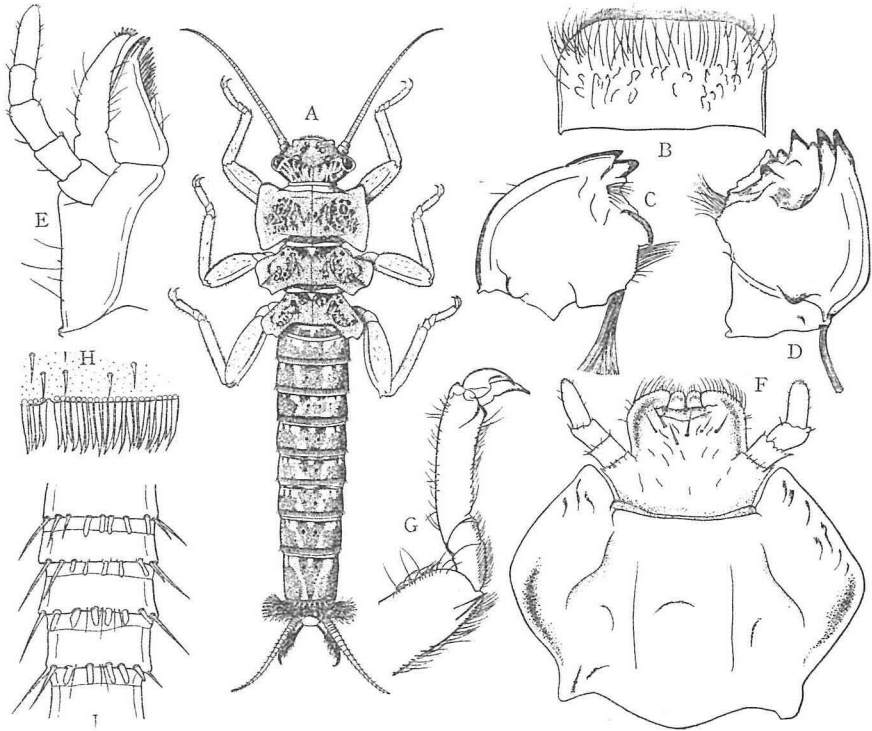
*Genotype*: *Scopura longa* (loc. Lake Towada).

1) For this new generic name, I am much indebted to Professor Dr. JAMES G. NEEDHAM.

*Scopura longa*, sp. nov.

(*Plate XXIV, Fig. 1; Text-figures 13 and 14.*)

Body large, remarkably elongated, cylindrical, dark greenish brown in colour. Head short and much narrower than prothorax; occipital part with distinct dark markings (Fig. 13, A); eyes moderate; three indistinct ocelli, hind ocelli widest apart; antenna strong, awl-shaped, tapering rapidly toward the tip, bare, deep brown. Pronotum prominent (Fig. 13, A), nearly twice as wide as long, rectangular, with the anterior and



Text-figure 13. *Scopura longa*, sp. nov.

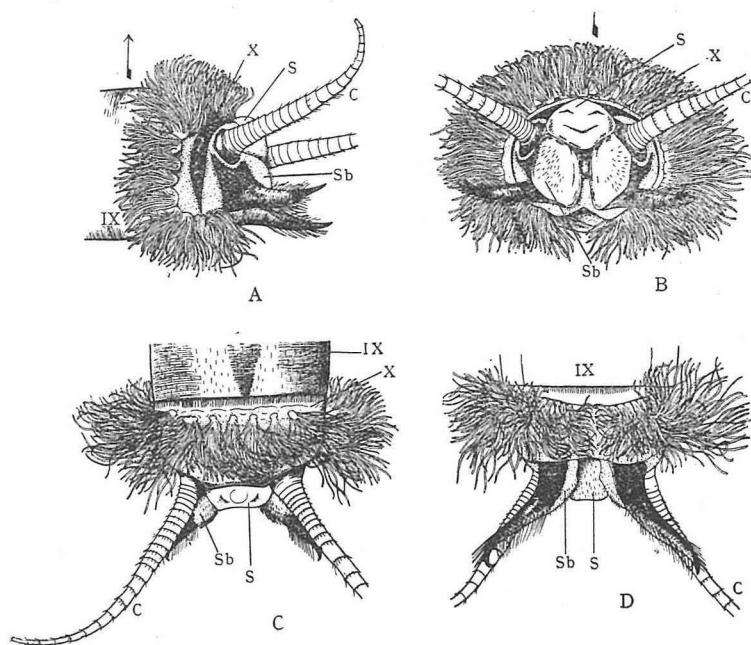
A. General view,  $\times 2\frac{1}{2}$ . B. Labrum,  $\times 32$ . C and D. Mandibles,  $\times 32$ . E. Maxilla,  $\times 32$ . F. Labium,  $\times 32$ . G. Tarsus of right hind-leg,  $\times 25$ . H. Posterior margin of abdominal tergite,  $\times 55$ . I. Cercus in dorsal view,  $\times 55$ .

posterior margins somewhat excavated, lateral margins slightly round, excised and pointed at the antero-lateral angles and marked with a pair of regular beautiful dark markings as in Fig. 13, A. Meso- and meta-notum also well developed but shorter than pronotum.

Mouth-parts are shown in Text-fig. 13: B, C, D, E and F. Labrum quadrangular, nearly twice as wide as long, with the antero-lateral angles rounded, frontal margin closely fringed with short hairs and on the upper surface covered with long hairs. Mandible broad, stout, with two large external canines; molar small but well preserved type. Lacinia of maxilla possesses two internal spines; galea large and broad, slightly extending beyond the tip of lacinia and provided with a few papilla-like setæ on the summit; the fourth joint of maxillary palpus shorter than the third, the terminal one the longest and as thick as the proximal. Glossæ and paraglossæ of labium very small, the former nearly as long as the latter; labial palpus a little longer than paraglossæ and its last joint as thick as and nearly twice as long as the second.

Legs strong; each joint without external long fringes but with short setæ only; the first two tarsal segments very short, the second of which being shorter than the first, these two together about  $1/3$  as long as the third (Fig. 13, G); tarsal claws small, curved and pointed.

Abdomen remarkably elongated, cylindrical, not exceedingly tapering behind (Fig. 13, A) and dark greenish brown in colour. Dorsum of each segment marked with a pair of light irregular stripes diverging anteriorly and also with a pair of small black spots on the median line, and covered with sparse minute spinules. Hind margin of each abdominal tergite armed with a series of flat minute spines (Fig. 13, H). Of all segments, the ninth is longer than the preceding eight; the tenth with a narrow transverse chitinous plate on the hind margin. Subanal lobes prolonged in conspicuous tusk-like chitinous projections close to the underside of each cercus (Fig. 14, A and D). No nymphs with such prominent projections of subanal lobes have never appeared in the literature of stoneflies, so far as I know. Supra-anal process rounded (Fig. 14, A, s). There is a unique development of a rosette of white gill-filaments around the tenth abdominal segment. Of this rosette, seven gill-tufts are arranged on the dorsal half as in Fig. 14: A, B, C and D. This rosette is, when the insect is alive, able to draw into the ninth abdominal segment. No thoracic gills at all.



Text-figure 14. Anal portion of the same nymph as in Fig. 13. A. Lateral view, B. Anal view, C. Dorsal view, D. Ventral view ( $\times 10$ ). X. Tenth tergite, S. Supra-anal process, sb. Subanal lobe with a tusk-like projection, c. Cercus.

Cerci very short, about  $1/4$  as long as body, strong, thick, tapering rapidly toward tip; each joint provided with a ring of short and long spinules (Fig. 14, A and C).

Length of body 22.4 mm.; of antennæ 7 mm.; of cerci 4 mm.

Type: A nymph. Paratypes: three young nymphs from the same locality.

*Habitats, etc.:* This striking nymph was first discovered by Professor T. KAWAMURA and the writer in the middle of July, 1925, in a small inlet stream of Lake Towada (latitude  $40^{\circ}25'N$ ), Prov. of Rikuchū. This stream is about 1 m. wide and flowing beneath dense growths of saxifrage *Rodogersia podophylla*. One well-grown (more than 22 mm. long) and three young nymphs (merely 7 mm. long) were taken from that place together with well-grown nymphs of Mayflies *Ephemera* and

*Baëtis*<sup>1)</sup> and also a larva of giant crane-fly. This nymph is very sluggish and has its habitat in the underside of mosses and dead leaves among the stones in that stream.

I have examined more specimens which were collected from the following localities: A mountain brook on Mt. Hachibuse (1920 m. a. s. l.), Prov. of Shinano (H. KIVOZAWA, June 15, 1925); an outlet torrent of a small lake, "Nôga-ike" (2700 m. a. s. l.), on Mt. Kiso-komagadake (H. YOKOUCHI, June, 1927); Nezu near Uéda, Prov. of Shinano (S. KOIZUMI, Aug., 1928); on Mt. Shirouma and Tsurugi, Prov. of Shinano, high up to between 1900-2600 m. above sea level, Prov. of Shinano (K. IMANISHI, Aug., 1928); Happô-ike (2100 m. a. s. l.), Prov. of Shinano (K. MIMURA, Aug., 1928).

Having had an opportunity of visiting the second named locality at the beginning of August, 1928, and collecting carefully there and its neighbouring torrents, I found that there were numerous nymphs of the same species creeping slowly on the sand beds or the underside of submerged granite stones. The temperature of the water in those torrents was quite low—as cold as 3°C at midday, because it flows out from the 'snow-couloir' in the upper valleys. From above-mentioned distribution, it is possible to say that this nymph is an alpine cold water form and the lower limit of its altitudinal distribution in the prov. of Shinano (latitudes 35°30'–36°40'N) is about 1900 m. above sea level.

*Remarks:* So far as I am aware, such an attractive nymph which possesses a unique rosette of gill-tufts around the anus appears in TILLYARD'S articles only<sup>2)</sup>. According to him, such a character is peculiar to the nymph of his Leptoperlidae<sup>3)</sup> which is distributed in the Southern tropical regions. On the other hand, the nymph with such a prominent pronotum seems to be limited to the nymph of *Pteronarcys*<sup>4)</sup>, so far as I know, which, however, differs from the present nymph by the presence

1) UENO (1928).—Some Japanese Mayfly Nymphs.—Mem. Coll. Sci., Kyoto Imp. Univ., Ser. B, Vol. IV, No. 1. Art. 2, pp. 22 and 50.

2) 1921, p. 37 and 1926, p. 118.

3) On this family, see the remarks of *Takagrillopteryx nigra* (p. 150).

4) NEDHAM (1918), p. 884, Fig. 1356.



of "gills upon the first two segments of abdomen"<sup>1)</sup>. There are still other important characters in the mouth-parts. The mandible, as described already, is of the well preserved type, the molar not reduced to lamina as in the Perlidæ. The labium is also of the well preserved type as in the nymphs of the other genera of the *FILIPALPIA*, the palpi being composed of short and thick joints, the last one being as thick as the others. Such things can be seen in the maxillary palpi too. According to TILLYARD's Table (1921, p. 39), as it seems to be based chiefly upon the adult characters, it may be said that the present nymph shows some archaic characters. From these important characteristics, I took this nymph as of a new genus, though its adult stage has not yet been completely ascertained. To my regret, it is difficult for me to determine at present the systematic position of this genus, owing to the lack of the literature and having been unable to examine its venation. It may be, however, later prove itself to be a member of the Leptoperlidæ or its allies, and appeal to us with an interesting consideration to regard to geographical distribution.

The life history of this new insect is, as mentioned already, not very clear. I have recently, however, seen a curious wingless stonefly which, from various features, seems to be the imago of this nymph. It was found in the middle of October, 1928, by Mr. K. IMANISHI, who had carefully observed this nymph in its habitat at Tsurugi-zawa, north of Mt. Tateyama (ca. 2300 m. above sea level), Prov. of Etchu. If that be really an imago, the occurrence of such an apteral form is a very queer circumstance in the Plecoptera. A brief description of this insect is added bellow.

Body stocky. Head broad, brownish yellow, occipital part with dark distinct markings; palpi grayish yellow; antennæ longer than the half of body, sub-moniliform, red-brown and composed of 32-joints. Pronotum wider than long, rectangular, front and hind margins nearly straight, lateral margins somewhat round, angles rounded, surface slightly rugose

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1) NEEDHAM, loc. cit., p. 885. I have not yet found the nymph which is identical with the form of *Pteronarcys*.

and without hairs, brown except the yellow lateral portions. Meso- and metanotum a little wider than pronotum. Legs yellow; the first two tarsal segments combined shorter than the third. Abdomen broad, dark brown; cerci red-brown, composed of 12-joints. No anal gill-filaments or prominent projections of subanal lobes as seen in the nymph are present. Length of body: 14 mm.; of antenna 9 mm.; of cerci 3.5 mm.

## II. Family: Nemouridae.

### 10. Genus: *Nemoura* LATREILLE, 1796.

Under the present genus some European workers recognize four subgenera: *Protonemoura* KEMPNY, *Amphinemoura* RIS, *Nemoura* s. str. and *Nemurella* KEMPNY. In our fauna, OKAMOTO (1922, p. 20) has also recognized the former three subgenera under which he has enumerated 17 Japanese species of adult forms. Recently, on the contrary, NEEDHAM and CLASSEN (1925, p. 198) have treated all the North American species as of the same genus *Nemoura* s. str., "particularly because the immature stages of only a few species are known." In the present work, however, I adopt here these subgenera as it seems to me to be more convenient, at least for grouping of the nymphal forms.

As for the cerci of the nymphs, TILLYARD (1921, p. 37) writes that "in the Nemouridae, these processes are reduced, both in larva and imago, to a single joint," but, so far as known to me, at least in the nymphs of Japanese *Nemoura* as in the illustrations of European authors, possess many jointed long cerci and not reduced to a single joint.

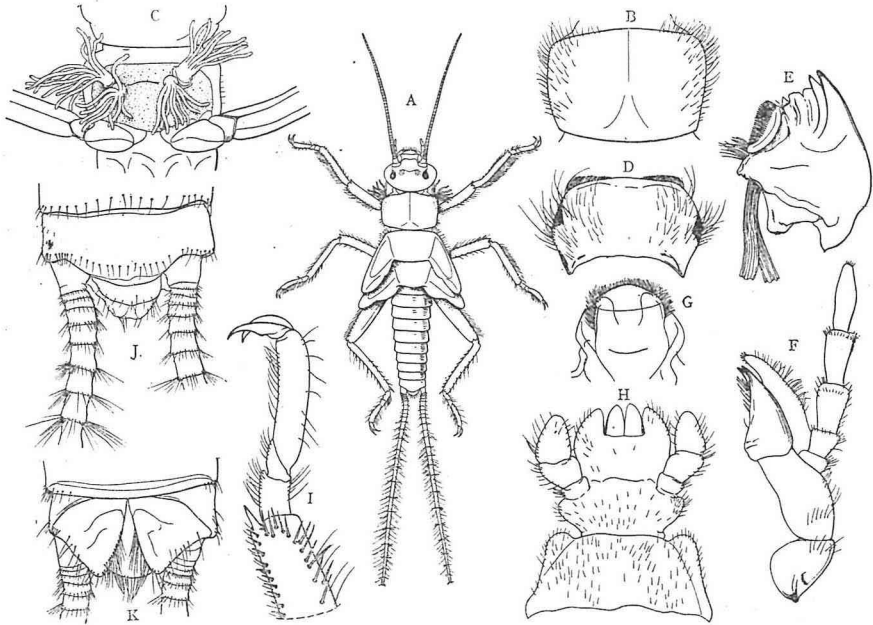
### Key to the Nymphs.

1. With a pair of gills on the underside of prothorax.....2.  
— Without gills on prothorax.....subgen. *Nemoura*.
2. With two tufts of about ten gill-filaments on both sides .....  
..... subgen. *Amphinemoura*.  
— With three long clavate white gills on both sides.....  
.....subgen. *Protonemoura*.

*Nemoura Nymph, No. 1 (Amphinemoura sp.).*

(Text-figure 15).

A small dark brown nymph. Head slightly narrower than prothorax, hind margin broad and round; antennæ filiform, gradually tapering, yellowish. Prothorax wider than long, quadrangular, somewhat arched above, lateral margins slightly convex, angles rounded and beset with fine setæ.



Text-figure 15. *Nemoura (Amphinemoura) sp.*, Nymphal form.

A. General view,  $\times 4$ . B and C, Prothorax in dorsal and ventral view,  $\times 12$ . D. Labrum,  $\times 25$ . E. Mandible,  $\times 42$ . F. Maxilla,  $\times 25$ . G. Hypopharynx,  $\times 42$ . H. Labium,  $\times 25$ . I. Right fore-leg,  $\times 42$ . J and K. Anal portion and cerci in dorsal and ventral view,  $\times 20$ .

Legs rather slender; fringed with scattered hairs and minute spines; the second tarsal segment very short and the last about twice as long as the basal two together; claws large. Mouth-parts are shown in Fig. 15: D, E, F, G and H. Mandible well developed, molar large and strong. The distal three joints of maxillary palpus nearly equal in length; apical denticles of lacinia small; galea slightly longer than lacinia. Labium broad and robust; glossæ nearly as large as paraglossæ, deeply cut into;

labial palpi not beyond the tip of paraglossæ, with the last joint broad and ovate. Labrum well developed.

Abdomen dark brown, ventral yellowish; tenth abdominal tergite with broadly rounded hind margin; subanal lobes triangular. Cerci long and rather robust.

Four tufts composed of from 8 to 12 white filamentous gills are present on the ventral side of prothorax in front of the coxæ of fore-legs. No other type of gills present.

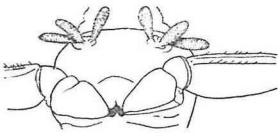
Length of body 9 mm.; of antennæ 5 mm.; of cerci 6.5 mm.

*Locality*: 14 specimens were collected by Mr. M. MOCHIZUKI in March, 1918, in a small stream at Higashiyama in Kyôto.

*Nemoura Nymph, No. 2 (Protonemoura sp.).*

(Text-figure 16).

In alcoholic specimens, body, legs, antennæ and cerci are all yellowish brown. Wing-cases blackish. A pair of thoracic gills of three short white gill-filaments are present on the ventral side of the prothorax in front of the coxæ of fore-legs.



Text-figure 16.  
Ventral view of the prothorax  
of *Nemoura (Protonemoura)*  
*sp.* X12.

Length of body 8-10 mm.; of antennæ 5-5.5 mm.; of cerci 6.5-7 mm. Some very young individuals were also taken from the same locality.

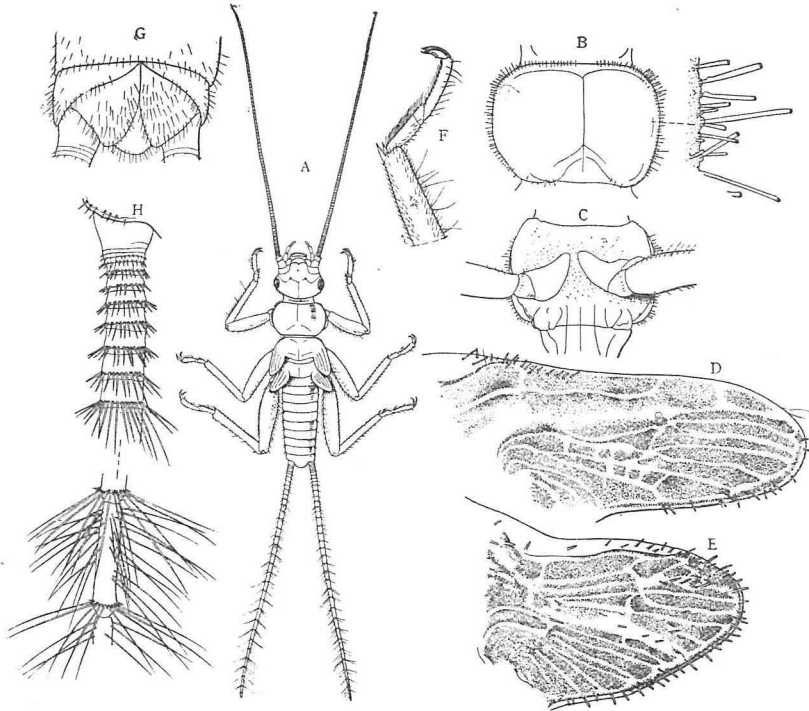
*Locality*: More than ten specimens were collected by Mr. K. IMANISHI from the end of July to the beginning of August in many torrents on the so-called "North Japanese Alps" in central Japan, of 1690-1800 m. above sea level.

*Nemoura Nymph, No. 3 (Nemoura sp.).*

(Text-figure 17).

A small brown nymph. Head brown, slightly narrower than prothorax, hind margin round; three small ocelli; antennæ long, pale

yellowish. Prothorax wider than long, angles rounded, its margins armed with bristles of varying length (Fig. 17, B). Legs rather stout; the first tarsal segment slightly shorter than the third, the middle very short. Nymphal wings show the typical venation of the genus *Nemoura* (Fig. 17, D and E).



Text-figure 17. *Nemoura (Nemoura) sp.* Nymphal form.  
 A. General view,  $\times 4$ . B and C. Prothorax in dorsal and ventral view,  $\times 16$ . D and E. Nymphal wings,  $\times 50$ . F. Right hind-leg,  $\times 16$ . G. Ventral view of anal portion,  $\times 20$ . H. Cerci in dorsal view,  $\times 20$ .

Abdomen short and cylindrical; tenth abdominal tergite broadly rounded behind; subanal lobes short and triangular. Cerci longer than body, each joint armed with long setae which increase in length in several distal joints. No type of thoracic gills are present.

Mouth-parts are similar to those of the preceding *Amphinemoura*. Length of body 7 mm.; of antennae 8.5 mm.; of cerci 8 mm.

It is to be noted that both antennæ and cerci of the present form are longer than the body.

*Locality*: Lake Towada, Prov. of Rikuchû in northern Japan (KAWAMURA & UÉNO, July, 1925). It was found under a stone on the wave-beaten shore of that lake.

***Nemoura Nymph, No. 4 (Nemoura sp.).***

This form is closely allied to the preceding one, but the prothorax is quadrangular and its margin armed with short setæ replacing bristles as in the former; the last tarsal segment of this form is longer than the first two together; cerci without such long setæ as in the former. Head and body brown; legs, antennæ and cerci all yellowish brown.

Length of body 7-9.5 mm.; of antennæ 5-7 mm.; of cerci 6-7 mm.

*Locality*: Nikkô, Prov. of Shimotsuke. Five well-grown and one young nymphs were collected by Prof. T. KAWAMURA and Mr. S. KITAGAMI in the middle of May, 1926, in a brook near Yumoto, Nikkô.

***Nemoura gladiata, sp. nov.***

(*Text-figure 18*).

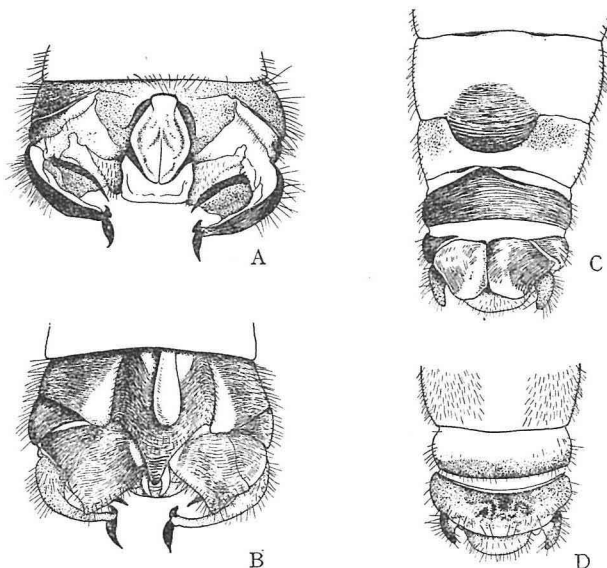
Slender brown stoneflies. Head brown, wider than prothorax; three ocelli, the hind ocelli slightly closer to the eyes than to each other; with a depression between the hind ocelli; occiput smooth; antennæ brown, basal two joints dark. Prothorax wider than long, narrowed behind, with angles somewhat rounded, surface minutely rugose; blackish brown, frontal margin black, in the male much darker. Legs rather long, brownish; the first tarsal segment slightly longer than the third, the second very short. Wings sub-hyaline and brownish infuscated; with narrow anal field in the hind-wings; venation distinct, brown, and quite agrees with that of *N. depressa* BANKS<sup>1)</sup>.

Male: Male genital parts greatly modified (Fig. 18, A and B). Subanal

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1) NEEDHAM and CLASSEN (1925), Pl. 32, fig. 6.

lobes produced into slender curved chitinous processes directed inwards; cerci greatly modified as an accessory organ of reproduction, large band-like, with the underside very much chitinized and strongly bent inward



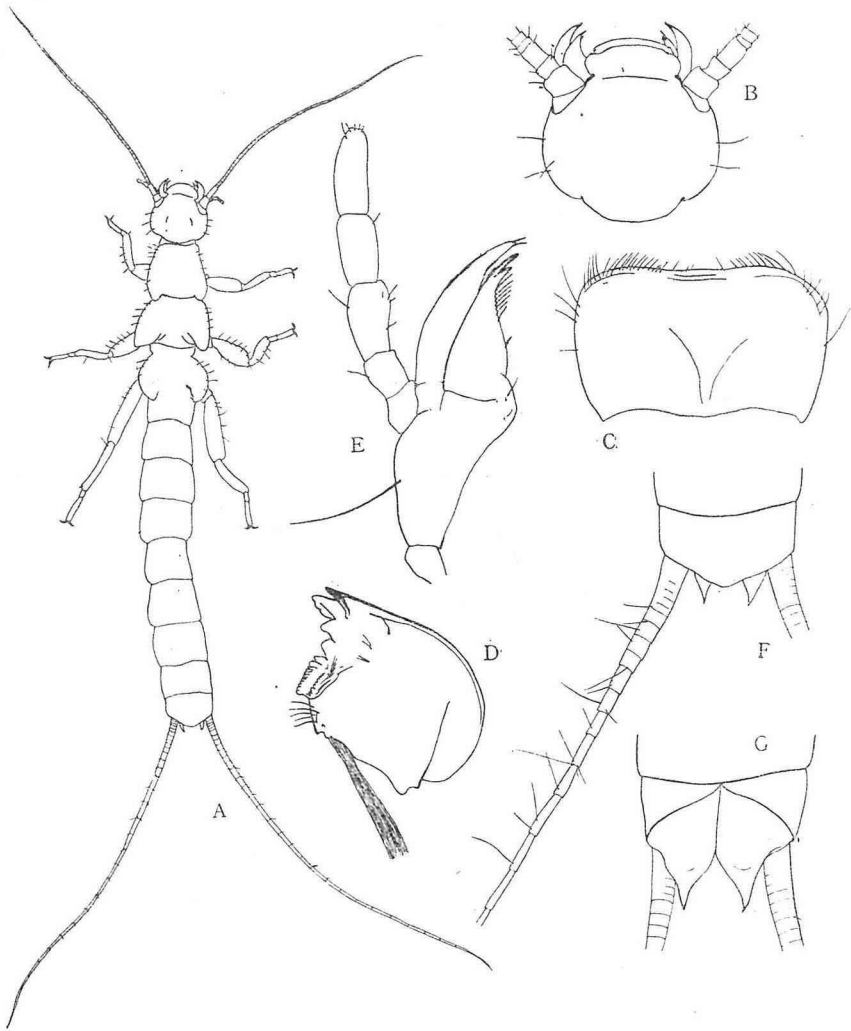
Text-figure 18. *Nemoura gladiata*, sp. nov.  
 A and B, Male genital part,  $\times 25$ ; A, dorsal view, B, ventral view. C and D, Female genital part,  $\times 18$ ; C, ventral view, D, dorsal view.

and ending in a sword-shaped process. Supra-anal process closely pressed upon the tergum and much widened in a hind membraneous part. Subgenital plate arises from hind end of eighth abdominal sternite, broad, hairy, rapidly narrowed toward tip and with many transverse ridges before the tip; ventral lobe about  $\frac{3}{5}$  as long as subgenital plate, and two and half times as long as wide.

Female: Seventh abdominal sternite produced into a subgenital plate which is rounded posteriorly, reaching the middle of eighth sternite. Anterior margin of ninth abdominal sternite somewhat produced anteriorly.

Male, length to tip of wings 11 mm.; of body 6.5 mm.; of antennæ 3.5 mm. Female, length to tip of wings 12.5 mm.; of body 10.5 mm.; of antennæ 6.5 mm.

Holotype a male, allotype a female; paratype: a female from same place. These specimens were collected by Mr. K. IMANISHI among the undergrowth at Suzukadani in Kibune, north of Kyôto (May 20, 1927).



Text-figure 19. *Leuctra?* Nymphal form.

A. General view,  $\times 10$ . B. Head in dorsal view,  $\times 25$ . C. Labrum,  $\times 110$ .  
 D. Mandible,  $\times 110$ . E. Maxilla,  $\times 110$ . F and G, Anal portion and cerci  
 in dorsal and ventral view,  $\times 25$ .



11. *Genus: Leuctra* STEPHENS, 1836.

*Nymph of Leuctra?*

(*Text-figure 19*).

Among many other stonefly nymphs collected by Mr. K. IMANISHI in a torrent on Mt. Tateyama, 1740 m. above sea level, Prov. of Etchû, my attention was called to a single delicate one corresponding to the genus *Leuctra*. In the alcoholic specimen, body, legs and antennæ are pale yellowish, and, oddly, it possesses neither eyes nor ocelli at all (Fig. 19, A and B). Body elongated; head nearly as wide as prothorax; antennæ filiform and nearly half the body length. Prothorax wider than long, widened posteriorly. Legs rather short, with scattered long setæ; the second tarsal segment fused with the first, so that the tarsus seems to be two joints. The characters of the mouth-parts, though I was unable to study the labium, are of the typical *Leuctra*-nymph. Labrum twice as wide as long, distal margin somewhat concave, angles rounded; mandibles well developed, canines and molar strong; maxillary palpus thick, nearly twice as long as lacinia and the last joint the longest. Abdomen cylindrical, not remarkably tapering toward the end; the tenth abdominal tergite broadly rounded behind; subanal lobes triangular and pointed; cerci very long, each joint with a few long setæ. Length of body 6.5 mm.; of antennæ 3 mm.; of cerci 5 mm.

12. *Genus: Tæniopteryx* PICTET, 1842.

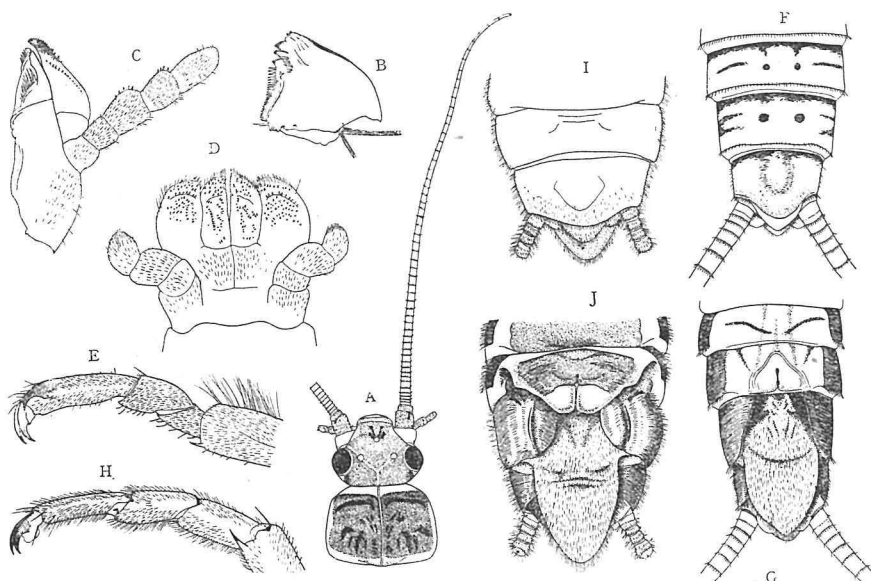
OKAMOTO (1922, p. 12) recognizes three genera, namely, *Rhabdiopteryx*, *Obiopteryx* and *Tæniopteryx* in Japan, but in my present opinion, they should all be better regarded as subgenera of the genus *Tæniopteryx*.

**Taeniopteryx (Rhabdiopteryx) japonica OKAMOTO.**

(Text-figure 20).

*Rhabdiopteryx japonica* OKAMOTO, 1922, p. 12-14; Taf. II., Fig. 1 & 2.

*Nymph*: Body rather long and cylindrical, grayish yellow. Head rather small, and slightly narrower than prothorax, grayish brown with a pair of black marks before the front ocellus; large and round eyes

Text-figure 20. *Taeniopteryx (Rhabdiopteryx) japonica*.

A-G, Nymph; A. Head, prothorax and antennae,  $\times 8$ . B. Mandible,  $\times 42$ . C. Maxilla,  $\times 25$ . D. Labium,  $\times 42$ . E. Tarsus of right fore-leg,  $\times 20$ . F and G. Hinder abdominal segments in dorsal and ventral view,  $\times 12$ . H-J, Imago; H. Tarsus of right fore-leg,  $\times 20$ . I and J. Hinder abdominal segments of female in dorsal and ventral view,  $\times 12$ .

and three ocelli. Antennæ brown, strong, about  $\frac{2}{3}$  as long as body, with more than 50 joints; the basal joint large and corpulent, each joint armed with a ring of fine spinules. Pronotum narrow, nearly as wide as long, brownish black, marked with markings as shown in Fig. 20, A. Mouth-parts hairy. Canines of mandible small. Lacinia of maxilla small and acicular, armed with four short spines on the inner margin, near the summit; distigalea slightly longer than lacinia and

armed with minute denticles on the tip; maxillary palpus robust, closely covered with fine hairs (Fig. 20, C). Glossæ and paraglossæ of labium very large; labial palpus three-jointed, shorter than paraglossæ, its last joint rounded. Abdominal dorsum brown and marked with a pair of small black spots and lines; the hind margin of each tergite armed with a series of spinules. Ventral side of abdomen somewhat flattened and pale white. Ninth abdominal sternite produced into long, parabolic, tongue-shaped subgenital plate. Subanal lobes small. Cerci yellow and strong, each joint with a ring of spinules. Legs rather slender, fringed externally on tibia and femur; all segments of legs closely covered with fine hairs; the terminal tarsal segments the longest, the basal two nearly subequal.

Length of body 10 mm.; of antennæ 7.5 mm.; of cerci 7 mm.

*Locality:* Shinkawa, Prov. of Echigo (coll. by K. IMANISHI, 1927).

The emergence of this species in the above-mentioned locality occurs at the beginning of February. In Hokkaidô, according to OKAMOTO, it emerges during May and July.

The imagines of this species before me slightly differ from the original descriptions. In the type, there is a cross-vein between  $Cu_1$  and  $Cu_2$  of the fore-wing, while in my materials such a cross-vein is not visible; the last joint of the maxillary palpus is not so dark as in the originals. Unfortunately, the male genital characters are unknown because my materials are all female. In regard to the female genitalia, OKAMOTO mentions only that "Die weibliche Supraanalplatte gross und breit, und zungenförmig gezogen" (1922, p. 13), giving no more details. Nevertheless, I believe that the present insects are exactly identical with *Rb. japonica* from many characteristics. The measurements of the imagines are:

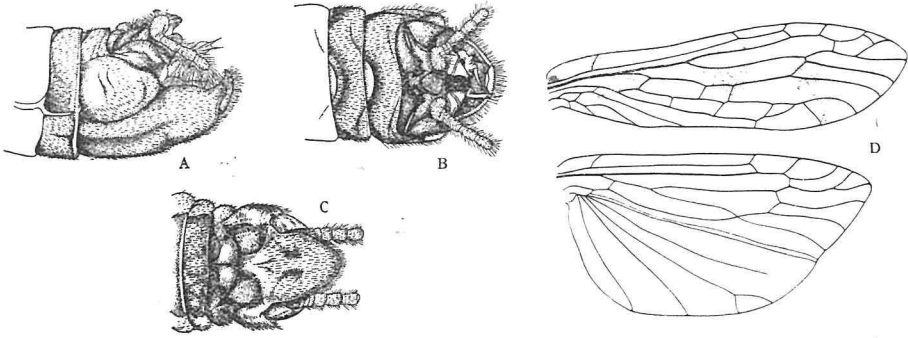
Present material: body 11 mm., antennæ 9.5 mm., fore-wing 10.5 mm.

OKAMOTO's material: body 7 mm., ———, fore-wing 10.0 mm.

*Tæniopteryx imanishii*,<sup>1)</sup> sp. nov.

(Text-figure 21).

General colour blackish brown. Head black, about as wide as prothorax, the area between the hind ocelli somewhat depressed, occiput rugose; with three distinct ocelli; antennæ dark brown, nearly as long as body, composed of 37 (in male) and 43 (in female) joints.

Text-figure 21. *Tæniopteryx imanishii*, sp. nov.

A and B. Male genital part in lateral and dorsal view,  $\times 18$ . C. Female genital part in ventral view,  $\times 18$ . D. Wings,  $\times 8$ .

Prothorax blackish brown, with yellowish anterior margin; slightly wider than long, widened posteriorly, lateral margins nearly straight, angles not rounded and the surface slightly rugose. Legs yellowish brown with irregular dark markings; tarsal segments subequal and the last one black. Wings sub-hyaline, spotted fuscous as shown in Fig. 21, D; venation sepia-brown, heavy in fore-wings and very delicate in hind-wings; cubital cross-veins quite irregular; anal field of hind-wing as large as the entire wing, re-entrant angle slight.

Abdomen dark brown, subgenital plate yellow. Cerci yellowish brown, with four joints in male, and five in female.

Male: Supra-anal process short, upturned, erect, at the tip bifurcated, with a bulbous membrane posterior to it and a small chitinous knob at the front base; subanal lobes complexly modified into asymmetrical

1) I have named this new stonefly in honour of Mr. K. IMANISHI who was the first to collect it.

processes which sharply bifurcate at tips, and their basal part below of each cercus white membranous; a raised granulate lobe present at the base of each cercus; tenth abdominal tergite with two black chitinous lobes with the tips turned rearward and pointed; ninth abdominal sternite greatly prolonged into a keel-shaped lobe, its lower extremity rounded and then the narrow long terminal portion upturned at right angles and thickly beset with long hairs; without any ventral lobe.

Female: Posterior margin of eighth abdominal sternite partially cleft, genital opening at this place; ninth abdominal sternite produced into a large, rounded-triangular, tongue-shaped yellow subgenital plate which extends beyond the end of abdomen.

Length to tip of wings, in male 11 mm., in female 11.5 mm.; length of body, in male 8 mm., in female 9 mm.; of antennæ, 8.5 mm.

Holotype a male, allotype a female; paratypes: three females from the same place.

*Locality:* Kaizu, north coast of Lake Biwa, Prov. of Omi (K. IMANISHI, Feb. 4, 1928), caught on the surface of the snow. All in IMANISHI's collection.

The present new species is closely allied to the North American *Teniopteryx (Doddsia) occidentalis* BANKS (1900), but differs from that by the following features: (i). Three ocelli present (in *T. occidentalis* two ocelli, (ii). Prothorax widened behind and angles not rounded (in *T. occ.*, not widened behind and angles rounded), (iii). Cubital cross-veins less than in *T. occ.*, (iv). Ninth abdominal sternite of male not pointed at the lower extremity as in *T. occ.* (v), Cerci large and long, reaching to the tip of ninth abdominal sternite.

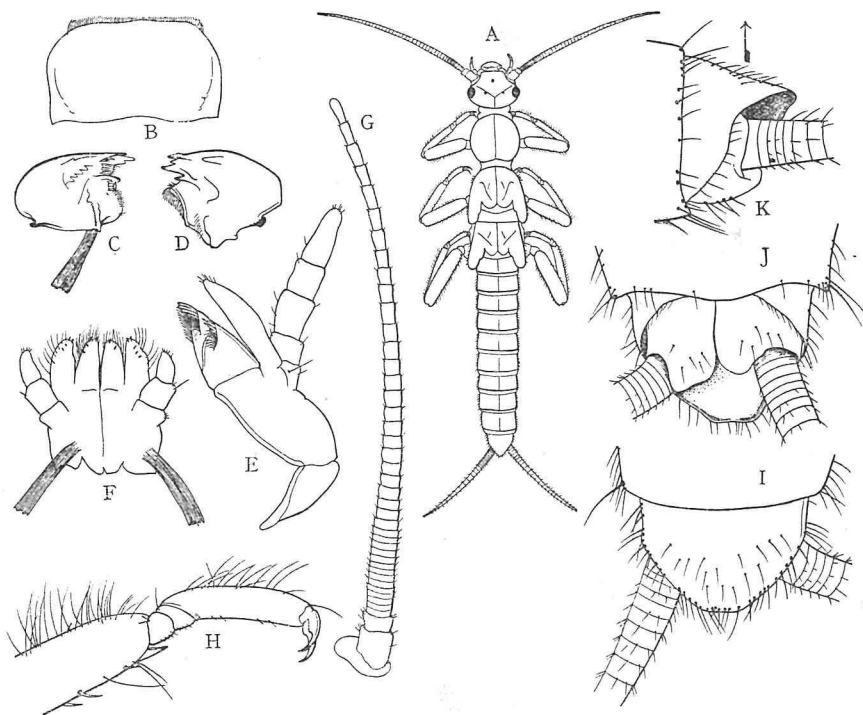
### III. Family: Capniidæ.

OKAMOTO (1922) has recorded three species under the genus *Capnia*. A new genus *Eucapnopsis* which he established at the same time seems to be identical with the genus *Capnia* as pointed out by NEEDHAM and CLASSEN (1925, p. 269).

13. Genus: *Capnia* PICTET, 1842.*Nymph of Capnia?*

(Text-figure 22).

Body slender and cylindrical. Head rounded triangular, with three ocelli; antennæ long, thick, whip-shaped and rapidly tapering distally (Fig. 22, A and G). Pronotum nearly as wide as long, with angles rounded and somewhat arched above. Mouth-parts are shown in Fig.

Text-figure 22. *Capnia* (?) sp., Nymphal form.

A. General view,  $\times 8$ . B. Labrum,  $\times 65$ . C and D. Mandibles,  $\times 65$ .  
 E. Maxilla,  $\times 65$ . F. Labium,  $\times 65$ . G. Antenna,  $\times 25$ . H. Tarsus of hind-leg,  $\times 55$ . I, J and K, Anal portion in lateral, ventral and dorsal view,  $\times 55$ .

22 : B, C, D, E and F. Mandibles small but strong, with well developed molar. Labium deeply cut into glossæ and paraglossæ and the former nearly as long as the latter; labial palpus very short, hardly reaching

to the tip of paraglossæ. Of maxilla, lacinia short, triangular, without any large teeth; galea broad and slightly longer than lacinia; maxillary palpus corpulent, its last joint the longest and nearly as thick as the others.

Legs rather strong; the first two tarsal segments very short, but the third nearly twice as long as the first two together; tarsal claws very small.

Abdomen cylindrical, not remarkably tapered posteriorly; the tenth abdominal tergite extending behind in parabolic shape; subanal lobes short and somewhat rounded. Neither thoracic nor anal gills present.

In alcoholic specimen, head, abdomen, legs and antennæ are all yellowish in colour.

Length of body 7 mm.; of antennæ 2.5 mm.; of cerci ca. 2 mm.

*Locality*: Only one specimen which was collected from the Yoda River, Prov. of Shinano (MOCHIZUKI, Dec. 1., 1918) is in the collection of the Ôtsu Hydrobiological Station.

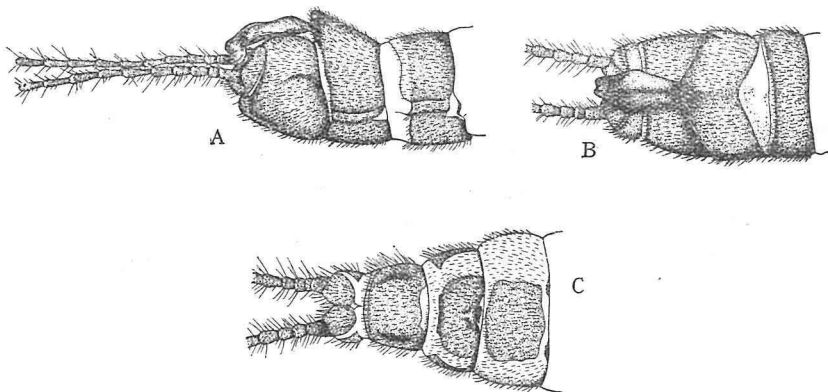
So far as I know, such a curious nymph does not appear in the literature of stoneflies. It should be noted that, if this nymph be really of *Capnia*, there is a new combination of two different types of characters: the relative length of three tarsal segments is the typical form of the Perlidæ, while the mouth parts show the typical features of the Capniidæ.

*Capnia nivalis*, sp. nov.

(Plate XXIV, Fig. 4 and Text-figure 23).

Small black stoneflies (Pl. XXIV, Fig. 4). Body narrow and elongated. Head small, slightly narrower than prothorax; with three ocelli. Prothorax black, slightly longer than wide, somewhat widened posteriorly, with angles rounded. Abdomen cylindrical, corpulent, widest across the fifth segment and thence tapering gradually and on the eighth segment rapidly narrowed; black, with a brown mid-dorsal longitudinal band. Legs rather slender and black. Cerci blackish, sub-moniliform, composed of about 10 joints. Posterior margin of the eighth abdominal tergite of male produced

upward and backward, with a broad knob at apex; supra-anal process long, recurved, somewhat dilated before the apex, ending in a pointed projection and reaching the raised knob of the eighth tergite. Subanal lobes of female rounded triangular. Antennæ, legs, abdomen and cerci are all covered with fine white hairs. It is remarkable that the wings of this species are lacking in both sexes (Plate XXIV, Fig. 4). Such is a very queer circumstance in the Capniidæ.



Text-figure 23. *Capnia nivalis*, sp. nov.

A. Male genital part, lateral view,  $\times 18$ . B. the same, dorsal view,  $\times 18$ .

C. Female genital part, ventral view,  $\times 18$ .

Length of body, in female 10 mm.; in male 9.5 mm.; of antennæ, in female 6.5 mm., in male 5.5 mm.; of ce.ci, in female 5 mm., of male 4.5 mm.

Holotype a male, allotype a female; paratypes: numerous males and females.

*Localities*: Numerous specimens were collected by Mr. K. IMANISHI from the end of July to the beginning of August in 1927, on the surface of the 'snow-couloir' on the so-called "North Japanese Alps" in central Japan, high up to between 1690-1800 m. above sea level. Other specimens are from: Tsubairo, Prov. of Tajima (K. IMANISHI, February 1928); Sasa-ga-mine, Prov. of Echigo (IMANISHI, March 24-26, 1928); Mt. Kashima-Yari, Prov. of Shinano (IMANISHI, March 29-30, 1928); Mt. Shirouma, Prov. of Shinano (M. IWATA, Aug 2, 1928); No-ga-ike, Mt. Kiso-koma, Prov. of Shinano (collector and date unrecorded).



Two forms are recognizable in this species, one as in the above description, the other having a more elongated body and the last two abdominal segments and supra-anal process being more stocky.

The life-history of this species is not very clear. It has been observed that they appear on the surface of the snow mostly on sunshiny mornings, and they often climb up the branches of small bushes at the margin of the 'snow-couloir'. The temperature of these places is often as low as 6°C at midday in summer. This stonefly has been known among our alpinists as "Sekkeimushi"<sup>1)</sup>.

*Capnia bituberculata*, sp. nov.

(*Text-figure 24*).

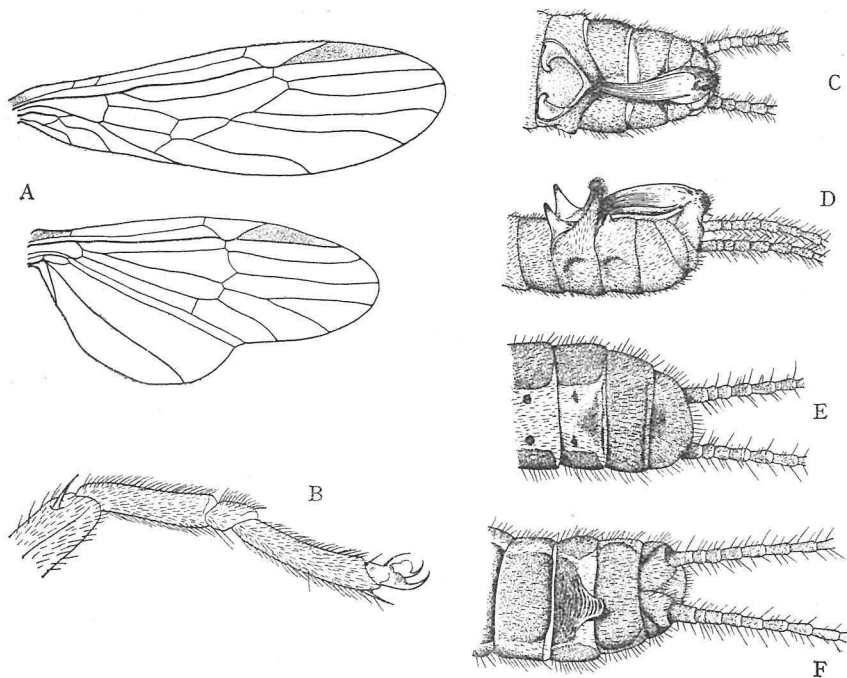
A small blackish brown species. Head black, slightly wider than prothorax, with three ocelli; antennæ brown, slender, about as long as body, with about from 36 to 37-joints. Prothorax black, wider than long, quadrangular, with the angles rounded. Legs long, slender, brown; the third tarsal segment nearly as long as the first, the second very short. Abdomen blackish brown, corpulent; in female, on the dorsum with a broad median light longitudinal band which extends to the posterior margin of the eighth tergite, the tenth tergite broadly rounded; abdomen of male without any such a longitudinal band. Cerci long, brownish, with about 18 joints in male and 22 joints in female. The hind margin of the seventh tergite of male raised a pair of upward pointing short tubercles at their anterior portion; ninth and tenth tergites with a broad shallow depression; supra-anal process recurved, broad, chitinous, bluntly pointed; ninth abdominal sternite slightly produced and broadly rounded behind. Hind margin of the eighth abdominal sternite of female produced into a narrow subgenital plate; subanal lobes small.

Wings longer than abdomen in both sexes, hyaline, venation brown. The venation of this species, as shown in Fig. 27, A, completely

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1) *Sekkei* = snow-couloir, *mushi* = insect.

agrees with that of the North American species *Capnia manitoba* CLASSEN, 1924<sup>1)</sup>.



Text-figure 24. *Capnia bituberculata*, sp. nov.

A. Wings of male,  $\times 18$ . B. Right fore-leg,  $\times 55$ . C and D. Male genital part in dorsal and lateral view,  $\times 18$ . E and F. Female genital part in dorsal and ventral view,  $\times 18$ .

Length to tip of wings, male 8 mm., female 10.5 mm.; of antennæ, male 5.5 mm., female 6.5 mm.; of cerci, male 3.5 mm., female 5 mm.

Holotype a male, allotype a female; paratype: a male. All were collected by Mr. K. IMANISHI on February 4th, 1928, at Tsubairo, Prov. of Tajima, and are in his collection.

*Nymph*: One nymph accompanying above described three imagos. Head, thorax, legs, abdomen and cerci are all blackish brown. Body 6 mm.; antennæ 3 mm., with 20 joints; cerci 3.5 mm., with 18 joints.

These specimens were found on the snow on a sunny morning. The emergence in this district occurs at the early part of February.

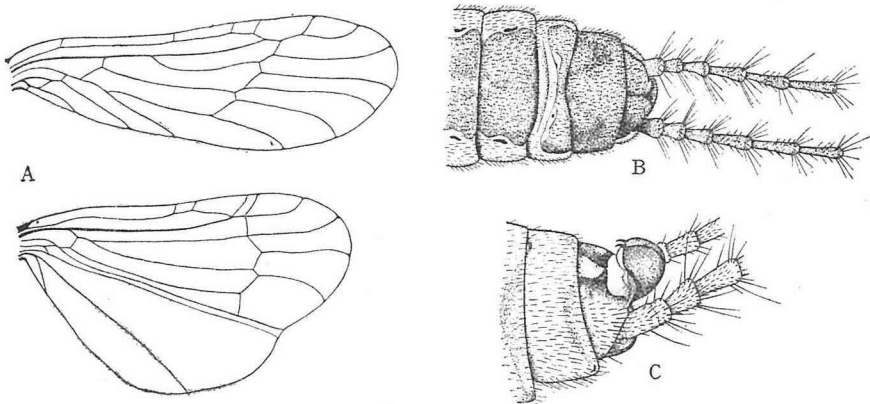
1) NEEDHAM and CLASSEN (1925), Pl. 47, fig. 4.

14. Genus: *Capnella* CLASSEN, 1924.

*Capnella bulba*, sp. nov.

(Text-figure 25).

Small brown stoneflies. Head wider than prothorax, black, covered with fine hairs; three ocelli; antennæ brown, two basal joints much darker, with 29 joints in male and 31 joints in female; maxillary palpi blackish brown. Prothorax somewhat wider than long, widened posteriorly with the angles rounded, blackish brown and somewhat rugose. Abdomen broad; in female with a broad mid-dorsal longitudinal band extending to the hind margin of the eighth tergite, the tenth tergite broadly rounded;



Text-figure 25. *Capnella bulba*, sp. nov.

A. Wings,  $\times 18$ . B. Female genital part in ventral view,  $\times 18$ .

C. Male genital part,  $\times 25$ .

male without such a stripe. Cerci brown, sub-moniliform, composed of 5 (in male), 6 or 7 (in female)-joints. Wings thin, hyaline, venation heavy, sepia-brown, as shown in Fig. 22, A. Sc long, with two costal cross-veins, 1A of hind-wings not branched.

Ninth abdominal tergite with a shallow median depression; supra-anal process recurved, bifid, bulbously enlarged and rapidly tapering to acutely pointed double tips; subanal lobes narrow, upturned and ending in pointed processes; ninth sternite rounded behind. Eighth abdominal sternite of female not produced into a distinct subgenital plate (Fig. 25, B).

Length to tip of wings, male 6.5 mm., female 8.5 mm.; of body, male 6 mm., female 7 mm.; of antennæ, both 4 mm.

Holotype a male, allotype a female; paratypes: a male and three females from the same locality. All in IMANISHI's collection.

*Locality*: Shinkawa, Prov. of Echigo (coll. by K. IMANISHI, May 31, 1927).

The wing-venation of this species is quite irregular, often ending blindly. In the paratypes, there are one or two cross-veins beyond the end of Sc in the fore-wing and branched 1A in the hind-wing.

15. *Genus*: **Takagriopteryx** OKAMOTO, 1922.

**Takagriopteryx nigra** OKAMOTO.

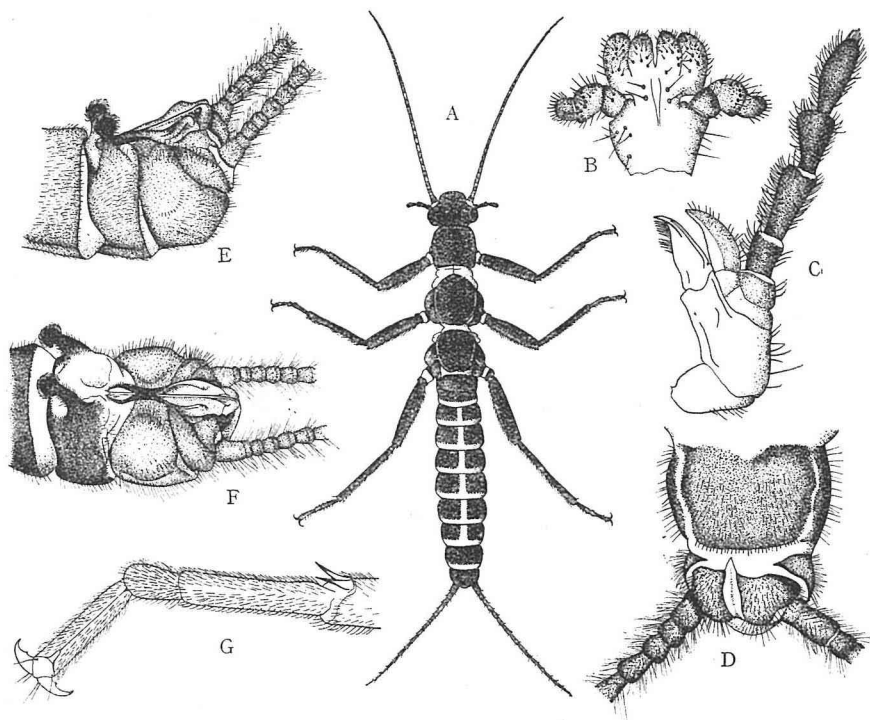
(*Text-figure 26*).

*Takagriopteryx nigra* OKAMOTO (1922), p. 4, Fig. 1, Taf. I, Fig. 1 and 2.

*Nymph*: A slender and black nymph. Head wider than prothorax, black; antennæ black, slender, filiform, slightly longer than the half of body and composed of more than 25 joints. Pronotum slightly wider than long, with the angles rounded, surface slightly rugose. Abdomen cylindrical, widest across the sixth segment and then rapidly tapering toward the end. Abdominal tergite from the third to the eighth with a mid-dorsal longitudinal stripe which extends the hind margin of the eighth. Legs slender and long, the second tarsal segment very short. Cerci black and hairy, with 16 joints.

Length of body 8 mm.; of antennæ 4.5 mm.; of cerci 3.5 mm.

*Imago*: A small blackish stonefly. Head blackish, wider than prothorax, with three ocelli. Antennæ blackish, longer than body, with more than 50 joints. Prothorax nearly as long as wide, somewhat widened behind, with the angles rounded and the surface slightly rugose. Abdomen blackish. Legs slender, femur black, tibia and tarsus brown; the first and third tarsal segments subequal, but the second joint very short, nearly 1/2 as long as the third. Cerci blackish brown, submoniliform, with 23 to 27 joints.



Text-figure 26. *Takigriphopteryx nigra*.

A-D. Nymph; E-G. imago. A. General view,  $\times 6$ . B. Labium,  $\times 55$ .  
 C. Maxilla,  $\times 55$ . D. Ventral view of terminal abdominal segments,  $\times 25$ .  
 E and F. Genital part of male in lateral and dorsal view,  $\times 18$ . G.  
 Tarsus of left leg,  $\times 35$ .

Wings sub-hyaline, slightly beyond the end of last abdominal segment; venation heavy, brown; in fore-wing Sc just reaching to a point half way between the origin of Rs and the cord, in hind-wing not reaching to a point in such a way; fore-wing without a cross-vein beyond the end of Sc, but in hind-wing a cross-vein near the end of it. The venation is quite irregular, even within the limit of a single individual.

Supra-anal process recurved, long, median grooved, with a slightly enlarged bulb at the tip; the eighth abdominal tergite of male bears a pair of tubercles which possess a slightly enlarged bulb at the tip, between which the tip of supra-anal process fits; the ninth and tenth abdominal tergites with a median longitudinal shallow groove in which the supra-anal process lies.

Length of forewing 6.5 mm.; of body 7.5 mm.; of antennæ 9 mm.; of cerci 7 mm.

*Locality*: Shinkawa, Prov. of Echigo (coll. by K. IMANISHI, May 1927).

The emergence of this species in central Japan occurs at the end of May. As Mr. R. TAKAHASHI<sup>1)</sup> has observed in the suburbs of Sapporo in Hokkaido, it emerges in great numbers on the snow during the months from January to April.

OKAMOTO (1922) proposed his new genus *Takagriopteryx* as a member of ENDERLEIN's family of Griptopterygidae<sup>2)</sup>, but it is very closely allied to *Capnella* in its venation and other characters. The wings of my specimen, which is identified as *T. nigra* with OKAMOTO's description, shows undoubtedly the venation of *Capnella*. OKAMOTO's illustration of the venation seems to be based upon an untypical one. I am inclined to think that the genus *Takagriopteryx* may be a variety of the genus *Capnella*, or, at least, should rightly be regarded as a genus of the Capniidae. It is said that the members of the Leptoperlidæ of TILLYARD<sup>3)</sup>, in which many noticeable Notogaean forms are included, possess wings more richly veined; in the fore-wing the presence of a series of median and cubital cross-veins and the lack of 1A, and the anal field of the hind-wing is not so large as shown in OKAMOTO's illustration of the wings of *Takagriopteryx*, being provided with three complete anal veins<sup>4)</sup>. For these reasons I at present place this genus in the family Capniidae.

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1) Trans. Nat. Hist. Soc. of Formosa, 1923, No. 64, p. 17 (in Japanese).

2) This name was replaced by that of Leptoperlidæ by TILLYARD (1921), including the insects of the Griptopterygidae.

3) see above 2).

4) The typical venation of the Leptoperlidæ appears in COMSTOCK's "The Wings of Insects" (1918), p. 259, Fig. 247.

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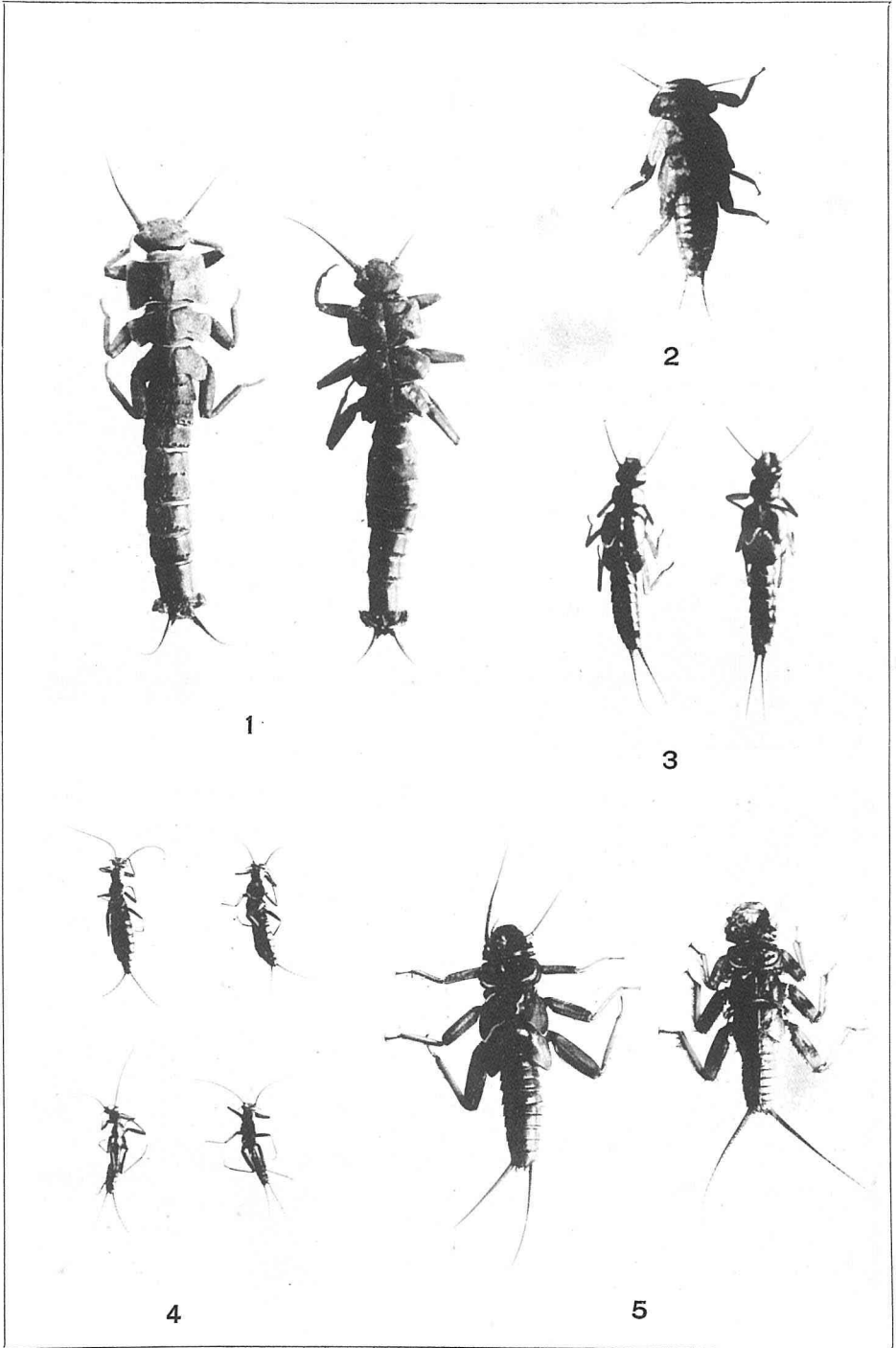
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EXPLANATION OF PLATE XXIV.

1. *Scopura longa*. Left: Type, dorsal view, ca.  $\times 2$ . Right: A nymph taken in a torrent on Mt. Kiso-Koma (ca. 2700 m. a. l.), August. Dorsal view,  $\times$  ca. 2.
  2. Nymph of *Peltoperla* sp. No. 1, dorsal view,  $\times 2$ . (For the locality see p. 121).
  3. Nymphs of *Alloperla shibakawae* (OKAMOTO). Dorsal view,  $\times 2$ . (collected in a torrent on Mt. Tsurugi of the "North Japanese Alps," August).
  4. *Capnia nivalis* nov. Dorsal view,  $\times 2$ . (collected on a 'snow-couloir' on Mt. Shirouma of the "North Japanese Alps," August). Upper, female; lower, male.
  5. Nymphs of *Pelra*. Dorsal view,  $\times 1\frac{1}{2}$ .  
Left: *P. tinctipennis* MCLACHLAN (collected in a torrent at Kiyotaki near Kyôto, April).  
Right: *P. sp.* (collected in the Sêta River at Nango, near Ôtsu, January).
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UÉNO photo.

UÉNO: Stoneflies of Japan.