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THEIR HYMENOPTEROUS PARASITES IN THAILAND

Partial result of a grant from the Ministry of Education, Japanese Government to
"Field survey on the biological control of rice stem-borers, aphids, diaspine scales and
phytophagous mites in S. E. Asia" (project leader: Dr. Keizo Yasumatsu)

By SHUN-ICHI NAKAO, SADAO TAKAGI, TETSUSABURO TACHIKAWA,
and TANONGCHIT WONGSIRI

Abstract

NAKAO, S., TAKAGI, S., TACHIKAWA, T., and WONGSIRI, T. 1977. Scale insects collected on citrus and other plants and their hymenopterous parasites in Thailand. *Ins. matsum. n.s.* 11: 61-72, 5 tabs., 2 figs.

Scale insects were collected from citrus and some other plants in Thailand in Oct. 20 to Dec. 27, 1970. Of them at least 12 species of scale insects were found to be injurious to citrus and *Coccus viridis*, *Coccus hesperidum* and *Aonidiella aurantii* were considered to be most injurious. From many of them hymenopterous parasites were reared. As an appendix *Aulacaspis yasumatsui* Takagi, n. sp., associated with a cycad at Bangkok, is described.

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INTRODUCTION

In connection with the project "Field survey on the biological control of rice stem-borers, aphids, diaspine scales and phytophagous mites in S. E. Asia" (project leader: Dr. Keizo Yasumatsu), one of the authors, S. Nakao, made an ecological study on the spider mites injurious to citrus in various localities of Thailand in the period between Oct. 20 and Dec. 27, 1970 (for the summary of this project, refer to a general report by Yasumatsu, Hirashima and Yano, 1975). During this study he also tried to collect scale insect pests of citrus and their hymenopterous parasites.

Scale insects were collected from citrus groves and also from other neighboring plants. The collected scales were reared to obtain hymenopterous parasites. As to scale insects in Thailand 88 species were recorded by Takahashi (1942), who enumerated 12 species as pests of citrus. Further records were made by Pholboon (1952, 1965), Napompeth (1966), Chamnanuej and Wongsiri (1971), and FAO (1975); these records included 5 species from mulberry, 2 from durian, 1 from tea, 2 from coffee, 2 from rice and 1 from sugarcane. As to parasites of citrus-feeding scale insects, none have been so far known there. A report is here made on scale insects collected during the survey and hymenopterous parasites emerged from those scale insects.

Fresh scale insects on twigs and leaves of the host plant were placed into small glass-tubes capped with cotton. The tubes were checked daily to get hymenopterous parasites.

The areas surveyed were Northwest Highland, Chao Phraya Plains and Chanta Buri Region of Thailand. The survey periods for these regions were as follows: Oct. 27–Nov. 7, Nov. 24–Dec. 2 and Dec. 9–21, 1970, Northwest Highland; Nov. 10–13, 1970, Chao Phraya Plains; Nov. 15–20, 1970, Chanta Buri Region.

The collected scale insects were sent for identification to S. Takagi, and emerged hymenopterous parasites to T. Tachikawa. Many of them, however, remained undetermined. Part of the scale insect materials were not adequate in condition for identification or contained only larval stages. Taxonomic studies of parasitic insects in Thailand are not quite developed, not all collected parasites were able to be specified.

RESULTS AND DISCUSSION

Table 1 shows the scale insects collected from citrus and other plants during the survey. The collection was not performed by quantitative method, therefore, results do not show the population density of each species of the scale insects. However, the species collected from many localities are regarded as being more dominant species. The table also shows that Coccidae are richest in species and Diaspididae are next. Of all, the following are considered dominant species from their large numbers of localities: – *Pseudococcus* sp. (species number in Table 1: 4), *Coccus hesperidum* (8), *Coccus mangiferae* (9), *Coccus viridis* (10), *Parasaissetia nigra* (15), *Aonidiella aurantii* (26), and *Parlatoria zizyphus* (32).

As seen in Table 2, more than 12 species are found to be associated with *Citrus*-species such as *Citrus grandis* (pomelo), *Citrus nobilis*, *Citrus reticulata*, etc., with all of the "dominant" species of scale insects included. Furthermore, from the

Table 1. List of scale insects collected.

— Family Margarodidae —	
1. <i>Icerya</i> sp. (larvae)	
Material examined:	
-1. Chiang Mai, 5. XI. 1970, citrus	
-2. Chiang Rai, 11. XII. 1970, citrus	
— Family Pseudococcidae —	
2. <i>Erium</i> sp. (close to <i>Erium dischidiae</i> (Takahashi) from Malaya)	
Material examined:	
-1. Chiang Dao, 2. XI. 1970, unknown plant	
3. <i>Ferrisia virgata</i> (Cockerell)	
Material examined:	
-1. Pimai, 24. X. 1970, unknown plant	
4. <i>Pseudococcus</i> sp.	
Material examined:	
-1. Prew, 17. XI. 1970, citrus	
-2. Chanta Buri, 19. XI. 1970, citrus	
-3. Chiang Mai, 25. XI. 1970, pomelo	
-4. Mae Chan, 10. XII. 1970, citrus	
5. Gen. sp. A (larvae)	
Material examined:	
-1. Fang, 29. XI. 1970, citrus	
6. Gen. sp. B (larvae)	
Material examined:	
-1. Fang, 29. XI. 1970, citrus	
— Family Coccidae —	
7. <i>Ceroplastes</i> sp. (<i>Ceroplastes ceriferus</i> ?)	
Material examined:	
-1. Fang, 28. XI. 1970, persimon-tree	
8. <i>Coccus hesperidum</i> L.	
Material examined:	
-1. Mae Jo, 5. XI. 1970, pomelo	
-2. Chiang Mai, 5. XI. 1970, citrus	
-3. San Pa Tong, 11. XI. 1970, pomelo	
-4. Prew, 17. XI. 1970, citrus	
-5. Prew, 17. XI. 1970, citrus	
-6. Chanta Buri, 19. XI. 1970, citrus	
-7. Fang, 28. XI. 1970, persimon-tree	
-8. Chiang Rai, 9. XII. 1970, citrus	
-9. Pan, 13. XII. 1970, pomelo	
9. <i>Coccus mangiferae</i> (Green)	
Material examined:	
-1. Mae Jo, 5. XI. 1970, pomelo	
-2. Chiang Mai, 5. XI. 1970, citrus	
-3. Prew, 18. XI. 1970, <i>Barleria longiflora</i>	
-4. San Pa Tong, 24. XI. 1970, pomelo	
10. <i>Coccus viridis</i> (Green)	
Material examined:	
-1. San Pa Tong, 31. X. 1970, pomelo	
-2. Chiang Mai, 5. XI. 1970, citrus	
-3. Chiang Mai, 5. XI. 1970, pomelo	
-4. Mae Jo, 5. XI. 1970, pomelo	
-5. Prew, 17. XI. 1970, citrus	
-6. Chanta Buri, 19. XI. 1970, citrus	
-7. Fang, 29. XI. 1970, citrus	
-8. Chiang Rai, 9. XII. 1970, citrus	
-9. Chiang Rai, 11. XII. 1970, citrus	
-10. Mae Sai, 12. XII. 1970, pomelo	
-11. Pan, 13. XII. 1970, gardenia	
11. <i>Coccus</i> sp. A	
Material examined:	
-1. Chiang Mai, 10. XI. 1970, litchi	
12. <i>Coccus</i> sp. B	
Material examined:	
-1. Thon Buri, 10. XI. 1970, durian	
13. <i>Coccus</i> sp. C	
Material examined:	
-1. Prew, 17. XI. 1970, citrus	
14. <i>Eucalymnatus tessellatus</i> (Signoret)	
Material examined:	
-1. Chiang Mai, 5. XI. 1970, guava	
-2. Prew, 18. XI. 1970, <i>Barleria longiflora</i>	
15. <i>Parasaissetia nigra</i> (Nietner)	
Material examined:	
-1. San Pa Tong, 28. X. 1970, hibiscus	
-2. San Pa Tong, 28. X. 1970, hibiscus	
-3. San Pa Tong, 31. X. 1970, hibiscus	
-4. San Pa Tong, 3. XI. 1970, poinsettia	
-5. San Pa Tong, 3. XI. 1970, hibiscus	

- 6. Pan, 13. XII. 1970, hibiscus
 -7. San Pa Tong, 18. XII. 1970, hibiscus
 -8. San Pa Tong, 18. XII. 1970, canna
16. *Parasaissetia* sp.
 Material examined:
 -1. San Pa Tong, 3. XI. 1970, poinsettia
 -2. San Pa Tong, 3. XI. 1970, hibiscus
 -3. Chiang Mai, 5. XI. 1970, guava
17. "*Pulvinaria*" *thespesiae* Green
 Material examined:
 -1. San Pa Tong, 3. XI. 1970, *Acalypha wilkesiana*
18. *Saissetia coffeae* (Walker)
 Material examined:
 -1. Fang, 29. XI. 1970, citrus
19. *Saissetia* sp.
 Material examined:
 -1. Prew, 17. XI. 1970, citrus
20. Gen. sp. C (larvae)
 Material examined:
 -1. Thon Buri, 10. XI. 1970, durian
21. Gen. sp. D (larvae)
 Material examined:
 -1. Sam Phran, 21. XI. 1970, citrus
22. Gen. sp. E (larvae)
 Material examined:
 -1. Fang, 29. XI. 1970, citrus
23. Gen. sp. F (larvae)
 Material examined:
 -1. Chiang Rai, 9. XII. 1970, citrus
24. Gen. sp. G (larvae)
 Material examined:
 -1. Mae Chan, 10. XII. 1970, citrus
25. Gen. sp. H (larvae)
 Material examined:
 -1. Mae Sai, 12. XII. 1970, pomelo
 — Family Diaspididae —
26. *Aonidiella aurantii* (Maskell)
 Material examined:
 -1. San Pa Tong, 28. X. 1970, pomelo
 -2. San Pa Tong, 31. X. 1970, pomelo
- 3. San Pa Tong, 3. XI. 1970, citrus
 -4. Mae Jo, 5. XI. 1970, pomelo
 -5. Chiang Mai, 5. XI. 1970, pomelo
 -6. San Pa Tong, 24. XI. 1970, pomelo
 -7. Pan, 13. XII. 1970, pomelo
 -8. Chiang Mai, 18. XII. 1970, citrus
27. *Aonidiella* sp. (*Aonidiella aurantii* ?)
 Material examined:
 -1. Chiang Mai, 5. XI. 1970, pomelo
 -2. Chiang Rai, 9. XII. 1970, citrus
 -3. Chiang Rai, 11. XII. 1970, citrus
28. *Lepidosaphes bechii* Packard
 Material examined:
 -1. Chiang Dao, 4. XI. 1970, citrus
 -2. Chiang Mai, 5. XI. 1970, citrus
 -3. Ban Tap Dua, 16. XII. 1970, citrus
29. *Lepidosaphes* (?) sp. (no mounted specimen available)
 Material examined:
 -1. Chiang Mai, 9. XII. 1970, citrus
30. *Parlatoria cinerea* Hadden
 Material examined:
 -1. San Pa Tong, 31. X. 1970, pomelo
31. *Parlatoria citri* McKenzie*
 Material examined:
 -1. San Pa Tong, 3. XI. 1970, citrus
32. *Parlatoria zizyphus* (Lucas)
 Material examined:
 -1. Chiang Mai, 5. XI. 1970, citrus
 -2. Chiang Mai, 5. XI. 1970, citrus
 -3. Chiang Rai, 11. XII. 1970, citrus
 -4. Chiang Rai, 11. XII. 1970, citrus
 -5. Pan, 13. XII. 1970, pomelo
33. *Parlatoria* sp. (larvae)
 Material examined:
 -1. San Pa Tong, 28. X. 1970, pomelo
34. *Pinnaspis* sp. (*Pinnaspis aspidistrae*-complex)
 Material examined:
 -1. San Pa Tong, 3. XI. 1970, hibiscus
 -2. Sam Phran, 11. XI. 1970, pomelo

* This species was originally described from Java as a feeder of citrus. The present record may give a new locality for it.

Table 2. Species and number of collecting places of scale insects associated with *Citrus* spp.

Locality	Northwest Highland										Chao Phraya Plain		Chanta Buri Region		Total
	Fang	Chiang Dao	Ban Tap Dua	Chiang Mai	San Pa Tong	Mae Jo	Mae Sai	Mae Chan	Chiang Rai	Pan	Sam Phran	Thon Buri	Prew	Chanta Buri	
1.* <i>Icerya</i> sp.				1					1						2
4. <i>Pseudococcus</i> sp.				1				1					1	1	4
8. <i>Coccus hesperidum</i>	1			1	1	1			1	1			2	1	9
9. <i>Coccus mangiferae</i>				1	1	1							1		4
10. <i>Coccus viridis</i>	1			2	1	1	1		2	1			1	1	11
18. <i>Saissetia coffeae</i>	1														1
19. <i>Saissetia</i> sp.													1		1
26. <i>Aonidiella aurantii</i>				2	4	1				1					8
27. <i>Aonidiella</i> sp.				1					2						3
28. <i>Lepidosaphes beckii</i>		1	1	1											3
29. <i>Lepidosaphes</i> (?) sp.				1											1
30. <i>Parlatoria cinerea</i>					1										1
31. <i>Parlatoria citri</i>					1										1
32. <i>Parlatoria zizyphus</i>				2					2	1					5
33. <i>Parlatoria</i> sp.					1										1
34. <i>Pinnaspis</i> sp.					1						1				2
Total	3	1	1	13	11	4	1	1	8	4	1		6	3	57

* Species number in Table 1.

large numbers of collection localities, it seems that *Coccus viridis* (green scale), *Coccus hesperidum* (soft brown scale) and *Aonidiella aurantii* (California red scale) are most injurious insects to the citrus. Table 2 also shows that most of the species were collected in Northwest Highland. This may, however, simply be due to the longest survey period there.

Table 3 gives hymenopterous parasites reared from scale insects collected in the survey. Parasites were obtained from all of the "dominant" scale insects mentioned in the previous part. Especially, various species of parasites were discovered from *Coccus viridis* and *Aonidiella aurantii*, which are among the most important pests. Large numbers of individuals reared show that *Coccophagus* sp. and Aphelinidae gen. sp., emerged from the material 4 of *Coccus hesperidum*, and *Coccophagus bogoriensis*, emerged from the material 7 and 11 of *Coccus viridis*, are strong natural enemies of the scale insects. *Aneristus ceroplastae* emerged from *Parasaissetia nigra* may also be a significant natural enemy, because many parasites emerged from relatively many scale insects.

Other records of parasites specifically identified are *Anicetus annulatus* from *Coccus hesperidum* (material 3), *Timberlakiella applanatonervus* from *Coccus hesperidum* (material 4), and *Aneristus ceroplastae* from "*Pulvinaria*" *thespesiae*.

In the case of materials from which no parasites were emerged any other

Table 3. List of hymenopterous parasites emerged.

-
- 2.* *Erium* sp.
 -1.** Aphelinidae gen. sp., 5. XI. 1970-2, *** Chiang Dao
 Encyrtidae gen. sp., 8. XI. 1970-2, Chiang Dao
Prochiloneurus nagasakiensis Ishii, 14. XI. 1970-1, Chiang Dao
4. *Pseudococcus* sp.
 -2. *Anagyrus* sp., 28. XI. 1970-2, Chanta Buri
5. Pseudococcidae gen. sp.
 -1. Encyrtidae gen. sp., 8. XII. 1970-1, Fang
8. *Coccus hesperidum* L.
 -1. *Encyrtus* sp. (near *lecaniorum* Mayr), 8-14. XI. 1970-2, Mae Jo
 -3. Aphelinidae gen. sp., 28. XI. 1970-1, San Pa Tong
Anicetus annulatus Timberlake, 25. XI-1.XII. 1970-3, San Pa Tong
 -4. *Timbelakiella applanatonervus* Compere, 22. XI. 1970-1, Prew
Coccophagus sp., 19-30. XI. 1970-30, Prew
 Aphelinidae gen. sp., 21. XI-3. XII. 1970-63, Prew
 -6. *Coccophagus* sp., 25-28. XI. 1970-7, Chanta Buri
 Aphelinidae gen. sp., 21. XI-1. XII. 1970-12, Chanta Buri
 -7. Aphelinidae gen. spp., 7-15. XII. 1970-11, Fang
 -8. *Aphytis* sp., 18. XII. 1970-1, Chiang Rai
Coccophagus sp., 18. XII. 1970-1, Chiang Rai
Metaphycus sp., 21. XII. 1970-1, Chiang Rai
9. *Coccus mangiferae* (Green)
 -2. *Coccophagus* sp., 21-25. XI. 1970-2, Chiang Mai
 -3. *Coccophagus* sp., 21-22. XI. 1970-3, Prew
 -4. Aphelinidae gen. spp., 1. XII. 1970-3, San Pa Tong
10. *Coccus viridis* (Green)
 -2. *Coccophagus* sp., 21-25. XI. 1970-2, Chiang Mai
 -7. *Coccophagus bogoriensis* Königsberger, 30. XI-20. XII. 1970-95, Fang
 -8. *Cheiloneurus* sp., 15. XII. 1970-3, Chiang Rai
 -11. *Coccophagus bogoriensis* Königsberger, 13-26. XII. 1970-36, Pan
14. *Eucalymnatus tessellatus* (Signoret)
 -1. *Coccophagus* sp., 21-28. XI. 1970-2, Prew
15. *Parasaissetia nigra* (Nietner)
 -1. *Aneristus ceroplastae* Howard, 29. X-8. XI. 1970-11, San Pa Tong
 -2. Aphelinidae gen. sp., 5. XI. 1970-1, San Pa Tong
 -6. *Eunotus* sp., 21. XII. 1970-3, Pan
 -7. *Coccophagus* sp., 21. XII. 1970-3, San Pa Tong
16. *Parasaissetia* sp.
 -3. *Aneristus ceroplastae* Howard, 6. XI. 1970-1, Chiang Mai
17. "*Pulvinaria*" *thespesiae* Green
 -1. *Aneristus ceroplastae* Howard, 8-17. XI. 1970-2, San Pa Tong
19. *Saissetia* sp.
 -1. *Coccophagus* sp., 19-30. XI. 1970-7, Prew
21. Coccidae gen. sp. D
 -1. Encyrtidae gen. sp., 21. XI. 1970-1, Sam Phran
26. *Aonidiella aurantii* (Maskell)
 -1. Aphelinidae gen. sp., 5. XI. 1970-1, San Pa Tong
 -2. *Aphytis* sp., 5. XI. 1970-1, San Pa Tong
 -3. Aphelinidae gen. sp., 21. XI. 1970-8, San Pa Tong
 -4. *Encyrtus* sp., 8. XI. 1970-3, Mae Jo
 Aphelinidae gen. sp., 10-21. XI. 1970-2, Mae Jo
 -5. *Aphytis* sp., 3. XII. 1970-3, San Pa Tong
-

* Species number in Table 1. ** Material number in Table 1. *** Number of specimens.

evidence of the existence of parasites was not available. This might be due to insufficient sampling. Indeed, this paper is a mere beginning for the expected promotion in the biological control of orchard pests in Thailand.

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Appendix

A NEW SPECIES OF AULACASPIS ASSOCIATED WITH A CYCAD IN THAILAND (HOMOPTERA: COCCOIDEA) [By SADAO TAKAGI]

The following species was found in materials of Coccoidea collected by Prof. K. Yasumatsu in Thailand and sent by him to me for possible identification. It is unique among the known species of *Aulacaspis*, being associated with a cycad. The specific name is dedicated to Prof. Yasumatsu for the memory of his stay in Thailand.

Aulacaspis yasumatsui Takagi, n. sp.

Material.—Collected at Bangkok, Thailand, on *Cycas* sp., 1972 and 1973, K.

Yasumatsu. Both the female and male occur on the underside of the leaves, their scales showing nothing particular for a member of the genus. The following description is based on 30 specimens of adult females collected in 1972. Holotype in the collection of the Entomological Institute, Hokkaidô University, Sapporo.

Adult female.—Body stout; prosoma rounded, at maturity broader than postsoma. Submedian and submarginal series of dorsal macroducts on abd. iii-v, each series with macroducts not numerous; 1 submedian macroduct (at times 2) on abd. vi. Submedian dorsal microducts on metathorax and abd. i and ii, and often also on mesothorax, few on each segment, at times 1 or 2 on abd. iii anteriorly to submedian series of macroducts. Short gland spines and small macroducts along lateral margin of abd. ii and iii; 1 or 2 gland spines at times on lateral lobe of abd. i. Marginal gland spines 2 on abd. iv, 1 on succeeding segments each (abd. v-viii). Median lobes sunken into apex of pygidium, divergent, minutely serrate on mesal margin, rounded apically. Second and 3rd lobes developed.

The body is typical of the genus in shape, although the prosomatic dilation is not remarkable even at full growth. When the adult female is teneral, the prosoma is little dilated; when matured, the mesothoracic region of the prosoma is a little broader than the metathorax, and the 1st 3 abdominal segments are gradually narrower posteriorly; these abdominal segments are moderately lobed out laterally. Pygidium broad, little rounded. Derm remaining membranous

Table 4. Number of disc pores in *Aulacaspis yasumatsui* (based on 30 adult females). Range, mean (in parentheses), and sample size (in brackets) are given.

Spiracular disc pores	Anterior spiracle	10-24	(15.0)	[48]
	Posterior spiracle	6-15	(8.5)	[59]
Perivulvar disc pores	Median group	12-17	(14.4)	[30]
	Anterolateral group	14-26	(21.3)	[60]
	Posterolateral group	14-21	(17.3)	[60]

Table 5. Numbers of dorsal macroducts, submedian dorsal microducts, lateral macroducts, and gland spines in *Aulacaspis yasumatsui* (based on 30 adult females). Range, mean (in parentheses), and sample size (in brackets) are given.

	Submedian macroducts	Submarginal macroducts	Submedian dorsal microducts	Lateral macroducts	Gland spines
Mesothorax	—	—	0-2(1.0) [55]	—	—
Metathorax	—	—	1-3(1.7) [57]	—	—
Abd. i	—	—	1-5(2.6) [57]	—	0-2(0.3) [57]
Abd. ii	—	—	1-6(2.8) [56]	1-4(2.6) [60]	1-5(2.4) [60]
Abd. iii	2-6(4.0) [60]	2-6(3.7) [60]	0-2(0.5) [54]	2-6(4.0) [60]	4-12(8.0) [60]
Abd. iv	2-6(3.2) [60]	1-5(2.6) [60]	—	—	2
Abd. v	1-4(2.2) [60]	1-4(2.3) [60]	—	—	1
Abd. vi	1-2(1.1) [60]	—	—	—	1
Abd. vii	—	—	—	—	1
Abd. viii	—	—	—	—	1

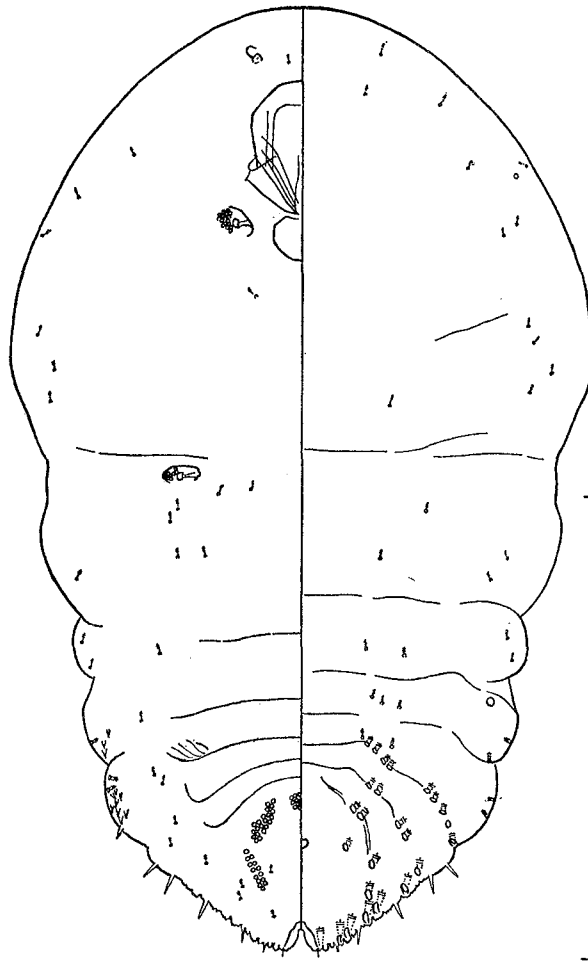
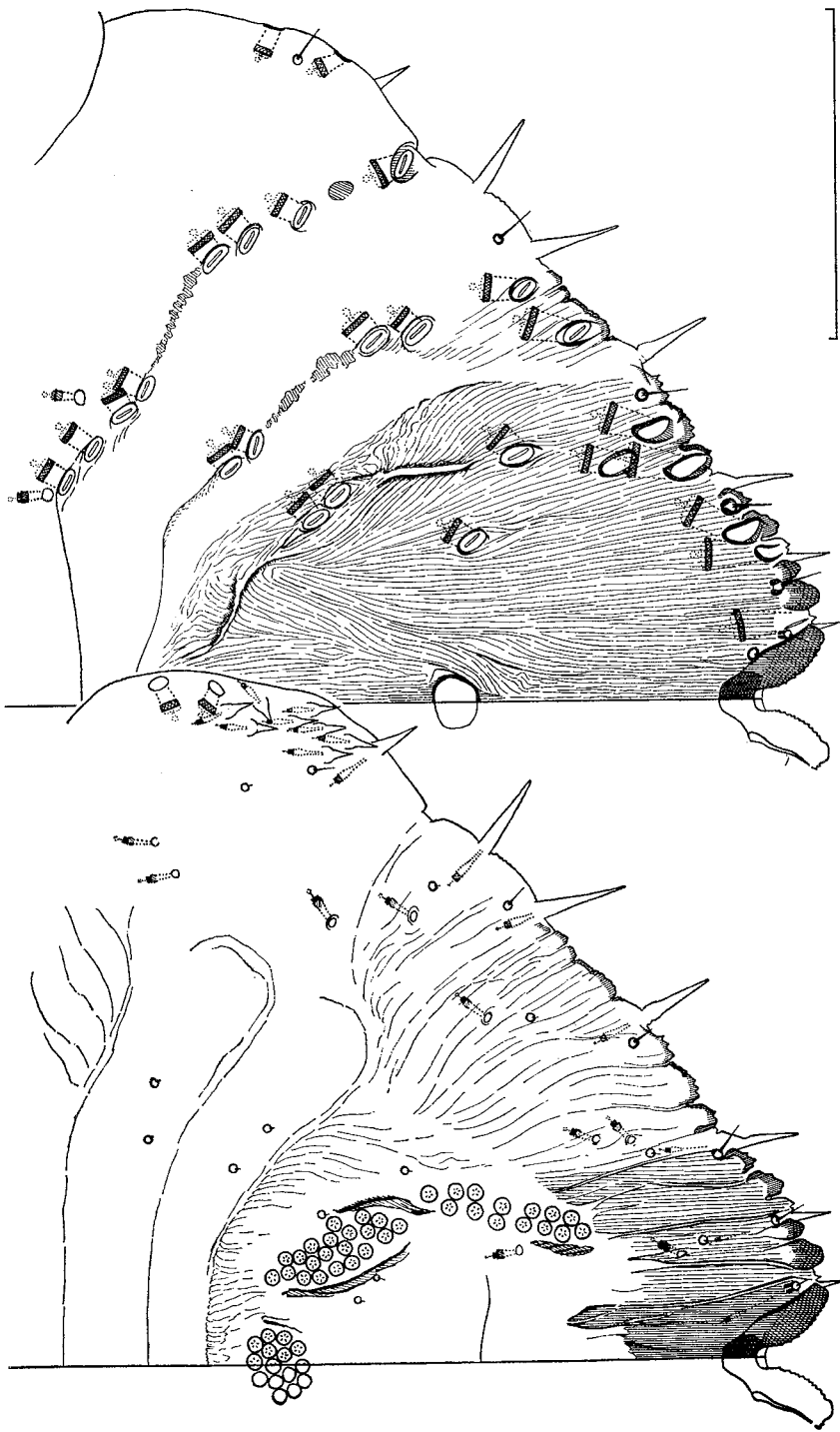


Fig. 1. *Aulacaspis yasumatsui* Takagi, n. sp. Adult female. Bangkok, on *Cycas* sp. Scale: 0.5 mm.

except for pygidium and small sclerotized patches of cephalothorax. A dorsal boss in posterolateral corner of abd. i, or in anterolateral corner of abd. ii; a smaller boss on abd. iii between submarginal series of macroducts and marginal macroduct. The median lobes of the pygidium are much larger than the lateral lobes. Second lobes with inner lobule rounded, and with outer lobule similar in shape but smaller. Third lobes with inner lobule well produced, and with outer lobule low and tending to be serrate. The number of the marginal macroducts is as usual for the genus (1 on abd. iii, 2 on iv-vi each, and 1 on vii). The numbers of other external secretory organs are given in Table 4 and 5.

Remarks. — This species is here compared with the type-species of the genus, *A. rosae* Bouché. It is considerably similar to the latter, but easily distinguished from

Fig. 2 *Aulacaspis yasumatsui* Takagi, n. sp. Adult female: pygidium. Bangkok, on *Cycas* sp. Scale: 0.1 mm.



the latter by having submedian dorsal microducts. It differs from the latter in the body shape at full growth owing to the less dilated prosoma and the less produced lateral lobes of the 2nd abdominal segment. The difference in the median lobes is rather subtle, although in *A. yasumatsui* these lobes are not angulated subbasally as in *A. rosae* but divergent from the bases on the mesal margins. So far as compared with some specimens of *A. rosae* collected in Japan *A. yasumatsui* has fewer submedian and submarginal macroducts, gland spines, and spiracular and perivulvar disc pores.

It is possible that this species is a close relative of *A. rosae*, although their difference in host plant is quite remarkable. The 2nd instar male of *A. yasumatsui* is very similar to that of *A. rosae*, but this may not be a positive evidence for their close relationship.