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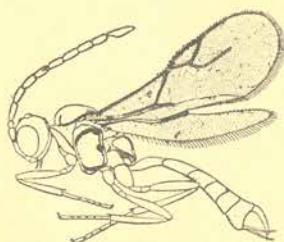
May 1, 1969

**HYMENOPTEROUS PARASITES OF CITRUS  
TOBACCO AND VEGETABLE APHIDS IN TAIWAN**

By

SHUI-CHEN CHIU & CHING-SHEN LIU

Report of Project A6-ENT-4, USDA under a Public Law 480 Grant



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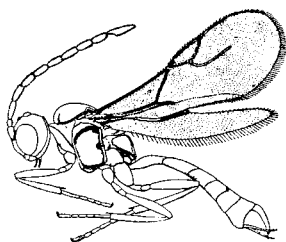
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# HYMENOPTEROUS PARASITES OF CITRUS TOBACCO AND VEGETABLE APHIDS IN TAIWAN<sup>(1)</sup>

SHUI-CHEN CHIU & CHING-SHEN LIU<sup>(2)</sup>

(Taiwan Agricultural Research Institute)

## Introduction

Since 1965, our institute has developed a field survey of the natural enemies of citrus, tobacco and vegetable aphids. The collecting areas are around Taipei city and its suburban areas, and a few trips were made to the mountain areas of Li-shan (1945 m.) and Shen-kwang (1500 m.) in the central part of Taiwan.

As a result of the four-year field survey in Taipei area, 12 species of hymenopterous parasites attacking aphids on citrus, tobacco and vegetable are reported in this paper. The parasites, *Aphidius gifuensis* Ashmead of the green peach aphid (*Myzus persicae* Sulzer) and *Binodoxys communis* (Gahan) of the cotton aphid (*Aphis gossypii* Glover) seem to be the most effective ones, so our research work has emphasized the parasites of these two aphids.

Six genera of Aphidiidae (*Aphidius*, *Binodoxys*, *Diaeretiella*, *Ephedrus*, *Lipolexis* and *Lysiphlebia*) and one genus of Aphelinidae (*Aphelinus*) were investigated. All parasites are evidently solitary endoparasites of Aphidinae. The *Aphelinus* parasites are rather difficult to identify, even after many attempts to name them. *Aphidius gifuensis* Ashmead, a parasite of the green peach aphids and *Binodoxys communis* (Gahan) of the cotton aphid are both very specific in host selection, *Ephedrus plagiator* (Nees) and *Lipolexis gracilis* Förster are not.

## Acknowledgments

This research was conducted with the financial assistance of the United States Department of Agriculture under a Public Law 480 Grant, for which the writers wish to express their sincere thanks.

The writers are also indebted to Misses Y. Y. Kuo and H. Y. Wu for their assistance during the course of study; to Messrs. K. H. Chang, H. H. Tseng and S. H. Lin for assisting in field survey during different periods; to Mr. K. C. Wu for making part of drawings in this paper; to Drs. P. Starý and M. Mackauer for their kindness in favoring us with their valuable papers of Aphidiidae; to Dr. H. K. Townes for reading and criticizing the manuscript; to Dr. S. C. Hsu, director of the institute, and Mr. C. C. Tao for their arrangements to make this study possible.

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(1) First report on the aphid parasites of project No. A6-ENT-4, USDA.

(2) Senior entomologist (Head of Department of Applied Zoology) and junior entomologist respectively.

I. List of citrus, tobacco and vegetable aphids and their parasites in Taiwan.

1. *Acyrtosiphon pisum* (Harris)<sup>7,13</sup>  
*Ephedrus* (*E.*) *plagiator* (Nees)
2. *Aphis gossypii* Glover<sup>7,13</sup>  
\**Aphelinus mali* (Haldeman)  
\**Binodoxys communis* (Gahan)  
\**Binodoxys indicus* Subba Rao and Sharma.  
*Ephedrus* (*E.*) *persicae* Froggatt  
*Ephedrus* (*E.*) *plagiator* (Nees)  
\**Lipolexis gracilis* Förster  
\**Lysiphlebia japonica* (Ashmead)
3. *Aphis spiraecola* Patch<sup>7,13</sup>  
*Aphelinus mali* (Haldeman)  
\**Ephedrus* (*E.*) *plagiator* (Nees)  
\**Ephedrus* (*E.*) *robustus* Liu  
\**Lipolexis gracilis* Förster  
*Lipolexis scutellaris* Mackauer
4. *Brevicoryne brassicae* Lin. <sup>6,7,13</sup>  
\**Diaeretiella rapae* (MacIntosh)
5. *Lipaphis erysimi* Kalt.  
*Aphidius gifuensis* Ashmead  
*Diaeretiella rapae* (MacIntosh)  
*Ephedrus* (*E.*) *persicae* Froggatt
6. *Myzus persicae* Sulzer<sup>1,7,13,15,17</sup>  
\**Aphidius gifuensis* Ashmead  
*Diaeretiella rapae* (MacIntosh)  
\**Ephedrus* (*E.*) *persicae* Froggatt  
*Ephedrus* (*E.*) *plagiator* (Nees)
7. *Sinomegoura citricola* (V. d. Goot)<sup>7,13</sup>  
\**Ephedrus* (*E.*) *plagiator* (Nees)  
*Binodoxys struma* (Gahan)
8. *Toxoptera aurantii* (Boyer de F.)<sup>7,13</sup>  
*Ephedrus* (*E.*) *plagiator* (Nees)  
*Lipolexis gracilis* Förster  
*Aphelinus mali* (Haldeman)
9. *Toxoptera citricidus* (Kirkaldy)  
*Lipolexis scutellaris* Mackauer
10. *Toxoptera odinae* V. d. Goot<sup>7,13</sup>  
*Ephedrus* (*E.*) *plagiator* (Nees)  
\**Lysiphlebia japonica* (Ashmead)

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\* Important parasites of the aphid.

## II. List of twelve hymenopterous parasites of aphids attacking citrus, tobacco, vegetable and other host plants.

### 1. *Aphelinus mali* (Haldeman)—Aphelinidae, Chalcidoidea.

Host aphids: *Aphis gossypii* Glover on *Hibiscus* sp., *Colocasia esculenta* Schott. *Luffa cylindrica* Roem. and *Psidium guajava* Linn.; *Myzus persicae* Sulzer on *Brassica* sp., *Brassica oleracea* Linn. (cabbage), *Prunus persicae* Batsch. (peach) and *Capsicum annuum* Linn. (sweet pepper); *Toxoptera aurantii* (Boyer de F.) on *Citrus* sp.

Distribution: Cosmopolitan.

### 2. *Aphidius gifuensis* Ashmead<sup>1,7,12,13,15,16</sup> (Fig. 18)

Host aphids: *Capitophorus* sp. on unknown plant; *Macrosiphum rosaeibarae* Mats. on *Rosa* sp.; *Lipaphis erysimi* Kalt. on *Brassica cernua* Forbes et Hemsl. (mustard) and *Brassica pekinensis* Rupr. (paitsai); *Myzus persicae* Sulzer on *Brassica* sp., *Raphanus sativus* Linn. (radish), *Prunus persicae* Batsch. (peach), *Lysopersicum esculatum* Mill. (tomato), *Brassica campestris* Linn. (rape green), *Brassica oleracea* Linn. (cabbage), *Brassica pekinensis* Rupr. (paitsai), *Capsicum annuum* Linn. (sweet pepper), *Solanum nigrum* Linn. (eggplant) and *Chrysanthemum coronarium* Linn.

Distribution: Taiwan, South Korea, Japan and Hawaii.

### 3. *Diaeretiella rapae* (MacIntosh)<sup>5,7,11,13,15</sup> (Fig. 19)

Host aphids: *Brevicoryne brassicae* Linn. on *Brassica oleracea* Linn. and *Brassica rapa* Linn.; *Lipaphis erysimi* Kalt. on *Brassica cernua* Forbes et Hemsl. and *Myzus persicae* Sulzer on *Brassica pekinensis* Rupr. and *Brassica* sp.

Distribution: Cosmopolitan.

### 4. *Lysiphlebia japonica* Ashmead<sup>1,7,13,15,16</sup> (Fig. 20)

Host aphids: *Aphis gossypii* Glover on *Hibiscus* sp., *Colocasia esculenta* Schott. and *Psidium guajava* Linn. (guava); *Aphis spiraeicola* Patch on *Citrus* sp.; *Longiunguis sacchari* Zehn. on *Holcus sorghum* Linn. (sorghum); *Aphis laburni* Kalt. and *Toxoptera odinae* V. d. Goot on unknown plants.

Distribution: Taiwan, Hongkong, South Korea and Japan.

### 5. *Ephedrus* (*E.*) *persicae* Froggatt<sup>5,7,9,11,12,16</sup> (Fig. 21)

Host aphids: *Aphis gossypii* Glover on *Chrysanthemum* sp. and *Hibiscus*

sp.; *Aphis spiraeicola* Patch on *Spiraea cantonensis* Lour.; *Hyalopterus arundinis* Fab. on *Prunus persicae* Batsch.; *Lipaphis erysimi* Kalt. on *Brassica* sp.; *Myzus persicae* Sulzer on *Brassica* sp. and *Hibiscus* sp.; *Tinocallis ulmi-parvifoliae* Tak. on *Ulmus* sp.

Distribution: Cosmopolitan.

6. *Ephedrus* (*E.*) *plagiator* (Nees)<sup>3,7,9,11,12,13,15,16</sup> (Fig. 22)

Host aphids: *Aphis gossypii* Glover on *Citrus* sp.; *Aphis spiraeicola* Patch on *Spiraea* sp.; *Hyperomyzus lactucae* Linn. on *Lactuca sativa* Linn. and *Sonchus* sp.; *Macrosiphum rosaeibarae* Mats. on *Rosa* sp. and *Sinomegoura citricola* (V. d. Goot) on *Murrata paniculata* Jack.; *Myzus persicae* Sulzer on *Nicotiana* sp. and *Brassica* sp.; *Toxoptera odinae* V. d. Goot on *Viburnum suspensum* Lindley; *Acyrtosiphon pisum* Harris on *Medicago sativa* Linn. (alfalfa).

Distribution: Taiwan, Europe, and Japan.

7. *Ephedrus* (*E.*) *robustus* Liu<sup>3</sup> (Fig. 23)

Host aphids: *Aphis spiraeicola* Patch on *Citrus* sp.; *Longiunguis sacchari* (Zehntner) on *Holcus sorghum* Linn. (sorghum).

Distribution: Taiwan.

8. *Binodoxys communis* (Gahan)<sup>2,7,13</sup> (Fig. 24)

Host aphids: *Aphis gossypii* Glover on *Hibiscus* sp., *Colocasia esculenta* Schott., *Luffa cylindrica* Roem. and *Psidium guajava* Linn. (guava).

Distribution: Taiwan.

9. *Binodoxys indicus* Subba Rao & Sharma<sup>7,13,14</sup>

Host aphids: *Aphis gossypii* Glover on *Hibiscus* sp.

Distribution: Taiwan and India.

10. *Binodoxys struma* (Gahan)<sup>2,7,13</sup> (Fig. 25)

Host aphids: *Sinomegoura citricola* (V. d. Goot) on *Cinnamomum camphora* Sieb. (camphor) and *Citrus* sp.

Distribution: Taiwan.

11. *Lipolexis gracilis* Förster<sup>7,8,12,13,16</sup> (Fig. 26)

Host aphids: *Aphis gossypii* Glover on *Hibiscus* sp., *Colocasia esculenta* Schott., *Luffa cylindrica* Roem. and *Psidium guajava* Linn.; *Myzus persicae* Sulzer on *Brassica* sp., *Raphanus sativus* Linn. (radish), *Prunus persicae* Batsch. (Peach), *Lycopersicon esculentum* Mill. (tomato), *Brassica*

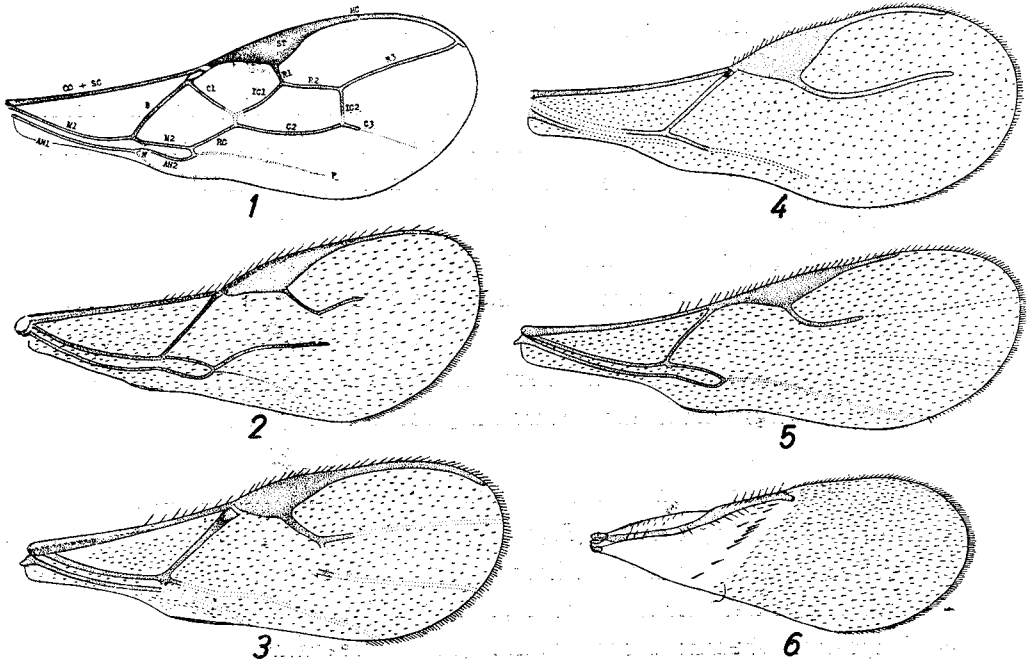
*campestris* Linn. (rape-green); *Aphis spiraeicola* Patch and *Toxoptera aurantii* (Boyer de F.) on *Citrus* sp.

Distribution: Orient and Europe.

12. *Lipolexis scutellaris* Mackauer<sup>4,7,13</sup> (Fig. 27)

Host aphids: *Aphis laburni* Kalt. on beans; *Aphis spiraeicola* Patch, *Toxoptera aurantii* (Boyer de F.) and *Toxoptera citricidus* (Kirk.) on *Citrus* sp.

Distribution: Taiwan and Hongkong.



Figs. 1-6. Fore wing: 1. *Ephedrus (E.) plagiator*, Anal (AN), [Basal (B), Cubitus (C), Costa (CO), Intercubitus (IC), Median (M), Metacarpus (MC), Nervulus (N), Parallel (P), Radius (R), Recurrent (RC), Subcosta (SC), Stigma (ST); 2. *Aphidius gifuensis*; 3. *Lysiphlebia japonica*; 4. *Lipolexis gracilis*; 5. *Diaeretiella rapae*; 6. *Aphelinus mali*.

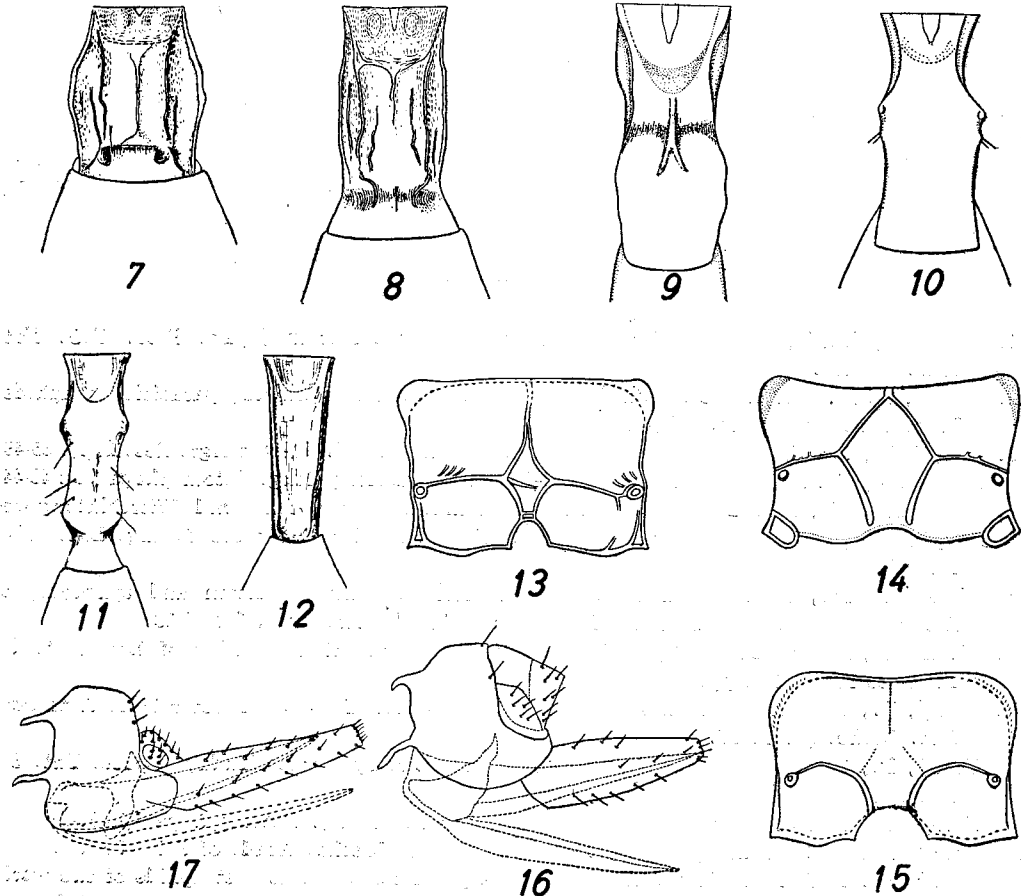
III. Key to the hymenopterous parasites of citrus, tobacco and vegetable aphids in Taiwan.

1. Fore wing (Fig. 6) venation very reduced, radius absent; thorax depressed; antenna geniculate; abdomen indistinctly petiolate... *Aphelinus mali* Hald.
- Fore wing (Figs. 1-5) venation not very reduced, radius always present; thorax not depressed; antenna filiform; abdomen distinctly petiolate... 2
2. Fore wing (Fig. 1) with first and second intercubitus present; antenna 11-segmented in both sexes; ovipositor sheaths long and almost straight ..... 3

- Fore wing (Fig. 2) with first and second intercubitus absent; antenna with more than 11 segments; ovipositor sheaths stout, or long and curved downwards ..... 5
- 3. Mesoscutum at the confluent point of notauli with a distinct and deep fovea; abdominal tergite I (Fig. 7) broad, only slightly longer than its width ..... *Ephedrus (E.) persicae* Froggatt
- Mesoscutum without any fovea at the confluent point of notauli; abdominal tergite I (Fig. 8) at least twice as long as its width ..... 4
- 4. Ovipositor sheaths (Fig. 16) a little stout, gradually narrowing towards apex, about 3.0 as long as wide at middle ..... *Ephedrus (E.) robustus* Liu
- Ovipositor sheaths (Fig. 17) slender and straight, about 4.0 as long as wide at middle ..... *Ephedrus (E.) plagiator* (Nees)
- 5. Fore wing (Fig. 2) with entirely distinct recurrent vein, second discocubital cell completely closed; antennal segments 16-18 in female; first and second radial abscissae about equal in length; metacarpus almost as long as pterostigma ..... *Aphidius gifuensis* Ashmead
- Fore wing (Figs. 3-5) with recurrent vein entirely effaced, second discocubital cell open below; antennal segments less than 16 in female; first radial abscissa longer than second radial abscissa, or the latter one absent ..... 6
- 6. Part of cubitus and second intercubitus present; propodeum with extremely weak, longitudinal and bifurcating carinae. (Fig. 15) ..... *Lysiphlebia japonica* Ashmead
- Cubitus and second intercubitus absent; propodeum with distinct, longitudinal and bifurcating carinae (Figs. 13-14) ..... 7
- 7. Last abdominal sternite without prongs in female ..... 8
- Last abdominal sternite with 2 prongs in female ..... 10
- 8. Ovipositor sheaths stout; radius (Fig. 5) reaching about to middle of metacarpus; areola (Fig. 13) narrow and small ..... *Diasretiella rapae* MacIntosh
- Ovipositor sheaths slender and curved downwards; radius (Fig. 4) reaching apex of metacarpus; areola (Fig. 14) broad ..... 9
- 9. Abdominal tergite I (Fig. 9) with distinctly and strongly bifurcating central carina; body mostly dark brown ..... *Lipolexis gracilis* Förster
- Abdominal tergite I (Fig. 12) without bifurcating central carina; body mostly yellowish ..... *Lipolexis scutellaris* Mackauer
- 10. Distance between primary and secondary tubercles of abdominal tergite I (Fig. 10) shorter than width at spiracles, the tergite with only two hairs behind second tubercles ..... *Binodoxys communis* (Gahan)
- Distance between primary and secondary tubercles of abdominal tergite I (Fig. 11) longer than width at spiracles, the tergite with sparse hairs all over ..... 11



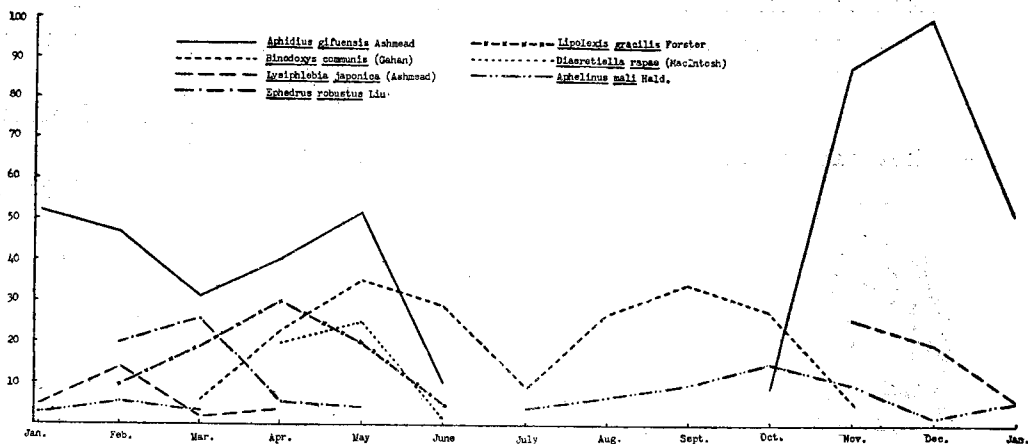
- 11. Head and thorax entirely brownish, only areas adjacent to mouthparts, and sometimes also prothorax and propodeum, yellowish brown; prongs with 4 long hairs .....  
 .....*Binodoxys indicus* Subba Rao and Sharma
- Head and thorax mostly yellow; prongs with 5 long hairs.....  
 .....*Binodoxys struma* (Gahan)



Figs. 7-17: First tergite (7-12)—7. *Ephedrus (E.) persicae*, 8. *Ephedrus (E.) robustus*, 9. *Lipolexis gracilis*, 10. *Binodoxys communis*, 11. *Binodoxys struma*, 12. *Lipolexis scutellaris*; Propodeum (13-15)—13. *Diaeretiella rapae*, 14. *Lipolexis gracilis*, 15. *Lysiphlebia japonica*; ♀ genitalia (16-17)—16. *Ephedrus (E.) robustus*, 17. *Ephedrus (E.) plagiator*.

**IV. Monthly occurrence of three aphids and their parasites in Taipei area.**

The tropical environment seems to have a similar influence on both the parasites and the aphids. The data on the monthly occurrence of seven aphid parasites have been accumulated in the past four years by means of field collecting and observations. The following illustrations show only the major parasites of the green peach aphid, cotton aphid and Spiraea aphid recorded in Taiwan.



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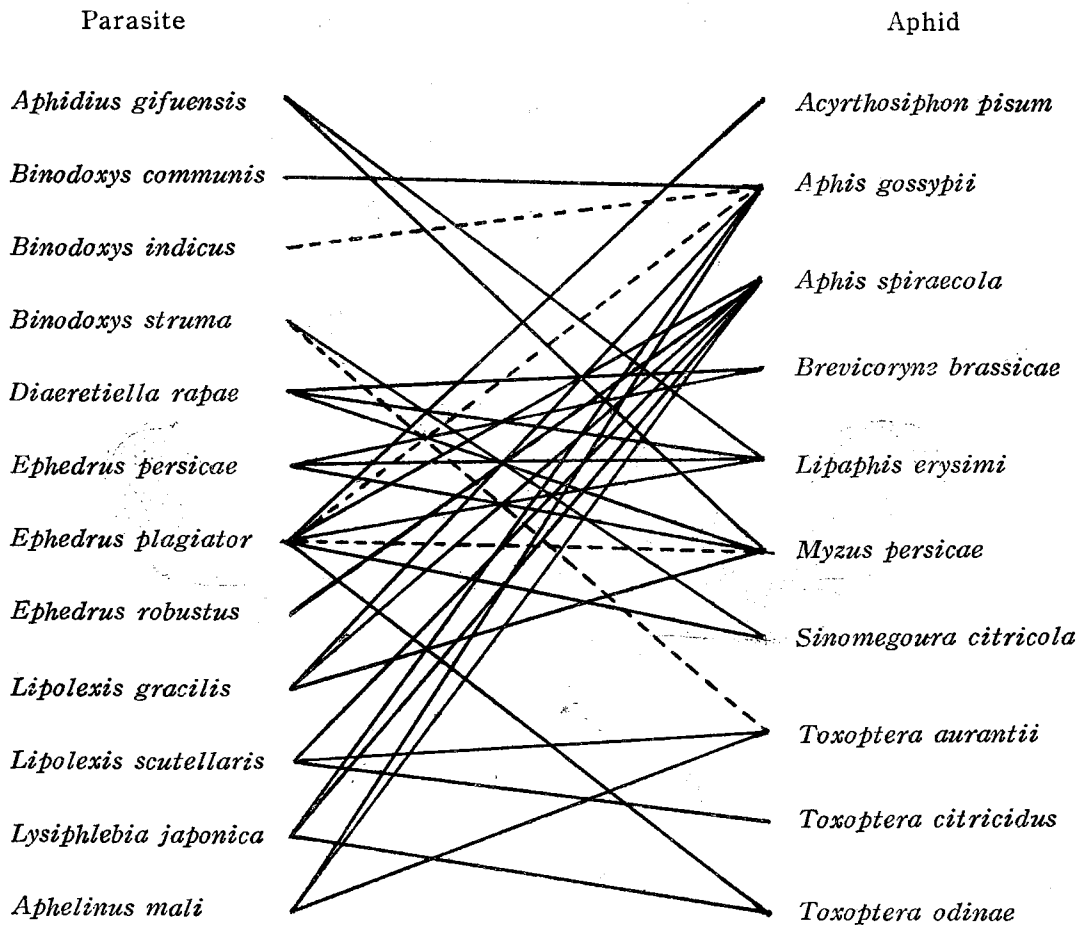
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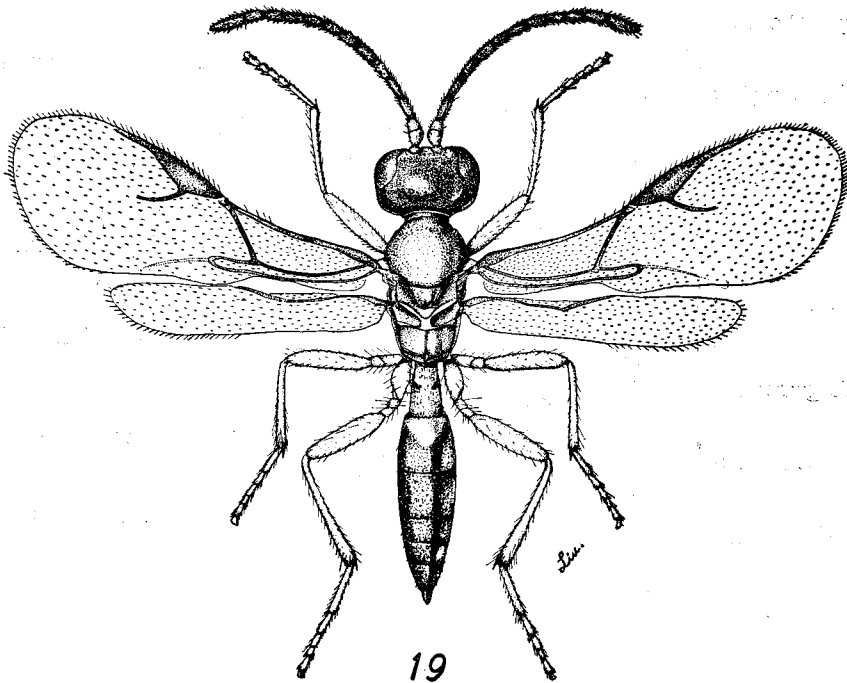
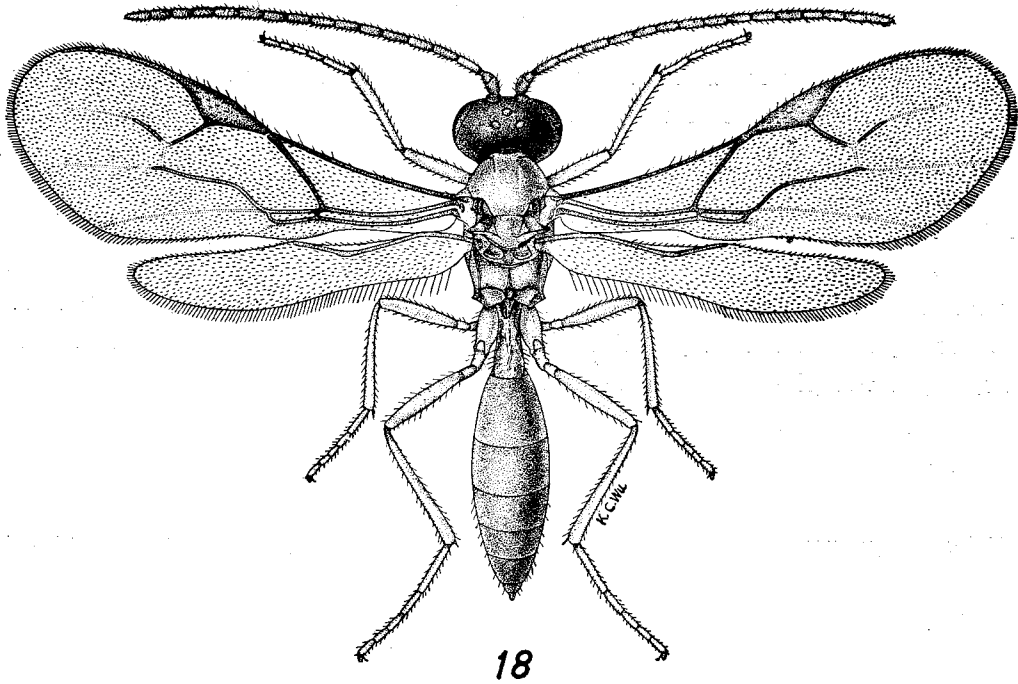
Summary

This report covers the results of a four-year field survey on the parasites of citrus, tobacco and vegetable aphids in Taiwan during 1965-1968.

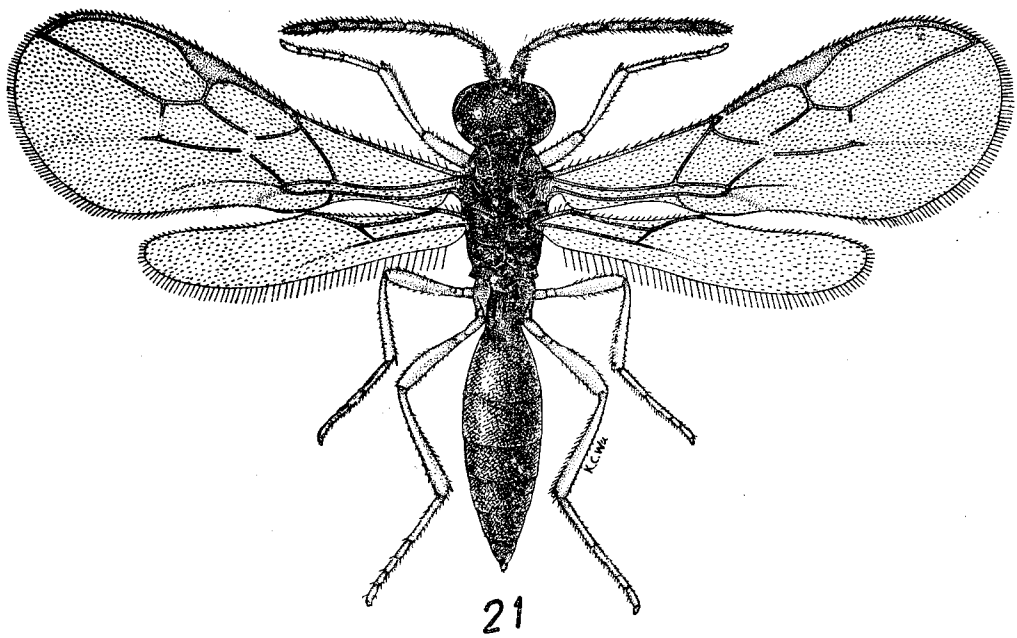
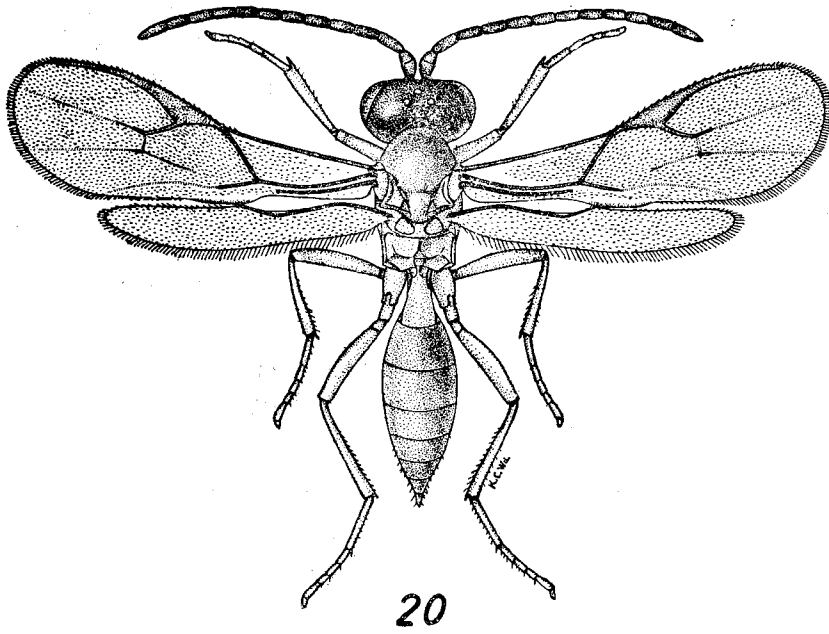
The areas of field survey are around Taipei city and Taipei district, plus a few trips made to the mountain areas of Li-shan (1945 m.) and Shen-kwang (1500 m.) in the central part of this island.

Ten species of citrus, tobacco and vegetable aphids and 12 species of hymenopterous parasites are treated in this paper. The relationships between the host aphids and their parasites are illustrated in the following diagram (solid line, major parasite; broken line, minor parasite).

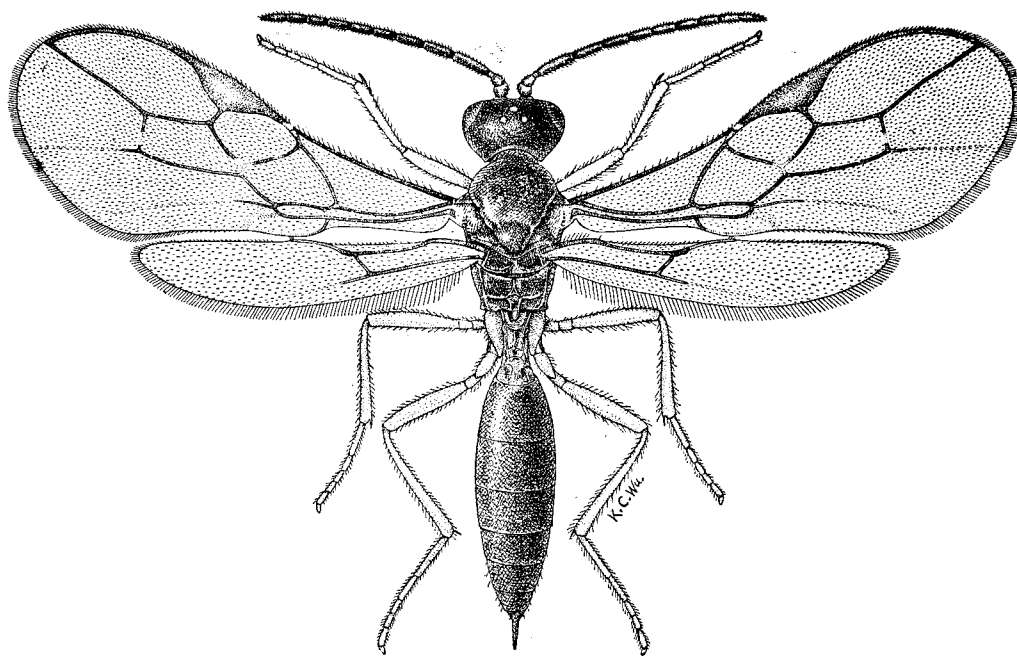




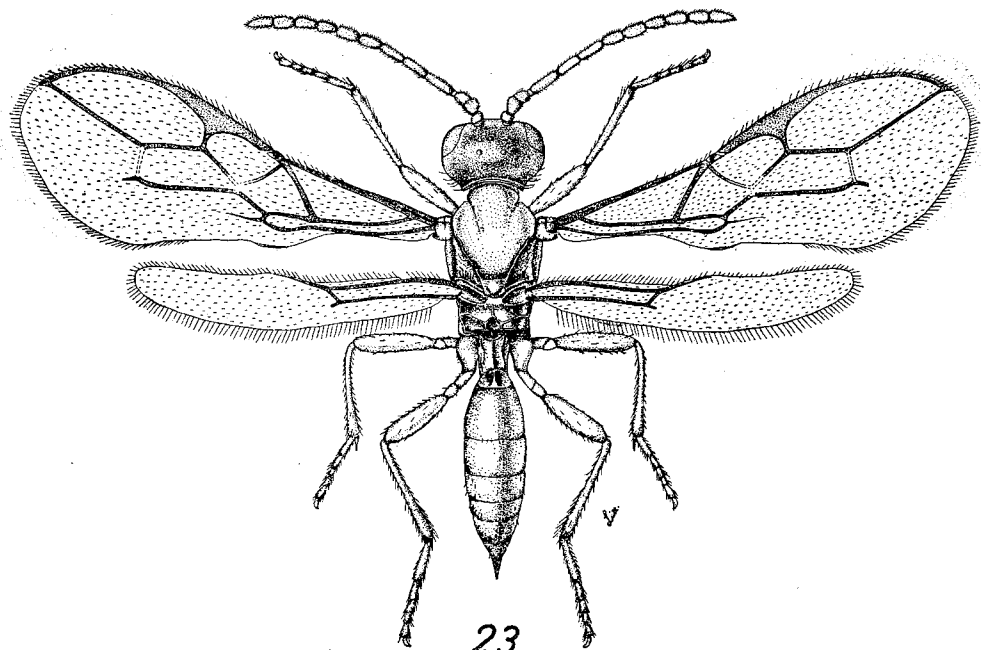
Figs. 18-19: 18. *Aphidius gifuensis* Ashmead (♀); 19. *Diaeretiella rapae* (MacIntosh) (♀).



Figs. 20-21: 20. *Lysiphlebia japonica* (Ashmead) (♀); 21. *Ephedrus* (*E.*) *persicae* Froggatt (♀).

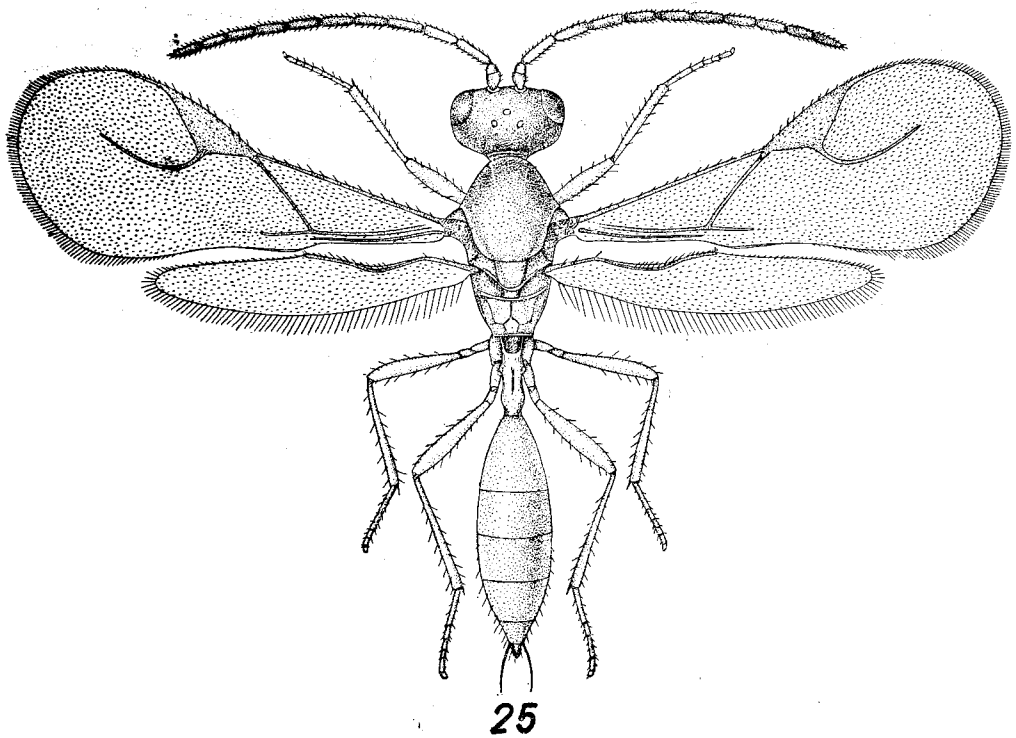
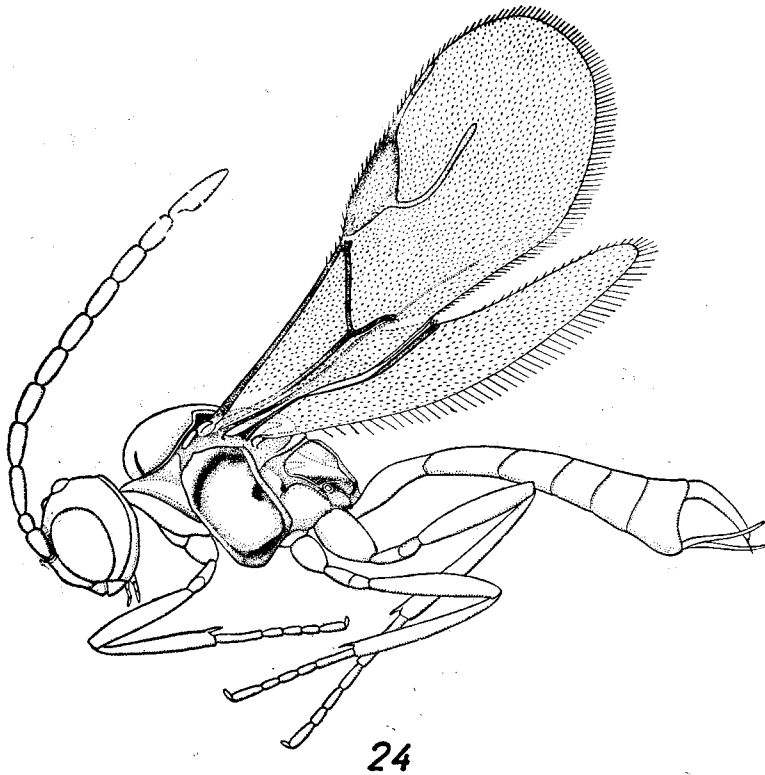


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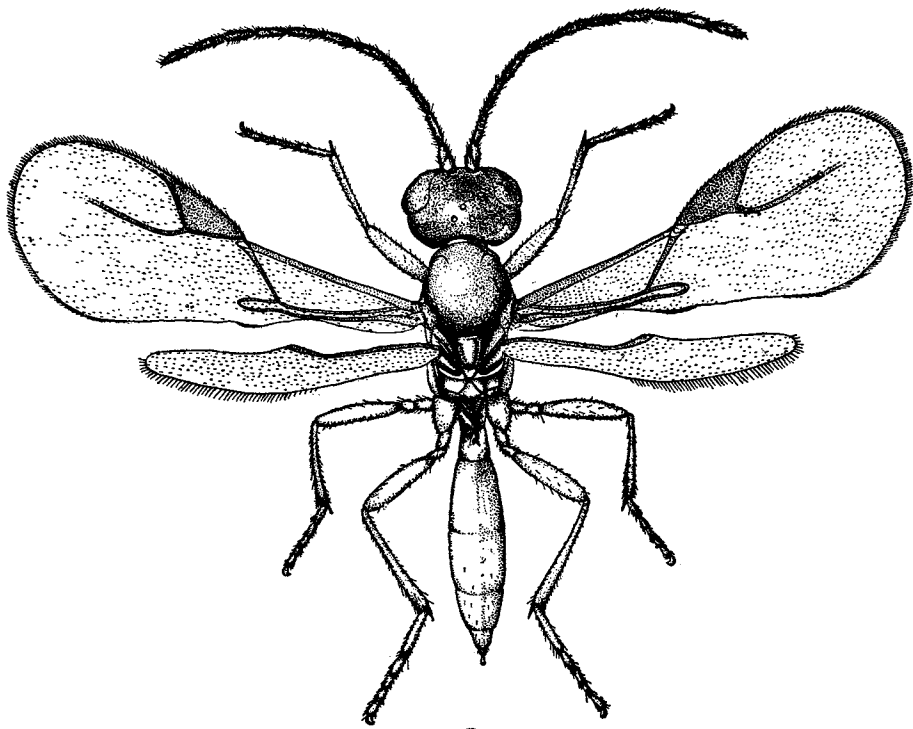


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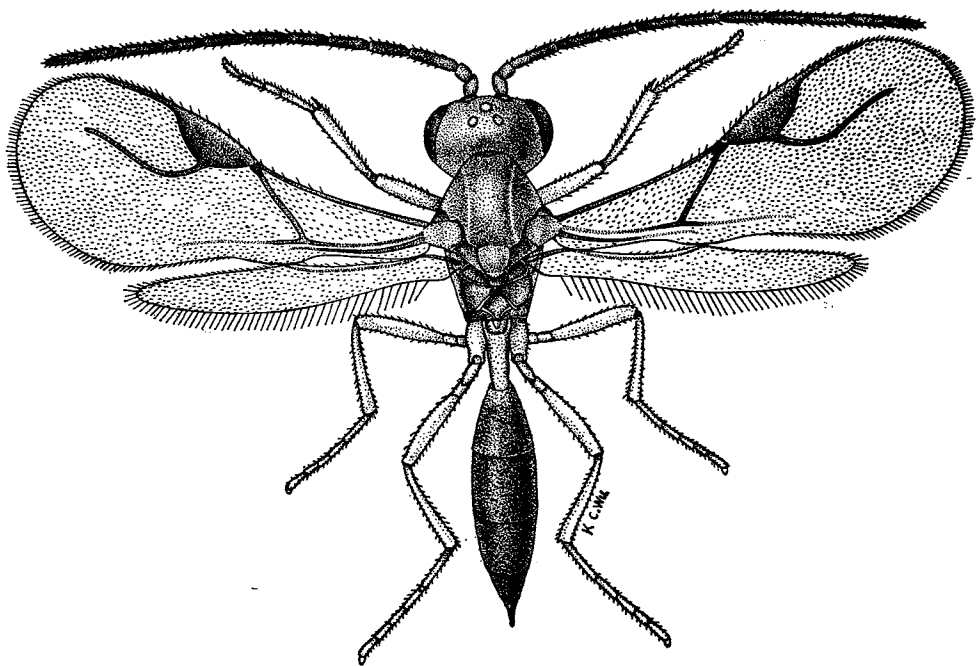
Figs. 22-23: 22. *Ephedrus* (*E.*) *plagiator* (Nees) (♀); 23. *Ephedrus* (*E.*) *robustus* Liu (♀).



Figs. 24-25: 24, *Binodoxys communis* (Gahan) (♀); 25, *Binodoxys struma* (Gahan) (♀).



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Figs. 26-27: 26. *Lipolexis graicilis* Förster (♀); 27. *Lipolexis scutellaris* Mackauer (♀).