



## Article

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### A review of the genus *Chrysomphalus* Ashmead (Hemiptera: Coccoidea: Diaspididae) with descriptions of a new species and a new, related genus

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#### Abstract

The taxonomy of the genus *Chrysomphalus* Ashmead (Diaspididae: Aspidiotinae) is reviewed. A new monotypic genus of armored scale, *Pentalaminaspis* Smith-Pardo, Evans and Dooley, is described and illustrated with *Chrysomphalus minutus* Kotinsky, 1908 as the type species. A new species, *Chrysomphalus nepenthivorus* Smith-Pardo, Evans & Dooley, is described and illustrated. This species was intercepted at a U.S. port of entry on hybrids of pitcher plants (*Nepenthes*) originating from Thailand. *Chrysomphalus greeni* Leonardi, 1914 is transferred to the genus *Melanaspis* and *Chrysomphalus degeneratus* Leonardi, 1896 is transferred to the genus *Diaspidiotus*. A discussion and key to species of the genus *Chrysomphalus* are provided as well as a key to aspidiotine genera similar to *Chrysomphalus*.

**Key words:** Sternorrhyncha, diaspidid, armored scales, *Nepenthes*, Thailand, carnivorous plants, diversity

#### Resumen

Se reviso la taxonomía del *Chrysomphalus* Ashmead, un género de escamas armadas (Diaspididae: Aspidiotinae). Se describe e ilustra un género nuevo y monotípico de escamas *Pentalaminaspis* Smith-Pardo, Evans y Dooley, con *Chrysomphalus minutus* Kotinsky, 1908 como la especie tipo. Se describe e ilustra una especie nueva de escama, *Chrysomphalus nepenthivorus* Smith-Pardo, Evans y Dooley que fue hallada en híbridos de plantas carnívoras del género *Nepenthes* procedentes de Tailandia. Se transfiere *Chrysomphalus greeni* Leonardi 1914 al género *Melanaspis* y la especie *Chrysomphalus degeneratus* Leonardi 1896 al género *Diaspidiotus*. Se presentan una lista y claves taxonómicas para las especies del género *Chrysomphalus* y los géneros de la subfamilia Aspidiotinae cercanos a *Chrysomphalus*.

**Palabras clave:** Sternorrhyncha, diaspidido, escamas armadas, *Nepenthes*, Tailandia, planta carnívora, diversidad

#### Introduction

Scale insects (Hemiptera: Coccoidea) comprise many of the world pests of a wide variety of plants. The family Diaspididae, commonly known as armored scales or hard scales for their hard waxy scale cover, is the largest family in the group with over 2500 species, which represents about one third of the total number of scale insect species (Ben-Dov *et al.* 2012). They are primarily pests of perennial plants in managed systems and cause damage by sucking plant juices from the host plant, causing yellowing or chlorotic areas on the leaves, sometimes leading to leaf drop. Fruit of infested trees is often smaller than usual and may drop prematurely from the tree. Trees that have been infested for several years often become weakened and less productive. Diaspididae are not known to be disease vectors, but nonetheless often cause major economic damage to plants when heavy infestations occur, sometimes leading to the death of the plant or rendering it unmarketable. Many species are major pests of ornamental plants on which they cause damage by directly feeding on the plant or by causing the plants to become esthetically undesirable to the consumer.

The genus *Chrysomphalus* was described by Ashmead (1880) with *Chrysomphalus ficus* Ashmead, currently a junior synonym of *Chrysomphalus aonidum* (L.), as the type species. The genus contains species that are major, worldwide pests. The Florida red scale, *C. aonidum* (Linnaeus 1758) is a pest of a wide variety of crops throughout most of the tropical and subtropical areas and in greenhouses elsewhere. The false Florida red scale or bifasciculate scale, *C. bifasciculatus* Ferris (1938), can so heavily infest ornamentals that the leaves become brown and dried up. *Chrysomphalus dictyospermi* (Morgan 1889), commonly known as Morgan's scale or Spanish red scale, is a serious pest of citrus, avocados and a wide array of subtropical and tropical plants. Herein, we review the genus and describe and illustrate a new species from Thailand. The new species is the only species in the genus known to be associated with carnivorous plants of the genus *Nepenthes* (Caryophyllales: Nepenthaceae). In addition, we provide a complete list of the *Chrysomphalus* species with an updated list of hosts and distribution, and taxonomic key to the species.

## Materials and methods

Information on the taxonomy, distribution and hosts of *Chrysomphalus* species was obtained from the ScaleNet (Ben-Dov et al. 2012), the Digitop (U.S. National Agricultural Library) database and from collection data associated with specimens deposited in the USNM scale insect collection. The depository for the type specimen(s) of each species is according to that in ScaleNet (Ben-Dov et al. 2012).

All the specimens used for the description of the new species were collected on hybrids of pitcher plants (*Nepenthes*) originating in Thailand and inspected at the USDA-APHIS-PPQ, Plant Inspection Station in South San Francisco, California, USA. The specimens were prepared following the standard methodology of Triplehorn and Johnson (2005) for mounting scales and were examined using a Nikon Eclipse 80i. Photographs were taken using a Nikon Digital sight DS-Fi1 on a Nikon SMZ1500 dissecting microscope.

Species descriptions follow the format and terminology used by Miller and Davidson (2005), and Watson (2002). Abdominal segments 1-8 of the prepygidium and pygidium are labeled consecutively from A1 (anterior most segment) to A8 (posterior most segment). The length of the cuticle was measured from the most anterior margin to the tip of L1. The width of the cuticle was measured from the widest point of each side. The length of the pygidium was measured on the dorsal surface of the anterior margin of A4 to the apical tip of the median lobes. The width of the pygidium was measured between the right and left lateral margins at the level of A4. The actual length and width (diameter) of the anal pore does not include the outer sclerotized ring. The distance between the anal opening and the base of L1 is taken from the posterior margin of the anal opening to the base of L1 midpoint between the setae marking the position of L1. Length of the three lobes of the pygidium is the distance from the seta marking the position of that lobe to the apical tip of the lobe. Length of each paraphysis is the distance between the basal margin and the apical tip of each paraphysis. The frequency of perivulvar pores is given as the number of pores per cluster on each side of the vulva, and does not include those medially above the vulva (absent in *C. nepenthivorus*). The abbreviations L1, L2, L3 and L4 are used for median, second, third and fourth pygidial lobes, respectively. A formula is used to indicate the number of plates between the various pygidial lobes and beyond the L4 lobe and is given as the number of plates between L1-L1/ L1-L2/ L3-L4/ >L4, respectively. For example, the formula 1-5-3-4 indicates that there is 1 plate between the L1 lobes, 5 plates between L1 and L2, 3 plates between L2 and L3, and 4 plates beyond (anterior to) L4.

Acronyms for museums where specimens are deposited are as follow: **ANIC** (Australian National Insect Collection, CSIRO, Canberra, Australia), **AMNH** (American Museum of Natural History, New York, New York, USA), **BMNH** (The Natural History Museum, London, England), **CAS** (California Academy of Sciences, San Francisco, California, USA), **EISC** (Entomological Institute, Shaanxi Agricultural University, Taigu, Shaanxi, China), **LSL** (Linnaean Society of London, England), **MEFLG** (Museo Entomológico Francisco Luis Gallego, Universidad Nacional de Colombia, Medellin, Colombia), **MNHN** (Museum Nationale d' Histoire Naturelle, Paris, France), **MPMP** (Entomological Collection, National Museum of the Philippines, Bureau of Science, Manila, Philippines), **NZAC** (New Zealand Arthropod Collection, Landcare Research, New Zealand), **QM** (Queensland Museum, South Brisbane, Queensland, Australia), **SEMC** (Snow Entomological Collection, Natural History Museum and Biodiversity Research Center, University of Kansas, Lawrence, Kansas, USA), **UCB** (Essig Museum of Entomology, University of California, Berkeley, California, USA), **UCD** (Bohart

Museum of Entomology, University of California, Davis, California, USA), **UNINA** (Universita di Napoli Federico II, Portici-Napoli, Italy), **USNM** (United States National Museum of Natural History, Smithsonian Institution, Washington D.C., USA).

## Systematics

The following key is for *Chrysomphalus* Ashmead and similar aspidiotine genera that have paraphyses arising from the bases of the pygidial lobes but lack the mosaic or areolate dorsal pattern on the pygidium. We have included the genus *Dynaspidiotus* Thiem & Gerneck, 1934 because some of the species currently placed in the genus would also key out here, although *Dynaspidiotus britannicus* Ferris, 1938, the type species for the genus, would not because the paraphyses are absent or poorly developed.

## Key to the Aspidiotinae (Diaspididae) genera similar to the genus *Chrysomphalus*

- 1a. Paraphyses arising only from basal angles of lobes, not from an interlobular space, sometimes with a weak sclerotization close to paraphysis at basal angle of lobe ..... 2
- 1b. Paraphyses arising from basal angles of lobes and at least one interlobular space, usually located more or less halfway between lobes ..... 5
- 2a (1a). Anal opening large, space between opening and posterior margin of pygidium not more than 2x diameter of opening; L2 and L3 usually reduced to small points; paraphyses wide and robust; plates usually with fringed apices ..... *Hemiberlesia* Cockerell, 1897
- 2b. Anal opening small, space between opening and posterior margin of pygidium more than 2x diameter of opening; L2 and often L3 well developed; paraphyses slender; plates variable ..... 3
- 3a (2b). L2 and L3 well developed; plates usually well developed and with fringed apices ..... *Abgrallaspis* Balachowsky, 1948
- 3b. L3 not developed; L2 developed but often only as small points; plates usually short, and spine-like, without fringed apices ..... 4
- 4a (3b). Paraphyses arising from lateral angle of L1 typically elongate, slender and terminating in a heavily sclerotized knob ..... *Clavaspis* MacGillivray, 1921
- 4b. Paraphyses arising from lateral angle of L1 not terminating in a heavily sclerotized knob .. *Diaspidiotus* Cockerell, 1897
- 5a (1b). Lateral margin of pygidium entirely without plates or gland spines; paraphyses absent anterior to L3 ..... *Targionia* Signoret, 1869
- 5b. Lateral margin of pygidium with at least a few plates or gland spines; paraphyses present or absent anterior to L3 ..... 6
- 6a (5b). Pygidium with 5 plates between L1 and L2; L2 larger than L1 with many short teeth and L2 closer to L3 than to L1; 2 paraphyses present between L1 and L2. .... *Pentalaminaspis* nov. gen.
- 6b. Pygidium with fewer than 4 plates or gland spines between L1 and L2; L2 not larger than L1, and L2 located closer to L1 than to L3; with 0 or 1 paraphyses present between L1 and L2 ..... 7
- 7a (6b). Pygidial margin anterior to L4 not heavily sclerotized, without a series of short paraphyses; plates anterior to L3 conspicuous, branched, fringed or clubbed, their length usually exceeding that of lobes; anus usually located closer to posterior margin than to vulva ..... 8
- 7b. Pygidial margin anterior to L4 heavily sclerotized, often with a series of short paraphyses; plates anterior to L3 not as long and conspicuous, and may be branched, fringed or spine-like, their length usually not exceeding that of lobes; anus usually in middle or closer to vulva than posterior margin ..... 10
- 8a (7a). Paraphyses absent or, if present, poorly developed, short, not exceeding length of lobes; paraphyses in L2–L3 interlobular space absent or not pronounced ..... *Dynaspidiotus* Thiem & Gerneck, 1934
- 8b. Paraphyses well-developed, long and slender, each as long as, or exceeding, length of lobes; paraphyses in L2–L3 interlobular space well-developed, long and slender ..... 9
- 9a (8b). Prosoma of mature female strongly sclerotized, reniform shaped with lateral lobes more or less enclosing pygidium in most species; paraphyses relatively short, about as long as lobes in most species .. *Aonidiella* Berlese & Leonardi, 1896
- 9b. Prosoma of mature female, if strongly sclerotized, not reniform in shape and with lateral lobes not enclosing pygidium; paraphyses relatively long, much longer than lobes in most species ..... *Chrysomphalus* Ashmead, 1880
- 10a (7b). Pygidium broad at the base, elongate and tapering apically to a point, lateral margins tending to be slightly concave; with 3 pairs of pygidial lobes; L4 reduced to a point or absent; margin anterior to L4 heavily sclerotized; and with or without an extended series of well-developed, quite long, closely set paraphyses; often with most or all paraphyses between L1 and L4 similar in length ..... 11
- 10b. Pygidium usually short and broad, not tapering apically to an acute point, lateral margins tending to be convex; usually with 4 or 5 pairs of pygidial lobes; L4 usually well developed; ; margin anterior to L4 lightly to heavily sclerotized, paraphyses anterior to L4 absent, weakly developed or rather few; often with most or all paraphyses between L1 and L4 variable in length ..... 13

- 11a (10a). Pygidium with 4 or more pairs of well-developed pygidial lobes; margin anterior to L4 without distinct paraphyses; plates between lobes long, distinctly longer than length of lobes. . . . . *Marginaspis* Hall, 1946
- 11b. Pygidium with 3 pairs of pygidial lobes; margin anterior to L4 with paraphyses; plates between lobes short to moderate in length, not distinctly longer than length of lobes . . . . . 12
- 12a (11b). Pygidium tapering apically an acute point. . . . . *Acutaspis* Ferris, 1941
- 12b. Pygidium tapering apically to a rounded or truncate apex . . . . . *Lindingaspis* MacGillivray, 1921
- 13a (10b). Pygidium with longest paraphyses arising from the lateral corner of base of lobes (usually with 2 paraphyses between L1 and L2 and between L2 and L3); dorsum of pygidium divided into sclerotized areas; large V-shaped reticulate sclerotized area on A6 always present . . . . . *Crenulaspidiotus* MacGillivray, 1921
- 13b. Pygidium with longest paraphyses in interlobular space(s); usually with 1 paraphysis between L1 and L2 and another between L2 and L3; dorsum of pygidium not divided into sclerotized areas and without a large V-shaped reticulate sclerotized area on A6. . . . . 14
- 14a (13b). Anterior margin of head of mature female distinctly sclerotized, differentiated from lateral margin, resembling a “cap” . . . . . *Mycetaspis* Cockerell, 1897
- 14b. Anterior margin of head of mature female not distinctly sclerotized or differentiated from lateral margin, not resembling a “cap” . . . . . *Melanaspis* Cockerell, 1897

### Genus *Chrysomphalus* Ashmead 1880

Fig. 1

*Chrysomphalus* Ashmead, 1880: 267. Type species: *Chrysomphalus ficus* Ashmead [= *Chrysomphalus aonidum* (Linnaeus)], by monotypy.

#### Generic diagnosis:

Belonging to the Aspidiotinae. Adult females of this subfamily are characterized by usually having one-barred type macroducts, L2 not bilobed, fringed plates present between lobes, and spiracles without associated disk pores.

#### Discussion:

*Chrysomphalus* differs from most other aspidiotine genera by the following combination of characters: (i) paraphyses arising from the bases of the lobes and also from center of one of the interlobular spaces, usually between L2 and L3, and (ii) paraphyses frequently present anterior to L3. *Chrysomphalus* is most similar to *Aonidiella*, but differs in that the cephalothorax is never reniform, the prepygidial lobes do not curve posteriorly to the pygidium, and the paraphyses are as long as, or longer than, the lobes, whereas in *Aonidiella*, the cephalothorax is usually reniform with the prepygidial lobes curving posteriorly to the pygidium and the paraphyses are much shorter, about as long as the lobes in most species (Takagi, 1969; Williams & Watson, 1988). It is also similar to *Acutaspis*, but the posterior margin of the pygidium is more or less truncate, not tapering to an acute apex as in *Acutaspis*. It also comes close to *Marginaspis*, *Lindingaspis* and *Melanaspis* but, in *Chrysomphalus*, the plates between L3 and L4 are more conspicuous and branched and longer than the lobes, whereas in the other genera the plates are short, not exceeding the length of the lobes. In addition, in *Lindingaspis* and *Melanaspis*, there is usually a series of short paraphyses anterior to L4 which are absent in *Chrysomphalus*.

#### Taxonomic revisions and regional accounts:

Robinson (1917) published a key to the *Chrysomphalus* species of the Philippines. McKenzie (1939) reviewed the genus which then included eight species, and later (McKenzie 1943) provided a key and discussion to its ten species in his comprehensive revision of the genus. Chou (1946) described *C. silvestrii* and later (Chou 1947) reviewed the genus in China. Williams and Watson (1988) provided a key, discussion and illustrations to the four species of *Chrysomphalus* which occur in the tropical south Pacific region and Danzig (1993) provided a key to the European species. Gill (1997) provided a key, discussion and illustrations for the three *Chrysomphalus* species known to occur in California, and Miller and Davidson (2005) covered the same three species. The following key to the world's species of *Chrysomphalus* does not include *Chrysomphalus greeni* Leonardi, which is transferred here to *Melanaspis*, nor *Chrysomphalus minutus* Kotinsky, which is the type species of a new monotypic genus, *Pentalaminaspis*, described herein.

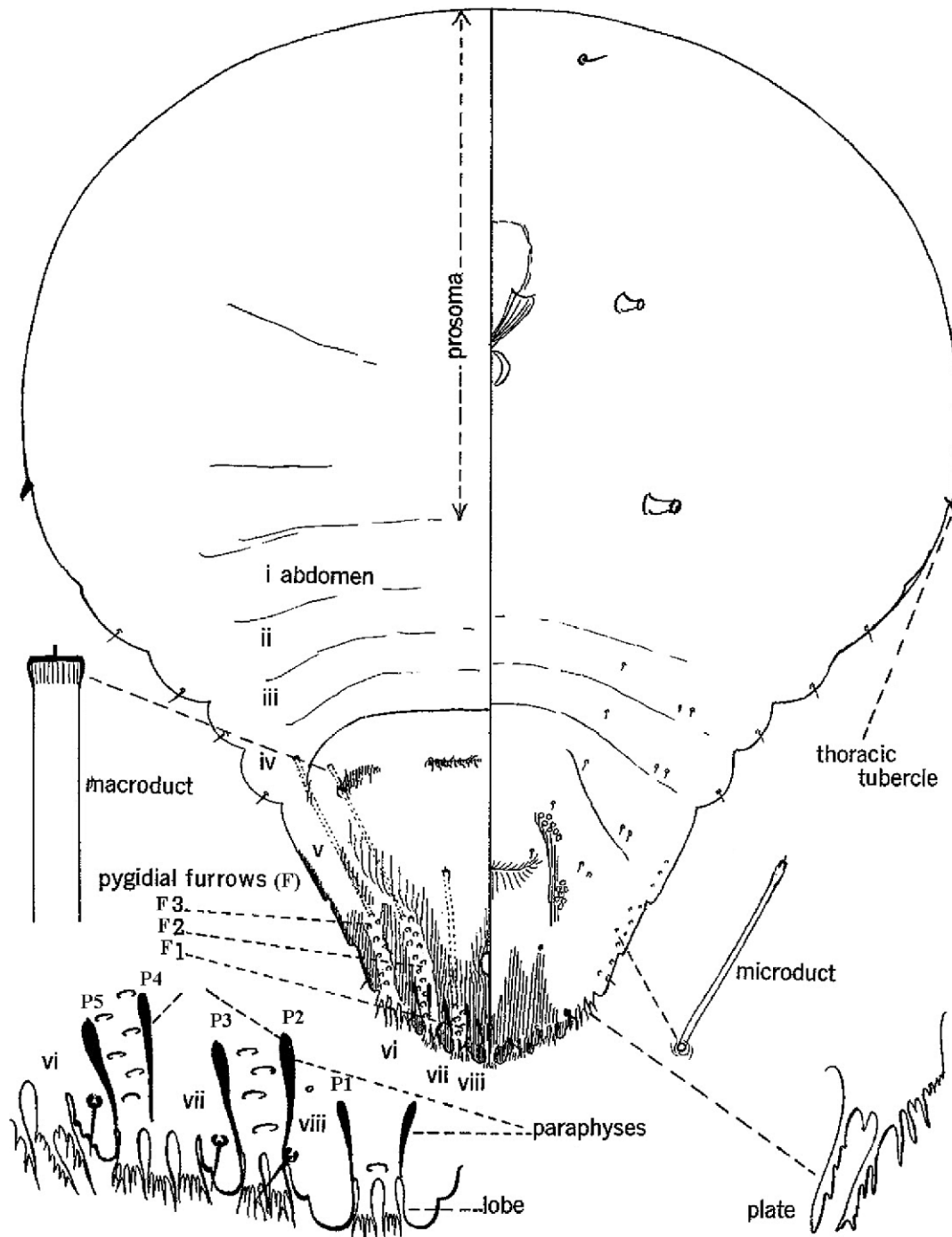


FIGURE 1. Adult female *Chrysomphalus* species (after McKenzie 1939).

**Key to the species of the genus *Chrysomphalus* based on adult females**

- 1a. Perivulvar pores absent (or with only 1 pair in some individuals of *C. variabilis*) ..... 2
- 1b. Perivulvar pores present ..... 7
- 2a (1a). Prosoma heavily sclerotized; paraphysis between L2 and L3 with a double apex; perivulvar pores absent or with only 1 pair; only known on *Santalum* in Australia ..... *C. variabilis* McKenzie (in part)
- 2b. Prosoma not heavily sclerotized; paraphysis between L2 and L3 with a single apex; perivulvar pores absent ..... 3
- 3a (2b). L1 with rounded apices; thoracic tubercle present or absent; only known on *Eucalyptus* in Australia ..... 4
- 3b. L1 with trilobed apices; thoracic tubercle absent; not known from Australia nor on *Eucalyptus* ..... 5
- 4a (3a). Thoracic tubercle present; second pygidial furrow each with 10-14 ducts in double rows. .... *C. rubribullatus* Brimblecombe

- 4b. Thoracic tubercle absent; second pygidial furrow with less than 10 ducts in a single row ..... *C. trifasciculatus* Brimblecombe
- 5a (3b). Plates anterior to L3 with clavate apices; L3 notched once on each side; only known on *Prunus* in China ..... *C. mume* (Tang)
- 5b. Plates anterior to L3 with fringed apices; L3 with two or more lateral notches on each side ..... 6
- 6a (5b). L1 tri-lobed, with a notch on each side; prepygidial segments A1-A3 each with 2 macroducts; on orchids in the Philippines ..... *C. nulliporus* (McKenzie)
- 6b. L1 bi-lobed, with a notch only on lateral margin; prepygidial segments A1-A3 apparently lacking macroducts; only known on tea (*Thea*) in Madagascar. .... *C. aberrans* (Mamet)
- 7a (1b). Prosoma heavily sclerotized, beset with fine irregular lines; only known from Australia ..... 8
- 7b. Prosoma membranous, without sclerotized fine irregular lines; widespread species or those known from other regions . . 9
- 8a (7a). Thoracic tubercle absent; perivulvar pore groups each with no more than 2 pores; second and third pygidial furrows each with 10–14 ducts in single or double rows; first pygidial plate anterior to L3 entire; only known on *Santalum* from Australia ..... *C. variabilis* McKenzie (in part)
- 8b. Thoracic tubercle present; perivulvar pore groups each with 2 to 4 pores; second and third pygidial furrows with 14–16 ducts in double or triple rows; first pygidial plate anterior to L3 forked; various hosts in Australia . . *C. fodiens* (Maskell)
- 9a (7b). First two plates anterior to L3 with clavate apices ..... 10
- 9b. First two plates anterior to L3 with fringed apices ..... 13
- 10a (9a). Prepygidial segments lacking a dorsal cluster of 4 or more ducts; numerous hosts, widespread. .... *C. dictyospermi* (Morgan)
- 10b. Prepygidial segments with at least one segment with a cluster of 4 or more dorsal ducts ..... 11
- 11a (10b). Prepygidial segments A2 and A3 each with a submarginal dorsal cluster of ducts; pygidial furrows two and three each with ducts forming a single irregular row; numerous hosts, widespread ..... *C. bifasciculatus* Ferris
- 11b. Only prepygidial segment A2 with a submarginal dorsal cluster of ducts; pygidial furrows two and three each with ducts forming 2 to 3 rows. .... 12
- 12a (11b). Test including exuvia uniformly reddish-brown in color; numerous hosts, widespread ..... *C. pinnulifer* (Maskell)
- 12b. Test variable from pale black to purplish in color, with only exuvia reddish-brown in color; numerous hosts, widespread . . . . . *C. diversicolor* (Green)
- 13a (9b). Prepygidial segment A2 with a dorsal cluster of 5 or more ducts along lateral margin; numerous hosts, widespread ..... *C. aonidium* (Linnaeus)
- 13b. Prepygidial segment A2 without a dorsal cluster of 5 or more ducts along lateral margin ..... 14
- 14a (13a). Second and third pygidial furrows each with 12-20 ducts; L1 notched only on outer margin ..... 15
- 14b. Second and third pygidial furrows each with less than 10 ducts; L1 notched on both margins or only on outer margin ..... 16
- 15a (14a). Prepygidial segments A1, A2 and A3 with 3, 2 and 1 macroduct, respectively ; on palms (Arecaceae) and *Pandanus* from Oriental and Pacific Island regions ..... *C. prosimus* Banks
- 15b. Prepygidial segment A3 with 2 or 3 macroducts; A2 with 0 or 1 macroducts and A1 without macroducts; on *Nepenthes* from Thailand ..... *C. nepenthivorus* sp. nov.
- 16a (14b). Pygidium with 3 fringed plates present between L3 and L4, each with a pair of terminal processes; anal opening separated from base of L1 by less than 1.5x its diameter; paraphysis arising from medial angle of L1 subequal in length of that arising from anterior base of L1; on *Cocos* and *Litsea* from Seychelles ..... *C. ansei* (Green)
- 16b. Pygidium with 4 fringed plates present between setae marking positions of L3 and L4, each without a terminal process; anal opening separated from base of L1 by more than 2x its diameter; paraphysis arising from medial margin of L1 about two-thirds length of that arising from lateral angle of L1; on Fabaceae in China. .... *C. silvestrii* Chou

### Distribution:

The genus *Chrysomphalus* is probably native to the Asia-Australian region (Table 1). Eleven of the 16 species of *Chrysomphalus* occur in Asia (Eastern Palearctic and Oriental region); of these, 6 species are not known to occur outside the region. Four of the six species found in Australia are endemic to Australia. Two species were described from, and are only known to occur in the Malagasian region; *C. aberrans* was described on tea (*Thea*) from Madagascar but it may have been introduced from Asia; *C. ansei* was described from the Seychelles on coconut (*Cocos*) and may also be native to Asia. Species present elsewhere are probably introduced species from Asia or Australia.

### *Chrysomphalus nepenthivorus* Smith-Pardo, Evans & Dooley sp. nov.

Fig. 2, 3, 4

### Diagnosis.

*Chrysomphalus nepenthivorus* is characterized by having: perivulvar pores, the first two plates anterior to L3 with fringed apices, prepygidial segments without a cluster of 5 or more macroducts, the second and third pygidial furrows each with 12-20 ducts and L1 notched only on outer margin. It is most similar to *Chrysomphalus*

*propsimus*, which also has these characters, but differs by apparently being restricted to *Nepenthes* and by having 2 or 3 macroducts on the lateral margin of A3, 1 macroduct on the lateral margin of A2, and no macroducts on A1; whereas, *C. propsimus* is only known on palms and has 3, 2 and 1 macroducts on A1, A2 and A3, respectively.

**TABLE 1.** Zoogeographic Distribution of *Chrysomphalus* species.

<i>Chrysomphalus</i>	Author	NA	NT	WP	AF	MG	EP	OR	AU	PI
<i>aberrans</i>	Mamet					T				
<i>ansei</i>	(Green)					T				
<i>aonidium</i>	(Linnaeus)	x	x	x	x	x	T	x	x	x
<i>bifasciculatus</i>	Ferris	T	x	x			x	x		
<i>dictyospermi</i>	(Morgan)	x	T	x	x	x	x	x	x	x
<i>diversicolor</i>	(Green)			T	x	x		x		
<i>fodiens</i>	(Maskell)								T	
<i>mume</i>	Tang						T			
<i>nepenthivorus</i>	n.sp							T		
<i>nulliporus</i>	McKenzie							T		
<i>pinnulifer</i>	(Maskell)		x	x	x	x		x		T
<i>propsimus</i>	Banks							T		x
<i>rubribullatus</i>	(Froggatt)								T	
<i>silvestrii</i>	Chou						T			
<i>trifasciculatus</i>	Brimblecombe								T	
<i>variabilis</i>	McKenzie								T	
<b>Total species = 16</b>	-	<b>3</b>	<b>4</b>	<b>5</b>	<b>4</b>	<b>6</b>	<b>5</b>	<b>8</b>	<b>6</b>	<b>4</b>

NA (Nearctic); NT (Neotropical); WP (Western Palearctic); AF (Afrotropical); MG (Malagasian);

EP (Eastern Palearctic); OR (Oriental); AU (Australian); PI (Pacific Islands). T = region from which the type material was collected (Ben-Dov et al., 2012).

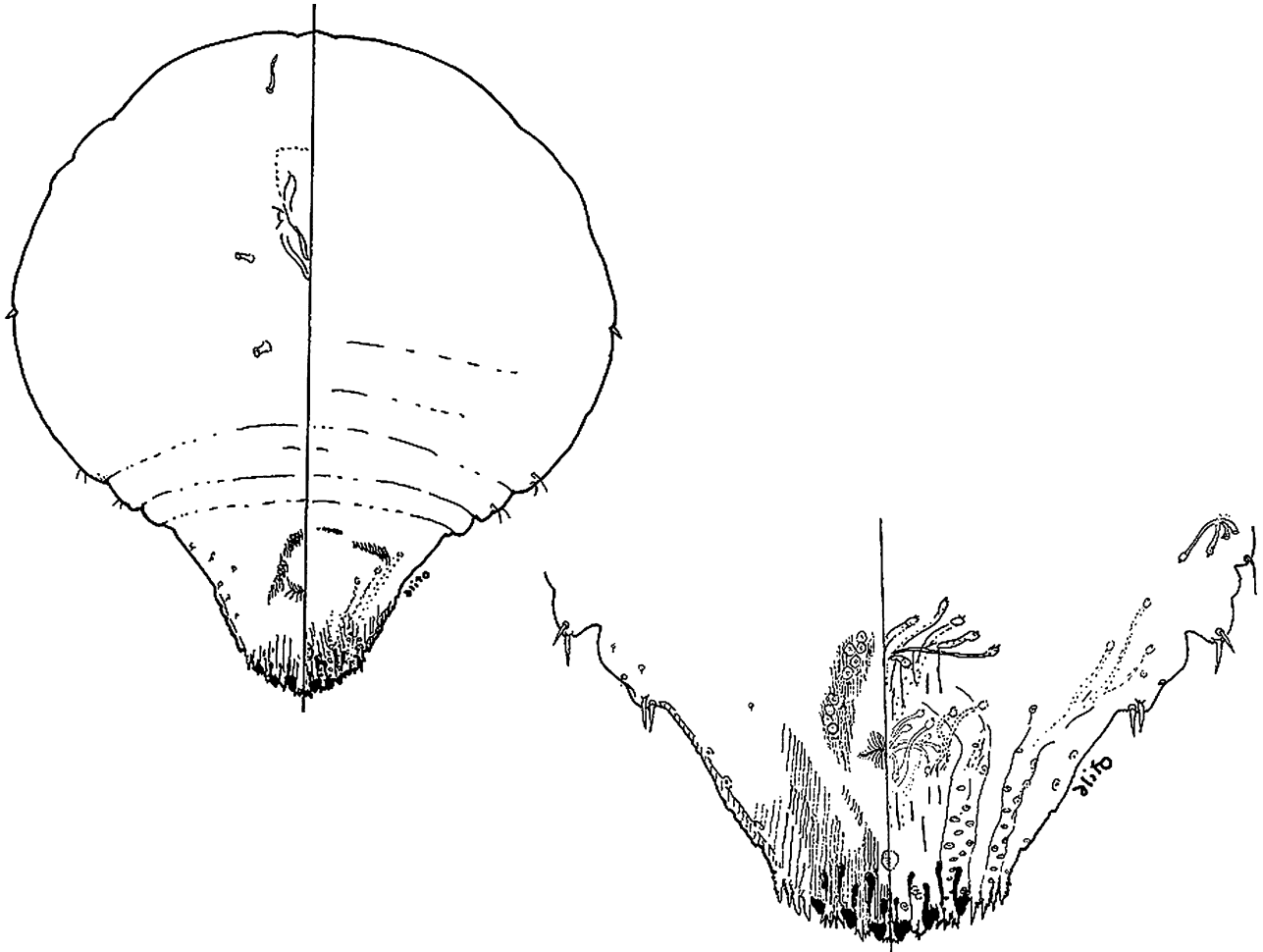
### Description.

*In nature:* Adult female non-pupillarial; scale cover reddish-brown, circular, more or less thick and with exuvium central (Fig. 4b).

*Slide mounted specimens* (ranges in parentheses refer to paratypes). Female (holotype): *Dimensions:* body length 1093 (554–1093)  $\mu\text{m}$  long, body width 950 (436–950)  $\mu\text{m}$ . *Pygidium* slightly broader than long (264  $\mu\text{m}$  long by 421  $\mu\text{m}$  wide), with a slightly truncate posterior margin. *Cephalothorax* (fig. 3): anterior margin of head membranous with slightly rugose integument. Each antennal composed of a conspicuous seta arising from base of a tubercle. Anterior and posterior spiracles without associated disc pores. Integument between anterior and posterior spiracle similar to that of rest of cephalothorax. Thoracic tubercle spur-like, sharply pointed (fig. 3c) and 11 (6–12)  $\mu\text{m}$  long. *Prepygidium:* lateral margin of A2 and A3 segments with 0 or 1 and 2 or 3 elongate macroducts, respectively; lateral margin of A1 and A4 without macroducts. *Pygidium:* with 3 well-developed lobes (L1, L2, L3), each with a rounded apex and 1 small notch along lateral margin (fig 3b) with the following lengths: L1 15–16 (13–19)  $\mu\text{m}$  long, L2 10–11 (10–17)  $\mu\text{m}$  long, and L3 10–11 (9–16)  $\mu\text{m}$  long. *Basal sclerosis:* L1 with a basal sclerosis arising from mesal angle of lobe, very narrow with slightly clavate apices, longer than length of L1 and about half as long as adjacent paraphyses. *Paraphyses:* 4 pairs present, all long and slender with slightly clavate apices; those arising from between L1 and L2 and those between L2 and L3 subequal in length, each about 2x as long as basal sclerosis and slightly longer than paraphyses arising from posterior margin (mesal angle) of L2 and L3; paraphyses lengths: anteromedial corner of L1 14–15 (13–20)  $\mu\text{m}$  long, anterolateral corner of L1 19–20 (19–27)  $\mu\text{m}$  long, anteromedial corner of L2 20–21 (15–23)  $\mu\text{m}$  long, between L2 and L3 20–21 (19–27)  $\mu\text{m}$  long, anteromedial corner of L3 16–17 (14–21)  $\mu\text{m}$  long. *Plates:* all plates with fringed apices, those between L1, L1 and L2 and L2 and L3 each with 4 or 5 tines, those anterior to L3 on 3 membranous protuberances, each dendritic with 2 primary tines and 7–9 secondary tines; with 1 pair of plates present between medial lobes; 2 plates between L1 and L2, 3 plates between L2 and L3, and 3 plates anterior to L3. Plate formula 2–2–3–3. Lateral margin of pygidial segments A4, A5, and A6 sclerotized and serrated,

but serrations blunt not sharp. *Macroducts*: all long and slender, first furrow (arising between L1 and L2) with 4 macroducts; second and third pygidial furrows each with 16 or more macroducts in double or triple rows. *Anal opening*: Small, 15–16 (12–17)  $\mu\text{m}$  long by 14–15 (10–15)  $\mu\text{m}$  wide; distance between anal pore and pygidial apex: 32–33 (25.1–35.2)  $\mu\text{m}$ . *Perivulvar pores*: present in 2 pairs of longitudinal clusters on each side of the vulva; each anterior pair with 6 (4–8) pores, each posterior pair with 4(2–5) pores, medial perivulvar pores absent.

**Male**: unknown.



**FIGURE 2.** Habitus and pygidium of the holotype (adult female) of *Chrysomphalus nepenthivorus* n.sp.

### Type material

*Holotype* adult female: THAILAND: on *Nepenthes* hybrid; intercepted at USDA-PPQ Plant Inspection Station, South San Francisco, CA. 08-01-2011. N. Pyle & A. H. Smith-Pardo Colls. Canadian Balsam. Slide# APWCA112136893001-01 (USNM).

*Paratype* adult females: same data as the holotype except slide numbers as follows: APWCA112136893001–02, 03, 04 (USNM), APWCA112136893001–05, 06, 07 (UCD), APWCA112136893001–08, 09, 10 (BMNH), APWCA112136893001–11, 12 (UCB), APWCA112136893001–13, 14 (AMNH), APWCA112136893001–15. Hoyer's, –16. Hoyer's (SEMC), APWCA112136893001–17. Hoyer's, –18. Hoyer's (MEFLG).

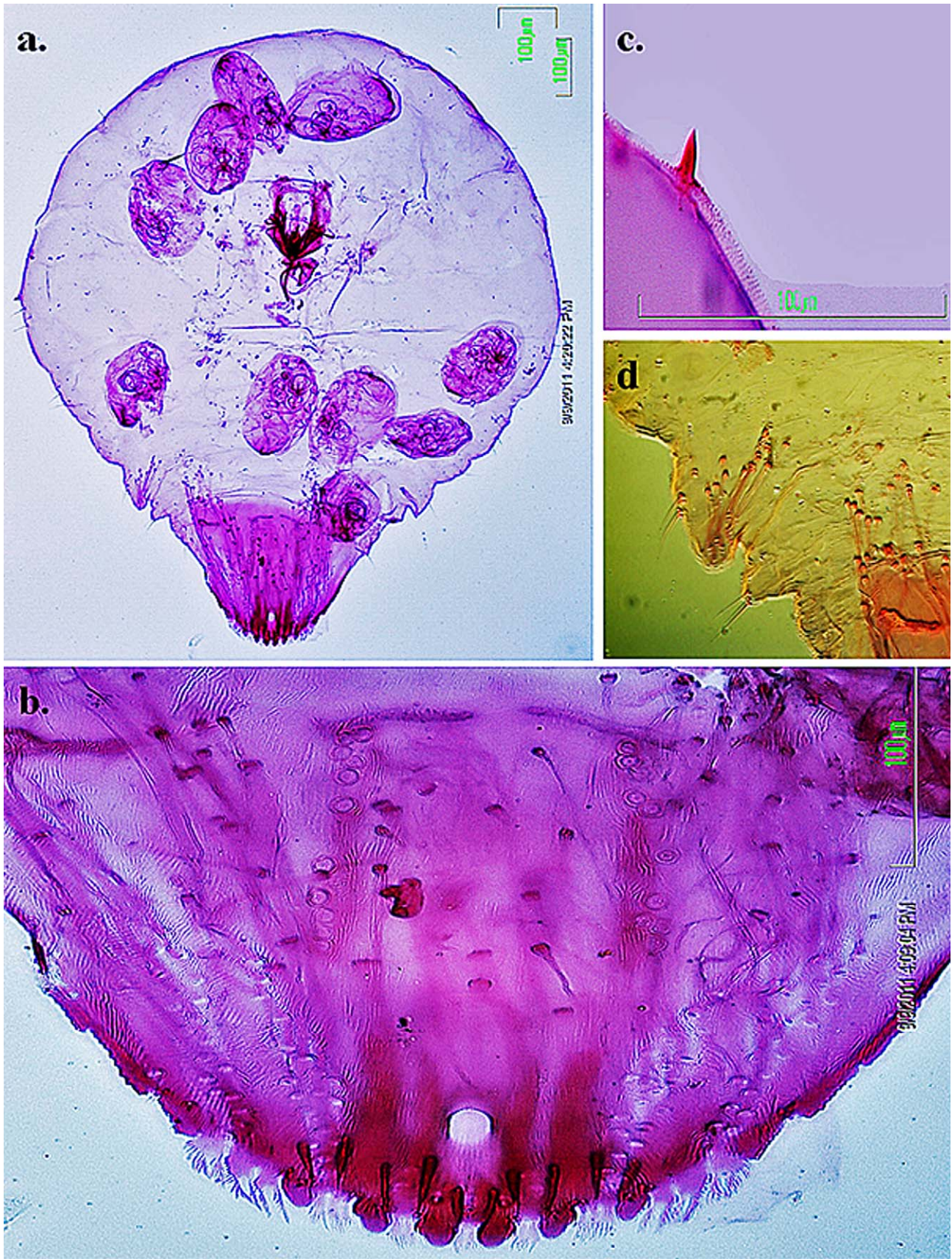
### Host

Live gravid females, 2<sup>nd</sup> and 3<sup>rd</sup> instars, and crawlers were collected on leaves of several hybrids of *Nepenthes* (Fig. 4a–4c).

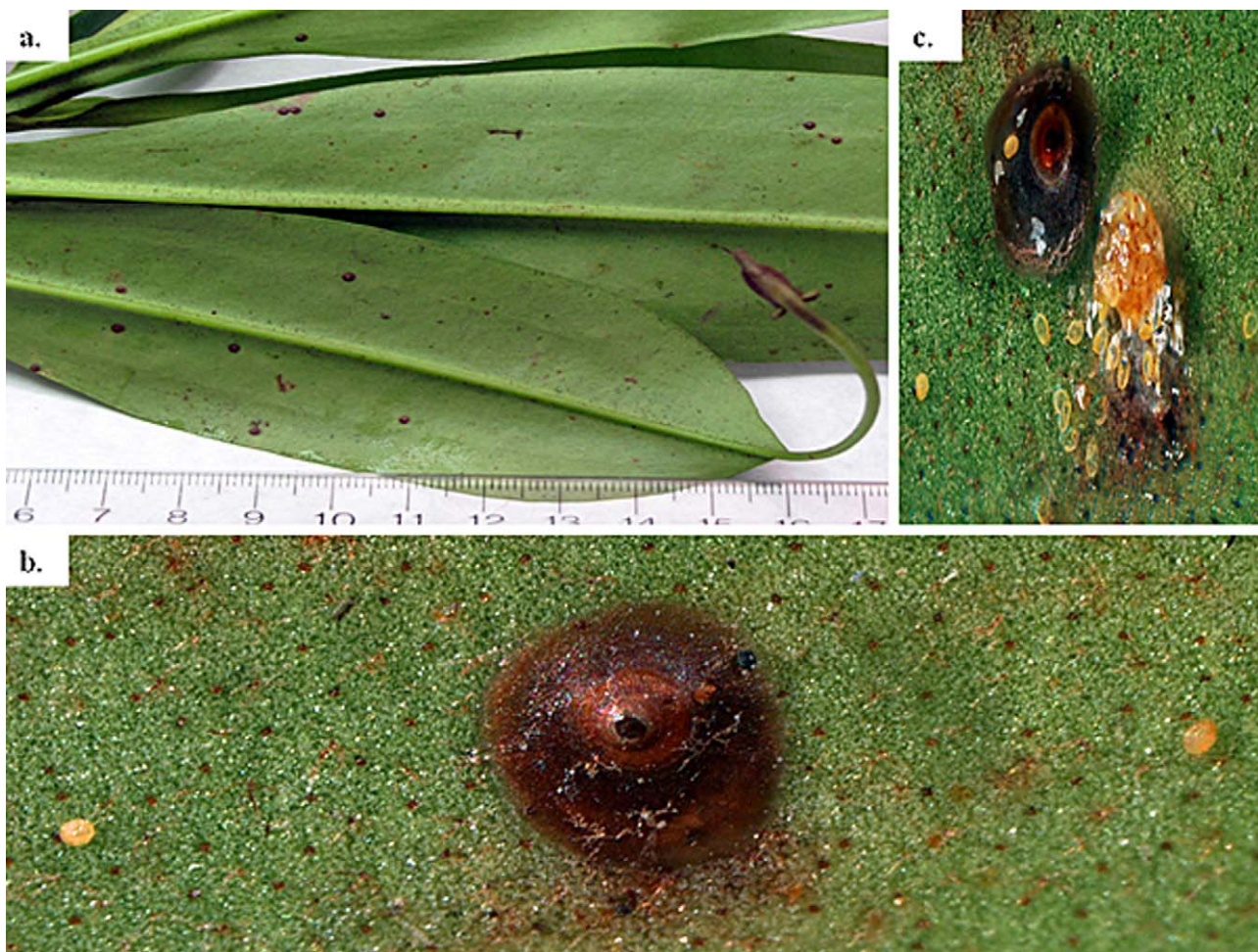
### Etymology

The species name is derived from a combination of host plant genus, *Nepenthes*, with the ending *vorus*, derived from the Latin verb *vorare* meaning to eat (referring to the phytophagous nature of the scale on the host plant - 'habitually eating' or 'feeding on').

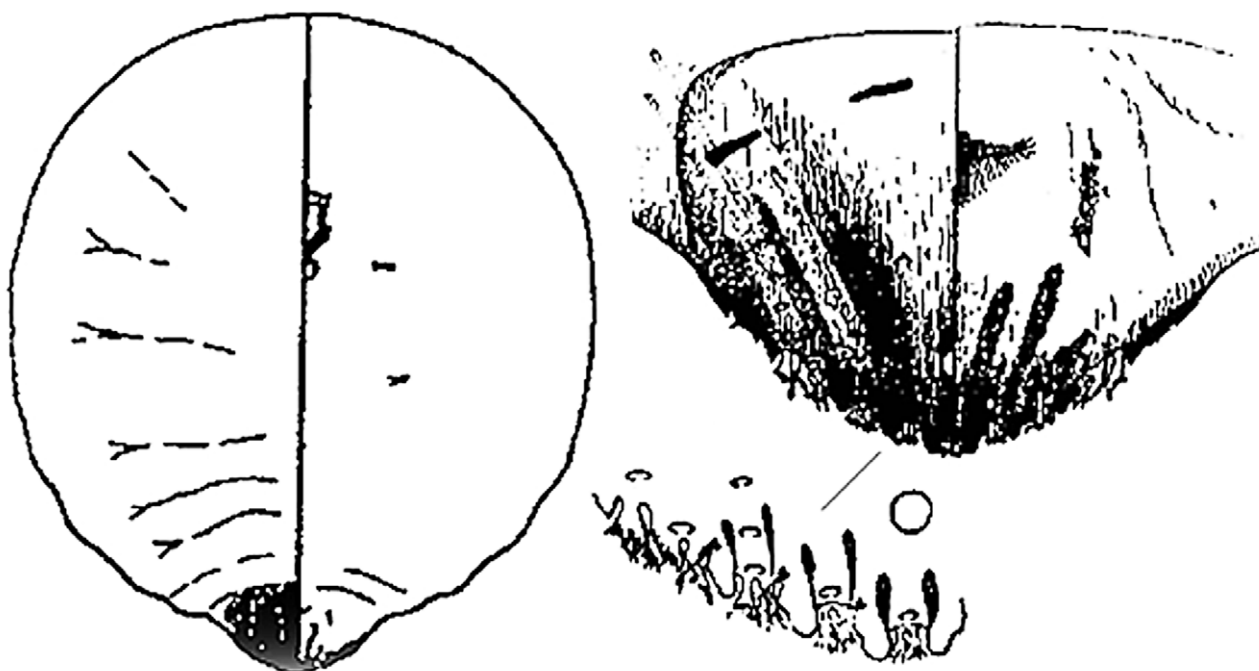




**FIGURE 3.** Photomicrographs of the holotype of *Chrysomphalus nepenthivorus* n.sp.: a. habitus, b. detail of pygidium, c. thoracic tubercle, d. macroducts on prepygidial (abdominal) segments.



**FIGURE 4.** Photograph of the host and scale of *Chrysomphalus nepenthivorus* n.sp.: a. host with scales on leaves (scale in centimeters), b. zoom in of scale, c. scale lifted showing female with immature (crawlers).



**FIGURE 5.** Habitus and pygidium of adult female *Chrysomphalus aberrans* (Mamet); after Mamet (1951).

**Catalog of the species of *Chrysomphalus***

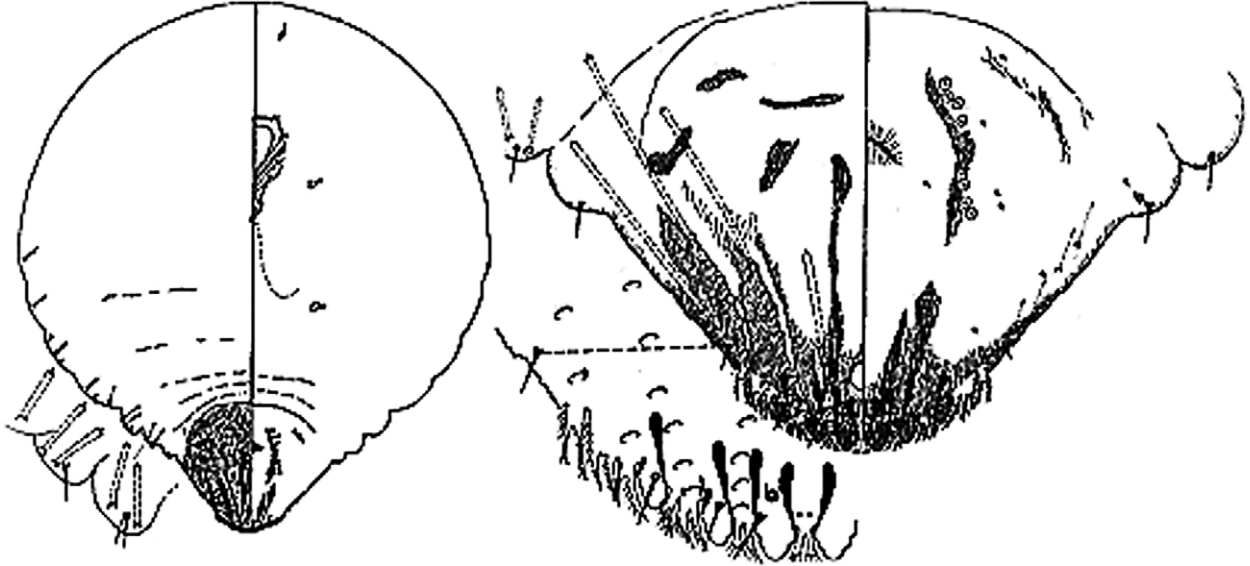
For a complete list of published records of host plants and geographic distribution *Chrysomphalus* species, see Ben-Dov, 2012.

1. *C. aberrans* Mamet, 1951 (Fig. 5)

Type material: Holotype: female. Type locality: Madagascar (North Tamatave), MNHN.

Distribution: *Malagasian*: Madagascar.

Host: *Thea* sp. (Theaceae).



**FIGURE 6.** Habitus and pygidium of adult female *Chrysomphalus ansei* (Green); after McKenzie (1939).

2. *C. ansei* (Green, 1916) (Fig. 6)

Type material: Syntype: female. Type locality: Seychelles (Anse aux Pins), MNHN.

Distribution: *Malagasian*: Seychelles.

Hosts: *Cocos nucifera* (Arecaceae), *Litsea glutinosa* (Lauraceae).

Note: The USNM has 2 slides that are marked “Type Material”. Contrary to McKenzie’s illustration of the species, which shows a short paraphysis in the L2–L3 interlobular space, the USNM specimens show a long, prominent paraphyses in this space on the right side of each specimen, but weaker and less conspicuous on the left side of the pygidium.

3. *C. aonidum* (Linnaeus, 1758) (Fig. 7)

Type material: Lectotype: female. Type locality: Asia (country not indicated), LSL.

Distribution: *Cosmopolitan*.

Hosts: This species has been reported on more than fifty families of host plants.

4. *C. bifasciculatus* Ferris, 1938 (Fig. 8)

Type material: Holotype: female. Type locality: USA (California, Pasadena), UCD.

Distribution: *Cosmopolitan*.

Hosts: This species has been reported from more than 26 families of host plants

Note: The USNM has 1 slide that is marked as being part of the type material.

5. *C. dictyospermi* (Morgan, 1889) (Fig. 9)

Type material: Syntype: female. Type locality: Guyana (Demerara), in BMNH.

Distribution: *Cosmopolitan*.

Hosts: This species has been reported from more than 50 families of host plants.

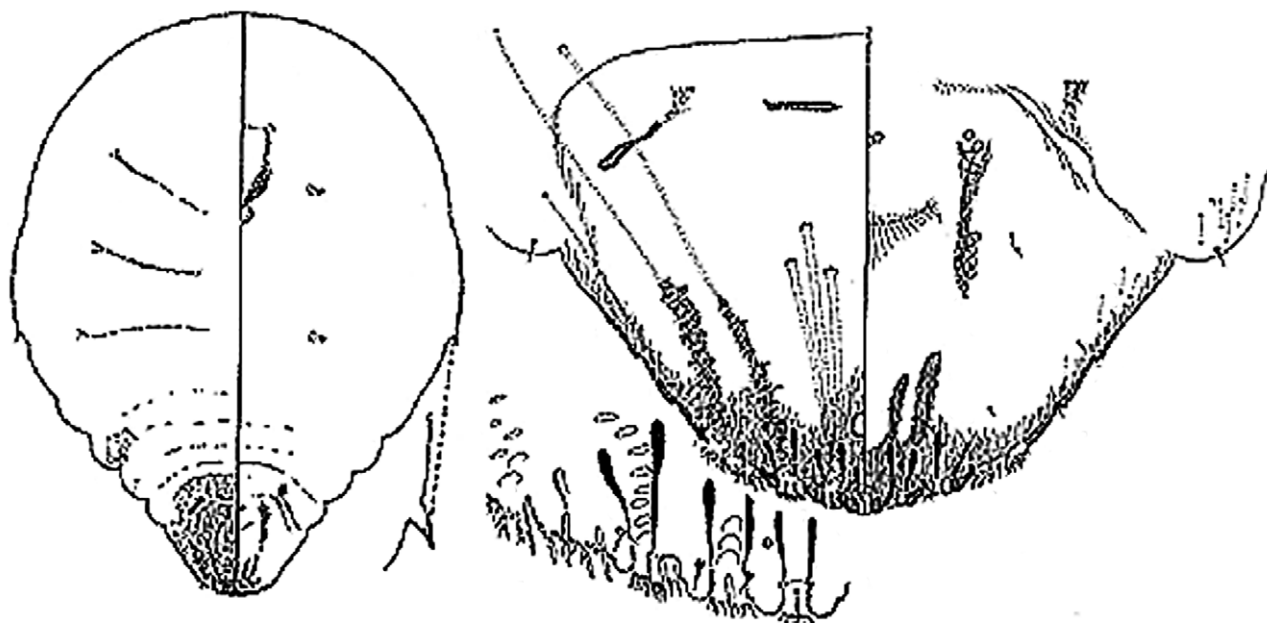


FIGURE 7. Habitus and pygidium of adult female *Chrysomphalus aonidum* (Linnaeus)[as *C. ficus*]; after Ferris (1938).

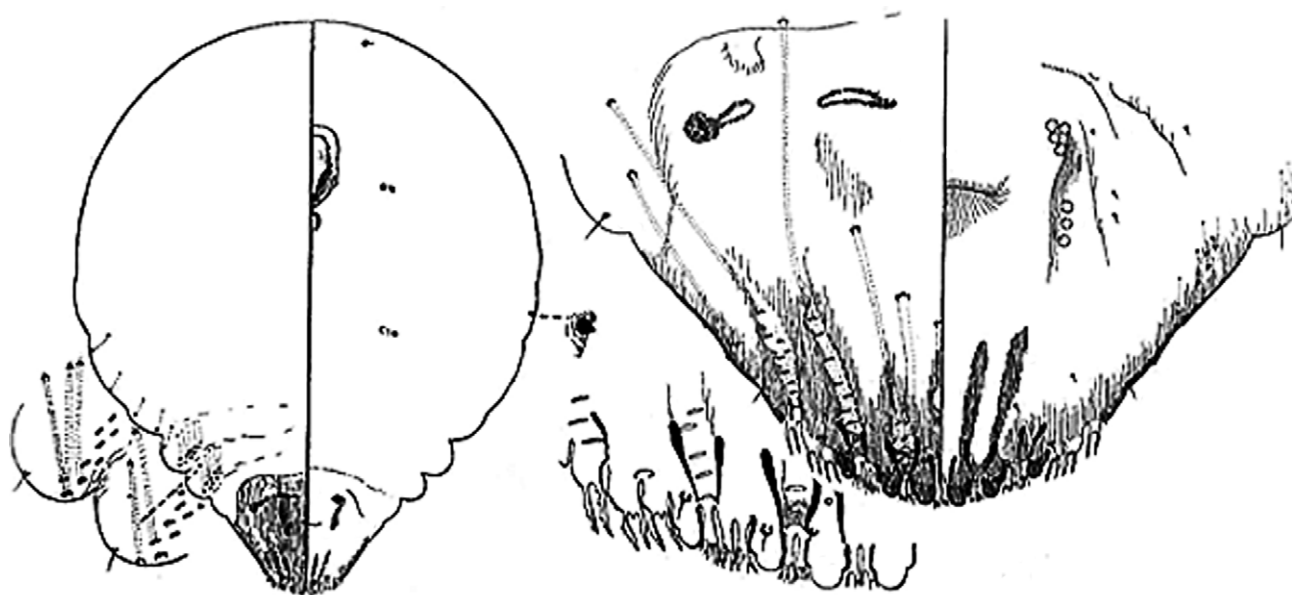


FIGURE 8. Habitus and pygidium of adult female *Chrysomphalus bifasciculatus* Ferris; after Ferris (1938).

6. *C. diversicolor* (Green, 1923) (Fig. 10)

Type material: Syntype: female. Type locality: Madeira, BMNH.

Distribution: *Western Palearctic*: Canary Islands, Madeira Islands, Spain, Portugal; *Afrotropical*: South Africa; *Malagasian*: Madagascar, Mauritius; *Oriental*: Hong Kong (new record), India, Sri Lanka.

Hosts: This species has been reported from more than 20 families of host plants.

7. *C. fodiens* (Maskell, 1892) (Fig. 11)

Type material: Syntype: female. Type locality: Australia, NZAC.

Distribution: *Australian*: Australia (Northern Territory and Victoria).

Hosts: *Acacia* sp. (Fabaceae), *Melaleuca leucadendron* (Myrtaceae), *Musa* sp. (Musaceae), *Pithecellobium moniliferum* (Fabaceae), *Strobilanthes viscosus* (Acanthaceae).

Note: The USNM has several slides from Australia that are labeled as this species that are from the Maskell collection. No other data is present on the slides to indicate whether they are part of the type series.

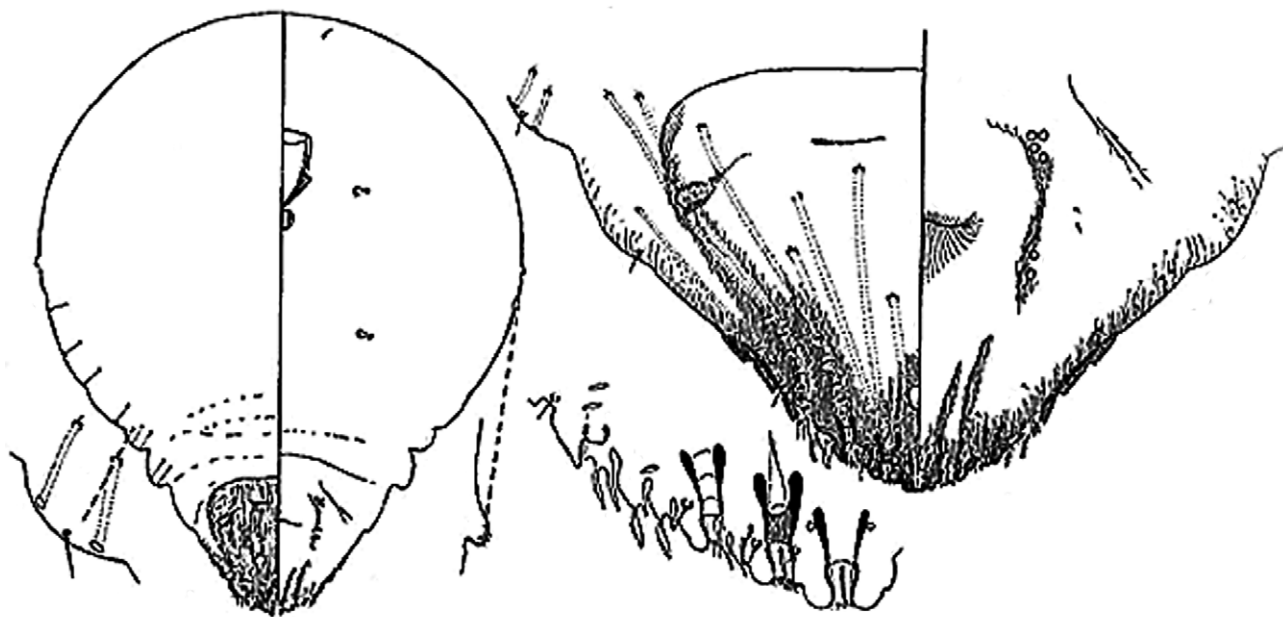


FIGURE 9. Habitus and pygidium of adult female *Chrysomphalus dictyospermi* (Morgan); after Ferris (1938).

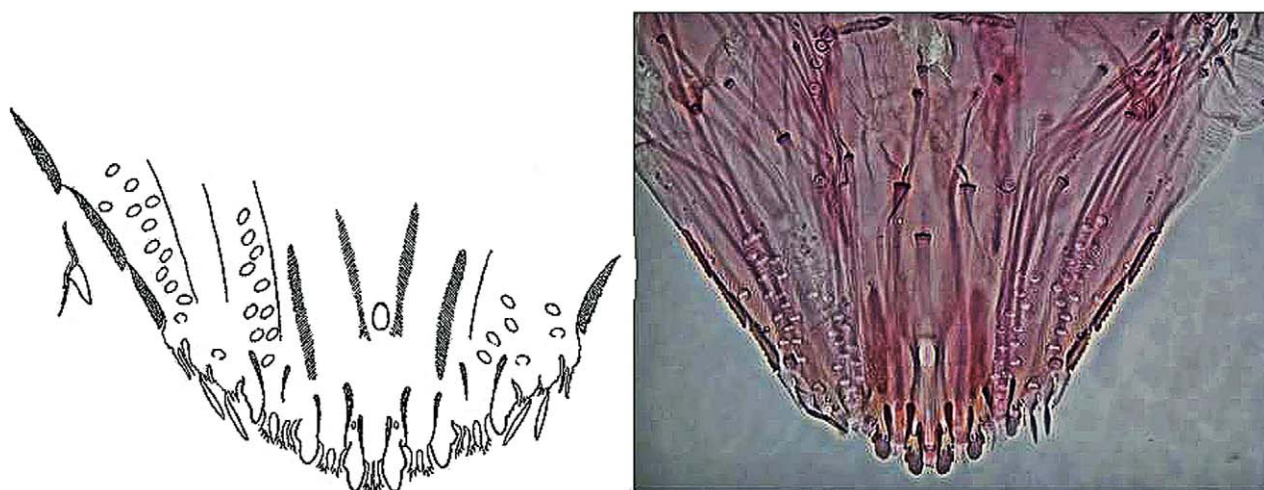


FIGURE 10. Habitus and pygidium of adult female *Chrysomphalus diversicolor* (Green); after Green (1923).

8. *C. mume* Tang, 1984 (Fig. 12)

Type material: Holotype: female. Type locality: China (Yunnan Province), EISC.

Distribution: Eastern Palearctic: China.

Hosts: *Prunus mume* (Rosaceae).

9. *C. nepenthivorus* Smith-Pardo, Evans & Dooley n. sp. (Figs 2–4)

Type material: Holotype: female. Type locality: Thailand (hybrid from nursery), USNM.

Distribution: *Oriental*: Thailand.

Hosts: *Nepenthes* spp. hybrids (Nepenthaceae).

10. *C. nulliporus* McKenzie, 1939 (Fig. 13)

Type material: Holotype: female. Type locality: Philippines, UCD.

Distribution: *Oriental*: India (new record), Philippines.

Hosts: *Epigeneium treacherianum* [= *Dendrobium lyonii*], *Pholidota* sp. (Orchidaceae).

Note: The USNM has 1 slide that was intercepted in New Jersey on *Dendrobium* sp. plants from India.

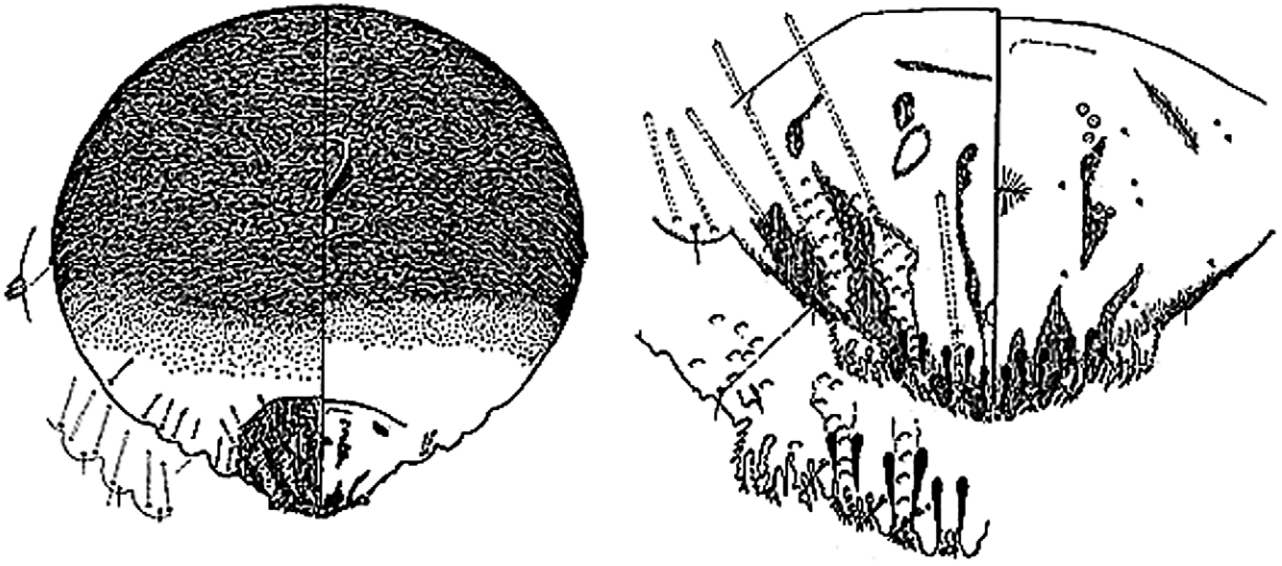


FIGURE 11. Habitus and pygidium of adult female *Chrysomphalus fodiens* (Maskell); after McKenzie (1939).

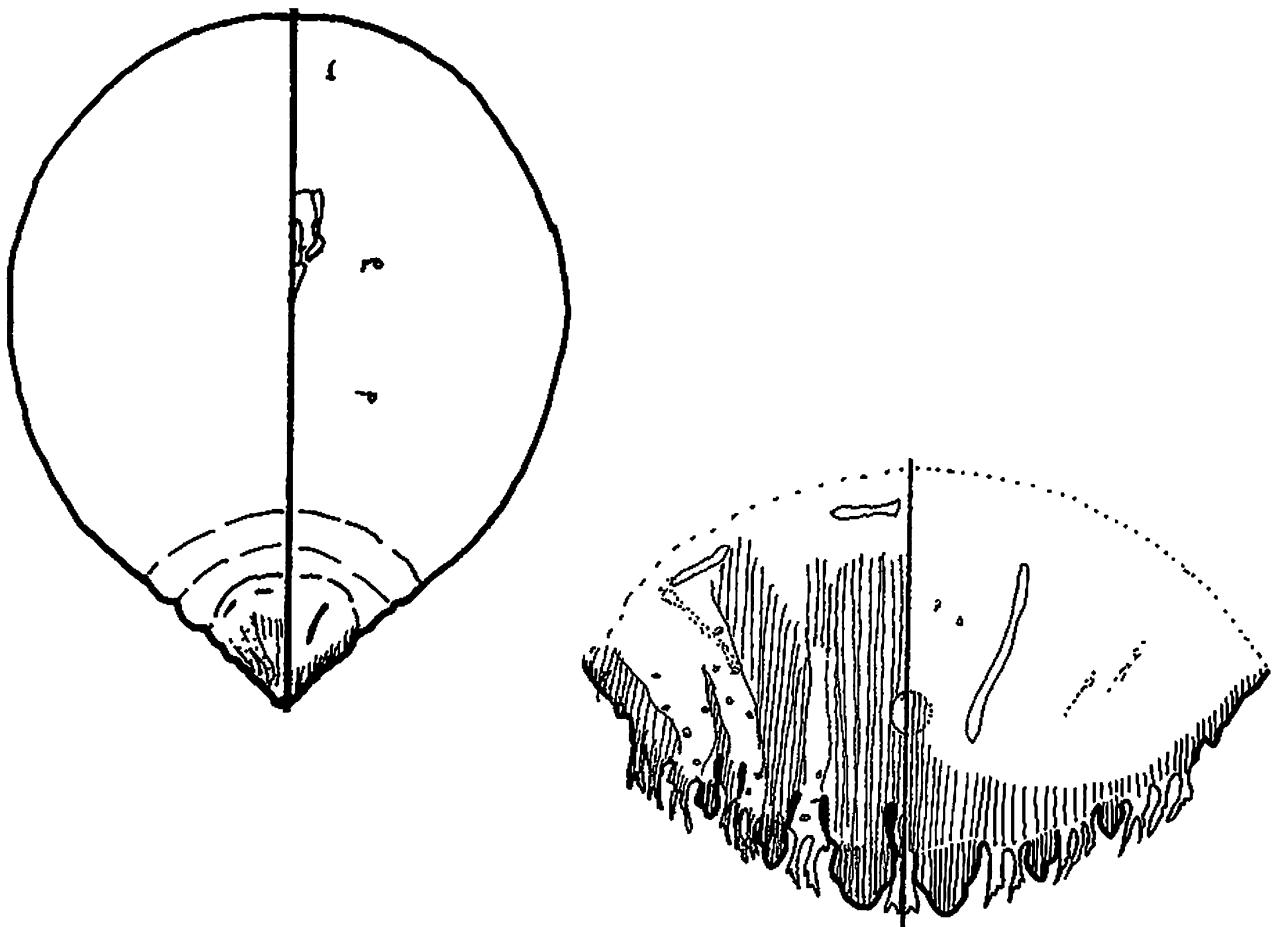


FIGURE 12. Habitus and pygidium of adult female *Chrysomphalus mume* Tang; after Tang (1984), interpreted and re-illustrated by AHSP.

11. *C. pinnulifer* (Maskell, 1891) (Fig. 14)

Type material: Syntypes: female. Type locality: Fiji, NZAC.

Distribution: *Neotropical*: Argentina, Brazil, Colombia, Dominican Republic, Guatemala, Peru; *Western Palearctic*: Algeria, Azores, Canary Islands, Italy, Madeira Islands, Portugal, Sicily, Spain, Turkey; *Afrotropical*: Angola, Kenya, Mozambique, South Africa; Zimbabwe; *Malagasian*: Madagascar, Reunion, Saint Helena, Seychelles; *Eastern Palearctic*: China, South Korea; *Oriental*: Bangladesh, India, Thailand; *Austro-Oriental*: Indonesia, Malaysia, Papua New Guinea, Philippines; *Australian*: Australia.

Hosts: reported from more than 36 families of plants.

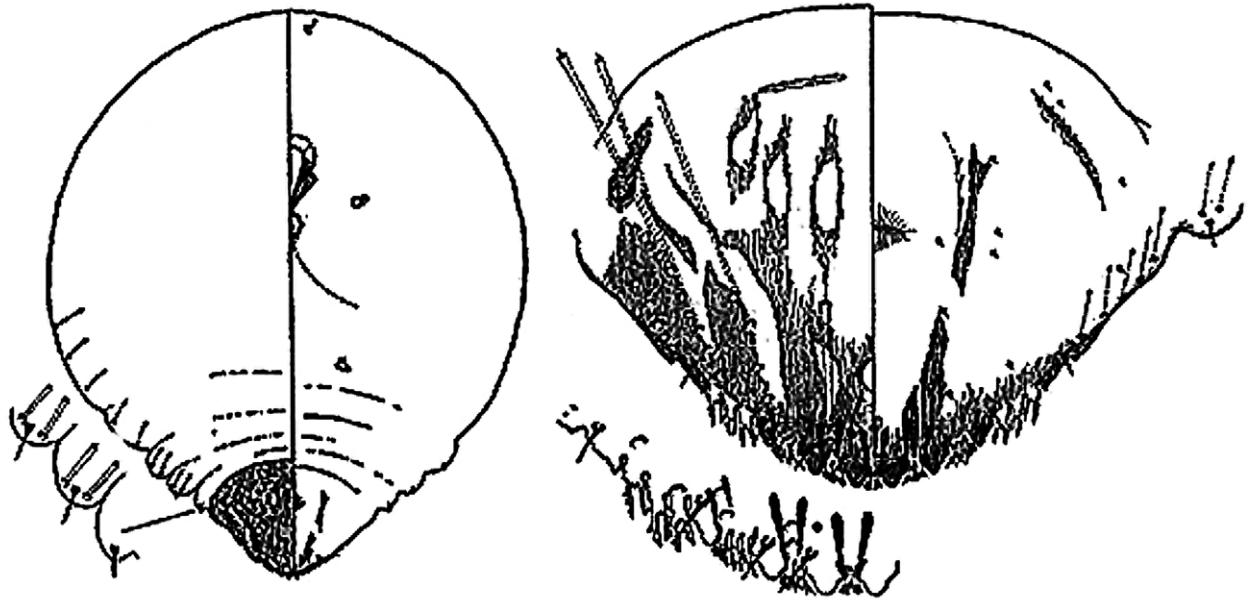


FIGURE 13. Habitus and pygidium of adult female *Chrysomphalus nulliporus* McKenzie; after McKenzie (1939).

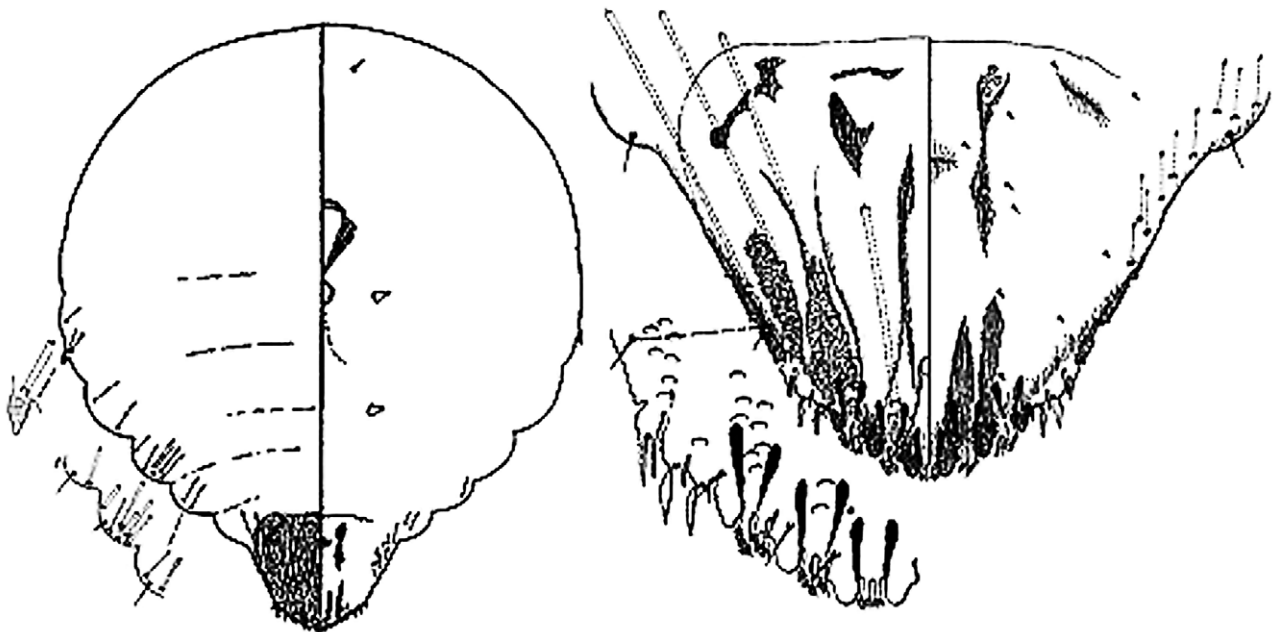


FIGURE 14. Habitus and pygidium of adult female *Chrysomphalus pinnulifer* (Maskell); after McKenzie (1939).

12. *C. prosimus* Banks, 1906 (Fig. 15)

Type material: Holotype: female. Type locality: Philippines (Manila), MPMP.

Distribution: *Eastern Palearctic*: China; *Oriental*: Hong Kong, Indonesia, Malaysia, Philippines, Vietnam; *Pacific Islands*: Hawaii, Kiribati, Tuvalu.

Hosts: *Calamus spectabilis*, *Cocos nucifera*, *Corypha elata*, *Metroxylon* sp. (Arecaceae).

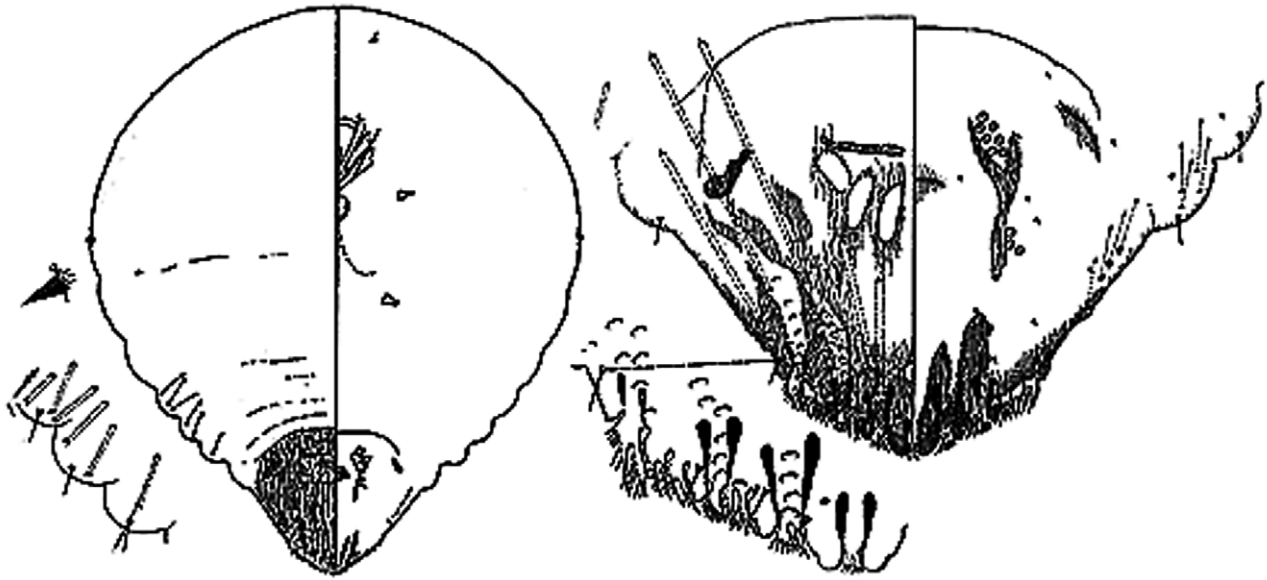


FIGURE 15. Habitus and pygidium of adult female *Chrysomphalus prosimus* Banks; after Ferris (1938).

13. *C. rubibullatus* (Froggatt, 1914) (Fig. 16)

Type material: Holotype: female. Type locality: Australia (Western Australia) ANIC.

Distribution: *Australian*: Australia (Western Australia).

Hosts: *Eucalyptus* spp. (Myrtaceae).

Note: The USNM has 1 slide marked cotype.



FIGURE 16. Habitus and pygidium of adult female *Chrysomphalus rubibullatus* (Froggatt); after Brimblecombe (1958).

14. *C. silvestrii* Chou, 1946 (Fig. 17)

Type material: Syntype: female. Type locality: China (Yunnan Province), depository unknown.

Distribution: *Eastern Palearctic*: China.

Hosts: undetermined Fabaceae.



15. *C. trifasciculatus* Brimblecombe, 1959 (Fig. 18)

Type material: Holotype: female. Type locality: Australia (Queensland), QM.

Distribution: *Australian*: Australia (Queensland and New South Wales).

Hosts: *Eucalyptus* spp. (Myrtaceae).

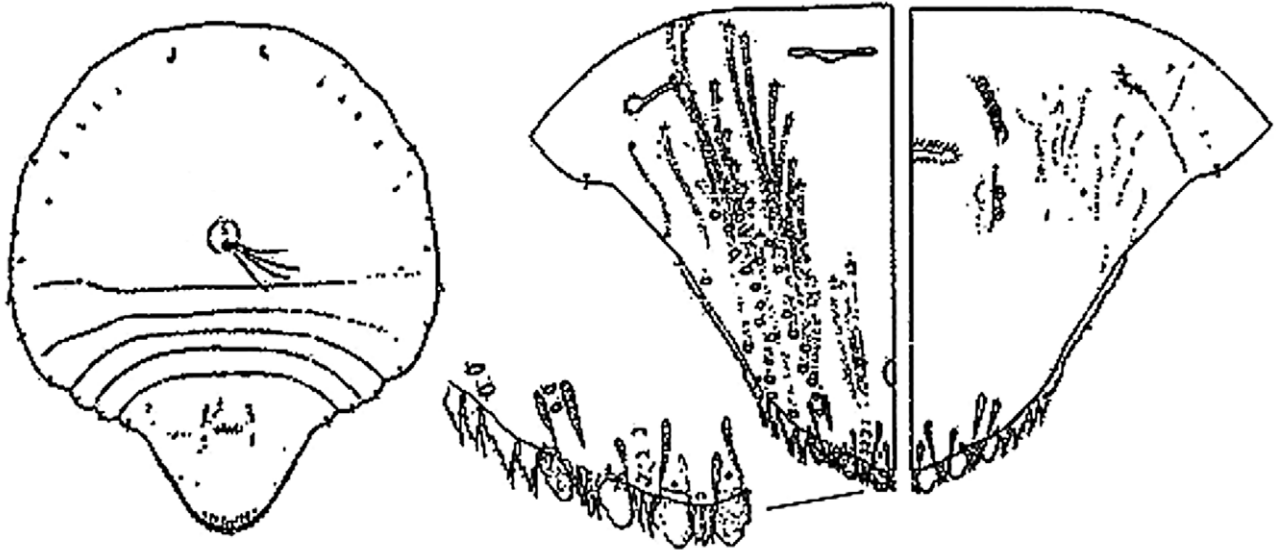


FIGURE 17. Habitus and pygidium of adult female *Chrysomphalus silvestrii* Chou; after Chou (1946).

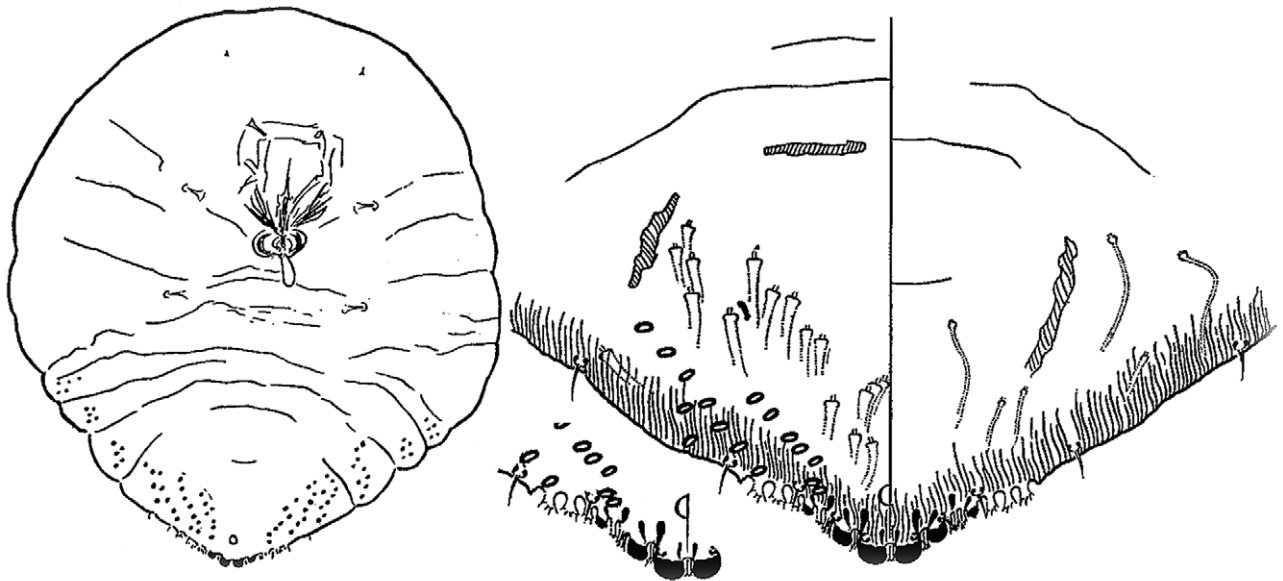


FIGURE 18. Habitus and pygidium of adult female *Chrysomphalus trifasciculatus* Brimblecombe; after Brimblecombe (1958).

16. *C. variabilis* McKenzie, 1943 (Fig. 19)

Type material: Holotype: female. Type locality: Australia (West Australia), UCD.

Distribution: *Australian*: Australia (Western Australia).

Hosts: *Santalum acuminatum* (Santalaceae).

Note: The USNM has 1 slide that is marked as "Type Material".

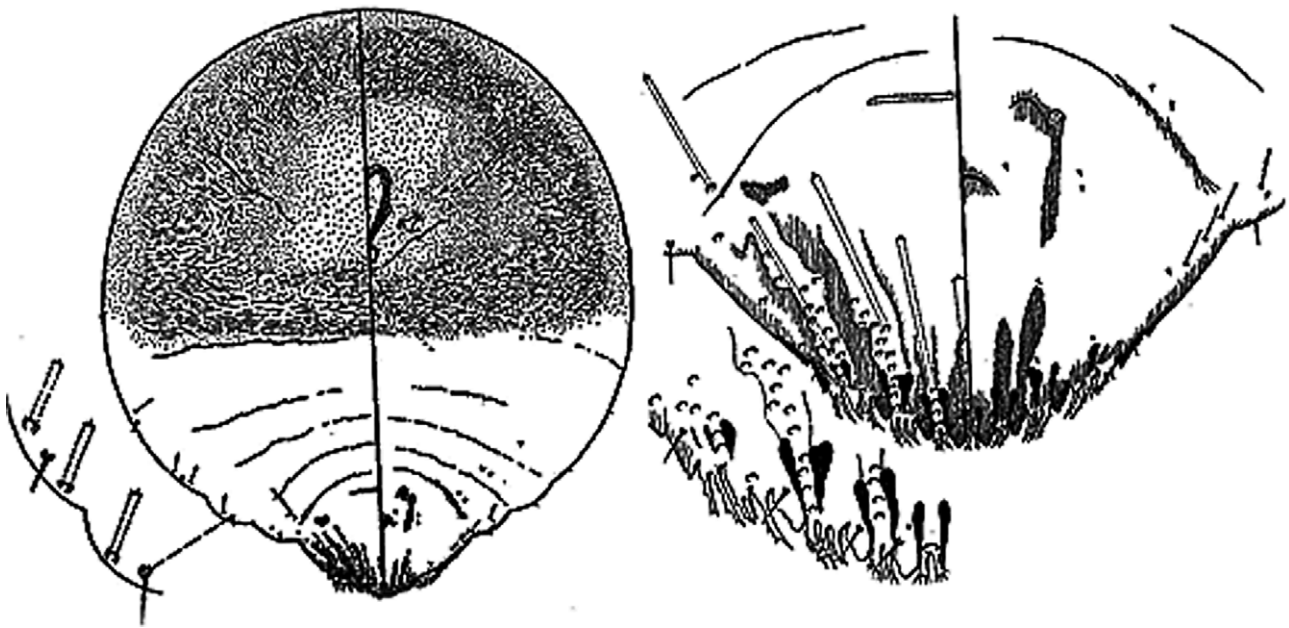


FIGURE 19. Habitus and pygidium of adult female *Chrysomphalus variabilis* McKenzie; after McKenzie (1939).

#### Other taxonomic changes proposed

##### *Melanaspis greeni* (Leonardi) 1914, stat. rev.

Fig. 20

*Chrysomphalus greeni* Leonardi, 1914. Type material: Syntype: female. Type locality: Guinea (Conakry), UNINA (examined).

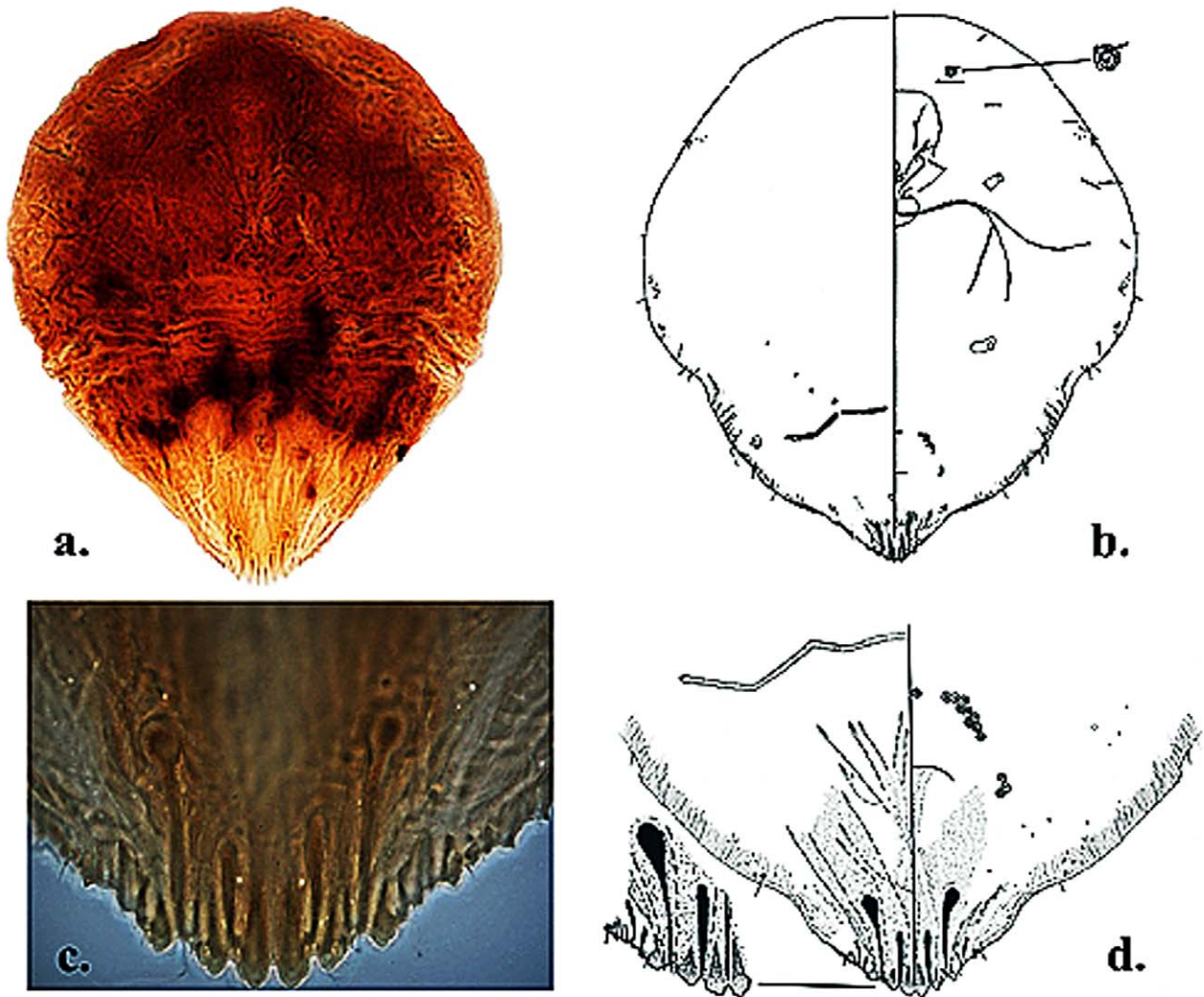
*Melanaspis greeni* (Leonardi); Lindinger 1943: 147. Change of combination.

*Chrysomphalus greeni* Leonardi; Borchsenius 1966: 290. Revived combination.

**Host:** unknown.

**Distribution:** *Afrotropical*: Guinea.

**Discussion:** Leonardi (1914) described *Chrysomphalus greeni* from specimens found on an unknown plant in Guinea. Lindinger (1943) transferred the species to *Melanaspis*, and later Borchsenius (1966) transferred it back to *Chrysomphalus*. Upon our request, Professor Antonio Pietro Garonna, curator of the insect collection of the Department of Entomology in Portici, Italy, kindly arranged for the loan of specimens of the type series. Unlike the pygidium of *Chrysomphalus* species, which lack a series of short paraphyses anterior to L3 and have conspicuous, long, branched or clubbed plates between L2 and L3 and anterior to L3, the pygidium of *C. greeni* is similar to that of *Melanaspis* in that: (i) the lateral margin is sclerotized with a series of short paraphyses anterior to L3 and (ii) the plates are short, spine-like and inconspicuous, not exceeding the length of the lobes. Relatively few species of *Melanaspis* have perivulvar pores, including this species. In the key of Deitz and Davidson (1986) to the North American species of *Melanaspis*, *M. greeni* would key out to and is most similar to *Melanaspis ponderosa* Ferris 1941, especially in the size and shape of the paraphyses. Of the Afrotropical species of *Melanaspis*, *M. greeni* comes closest to *Melanaspis sansevii* Mamet 1959, a species described from Madagascar on a crucifer, which has perivulvar pores and paraphyses similar to those of *M. greeni*. Peculiarly, L1–L3 of *M. greeni* each has a wide basal scleriosis similar to those observed in *Pygidiaspis cedri* Green 1915; whereas the basal scleroses are normally restricted to the median lobes.



**FIGURE 20.** Adult female from type series of *Melanaspis greeni* (Leonardi, 1914): a. photograph of female habitus, b. illustration of female habitus (left dorsal view, right ventral view), c. photograph of pygidium, d. illustration of pygidium.

***Diaspidiotus degeneratus* (Leonardi), 1896 (Fig. 11), stat. rev.**

Fig. 21

*Chrysomphalus degeneratus* Leonardi in Berlese & Leonardi, 1896: 345. Type data: Italy (Portici) on leaves of *Pandanus graminifolia*. Type depository: Portici: Dipartimento de Entomologia e Zoologia Agraria di Portici, Universita di Napoli Federico II, Italy

*Aspidiotus degeneratus* (Leonardi); Cockerell, 1896: 334.

*Aspidiotus (Chrysomphalus) degeneratus* (Leonardi); Cockerell, 1897: 29.

*Hemiberlesia degenerata* (Leonardi); McKenzie, 1939: 54.

*Abgrallaspis degeneratus* (Leonardi); Balachowsky, 1948: 317; Miller & Davidson, 2005: 42.

*Diaspidiotus degeneratus* (Leonardi); Borchsenius, 1950: 225.

*Dynaspidiotus degeneratus* (Leonardi); Borchsenius, 1966: 282; Danzig, 1993: 151.

**Distribution:** *Nearctic:* USA; *Western Palearctic:* Georgia, Greece, Italy, Portugal; *Eastern Palearctic:* China, Japan, North Korea.

**Host families:** Araliaceae, Aquifoliaceae, Celastraceae, Ericaceae, Oleaceae, Pandanaceae, Rutaceae, and Theaceae.

**Discussion:** Scale insect workers have found it difficult to place *Chrysomphalus degeneratus* in an appropriate genus based on its morphology, since it lacks some of the characteristics that define the various genera and/or

exhibits characteristics intermediate between genera. Since Leonardi described it in 1896, it has been placed in the following genera: *Abgrallaspis*, *Aspidiotus*, *Diaspidiotus*, *Dynaspidiotus* and *Hemiberlesia*. Prior to this study, it was placed in the genus *Abgrallaspis*. Research on the molecular systematics of diaspidid species by Andersen *et al.* (2010) and by Rugman-Jones *et al.* (2010), which included *Abgrallaspis degeneratus*, *Chrysomphalus aonidum*, *C. dictyospermi*, *Abgrallaspis cyanophylli* (the type species of the genus *Abgrallaspis*) and numerous species from several other aspidiotine genera, showed a very close relationship between *A. degeneratus* and species of *Chrysomphalus*, *Aonidiella* and *Diaspidiotus* and a relatively distant relationship to the *Abgrallaspis* species included in their study. After discussion with Benjamin Normark (*pers. comm.*) and consideration of the results of Anderson *et al.* (2010) and Rugman-Jones *et al.* (2010) it was decided to examine the morphology of *Abgrallaspis degeneratus* to determine whether it supported the molecular findings.

Although the genus *Abgrallaspis* has been shown to be paraphyletic (Andersen *et al.*, 2010; Rugman-Jones *et al.*, 2010) and its limits poorly-defined, it appears that the species currently placed in *Abgrallaspis* lack the paraphysis in the L2–L3 interlobular space and lack the long and slender paraphysis arising from the mesal corner of L1 typical of *Chrysomphalus*, *Aonidiella* and certain species of *Diaspidiotus* [as well as in *A. degeneratus*]. In *Abgrallaspis*, the paraphysis arising from the mesal corner of L1 is entirely absent, extremely short, or forms a wide basal sclerosis, at least half the width of L1, and the paraphysis arising from the lateral corner of L1 is either absent, or relatively short and/or weakly developed. In addition, most *Abgrallaspis* species have 3 pairs of well-developed pygidial lobes. Unlike *Chrysomphalus* species, the paraphyses of *A. degeneratus* are less well-developed, about as long as, or shorter than, the pygidial lobes, the paraphysis in the interlobular space between L2 and L3 is absent or very short and inconspicuous, and the margin anterior to L3 has a series of 3 short glandular spines, whereas in *Chrysomphalus* the paraphyses are well-developed, usually longer than the pygidial lobes with a well-developed, elongate paraphysis in the interlobular space between L2 and L3 and the margin anterior to L3 has a series of plates with clubbed, fringed or bifurcate apices. Based on these characters, we believe that *A. degeneratus* is better placed in *Diaspidiotus*, the genus in which Borchsenius (1950) had placed it. It is most similar to *Diaspidiotus africanus* (Marlatt, 1908) in the presence of perivulvar pores and in the shape of the lobes, paraphyses, plates and spines.

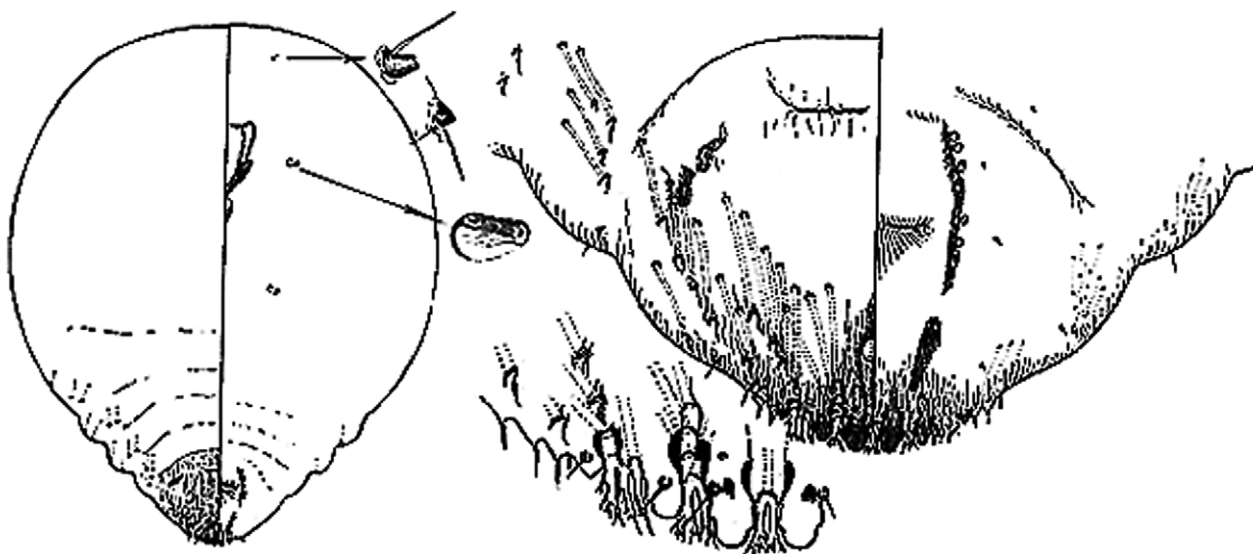


FIGURE 21. Habitus of adult female *Diaspidiotus degeneratus* (Leonardi), 1896

### *Pentalaminaspis* Smith-Pardo, Evans & Dooley, new genus

Fig. 22

Type species: *Chrysomphalus minutus* Kotinsky, 1908 by monotypy.

#### Generic diagnosis:

Aspidiotine, adult female broadly oval, nearly round with head and thorax membranous; pygidium with 3 pairs of well-developed lobes, L1 about as long as wide, L2 and L3 broadly spatulate with numerous (about 10) small teeth

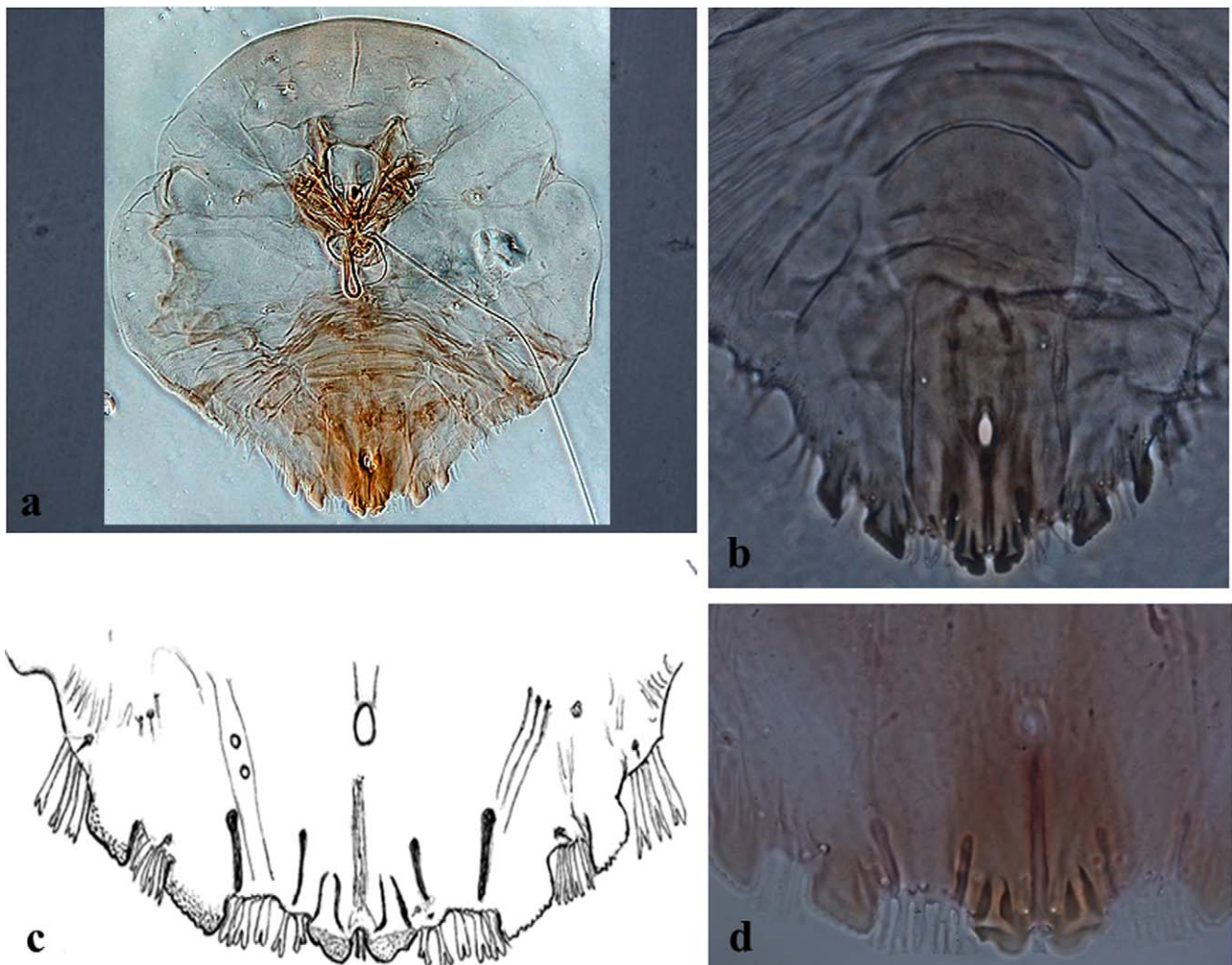
along apex of each lobe; L2 larger than L1 and located closer to L3 than to L1; 1 pair of plates present between L1; each side of pygidium with 5 bifurcate plates between L1 and L2, 3 bifurcate plates between L2 and L3, and 3 elongate, bifurcate plates anterior to L3; paraphysis arising from base of each side of L1, L2 and L3 slender, elongate, sinuous; 2 rod-shaped paraphyses present between L1 and L2; anus relatively small and oval, located medially about half way between vulva and posterior apex of abdomen; perivulvar pores absent in type species.

#### Discussion:

*Pentalaminaspis* appears to be most similar to *Chrysomphalus* but can be distinguished easily by: presence of the 5 bifurcate plates between L1 and L2, the very large size of the L2 and L3 lobes, each with numerous apical teeth, and the number, arrangement and relative size of the paraphyses.

#### Etymology:

The name *Pentalaminaspis* comes from a combination of the two Latin words: *penta* (= 5) and *lamina* (= plates) referring to the 5 plates between L1 and L2, and the ending *-aspis*, a common ending for genera of armored scales, from the Greek word meaning "shield", and is feminine in gender.



**FIGURE 22.** Adult female of *Pentalaminaspis minuta* (Kotinsky, 1908): a. photograph of female habitus, b. photograph of female abdomen, c. illustration of pygidium, d. photograph of pygidium.

#### *Pentalaminaspis minuta* (Kotinsky, 1908), new combination.

Fig 22

*Chrysomphalus minutus* Kotinsky, 1908: 170. Type data: Singapore: on undetermined plant. Holotype female. Type depository: Davis: The Bohart Museum of Entomology, University of California, California, USA; type no. 853 (examined).

*Aonidiella minuta* (Kotinsky); MacGillivray, 1921: 444.

*Aspidiotus pigmaeus* Lindinger, 1937: 180. Unjustified replacement name for *Chrysomphalus minutus* Kotinsky; discovered by Borchsenius, 1966: 371.

#### Material examined:

Holotype: female, Singapore, UCD; Australia: Mont. Rhasia, ex. *Loranthus ampullaceus* [= *Macrosolen cochinchinensis*]; Borneo: Summit of Muasi, Jan. 12, 1914, JC Moulton, ex. *Elytranthe* sp; China: Yunnan, ex. *Elytranthe bibracteolata* var. *acuminatissima*; Indochina: Delat Southern Anom, April 1932, R. W. Squires, ex. *Elytranthe* [= *Macrosolen*] *cochinchinensis* (Loranthaceae); Java: Ambrova, herbarium of Otto Kuntze, May 1875, ex. *Loranthus pentandrus*; Sumatra: near Idi, July 4, 1932, WM and CM Baughman, ex. *Loranthus*; Singapore: Malay Peninsula, Feb. 1907, E. Muir #249, no host recorded (2 cotype on 2 slides, adult females poor condition); Singapore: Malay Peninsula, Feb. 1907, Kotinsky and E. Muir, no host recorded, 2 slides, 1 slide with scale cover and incomplete adult male scale, other slide with 1 adult female.

#### Description of adult female:

Slide mounted specimens: Aspidiotine, adult female broadly oval, nearly round with head and thorax membranous. Pygidium sclerotized, A5–A8 with a large, rectangular central area, A3–4 with a wide, crescent-shaped central area. Lobes in 3 pairs (L1, L2, L3), well developed; L1 wider than long, rounded apically with 1 tooth; L2 spatulate, distinctly larger than L1 with numerous small teeth along apex; L3 spatulate, distinctly larger than L1 but smaller than L2, also with numerous small teeth along apex. Plates with bifurcate apices: with 2 short plates, not exceeding length of L1 between L1; 5 long plates, each exceeding length of L1 and L2, present between L1 and L2; 3 long plates, each exceeding length of L2 and L3, present between L2 and L3; and 3 long plates, each exceeding length of L3, anterior to L3. Paraphyses in 4 pairs, those arising from each side of L1, L2 and L3 slender and sinuous with pointed apices, sub-equal in length but each longer than L1 and about 2/3 as long as adjacent paraphyses; with 2 pairs of paraphyses between L1 and L2, each rod-shaped, sub-equal in length, longer than L2; margin anterior to L3 with a series of short striations. Dorsal ducts 1-barred, long and slender, apparently few in number (difficult to see in specimens). Perivulvar pores absent. Anus relatively small, located more or less in center of pygidium, about the level with anterior margin of L3.

#### Variation:

The body length and width of ten specimens of *P. minuta* from various locations were measured (in microns). The species varies considerably in body size, ranging from 561–1687 µm long, 470–1526 µm wide, and 0.9–1.2 times as long as wide. The (average mean) length and width were 920 and 870 µm, respectively. The number and shape of the plates between the pygidial lobes did not vary, all of the specimens having 2 short, forked plates between the L1 lobes, 5 long, forked plates between L1 and L2, 3 long, forked plates between L2 and L3, 4 very long, forked plates lateral to the L3 lobes, followed by a series of 5–7 thick spines along each lateral margin. The shape and number of teeth on the lobes, and the shape and size of the paraphyses also did not vary much between all of the specimens examined.

**Distribution:** Eastern Palearctic: China; Oriental: Borneo, Java, Singapore, Sumatra, and Australian: Australia.

**Hosts:** *Dendrophthoe pentandra*, *Elytranthe bibracteolata* var. *acuminatissima*, *Elytranthe cochinchinensis*, *Elytranthe* sp; *Loranthus forbesii*, *Macrosolen cochinchinensis* (Loranthaceae).

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