# FAUNAL AND BIOLOGICAL STUDIES ON THE INSECTS OF PADDY FIELDS IN ASIA Part I. Introduction and Sciomyzidae from Asia (Diptera)

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# FAUNAL AND BIOLOGICAL STUDIES ON THE INSECTS OF PADDY FIELDS IN ASIA

## Part I. Introduction and Sciomyzidae from Asia (Diptera) [1)]

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## I. Introduction

Needless to say, paddy field is one of the biggest agro-ecosystems in the world, and rice holds a responsible position in the world food problem. It is more excessive in Asia where paddy field is the largest and probably one of the oldest agro-ecosystems there. It is not too much to say that paddy field is the environment itself of the Asian people whose dwellings are near or mostly amongst the field like a desert island. It may be safely said that paddy fields are concerned with environmental problems in addition to agricultural and medical entomology. Surprisingly, however, insect fauna of paddy field in any areas of the world has been remained unknown except for the limited major pests and their natural enemies. This is probably owed to the non-biological pest management representing by the spray of synthetic insecticides on a large scale. Several major or permanent pests only have been marking by that policy. For better pest management which would be founded on biological basis and to obtain the basic data of the ecosystem itself, no one could leave whole insect fauna comprising probably as many as several hundreds of species in a given paddy field out of consideration.

This study is intended to present the knowledge on the fauna and biology of paddy field insects of Japan and other Asian countries. Following topics will be covered hereafter. Taxonomic and biological_ studies of various groups of paddy dwelling insects including non-pest of rice, and those attacking weeds in paddy and their parasites and predators. All insects associated with paddy fields are consequently involved. The whole insect fauna of paddy will be hopefully scheduled to show in later, but it would take time since many species are taxonomically unknown and are required for further taxonomic studies. Differences of insect

1) Contribution from the Entomological Laboratory, Faculty of Agriculture, Kyushu University, Fukuoka (Ser. 3, No. 41). Partial result of grants (1970, 1973) from the Ministry of Education, Japanese Government to "Field surveys on the biological control of rice stemborers, aphids, diaspine scales and phytophagous mites in S. E. Asia." (Principal investigator: Prof. K. Yasumatsu in 1970, Prof. Y. Hirashima in 1973).

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fauna of probably more or less selected taxonomic groups from paddies in different managements, situations, geographical areas, longitudinal positions, historical time of cultivation and so on will be discussed. Fauna1 changes in short and long terms are also intended to approach. Papers will be written together with other authors occasionally in accordance with the co-operative works.

## REVIEW FOR THE INSECT FAUNA

Though this study is not going to enumerate the whole insect fauna of a given area in the beginning, records for number of species from paddy field are reviewed here to give a general situation of the problem. Detailed review on the respective insect groups including their biologies will be made in the later papers of the respective groups.

***Japan.*** Insect pests of rice in Japan have been enumerated by various authors since Kaibara (1709).[1] Some of them are cited here : Kaibara (1709) -4 species, Okura (1826) -10 species, Matsumura (1906) -71 species, Okajima (1926) – 125 species,[2] Y ago (1943) – 216 species[2], Kuwayama (1952) – 203 species. In these lists only pest insects are recorded as mentioned above. Pest species and its direct control have always been emphasized and non-pests or other paddy dwelling insects have never been paid attention for research. Natural enemies of pest insects have not been listed extensively. So many works on the major pests of rice have been done in Japan and these are not subject primarily for the present study. Following papers treating insect groups other than major pests are reviewed here. Kuroda (1930) mentioned 94 animal species including 27 insect species were found from paddy field water, though it is not sorted to species level. This study seems to be intended to know the differences between paddy fauna and other fresh water habitats such as ponds or rivers. Fukaya (1945) recorded 179 insect species belonging to 7 orders from the nursery in Kurashiki, Honshu. Yasumatsu (1950) stated that about 500 species of insects were attracted to a light trap amongst paddy field in Kyushu. This figure does not 'mean the paddy dwelling insects, but does present the information about the problem concerned. In 1973, Kobayashi et ***al.*** reported Arthropod fauna of paddy fields in Tokushima Prefecture, and listed about 450 species of insect and presented various informations. Though it contains many unidentified species, this may be the most important work on the whole insect fauna of paddy ever done in Japan. In the field of medical entomology, mosquito and horse fly faunae of paddy fields have been studied and around 10 species each are known (Otsuru and Ogawa, 1959; Ishino, Yamaguchi and Orii, 1966; Kamimura, Wada and Watanabe, 1968 ; Makiya, 1970 and 1971; Yoshida, Watanabe and Yajima, 1974; etc.). In this field, some insect natural enemies of mosquitoes have been recorded also (Watanabe et ***al.,*** 1968; Watanabe and Wada, 1969). There are fragmental records in which some nontarget species are mentioned.

***Other areas*** : In most rice growing countries in Asia, major pests of rice only have been usually listed as mentioned below: 98 species in Korea (Paik, 1967), 21 species in Hong Kong (So, 1967), 51 species in Thailand (Dept. of Agr. and USOM

[1] **There** are more older but rather fragmental records of insect pests of rice before 1709.

[2] Original figures of these reports include those for Korea and Taiwan. These figures presented here are for Japan only.

to Thailand, 1965), 31 species in Vietnam (Ngoan, 1972), about 130 species including stored rice pests in the Philippines (Capco, 1959 and Baltazar, 1968), 159 species in Malaya (Yunus, 1967), 23 species in Bangladesh (Alam, 1967) and so on. These figures are listed by the different ways under different situations of pest researches, and do not show the differences of pest insect conditions in these areas. In 1972, 341 species of rice pests in Southeast Asia and Pacific Region were listed by FAO. This is a bibliographical work based on the known records of pests. Two lists of insect pests of rice of the world are known as follows. Walker (1962) listed 1378 species from the world, and Grist and Lever (1969) enumerated 818 species including stored rice pests. These are based on the published records and do not cover nontarget species.

In 1974, Pawar presented a report of insects of paddy fields and adjacent fields in the Philippines based on the collectings. In the report, though it is mimeographed, 371 species including stored rice pests were listed.[1] This report seems to be intended to know the occasional or potential pests of rice in addition to major pests. Though it may not be focused the situation of insects in the paddy ecosystem, this report offers the valuable information together with that of Kobayashi *et al.* (1973). Yano et al. (1975) reported the collections comprising 14 insect orders made by a modified Malaise trap in paddy fields in Thailand, the Philippines and Hong Kong. The paper in which the collections are not principally sorted to species level, was the preliminary work of the series of the present study.

Looking to other areas besides Asia, there seems to be no trial to find out the whole insect fauna of paddy field ecosystem so far as I ware, though there are rather fragmental records on the nontarget species. Serial studies of Olmi (1968, 1969, 1971, 1975) and Olmi and Villani (1975) seem to focus on the economic important pests of rice. Midges and mosquitoes associated with paddy fields have been occasionally reported in some areas, such as 30 species of Chironomidae in California (Darby, 1962) and 35 species of Culicidae in Kenya (Chandler and Highton, 1975).

Natural enemies of rice pests have been reported from various rice growing areas. Yasumatsu and Torii (1968) stated that about 100 species of natural enemies including diseases are known from the rice stem borers in Asia. Followings are some of the works dealing with the natural enemies of rice pests. Momoi (1966, 1968, 1969) (Ichneumonidae) ; Momoi, Kusigemati and Nakanishi (1968) (Ichneumonidae) ; Watanabe (1967) (Braconidae) ; Descamps (1956) (Hymenoptera) ; Rao et al. (1968) (Hymenoptera) ; Sasaji (1968) (Coccinellidae) ; Asahina (1972) (Odonata) ; Nakao et ***al. (1976)*** (Odonata). Yano (1968) reported the Sciomyzidae that supposedly playing the role as the alternate host of the *Trichogramma* wasps. Abundant species of parasitic and predaceous insects attacking paddy dwelling ones are expected to be enumerated in accordance with the further studies like Service (1977).

According to the published records, following 17 orders of insects have been recorded from paddy fields in the world : Collembola, Ephemeroptera, Odonata, Isoptera, Dictyoptera, Orthoptera, Dermaptera, Psocoptera, Hemiptera, Thysanoptera, Neuroptera, Trichoptera, Lepidoptera, Diptera, Coleoptera, Strepsiptera and Hymeno-

[1] It is mentioned in the report that 650 species are differentiated though these are not listed.

ptera, Walker (1962), and Grist and Lever (1969) who focused on the pests listed 12 and 10 orders respectively based on the published record. Based on the collected materials from rather limited areas, Kobayashi et al. (1973) listed 12, Pawar (1974) 8 and Yano *et* ***al.*** (1975) 14 orders respectively. I collected Mecoptera in Japan (unpublished data) which will be the eighteenth order. It is supposed that several more orders such as Plecoptera, Phasmida and others will be certainly found from the paddy fields since some paddies are surrounded by various vegetations. **The** status of each order in paddy field ecosystem will be discussed later in accordance with the studies progressing on their biologies.

## II. Sciomyzidae from Asia (Diptera)

First record of the occurrence of the fly of Sciomyzidae from paddy field is probably the one made by Kato (1950) who mentions the occurrence of " Sepedon ***sphegeus*** " in Japanese paddy fields. Since 1963, the Sciomyzid flies in paddy fields have been collected from Asia according to its supposed ecological status in the biological control of rice stem borers (Yano, 1968). In 1968, I reported 8 species of the family collected in paddy fields from Asia based on the materials mentioned above. Several papers concerning more or less with the paddy field Sciomyzidae have been published since then (ChannaBasavanna and Yano, 1969; Nishida and Torii, 1970; Momoi *et* ***al.,*** 1975 ; Yano, 1975 ; Yano *et* ***al.,*** 1975). On the fauna1 studies, however, no additional species have been reported in these papers except ***Sepedon*** *lobifera* Hendel though it has treated without collecting data (Momoi *et al.,* 1975).

In the present paper, 16 species including those treated in my previous paper (Yano, 1968) are mentioned. Seven species among the known paddy dwelling species are biologically known though almost of the data are derived from natural vegetation. The larvae of these species feed on snails as cited in the following pages. The remaining species might be snail feeders also judging from the present knowledge of the family. They have other status relating liver flukes of cattle and egg parasites of rice stem borers as already known. Thus five groups of paddy dwelling organisms, Sciomyzid flies-snails – liver flukes -egg parasites (*Trichogramma*)–rice stem borers, are involving together in the ecosystem. The role played by the Sciomyzid flies in the rice pest management will be evaluated with further studies.

Judging from the past collectings and observations, there is few possibilities that more species are found in paddy fields from Japan since (1) the pest control procedures have been uniformly, widely and intensively carried out throughout Japan, and have resulted in supposed rather uniform fauna we see now, and (2) searches for the fly by myself have done rather well in some parts of Japan.

Besides Asia, there is only two records on the paddy field Sciomyzidae so far as I know. Grist and Lever (1969) stated " ***Sepedon*** *senegalensis* Macq. (Sciomyzidae) is a minor pest in Senegal and Mali" in their book entitled "Pests of rice," though its economical point is probably erroneous since all of the known larvae of the family of the world feed on snails. Ayatollahi (1971) recorded the larvae of *Psacadina zernyi* (Mayer) from Iran.

## LIST OF THE SPECIES

As all specimens treated here were collected from paddy fields, no indications are mentioned in the data. Literature cited in the following lines is limited to those concerning paddy fields and principal ones on taxonomy and biology. Locality names of the specimens examined are cited from the labels of the specimens, so different spellings are seen such as Sanpatong-San Pa Tong. Details on this matter and informations of localities are referable to Yasumatsu, Hirashima and Yano (1975).

### 1. Knutsonia albiseta (Scopoli, 1763)

*Musca albiseta* Scopoli, 1763, Entom. carn.: 341.
*Elgiva albiseta* : Sack, 1939, In Lindner : Fliegen, 37 : 63.
*Knutsonia albiseta* : Rozkošný, 1366, Folia Fac. sc. nat. Univ. Purky. Brunensis, Biologia 7(4): 66; Rozkošný, 1967, Acta sc. nat. Brno l(4): 152, pi. 9, figs. l-10; Knutson and Berg, 1967, Bull. Inst. r. Sci. nat. Belg. 43(7): 6, 26, 15 figs.; Knutson and Berg, 1971, Norsk. Ent. Tidssk. 18(2): 127; Beaver, 1972, Entomologist 105: 286.

Specimen examined : IRAN. 1♂, Rasht, 28. ix. 1964, T. Nishida.

Distribution : Europe to Turkey and Iran.*

The present specimen was collected at Rasht together with the specimens of ***Psacadina*** *zernyi* (Mayer) and ***Pherbina*** *coryleti* (Scopoli). The present record is the most eastern distribution of this species, and is the only one from paddy fields among known distribution.

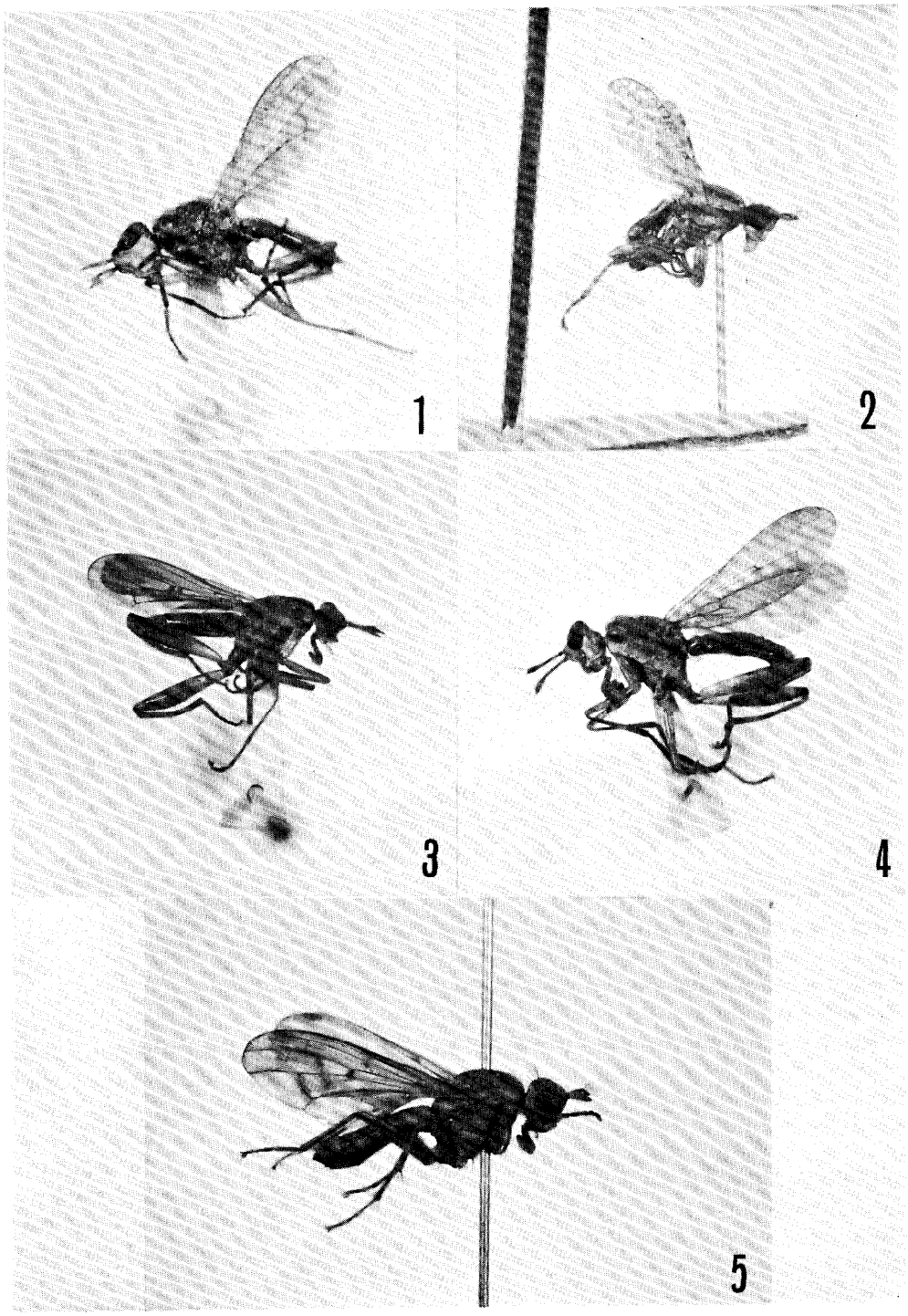
Biology : Immature stages and biology are referable to Knutson and Berg (1967, 1971), Rozkošný (1967) and Beaver (1972, 1974). In Europe, this species spends one generation a year in temporary and permanent freshwater habitats and the larvae feed on the snails belonging to *Helisoma*, ***Lymnaea*** and *Physa* (Knutson and Berg, 1967, 1971).

### 2. ***Limnia japonica*** sp. nov.

(Figs. 1, 6-10)

***Head.*** Frons yellow ; frons+vertex longer than width of frons; shallowly concaved mid-frontal stripe yellow but margined by brown, about 1/4 to 1/3 width of frons (1 male, 3 females), narrowed toward ocelli; anterior margin of frons pale yellowish brown but not so shiny; anterior fronto-orbital bristles surrounded by slender black patch ; posterior fro&o-orbital bristles with a minute brown patch; ocellar and postocellar bristles prominent, longer than fronto-orbital bristles ; ocellar triangle brown ; velvety black patch situated on occiput immediately posteriad of postocellar bristles ; anterior part of frons with scattered fine black hairs. Minute brown patch located immediately dorsad of each antenna. Black, triangular large spot at base of antenna on parafacialia. Face whitish ; medifacies bare ; parafacies with fine black hairs; medifacies with a brownish stripe centrally, and broadened near oral margin. Antennae with basal segment pale brown with short hairs dorsally; second segment yellow with brownish area on dorsal 1/3, usually with

* Locality based on the paddy field material is shown with asterisk.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one long bristle (rarely two) on dorso-apical part, longer than third segment; third segment yellow tinged with brown except dorsal and basal parts ; arista with white hairs.

*Thorax*. Notum dark grey with two narrow brown stripes centrally, almost united together except cephalic end, almost disappeared at caudal margin of mesonoturn, and appeared as a rather broad stripe on scutellum; a broad brown stripe laterally. Pro-, meso- and pteropleura brown in upper 1/3, pruinose in the remaining parts. Subalar setae 2 to 3 per side. Legs yellow to pale brownish; femora somewhat paler than tibiae and tarsi; tarsi especially distal segments blackish ; fore femora with about 5 bristles in a row dorsally; hind femora with two preapical bristles dorsally, and with two rows of bristles ventrally in male and not in female. Wings pale yellowish brown with brown reticulations; costal margin darker; posterior cross vein slightly curved outwardly. Wing length : 6 mm (holotype male), 6-6.5 mm (3 females).

*Abdomen*. Greyish brown. Postabdomen, 4th and 5th sterna as in Figs. 8～10.

Specimens examined : Holotype (♂) (Type No. 2082, Kyushu Univ.), allotopotype (♀) and paratopotype (1♀): JAPAN. Shimobaru, Fukuoka, Kyushu, 20. ix. 1967, K. Yano. Paratype (1♀): JAPAN. Kawachi, Nako, Yamaguchi Pref., Honshu, 25. viii. 1968, K. Yasumatsu.

Distribution : Japan* (Honshu and Kyushu).

Four specimens have been collected from two restricted localities so far, This species is apparently not abundant in the paddy fields of Kyushu and probably so in other areas.

This species is allied to *L.* unguicornis (Scopoli, 1763) from Europe superficially, but it may be distinguished from the latter species by the following characters. Black patch associated with anterior fronto-orbital bristles is usually oval in unguicornis, longer in this species. Postabdomen especially surstylus and hypandrium of this species is apparently different from those of *unguicornis* and its allied species, *paludicola* Elberg, 1965 from Europe and Siberia.

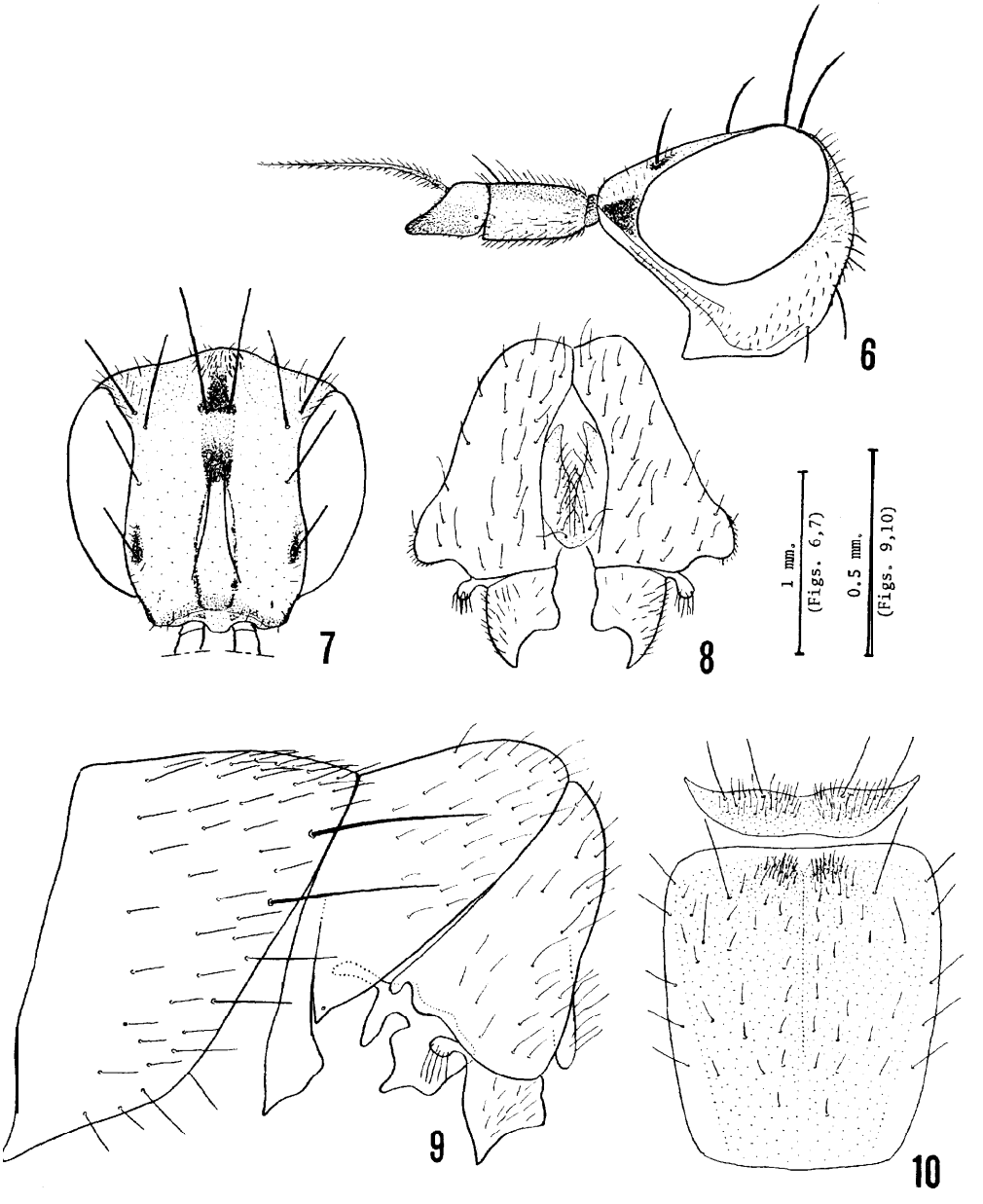
Biology : Unknown.

### 3. ***Limnia setosa*** sp. nov.

(Figs. 2, 11～15)

*Head*. Frons yellow with somewhat metallic iridescence, wider than frons+vertex; shallowly concaved mid-frontal stripe yellowish brown margined by brown, about 1/5 to 1/4 width of frons (3 males, 4 females), slightly narrowing toward ocelli in some specimens; anterior margin of frons pale yellowish brown but not so shiny ; anterior fronto-orbital bristles surrounded by slender or oval black patch;

**Fig. 1.** ***Limnia japonica*** sp. nov., female (paratype). Kawachi, Nako, Yamaguchi Pref., Honshu, Japan, 25. viii. 1968, K. Yasumatsu. **Fig. 2.** ***Limnia setosa*** sp. nov., male (paratopotype). Kasugai, Aichi, Honshu, Japan, 15. v. 1965, T. Okadome. **Fig. 3.** *Sepedon* sp.. female. Oomachi, Nagano Pref., Honshu, Japan, 25. viii. 1972, K. Yano. Fig. 4. *Sepedon lobifera* Hendel, female. Yuching, Tainan Hsien, Taiwan, 17. iii. 1966, K. Yano et H. Kajita. **Fig. 5.** *Tetanocera arrogans* Meigen, female. Sapporo, Hokkaido, Japan, 28. viii. 1965, K. Kusigemati.




**Figs. 6-10.** ***Limnia*** *japonica* sp. nov. **6.** Head, lateral view, male. **7.** Ditto, dorsal view. 8. Postabdomen, posterior view. 9. Ditto, lateral view, excluding aedeagus. 10. Fourth and 5th sterna.

posterior fronto-orbital bristles without patch in the examined specimens ; ocellar and postocellar bristles prominent, longer than fronto-orbital bristles ; ocellar triangular brown, sometimes not darker than mid-frontal stripe; velvety brownish black patch situated on occiput immediately posteriad of postocellar bristles; anterior part of frons with scattered fine black hairs. Minute brown patch located immediately dorsad of each antenna, sometimes indefinite and linear. Black, triangular large spot at base of antenna on parafacialia. Face whitish, somewhat pruinose ; medifacies bare ; parafacies with fine black hairs; minute brown patch rarely located immediately ventral of each antenna. Antennae with basal segment yellowish to pale yellowish brown with short hairs dorsally; second segment yellow with brownish area on dorsal 1/3, with one or two long bristles on dorso-apical part; third segment yellow tinged with brown except basal part; arista with white hairs.

***Thorax.*** Notum pale brown to pale brownish grey with two brown stripes centrally, a broad similar stripe on scutellum; a broader stripe laterally. Pro-, meso- and pteropleura brown in upper half, lightly pruinose in the remaining parts. Subalar setae 1 to 2 per side. Mesopleuron with 3 to 4 setae at caudal margin in addition to fine hairs; pteropleuron with one distinct bristle. Legs yellow to pale brownish ; distal segments of tarsi dark brownish; fore femora with prominent bristles in addition to small ones, about 5 of which dorsally in a row, others laterally and ventrally; hind femora usually with two preapical bristles dorsally, and with two rows of bristles ventrally in male, and not in female. Wings whitish with brown reticulations ; posterior cross vein slightly curved outwardly. Wing length : 4.5-5 mm (3 males), 5 -6 mm (4 females).

***Abdomen.*** Pale yellowish brown with a brown stripe mid-dorsally, and a similar stripe at each lateral side. Postabdomen, 4th and 5th sterna as in Figs. 13-15.

**Specimens examined :** Holotype (♂) (Type No. 2083, Kyushu Univ.), allotopotype (♀) and paratopotypes (2♂♂, 2♀♀): JAPAN. Kasugai, Aichi, Honshu, 15. v. 1965, T. Okadome. 1♀. JAPAN. Okutsu-onsen, Okayama Pref., Honshu, 3. x. 1974, K. Yano.

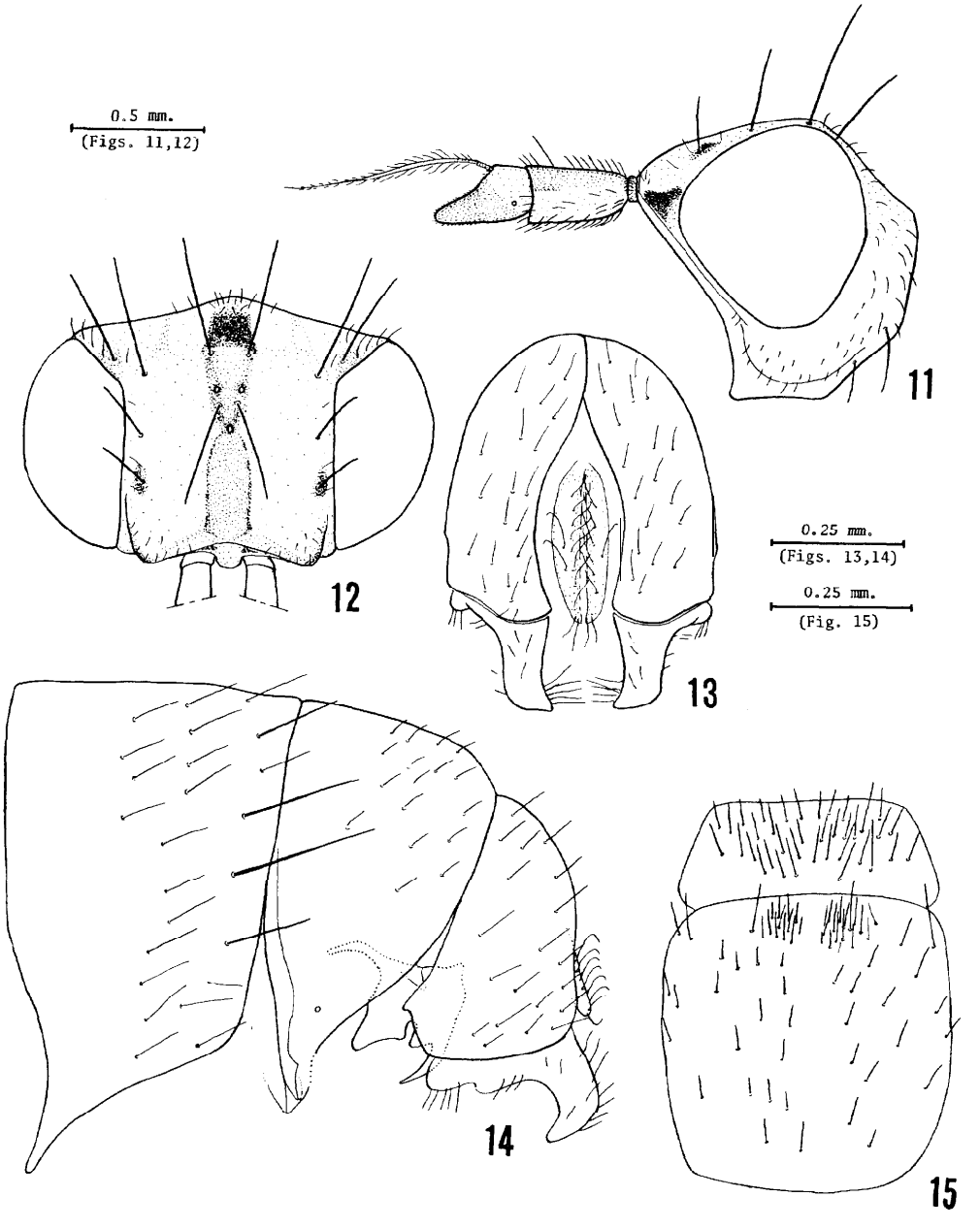
**Distribution :** Japan* (Honshu).

This species seems to be not common in paddy fields of Japan as preceding species so far as the past collectings show, though it is expected to be found from more localities in Honshu.

This species is allied to *L. pacifica* Elberg, 1965 from the Kurile Islands superficially, but it is separable by the character of postabdomen especially hypandrium. Postabdomen of this species is somewhat resemble to those of *unguicornis* and *paludicola*, but it is separable from these species by the detail characters of postabdomen and wing reticulations.

This species is somewhat peculiar among the genus in having the following characters. Meso- and pteropleura with some bristles in addition to fine hairs. It has not been treated as the character for the genus ***Limnia*** (e. ***g.*** Knutson and Lyneborg, 1965), but for the allied genus ***Pherbina.*** Arista of antenna, however, has white hairs in this species, not dark as in ***Pherbina.*** Subalar bristles and other characters also show that this species belongs to the genus *Limnia.*

**Biology :** Unknown.




**Figs. 11-15.** *Limnia setosa* sp. nov. 11. Head, lateral view, male. 12. Ditto, dorsal view. 13. Postabdomen, posterior view. 14. Ditto, lateral view, excluding aedeagus. 15. Fourth and 5th sterna.

### 4. **Psacadina zernyi** (Mayer, 1953)

*Pherbina zernyi* Mayer, 1953, Ann. nat. Mus. Wien 59: 204.
*Psacadina zernyi* : Rozkošný, 1965, Beitr. z. Ent. 15(5/6): 749; Yano, 1968, Mushi 41(15): 196, fig. 8, pl. 4, fig. 4; Nishida and Torii, 1970, IBP Handbook 14: 35 ; Knutson, Rozkošný and Berg, 1975, Acta sc. nat. Brno 9(1): 19, 32, map 3, pls. 1, 2, 6, 7.

**Distribution** : Europe to Iran.*

No additional specimens from paddy fields have been examined since Yano (1968), but the following record has appeared. Ayatollahi (1971) recorded the larvae of this species from rice stem in Iran from where the adult specimens were collected (Yano, 1968).

**Biology** : Immature stages and biology are referable to Knutson, Rozkošný and Berg (1975). Snails of the following genera have been recorded as hosts: *Aplexa, Bathyomphalus*, ***Biomphalaria, Gyraulus, Helisoma, Lymnaea, Oxyloma*** and ***Succinea.***

### 5. **Pherbina intermedia** Verbeke, 1948

*Pherbina intermedia* Verbeke, 1948, Bull. Mus. Hist. nat Belg. 24(3); *24, fig.* 10; Verbeke, 1960, Bull. Inst. r. Sci. nat. Belg. 36(34): 11, figs. 4, 10, 14 ; Yano, 1968, Mushi 41(15): 196, fig. 9, pl. 3, pl. 4, fig. 5; Nishida and Torii, 1970, IBP Handbook 14: 35; Knutson, Rozkošný and Berg. 1975, Acta sc. nat. Brno 9(1); 14, 26, map 2, pl. 1, fig. 8, pl. 4, figs. 67-70.

**Specimens examined** : JAPAN. 8♂♂, 16♀♀, Hiroshima, Sapporo-gun, Hokkaido, 24. viii. 1976, K. Yano.

**Distribution** : Europe, China, Japan* (Hokkaido).

I recorded this palearctic species from Japan in 1968 based on the specimens collected at Sapporo, Hokkaido. Recently I had a chance to see, and collect the species at an area about 25 km from the locality where the material of 1968 were collected. Total 24 specimens were collected within limited hours. Several specimens of ***Tetanocera arrogans*** Meigen were also collected from this area. In Nayoro, northern Hokkaido, however, no specimens of this species and any other Sciomyzidae were collected in the following days. This may be due to the difference of developmental stages of rice plants and conditions of paddy fields. It is supposed that this species may distribute rather widely in Hokkaido judging from the collectings made in Hokkaido and distribution data in Europe.

**Biology** : Immature stages and biology are referable to Knutson, Rozkošný and Berg (1975). The larvae ate the snails of *Helisoma trivolvis*, ***Physa*** spp. and ***Lymnaea*** *palustris* according to these authors.

### 6. **Pherbina coryleti** (Scopoli, 1763)

*Musca coryleti* Scopoli, 1763, Ent. carn.: 336.
*Tetanocera reticulata* Fabricius, 1781, Spec. Ins. 2: 450.
*Tetanocera coryleti* : Rondani, 1868, Atti Soc. it. Mil. 1868: 226.
*Pherbina coryleti* : Hendel, 1900, Verh. k.-k. zool.-bot. Ges. Wien 50(7): 347; Sack, 1939, In Lindner: Fliegen 37: 59, pl. 2, fig. 12, pl. 4, fig. 41; Verbeke, 1960, Bull. Inst. r. Sci. nat.

Belg. 36(34): 9, figs. 3, 8, 14; Rozkošný, 1967, Acta SC. nat. Brno l(4): 151, pl. 6, figs. 5-11; Yano, 1968, Mushi 41(15); 197, fig. 10; Nishida and Torii, 1970, IBP Handbook 14: 35; Knutson and Berg, 1971, Norsk. Ent. Tidssk. 18(2): 128; Knutson, Rozkošný and Berg, 1975, Acta SC. nat. Brno 9(1): 10, 25, map 1, figs. 114, 115, pl. 1, figs. 1, 3, 5-7, pl. 2, figs. 25, 30, 35, 40, pl. 3, figs. 42-54, pl. 4, fig. 64, pl. 7, figs. 107, 109-111.

Distribution: Europe, Iran,* C. Asia to Afghanistan.

No additional specimens from paddy fields have been examined since Yano (1968).

Biology : Immature stages and biology are referable to Knutson and Berg (1971), Beaver (1972, 1974), and Knutson, Rozkošný and Berg (1975). According to these, the species has one generation a year and the larvae feed on the snails belonging to 11 genera.

### 7. Sepedon (Mesosepedon) sauteri Hendel, 1911[1)]

(Figs. 16 and 17)

***Sepedon sauteri*** Hendel, 1911, Ann. Mus. Nat. Hungarici 9: 270; Hendel, 1913, Ent. Mitt. 2: 33 ; Nagatomi and Kushigemachi, 1965, Kontyû 33(1): 35, figs. 1-6; Nagatomi and Tanaka, 1967, Kontyû 35(1): 31, figs. l-4 ; ChannaBasavanna and Yano, 1969, Mushi 42(15): 181; Nishida and Torii, 1970, IBP Handbook 14: 35, fig. 9.

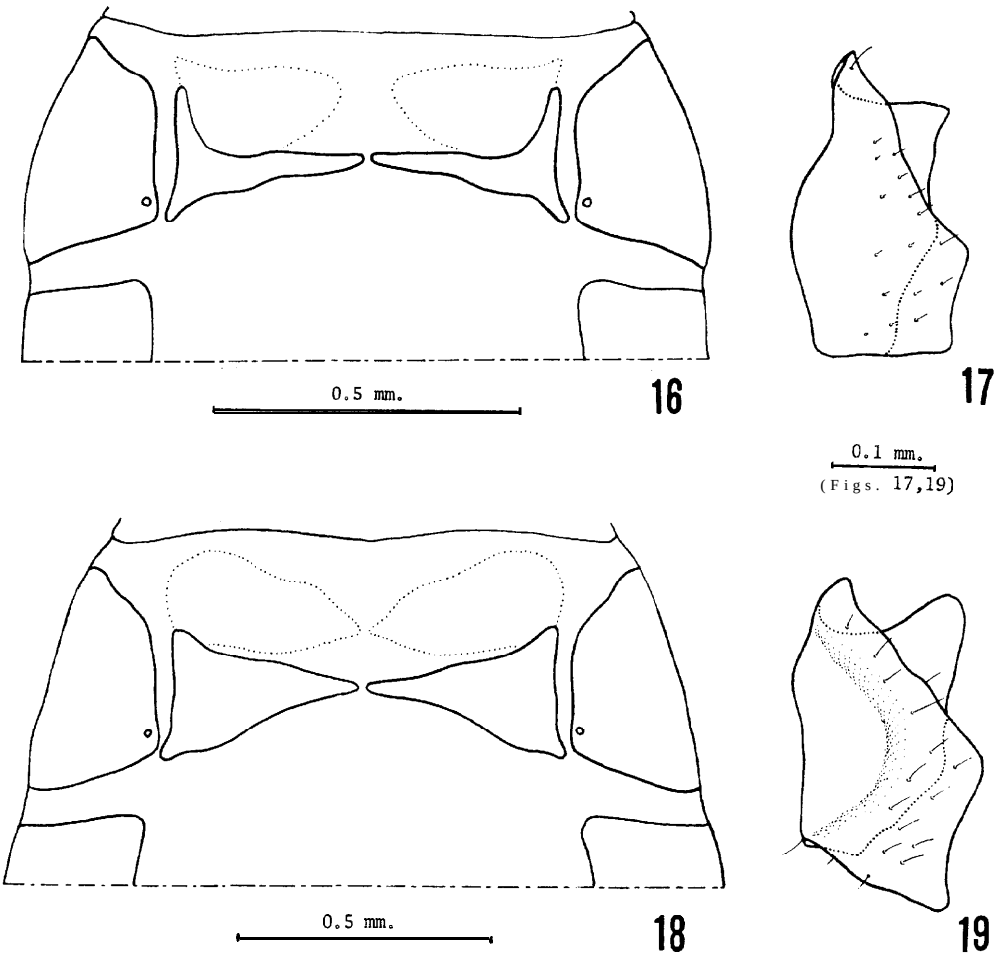
Sepedon ***(Mesosepedon) sauteri*** : Yano, 1968, Mushi 41(15): 190, pl. 2, pl. 4, fig. 1.

***Sepedon sphegeus*** : Kato (nec Fabricius), 1950, In : Icon. Ins. Jap. (rev. ed.): 1669, fig. 4805 ; Momoi ***et al.,*** 1975, JIBP Synthesis 7: 80.

Specimens examined : In addition to the materials reported by Yano (1968), following 897 specimens have examined.

JAPAN. HONSHU. Nagano Pref. : Hakuba-mm-a, 4 exs. (Aug.); Hata-mura, 10 exs. (Aug.) ; Oomachi, 3 exs. (Aug.) ; Asama-onsen, 7 exs. (July). Gifu Pref.: Kosaka, 1 ex. (Aug.). Aichi Pref.: Kasugai, 16 exs. (Aug.). Osaka Pref.: Kumatori, 1 ex. (Aug.). Okayama Pref. : Okutsu-onsen, 6 exs. (Oct.). Shimane Pref.: Hikimi, 3 exs. (July). Yamaguchi Pref.: Igami, 6 exs. (Aug.); Nako, 50 exs. (Aug.). SHIKOKU. Ehime Pref. : Yokogawara, 3 exs. (Oct.). KYUSHU. Fukuoka Pref. : Hisayama, 27 exs. (June, Sept., Oct.) ; Amagi, 4 exs. (Oct.) ; Tachibanayama, 8 exs. (Oct.). Miyazaki Pref.: Miyazaki, 6 exs. (Oct.); Nango, 20 exs. (Nov.); Aburatsu, 17 exs. (NOV.). Kagoshima Pref. : Koshiki I., Teuchi, 79 exs. (Aug.) ; Kushira, 1 ex. (Nov.) ; Shibushi, 19 exs. (Nov.). TSUSHIMA. Shimoagata: Kyozuka, 4 exs. (Oct.); Tsutsu, 51 exs. (June, Oct.) ; Kechi, 18 exs. (June) ; Azamo, 17 exs. (June, Oct.) ; Kusubo, 6 exs. (June) ; Naiin, 12 exs. (June, Oct.) ; Komoda, 4 exs. (June) ; Tamatsuke, 23 exs. (June) ; Nii, 98 exs. (Aug., Oct.). Kamiaga ta : Sago, 2 exs. (Aug.). RYUKYUS. Okinawa-honto : Haneji, 8 exs. (June) ; Hyakuna, 21 exs. (June) ; Shikenbaru, 19 exs. (June). Ishigaki I. : Hiratabaru, 6 exs. (June). HONG KONG. New Territories : Tai Lung Farm, 8 exs. (Aug.); Shek Kiu Tau, 1 ex. (Aug.) and 36 exs. from New Territories (Feb.). PHILIPPINES. LUZON: Pili, Camarines Sur, 2 exs. (Aug.). MINDANAO : Calinan, Davao, 9 exs. (Sept.); Tugbok, Davao, 1 ex. (Sept.). THAILAND. San Pa Tong, 142 exs. (January, July, Aug.) ; Songquare nr San Pa Tong, 21 exs. (July) ;

1) The revisional study on the species group " ***Sepedon sphegea*** " will be published shortly by Dr. L. V. Knutson, and the present species will be consequently treated in the paper.




Figs. 16 and 17. *Sepedon sauteri*. 16. Fifth sternum. 17. Surstylus. Figs. 18 and 19. *Sepedon* sp. 18. Fifth sternum. 19. Surstylus.

Chomtong, 8 exs. (July); Chiang Dao, 1 ex. (July); Sara pinr Chiang Mai, 2 exs. (July) ; Lampoon, 15 exs. (July) ; Ban Tap Dua, 1 ex. (Aug.) ; Mae Sai, 1 ex. (July); Mae Rim, 2 exs. (July) ; Bangkhen, 38 exs. (January, February, Aug.) ; Sam Phran, 1 ex. (Aug.).

**Distribution :** Japan,* Ryukyus,* China, Taiwan,* Hong Kong,* Philippines,* Thailand,* Nepal,* India,* Bangladesh,* Pakistan,* Hawaii (introduced).

The present species which has been recorded under the names of ***sphegea*** or ***sauteri*** from Asian paddy fields is the most common one among the known paddy

dwelling Sciomyzid flies. The population density of this species especially in Japan, Ryukyus and Taiwan is very high in paddy fields and its surrounding wet habitats. In Japan, it is more abundant in western part than north-eastern part of Japan. Surveys made in Hokkaido, Akita, Nagano, Gifu areas show it clearly.

This species was introduced to Hawaii in 1966 from Japan for the control of liver fluke snail and successfully propagated and established there (Davis and Krauss, 1967; Yano, 1968 ; Davis and Chong, 1969).

The quantitative data for the role concerning the egg parasites of rice stem borers (Yano, 1968) are required.

**Biology**: Immature stages and biology are referable to Nagatomi and Kushigemachi (1965), Nagatomi and Tanaka (1967), ChannaBasavanna and Yano (1969), and Yano (1975). *Lymnaea ollula* is known as host snails in Japan.

Following two cases of collectings may be worth to mention here though these are not from paddy field. I examined one male specimen attracted to light (Fukuoka, Japan, 5. v. 1969, collected by K. Yasumatsu at the midst of town.). Mochida and Kisimoto (1970) reported two specimens (male and female) of this species caught on ship on the Eastern China Sea (29. vi. 1969) at the location about 160 km from the China continent (about 123 east longitude and 32.5 north latitude). Female of this material was attracted to light trap on ship.

I observed the following behavior of this species on March 27, 1969 at irrigation channel of paddy field in Fukuoka, Fukuoka Pref., Kyushu, Japan. Two adult flies resting on a leaf of *Rumex japonicus* Houttuyn (Polygonaceae) were found at 14 : 02. One of these had pulling up minute amount of sticky milky white substance on the leaf by mouth parts to the level of body, and thrusting its mouth parts to the small amount of substance on the leaf. The fly repeated this movement and milky white substance was never snapped during the work like gum. Another fly on the leaf was resting with some distance without any movement during this period. As the fly stopped the movement at 14 : 05, I swept the leaf and found 1 male and 2 females. One more fly might have been resting near the leaf. The sex of the fly concerned was consequently not known. The substance on the leaf was transparent when it was brought back to laboratory for microscopic examination. Similar but more longer work of ***Sepedon senex*** was observed in Thailand (cf. page 18).

Following feeding habit of this species was observed in Thailand. I found 5 adult flies of this species on a leaf of rice plant at San Pa Tong, northwestern Thailand, on July 24, 1970. These flies were licking a dead earthworm on the leaf. The earthworm was dead but looked fresh and wet enough for licking. This behavior reminds us the mass production technique for this species adopted by the State Department of Agriculture, Hawaii where crushed snails are given to adult flies for food and oviposition.

One male collected from paddy field of Iran (Rasht, 27. ix. 1964, T. Nishida) seems to belong to another species closely allied to sauteri. It is not easy to distinguish these species superficially, but surstylus and fifth sternum are distinctly different (see Figs. 18 and 19). Several specimens of the same data which are not dissected yet seem to belong to this allied species.

## 8. Sepedon (Parasepedon) sp.[1)]

(Fig. 3)

Specimens examined : JAPAN. HONSHU. 33♂♂, 24♀♀, Kasugai, Aichi Pref., 28. viii. 1972, K. Yano; 6♂♂, 9♀♀, Hakuba-mm-a, Nagano Pref., 25. viii. 1972, K. Yano; 16♂♂, 15♀♀, Oomachi, Nagano Pref., 25. viii. 1972, K. Yano; 8♂♂, 3♀♀, Hatamura, Nagano Pref., 27. viii. 1972, K. Yano; 20♂♂, 9♀♀, Asama-onsen, Nagano Pref., 20. vii. 1973, K. Yano. TSUSHIMA. 1♂, 3♀♀, Nii, Shimoagata, 12. x. 1973, K. Yano.

Distribution : Japan* (Honshu and Tsushima).

I have examined 149 specimens which were mainly collected from Nagano and Aichi Prefectures, central Honshu. Four specimens were collected in Tsushima, Kyushu. Judging from the rather intensive collectings made in Kyushu, this species is rare in Kyushu and may common in central Honshu. In Kasugai, Aichi Pref., this species and *S. sauteri* were collected together from the restricted paddy fields.

Biology : I reared this species in giving *Limnaea ollula* for larval food which was abundant in the above paddy fields.

## 9. Sepedon (Parasepedon) plumbella Wiedemann, 1830

(Figs. 20 and 21)

*Sepedon plumbellus* Wiedemann, 1830, Ausser. zweifl. Ins. 2: 577; Brunetti, 1907, Rec. Ind. Mus. 1: 212; Hendel, 1911, Ann. Mus. Nat. Hungarici 9: 267; Nishida and Torii, 1970, IBP Handbook 14: 35 (partim).

*Sepedon (Parasepedon) plumbellus*: Yano, 1968, Mushi 41(15): 193 (partim).

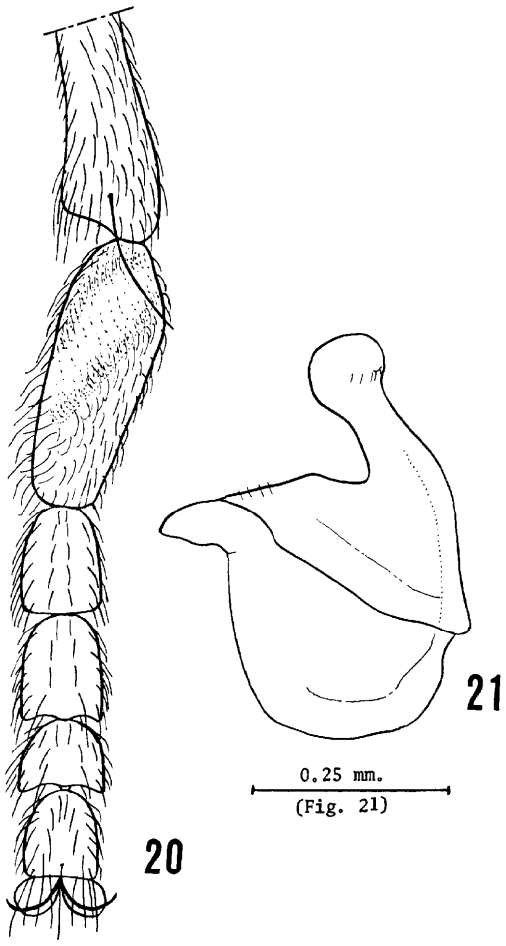
*Sepedon plumbella*: Steyskal and Knutson, 1975, Ann. Ent. Soc. Amer. 68(2): 370, fig. 5.

Specimens examined : SARAWAK. 1♂, Tarat, 35 miles S of Kuching, 17-19. xi. 1964, Y. Hirashima. THAILAND. 56♂, Songquare nr Sanpatong, 4-11. vii. 1970, K. Yano ; 2s♂, San Pa Tong, 17. viii. 1973, K. Yano ; 1♂, Sarapi nr Chieng Mai, 18. vii. 1970, K. Yano ; 1♂, Lampang, 16. vii. 1970, K. Yano ; 1♂, Pan, 14. vii. 1970, K. Yano ; 1♂, Mae Chan, 13. vii. 1970, K. Yano ; 1♂, Bangkhen, 1. ii. 1971, A. Nagatomi. INDIA. 2♂♂, Nuapalli, Bhubaneswar, Orissa, 12. xi. 1963, K. Yasumatsu et K. Yano; 1♂, Hebbal, Bangalore, 7. i. 1970, G. P. Channa-Basavanna.

Distribution : China, Taiwan, Hong Kong, Thailand,* Philippines, Sarawak,* Sumatra, Celebes, New Guinea, Burma, India.*

It has been found by the further studies that the specimens recorded by Yano (1968) under the name of *plumbellus* were not conspecific but mixed with the following species. Following notes on the characters may be helpful for distinguish these species, but it should be checked by further studies including the examinations of the type specimens. Dr. R. Lichtenberg, Naturhistorisches Museum Wien, was so helpful in checking the fore legs of the type specimens of *plumbella* and senex.

[1)] This species is going to be described by Mr. G. C. Steyskal in " Insects of Hawaii" based on the material shipped from Japan to Hawaii for the control of liver fluke snails by the State Department of Agriculture, Hawaii.




Figs. 20 and 21. *Sepedon plumbella*. **20.** Left fore tarsus in dorsal view, male. 21. Surstylus.

Frons of these three species show convenient superficial characters as follows. Frons of *plumbella* is dark brown in color except anterior margin. Those of the following species and senex are more lighter showing yellowish brown except both sides where it is brownish.

Males of this species and the following species have characteristic fore legs helping to distinguish these from senex. Basitarsi of these two species are twisted and the following segments are enlarged. Second and third tarsal segments of fore legs are longer than wide in this species, while shorter in the following species. Fore tarsus of this species is shown in Fig. 20, and that of the following species is shown in Fig. 1 of Yano (1968, p. 194). In senex, fore tarsus is normal as shown in Fig. 2 of Yano (1968). Surstylus of this species is shown in Fig. 21, those of the following species and senex are shown in Figs. 5 and 6 of Yano (1968) respectively. Females of these three species are closely allied each other, and it is not

easy to distinguish them. Genitalic characters of females of these three species show no distinct difference also. Characters of relative length of antennae of *plumbella* and senex presented by Hendel (1911) and of coloration of hind tibia presented by Yano (1968) seem to be not useful to distinguish these species. It is excluded the female record of this species here owing to the above-mentioned reasons.

This species is widely distributed in S. E. Asia according to the published record. It is expected to be found from the paddy fields from these areas.

**Biology :** Unknown.

### 10. **Sepedon (Parasepedon)** sp.

***Sepedon (Parasepedon) plumbellus*:** Yano, 1968, Mushi 41(15): 193 (partim).

Male. Similar to *plumbella* except the following characters. Head with frons yellowish brown, rarely darker at both sides. Basitarsus of fore leg is prominently twisted, and the remaining tarsal segments are enlarged as shown in Fig. 1 of Yano (1968). Surstylus is shown in Fig. 5 of Yano (1968).

**Specimens examined :** RYUKYUS. 2♂♂, 1♀, Hiratabaru, Ishigaki I., 19. x. 1965, T. Nishida. PHILIPPINES. 1♂, Malygaya, Nueva, 25. ix. 1964, K. Yasumatsu; 2♂♂, Laguna, 5. xii. 1963, K. Yasumatsu ; 2♂♂, 1♀, Senery Batangas, Luzon, 14. x. 1965, T. Nishida ; 1♂, Pili, Camarines Sur, 19. ix. 1964, K. Yasumatsu; 2♂♂, 1♀, ditto, 14-15. viii. 1970, K. Yano.

**Distribution :** Ryukyus,* Philippines.*

This species is closely allied to the preceding one, *plumbella*, but is easily separable by the character of male fore tarsus. Judging from the note given by Brunetti (1907), this is also quite different from ***Sepedon*** *javanensis* Rob.-Desv. which has been treated as synonym of *plumbella*. It has not been ascertained, however, the synonymy between this species and ***Sepedon*** *sanguinipes* Brunetti which has been treated as synonym of *plumbella* also, and thus the present species is not named here. The female of this species resembles to those of *plumbella* and senex as mentioned already. It is, however, tentatively recorded here since the female specimens recorded here were collected at the same time together with male specimens.

**Biology :** Unknown.

### 11. **Sepedon (Parasepedon) senex** Wiedemann, 1830

***Sepedon senex*** Wiedemann, 1830, Aussereur. zweifl. Ins. 2 : 578; Hendel, 1911, Ann. Mus. Nat. Hungarici 9: 268 ; Nishida and Torii, 1970, IBP Handbook 14: 35 ; Steyskal and Knutson, 1975, Ann. Ent. Soc. Amer. 68(2); 370, fig. 2.

***Sepedon (Parasepedon) senex*** : Yano, 1968, Mushi 41(15): 194, figs. 2, 4, 6, pl. 4, fig. 3.

**Specimens examined :** HONG KONG. 1♂, Fung Yuen, Tai Po, New Territory, 23-24. iv. 1964, H. A. Bess; 1♂, Man Uk Ping-Ma Tseuk Leug, New Territory, 29. ix, 1964, K. Yasumatsu ; 7♂♂, New Territories, 16. ii. 1971, A. Nagatomi. MALAYA. 8♂♂, Parit Buntar, 12. xi. 1964, Y. Hirashima; 3♂♂, Penang, 12. xi. 1964, Y. Hirashima. THAILAND. 5♂♂, Songquare nr Sanpatong, 6-9. vii. 1970,

K. Yano ; 1♂, Lampoon, 19. vii. 1970, K. Yano ;1♂, San Pa Tong, 13. **i.** 1971, A. Nagatomi ;2♂♂, ditto, 17-24. viii. 1973, K. Yano ;1♂, Mae Rim, 10. xi. 1966, K. Yasumatsu et K. Yano ;1♂, Bangkhen, 5. i. 1971, A. Nagatomi ;5♂♂, ditto, 1. ii. 1971, A. Nagatomi; 1 ♂, Rangsit nr Bangkok, 6. viii. 1970, K. Yano. INDIA. 2♂♂, Mandakalli, Mysore, 19. xi. 1963, K. Yasumatsu et K. Yano.

**Distribution** : Taiwan, Hong Kong,* Thailand,* Sumatra, Malaya,* India.*

Female of this species is not recorded here owing to the reasons mentioned in the note of *plumbella*.

**Biology** : The following behavior of this species was observed in Thailand. I found one male adult fly resting on a graminaceous grass leaf in paddy field preparing for transplanting at Songquare, northwestern Thailand at 11 : 40 on July 8, 1970. The fly directed downward on the leaf had rubbing hind legs, moved abdomen up and down, and had rubbing proboscis by fore legs actively. Milky white foam like substance was soon appeared at labellum, increased its size and became a small mass of about 3 mm in diameter. About 15 minutes had been passed since the beginning until the fly then put the mass on the leaf. The fly worked for the next mass within following 10 minutes taking a rest now and then, and put the next mass on the first one on the leaf. The fly then pecked the mass meanwhile and contracted it by mouthparts and fore legs into about half volume. Then he began to feed and ate all mass. It took about 30 minutes and a fraction from the start of the observation. Earlier stages and host snails are unknown.

### 12. **Sepedon (Parasepedon) ferruginosa** Wiedemann, 1824

(Figs. 22 and 23)

*Sepedon ferruginosus* Wiedemann, 1824, Anal. entomol. : 56, 137; Brunetti, 1907, Rec. Ind. Mus. 1: 215 ; Hendel, 1911, Ann. Mus. Nat. Hungarici 9: 272; Nishida and Torii, 1970, IBP Handbook 14: 35.

***Sepedon (Parasepedon) ferruginosus*** : Yano, 1968, Mushi 41(15): 195, fig. 7 (partim).

***Sepedon ferruginosa*** : Steyskal and Knutson, 1975, Ann. Ent. Soc. Amer. 68(2): 370.

**Specimens examined** : In addition to the material recorded by Yano (1968), following specimens have examined.

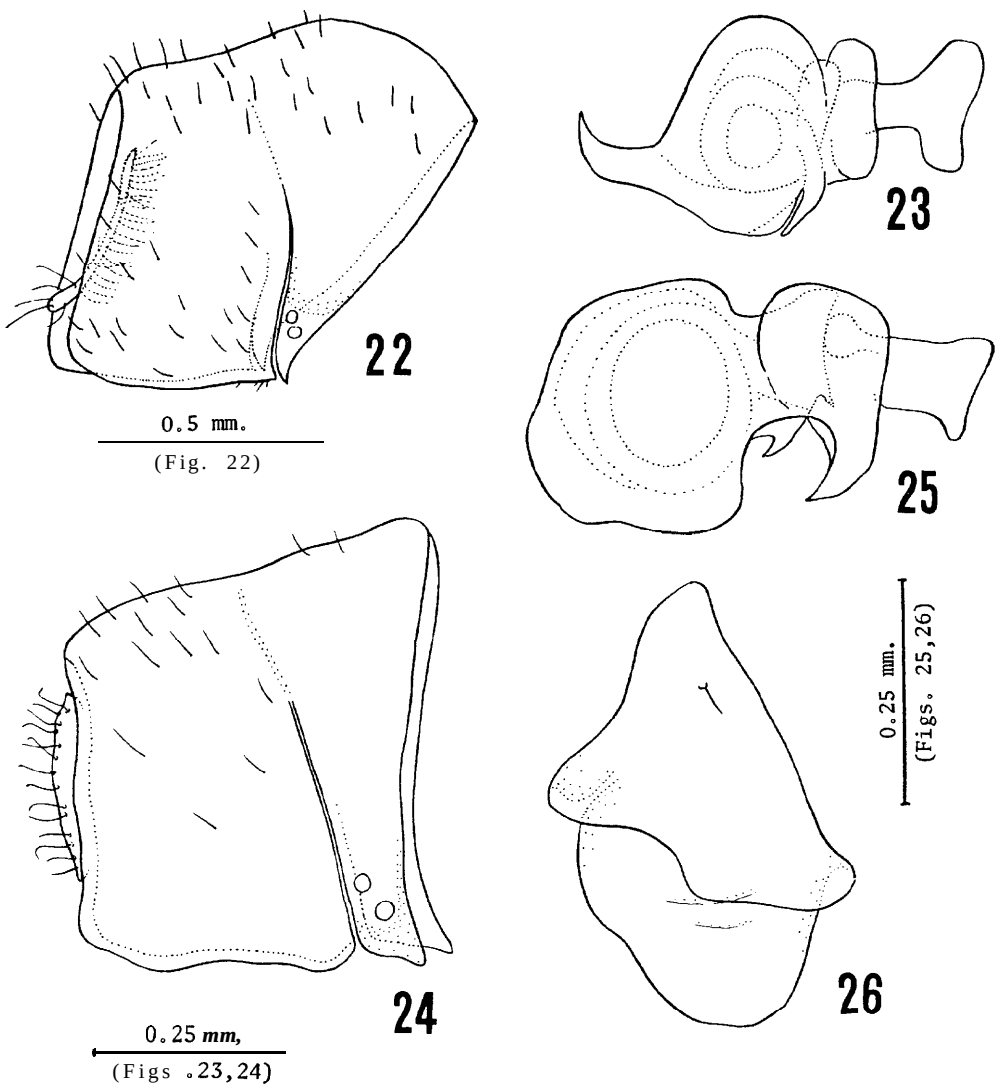
THAILAND. 2♂♂, **2** ♀♀, Sanpatong, 10. vii. 1970, K. Yano ;18♂♂, 13 ♀♀, ditto, 21. vii. 1970, K. Yano; 4♂♂, 4 ♀♀, ditto, 17. viii. 1973, K. Yano ;1♂, Mae Rim nr Chieng Mai, 3. vii. 1970, K. Yano ;14♂♂, 13 ♀♀, Songquare nr Sanpatong, 4-11. vii. 1970, K. Yano ;4♂♂, 3 ♀♀, Sarapi nr Chieng Mai, 18. vii. 1970, K. Yano; 1♂, Mae Chan, 13. vii, 1970, K. Yano ;2♂♂, 1 ♀, Pan, 14. vii. 1970, K. Yano ; 1 ♀, Lampoon, 17. vii. 1970, K. Yano ;1 ♀, Rangsit nr Bangkok, 6. viii. 1970, K. Yano.

**Distribution** : Philippines, Thailand*, Burma, Nepal,* India*, Pakistan.*

As the specimens recorded from Taiwan by Yano (1968) are not this species but *lobifera* (cf. page 20), there is no specimens available from Taiwan.

This species is variable in coloration. Thorax is dark to pale brown dorsally, and distal two-thirds of femur (especially hind leg) is reddish to not reddish.

The closely allied one to this species is distributed in southern India. Through the courtesy of Dr. G. P. ChannaBasavanna, I have examined one male and one




Figs. 22 and 23. ***Sepedon ferruginosa. 22.*** Postabdomen, lateral view. 23. Aedeagus.
Figs. 24-26. *Sepedon* **sp.** nr ***ferruginosa.*** 24. Postabdomen, lateral view. 25. Aedeagus. 26. Surstylus.

female specimens collected at Hebbal, Bangalore on January 12, 1970. Postabdomen, surstylus and aedeagus (Figs. 24-26) are distinctly different from those of ***ferruginosa*** (Figs. 22, 23 and fig. 7 of Yano, 1968). It is required to study further about this species based on more specimens.

**Biology :** Unknown.

### 13. Sepedon (Parasepedon) lobifera Hendel, 1911

(Fig. 4)

*Sepedon lobiferus* Hendel, 1911, Ann. Mus. Nat. Hungarici 9: 271; Momoi et a?., 1975, JIBP Synthesis 7: 80.
*Sepedon lobifera*: Steyskal and Knutson, 1975, Ann. Ent. Soc. Amer. 68(2): 370.
*Sepedon (Parasepedon) ferruginosus*: Yano (nec Wiedemann), 1968, Mushi 41(15): 195, fig. 7 (partim).

**Specimens examined :** TAIWAN. 1♀, Yuching, Tainan Hsien, 17. iii. 1966, K. Yano et H. Kajita; 1♂, 5♀♀, ditto, 21. iii. 1966, K. Yano et H. Kajita. PAKISTAN. 2♀♀, Mansehra, Rawalpindi, 19. ix. 1964, T. Nishida ; 2♀♀, Malakand – Saidu Sharif, Swat, 25. x. 1963, K. Yasumatsu et K. Yano.

**Distribution :** Taiwan,* Hong Kong, Thailand, Pakistan.*

This species was originally described from Taiwan based on five specimens in 1911 and was listed from paddy field for the first time in 1975 without data of material (Momoi ***et al., 1975).*** The above record in 1975 was based on the present specimens examined here. Besides the above mentioned material, I have found the following specimens in the collection of Kyushu University : Hong Kong, 4♂♂, Pakkong, 22. iv. 1965, T. Saigusa; Thailand, 1♂, Mae Klang, Chiang Mai, 11. vi. 1965, Y. Miyatake. These specimens were collected from natural vegetation in the course of the Japan-U.S. Co-operative Science Program.

So far as the field observations done before, this species seems to be not common but rare in paddy fields. From Yuching, Taiwan, where the present specimens were collected, rather many specimens of ***Sepedon sauteri*** were also collected (Yano, 1968).

This species is closely allied to ***ferruginosa,*** but may be separable by having the following characters. Larger body size (body length : 7-10 mm in this species, 6-7 mm in ***ferruginosa)*** ; second and third tarsal segments of male fore leg is wider than length, while longer than width in ***ferruginosa;*** black frontal spots usually larger than those in ***ferruginosa.***

***I*** recorded six specimens of this species from Yuching, Taiwan, under the name of ***ferruginosus*** erroneously in 1968.

**Biology :** Unknown.

### 14. Sepedomerus macropus (Walker, 1849)

*Sepedon macropus* Walker, 1849, List Dipt. Ins. Coll. Brit. Mus. 4: 1078 ; Steyskal, 1950, Wasm. J. Biol. 8(3): 276, pl. 5, fig. 24; Neff and Berg, 1966, Bull. Agr. Exp. St. Virginia Polytech. Inst. 566: 38, figs. 4, 56, 57; Nishida and Torii, 1970, IBP Handbook 14 : 13.
*Sepedon (Parasepedon)* macropus: Yano, 1968, Mushi 41(15): 193.
*Sepedomerus macropus*: Steyskal, 1973, Ent. News 84(5): 144.

**Distribution** : N. C. & S. America, Hawaii (introduced).

No additional specimens have been examined since Yano (1968). As there is actually no paddy fields in Hawaii where this species is distributed, and no specimens have been collected from Asian paddy fields, it may be safe to exclude this species from the paddy dwelling species of Asia.

**Table 1.** Distribution list of the paddy field Sciomyzidae of Asia based on the collected specimens.[1)]

| Species \ Locality | Japan | | | | | | | | | | | | | | | | | | | | | Others[2)] |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Hokkaido | Honshu | Shikoku | Kyushu | Tsushima | Ryukyus | Korea | China | Taiwan | Hong Kong | Philippines | Sabah | Sarawak | Malaya | Thailand | Bangladesh | India | Nepal | Pakistan | Iran | |
| *Knutsonia albiseta* | | | | | | | | | | | | | | | | | | | | ● | Europe to Turkey |
| *Limnia japonica* | | × | | ● | | | | | | | | | | | | | | | | | |
| *Limnia setosa* | | × | | | | | | | | | | | | | | | | | | | |
| *Psacadina zernyi* | | | | | | | | | | | | | | | | | | | | ● | Europe |
| *Pherbina intermedia* | ● | | | | | | | | | | | | | | | | | | | | Europe, China |
| *Pherbina coryleti* | | | | | | | | | | | | | | | | | | | | ● | Europe, C. Asia to Afghanistan |
| *Sepedon sauteri* | × | × | | ● | × | ● | | | ● | ● | ● | | | | ● | | ● | ● | × | | China, Hawaii (introduced) |
| *Sepedon* sp. | | × | | | × | | | | | | | | | | | | | | | | |
| *Sepedon plumbella* | | | | | | | | | | | | | ● | | ● | | × | | | | S. E. Asia |
| *Sepedon* sp. nr *plumbella* | | | | | | ● | | | | | ● | | | | | | | | | | |
| *Sepedon senex* | | | | | | | | | | ● | | | | ● | × | | × | | | | Taiwan, Sumatra |
| *Sepedon ferruginosa* | | | | | | | | | | | | | | | × | | × | ● | × | | Philippines, Burma |
| *Sepedon lobifera* | | | | | | | | | ● | | | | | | | | | | × | | Hong Kong, Thailand |
| *Tetanocera arrogans* | ● | | | | | | | | | | | | | | | | | | | | Europe to Turkey, Siberia |
| *Tetanocera* sp. | | | | | ● | | | | | | | | | | | | | | | | |
| Number of species | 3 | 4 | 1 | 2 | 3 | 2 | | | 2 | 2 | 2 | | 1 | 1 | 4 | 1 | 4 | 2 | 3 | 3 | |
| | 8 | | | | | | | | | | | | | | | | | | | | |

[1)] *Sepedomerus macropus* is excluded (cf. page 20).

[2)] From published record other than paddy field.

**Biology:** Immature stages and biology are referable to Neff and Berg (1966).

## 15. **Tetanocera arrogans** Meigen, 1830

(Fig. 5)

***Tetanocera arrogans*** Meigen, 1830, Syst. Beschr. 6: 41; Verbeke, 1964, Bull. Inst. r. Sci. nat. Belg. 40(8): ***14, fig. 3;*** Knutson and Berg, 1971, Norsk. Ent. Tidssk. 18(2): 129.

**Specimens examined** : JAPAN. 2♂♂, 1♀, Sapporo, Hokkaido, 24. vi. 1965, K. Kusigemati; **1** ♀, ditto, 23. viii. 1965, K. Kusigemati ; 1♀, ditto, 28. viii. 1965, K. Kusigemati ; 3♂♂, **2** ♀♀, Hiroshima, Sapporo-gun, Hokkaido, 24. viii. 1976, K. Yano.

**Distribution** : Europe to Turkey, Siberia, Japan* (Hokkaido).

This widely distributed species has recorded here for the first time from paddy fields and from Japan. The Japanese specimens examined here are larger than those of Europe, but it is identical in other characters.

**Biology** Immature stages and biology are referable to Rozkošný (1965, 1967) and Beaver (1972). *Succinea* is known as the host snails of this species.

## 16. **Tetanocera** sp.

**Specimen examined :** JAPAN. 1 ♂, Nii, Shimoagata, Tsushima, Kyushu, 2. x. 1975, K. Yano.

This specimen resembles superficially to the Holarctic species, 7'. *robusta* Loew, 1847, but it is distinguished from the latter species by having no protuberance on the epandrium in male. It is required to obtain more material for naming of this species.

The distribution areas of the present species are listed in Table 1. Following key to the species from paddy fields is based on those mentioned in Knutson and Lyneborg (1965), Nishida and Torii (1970) and Momoi *et al.* (1975).

### KEY TO THE SPECIES FROM PADDY FIELDS IN ASIA[1)]

1. Ocellar setae present ..... 2
– Ocellar setae absent ..... 8
2. Hind tibiae with 2 dorsal, preapical setae ..... **Tetanocera arrogans**
– Hind tibiae with 1 dorsal, preapical seta ..... 3
3. Subalar setae present ..... 4
– Subalar setae absent. ..... **Psacadin a zernyi**
4. Wing with more or less distinct reticulate pattern ..... 5
– Wing without reticulate pattern, but with few isolated spots.. ..... **Knutsonia albiseta**
5. Arista with long, dark hairs ..... 6
– Arista with short, whitish hairs ..... 7
6. Wing with rather distinct reticulate pattern of brown spots, especially in cell $M_4$; thorax broadly but distinctly striped on scutellum ; surstylus of male genitalia without tuft of black setae ..... **Pherbina intermedia**

[1)] ***Tetanocera*** sp. is excluded from this key.

Wing with less distinct reticulate pattern of brown spots, especially in cell $M_4$; thorax less distinctly striped on scutellum ; surstylus of male genitalia with prominent tuft of black setae ..... **Pherbina coryleti**

7. Thorax dark grey in ground color; frons+ vertex longer than width of frons; wing length 6-6.5 mm .....**Limnia japonica sp. nov.**
   Thorax pale brown to pale brownish grey in ground color ; frons+vertex shorter than width of frons; wing length 4.5-6 mm .....**Limnia setosa sp. nov.**
8. Head bluish black without spots .....**Sepedon sauteri**
   Head light brown at least partially, with or without spots ..... 9
9. Head with black spots on frons or on face .....12
   Head without spots ..... 10
10. Basitarsus of fore leg distinctly twisted in male .....11
    Basitarsus of fore leg normal, not twisted in male ..... **Sepedon senex**
11. Second and third tarsal segments of fore leg in male longer than wide ..... **Sepedon plumbella**
    Second and third tarsal segments of fore leg in male shorter than wide ..... .....**Sepedon** sp. nr **plumbella**
12. Face with a pair of black spots .....**Sepedon sp.**
    Face without black spots ..... 13
13. Head with a pair of rather small spots on frons; tarsal segment of fore leg normal in male. Wing length 5.3-6 mm ..... **Sepedon f erruginosa**
    Head with a pair of long and large spots on frons; second to fifth tarsal segments of fore leg distinctly expanded in male; wing length 6.5-8 mm ..... ..... **Sepedon lobifera**

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