

**CONTRIBUTIONS
OF THE
AMERICAN ENTOMOLOGICAL INSTITUTE**

Volume 34, Number 5

A SYSTEMATIC REVISION OF THE ARMORED
SCALE GENUS *FURCASPIS* LINDINGER
(DIASPIDIDAE; COCCOIDEA; HEMIPTERA)

by

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The American Entomological Institute
3005 SW 56th Avenue
Gainesville, FL 32608-5047

2006

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ISSN: 0569-4450

**A SYSTEMATIC REVISION OF THE ARMORED SCALE GENUS *FURCASPIS*
LINDINGER (DIASPIDIDAE; COCCOIDEA; HEMIPTERA)**

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ABSTRACT

A systematic revision of the armored scale genus *Furcaspis* Lindinger is presented. Twenty-eight species are treated, including 15 that are described as new by Williams and Miller: *Furcaspis aequatorialis*, *F. cyphokentiae*, *F. dominicae*, *F. exophthalma*, *F. glandulosa*, *F. intercepta*, *F. matileae*, *F. mexicana*, *F. oaxacae*, *F. palmaria*, *F. paxilliloba*, *F. peruviana*, *F. scleropymna*, *F. sibuyanensis*, and *F. tasmanica*. The 13 previously described species are: *Furcaspis andamanensis* (Green), *F. biformis* Cockerell, *F. bromeliae* Hempel, *F. capensis* (Walker), *F. charmoyi* Brain, *F. cladii* (Maskell), *F. haematochroa* Cockerell, *F. mauritiana* (Newstead), *F. oceanica* Lindinger, *F. plana* Hempel, *F. proteae* Brain, *F. rufa* Lindinger, and *F. taquarae* Fonseca. Adult females of 28 species are described and illustrated, a key for their identification is presented, and a phylogeny based on morphological characters is given. The genus *Separaspis* MacGillivray is a junior subjective synonym of *Furcaspis*, and the genera *Tollaspidotus* MacGillivray, *Truncaspidotus* MacGillivray, *Paraonidiella* MacGillivray, and *Neofurcaspis* Green are listed as junior subjective synonyms in agreement with previous authors.

INTRODUCTION

The genus *Furcaspis* was described by Lindinger (1908) to include *F. biformis* (Cockerell) and *F. capensis* (Walker). Brain (1918) redefined the genus and added two new species, *F. charmoyi* and *F. proteae*. MacGillivray (1921) recognized *Furcaspis* as an accepted genus, including *F. biformis*, but also included a diverse array of other species now referable to *Abgrallaspis* Balachowsky, *Aonidiella* Berlese & Leonardi, *Diaspidiotus* Berlese, *Dynaspidiotus* Thiem & Gerneck, *Hemiberlesia* Cockerell, and *Hypaspidiotus* Takahashi. He also placed several species, currently considered to be part of *Furcaspis*, in new genera, i.e., *Paraonidiella* with *P. cladii*, *Separaspis* with *S. proteae*, *Spinaspidotus* with *S. oceanicus*, *S. haemotochrous*, and *S. charmoyi*, *Tollaspidotus* with *T. mauritiana* and *T. rufa*, and *Truncaspidiotus* with *T. capensis*. Finally, he described the new genus *Stringaspidiotus* including *S. curculiginis* (Green), which Lindinger (1937, 1943b) considered to be a junior synonym of *Furcaspis*. Ferris (1921) wrote a scathing review of MacGillivray's (1921) book and mentioned that many of the species placed in *Furcaspis* really didn't belong there and several of the species that should be in the genus were placed elsewhere. In 1926, Green also described a new genus and species, *Neofurcaspis andamanensis*, for a species that currently is placed in *Furcaspis*.

Although coccidologists have had diverse opinions about the MacGillivray system as it pertains to *Furcaspis* and similar genera, they have consistently ignored MacGillivray's broad definition of the genus. Lindinger (1937, 1943b) treated *Neofurcaspis*, *Paraonidiella*, *Stringaspidiotus*, *Tollaspidotus*, and *Truncaspidiotus* as junior synonyms of *Furcaspis*. Ferris (1938b) studied the type species of three of MacGillivray's *Furcaspis*-like genera, but indicated that a more detailed revisionary study was necessary to arrive at definitive conclusions about their status. Balachowsky (1958) accepted the genera *Furcaspis*, *Neofurcaspis*, *Paraonidiella*, *Separaspis*, and *Tollaspidotus* and included them in a new subtribe Furcaspina. He diagnosed the group as having spatula-shaped plates that are bifurcate with a hyaline membrane between the points, pores near the anterior spiracles, and antennae with two to six setae. Borchsenius (1966) concurred and added a sixth genus to the subtribe, i.e., *Stringaspidiotus*. Beardsley (1966) concluded that *Neofurcaspis* is a junior synonym of *Furcaspis* thus confirming the synonymy by Lindinger (1937) and presented an analysis of the species similar to *F. oceanica*. Ben-Dov and German (2003) treated *Paraonidiella*, *Separaspis*, and *Tollaspidotus* as accepted generic names and considered *Neofurcaspis* to be a junior synonym of *Furcaspis* and *Truncaspidiotus* to be a junior synonym of *Separaspis*. *Stringaspidiotus* and *Spinaspidotus* were accepted generic names, but apparently were not considered to be closely related to *Furcaspis*.

Few species in *Furcaspis* have reached pest status. *Furcaspis oceanica*, the red coconut scale, is a pest of coconut in some parts of the Pacific region especially when it is accidentally introduced to an island without its natural enemies. The species is considered to be endemic to Micronesia and is present on all of the high islands of the Caroline Islands, several smaller atolls in this group of islands, and in several atolls in the Marshall Islands. During World War II, it was introduced accidentally into Saipan and in 1948 became a serious pest of coconut. A similar situation occurred in Guam where it was introduced in the early 1970's. Introduction of the native parasites *Adelencyrtus oceanica* Doutt (Encyrtidae) reduced the species to a rare or incidental pest (Nafus 1996, Muniappan and Marutani 1989, Marutani and Muniappan 1990, Muniappan et al. 2003). The only other species of *Furcaspis* considered to be a pest is the orchid scale, *F. biformis*, which is regarded as a pest of orchids (Schmutterer et al. 1957, Zimmerman 1948). Species of the genus frequently have been intercepted at U. S. ports-of-entry in decades past, but reduced trade in field collected bromeliads and orchids apparently has caused there to be fewer interceptions over the past 20 years. The potential for *Furcaspis* species to

become invasive pests is quite high since many occur on palms (9 species) and bromeliads (6 species), many are intercepted at U. S. ports, and many occur on common ornamental plants. The objectives of this paper are: 1) to examine all genera in the Furcaspina and make decisions about their nomenclatural status; 2) redescribe and illustrate all known species; 3) describe and illustrate all new species, especially those taken in quarantine; 4) provide identification keys; and 5) present a phylogeny of the group.

MATERIALS AND METHODS

Terminology in the descriptions follows that of Williams and Watson (1988) and Miller et al. (1984) except we use the term "cicatrices" instead of "bosses." Measurements and numbers are from 10 specimens when available, and are given as a range followed by an average in parentheses. Depositories of specimens are: Australian National Insect Collection, CSIRO Entomology, Canberra, Australia (ANIC); The Natural History Museum, London (BMNH); California State Collection of Arthropods, California Department of Food & Agriculture, Sacramento, California, United States (CDFA); Instituto Biológico, Centro de Sanidade Vegetal, Coleção Entomológica Adolph Hempel, São Paulo, Brasil (IBSP); Muséum national d'Histoire naturelle, Paris, France (MNHN); South African National Collection of Insects, Pretoria, South Africa (SANC); Bohart Museum of Entomology, University of California, Davis, California, United States (UCD); Entomological Museum, Museum of Natural History, University of the Philippines at Los Baños, Laguna, Philippines (UPLB); United States National Entomological Collection, U.S. National Museum of Natural History, Beltsville, Maryland (USNM); Zoologisches Institut und Zoologisches Museum, Universität von Hamburg, Germany (ZIZM).

Williams and Miller were primarily responsible for the descriptive portions of the paper and Rung did most of the phylogenetic work.

TAXONOMY

Furcaspis Lindinger

Nomenclature:

Furcaspis Lindinger 1908: 99. Type species: *Aspidiotus biformis* Cockerell. By subsequent designation of Sanders 1909: 54.

Tollaspidiotus MacGillivray 1921: 389. Type species: *Aspidiotus mauritanus* Newstead, by original designation and monotypy. Synonymy by Lindinger 1937: 197.

Separaspis MacGillivray 1921: 390. Type species: *Furcaspis proteae* Brain, by original designation and monotypy. **New Synonymy.**

Truncaspidiotus MacGillivray 1921: 390. Type species: *Lecanium capense* Walker, by original designation and monotypy. Synonymy by Lindinger 1937: 197.

Paraonidiella MacGillivray 1921: 392. Type species: *Aspidiotus cladii* Maskell, by original designation and monotypy. Synonymy by Lindinger 1937: 192.

Neofurcaspis Green 1926: 61. Type species: *Neofurcaspis andamanensis* Green, by original designation and monotypy. Synonymy by Lindinger 1943b: 220.

Furoaspis Lindinger; Lindinger 1937: 197. Misspelling.

Generic Diagnosis: Characters important in diagnosing our concept of *Furcaspis* include: plates that are bifurcate or rarely trifurcate and with no fringing; first 3 pairs of lobes similar in size and shape and without notches; antennae with more than one seta, usually 3-6; macroducts thin and similar in appearance to microducts; with paraphyses; perispiracular pores absent from near the posterior spiracles. Characters that are present in most but not all species of *Furcaspis*

are: gland tubercles, perispiracular pores near the anterior spiracles, and dorsal sclerotized areas on the pygidium. Scale cover of adult female convex and thick; ventral cover thick.

Affinities: In recent years several of the genera here considered to be junior synonyms have been treated as accepted genera. For example, Ben-Dov and German (2003) considered *Paraonidiella*, *Separaspis*, and *Tollaspidiotus* to be separate from *Furcaspis*. Borchsenius (1966) considered *Neofurcaspis* as separate also, and included *Stringaspidiotus* MacGillivray in the subtribe Furcaspina. Our study shows that there are groups of species with similar suites of characters that sometimes are concordant with the geographic distribution of these species, but there is sufficient variation in these characters to warrant consolidating the species into a single genus (for further discussion see the conclusions and phylogeny sections). Acceptance of these genera would add to the trend of increasing numbers of monotypic genera in the Diaspididae which reduces the information content of the classification system (Miller et al. 2005).

The genera that we consider junior synonyms previously were characterized by possessing the following characters: *Paraonidiella* lacks perispiracular pores and has bilobed second lobes. Because there are species in other genera that have perispiracular pores on some species and not on others, e.g., *Situlaspis* MacGillivray, and because we have seen at least one specimen of *F. paxilliloba* that has one perispiracular pore on one side and none on the other, we consider this character to be important for separating species. The presence of bilobed second lobes is an interesting and unique character. However, the third lobes of *F. aequatorialis* could be interpreted as being bilobed, but the close similarity of *F. aequatorialis* to *F. palmaria* and *F. taquarae* suggests that the lobes should be treated as a specific character. *Separaspis* has enlarged submarginal setae and no perivulvar pores. Enlarged submarginal setae intergrade from large conspicuously swollen, bulbous setae in some species, to slightly enlarged pointed setae or thin normal appearing setae in other species. In light of these intergradations, we treat this as a specific character. The presence or absence of perivulvar pores generally is considered to be a species-level character in genera such as *Hemiberlesia* Cockerell, *Unaspis* MacGillivray, and *Diaspidiotus* Cockerell. *Tollaspidiotus* is circular in shape and has prepygidial segmental lobes. There are numerous examples of genera that contain species of various body shapes such as *Pseudaulacaspis* MacGillivray, *Pseudoparlatoria* Cockerell, and *Howardia* Berlese and Leonardi. Conspicuous, prepygidial, marginal, segmental lobes are present in some species of *Crenulaspidiotus* MacGillivray but in others, they are reduced or are completely absent. Within *Furcaspis*, the presence and development of these lobes seems to be related partially to the age of the female and is quite variable. *Neofurcaspis* has a double row of perivulvar pores. The relative development and presence or absence of perivulvar pores generally is considered to be a species-level character. Different specimens of *F. bromeliae* have either a second row of perivulvar pores or lack them. For all of these reasons we have decided to consider these genera as synonyms of *Furcaspis*.

We believe that *Stringaspidiotus* should be placed in the subtribe Pseudoonidiina, not Furcaspina, with lobes with lateral notches and antennae with a single obvious seta. *Furcaspis* shares some characteristics with *Melanaspis* Cockerell, *Crenulaspidiotus*, and *Hemigymnaspis* Lindinger. All produce thick, convex scale covers and have thick ventral covers. They also have plates that lack fringing and have paraphyses. *Melanaspis* has dorsal sclerotized areas and narrow macroducts, but has lobes that are notched and are broader anteriorly, lacks perispiracular pores near the anterior spiracle, lacks gland tubercles, and has a single antennal seta. *Crenulaspidiotus* has dorsal sclerotized areas, narrow macroducts, and gland tubercles, but has notched lobes that are broader anteriorly, lacks perispiracular pores near the anterior spiracle, and has 1 antennal seta. *Hemigymnaspis* has dorsal sclerotized areas, narrow macroducts, several antennal setae, and gland tubercles, but has lobes that are notched and are broader anteriorly and lacks perispiracular pores near the anterior spiracle.

Preliminary molecular data from *F. biformis* suggest that it is in the basal part of the diaspidid tree and is unrelated to *Melanaspis*, *Crenulaspidotus*, or *Hemigymnaspis* (B. Normark pers. comm., October 28, 2005).

TREATMENT OF SPECIES

Furcaspis aequatorialis Williams and Miller, new species

Figure 1

Type material.— Holotype adult female top specimen on slide with 1 additional adult female paratype labeled as follows: left label “Ecuador/ex Bromeliaceae/ VIII-14-75 leaf/ JFKIA 20949/ N. Adams/ Balsam” right label “*Furcaspis aequatorialis*/ Williams and Miller/ HOLOTYPE/ PARATYPE.” A map on the right label gives the location of the holotype and the paratype. Holotype deposited in USNM. In addition, there are 55 adult female paratypes on 14 slides. For detailed specimen data of paratypes see specimens examined section below.

Slide-mounted Characters: Holotype adult female (Fig. 1) 1.2 mm long (paratypes 0.8-1.4 (1.2) mm long), 1.0 mm wide (paratypes 0.7-1.1(0.9) mm wide), pygidium wider than long at level of seta marking segment 4 (length/width 0.4) (paratypes 0.4-0.5 (0.4)), with 3 definite pairs of lobes, pygidial margin with series of projections forward to seta marking segment 4; sometimes with few projections anterior of seta marking segment 4; prepygidial segments moderately lobed on body margin forward to segment 1. Paraphysis formula 2-1 (paratypes with 2-2, 2-3, 3-1), usually without paraphyses in space between third and fourth lobes; paraphyses shorter than length of median lobes. Median lobes apically rounded, longer than wide (length/width 2.3 (paratypes 1.6-2.0 (1.8)), separated by space 1.6 times width of median lobe (paratypes 1.0-1.6(1.3)), with small paraphysis attached to medial margin of each median lobe, with 2 small paraphyses between median lobes (paratypes 1-3(3)); second lobes about same size as median lobes or slightly larger, same shape; third lobes same shape but slightly smaller; fourth and fifth lobes part of series of points mentioned above. Plates thin, distinctly bifurcate, slightly shorter than or equal to length of lobes, with 1 duct opening near apex; plate formula 2-3-1; 2 plates between median lobes. Macroducts usually of 1 size, narrow and elongate, present along body margin from segment 3 or 4 to 8, with 35 and 37 macroducts on each side of body on segments 5-8 (paratypes with 29-43(38)), some hidden by paraphyses, with several macroducts anterior of anal opening. Prepygidial microducts on venter rare, in submedial areas of metathorax and any of segments 1-4, in lateral clusters from prothorax or mesothorax to segment 4; on dorsum prepygidial microducts in submedial areas of any or all of metathorax and segments 1-4, in lateral areas from metathorax to segment 4. Gland tubercles on meso- and metathorax, with 8 and 6 on each side of body (paratypes 4-10(7)). Ventral submarginal setae slender, not conspicuously enlarged; longest seta on margin of segment 3 22 μ long (paratypes 27-40(34) μ long). Perivulvar pores absent. Perispiracular pores each with 3 or 5 loculi (predominantly 5), anterior spiracles with 3 and 5 pores (paratypes with 2-7(4) pores). Anal opening located 6.9 times length of anal opening from base of median lobes (paratypes 5.1-8.4 (7.1) times), anal opening 14 μ long (paratypes 11-17 (13) μ). Eyes absent. Antennae each with 4 setae (paratypes with 4-6 (5) setae). Cicatrices normally present on prothorax and segment 1, cicatrix on prothorax usually divided and sclerotized, cicatrices on other segments variable, lighter, and often divided. Body pear shaped, dorsally with central sclerotized area and lateral sclerotized areas originating from margin marking segments 6, 5 and 4, ventrally lightly sclerotized throughout pygidium. Pattern anterior of anal opening with a few longitudinal lines. Sclerotized spots in submarginal areas of segments 4 and 5, possibly cicatrices. Third lobe closely appressed to adjacent anterior projection. Perispiracular pores incorporated in sclerotized area including spiracle.

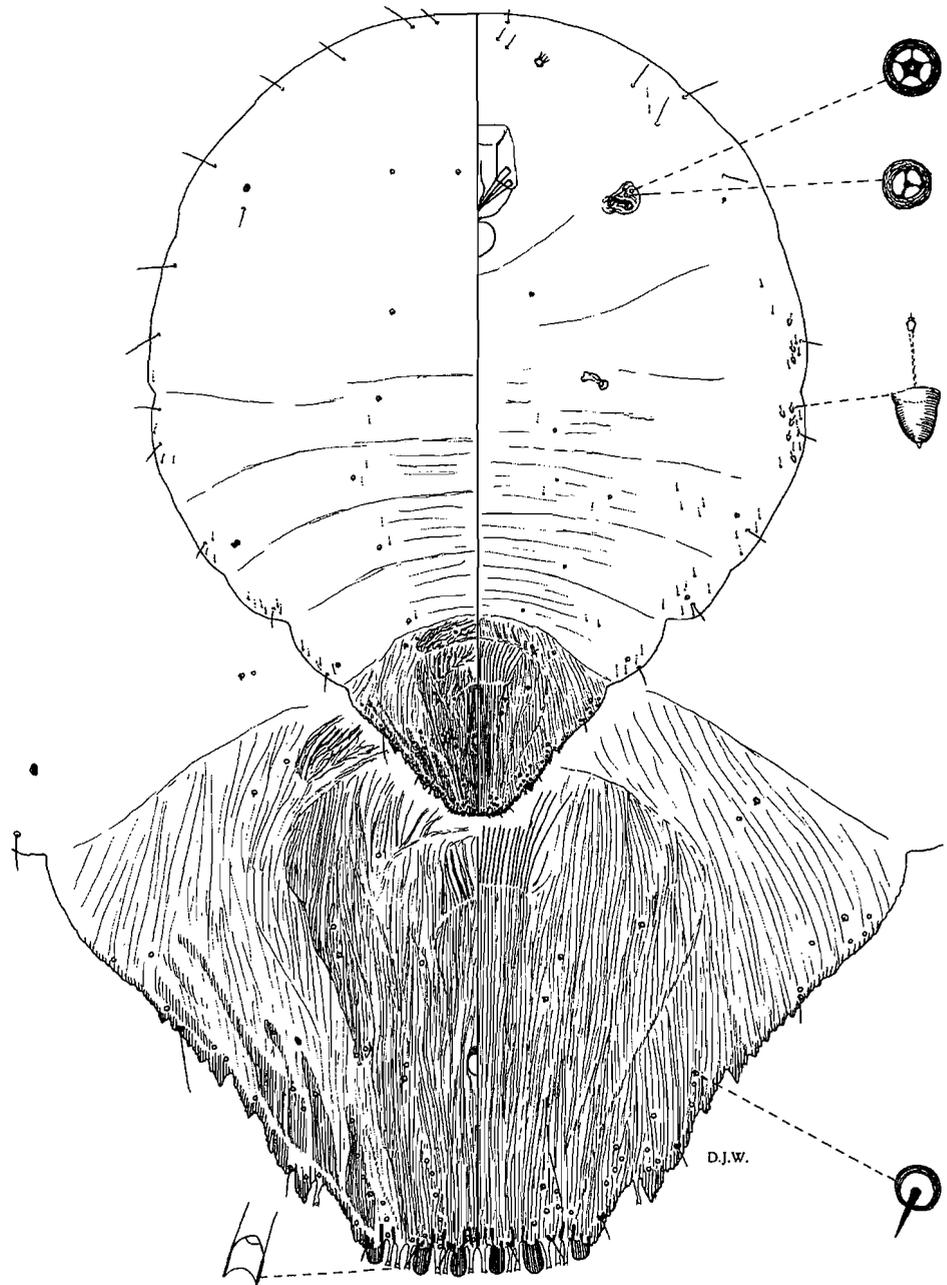


Figure 1. *Furcaspis aequatorialis* Williams and Miller. Specimen from Ecuador, intercepted at New York City, New York, on Bromeliaceae, VIII-14-75, N. Adams.

Affinities: *Furcaspis aequatorialis* is very similar to *F. palmaria* and *F. taquarae* (all Neotropical species) in general facies, but differs from *F. palmaria* by having predominantly 5-locular pores near the anterior spiracles (3 locular in *F. palmaria*) which are incorporated in sclerotization contiguous with the spiracle (in membranous area in *F. palmaria*). *Furcaspis aequatorialis* differs from *F. taquarae* in the characteristic third lobes which are closely appressed to the adjacent lateral projection (basally separate in *F. taquarae*) and in the presence of lateral sclerotized areas on the dorsal pygidium near the setae marking segments 4 and 5 (absent in *F. taquarae*).

Hosts: On *Tillandsia* sp. and an undetermined bromeliad species. Probably on many species of bromeliads.

Distribution: Ecuador.

Additional paratype specimens not including paratype on holotype slide: ECUADOR: Quito, in quarantine at Lemon Grove, California, on bromeliad, XI-19-1976, J. Kenyo, E. Gordon (3 ad. females on 2 slides)(CDFA); in quarantine at Miami, Florida, on bromeliads, VIII-14-1972, VIII-1-1975, XII-22-1975, VII-12-1978, VII-25-1979, VII-28-1979, IV-7-1980, IV-16-1980, E. M. Joner, B. Stone, H. Hannagan, J. Torres, F. D. Matthews, J. C. Buff, B. K. Dozier (45 ad. females on 13 slides) (BMNH, UCD, USNM); in quarantine at Houston, Texas, on *Tillandsia* sp., XII-3-1991, E. Cortez (1 ad. female on 1 slide)(USNM).

Etymology: The name "*aequatorialis*" is a Latinized adjective of the locality "Ecuador."

Furcaspis andamanensis (Green)

Figure 2

Nomenclature:

Neofurcaspis andamanensis Green 1926: 62.

Furcaspis andamanensis (Green); Lindinger 1943b: 220.

Neofurcaspis andamanensis Green; Borchsenius 1966: 243.

Type Material: A lectotype is designated to clarify the status of this species. It is selected from material in BMNH which is labeled: left label "Neofurcaspis/ andamanensis/ Green/ on Coconut Palm./ Port Blair/ Andaman Is./ Coll. P. V. Isaac. 11;" right labels have 10 scale covers and a round label with "TYPE." The envelope containing the slide gives the following information "20-II-1925" and "BM, 1940, 180." There are 9 specimens on the slide, the 6th specimen from the left is the lectotype and a label showing its position is on the back of the slide. In addition, there is one other original slide from Ross Island collected 5-III-1925 by the same collector. This slide contains 4 adult female paralectotypes (BMNH). There are 3 other slides mounted subsequently from dry material of the type series from Ross Island containing 16 adult female paralectotypes (BMNH). In addition there are 3 2nd instar paralectotypes and 5 adult female paralectotypes on 2 slides and several 1st instars on a third slide labeled as "Part of Type Mat." from Andaman Islands on coconut (USNM).

Field Characters: According to Green (1926) "Puparium of female subcircular to subovate; reddish brown, the margin paler; exuviae impinging upon the margin, outlined with a brighter red, that of the larva with a small whitish central boss. Ventral scale stout. Margin of dorsal scale expanded and flattened; with sinuous raised lines on the undersurface. Longer diameter

2.75 to 4 mm. Male puparia of similar form, but smaller and of a brighter red colour. Longer diameter 1.5 mm."

Slide-mounted Characters: Adult female (Fig. 2) 0.8-1.6(1.2) mm long, 0.6-1.1(0.8) mm wide, pygidium slightly wider than long at level of seta marking segment 4, (length/width 0.4) (paratypes 0.3-0.4 (0.4)), with 3 definite pairs of lobes, pygidial margin with series of projections forward to seta marking segment 4; without projections anterior of seta marking segment 4; prepygidial segments moderately lobed on body margin forward to prothorax. Paraphysis formula variable from 3-5 to 4-6, usually with several small paraphyses in space between third and fourth lobes; longest paraphysis longer than or about as long as length of median lobes. Median lobes nearly quadrate, slightly longer than wide (length/width 0.8-1.2(1.0)), separated by space 0.6-1.4(0.8) times width of median lobe, with small paraphysis attached to medial margin of each median lobe, usually with 1 small paraphysis between median lobes; second lobes approximately same size as median lobes, lobe margins slightly more divergent; third lobes same shape, about equal or slightly smaller and broader than second lobes; fourth and fifth lobes apparently part of series of points described above. Plates thin, with bifurcate apex, with 1 duct opening near apex; plate formula 2-3-1, 2-3-2, or 2-3-0; 2 plates between median lobes, conspicuous. Macroducts usually quite narrow and similar in appearance to microducts, usually with a few between median lobes and on segments 3 and 4 shorter, present along body margin from segment 3 or 4 to 8, with 13-40(30) macroducts on each side of body on segments 5-8, some hidden by paraphyses, with several macroducts anterior of anal opening. Prepygidial microducts on venter in submedial areas of prothorax to segments 1-4, in lateral clusters from prothorax or mesothorax to segment 4; on dorsum prepygidial microducts in submedial areas of metathorax and segments 1-4, in lateral areas from mesothorax to segment 3 or 4. Gland tubercles present in lateral areas of pro- and mesothorax, sometimes absent from mesothorax; with 6-43(18) tubercles on each side of body. Ventral submarginal setae slender, not enlarged; longest seta on margin of segment 3 37-90 (44) μ long. Perivulvar pores unusual in distribution pattern, present in 2 concentric half circles around vulva, rarely with single pore in third half circle, not aggregated into clusters, 5-9(7) pores on each side of body in inner circle, 5-10(7) pores on each side of body in second circle, 0-1(0) pores on each side of body in third circle. Perispiracular pores each with 5 loculi, anterior spiracles with 0-5(3) pores. Anal opening located 1.9-5.6(3.5) times length of anal opening from base of median lobes, anal opening 16-37(25) μ long. Eyes conspicuous, oval and dome shaped, without sclerotized spurs, present laterad of clypeolabral shield. Antennae each with 3-6(6) setae. Cicatrices usually present on prothorax and segment 1, without sclerotized spots. Body oval, dorsally without conspicuous sclerotized areas, ventrally lightly sclerotized throughout pygidium. Pattern anterior of anal opening with many longitudinal lines.

Affinities: *Furcaspis andamanensis* is similar to *F. exophthalma* and *F. haematochroa* (all from the same general geographic region) by having 2 concentric circles of perivulvar pores surrounding the vulva and 5-locular pores near the anterior spiracles. *Furcaspis andamanensis* differs from both of these species in lacking spurs on the eyes.

Hosts: Only known from coconut palm. Probably occurring on other palms as well.

Distribution: Known only from the Andaman Islands. Specimens examined in addition to type series: India: Andaman Islands: Nicobar Islands -- Car Nicobar, on *Cocos nucifera*, IV-30-1988, T. K. Jacob (BMNH).

Important Publications: Beardsley 1966.

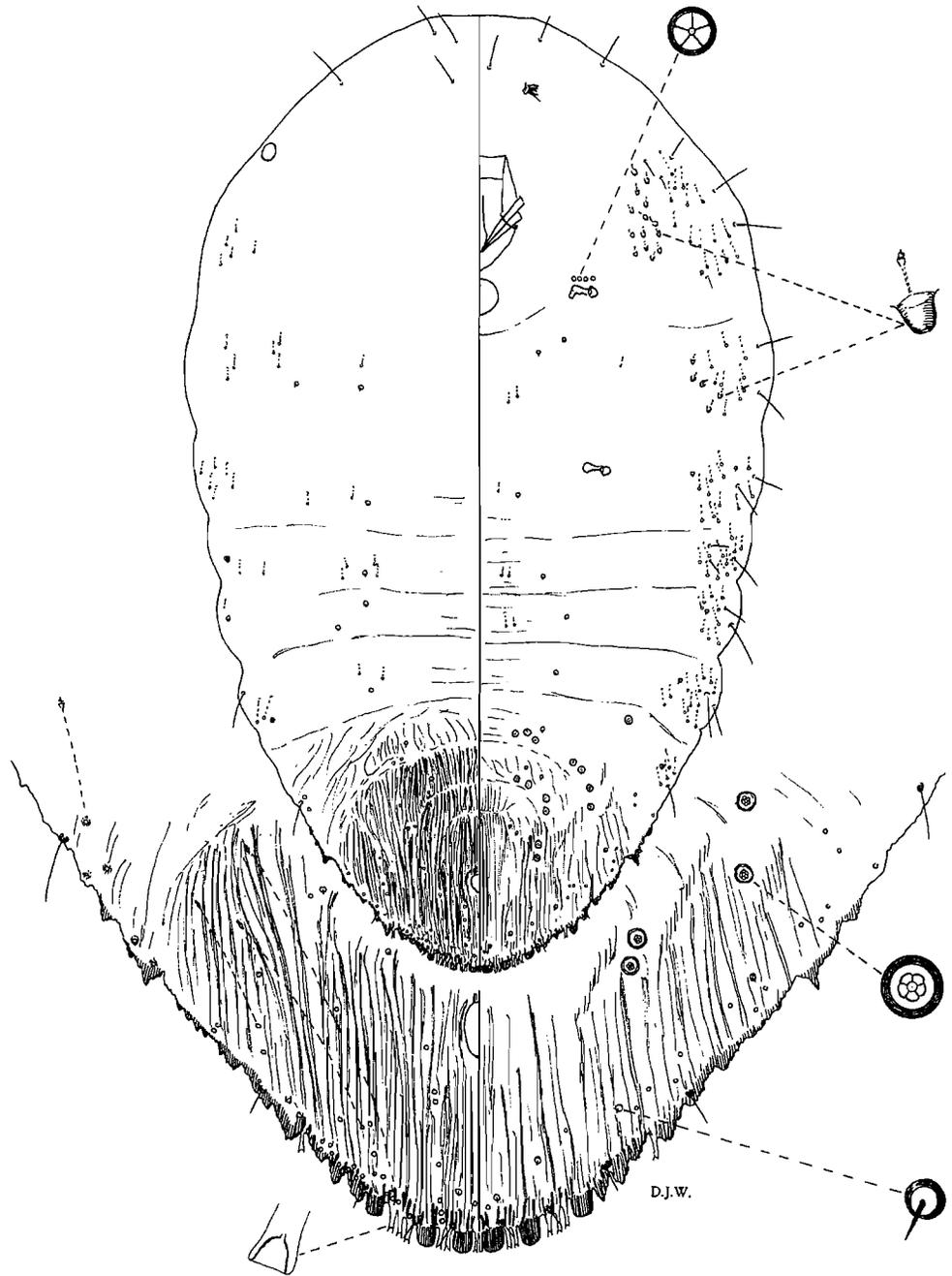


Figure 2. *Furcaspis andamanensis* (Green). Specimen from Andaman Islands, Ross Island, Port Blair, on *Cocos nucifera*, II-20-1925, P. V. Isaac.

Furcaspis biformis (Cockerell)

Figure 3

Common name: Orchid scale, red orchid scale

Type Material: A lectotype is here designated to clarify the status of this species. It is selected from material deposited in USNM labeled as follows: left label "A. biformis/ orchids/ San Fernando/ (Guppy) Trinidad/ (Cockerell);" right label "LECTOTYPE/ designated by/ Williams &/ Miller." There is a single specimen on the slide. There is a second slide with the same data (except it has number 5489) containing 2 scale covers (USNM).

Nomenclature:

Aspidiotus biformis Cockerell 1893a: 255.

Aspidiotus biformis Cockerell 1893b: 548.

Aspidiotus biformis var. *cattleyae* Cockerell 1893b: 548.

Aspidiotus (Chrysomphalus) biformis Cockerell 1897: 13, 23.

Aspidiotus (Chrysomphalus) biformis var. *cattleyae* Cockerell 1897: 13, 23. Synonymized by Borchsenius 1966: 241.

Aspidiotus (Evaspidiotus) biformis Cockerell; Leonardi 1898: 76.

Chrysomphalus biformis (Cockerell); Cockerell 1899: 26.

Chrysomphalus biformis cattleyae (Cockerell); Fernald 1903: 289.

Furcaspis biformis (Cockerell); Lindinger 1908: 99.

Aspidiotus biprominens Kuwana and Muramatsu 1931: 653. Synonymized by Ferris 1941: 41.

Aspidiotus cattleyae (Cockerell); Ferris 1941: 41.

Targionia biformis (Cockerell); Lindinger 1943a: 152.

Field Characters: Adult female cover moderately convex, circular or slightly elliptical, dark reddish brown, scale margin sometimes lighter; exuviae central or subcentral, about same color as rest of cover. Male cover same color as female cover, elongate; exuviae subterminal. Normally occurs on leaves or pseudobulbs.

Slide-mounted Characters: Adult female (Fig. 3) 0.9-1.3(1.0) mm long, 0.7-1.1(0.9) mm wide, pygidium wider than long at level of seta marking segment 4 (length/width 0.3-0.5(0.4)), with 3 definite pairs of lobes, pygidial margin with 2 or 3(3) projections between marginal setae marking segments 6 and 5, each projection with series of small notches, anterior projection usually largest and representing lobe 4; pygidial margin with 4-6(5) projections between marginal setae marking segments 5 and 4, each projection with series of small notches, usually with space between anterior projection and posterior series of projections, anterior projection probably representing lobe 5; without projections anterior of seta marking segment 4; prepygidial margin smooth; prepygidial segments moderately lobed on body margin forward to segment 1. Paraphysis formula variable from 2-2 to 4-3, usually with several small paraphyses in space between third and fourth lobes; longest paraphysis equal to or slightly shorter than length of median lobes. Median lobes apically rounded, slightly longer than wide (length/width 1.0-1.6(1.3)), separated by space 0.6-1.0(0.8) times width of median lobe, with small paraphysis attached to medial margin of each median lobe, with 1 small paraphysis between median lobes; second lobes slightly smaller than median lobes, same shape; third lobes same shape but smaller; fourth and fifth lobes apparently part of series of points described above. Plates thin, with bifurcate apex, with 1 duct opening near apex; plate formula 2-3-1; 2 plates between median lobes, conspicuous. Macroducts usually narrow and similar in appearance to microducts, occasionally with few between median lobes and on segments 3 and 4 shorter,

present along body margin from segment 3 or 4 to 8, with 28-48(37) macroducts on each side of body on segments 5-8, some hidden by paraphyses, with several macroducts anterior of anal opening. Prepygidial microducts on venter in submedial areas of meso- or metathorax and segments 1-4, in lateral clusters from pro- or mesothorax to segment 4; on dorsum prepygidial microducts in submedial areas of metathorax and segments 1-4, in lateral areas from mesothorax or metathorax to segment 4. Gland tubercles present in lateral areas of meso- and metathorax, sometimes on segment 1; with 10-30(19) tubercles on each side of body. Ventral submarginal setae slender, not enlarged; longest seta on margin of segment 3 32-52(41) μ long. Perivulvar pores in half circle band around vulva, not separated into distinct groups, 3-11(8) pores on each side of body. Perispiracular pores each with 3 loculi, anterior spiracles with 3-14(9) pores. Anal opening located 4.3-8.4(6.8) times length of anal opening from base of median lobes, anal opening 10-18(14) μ long. Eyes absent. Antennae each with 3-4(4) setae. Cicatrices normally present on prothorax and segment 1, rarely on segment 3, cicatrix on prothorax and segment 1 often sclerotized and divided into 2 distinct cicatrices. Body pear shaped, dorsally with single central sclerotized area, and 1 narrow sclerotized area originating from body margin between setae marking segments 6 and 5 and another area originating from margin marking segments 5 and 4; ventrally lightly sclerotized throughout pygidium. Pattern anterior of anal opening with a few longitudinal lines. Longitudinal line of macroducts present in membranous area between medial sclerotized area and area between segments 6 and 5.

Affinities: *Furcaspis biformis* is similar to *F. intercepta* and *F. peruviana* (Neotropical species) by having 1 concentric ring of perivulvar pores around the vulva and 3-locular pores near the anterior spiracles. *Furcaspis biformis* differs from *F. intercepta* in possessing perivulvar pores anterior of the vulva (laterad or posterior in *F. intercepta*). It differs from *F. peruviana* by having no laterocentral group of perivulvar pores (present in *F. peruviana*), setae on thorax slender and not enlarged (enlarged and conical on *F. peruviana*), and no gland tubercles on the prothorax (present in *F. peruviana*).

Hosts: This species is often found on orchids. Borchsenius (1966) records 8 host genera in 1 family. Dekle (1977) reports the orchid scale on 4 host genera in Florida including *Philodendron*. We have examined material from *Agave* (Agavaceae), *Aloe* (Aloaceae), *Bromelia* (Bromeliaceae), *Brassavola* (Orchidaceae), *Brassia* (Orchidaceae), *Cattleya* (Orchidaceae), *Cymbidium* (Orchidaceae), *Dendrobium* (Orchidaceae), *Epidendrum* (Orchidaceae), *Ionopsis* (Orchidaceae), *Hoya* (Asclepiadaceae), *Laelia* (Orchidaceae), *Melocactus* (Cactaceae), *Musa* (Musaceae), *Oncidium* (Orchidaceae), *Pedilanthus* (Euphorbiaceae), *Piper* (Piperaceae), *Psychotria* (Rubiaceae), *Pyrenoglyphis* (Arecaceae), *Renanthera* (Orchidaceae), *Schomburgkia* (Orchidaceae), *Strelitzia* (Strelitziaceae), *Syzygium* (Myrtaceae), *Vanda* (Orchidaceae), and *Yucca* (Agavaceae).

Distribution: Known from all zoogeographic regions except Afrotropical.

Specimens examined: Because of the large number of records of this species, we are including only the country name and the hosts from which they were collected. ANTIGUA: orchid, *Oncidium* sp.; AUSTRALIA: *Dendrobium wilkianum*; BAHAMAS: *Oncidium* sp.; BARBADOS: *Agave* sp., herbs, *Psychotria* sp., *Yucca* sp.; BRAZIL: *Cattleya intermedia*, *Laelia* sp., *Laelia purpurata*, Orchidaceae; BRUNEI: *Cattleya* sp.; COLOMBIA: *Cattleya* sp., *C. schroederiae*, *C. trianae*, *Epidendrum* sp., *Oncidium* sp., Orchidaceae; COSTA RICA: *Cattleya aurantiaca*, *C. chocoensis*, *C. trianae alba*, *Epidendrum atropurpureum*, Orchidaceae; CURAÇAO: *Cattleya* sp., Orchidaceae; DOMINICA: *Pedilanthus tithymaloides*; DOMINICAN REPUBLIC: *Brassia caudata*, *Epidendrum* sp., *Ionopsis utricularioides*, *Musa*

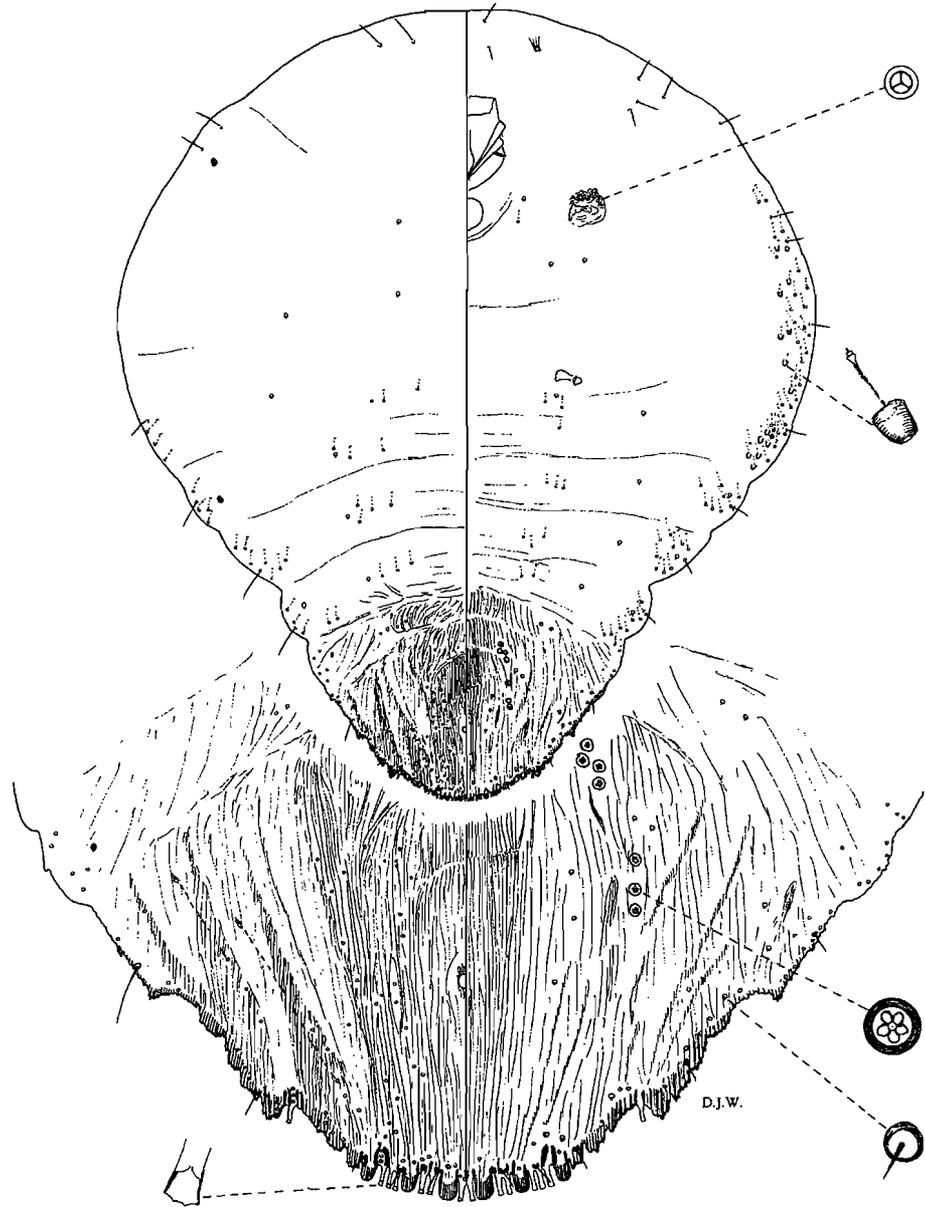


Figure 3. *Furcaspis biformis* Cockerell. Specimen from Panama, intercepted at Miami, Florida, on Orchidaceae, IX-24-1975, R. P. Higgins.

sp., *Oncidium cebolleta*, *O. henneckii*, *O. polyrrhiza*, *Oncidium* sp., Orchidaceae; FIJI: *Oncidium* sp., Orchidaceae; GRENADA: *Agave* sp., *Oncidium altissimum*, *O. luridum*, Orchidaceae, *Schomburgkia humboldtii*, *Vanda teres*; GUADELOUPE: *Vanda teres*; GUAM: *Cattleya* sp.; GUATEMALA: *Cattleya gigas*, *Cattleya* sp., Bromeliaceae, Orchidaceae; GUYANA: *Agave sisalana*, *Agave* sp., *Cattleya* sp., *C. superba*, *Oncidium altissimum*, Orchidaceae, *Schomburgkia lyonsii*, *Vanda* sp.; HAITI: Orchidaceae; HAWAII: *Agave sisalana*, *Cattleya* sp., *Cymbidium* sp., *Dendrobium* sp., Orchidaceae, *Strelitzia regina*, *Vanda* sp.; HONDURAS: Orchidaceae, *Schomburgkia* sp.; INDONESIA: *Dendrobium lancianum*, *Oncidium sphacelatum*, Orchidaceae, *Pedilanthus* sp.; JAMAICA: *Brassavola nodosa*, *Cattleya gigas*, *Cattleya* sp., *Oncidium luridum*, Orchidaceae, *Pedilanthus* sp., *Schomburgkia* sp.; JAPAN: Orchidaceae; JAVA: *Cattleya* sp.; LAOS: Orchidaceae; MALAYSIA: *Dendrobium* sp., *Vanda* sp.; MARTINIQUE: Orchidaceae; MEXICO: *Cattleya* sp.; MICRONESIA: *Cattleya* sp., Orchidaceae; PANAMA: Bromelia sp., Orchidaceae, *Piper* sp., *Pyrenoglyphis* sp.; PHILIPPINES: *Cattleya* sp., *Vanda batemanii*; PUERTO RICO: *Agave fourcroydes*, *A. sisalana*, *Bromelia penguin*, *Cattleya* sp., *Epidendrum atropurpureum*, *Oncidium splendidum*, Orchidaceae, *Syzygium jambos*; SINGAPORE: *Cattleya portia*, *Oncidium multiflorum*, *O. sphacelatum*, Orchidaceae, *Renanthera elongata*, *Vanda* sp.; SRI LANKA: Orchidaceae; ST. LUCIA: Orchidaceae; ST. VINCENT: *Dendrobium* sp., *Vanda* sp.; SURINAM: *Cattleya* sp., *Oncidium* sp., Orchidaceae; THAILAND: *Dendrobium nachatum*, Orchidaceae; TRINIDAD: *Cattleya* sp., *Oncidium aematochilum*, *O. lanceanum*, *O. sprucei*, *Oncidium* sp., *Epidendrum atropurpureum*, Orchidaceae, *Schomburgkia* sp.; UNITED STATES: *Cattleya* sp., *Cattleya percivaliana*, *Cattleya trianaei*, Orchidaceae; US VIRGIN ISLANDS: *Agave* sp., *Cattleya* sp., *Hoya* sp., *Melocactus cycas circinatus*. Orchidaceae; VENEZUELA: *Agave* sp., *Aloe* sp., *Brassavola* sp., *Cattleya percivaliana*, *C. speciosissima*, *Cattleya* sp., *Epidendrum* sp., *Oncidium* sp., Orchidaceae, *Schomburgkia* sp.; VIETNAM: Orchidaceae.

Economic Importance: The orchid scale is regarded as a minor pest of orchids (Schmutterer et al. 1957, Zimmerman 1948).

Important References: Williams and Watson (1988), Ferris (1938a).

Notes: Cockerell treated this species in two separate publications in 1893. In April, he published "A list of West Indian Coccidae" (Cockerell, 1893a), included an illustration of the pygidium, and gave a host and locality. In May, he published an article on the "Coccidae, or scale insects, which live on orchids" (Cockerell, 1893b) and provided a description and illustration of the species on a leaf. The catalogs by Borchsenius (1966) and Ben-Dov and German (2003) treat the April publication as a *nomen nudum* and list the May paper as the one that validated the name. Our interpretation is that the April article validated the name since the illustration of the pygidium is sufficient to make the name available.

Furcaspis bromeliae Hempel

Figure 4

Nomenclature:

Furcaspis bromeliae Hempel, 1932: 335.

Type material: We have examined 17 adult females on 3 slides from the syntype series. They are labeled as follows: left label "Brazil/ Laguna/ Bromeliaceae/ J. Deslandes/ vi.1930/ from cotype material/ C.I.E." right label "Furcaspis/ bromeliae/ Hempel" (BMNH). We have not selected a lectotype from this material since it should be designated from specimens deposited in a Brazilian collection. Type material apparently is deposited in IBSP.

Slide-mounted Characters: Adult female (Fig. 4) 0.7-1.3(1.0) mm long, 0.6-1.0(0.9) mm wide, pygidium wider than long at level of seta marking segment 4 (length/width 0.3-0.4(0.4)), with 3 definite pairs of lobes, pygidial margin with series of projections forward to seta marking segment 4; occasionally with 1 or 2 projections anterior of seta marking segment 4; prepygidial segments moderately lobed on body margin forward to segment 1. Paraphysis formula difficult to discern possibly 2-2 or 2-3, usually with some small paraphyses in space between third and fourth lobes; paraphyses short, considerably shorter than length of median lobes. Median lobes apically rounded, slightly longer than wide (length/width 1.1-1.5(1.2)), separated by space 0.8-1.2(1.1) times width of median lobe, with small paraphysis attached to medial margin of each median lobe, with 1 small paraphyses between median lobes; second lobes slightly wider than median lobes, same series of projections. Plates thin, weakly or strongly bifurcate, with 1 duct opening near apex; plate formula 2-3-1; 2 plates between median lobes, conspicuous. Macroducts usually narrow and similar in appearance to microducts, present along body margin from segment 3 or 4 to 8, with 27-52(34) macroducts on each side of body on segments 5-8, some hidden by paraphyses, with several macroducts anterior of anal opening. Prepygidial microducts on venter in submedial areas of meso- or metathorax and segments 1-4, abundant laterally from pro- or mesothorax to segment 4; on dorsum prepygidial microducts uncommon, in submedial areas of any or all of metathorax and segments 1-4, in lateral areas rare on thorax, in small clusters on segments 1 to 4. Gland tubercles on pro- or mesothorax, with 0-8(4) tubercles on each side of body, rarely with 1 on metathorax. Ventral submarginal setae slender, slightly enlarged; longest seta on margin of segment 3 30-80(45) μ long. Perivulvar pores in half circle band around vulva, often with additional pores on segment 7 inside of normal clusters, not separated into distinct groups, 10-25(17) pores on each side of body; some of perivulvar pores with 3 loculi. Perispiracular pores each with 3 loculi, anterior spiracles with 5-15(10) pores. Anal opening located 5.0-9.4(7.3) times length of anal opening from base of median lobes, anal opening 9-15(11) μ long. Eyes absent. Antennae each with 4-5(4) setae. Cicatrices normally on prothorax and often divided into 2 pieces. Body turbinate, dorsal surface with single central sclerotized area, and 1 narrow sclerotized area originating from body margin between setae marking segments 6 and 5 and another area originating from margin marking segments 5 and 4; with longitudinal line of macroducts in membranous area between medial sclerotized area and area between segments 6 and 5. Pattern anterior of anal opening with a few longitudinal lines.

Affinities: *Furcaspis bromeliae* is similar to *F. glandulosa*, *F. intercepta*, *F. peruviana*, and *F. biformis* (all Neotropical) by having perivulvar pores around the vulva and 3-locular pores near the anterior spiracles. Specimens of *F. bromeliae* with 2 rows of perivulvar pores are similar to *F. glandulosa* but differ by having fewer gland tubercles and no gland tubercles on the metathorax (present on *F. glandulosa*). *Furcaspis bromeliae* differs from *F. intercepta* in possessing perivulvar pores anterior of the vulva (laterad or posterior only in *F. intercepta*). It differs from *F. peruviana* by having no laterocentral group of perivulvar pores (present in *F. peruviana*) and setae on the thorax slender and not enlarged (enlarged and conical on *F. peruviana*). It differs from *F. biformis* by lacking metathoracic gland tubercles (present in *F. biformis*).

Specimens examined: Brazil: Laguna, on Bromeliaceae, VI-?-1930, J. Deslandes (BMNH); Santos, on Bromeliaceae, XII-11-1932, H. S. Lepage (BMNH); São Paulo, on *Bromelia* sp., date?, H. S. Lepage (BMNH).

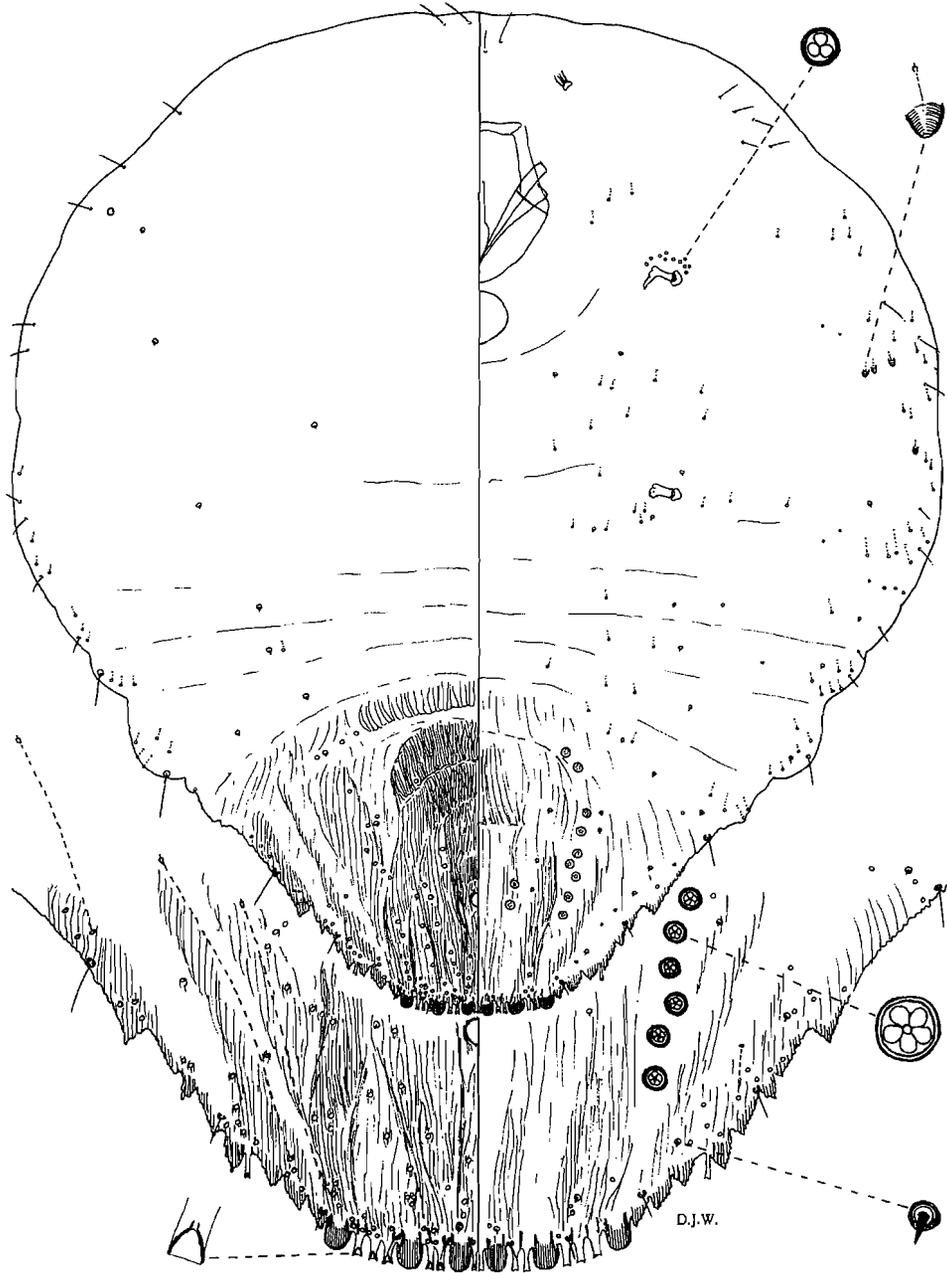


Figure 4. *Furcaspis bromeliae* Hempel. Specimen from Brazil, Santos, on Bromeliaceae, XII-11-1932, H. S. Lepage.

Hosts: On bromeliads. It also has been recorded on *Aechmea* sp. and *A. nudicaulis* by Claps et al. (2001).

Distribution: Brazil.

Important References: Claps et al. (2001); Hempel (1932).

Furcaspis capensis (Walker)

Figure 5

Nomenclature:

Lecanium capense Walker 1852: 1079.

Aspidiotus (*Aonidiella*) *capensis* (Walker); Green 1904: 375.

Furcaspis capensis (Walker); Lindinger 1908: 99.

Aspidiotus reticulatus Newstead 1912: 17. Synonymized by Borchsenius 1966: 242.

Spinaspidotus reticulatus Newstead; MacGillivray 1921: 430.

Truncaspidotus capensis (Walker); MacGillivray 1921: 431.

Separaspis capensis (Walker); Balachowsky 1958: 252.

Type Material: A lectotype is here designated to clarify the status of this species and is selected from original material mounted by E. E. Green deposited in the BMNH. It is labeled as follows: right label "*Aspidiotus* Type/ (*Aonidiella*)/~~*capense* (Walk.)~~ coll. Dr. Pereira/ Algoa Bay [Eastern Cape Province]." There are 4 pieces of paper on the left that once contained glued scale covers. There is a label on the back on the right that states "Mounted by/ E. E. Green/ 1904." On the back on the left we have placed a label "LECTOTYPE/ paralectotypes/ desig. Williams &/ Miller." There are 5 specimens on the slide, the top specimen is selected as the lectotype and a map is given showing its location. We have studied 5 syntype slides of *Aspidiotus reticulatus* that were mounted by Williams from Newstead's original dry material and are deposited in BMNH. They are labeled as follows: "SOUTH WEST AFRICA/ Klein-Namaland/ Steinkopf/ On ?/ Coll. L. Schultze/ 1904 Aug/ C.I.E." The original Newstead slide-mounted material is in ZIZM.

Field Characters: According to Brain (1918) "Scale of adult female sub-circular or oval, moderately convex, very dense and tough, with the highest point towards one side, from which, as a centre concentric ridges or corrugations extend to the margin. The first exuviae are laterad again of the highest point and appear as a rounded prominence, thus giving the whole scale the exact appearance of a minute shell. The colour of the scale varies with age. When young it is a rich pale brown, but becomes more reddish later. The most common colour in dry material is dry-blood colour. In living specimens the adult female scale is sometimes very beautiful, with the margins and first exuviae orange brown, the second exuviae covered with deep red and the concentric ridges very dark, almost black. The average size of the adult female scale is 2.5 mm. in largest diameter, but occasional specimens reach 3.5 mm. Ventral scale very dense and tough, yellowish white. The male puparium is small, linear, tapering slightly to the posterior extremity, brown with the exuviae at the front end and the hind end paler. Length about 1.2 mm."

Slide-mounted Characters: Adult female (Fig. 5) 0.9-1.2(1.0) mm long, 0.6-0.9(0.8) mm wide, pygidium wider than long at level of seta marking segment 4 (length/width 0.3-0.4(0.3)); with 3 definite pairs of lobes; pygidial margin with series of projections forward to seta marking segment 5; with few or no projections anterior of seta marking segment 5; prepygidial

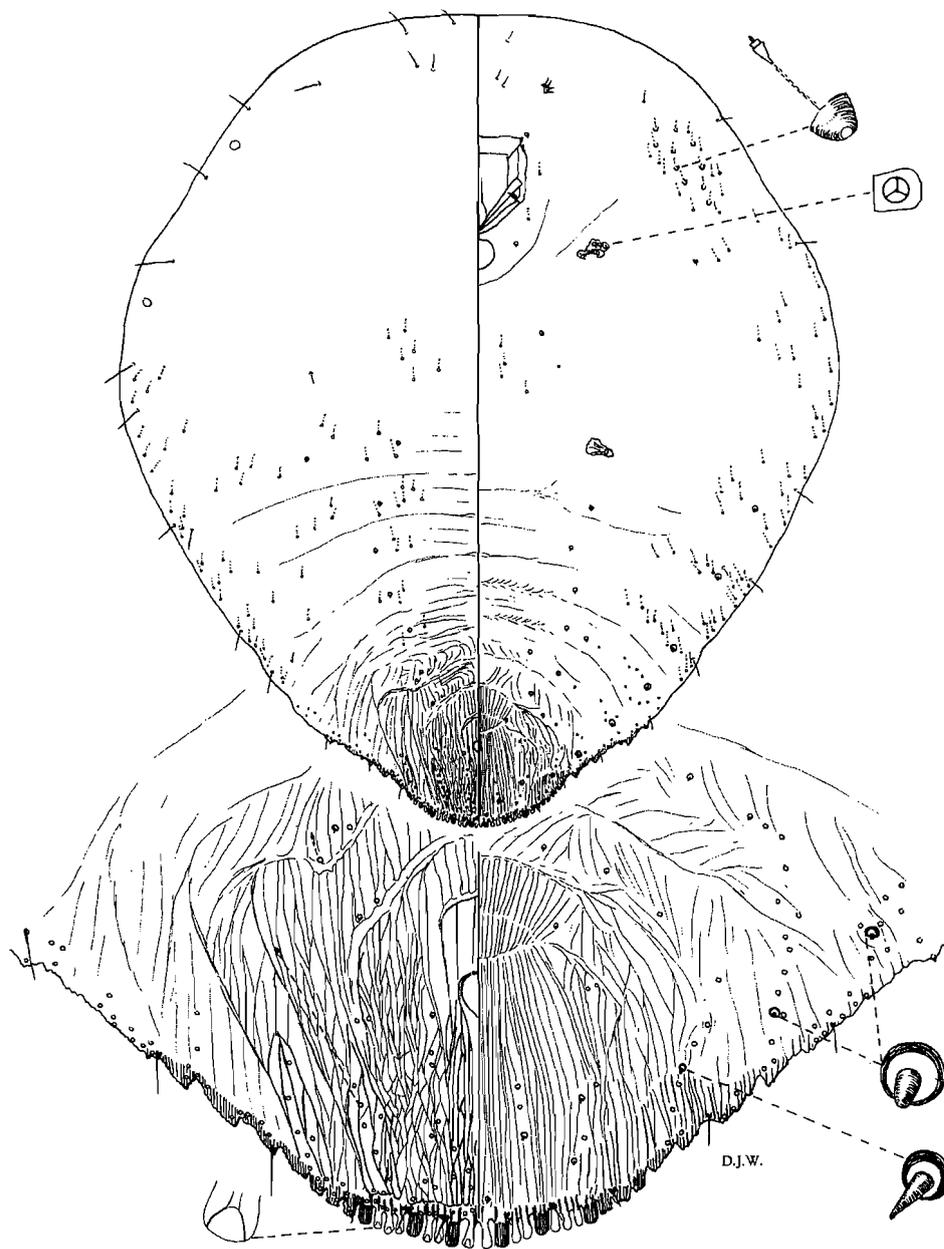


Figure 5. *Furcaspis capensis* Brain. Specimen from South Africa, Stellenbosch, on *Aloe* sp., VI-8-1954, C. J. Joubert.

margin of segments 2 to 4 relatively smooth; prepigidial segments without segmental lobes on body margin forward to segment 1. Paraphysis formula variable, from 2-3 to 4-7 or 6-6, with few small paraphyses along body margin anterior of lobe 3; longest paraphysis in either interlobular space between lobes 1 and 2 or lobes 2 and 3, paraphyses shorter than length of median lobes. Median lobes rounded apically, longer than wide (length/width 1.3-2.0(1.6)), separated by space 1.2-2.4(1.7) times width of median lobe, with small paraphysis attached to medial margin of each median lobe, with 3-4(3) paraphyses between median lobes; second lobes about same width as median lobes, same shape; third lobes same shape but slightly smaller; fourth lobes apparently part of series of points. Plates with rounded apices, bifurcations inconspicuous, with 1 or 2 duct openings near apex; plate formula 2-3-0. Macroducts usually narrow and similar in appearance to microducts, occasionally with a few between median lobes and on segments 3 and 4 shorter, present along body margin from segments 5 to 8, present in submedial area on segments 5 to 8, with 33-55(44) macroducts on each side of body on segments 5-8, some hidden by paraphyses, with few macroducts anterior of anal opening. Prepigidial microducts on venter of submedial areas uncommon, present on mesothorax to segment 5, in lateral clusters from prothorax to segment 4; on dorsum prepigidial microducts present on submedial areas of metathorax to segments 1-4, restricted to margin of meso- or metathorax to segment 4. Gland tubercles present on prothorax, sometimes with 1 on mesothorax, with 4-13(8) on each side of body. Ventral submarginal setae enlarged, cone shaped, posterior setae with acute apex, anterior setae with rounded apex, present on prothorax to segment 7, without sclerotization surrounding microduct orifice attached to setal base; longest seta on margin of segment 3 32-50(43) μ long. Perivulvar pores absent. Perispiracular pores each with 3 loculi, anterior spiracles each with 2-6(4) pores. Anal opening 24-34(30) μ long, located 3.3-4.3(3.8) times length of anal opening from base of median lobes. Eyes absent. Antennae each with 5-7(6) setae. Cicatrices often present on pro- and mesothorax. Body oval, dorsal surface of pygidium sclerotized throughout, without sclerotization surrounding macroduct orifices. Pattern anterior of anal opening with few longitudinal lines. With distinct reticulated pattern on dorsum between pygidium apex forward to segment 6. Perispiracular pores in tight group around anterior spiracle.

Affinities: *Furcaspis capensis* is similar to *F. charmoyi*, *F. proteae*, and *F. rufa* (all from the Afrotropical and Malagasian Region) by having enlarged submarginal setae and 3-locular pores near the anterior spiracles. It differs from these species by having a conspicuous cluster of gland tubercles on the prothorax and a reticulate pattern laterad of the anal opening (*F. proteae* has a similar pattern anterior of the anal opening).

Specimens examined in addition to type series: KENYA: Nairobi, on unknown host, III-19-1950, R. Le Pelley (BMNH). SOUTH AFRICA: Kwazulu/Natal Province -- Muden, on unknown host, IV-15-1937, (UCD). Eastern Cape Province -- Euitenhague, on *Aloe* sp., 1920's, H. J. Webber (CDFA); Port Elizabeth, on *Aloe* probably *ferox*, 3-29-1937, G. G. Becker (USNM). Gauteng Province -- Rosebank, on *Aloe* sp., VIII-1914 (USNM). Western Cape Province -- Stellenbosch, on *Aloe* sp., VI-8-1954, C. J. Joubert (BMNH); Northern Province -- Tzaneen, on *Aloe* sp., I-17-1964, C. J. Cillers (BMNH, SANC). Locality?, on *Aloe* sp., date and host unknown, C. K. Brain (BMNH); Province unknown -- Locality ?, on *Aloe ferox*, VII-1973 collected at Royal Botanical Gardens, Kew (BMNH).

Hosts: *Aloe* sp. (Aloaceae).

Distribution: Kenya and South Africa.

Important References: Green (1904); Balachowsky (1958).

Notes: Balachowsky (1958) indicated that the lobes of *Furcaspis capensis* have lateral notches, but he did not provide specimen-label data for this material and we have never examined specimens with this condition. We have examined a series of 3 specimens from Tzaneen, South Africa that have considerably more gland tubercles 23-73(48) than typical specimens of this species. However, careful examination of these specimens did not provide additional characters that could be used to separate them as a different species. Therefore, we have decided to tentatively include them as part of *F. capensis*.

Furcaspis charmoyi Brain

Figure 6

Nomenclature:

Aspidiotus cladii Maskell; Grandpré & Charmoy, 1899: 22. Misidentification.

Furcaspis charmoyi Brain 1918: 138.

Spinaspidotus charmoyi (Brain); MacGillivray 1921: 430.

Type Material: This species was originally mentioned by Grandpré and de Charmoy (1899) as *Aspidiotus cladii*. Brain (1918) realized that the species was different from *A. cladii* and named it *F. charmoyi* Brain. We have been unable to locate any original slides for certain. We do have 3 slides that were mounted by Green from material that was sent by de Charmoy collected in Mauritius on palms; no date is given (BMNH). This may be original material. There are 3 slides from Mauritius from de Charmoy with no further data that also could be authentic material (UCD); 2 slides were recently mounted from dry material. There is yet another slide mounted by Munting about 1963 labeled "Mauritius, on palm, original material" that is deposited in BMNH. The portion of the Brain collection that is in the USNM contains 7 slides that were collected in Mauritius on palms and a date of February 1915 is given. It is possible that the description given by Brain (1918) was based on this material and therefore is the type series, but it is not clear.

Field Characters: Scale cover yellow-brown to dark brown, tinged with a greenish color (Brain, 1918). "Female puparium roundish to more or less elongate, fairly convex, dark reddish-brown. Exuviae near anterior extremity, roundish. Larval exuvium shiny, reddish. Nymphal exuvium sometimes obscured by a layer of whitish secretion. Male puparium similar to that of female, but smaller. (Mamet, 1946).

Slide-mounted Characters: Adult female (Fig. 6) 0.7-1.1(0.8) mm long, 0.5-0.8(0.5) mm wide, pygidium wider than long at level of seta marking segment 4 (length/width 0.3-0.4(0.3)); with 3 definite pairs of lobes; pygidial margin with series of projections forward to seta marking segment 5; with few or no projections anterior of seta marking segment 5; prepygidial margin of segments 2 to 4 relatively smooth; prepygidial segments moderately lobed on body margin forward to head. Paraphysis formula variable, from 2-1 to 3-4, with few small paraphyses along body margin anterior of lobe 3; longest paraphysis in either interlobular space between lobes 1 and 2 or lobes 2 and 3, paraphyses shorter than length of median lobes. Median lobes rounded apically, longer than wide (length/width 1.1-1.7(1.4)), separated by space 1.0-2.0(1.5) times width of median lobe, with small paraphysis attached to medial margin of each median lobe, with 1-3(2) paraphyses between median lobes; second lobes wider than median lobes, same shape; third lobes same shape but slightly smaller; fourth lobes apparently part of series of points. Plates wide, bifurcate or trifurcate, usually with 1 or 2 trifurcate plates on each side of body, with 1 or 2 duct openings near apex; plate formula 2-2-0. Macroducts usually of 1 size, quite narrow and similar in appearance to microducts, occasionally with a few

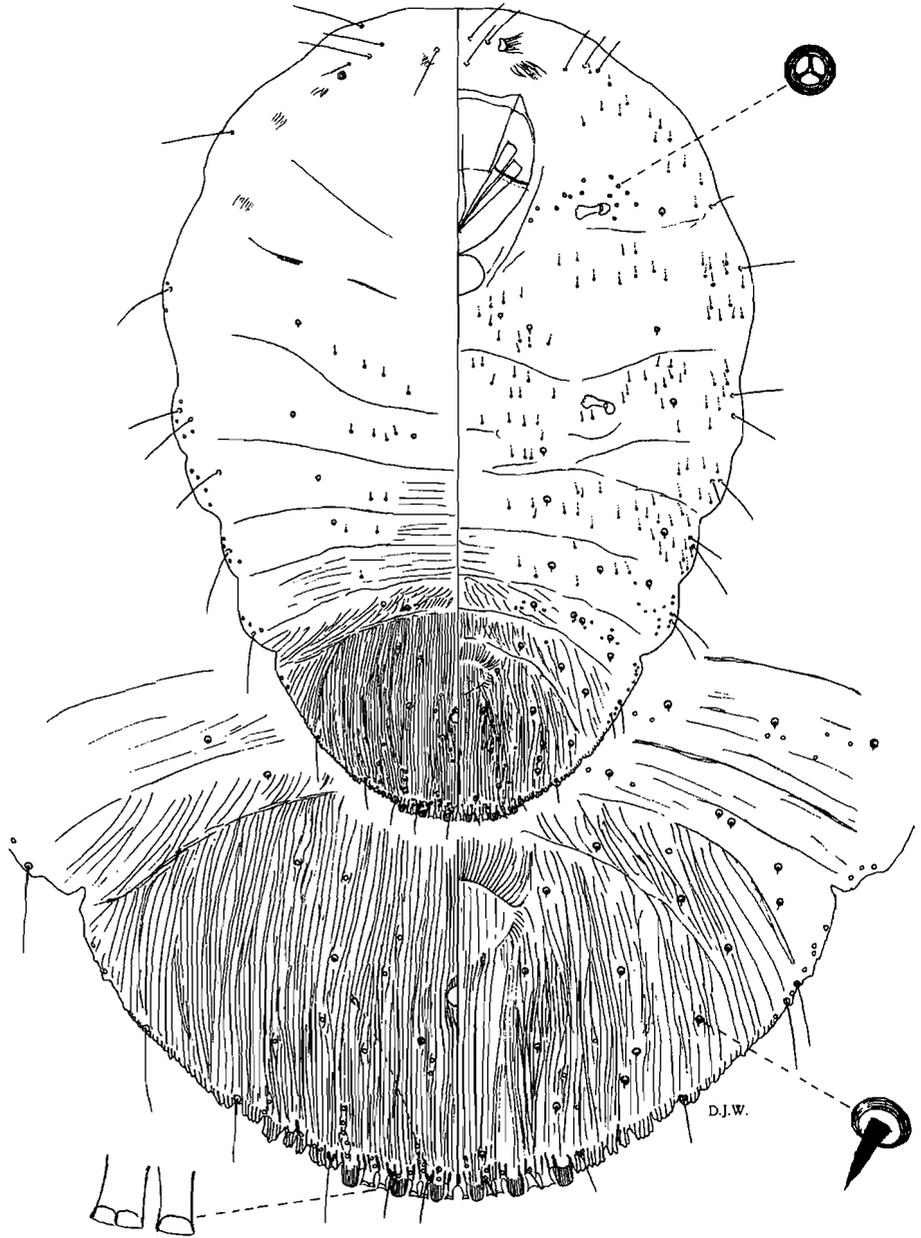


Figure 6. *Furcaspis charmoyi* Brain. Specimen from Mauritius, on palm, date and collector unknown.

between median lobes and on segments 3 and 4 shorter, present along body margin from segments 5 to 8, present in submedial area on segments 5 to 8, with 19-37(25) macroducts on each side of body on segments 5-8, some hidden by paraphyses, with few macroducts anterior of anal opening. Prepygidial microducts on venter of submedial areas abundant, present on mesothorax to segment 5, in lateral clusters from prothorax to segment 4; on dorsum prepygidial microducts present on submedial areas of meso- or metathorax to segments 1-4, restricted to margin of meso- or metathorax to segment 4. Gland tubercles absent. Ventral submarginal and submedial setae enlarged, cone shaped, apex acute, present on prothorax to segment 7, without sclerotization surrounding microduct orifice attached to setal base; longest seta on margin of segment 3 42-80(53) μ long. Perivulvar pores absent. Perispiracular pores each with 3 loculi, anterior spiracles each with 11-27(19) pores. Anal opening 12-17(14) μ long, located 5.0-7.0(6.4) times length of anal opening from base of median lobes. Eyes present at level of anterior edge of clypeolabral shield. Antennae each with 5-8(7) setae. Cicatrices absent. Body oval, dorsal surface of pygidium sclerotized throughout, without sclerotization surrounding macroduct orifices. Pattern anterior of anal opening with many longitudinal lines. Dorsal submedial setae slightly enlarged. Perispiracular pores widely scattered around anterior spiracles, not in tight group. Mature females heavily sclerotized on head and prothorax.

Affinities: *Furcaspis charmoyi* is similar to *F. capensis*, *F. proteae*, and *F. rufa* (all from the Afrotropical and Malagasian Regions) by having enlarged submarginal setae and 3-locular pores near the anterior spiracles. It differs from these species and all other species in *Furcaspis* by having the perispiracular pores widely dispersed around the anterior spiracle rather than in a compact cluster.

Specimens examined: MAURITIUS: Moka, on *Dictyosperma alba*, IX-07-1933, R. Mamet (BMNH); Rose Hill, on *D. alba*, IX-09-1933, A. Moutia (BMNH); Redit, on *D. alba*, IX-1990, J. R. Mamet and J. R. Williams (BMNH); locality unknown, on *Dictyosperma alba*, date unknown, R. Mamet (UCD). SOUTH AFRICA: Natal, Durban, on palm, II-02-1962, J. Munting (BMNH); Durban, on palm, I-10-1963, D. Thomas (BMNH, UCD). Pretoria, host ?, 1947, H. Compere (USNM).

Hosts: Palms.

Distribution: Mauritius and South Africa.

Important references: Mamet (1946); Munting (1965).

Furcaspis cladii (Maskell)

Figure 7

Nomenclature:

Aspidiotus cladii Maskell 1891: 3.

Aspidiotus (Chrysomphalus) cladii Maskell; Cockerell 1897: 26.

Aonidiella cladii (Maskell); Leonardi 1899: 176.

Chrysomphalus cladii (Maskell); Fernald 1903: 289.

Furcaspis cladii (Maskell); Cockerell 1919: 116.

Paraonidiella cladii (Maskell); MacGillivray 1921: 442.

Type Material: There is a single specimen on a slide that is here designated as the lectotype (ANIC). It is the only original slide prepared by Maskell (Deitz and Tocker 1980). This specimen is here designated as the lectotype to fix and stabilize the current concept of the name. Type data from Maskell (1891) are as follows: "In Australia, on *Cladium*, a species of rush. My specimens were sent to me by Mr. French." There are additional possible paralectotype specimens in the USNM as follows: 6 slides containing 11 adult females, 1 slide containing 2 first instars, and 6 slides containing 13 scale covers. One slide in the series is not *Furcaspis cladii* but instead is a specimen of *Aspidiotus nerii* Bouché. These slides are from the Maskell collection mounted by Morrison (for details see Miller et al. 1998 and Morrison and Morrison 1922) but do not contain specimen label information other than the name of the species, the country of origin, and Maskell Collection Number 122. Deitz and Tocker (1979) list them as subsequently mounted specimens apparently from the type series. There is 1 additional possible paralectotype slide containing 1 adult female and 1 scale cover in BMNH.

Field Characters: Adult female cover convex, circular, dark brown, scale margin orange-red; exuviae central, dark yellow. Male cover same color as female cover, elongate; exuviae subterminal (Maskell, 1891).

Slide-mounted Characters: Adult female (Fig. 7) 0.8-1.3(1.0) mm long, 0.6-1.1(0.8) mm wide, pygidium wider than long at level of seta marking segment 4 (length/width 0.4-0.5(0.5)) with 3 definite pairs of lobes; pygidial margin with series of projections forward to seta marking segment 5; with few or no projections anterior of seta marking segment 5; prepygidial margin of segments 2 to 4 irregular; prepygidial segments moderately lobed on body margin forward to head. Paraphysis formula variable, from 3-4 to 4-6, usually 3-4, with series of small paraphyses along body margin anterior of lobe 3; longest paraphysis in interlobular space between lobes 1 and 2, longest paraphyses longer than length of median lobes. Median lobes rounded apically, slightly longer than wide (length/width 1.0-1.9(1.5)), separated by space 0.9-1.7(1.3) times width of median lobe, with small paraphysis attached to medial margin of each median lobe, with 1 or 3 paraphyses between median lobes; second lobes about same size or slightly smaller than median lobes, same shape, but with second lateral lobule noticeably smaller than inner lobule; third lobes same shape as median lobe but slightly smaller, sometimes wider; fourth lobes apparently part of series of points between setae marking segments 6 and 5; fifth lobe absent. Plates enlarged apically, bifurcate, but with faint outline of plate outside of furcation, with rounded apex, with 1 duct opening near apex; plate formula 2-2-0; plates between median lobes conspicuous. Macroducts usually of 1 size, quite narrow and similar in appearance to microducts, present along body margin from segment 3 to 8, uncommon in submedial areas, with 21-36(26) macroducts on each side of body on segments 5-8, some hidden by paraphyses, without macroducts anterior of anal opening, or rare. Prepygidial microducts on venter of submedial areas on 1 or all of metathorax or segments 1-5, in lateral clusters from meso- or metathorax to segment 4; on dorsum prepygidial microducts in submedial areas of any or all of metathorax to segments 1-4, in small numbers in lateral areas of mesothorax to segment 4. Gland tubercles absent. Ventral submarginal setae not enlarged; longest seta on margin of segment 3 32-59(54) μ long. Perivulvar pores absent. Perispiracular pores absent. Anal opening 17-20(19) μ long, located 5.2-13.8(7.4) times length of anal opening from base of median lobes. Eyes present near lateral margin at level of anterior edge of clypeolabral shield. Antennae each with 5 or 6(6) setae. Cicatrices absent. Body oval or round, pygidium concave laterally, dorsal surface without obvious sclerotized areas. Pattern anterior of anal opening with many longitudinal lines. Second lobes bilobed.

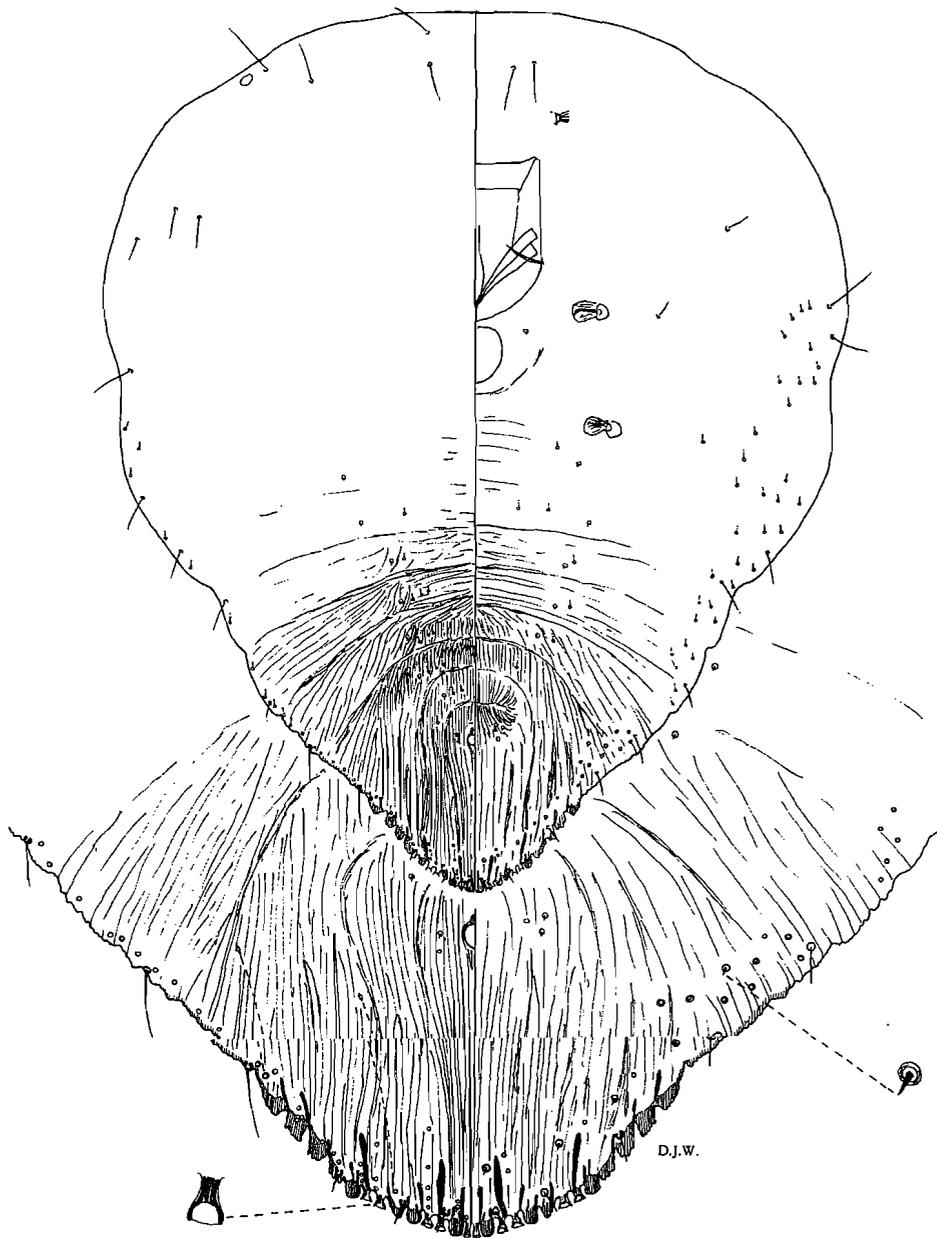


Figure 7. *Furcaspis cladii* (Maskell). Specimen from Australia, South Australia, near Mt. Pleasant, on *Juncus* sp., I-1-1964, R. S. Bungey.

Affinities: *Furcaspis cladii* is similar to *F. tasmanica* (both from Australia) by lacking perispiracular pores and by having bilobed second lobes. *Furcaspis cladii* differs by having conspicuously long paraphyses (short in *F. tasmanica*), quadrate-shaped lobes (narrow in *F. tasmanica*), and by lacking eyes (present in *F. tasmanica*).

Specimens examined in addition to type series: Australia: New South Wales -- Sydney, on *Xerotes* sp., VI-20-1910, W. W. Froggatt (USNM); Sydney, host unknown, ?-?-1897, W. W. Froggatt (BMNH); specific locality unknown, on *Xerotes* sp., XI-?-1925, E. E. Green (BMNH); specific locality unknown, host unknown, date unknown, E. E. Green (USNM). South Australia -- Black Hill, on *Lepidosperma viscida*, IX-14-1952, D. E. Symon (ANIC); Hawk's Nest Station, Kangaroo Island, on *Lepidosperma viscida*, IV-?-1933, collector unknown (ANIC); near Mt. Pleasant, on *Juncus* sp., I-1-1964, R. S. Bungey (ANIC, CDFA). Victoria -- Bendigo, on *Gahnia* sp., 1925, J. E. Dixon (BMNH). State unknown: specific locality unknown, host unknown, date unknown, A. Koebele (USNM); specific locality unknown, host unknown, date unknown, W. W. Froggatt (BMNH).

Hosts: *Cladium* (Cyperaceae), *Gahnia* (Cyperaceae), *Juncus* (Juncaceae), *Lepidosperma* (Cyperaceae), *Xerotes* (= *Lomandra*) (Lomandraceae). According to Borchsenius (1966) it also is reported on *Aloe*.

Distribution: Australia.

Important Publications: Maskell (1891); Laing (1929).

Notes: This species has been reported from Japan (Green, 1907; Kuwana, 1917; Ben-Dov and German, 2003), but we have been unable to locate specimens from this country and suspect the records are erroneous. It also has been reported from Mauritius (Green, 1907; Ben-Dov and German, 2003), but these specimens were later described as *Furcaspis charmoyi* Brain (1918). We have examined a slide labeled "New Zealand/ Maskell Colr./ Cooley Coll. 356," but we suspect that the slide is mislabeled and was originally from Australia.

Furcaspis cyphokentiae Williams and Miller, new species

Figure 8

Type material.— Holotype adult female mounted on slide by itself labeled as follows: left label "New Caledonia/ ex Cyhokenpia [sic]/ macrostachya seed/ XII-3-77/ Hawaii 42051/ Kunishi/ Balsam;" right label "Furcaspis/ cyphokentiae/ Williams and/ Miller/ HOLOTYPE." The holotype is in the USNM. There are no additional specimens.

Slide-mounted Characters: Holotype adult female (Fig. 8) 2.1 mm long, 1.1 mm wide, pygidium wider than long at level of seta marking segment 4 (length/width 0.7), with 3 definite pairs of lobes, pygidial margin with series of projections forward to seta marking segment 4; with no projections anterior of seta marking segment 4; prepygidial margin of segments 2 to 4 relatively smooth; prepygidial segments lobed on body margin forward to thorax. Paraphysis formula 2-3 and 2-4, with series of small paraphyses along body margin anterior of lobe 3; paraphyses subequal in length, longest paraphyses shorter than length of median lobes. Median lobes rounded or truncate apically, noticeably longer than wide (length/width 1.5), separated by space 1.3 times width of median lobe, with small paraphysis attached to medial margin of each median lobe, with 2 paraphyses between median lobes; second lobes slightly longer and wider than median lobes, same shape; third lobes same shape

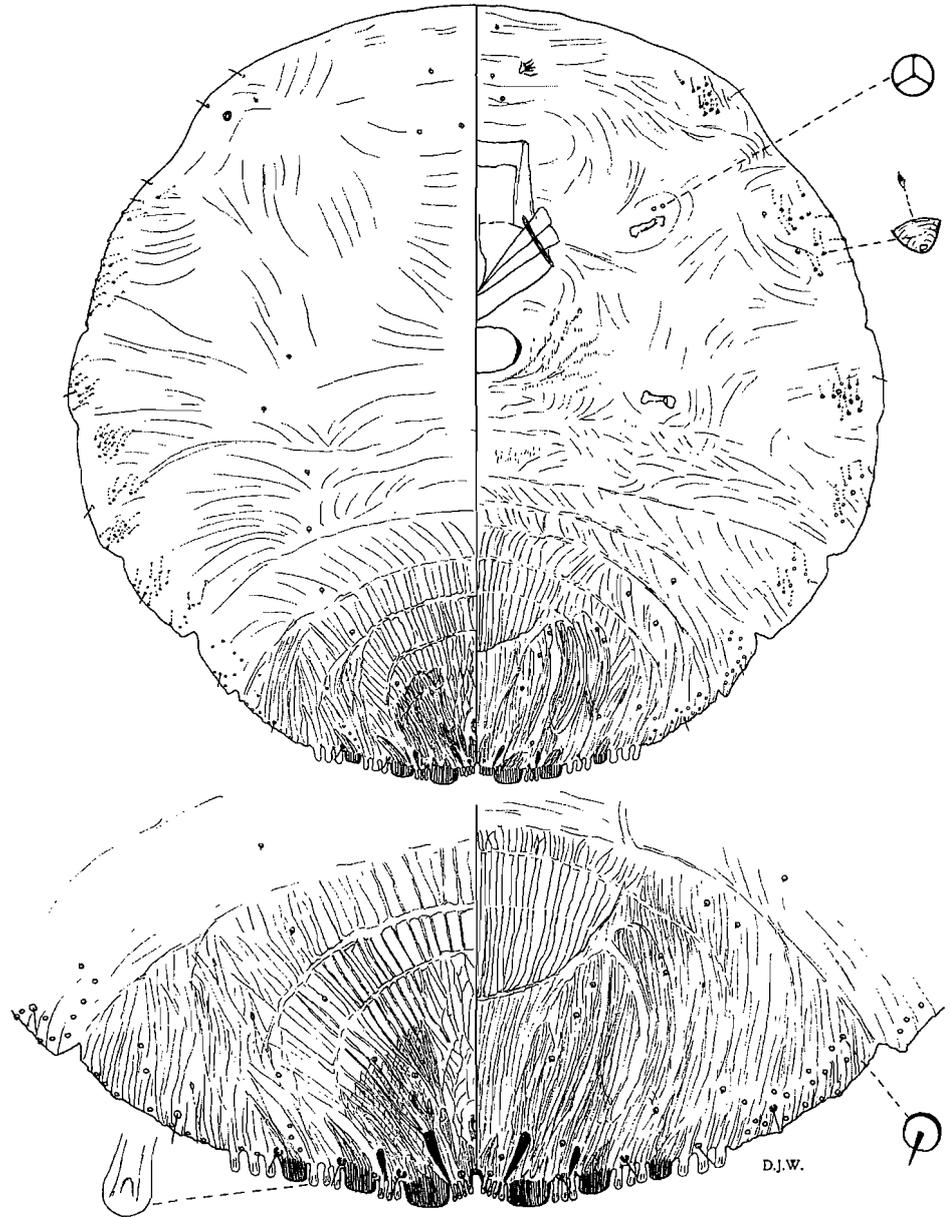


Figure 9. *Furcaspis dominicae* Williams & Miller. Specimen from Dominica, Salisbury, near Salisbury River, on unknown host, II-28-1964, D. F. Bray

third lobes smaller than second lobes, similar shape; fourth and fifth lobes absent. Plates thin medially, becoming wider anteriorly, with rounded apex, with 1 duct opening near apex; plate formula 3-3-3, rarely 3-2-2; 6-8 plates between median lobes, conspicuous. Macroducts usually without ducts between median lobes and on segment 7, present along body margin from segment 3 or 4 to 6, with 13 and 14 macroducts on each side of body on segments 5-8, (paratypes with 8-16(12) macroducts), some hidden by paraphyses, without macroducts anterior of anal opening. Prepygidial microducts on venter absent from submedial areas of posterior thorax and abdominal segments 1-4, in lateral clusters from prothorax to segment 4; on dorsum prepygidial microducts of 1 size absent from submedial areas, present in lateral areas from mesothorax to segment 4. Gland tubercles present in lateral areas of pro-, meso-, and metathorax; with 19 and 22 tubercles on each side of body (paratypes 19-29(23)). Ventral submarginal setae slender, not enlarged; longest seta on margin of segment 3 6μ long (paratypes 6-11(8) μ). Perivulvar pores absent. Perispiracular pores each with 3 loculi, anterior spiracles with 2 pores (paratypes 1-3(2) pores). Anal opening located 3.4 times length of anal opening from base of median lobes (paratypes 2.8-4.2(3.2) times), anal opening 5μ long (paratypes 4.5-8.0(3.2) μ). Eyes present laterad of anterior margin of clypeolabral shield. Antennae each with 5 and 6 setae (paratypes 4-6(5) setae). Cicatrices absent. Body circular, dorsal surface without conspicuous sclerotized areas; heavily striated in fanlike pattern. Pattern anterior of anal opening weakly reticulate. Paraphysis attached to medial margin of each median lobe unusually long, 20μ long (paratypes 19-22(20) μ). Distinct sclerotized notch between median lobes. Anal opening minute. Long paraphyses clavate.

Affinities: *Furcaspis dominicae* is unique among the species of *Furcaspis* in possessing 6 to 8 plates between the median lobes and a distinct notch at the pygidial apex.

Distribution: Dominica.

Etymology: The name is based on the country name Dominica.

***Furcaspis exophthalma* Williams and Miller, new species**

Figure 10

Type Material: Holotype adult female single specimen on slide labeled "NEW GUINEA/ Pt. Moresby Papua/ on Pandanus/ Coll. J. H. Barrett/ 7.IV.1937 1017/ C.I.E. 4651/15426" right label "*Furcaspis/ exophthalma/ Williams and Miller/ HOLOTYPE.*" Deposited in BMNH. In addition, there are 15 adult female paratypes on 15 slides with the same data as the holotype. (ANIC, BMNH, UCD, USNM).

Slide-mounted Characters: Adult female (Fig. 10) 0.8 mm long (paratypes 0.7-1.2(0.9) mm), 0.5 mm wide (paratypes 0.5-0.8(0.6) mm), pygidium wider than long at level of seta marking segment 4 (length/width 0.4) (paratypes 0.3-0.5(0.4)), with 3 definite pairs of lobes; pygidial margin with series of projections forward to area anterior of seta marking segment 4; prepygidial margin irregular, prepygidial segments not lobed on body margin forward to head. Paraphysis formula 3-5 (paratypes highly variable from 3-2 to 4-6), usually with several small paraphyses in space between third and fourth lobes; paraphyses longer than length of median lobes. Median lobes apically rounded, expanded apically, slightly longer than wide (length/width 0.8) (paratypes 0.6-1.0(0.8)), separated by space 0.5 times width of median lobe (paratypes 0.4-0.8(0.6)), with small paraphysis attached to medial margin of each median lobe, with 1 small paraphysis between median lobes (paratypes 1 or 2); second lobes approximately same size as median lobes, same shape; third lobes same shape about equal or slightly smaller;

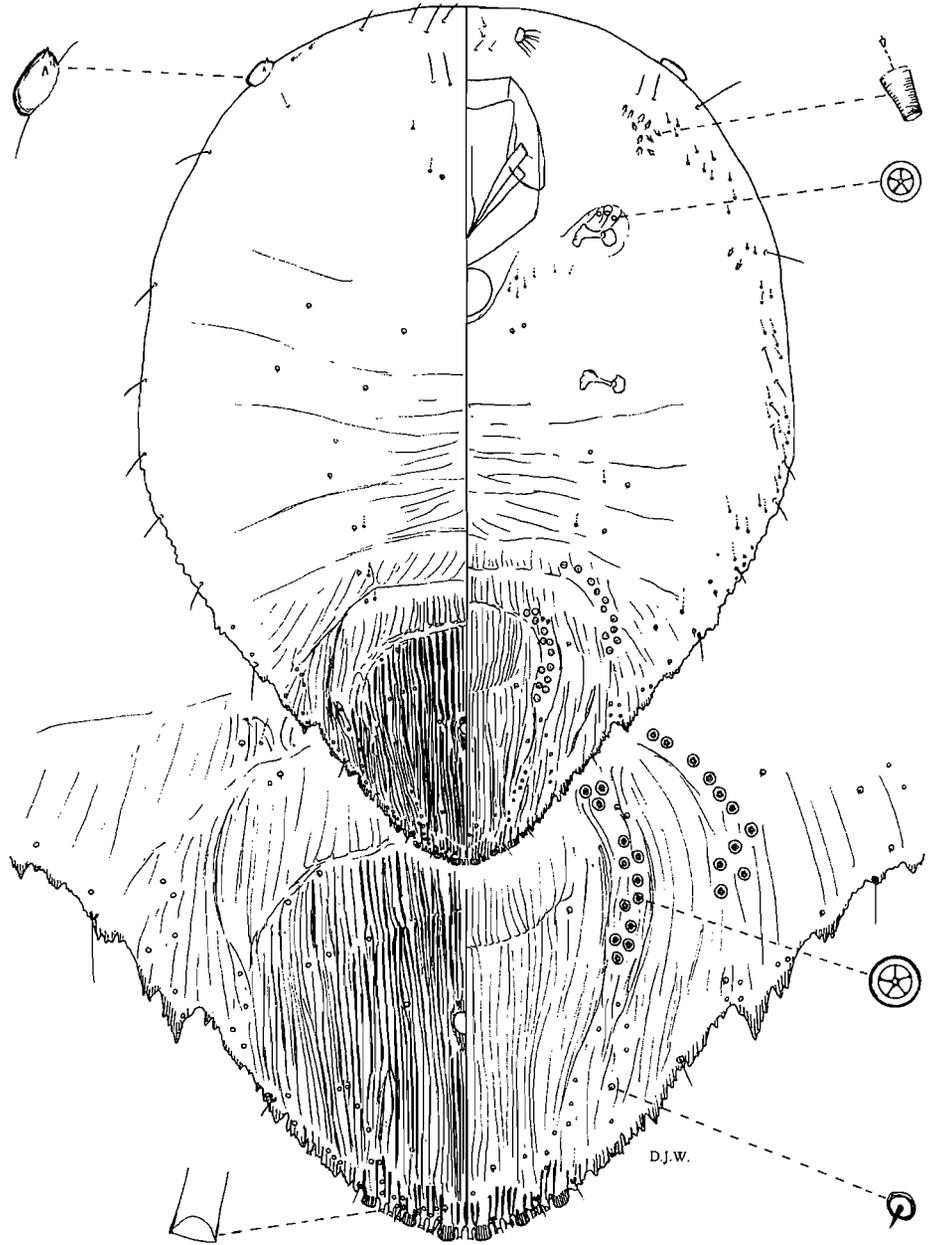


Figure 10. *Furcaspis exophthalma* Williams & Miller. Specimen from Papua New Guinea, Port Moresby, on *Pandanus* sp., IV-7-1937, J. H. Barrett.

present in cluster near anterior spiracle, in lateral clusters from pro- or mesothorax to segment 4; on dorsum prepygidial microducts of 1 or 2 sizes in submedial areas of metathorax and segments 1-4, in lateral areas from mesothorax or metathorax to segment 4. Gland tubercles present in lateral areas of pro- and mesothorax; with 12 and 14 tubercles on each side of body (paratypes 8-16(11)). Ventral submarginal setae slender, not enlarged; longest seta on margin of segment 3 49 μ long (paratypes 47-72(56) μ). Perivulvar pores unusual in distribution pattern, usually present in 2 concentric half circles around vulva, not aggregated into clusters, 9 and 13 pores on each side of body in inner circle (paratypes with 5-13(9) pores), 11 and 12 pores on each side of body in outer circle (paratypes 6-15(10) pores), 1 specimen with third circle on segment 7. Perispiracular pores each with 5 loculi, anterior spiracles with 2 and 4 pores (paratypes 2-8(3) pores). Anal opening located 4.3 times length of anal opening from base of median lobes (paratypes 5.1-7.2(5.9) times), anal opening 23 μ long (paratypes 14-23(17) μ). Eyes large, conspicuous, often protruding from margin, usually with 1-3 sclerotized spurs, present laterad of anterior margin of clypeolabral shield. Antennae each with 7 setae (paratypes 3-7(6) setae). Cicatrices absent. Body pear shaped, dorsal surface without conspicuous sclerotized areas. Pattern anterior of anal opening with many longitudinal lines. Mature specimens with heavy sclerotization on head and anterior thorax.

Affinities: *Furcaspis exophthalma* is similar to *F. haematochroa* (both from the same geographic area) by having 2 concentric rows of perivulvar pores, large eyes with spurs, and 5-locular pores associated with the anterior spiracles. *Furcaspis exophthalma* differs by having eyes that protrude from the body margin (not protruding on *F. haematochroa*) and perivulvar pores that are close together (more widely spaced in *F. haematochroa*).

Notes: We have seen 3 second instars from Indonesia, Irian Jaya, Schouten Islands, on *Pandanus* sp., that are similar in appearance, but they have bilobed second and third lobes.

Hosts: *Pandanus* (Pandanaceae).

Distribution: Papua New Guinea.

Etymology: The name is based on the Greek adjective "*exophthalmos*" meaning "with bulging eyes" referring to the large eyes of this species.

Furcaspis glandulosa Williams and Miller, new species

Figure 11

Type material.- Holotype adult female bottom left specimen on slide with 3 additional adult female paratypes labeled as follows: left label "*Furcaspis/ biformis* (Ckll.)/ on orchid/ Venezuela at D.C./ C. E. Prince/ June 12, 1935/ EQ # 31565;"right label "*Furcaspis glandulosa/ Williams &/ Miller/ HOLOTYPE/ PARATYPES/ USNM.*" Deposited in USNM. A map on the right label gives the location of the holotype and 3 paratypes.

Slide-mounted Characters: Holotype adult female (Fig.11) 0.8 mm long (paratypes 1.0-1.3(1.1) mm long), 0.7 mm wide (paratypes 0.8-0.9(0.8) mm wide), pygidium wider than long at level of seta marking segment 4 (length/width 0.3) (paratypes 0.3-0.4(0.3)), with 3 definite pairs of lobes, pygidial margin with series of projections forward to seta marking segment 4; with no projections anterior of seta marking segment 4; prepygidial segments moderately lobed on body margin forward to thorax. Paraphysis formula 4-4 and 5-3 on holotype (paratypes with 2-3, 4-3, 4-4, 5-4), with several small paraphyses in space between third and fourth lobes; longest

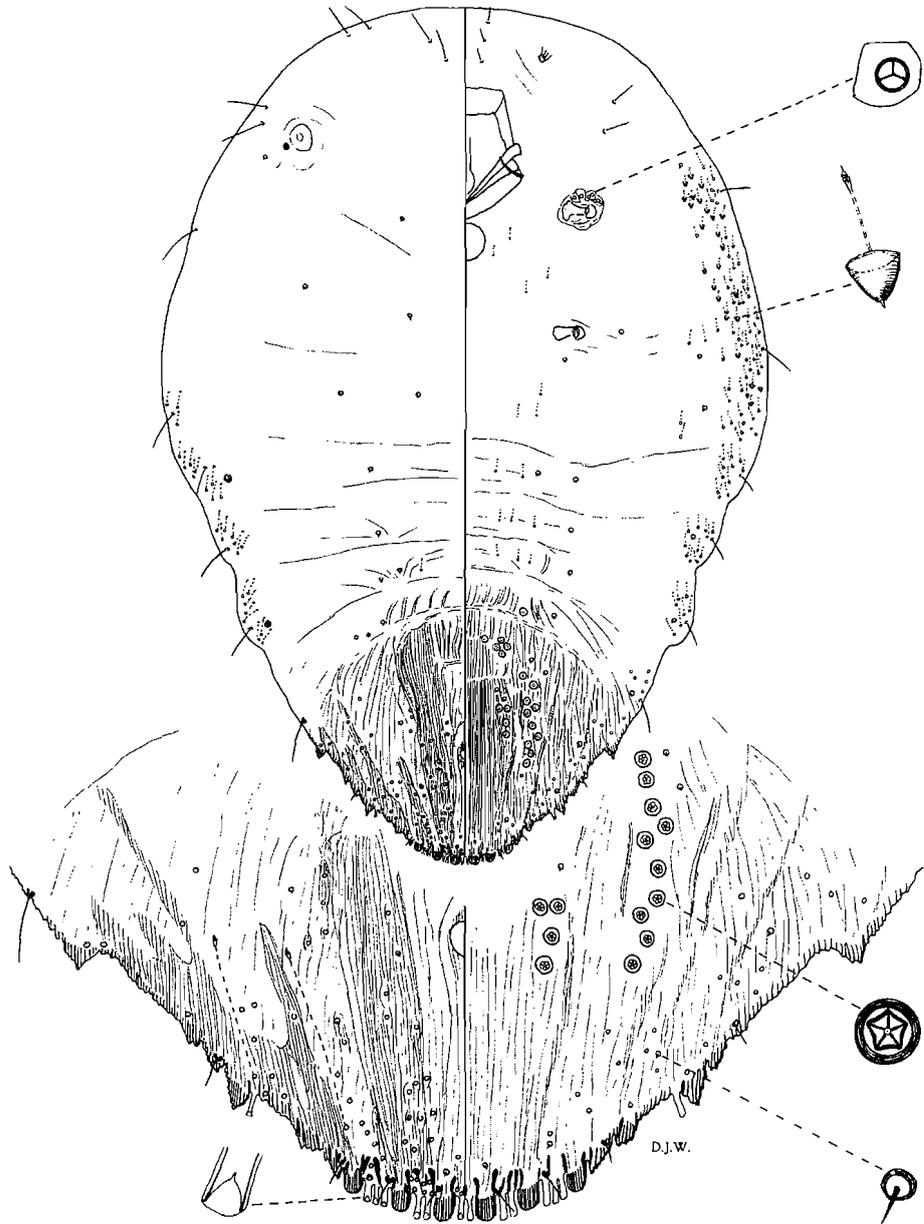


Figure 11. *Furcaspis glandulosa* Williams & Miller. Specimen from Venezuela, intercepted at Washington, D.C., on Orchidaceae, VI-12-1935, C. E. Prince.

paraphysis slightly longer than length of median lobes. Median lobes with round apices, slightly longer than wide (length/width 1.3) (paratypes 1.0-1.2(1.1)), separated by space 1.2 times width of median lobe (paratypes 0.9), with paraphysis attached to medial margin of each median lobe, with 3 paraphyses between median lobes; second lobes about same length as median lobes, slightly wider, similar shape; third lobes nearly quadrate, shorter than second lobes; fourth and fifth lobes apparently part of series of points between segments 4 and 6. Plates with apices rounded with bifurcate apex, with 1 duct opening near apex; plate formula 2-3-1; 2 plates between median lobes, conspicuous. Macroducts usually of 1 size, narrow and elongate, present along body margin from segment 3 or 4 to 8, with 35 and 37 macroducts on each side of body on segments 5-8 (paratypes with 40-55(44) ducts), some hidden by paraphyses, with few macroducts anterior of anal opening. Prepygidial microducts on venter in submedial areas of any of meso- or metathorax and segments 1-4, in lateral clusters from pro- or mesothorax to segment 4; on dorsum prepygidial microducts rare in submedial areas of metathorax and segments 1-4, in lateral areas from mesothorax to segment 4. Gland tubercles present in lateral areas of meso- and metathorax; with 23 and 20 tubercles on each side of body of holotype (paratypes with 11-28(19) tubercles). Ventral submarginal setae not enlarged; longest seta on margin of segment 3 38 μ long (paratypes 43-50 (45) μ). Perivulvar pores unusual in distribution pattern, present in 2 or 3 concentric half circles around vulva, 2 or 3 pores on each side of body in inner circle (paratypes 2-4(3) pores), 10 or 12 pores on each side of body in second circle (paratypes 9-16(13) pores), 0-1(0) pores on each side of body in third circle. Perispiracular pores with 3 loculi, anterior spiracles with 6 or 9 pores on each side of body (paratypes with 5-9(7) pores). Anal opening located 6.0 times length of anal opening from base of median lobes (paratypes 4.0-7.3(5.8) times), anal opening 16 μ long (paratypes 14-28(19) μ). Eyes conspicuous, each usually adjacent to prothoracic cicatrix. Antennae each with 4 setae (paratypes with 5 setae). Cicatrices present on prothorax, segment 1 and 3, cicatrix on prothorax dark and sometimes divided. Body oval, with single central sclerotized area, with sclerotized area along body margin of pygidium with darker area originating from margin marking segments 5 and 4. Pattern anterior of anal opening with a few longitudinal lines. Perispiracular pores encompassed in area of sclerotization including anterior spiracle. Inner circle of perivulvar pores on segment 7.

Affinities: *Furcaspis glandulosa* is similar to *F. bromeliae*, *F. intercepta*, *F. peruviana*, and *F. bififormis* (all Neotropical) by having perivulvar pores around the vulva and 3-ocular pores near the anterior spiracles. It is most similar to *Furcaspis bromeliae* in normally possessing 2 rows of perivulvar pores but differs by having more gland tubercles and by having gland tubercles on the metathorax (absent from *F. bromeliae*).

Hosts: orchids.

Distribution: Venezuela

Etymology: The word "*glandulosa*" is based on the Latin word "*glandula*" meaning "small gland" and the Latin suffix "*osus*" meaning "full of."

***Furcaspis haematochroa* Cockerell**

Figure 12

Nomenclature:

Furcaspis haematochroa Cockerell 1919: 116.

Spinaspidiotus haematochrous (Cockerell); MacGillivray 1921: 430.

Furcaspis hematochroa (Cockerell); Lepesme 1947: 214.

Spinaspidiotus haematochroa (Cockerell); Ben-Dov and German 2003: 502.

Type Material: A lectotype is here designated to clarify the status of this species. It is selected from material deposited in the USNM which is labeled as follows: "Furcaspis/ haematochroa/ Ckll./ Type/ on Coconut Leaves/ Batbatan Is., Antique/ Prov., Panay, P. I./ T. D. A. Cockerell, Coll./ June 30, 1918." There are 2 specimens on the slide, the right specimen is selected as the lectotype and a map is given showing its location. There are additional paralectotype specimens in the USNM as follows: 1 slide containing 1 adult female, 1 slide containing a piece of an adult female and a second-instar female, and 1 slide containing 1 scale cover. There is 1 additional paralectotype slide containing 1 adult female in the BMNH. There also are 2 slides at UCD labeled "Furcaspis type material/ haematochroa Ckll./ From Coconut/ palm/Batbatan, P. Id./ McGregor, coll./ From Ckll. one slide contains 5 scale covers, the other has 1 adult female syntype. However the adult female appears to be a species of *Pseudaonidia* and not *Furcaspis*.

Field Characters: According to Cockerell (1919) "Female scales on leaves of cocoanut [sic] palm, scattered. Scale deep rich red, suggesting a drop of blood; circular, slightly convex, with the large, circular exuviae to one side, often reaching or slightly overlapping the margin, first skin nipple-like, prominent; width of scale about 2.5 mm. Male scales suboval."

Slide-mounted Characters: Adult female (Fig. 12) 0.7-1.3(1.0) mm long, 0.5-0.9(0.7) mm wide, pygidium wider than long at level of seta marking segment 4 (length/width 0.4-0.6(0.5)), with 3 definite pairs of lobes; pygidial margin with series of projections forward to seta marking segment 4; without projections anterior of seta marking segment 4; prepygidial margin sometimes irregular, prepygidial segments moderately lobed on body margin forward to head. Paraphysis formula variable from 3-4 to 6-6, usually with several small paraphyses in space between third and fourth lobes; paraphyses equal to or slightly shorter than length of median lobes. Median lobes apically rounded, slightly longer than wide (length/width 0.7-1.2(0.9)), separated by space 0.6-1.0(0.8) times width of median lobe, with small paraphysis attached to medial margin of each median lobe, with 3 small paraphyses between median lobes; second lobes approximately same size as median lobes, same shape; third lobes same shape, about equal or slightly smaller and broader; fourth and fifth lobes apparently part of series of points described above. Plates moderately wide, with bifurcate apex, with 1 duct opening near apex; plate formula 2-3-1; 2 plates between median lobes, conspicuous. Macroducts present along body margin from segment 3 or 4 to 7, with 28-44(37) macroducts on each side of body on segments 5-8, some hidden by paraphyses, with several macroducts anterior of anal opening. Prepygidial microducts on venter in submedial areas of meso- or metathorax and segments 1-4, in lateral clusters from pro- or mesothorax to segment 4; on dorsum prepygidial microducts in submedial areas of metathorax and segments 1-4, in lateral areas from mesothorax or metathorax to segment 4. Gland tubercles present in lateral areas of pro- and mesothorax; with 22-37(30) tubercles on each side of body. Ventral submarginal setae slender, not enlarged; longest seta on margin of segment 3 67-91(82) μ long. Perivulvar pores unusual in distribution pattern, present in 2 concentric half circles around vulva, not aggregated into clusters, 5-10(7) pores on each side of body in inner circle, 3-10(7) pores on each side of body in outer circle. Perispiracular pores with 5 loculi, anterior spiracles with 1-5(3) pores. Anal opening located 3.3-6.1(4.3) times length of anal opening from base of median lobes, anal opening 15-22(20) μ long. Eyes large, conspicuous, usually with 1 to 3 sclerotized spurs,

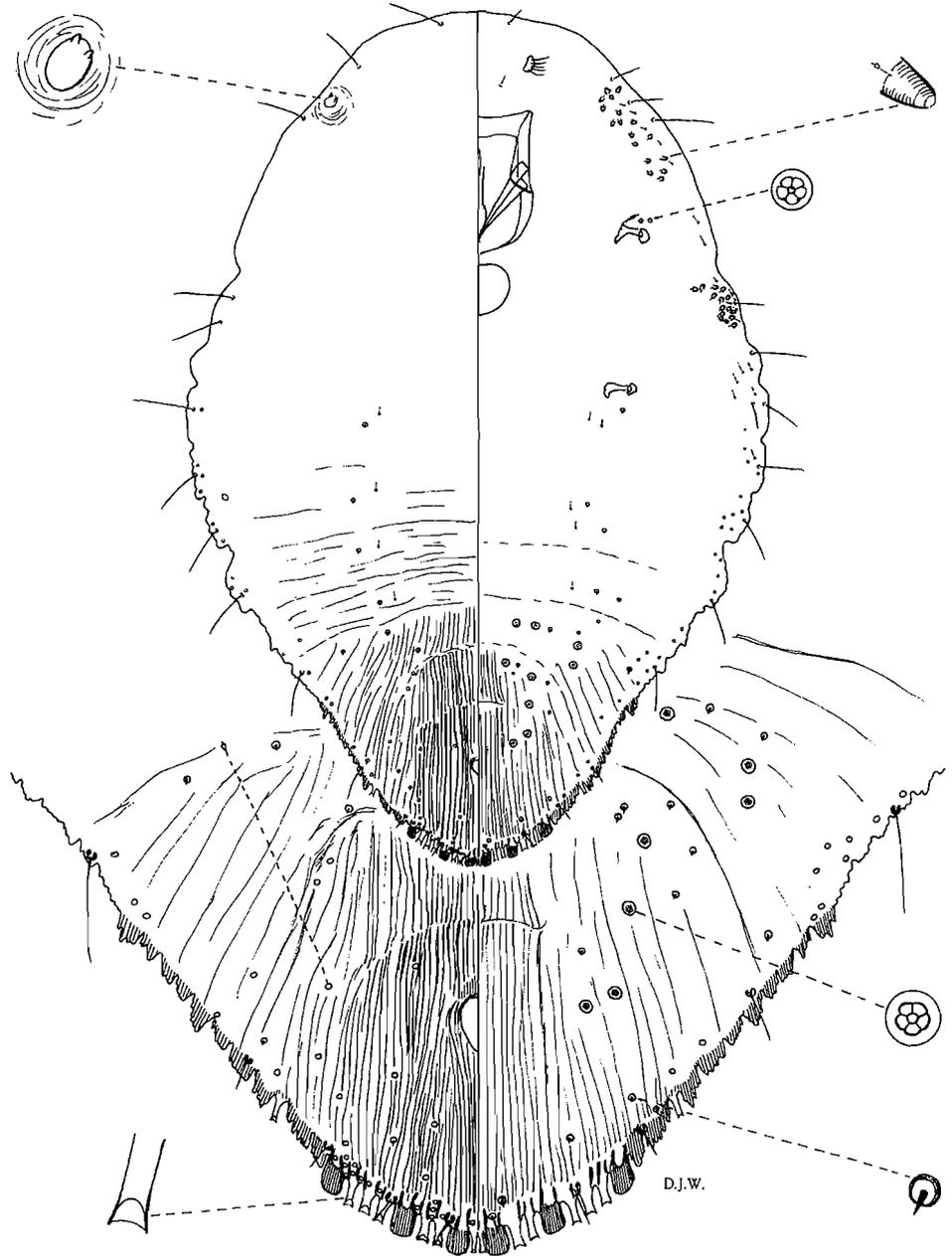


Figure 12. *Furcaspis haematochroa* Cockerell. Specimen from Philippines, intercepted at San Diego, California, on *Kentia* sp., V-16-1960, F. J. Phelan. 1918;"

present laterad of clypeolabral shield. Antennae each with 5-7(6) setae. Cicatrices transparent, on segment 2 and near intersegmental line of segments 3 and 4. Body oval, dorsal surface without conspicuous sclerotized areas. Pattern anterior of anal opening with many longitudinal lines. Opening of vulva difficult to see.

Affinities: *Furcaspis haematochroa* is similar to *F. exophthalma* (both from same geographic area) by having 2 concentric rows of perivulvar pores, large eyes with spurs, and 5-locular pores associated with the anterior spiracles. *Furcaspis haematochroa* differs by having eyes that do not protrude from the body margin (protruding on *F. exophthalma*) and perivulvar pores that are widely spaced (close together in *F. exophthalma*).

Specimens examined in addition to type series: Philippine Islands: Luzon Island: Laguna Province -- Laguna, UPLB Campus, on *Corypha utan*, VI-02-1969, R. A. Olaguer (Lit Collection UPLB); Laguna, UPLB Campus, on *Corypha elata*, IV-18-1969, R. A. Olaguer (Lit Collection UPLB). Specific locality unknown, taken in quarantine at San Diego, California, on *Kentia* sp., V-16-1960, F. J. Phelan (USNM).

Hosts: Areaceae: *Cocos nucifera*, *Corypha utan*, *C. elata*, and *Kentia* sp. Probably occurring on many species of palms.

Distribution: Philippine Islands.

Furcaspis intercepta Williams and Miller, new species

Figure 13

Type material.— Holotype adult female right specimen on slide with 2 additional adult female paratypes labeled as follows: left label "*Furcaspis*/ Brazil/ ex Bromeliad leaf/ V-18-79/ San Francisco 9281/ P. Meyerson/ Balsam"; right label "*Furcaspis*/ *intercepta*/ Williams and Miller/ HOLOTYPE/ PARATYPES." A map on the right label gives the location of the holotype and 2 paratypes. The holotype is deposited in the USNM.

Slide-mounted Characters: Holotype adult female (Fig. 13) 1.4 mm long (paratypes 1.3 and 1.4 mm long), 1.3 mm wide (paratypes 1.1 mm wide), pygidium wider than long at level of seta marking segment 4 (length/width 0.4), with 3 definite pairs of lobes, pygidial margin with 3 projections between marginal setae marking segments 6 and 5, paratypes with 3-5(3), each projection with series of small notches, anterior projection largest and representing lobe 4; pygidial margin with 3 or 4 projections between marginal setae marking segments 5 and 4, each projection with series of small notches, usually with space between anterior projection and posterior series of projections, anterior projection probably representing lobe 5; without projections anterior of seta marking segment 4; prepygidial margin smooth, without segmental lobes. Paraphysis formula 3-3 (paratypes with 2-3 or 3-3) occasionally with several small paraphyses in second space, usually with several small paraphyses in space between third and fourth lobes; paraphyses slightly shorter than length of median lobes. Median lobes apically rounded, slightly longer than wide (length/width 1.1 (paratypes 1.3 and 1.4)), separated by space 0.7 times width of median lobe (paratypes 0.9 and 1.0), with small paraphysis attached to medial margin of each median lobe, with 3 small paraphyses between median lobes; second lobes about same length as median lobes, slightly wider, same shape; third lobes same shape but slightly smaller; fourth and fifth lobes apparently part of series of points described above. Plates thin, with bifurcate apex, with 1 duct opening near apex; plate formula 2-3-1; 2 plates between median lobes, conspicuous. Macroducts present along body margin from segment 3 or

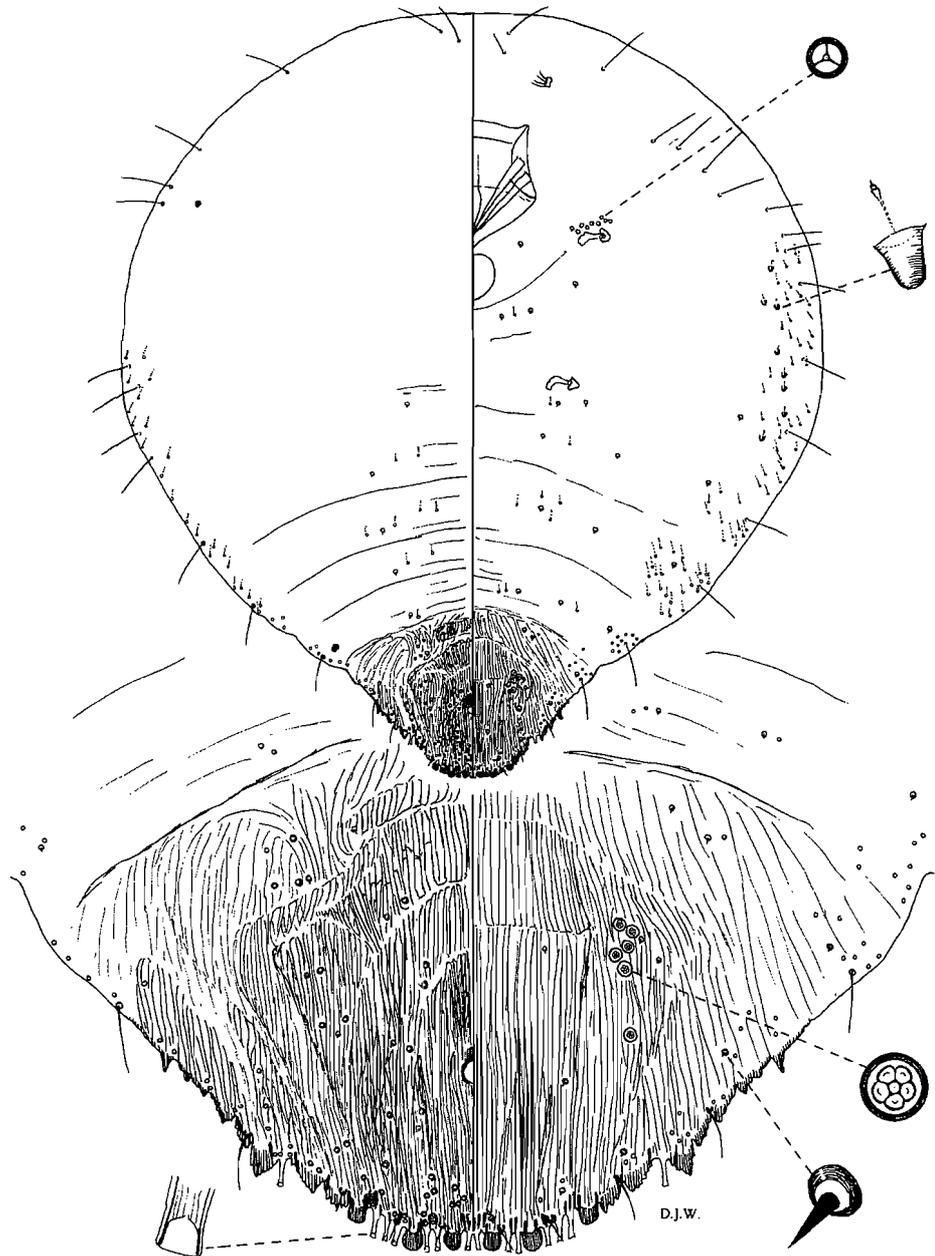


Figure 13. *Furcaspis intercepta* Williams & Miller. Specimen from Brazil, intercepted at San Francisco, California, on Bromeliaceae, V-18-79, P. Meyerson.

4 to 8, with 32 macroducts on each side of body on segments 5-8 (paratypes with 33 and 35), some hidden by paraphyses, with several macroducts anterior of anal opening. Prepygidial microducts on venter in submedial areas of meso- or metathorax and segments 1-4, in lateral clusters from mesothorax to segment 4; on dorsum prepygidial microducts in submedial areas of metathorax and segments 1-4, in lateral areas from mesothorax to segment 4. Gland tubercles present in lateral areas of meso- and metathorax, sometimes on segment 1; with 0 and 4 tubercles on each side of body of holotype (paratypes with 1-8(4) gland tubercles). Ventral submarginal setae slender, slightly enlarged; longest seta on margin of segment 3 62 μ long (paratypes 50-70(59) μ long). Perivulvar pores present, not in half circle band around vulva, separated into 2, 4 and 5 pores on each side of body (paratypes with 0-2(1) pores). Perispiracular pores with 3 loculi, anterior spiracles with 7 and 9 pores (paratypes with 5-9(7) pores). Anal opening located 8.0 times length of anal opening from base of median lobes (paratypes 6.7 and 8.3 times), anal opening 18 μ long (paratypes 17 and 22 μ). Eyes absent. Antennae each with 3 or 4 setae. Cicatrices normally present on prothorax and segment 3, cicatrix on prothorax dark and undivided, on segment 3 lighter and often divided. Body pear shaped, dorsal surface with single central sclerotized area, with sclerotized area along body margin of pygidium with darker area originating from margin marking segments 5 and 4 on each side of body; with longitudinal line of macroducts in membranous area between medial sclerotized area and area between segments 6 and 5. Pattern anterior of anal opening with a few longitudinal lines.

Affinities: *Furcaspis intercepta* is similar to *F. biformis* and *F. peruviana* by having 1 ring of perivulvar pores around the vulva and 3-locular pores near the spiracles. *Furcaspis intercepta* differs from *F. biformis* in lacking perivulvar pores anterior to the vulva (present in *F. biformis*). It differs from *F. peruviana* by having no laterocentral group of perivulvar pores (present in *F. peruviana*), setae on thorax slender and not enlarged (enlarged and conical on *F. peruviana*), and no gland tubercles on the prothorax (present in *F. peruviana*).

Hosts: Bromeliaceae: unknown species of bromeliad.

Distribution: Brazil

Etymology: The name is a Latin passive participle meaning "intercepted" relating to being intercepted at U. S. ports-of-entry.

***Furcaspis matileae* Williams and Miller, new species**

Figure 14

Type material.— Holotype adult female mounted on slide by itself labeled as follows: left label "Nlle CALEDONIE:/ Pleine des Lacs, bord du Lac en huit / 30.III.1976/ Fabres rac./ 6548/1/MNHN – Paris;" right label "S/ Lepidosperma/ perteres." There is a label on the back of the slide "HOLOTYPE/ *Furcaspis/ matileae/ Williams &/ Miller.*" The holotype is deposited in the MNHN. In addition, there are 15 adult female paratypes on 10 slides from the same locality as the holotype (BMNH, MNHN, USNM); there are 10 adult female paratypes on 3 slides from Nouméa (MNHN); and there are 5 adult female paratypes and a second-instar paratype on 3 slides from Plum (MNHN). Specific data are given in specimens examined section. The type locality is "Yatè, Plaine des Lacs, bord du Lac-en-Huit"(personal communication, Danièle Matile, June 23, 2005).

Slide-mounted Characters: Holotype adult female (Fig. 14) 1.1 mm long (paratypes 1.2-2.1 (1.4) mm long), 0.9 mm wide (paratypes 0.9-1.2 (1.1) mm wide), pygidium wider than long at level of seta marking segment 4 (length/width 0.2) (paratypes 0.2-0.3(0.2)), with 3 definite pairs of lobes, pygidial margin with series of projections forward to seta marking segment 4; with no projections anterior of seta marking segment 4; prepygidial segments moderately lobed on body margin forward to head. Paraphysis formula 4-5 (paratypes variable, from 2-3 to 5-6, with series of small paraphyses along body margin anterior of lobe 3; longest paraphysis in interlobular space between lobes 1 and 2, or 2 and 3, longest paraphyses about same length as median lobes. Median lobes rounded apically, noticeably longer than wide (length/width 2.5) (paratypes 1.5-2.5 (2.3)), separated by space 2.5 times width of median lobe (paratypes 1.3-4.0(2.8)), with small paraphysis attached to medial margin of each median lobe, with 3 paraphyses between median lobes (paratypes 2-4(3) paraphyses); second lobes slightly wider than median lobes, same shape; third lobes same shape as median lobes but slightly larger and wider; fourth and fifth lobes apparently part of series of points between setae marking segments 6 and 4. Plates elongate, rounded, bifurcations not obvious, with 1 duct opening near apex; plate formula 2-3-2; 2 or 3 plates between median lobes, conspicuous. Macroducts present along body margin from segments 4 to 8, present in submedial area on segments 4 to 7 or 8, with 47 and 50 macroducts on each side of body on segments 5-8 (paratypes with 16-51(46) ducts), some hidden by paraphyses, with several macroducts anterior of anal opening. Prepygidial microducts on venter of submedial areas present on any of segments 1-5, with many on thorax, especially near spiracles, rare on head, in lateral clusters from head or prothorax to segment 4; on dorsum prepygidial microducts in submedial areas of any or all of head to segments 1-4, abundant in lateral areas of head or prothorax to segment 4. Gland tubercles present on prothorax with 18 and 21 on each side of body (paratypes 12-19(15)). Ventral submarginal setae small and pointed, with large sclerotized collar; longest seta on margin of segment 3 58 μ long (paratypes 45-58(52) μ). Perivulvar pores absent. Perispiracular pores each with 5 loculi, with 6 and 8 pores associated with each anterior spiracle (paratypes 2-12(6)). Anal opening located 6.2 times length of anal opening from base of median lobes (paratypes 4.7-6.3(5.4)), anal opening 16 μ long (paratypes 15-22(18) μ). Eyes large and conspicuous, located near lateral margins at level of anterior edge of clypeolabral shield. Antennae each with 6 setae (paratypes 6(5-8) setae). Cicatrices small, present on prothorax. Body subcircular, pygidium concave laterally, dorsal surface without obvious sclerotized areas. Pattern anterior of anal opening with many longitudinal lines. Dorsal setae adjacent to lobes conspicuously longer than lobes. Plates conspicuously longer than lobes.

Paratype Specimens Examined: New Caledonia: Yaté, Plaine des Lacs, bord du Lac-en-Huit, on *Lepidosperma perteres*, III-30-1976, G. Fabres (BMNH, MNHN, USNM); Nouméa, ORSTOM, on *Lepidosperma perteres*, XII-20-1983, D. Matile; Plum, "maquis minier;" on *Lepidosperma perteres*, XI-17-1983, D. Matile.

Affinities: *Furcaspis matileae* is similar to *F. cyphokentiae* (both from New Caledonia) by lacking perivulvar pores, having 2 plates anterior to each third lobe, conspicuously long dorsal setae near the lobes, and 5-locular pores associated with the anterior spiracles. *Furcaspis matileae* differs mainly by lacking gland tubercles on the mesothorax (present on *F. cyphokentiae*) and by lacking sclerotized lateral areas on the thorax (present on *F. cyphokentiae*).

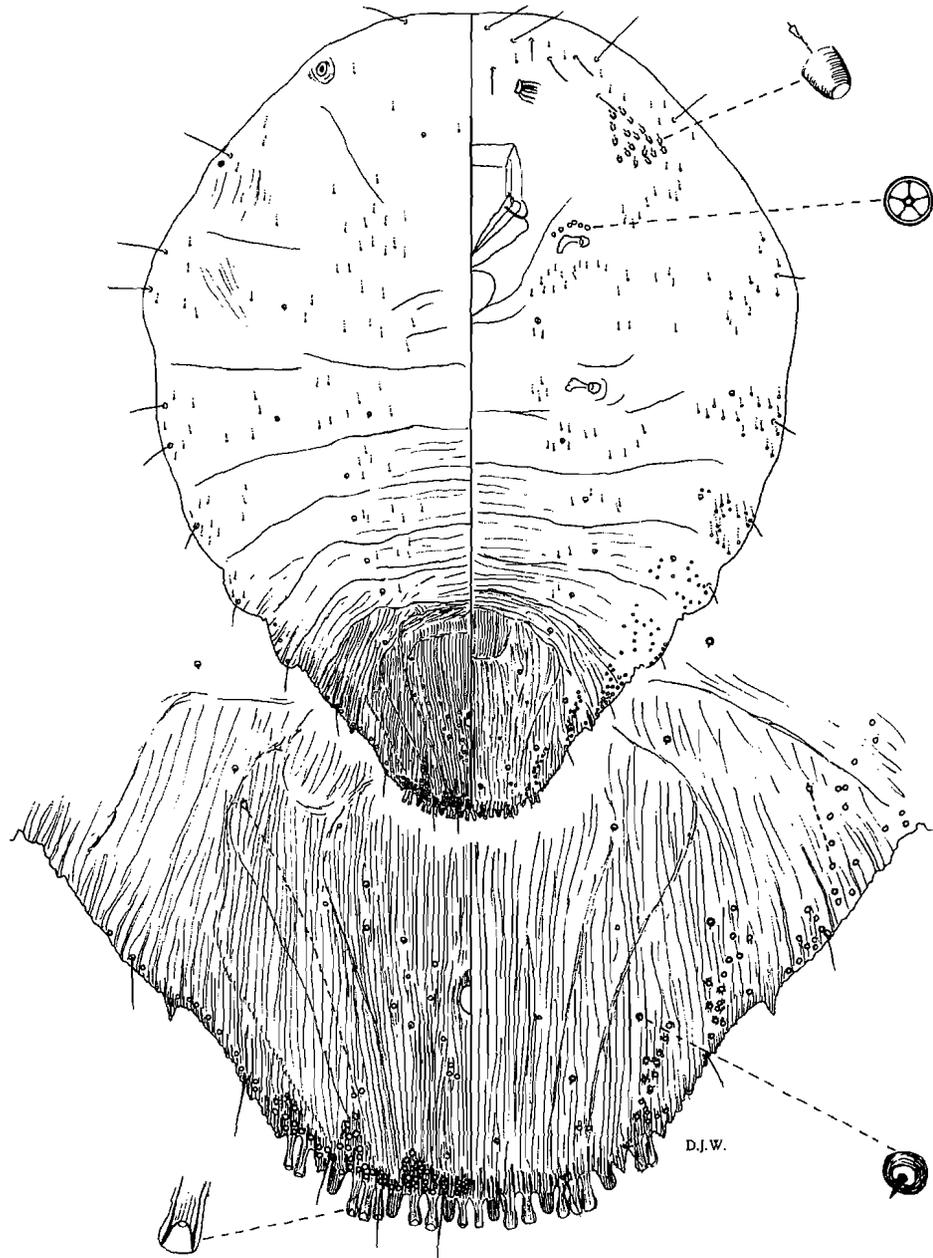


Figure 14. *Furcaspis matileae* Williams & Miller. Specimen from New Caledonia, Pleine des Lacs, bord du Lac en huis, on *Lepidosperma perteres*, III-30-1976, G. Fabres.

Hosts: *Lepidosperma perteres* (Cyperaceae).

Distribution: New Caledonia.

Etymology: This species is named in honor of Danièle Matile, Museum national d'Histoire naturelle, Paris, who kindly allowed us to include it in this publication.

Furcaspis mauritiana (Newstead)

Figure 15

Nomenclature:

Aspidiotus (*Chrysomphalus*?) *mauritanus* Newstead 1917: 374

Tollaspidiotus mauritanus (Newstead); MacGillivray 1921: 426.

Furcaspis mauritiana (Newstead); Lindinger 1932: 200.

Furcaspis mauritana (Newstead); Ben-Dov and German 2003: 811.

Type Material: We have selected as lectotype an adult female on a slide with 3 additional adult female paralectotypes; the lectotype is the bottom right specimen on the slide and a map is given of the location of the specimen. This specimen is here designated as the lectotype to fix and stabilize the current concept of the name. The slide is labeled as follows: left label "Dept. Agr. Mauritius/ on palm trees/ Botanic Gardens/ Mauritius. 1915/ de Charmoy. 10b/ 322." right label "Aspidiotus/ mauritanus./ Newst./ Type lot./ BM/ R.N. 1945, 121." The label on the back states "*Aspidiotus/ mauritanus/* Newstead/ LECTOTYPE/ PARALECTOTYPES." The lectotype is deposited in BMNH. In addition, there are 11 adult female, 1 adult male, 3 second-instar male paralectotypes on 4 slides (BMNH). There also is a slide containing 13 scale covers, and there are 10 adult females mounted on 10 slides from dry material, labeled Mauritius, Botanic Gardens, on palm leaves, 1915, de Charmoy, from type lot (BMNH). In the USNM there are 11 adult females and 1 adult male on 5 slides that apparently are also part of the syntype series.

Field Characters: "*Female puparium*. Subcircular: anterior extremity very slightly produced; posterior extremity strongly uptilted by the ventral pellicle, which is markedly thickened and tongue-shaped, but does not project beyond the dorsal pellicle; the thickened portion rests upon a thinner pellicle of secretory matter, so that when examined in profile the puparium resembles the partly opened bivalve shell of a mollusc with the 'foot' showing between the valves. Larval pellicle subcentral, very prominent, and somewhat hemispherical. Colour bright yellowish-buff or reddish-buff, with generally distinct concentric bands of a darker colour. *Male puparium*. Larger than that of the female and strongly produced posteriorly. Pellicle central and very prominent; colour as in that of the female, but with no zonal bands. Chiefly on the upper surface of the leaves, in association with *Asterolecanium spectabile* sp. nov., but the latter most exclusively on the 'under' surface of the leaf" (Newstead 1917).

Slide-mounted Characters: Adult female (Fig. 15) 0.5-0.7(0.6) mm long, 0.5-0.6(0.5) mm wide, pygidium wider than long at level of seta marking segment 4 (length/width 0.3); with 3 definite pairs of lobes; pygidial margin with series of projections forward to seta marking segment 4; with few or no projections anterior of seta marking segment 4; prepygidial margin of segments 2 to 4 irregular with protruding microduct orifices; prepygidial segments conspicuously lobed on body margin forward to mesothorax. Paraphysis formula variable, from 2-1 to 3-4, without paraphyses along body margin anterior of lobe 3; longest paraphysis usually in interlobular space between lobes 2 and 3, paraphyses shorter than length of median lobes.

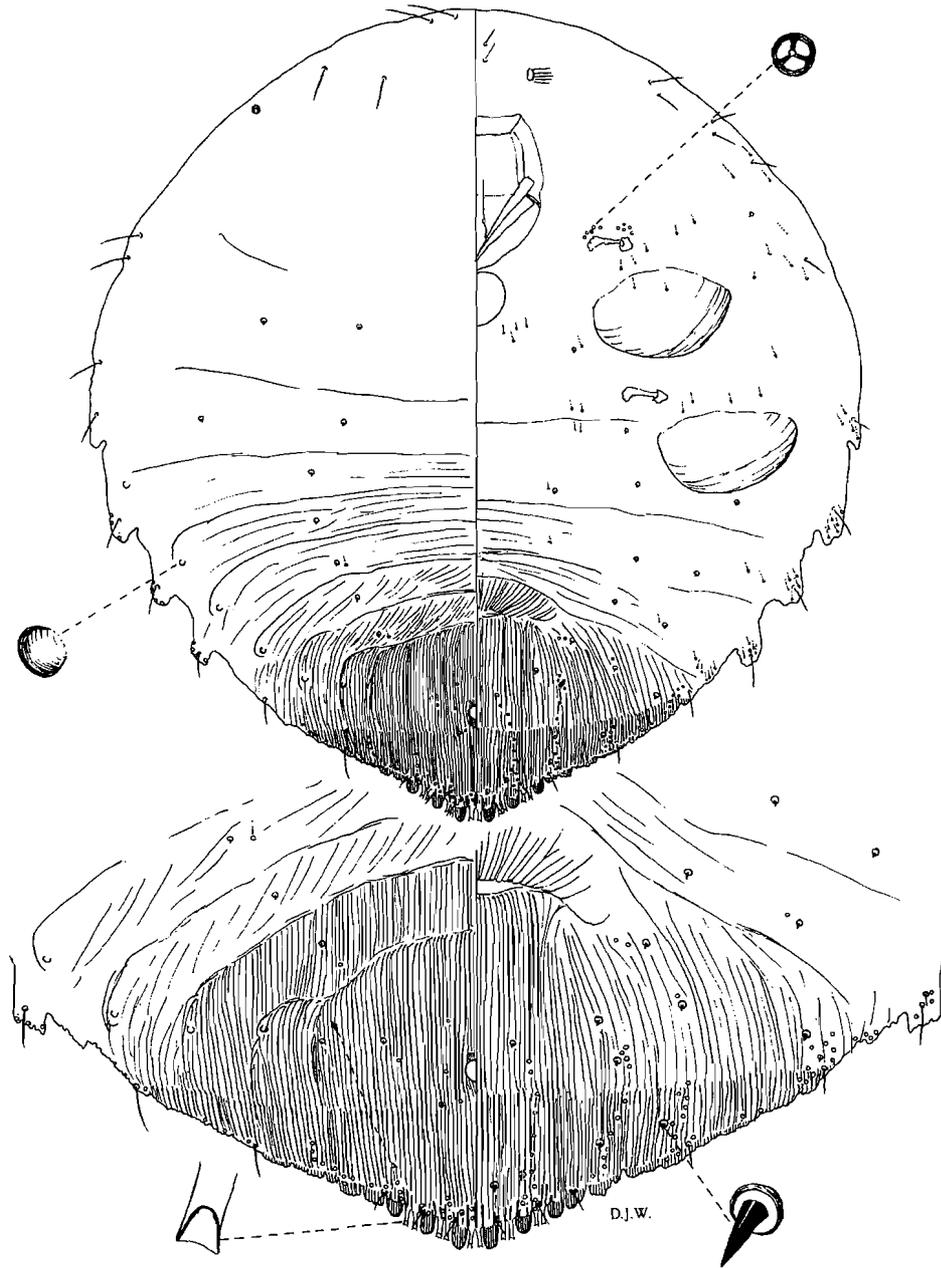


Figure 15. *Furcaspis mauritiana* (Newstead). Specimen from Mauritius, Botanic Gardens, on palm leaves, 1915, de Charmoy.

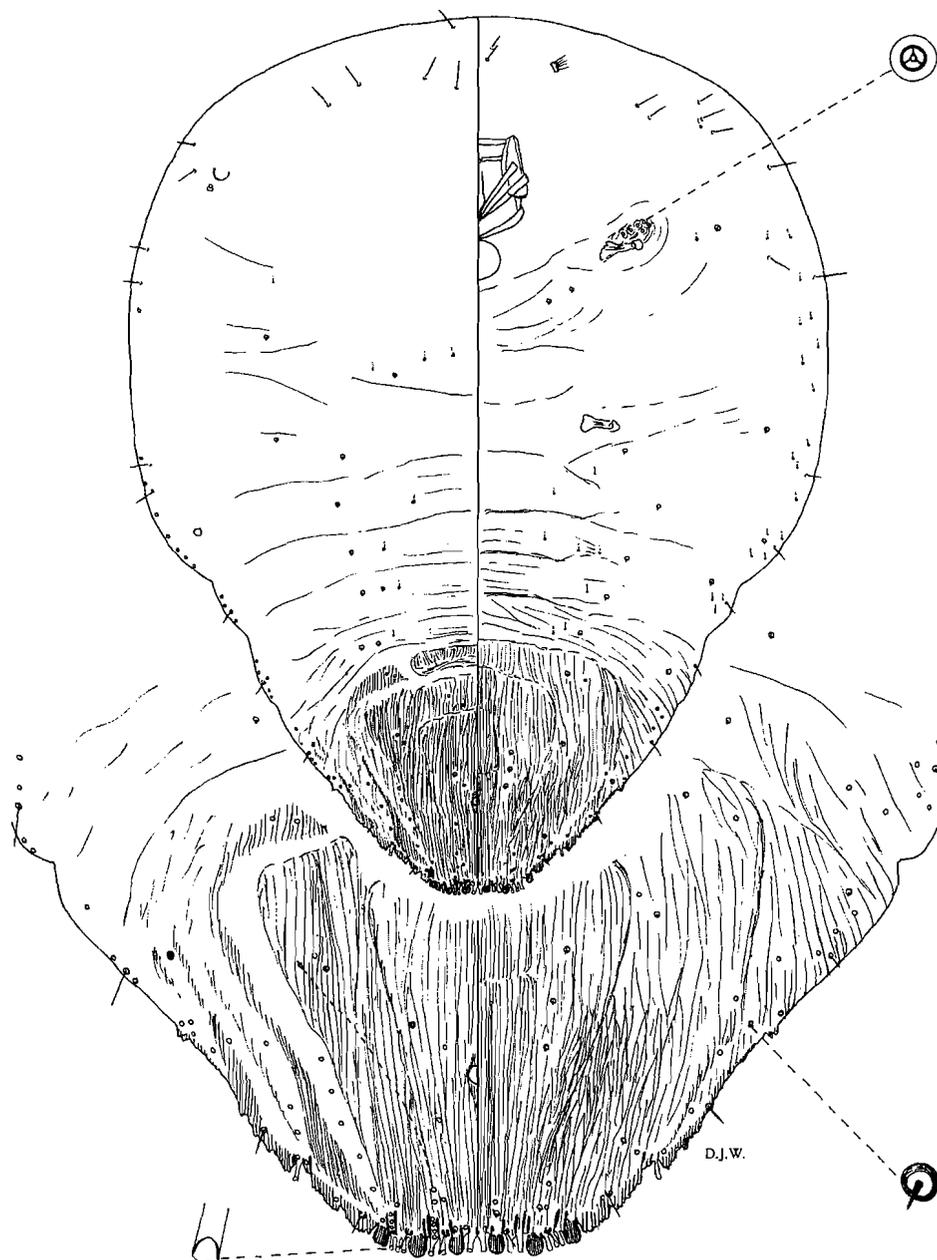


Figure 16. *Furcaspis mexicana* Williams & Miller. Specimen from Mexico, intercepted at San Diego, California, on Bromeliaceae, XII-2-1975, B. K. Dozier.

(1 ad. fem. on 1 sl.)(CDFA); intercepted at La Mesa, California, on *Tillandsia* sp., XII-17-1981, M. Dorsey (9 ad. fem. on 2 sl.)(CDFA); intercepted at La Mesa, California, on *Tillandsia baileyi*, XII-03-1985, V. Cooke (10 ad. fem. on 3 sl.)(CDFA); intercepted at San Diego, California, on bromeliad, IX-3-1975, R. M. Meliczer and B. K. Dozier (1 ad. fem. on 1 sl.)(CDFA); intercepted at San Diego, California, on bromeliad leaf, XII-2-1975, B. K. Dozier (4 ad. fem. on 2 sl.)(USNM); Guadalajara, intercepted at San Diego, California, on bromeliad leaf, VI-10-1977, P. Gomes (2 ad. fem. on 1 sl.)(USNM); intercepted at Brownsville, Texas, on *Tillandsia* sp. leaf, VIII-16-1977, Burgess and J. Van Valkenburgh (6 ad. fem. on 2 sl.)(BMNH, USNM); intercepted at Brownsville, Texas, on *Tillandsia polystachya* leaf, X-18-1983, J. Van Valkenburgh (2 ad. fem. on 2 sl.)(USNM); intercepted at Brownsville Texas, on *Tillandsia* sp. leaves, XI-25-1985 D. Riley, (7 ad. fem. on 2 sl.)(BMNH, USNM); intercepted at Brownsville, Texas, on *Tillandsia* sp. leaves, VII-1-1988, D. Riley (2 ad. fem. on 2 sl.)(USNM).
 NON-PARATYPE: intercepted at Miami, Florida on *Chamaedorea* sp., I-19-1982, H. D. Hannagan (2 ad. fem. on 1 sl.)(USNM).

Hosts: Bromeliaceae: *Tillandsia* sp., *T. baileyi*, and *T. polystachya* and unidentified bromeliads.

Distribution: Mexico.

Etymology: The name of this species is based on Mexico, the country of origin and is formed from the Latin suffix "-anus" meaning "belonging."

Furcaspis oaxacae Williams and Miller, new species

Figure 17

Type material.— Holotype adult female left specimen on slide with 2 additional adult female paratypes labeled as follows: left label "Furcaspis/ Mexico (Oaxaca)/ ex *Beaucarnea/ recurvata* leaf/ I-29-74/ Hidalgo 1135/ Burgess, Riley/ Balsam;" right label "HOLOTYPE/ *Furcaspis/ oaxacae* Williams/ and Miller." The holotype is deposited in the USNM. In addition there are 12 paratypes on 5 slides. Detailed information is given at the end of the treatment of this species.

Slide-mounted Characters: Holotype adult female (Fig. 17) 1.4 mm long (paratypes 0.7-1.5(1.3) mm long), 1.1 mm wide (paratypes 0.6-1.3(1.1) mm wide), pygidium wider than long at level of seta marking segment 4 (length/width 0.4) (paratypes 0.3-0.4 (0.4)), with 3 definite pairs of lobes, pygidial margin with series of projections forward to seta marking segment 4; without projections anterior of seta marking segment 4; prepygidial segments with small lobes on body margin forward to mesothorax. Paraphysis formula 3-3 (paratypes 3-2, 3-3, 3-4, or 4-3), with small paraphyses in space between third and fourth lobes; longest paraphysis equal to or slightly longer than length of median lobes. Median lobes apically rounded, slightly longer than wide (length/width 1.3 (paratypes 1.2-1.7(1.4))), separated by space 0.6 times width of median lobe (paratypes 0.6-1.3(0.9)), with paraphysis attached to medial margin of each median lobe, with 1 paraphysis between median lobes (paratypes 1-3(2)); second lobes about same size and shape as median lobes; third lobes same shape but slightly smaller; fourth and fifth lobes apparently part of series of points anterior of third lobe. Plates thin, bifurcate, tines long, with 1 duct opening near apex; plate formula 2-3-1; 2 plates between median lobes, conspicuous. Macroducts present along opening located 7.6 times length of anal opening from base of median lobes (paratypes 3.9-8.0(5.2) times), anal opening 13 μ long (paratypes 11-22(16) μ). Eyes small, inconspicuous. Antennae each with 6 and 5 setae (paratypes with 3-6(5) setae). Cicatrices sometimes on segments 1 and 3. Body turbinate, dorsal surface without

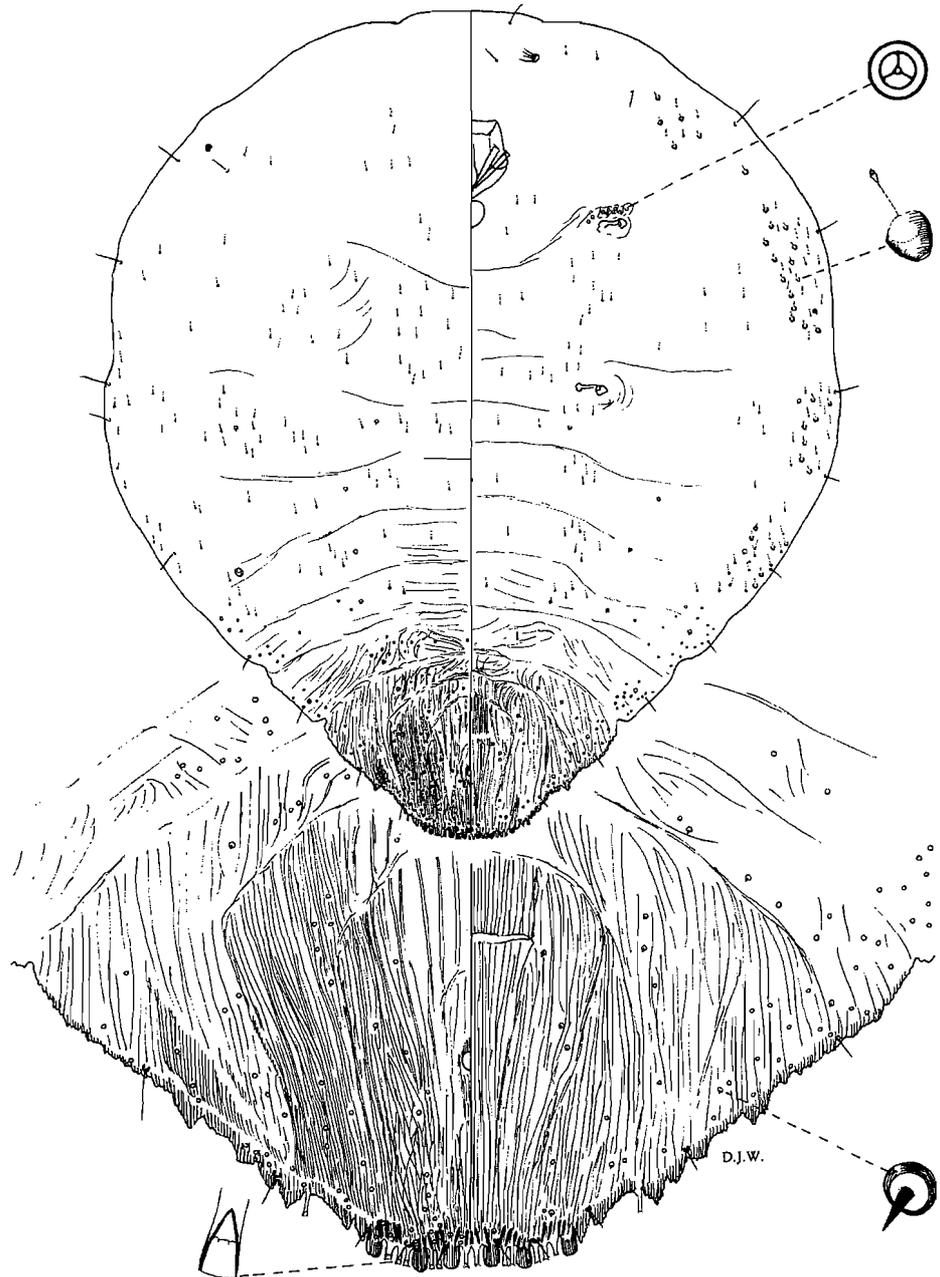


Figure 17. *Furcaspis oxaccae* Williams & Miller. Specimen from Mexico, intercepted at Hidalgo, Texas, on *Beaucarnea recurvata*, 1-29-1974, Burgess and Riley.

sclerotized areas. Pattern anterior of anal opening with a few longitudinal lines. Second and third lobes protruding posteriorly slightly further than median lobes. Margin slightly notched between meso- and metathorax.

Affinities: *Furcaspis oaxacae* is similar to *F. mexicana* (both from Mexico) in lacking perivulvar pores, in having second and third lobes protruding posteriorly slightly further than median lobes, and by having 3-locular pores associated with the anterior spiracles. *Furcaspis oaxacae* differs by having gland tubercles (absent from *F. mexicana*) and numerous prepygidial microducts (uncommon on *F. mexicana*).

Specimens examined: PARATYPES -- Mexico: intercepted at Hidalgo, Texas, on *Beaucarnea recurvata*, I-29-1974, Burgess, Riley (UCD, USNM); intercepted at Brownsville, Texas, on *Beaucarnea recurvata*, I-29-1974, Maldonado, Heinrich (3 ad. fem. on 1 sl) (USNM); intercepted at Brownsville, Texas, on *Beaucarnea recurvata*, III-7-1974, Heinrich, Garcia (BMNH, USNM).

Hosts: *Beaucarnea recurvata* (Dracaenaceae).

Distribution: Mexico.

Etymology: The name of this species is based on the area of origin and means "of Oaxaca."

Furcaspis oceanica Lindinger

Figure 18

Nomenclature:

Furcaspis oceanica Lindinger 1909: 149.

Spinaspidiotus oceanicus (Lindinger); MacGillivray 1921: 430.

Chrysomphalus saipanensis Sasaki 1935: 866.

Furcaspis saipanensis Sasaki; McKenzie 1939: 54

Type material – We have examined 3 specimens that were apparently identified by Lindinger from the Marshall Islands, Jaluit, Kapenbob (BMNH). There are no further data. We have not examined the type series (ZIZM).

Field Characters: Similar to *Furcaspis biformis* (Lindinger 1909).

Slide-mounted Characters: Adult female (Fig. 18) 0.8-1.8(1.2) mm long, 0.6-1.3(0.8) mm wide, pygidium wider than long (length/width 0.6-0.8(0.8)), with 3 definite pairs of lobes; pygidial margin with series of projections forward to seta marking segment 4; with no projections anterior of seta marking segment 4; prepygidial margin smooth; prepygidial segments moderately lobed on body margin forward to thorax especially on newly-matured females. Paraphysis formula variable, from 3-3 to 5-5, usually 3-4, with several small paraphyses along body margin anterior of lobe 3; longest paraphysis usually in interlobular space between lobes 1 and 2, longer than length of median lobes. Median lobes apically rounded and slightly longer than wide (length/width 1.1-1.4(1.2)), separated by space 1.0-1.7(1.3) times width of median lobe, with small paraphysis attached to medial margin of each median lobe, with 1 long paraphysis between median lobes; second lobes slightly larger than median lobes, same shape; third lobes same shape but slightly larger; fourth and fifth lobes apparently part of series of points described above. Plates wide, usually with trifurcate apex,

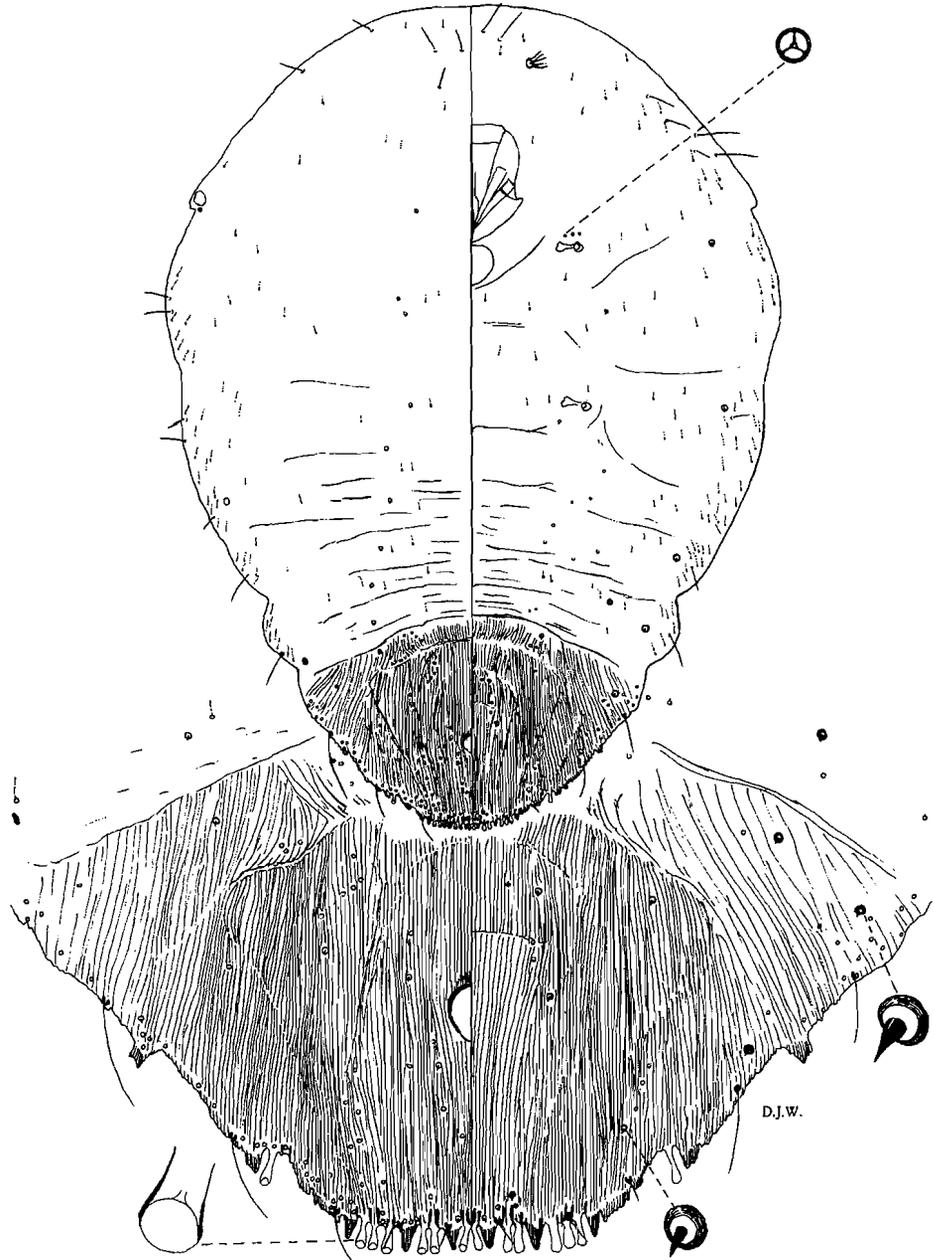


Figure 20. *Furcaspis paxilliloba* Williams & Miller. Specimen from Mexico, intercepted at Brownsville, Texas, on *Dioon spinulosum*, VI-4-1987, D. Riley.

without projections anterior of seta marking segment 4; prepygidial segments moderately lobed on body margin forward to head. Paraphysis formula 3-3 (paratypes with 2-3, 3-3, 2-2, or 2-1), usually with several small paraphyses in space between third and fourth lobes; paraphyses shorter than length of median lobes. Median lobes apically pointed, longer than wide (length/width 2.1 (paratypes 1.8 and 2.9 (2.1)), separated by space 1.8 times width of median lobe (paratypes 1.4-2.0(1.7)), with small paraphysis attached to medial margin of each median lobe, with 3 small paraphyses between median lobes; second lobes about same length as median lobes, wider, same shape; third lobes same shape but slightly smaller; fourth and fifth lobes part of series of points mentioned above. Plates large, with rounded apex, not distinctly bifurcate, with 1 duct opening near apex; plate formula normally 2-3-1, sometimes 3-3-1; normally 2 plates between median lobes, rarely 1, 3, or 4, conspicuous. Macroducts present along body margin from segment 3 or 4 to 7, with 40 and 34 macroducts on each side of body on segments 5-8 (paratypes with 32-52(40)), some hidden by paraphyses, with several macroducts anterior of anal opening. Prepygidial microducts on venter in submedial areas of pro-, meso-, or metathorax and segments 1-4, in lateral clusters from head or prothorax to segment 4; on dorsum prepygidial microducts in submedial areas of metathorax and segments 1-4, in lateral areas from mesothorax to segment 4. Gland tubercles absent. Ventral submarginal setae slightly enlarged, most enlarged on thorax and anterior abdominal segments; longest seta on margin of segment 3 100 μ long (paratypes 57-110(83) μ long). Perivulvar pores absent. Perispiracular pores with 3 loculi, anterior spiracles with 3 and 2 pores (paratypes with 0-3(2) pores). Anal opening located 4.0 times length of anal opening from base of median lobes (paratypes 3.3-6.0 (3.9) times), anal opening 24 μ long (paratypes 19-26(23) μ). Eyes represented by clear area on prosomatic lobe laterad of anterior spiracle. Antennae each with 6 setae (paratypes with 5 or 6 (6) setae). Cicatrices normally present on prothorax, segment 1, and segment 3, cicatrix on prothorax dark and undivided, on segments 1 and 3 lighter and often divided. Body pear shaped, dorsal surface evenly sclerotized, without distinctly darker sclerotized area. Pattern anterior of anal opening with few longitudinal lines. Prosomatic lobes present in most specimens. Median lobes occasionally fused. Perispiracular pores unusually small. Plates slightly longer than lobes.

Affinities: *Furcaspis paxilliloba* is similar to *F. sibuyanensis* by having pointed median and second lobes, 3-locular pores associated with the anterior spiracles, and lacking perivulvar pores and thoracic gland tubercles. *Furcaspis paxilliloba* differs by having a single plate anterior of the third lobe (absent in *F. sibuyanensis*) and enlarged submarginal setae (slender in *F. sibuyanensis*).

Hosts: Cycadaceae: *Dioon spinulosum*. Clusiaceae: *Clusia* sp.

Distribution: Mexico and Guatemala.

Etymology: The name is based on the Latin words "*paxillus*" meaning "peg" and "*lobus*" meaning "a rounded projection" referring to the slender lobes.

Furcaspis peruviana Williams and Miller, new species

Figure 21

Type material.— Holotype adult female left specimen on slide with 1 additional adult female paratype and 1 second instar female labeled as follows: left label "*Furcaspis*/ On Tupa-sheire hembra/ Peru: at New York/ Whitlock & Lennox, Colrs./ Aug. 18, 1941/ N.Y. 90592"; right label "*Furcaspis peruviana* Williams &/ Miller/ HOLOTYPE &/ PARATYPES/ USNM." A

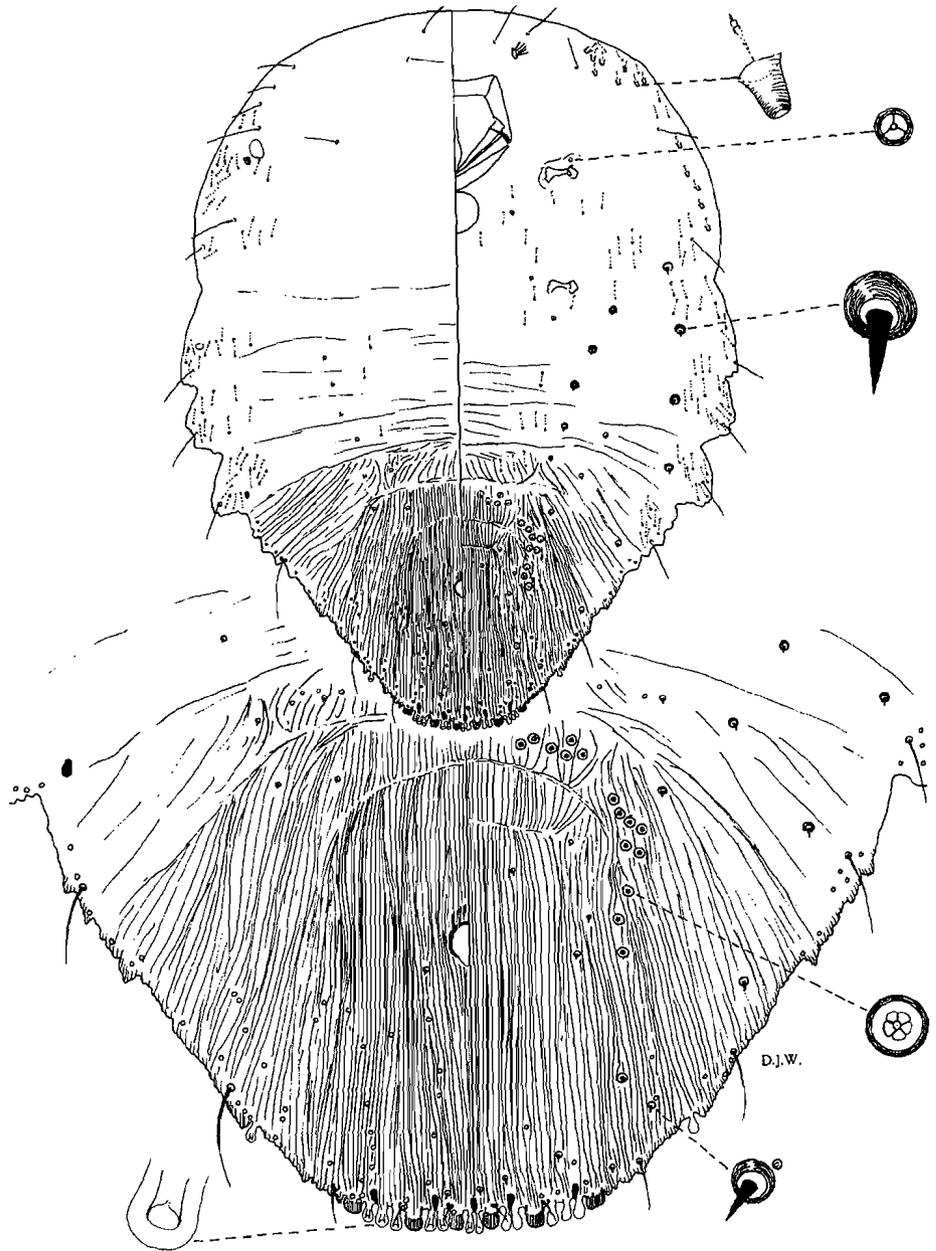


Figure 21. *Furcaspis peruviana* Williams & Miller. Specimen from Peru, intercepted at New York City, New York, on *Tupa-sheire* hembra, VIII-18-1941, Whitlock and Lennox.

map on the right label gives the location of the holotype and 2 paratypes. The holotype is deposited in USNM.

Slide-mounted Characters: Holotype adult female (Fig. 21) 1.5 mm long (paratype 0.8 mm long), 1.2 mm wide (paratype 0.6 mm wide), pygidium wider than long at level of seta marking segment 4 (length/width 0.4), with 3 definite pairs of lobes, pygidial margin with series of projections forward to seta marking segment 4; with small projections anterior of seta marking segment 4; prepygidial segments conspicuously lobed on body margin forward to head. Paraphysis formula 1-1, without obvious paraphyses in space between third and fourth lobes; paraphyses slightly shorter than length of median lobes. Median lobes apically rounded, bulbous shaped, slightly longer than wide (length/width 1.2), separated by space 1.2 times width of median lobe (paratype 0.7), without paraphysis attached to medial margin of each median lobe, with 1 paraphysis between median lobes; second lobes about same length as median lobes, slightly wider, same shape; third lobes same shape but slightly smaller; fourth and fifth lobes apparently part of series of points described above. Plates thicker than usual, with rounded apex, not distinctly bifurcate, with 1 duct opening near apex; plate formula 2-3-1; 2 plates between median lobes, conspicuous. Macroducts present along body margin from segment 3 to 8, with 23 macroducts on each side of body on segments 5-8 (paratype with 33), some hidden by paraphyses, with several macroducts anterior of anal opening. Prepygidial microducts on venter in submedial areas of meso- or metathorax and segments 1-4, in lateral clusters from prothorax to segment 4; on dorsum prepygidial microducts in submedial areas of metathorax and segments 1-4, in lateral areas from prothorax to segment 4. Gland tubercles present in lateral areas of pro- and mesothorax; with 12 and 17 tubercles on each side of body of holotype (paratype with 11 gland tubercles). Ventral submarginal setae enlarged, apically acute; longest seta on margin of segment 3 85 μ long (paratype 80 μ long). Perivulvar pores in semicircular band around vulva, with 16 and 15 pores on each side of body (paratype with 15 and 16 pores). Perispiracular pores with 3 loculi, anterior spiracles with 1 pore on each side of body (paratype also with 1 pore). Anal opening located 6.1 times length of anal opening from base of median lobes (paratype 5.5 times), anal opening 22 μ long (paratype 25 μ). Eyes conspicuous, cicatrix closely associated, located laterad of clypeolabral shield. Antennae each with 5 setae. Cicatrices normally present on prothorax, segment 1, and segment 3, cicatrix on prothorax dark and sometimes divided. Body pear shaped, sclerotization indistinct. Pattern anterior of anal opening with a few longitudinal lines. Ventral submarginal setae larger on thorax than on abdomen, decreasing in size posteriorly.

Affinities: *Furcaspis peruviana* is similar to *F. biformis* (both Neotropical species) by having 1 semicircular ring of perivulvar pores around the vulva and 3-locular pores near the anterior spiracles. *Furcaspis peruviana* differs by having laterocentral groups of perivulvar pores (absent in *F. biformis*), submarginal setae on thorax enlarged (slender on *F. biformis*), and gland tubercles on the prothorax (absent in *F. biformis*).

Hosts: Tupa-sheire hembra. We are uncertain of the name of the host plant other than this vernacular name. "Hembra" means female in Spanish. There is a *Lobelia tupa*, but it is an unlikely host of a species of *Furcaspis*.

Distribution: Peru.

Etymology: The name is based on the country of origin and the Latin suffix "*anus*" meaning "belonging."

Furcaspis plana Hempel

Figure 22

Nomenclature:

Furcaspis plana Hempel, 1937: 29.

Type Material: We have selected as lectotype an adult female mounted alone on a slide. This specimen is here designated as the lectotype to fix and stabilize the current concept of the name. The slide is labeled as follows: left label "Instituto Biológico/ *Furcaspis/ plana* Hempel/ sp. n. Typo./ Coll. H. S. Lepage/ 720;" right label "gav. 32/ Div. 8." The label on the back states "*Furcaspis/plana/* Hempel/ LECTOTYPE/." The lectotype is deposited in IBSP. In addition there is a second slide with the same data that contains 7 adult female paralectotypes, and 1 first-instar paralectotype (IBSP). We also have examined 10 specimens that were slide mounted from dry material sent to Green by Hempel and correspond with data published in the original description, i.e., Santos, São Paulo, Brazil on grumixama (= *Eugenia brasiliensis*), July 28, 1932, collected by J. Deslandes" (BMNH, USNM).

Field Characters: The outline of the female cover is irregular, usually asymmetrical, sometimes approximately circular, flat, orange in color, with small, darker exuviae close to the center. Older specimens are darker, chocolate in color. The largest specimens are ca 3 mm in length. The male cover is similar to the female's, however, it is more regular in shape and smaller in size. The shape is approximately circular, with the exuviae darker and close to the anterior margin. The posterior margin is also darker. The shield is ca 1 mm in length and 0.97 mm in diameter.

Slide-mounted Characters: Adult female (Fig. 22) 0.7-1.0(0.8) mm long, 0.5-0.9(0.7) mm wide, pygidium wider than long at level of seta marking segment 4 (length/width 0.5-0.8(0.6)), with 3 definite pairs of lobes, pygidial margin with series of projections forward to seta marking segment 4; with projections anterior of seta marking segment 4; prepygidial segments without segmental lobes on body margin. Paraphysis formula variable, from 4-3 to 5-4, usually 4-4, with few small paraphyses along body margin anterior of lobe 3; longest paraphysis usually in interlobular space between lobes 1 and 2 or attached to lateral margin of median lobe, paraphyses shorter than length of median lobes. Median lobes apically rounded and elongate, much longer than wide (length/width 1.8-2.3(2.0)), separated by space 1.2-1.6(1.4) times width of median lobe, with small paraphysis attached to medial margin of each median lobe, with 1 or rarely 3 paraphyses between median lobes; second lobes about same size or slightly smaller than median lobes, same shape; third lobes same shape but slightly smaller; fourth and fifth lobes apparently part of series of points described above. Plates thin, with rounded apex, not distinctly bifurcate, with 1 duct opening near apex; plate formula usually 2-3-1, rarely 2-2-1; 2 plates between median lobes, conspicuous. Macroducts present along body margin from segment 4 to 8, with 19-29(24) macroducts on each side of body on segments 5-8, some hidden by paraphyses, with several macroducts anterior of anal opening. Prepygidial ducts on venter not seen in submedial areas, in lateral clusters from metathorax to segment 4; on dorsum prepygidial microducts in submedial areas of any or all of metathorax and segments 1-4, not seen in lateral areas. Gland tubercles absent, replaced by unsclerotized protruding microducts present along lateral margins of mesothorax to segment 3 or 4; with 6-9(8) on each side of body, all approximately equal in size. Ventral submarginal setae slender, not enlarged; longest seta on margin of segment 3 23-35(29) μ long. Perivulvar pores absent. Perispiracular pores with 3 loculi, anterior spiracles each with 1 pore. Anal opening located 5.4-9.1(6.4) times length of anal opening from base of median lobes, anal opening 12-16(14) μ long. Eyes present near lateral margin at level of middle of clypeolabral shield. Antennae each with 3-5(4) setae. Cicatrices normally present on segments 1 and 3, divided or single on prothorax. Body

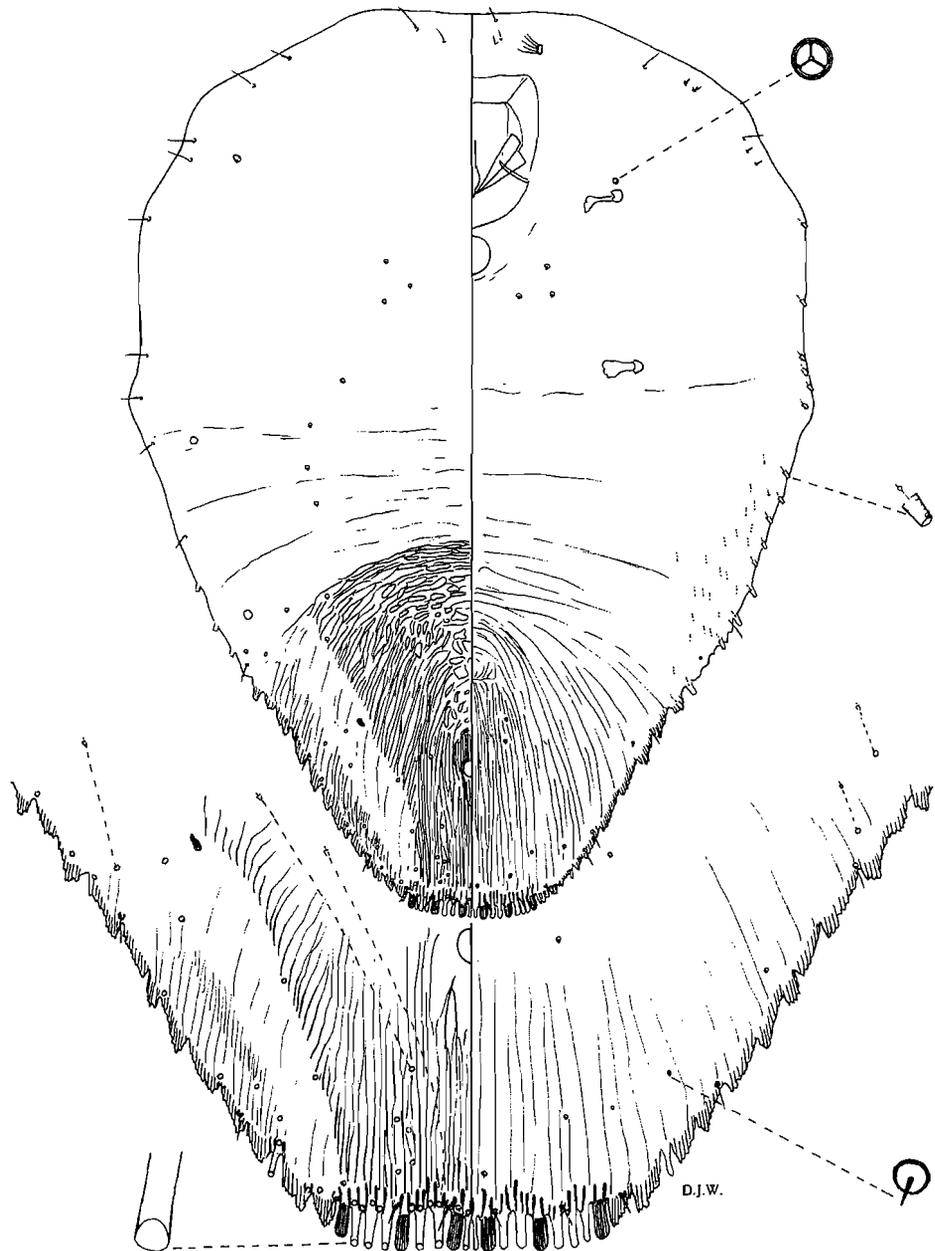


Figure 22. *Furcaspis plana* Hempel. Specimen from Brazil, São Paulo State, Santos, on *Eugenia* sp., VII-28-1932, J. Deslades.

turbinate, dorsal surface with single central sclerotized area, without lateral areas, occasionally with sclerotization surrounding some of macroduct orifices. Pattern anterior of anal opening mottled, not longitudinal lines. Sclerotized spots in submarginal areas of segment 4, possibly cicatrices.

Affinities: *Furcaspis plana* is unique among species of *Furcaspis* by having slender lobes and plates, unsclerotized protruding microducts present along the lateral margins of the mesothorax to segments 3 or 4, few 3-locular pores near the anterior spiracles, and a unique mottled pattern anterior of the anal opening.

Hosts: Myrtaceae: *Eugenia brasiliensis*.

Distribution: Brazil.

Note: We have examined one specimen from Peru, Jenaro Herrera, Ferro Caño (Loreto), on *Geonoma spixiana* (Arecaceae), received in MNHN X-14-1991. The specimen is in poor condition but appears to be similar to, if not the same, as *Furcaspis plana*. It has 2 perispiracular pores and the lobes are not quite as narrow.

Furcaspis proteae Brain

Figure 23

Nomenclature:

Furcaspis proteae Brain 1918: 139.

Separaspis proteae (Brain); MacGillivray 1921: 427

Type Material: A lectotype was designated by Munting (1970) for a specimen from Buffelspoort, Rustendberg District, South Africa, on *Faurea saligna*, IX-1909, collected by F. Thompsen (SANC). Brain (1918) also included a series of specimens from Henops River, Pretoria, on *Protea* sp., VII-1915, by Mogg. We have examined specimens from original material of both collections.

Field Characters: According to Brain (1918) "Scale of adult female similar to that of *capensis*, but smaller and more brown than red. Average size 1.6 mm. in diameter. Male puparium comparatively larger and wider than in *capensis*. In dry material the exuviae often appear whitish owing to the secretory layer becoming detached from the pellicle."

Slide-mounted Characters: Adult female (Fig. 23) 0.7-1.2(0.8) mm long, 0.6-1.0(0.8) mm wide, pygidium wider than long at level of seta marking segment 4 (length/width 0.2-0.3(0.3)); with 4 definite pairs of lobes; pygidial margin with series of projections forward to seta marking segment 4; with few or no projections anterior of seta marking segment 4; prepygidial margin of segments 2 to 4 relatively smooth; prepygidial segments conspicuously lobed on body margin forward to segment 1 or 2. Paraphysis formula variable, from 3-5 to 4-7 or 6-7, with few or no small paraphyses along body margin anterior of lobe 3; paraphysis lengths all about same, paraphyses shorter than length of median lobes. Median lobes rounded apically, occasionally slightly expanded apically, longer than wide (length/width 1.6-2.3(2.1)), separated by space 1.1-2.7(1.8) times width of median lobe, with small paraphysis attached to medial margin of each median lobe, with 3-5(4) paraphyses between median lobes; second lobes about same width as median lobes, same shape; third lobes same shape and size; fourth lobes same shape, slightly smaller. Plates bifurcate or trifurcate, sometimes with middle plate in second

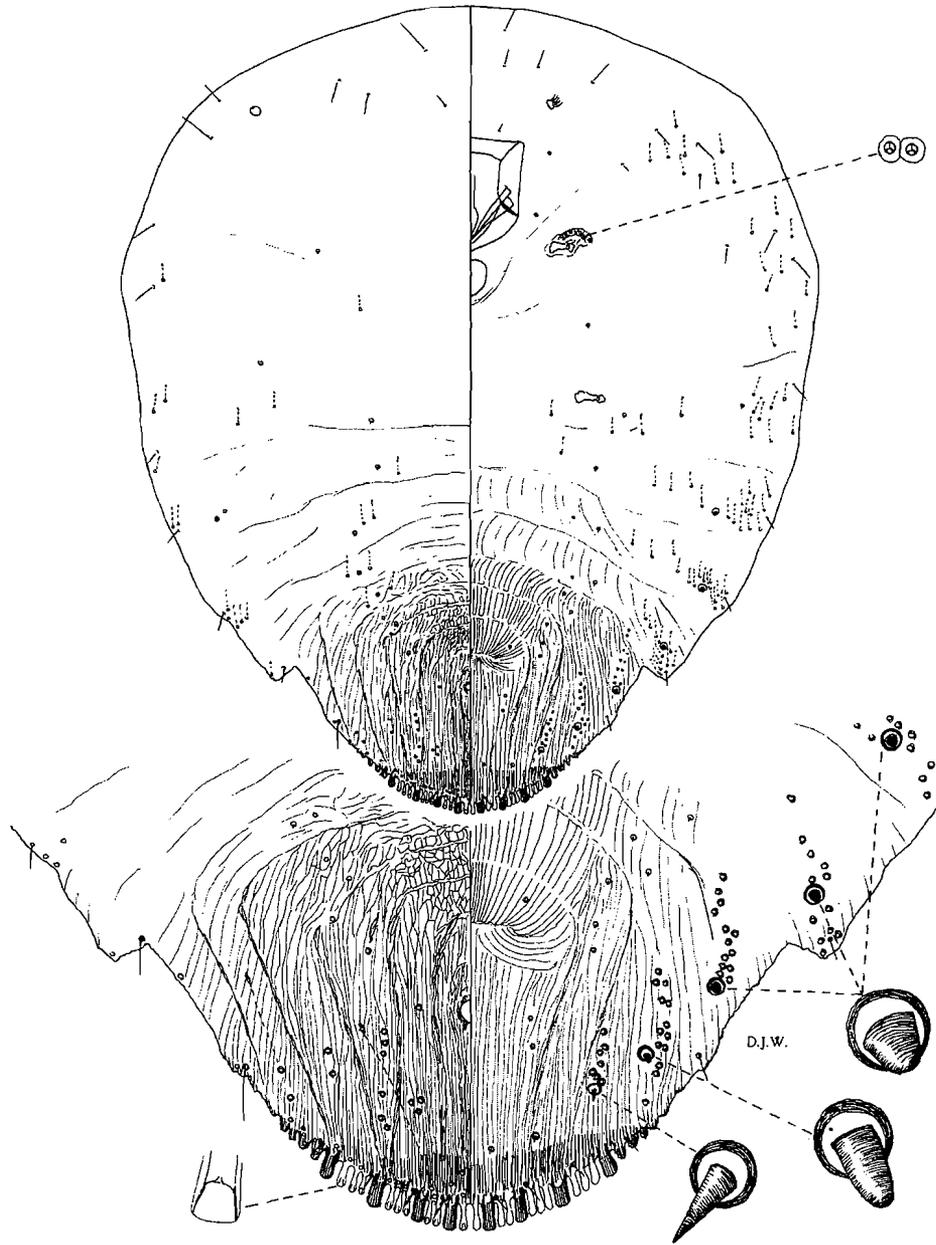


Figure 23. *Furcaspis proteae* Brain. Specimen from South Africa, on *Protea* sp., date unknown, from Brain Collection.

and third spaces trifurcate, with rounded apex, with 1 or 2 duct openings near apex; plate formula 2-3-3. Macroducts present along body margin from segment 5 to 8, present in submedial area on segments 5 to 8, with 25-46(35) macroducts on each side of body on segments 5-8, some hidden by paraphyses, with few macroducts anterior of anal opening. Prepygidial microducts on venter of submedial areas uncommon, present on mesothorax to segment 5, in lateral clusters from prothorax to segment 4; on dorsum prepygidial microducts present on submedial areas of mesothorax, metathorax or segment 1 to segments 2-4, restricted to margin of meso- or metathorax to segment 4. Gland tubercles absent. Ventral submarginal setae enlarged, cone shaped, posterior setae with acute apex, anterior setae with rounded apex, present on segments 1 to 7, with sclerotization surrounding microduct orifice attached to setal base; longest seta on margin of segment 3 25-47(34) μ long. Perivulvar pores absent. Perispiracular pores each with 3 loculi, anterior spiracles each with 2-7(4) pores. Anal opening located 5.3-8.6(6.9) times length of anal opening from base of median lobes, anal opening 14-19(17) μ long. Eyes present near lateral margin at level of middle of clypeolabral shield. Antennae each with 5-7(6) setae. Cicatrices absent. Body broadly oval, posterior end of pygidium heavily sclerotized at maturity, with sclerotization surrounding macroduct orifices. Pattern anterior of anal opening reticulated. Perispiracular pores in tight group around anterior spiracle.

Affinities: *Furcaspis proteae* is similar to *F. charmoyi*, *F. capensis*, and *F. rufa* (all from the Afrotropical and Malagasian Regions) by having enlarged submarginal setae and 3-locular pores near the anterior spiracles. It differs from these species by having 4 distinctive pairs of lobes.

Specimens examined: SOUTH AFRICA: intercepted at USA, Atlanta, Georgia, on *Protea* sp., III-23-2000, C. Mattocks (USNM); New York, New York, on *Protea* sp., II-20-1981, J. Morse (USNM); at New York, New York, on *Protea* sp., III-16-1984, J. Yee (USNM); at New York, New York, on *Protea* sp., III-6-1985, L. Rydl (USNM). Gauteng Province – Pretoria, Henops River, on *Protea* sp., VII-1915, A. Mogg (BMNH, SANC, UCD, USNM); North-West Province – Rustenburg, on *Faurea saligna*, VI-1958, D. C. A. Hoffman (BMNH). Thompsen (SANC, USNM).

Hosts: Proteaceae: *Faurea saligna*, *Protea* sp.

Distribution: South Africa.

Notes: One specimen has a single gland tubercle on 1 side of the body on the prothorax.
Important References: Balachowsky (1958).

Furcaspis rufa Lindinger

Figure 24

Nomenclature:

Furcaspis rufa Lindinger 1913: 97.

Tollaspidiotus rufa (Lindinger); MacGillivray 1921: 426.

Type Material: We have examined 18 slides mounted subsequently from the original material labeled as follows; "RÉUNION/ St. Denis/ Erythroxydon sp/ ii. 1911/ leg. Loher/ Nr 6/1965 1." These specimens were mounted from dry material (BMNH, USNM, ZIH). We are uncertain of the existence of the material used by Lindinger for the original description.

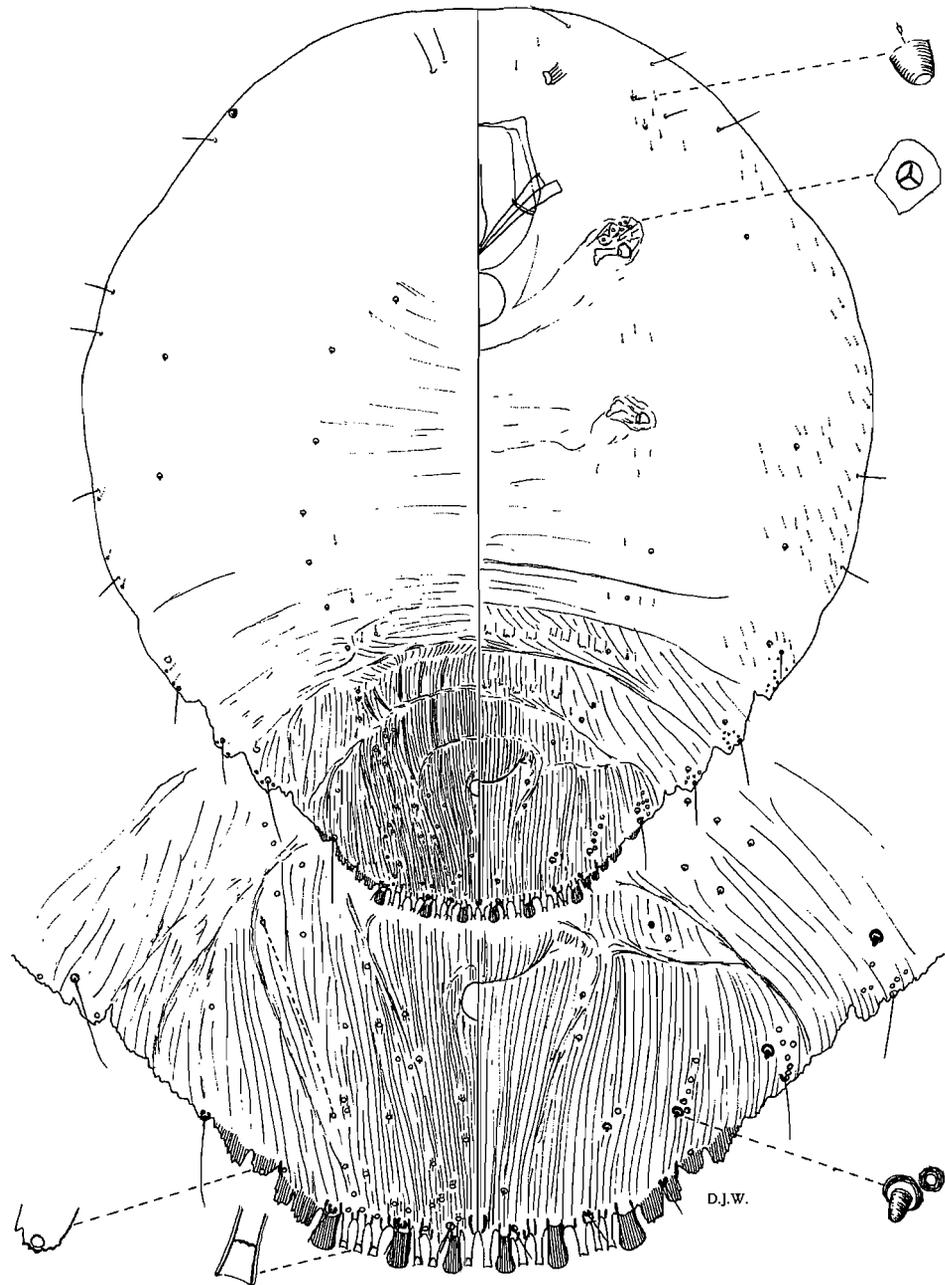


Figure 24. *Furcaspis rufa* Lindinger. Specimen from Réunion, St. Denis, on *Erythroxylon* sp., II-1911, Loher.

Field Characters: Scale of young female broadly elliptical, parallel-sided, 1.5-2.0 mm in diameter; red brown, thick, robust; exuviae lighter in color, not concentric; ventral scale white. Male scale narrow, linear, 1.3-1.5 mm long, 0.5 mm wide; red brown, with yellow exuviae at head end (Lindinger, 1913).

Slide-mounted Characters: Adult female (Fig. 24) 0.7-0.8(0.8) mm long, 0.5-0.6(0.6) mm wide, pygidium wider than long at level of seta marking segment 4 (length/width 0.3-0.4(0.4)), with 3 definite pairs of lobes; pygidial margin with series of projections forward to seta marking segment 5; with few or no projections anterior of seta marking segment 5; prepygidial margin of segments 2 to 4 irregular with protruding microduct orifices; prepygidial segments conspicuously lobed on body margin forward to segment 1 or 2. Paraphysis formula variable, from 3-4 to 5-6, usually 4-4, usually without paraphyses along body margin anterior of lobe 3, rarely with 1 or 2; longest paraphysis usually in interlobular space between lobes 1 and 2, paraphyses shorter than length of median lobes. Median lobes clubbed apically, without medial or lateral notches, much longer than wide (length/width 1.7-2.3(2.0)), separated by space 1.0-1.7(1.3) times width of median lobe, with small paraphysis attached to medial margin of each median lobe, with 1 or 3 paraphyses between median lobes; second lobes about same size, slightly smaller, or larger than median lobes, same shape; third lobes same shape but slightly smaller and wider; fourth lobes apparently part of series of points. Plates bifurcate, with truncate apex, with 1 duct opening near apex; plate formula usually 2-3-0; plate near fourth lobe lobe-like, with macroduct orifice at apex; 2 plates between median lobes, conspicuous. Macroducts present along body margin from segment 6 to 8, present in submedial area on segments 3 or 4 and 5, with 19-29(24) macroducts on each side of body on segments 5-8, some hidden by paraphyses, with several macroducts anterior of anal opening. Prepygidial microducts on venter of submedial areas of 1 or all of segments 1-4, in lateral clusters from pro- or mesothorax to segment 4; on dorsum prepygidial microducts in submedial areas of any or all of metathorax to segments 1-4, in small numbers in lateral areas of mesothorax to segment 4. Gland tubercles present on prothorax, often with tubercle slightly or not sclerotized, but with definite swollen orifice; with 1-3(2) on each side of body. Ventral submarginal setae greatly enlarged, bluntly pointed, apex rounded, present on segments 1 to 7, often with sclerotization surrounding microduct orifice attached to setal base; longest seta on margin of segment 3 22-36(29) μ long. Perivulvar pores absent. Perispiracular pores with 3 loculi, anterior spiracles each with 5-10(7) pores. Anal opening located 11.0-16.9(13.5) times length of anal opening from base of median lobes, anal opening 4-7(5) μ long. Eyes present near lateral margin at level of middle of clypeolabral shield. Antennae each with 5 or 6(6) setae. Cicatrices normally present on segment 2, and in intersegmental area between segments 3 and 4, absent from prothorax. Body oval or round, dorsal surface with single central sclerotized area, without lateral areas, without sclerotization surrounding macroduct orifices. Pattern anterior of anal opening with many longitudinal lines. Anal opening located directly opposite vulva on dorsal surface.

Affinities: *Furcaspis rufa* is similar to *F. charmoyi*, *F. capensis*, and *F. proteae* (all from the Afrotropical and Malagasian Regions) by having enlarged submarginal setae and 3-locular pores near the anterior spiracles. It differs from these species by having lobes that are swollen apically.

Hosts: Erythroxylaceae: *Erythroxylon*.

Distribution: Réunion.

Notes: The dry material was kindly made available for study by Professor Dr. H. Strümpel, Universität Hamburg, Zoologisches Institut und Zoologisches Museum, Germany. When Lindinger illustrated this species he must have seen slide-mounted specimens, but apparently these no longer exist.

Furcaspis scleropymna Williams and Miller, new species

Figure 25

Type material.— Holotype adult female left specimen on slide with 6 additional adult female paratypes labeled as follows: left label “Rd. 120 km 18 Maricao,/ PUERTO RICO:/ ex: on unknown tree/ 5 Nov. 2002/ D. R. Miller/ Balsam;” right label “HOLOTYPE/ PARATYPES/ *Furcaspis/ scleropymna* Williams and Miller.” A map on the right label gives the location of the holotype. The holotype is deposited in the USNM. In addition, there are 32 adult females on 8 slides (BMNH, UCD, USNM). For more information on the paratypes see the specimens examined below.

Field Characters: Adult female cover moderately convex, circular or slightly elliptical, dark reddish brown with light concentric rings; shed skins central or subcentral, about same color as rest of cover. Male cover lighter red than female cover, more elongate; shed skin submarginal. Occurring on leaves.

Slide-mounted Characters: Holotype adult female (Fig. 25) 0.6 mm long (paratypes 0.6-0.8(0.7) mm long), 0.5 mm wide (paratypes 0.5-0.7(0.6) mm wide), pygidium wider than long at level of seta marking segment 4 (length/width 0.4) (paratypes 0.3-0.5(0.4)), with 3 definite pairs of lobes, pygidial margin with series of projections forward to seta marking segment 4; with projections forward to seta marking segment 3; prepygidial margin with small segmental lobes anterior of segment 4. Paraphysis formula unclear because of heavy sclerotization on posterior pygidium; paraphyses longer than length of median lobes. Median lobes apically rounded or truncate, slightly expanded apically, about as long as wide (length/width 1.0 (paratypes 0.7-1.2(1.0)), separated by space 1.0 times width of median lobe (paratypes 0.8-1.2 (0.9)), with small paraphysis attached to medial margin of each median lobe, with 2 small and 1 long paraphyses between median lobes; second lobes about same length as median lobes, same shape; third lobes same shape but slightly smaller; fourth and fifth lobes part of series of points mentioned above. Plates thin, with bifurcate apex, with 1 duct opening near apex; plate formula 2-3-0; 2 plates between median lobes, conspicuous. Macroducts present along body margin from segment 4 or 5-8, with 30 and 32 macroducts on each side of body on segments 5-8 (paratypes with 15-32 (22)), some hidden by paraphyses, with several macroducts anterior of anal opening. Prepygidial microducts on venter in submedial areas of pro-, meso-, or metathorax and segments 1-3 or 4, in lateral clusters from prothorax to segment 4; on dorsum prepygidial microducts in submedial areas of metathorax and segments 1-3 or 4, in lateral areas sparse, from mesothorax to segment 4. Gland tubercles absent. Ventral submarginal setae slightly enlarged with acute apex, most enlarged on abdomen, narrow on thorax; longest seta on margin of segment 3 13 μ long (paratypes 11-35(15) μ long). Perivulvar pores absent. Perispiracular pores with 3 loculi, anterior spiracles with 3 and 5 pores (paratypes with 1-7(3) pores). Anal opening located 4.8 times length of anal opening from base of median lobes (paratypes 3.7-8.6(6.1) times), anal opening 18 μ long (paratypes 9-17(14) μ). Eyes present laterad of anterior spiracle. Antennae each with 4 and 5 setae (paratypes with 3-5(4) setae). Cicatrices unusual in appearance, sometimes on 1 side only, present on any or all of segments from metathorax to segment 3. Body rotund, dorsal and ventral surfaces heavily sclerotized on

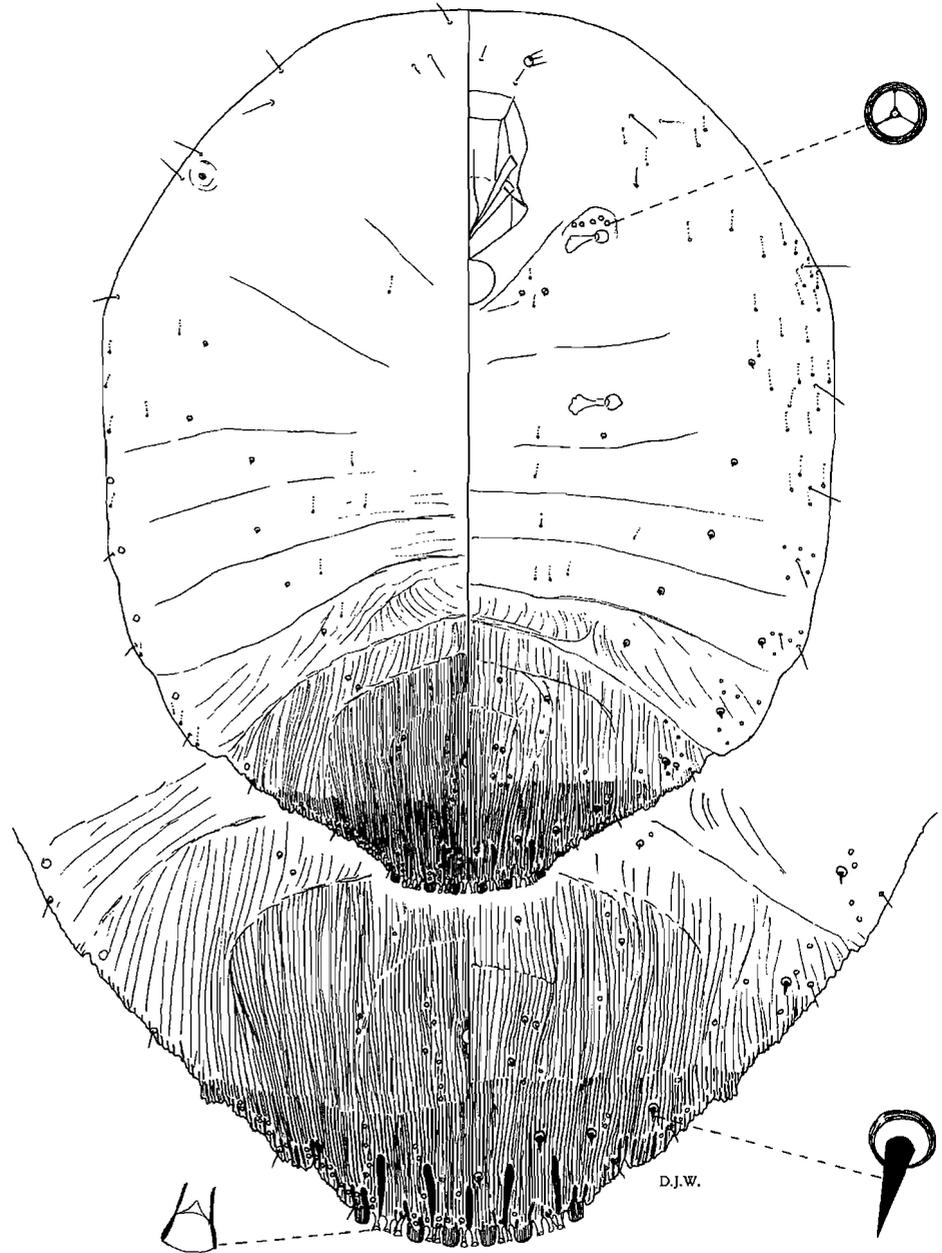


Figure 25. *Furcaspis scleropyrna* Williams & Miller. Specimen from Puerto Rico, near Maricao, Rd. 120, km 18, on unknown tree, XI-5-2002, D. R. Miller.

posterior portion of pygidium. Pattern anterior of anal opening with many longitudinal lines.

Paratype specimens examined: Puerto Rico: 18 km. marker on Road 120, near Maricao, on unknown tree, IX-5-2002, D. R. Miller (25 ad. fem. on 5 sl)(BMNH, UCD, USNM); Maricao Forest Reserve, on unknown plant, VII-21-1977, S. Nakahara (8 ad. fem. on 3 sl)(USNM).

Affinities: *Furcaspis scleropymna* is similar to *F. proteae* and *F. mauritiana* in possessing the posterior end of the pygidium with a heavily sclerotized area, lacking perivulvar pores, having enlarged submarginal setae, and possessing 3-locular pores associated with the anterior spiracles. *Furcaspis scleropymna* differs by having paraphyses conspicuously longer than length of median lobes (shorter than median lobes in *F. proteae*, shorter or same length in *F. mauritiana*). It has lateral cicatrices on any or all of metathorax to segment 3 (present on segments 1 to 6 on *F. mauritiana*, absent from *F. proteae*).

Hosts: Unknown.

Distribution: Puerto Rico.

Etymology: The name is based on the Greek word "*skleros*" meaning "hard" and "*prymnos*" meaning "hindmost," alluding to the heavily sclerotized edge of the pygidium.

***Furcaspis sibuyanensis* Williams and Miller, new species**

Figure 26

Type material.— Holotype adult female left specimen on slide with 1 additional adult female paratype labeled as follows: left label "*Furcaspis*/ on *Heterospatha*/ *sibuyanensis*/ Magallanes (Mt. Giting-giting)/ Sibuyan, Phil. Isl./ Apr. 1910/ A. D. E. Elmer, Coll./ USNH - 1235971"; right label "*Furcaspis/sibuyanensis*/ Williams &/ Miller/ HOLOTYPE/ PARATYPE." A map on the right label gives the location of the holotype and paratype. The holotype is deposited in the USNM.

Slide-mounted Characters: Holotype adult female (Fig. 26) 0.9 mm long (paratype 0.9), 0.8 mm wide (paratype 0.8 mm wide), pygidium wider than long at level of seta marking segment 4 (length/width 0.2) (paratype 0.3), with 4 definite pairs of lobes, pygidial margin with series of projections forward to seta marking segment 4; with projections forward to seta marking segment 3; prepygidial margin with small segmental lobes anterior of segment 4. Paraphysis formula 3-4 or 3-6 (paratype with 3-4 or 3-5), usually with several small paraphyses in space between third and fourth lobes; longest paraphysis longer than length of median lobes. Median lobes apically tapering with small, rounded tip, longer than wide (length/width 1.8) (paratype 2.3), separated by space 0.8 times width of median lobe (paratype 1.6), with small paraphysis attached to medial margin of each median lobe, with 1 paraphysis between median lobes; second lobes slightly longer than median lobes, wider, with broader tip; third lobes elongate quadrate, larger than median and second lobes; fourth lobes about same size and shape as third lobes; fifth lobes absent. Plates thick, with bifurcate apex, with 1 duct opening near apex; plate formula 2-3-0; 1 or 2 plates between median lobes, conspicuous. Macroducts present along body margin from segment 5 to 8, with 13 and 14 macroducts on each side of body on segments 5-8 (paratype 11 and 15), some hidden by paraphyses, with several macroducts anterior of anal opening. Prepygidial microducts on venter in submedial areas of meso- or metathorax and segments 1-4, in lateral clusters from head to segment 4; on dorsum prepygidial

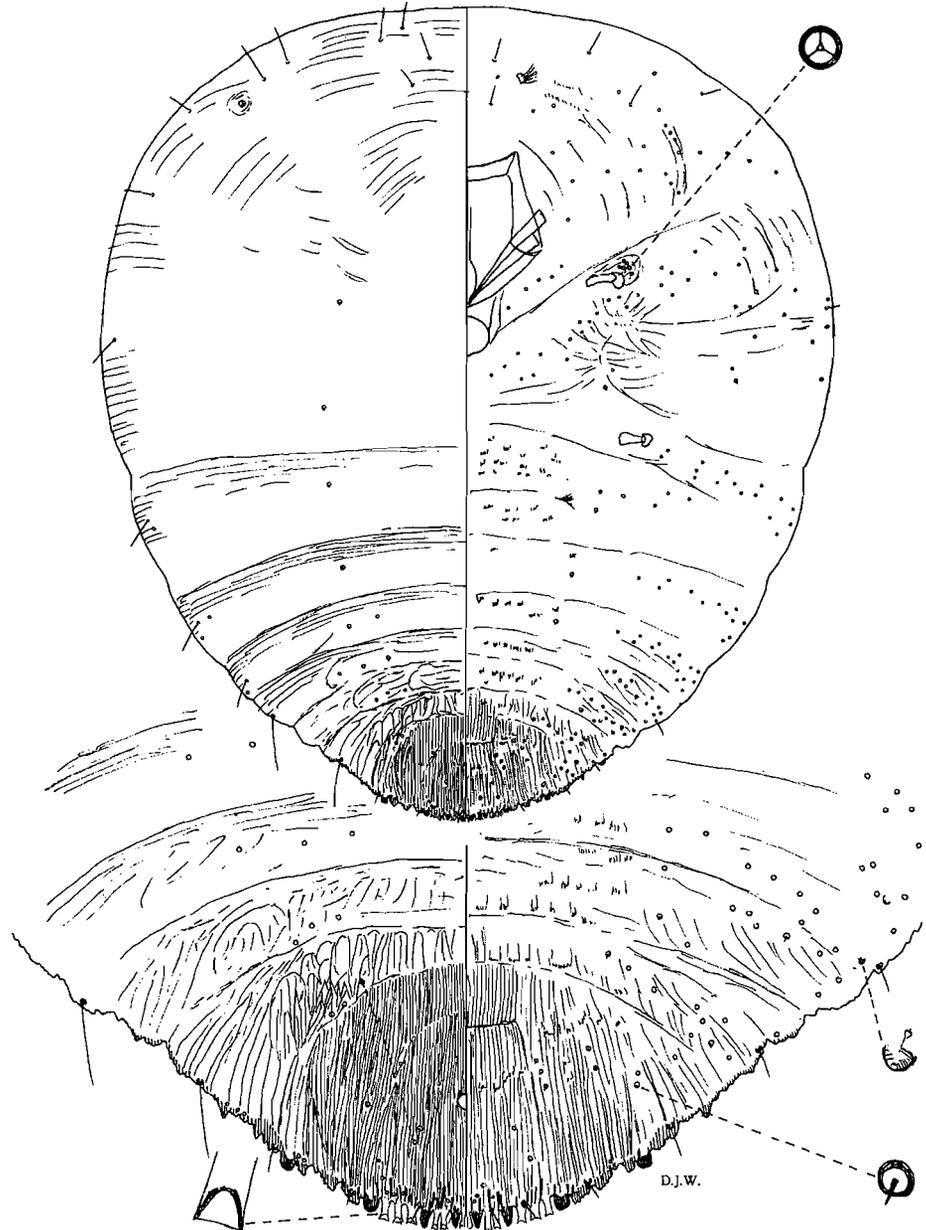


Figure 26. *Furcaspis sibuyanensis* Williams & Miller. Specimen from Philippines, Magallanes, Sibuyan, Mt. Giting-giting, on *Heterospatha sibuyanensis*, date unknown, A. D. E. Elmer.

microducts in submedial areas of metathorax and segments 1-4, absent or rare in lateral areas. Gland tubercles with small sclerotized dome, rare in lateral areas of segments 3 and 4; with 3 and 4 tubercles on each side of body of holotype (paratype with 2 or 4 gland tubercles). Ventral submarginal setae slender, not enlarged; longest seta on margin of segment 3 43 μ long (paratype 39 μ long). Perivulvar pores absent. Perispiracular pores with 3 loculi, anterior spiracles with 5 and 7 pores (paratype with spiracles missing). Anal opening located 6.6 times length of anal opening from base of median lobes (paratype 8.3 times), anal opening 8 μ long (paratype 6 μ). Eyes present, oval, located near body margin near level of anterior edge of clypeolabral shield. Antennae each with 6 setae. Cicatrices inconspicuous on prothorax. Body turbinate, dorsal surface without distinctive sclerotization. Pattern lateral and anterior of anal opening with small squamate areas.

Affinities: *Furcaspis sibuyanensis* is similar to *F. paxilliloba* by having pointed median and second lobes, 3-locular pores associated with the anterior spiracles, and by lacking perivulvar pores and thoracic gland tubercles. *Furcaspis sibuyanensis* differs by lacking a plate anterior of the third lobe (present in *F. paxilliloba*) and having slender, submarginal setae (enlarged in *F. paxilliloba*).

Hosts: Arecaceae: *Heterospathe* sp.

Distribution: Philippine Islands.

Etymology: The name is based on the locality Sibuyan and the Latin suffix “-ensis” denoting place.

***Furcaspis taquarae* Fonseca
Figure 27**

Nomenclature:

Furcaspis biformis taquarae Fonseca 1969: 35.

Furcaspis taquarae Fonseca; Ben-Dov and German 2003: 504.

Type material – From the syntypes, we have selected as lectotype an adult female on a slide with 2 additional adult female paralectotypes; the lectotype is the bottom right specimen on the slide and a map is given of the location of the specimen. This specimen is here designated as the lectotype to fix and stabilize the current concept of the name. The slide is labeled as follows: left label “INSTITUTO BIOLÓGICO/ *Furcaspis/ biformis/ taquarae/ Fonsc.*” There are two small labels on the right side of the slide with: “860” and “Cotypus.” We have made an additional label that is on the back of the slide: “*Furcaspis/ biformis taquarae/ Fonseca/ LECTOTYPE / PARALECTOTYPE*” (IBSP). There is a second slide containing 1 adult female paralectotype. We have examined a dry sample of the original host material but were unable to locate additional specimens of this species. The dry material is labeled as follows: “INSTITUTO BIOLÓGICO Tipo/ Parasitologia Vegetal/ NUM. 860/ NOME. *Furcaspis biformis taquarae/ HOSP. Merostachys* sp. Fonsc./ LOCAL. S. Paulo, Cantareira/ COL. J. Pinto Fonseca/ DET. J. Pinto Fonseca.”

Field Characters: Adult female cover more convex than in *F. biformis*, but otherwise similar in appearance (Fonseca 1969).

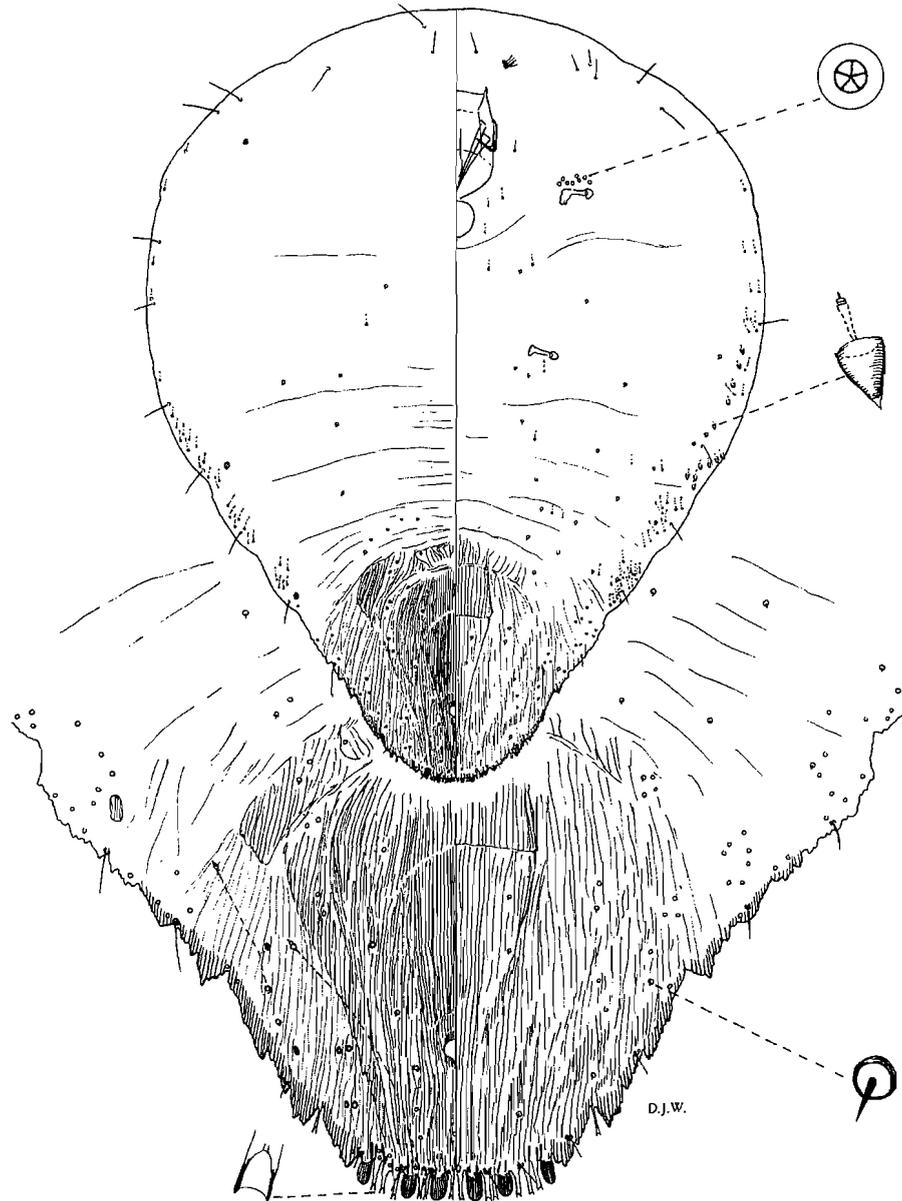


Figure 27. *Furcaspis taquarae* Hempel. Specimen from Brazil, intercepted at Miami, Florida, on bromeliads, VII-27-1978, B. M. Jones.

Slide-mounted Characters: Adult female (Fig. 27) 0.8-1.6(1.1) mm long, 0.7-1.3(0.9) mm wide, pygidium wider than long at level of seta marking segment 4 (length/width 0.3-0.5(0.4)), with 3 definite pairs of lobes, pygidial margin with series of projections forward to seta marking segment 4; with few projections anterior of seta marking segment 4; prepygidial margin with small segmental lobes anterior of segment 4. Paraphysis formula variable from 4-3 to 2-2, with few or no paraphyses in space between third and fourth lobes; paraphyses shorter than length of median lobes. Median lobes apically rounded, quite variable, longer than wide (length/width 1.2-2.7(1.9)), separated by space 1.0-1.7(1.2) times width of median lobe, with small paraphysis attached to medial margin of each median lobe, with 2-5(3) small paraphyses between median lobes; second lobes about same length as median lobes, slightly smaller or same size, same shape; third lobes slightly smaller and narrower; fourth and fifth lobes apparently part of series of points between segments 4 and 6. Plates thin, truncate, with bifurcate apex, with 1 duct opening near apex; plate formula 2-3-1; 2 plates between median lobes, conspicuous. Macroducts present along body margin from segment 3 or 4 to 7, with 17-39(26) macroducts on each side of body on segments 5-8, some hidden by paraphyses, with several macroducts anterior of anal opening. Prepygidial microducts on venter present in submedial areas of meso- or metathorax and segments 1-4, in lateral clusters from mesothorax to segment 4; on dorsum prepygidial microducts in submedial areas of segments 3-4; in lateral areas from mesothorax to segment 4. Gland tubercles present in lateral areas of meso- and metathorax, sometimes on segment 1; with 5-16(10) tubercles on each side of body. Ventral submarginal setae slender, not enlarged; longest seta on margin of segment 3 20-32(26) μ long. Perivulvar pores absent. Perispiracular pores predominantly with 5 loculi, anterior spiracles with 2-10(5) pores. Anal opening located 3.7-8.0(4.6) times length of anal opening from base of median lobes, anal opening 10-22(15) μ long. Eyes absent. Antennae each with 4-6(5) setae. Cicatrices normally present on prothorax, segment 1, and segment 3, cicatrix on prothorax and segment 3 often sclerotized and divided. Body pear shaped, dorsal surface with single central sclerotized area, other sclerotized areas apparently absent except along body margin of pygidium. Pattern anterior of anal opening with a few longitudinal lines. Sclerotized spots in submarginal areas of segments 4 and/or 5, possibly cicatrices.

Affinities: *Furcaspis taquarae* is similar to *F. palmaria* and *F. aequatorialis* (all Neotropical species) by lacking perivulvar pores, by having a single plate anterior of the third lobe, and by having gland tubercles. *Furcaspis taquarae* differs from *F. palmaria* by having 5-locular pores near the anterior spiracles (3 locular in *F. palmaria*). It differs from *F. aequatorialis* by having the third lobes basally separate from the adjacent lateral projection (closely appressed in *F. aequatorialis*) and having perispiracular pores in a membranous area (in sclerotized area in *F. aequatorialis*).

Specimens examined other than type material: BRAZIL: in quarantine at San Diego, California, on bromeliad, IV-22-1969, J. O. Wible (USNM); in quarantine at Miami, Florida, on bromeliads, XI-3-1966, A. S. Mills (USNM); in quarantine at Miami, Florida, on bromeliads, VII-27-1978, B. M. Jones (USNM); in quarantine at Hoboken, New Jersey, on bromeliad, X-30-1940, Limber, Kostal (BMNH); : in quarantine at Hoboken, New Jersey, on *Vriesia* sp., XI-9-1959, L. M. Fenner (USNM); in quarantine at New York, New York, on *Areca* sp., X-17-1940, Whitlock (USNM); in quarantine at Washington, D.C., on *Nidularium* sp., X-10-1939, Singleton (USNM); Desvio, Ypiranga, on *Areca* sp., IV-9-1911, L. Dusen (USNM).

Hosts: Bromeliaceae: *Nidularium* sp. and *Vriesia* sp. Poaceae: *Merostachys* sp.

Distribution: Brazil.

Notes: The type series of this species is in poor condition making it difficult to see some characters; microducts are particularly difficult to discern. There is considerable variation in the length of the lobes, with the type series having relatively short lobes. However, we could find no other characters to distinguish longer-lobed specimens as a separate species.

Furcaspis tasmanica Williams and Miller, new species

Figure 28

Type material – Holotype adult female center specimen on slide with 2 additional adult female paratypes labeled as follows: left label “Australia/ Tasmania/ Launceston/ on Sedge/ F. M. Littler/ CIE” right label “*Furcaspis tasmanica*/ Williams and Miller/ HOLOTYPE/ PARATYPES.” A map on the right label gives the location of the holotype and the paratypes. Holotype is deposited in BMNH. In addition, there are 13 adult females and several scale covers on 3 slides with the same data as the holotype (ANIC, BMNH, USNM).

Slide-mounted Characters: Holotype adult female (Fig. 28) 1.2 mm long (paratypes 1.0-1.1 (1.1) mm long), 0.9 mm wide (paratypes 0.7-0.9 (0.8) mm wide), pygidium wider than long at level of seta marking segment 4 (length/width 0.3) (paratypes 0.4), with 3 definite pairs of lobes, pygidial margin with series of projections forward to seta marking segment 4; with no projections anterior of seta marking segment 4; prepygidial margin with small segmental lobes anterior of segment 4. Paraphysis formula variable, from 2-3 to 3-4, usually 3-4, with series of small paraphyses along body margin anterior of lobe 3; longest paraphysis in interlobular space between lobes 1 and 2, or 2 and 3, longest paraphyses shorter than length of median lobes. Median lobes rounded apically, noticeably longer than wide (length/width 2.1) (paratypes 1.9-2.2(2.0)), separated by space 0.9 times width of median lobe (paratypes 0.6-1.3(1.0)), with small paraphysis attached to medial margin of each median lobe, with 1 or 3 paraphyses between median lobes; second lobes slightly smaller than median lobes, same shape but with second lateral lobule noticeably smaller than medial lobule; third lobes same shape as median lobe but smaller and wider, sometimes with second lobule; fourth and fifth lobes apparently part of series of points between setae marking segments 6 and 4. Plates wide, rounded, weakly bifurcate, with 1 duct opening near apex; plate formula 2-2-0; 2 plates between median lobes, conspicuous. Macroducts present along body margin from segment 6 to 8, present in submedial area on segments 3 to 7 or 8, with 21 macroducts (paratypes with 20-25(23) ducts on each side of body on segments 5-8, some hidden by paraphyses, with several macroducts anterior of anal opening. Prepygidial microducts on venter of submedial areas rare, some present on any of segments 1-5, with 1 or 2 on thorax, in lateral clusters from metathorax to segment 4; on dorsum prepygidial microducts in submedial areas of any or all of metathorax to segments 1-4, in small numbers in lateral areas of mesothorax to segment 4. Gland tubercles absent. Ventral submarginal setae slightly enlarged; longest seta on margin of segment 3 42 μ long (paratypes 40-50(43) μ). Perivulvar pores absent. Perispiracular pores absent. Anal opening located 5.2 times length of anal opening from base of median lobes (paratypes 5.5-6.2(5.8)), anal opening 20 μ long (paratypes 17-20(18) μ). Eyes absent, present on 1 specimen, located near lateral margin at level of anterior edge of clypeal shield. Antennae each with 6 setae (paratypes 4 or 5(5) setae). Cicatrices normally absent, prothoracic pair present on 1 specimen. Body oval or round, dorsal surface without obvious sclerotized areas. Pattern anterior of anal opening with many longitudinal lines and reticulations.

Affinities: *Furcaspis tasmanica* is similar to *F. cladii* (both from Australia) by lacking perispiracular pores and by having bilobed second lobes. *Furcaspis tasmanica* differs by

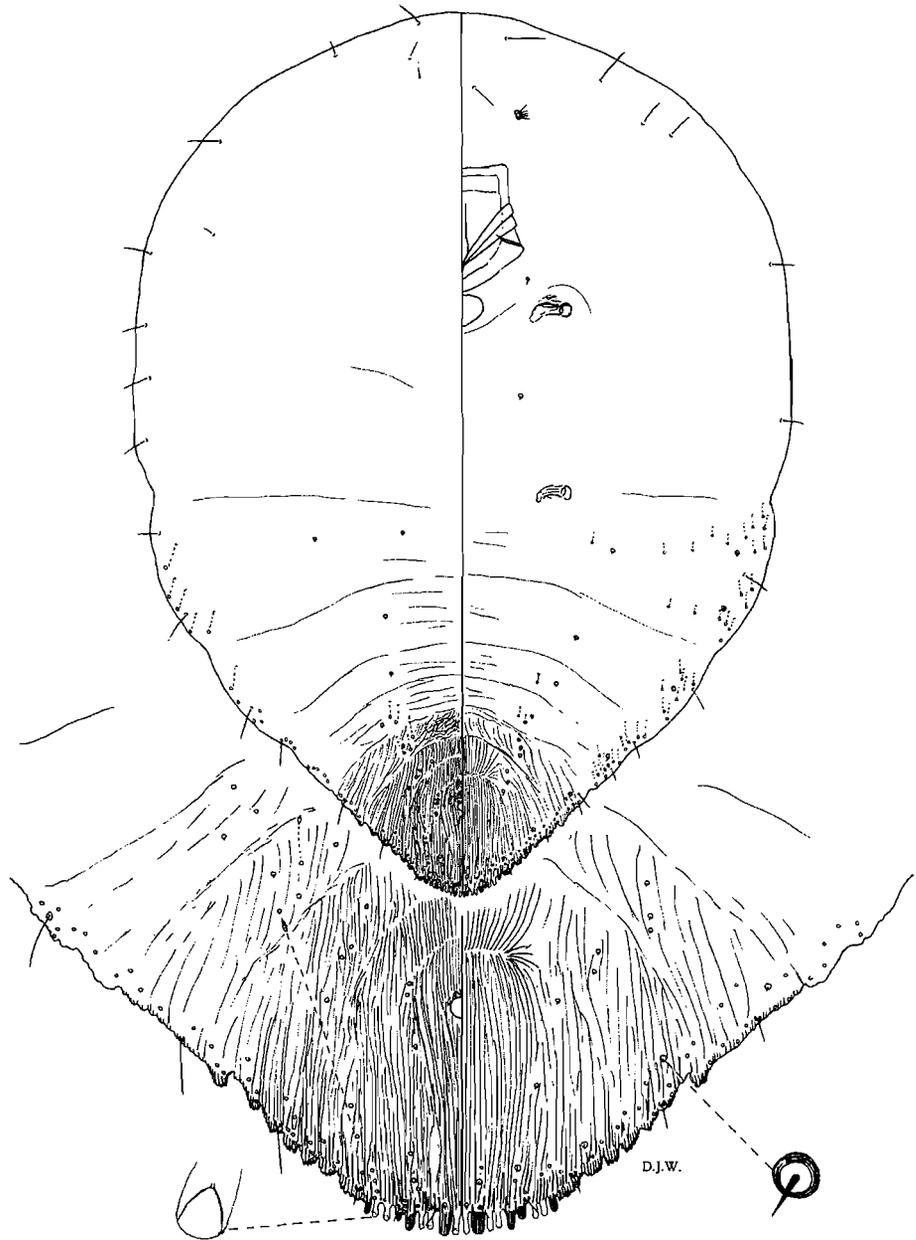


Figure 28. *Furcaspis tasmanica* Williams & Miller. Specimen from Australia, Tasmania, Launceston, on Sedge, date unknown, F. M. Littler.

having conspicuously short paraphyses (long in *F. cladii*), narrow lobes (quadrate-shaped in *F. cladii*), and eyes (absent in *F. cladii*).

Distribution: Tasmania.

Host: Cyperaceae.

Etymology: The name is based on the locality Tasmania combined with the Latin suffix “-acus” meaning “belonging to.”

KEY TO ADULT FEMALES

- | | | |
|-------|--|-----------------------------------|
| 1 | Perivulvar pores present | 2 |
| -- | Perivulvar pores absent..... | 10 |
| 2(1) | Perivulvar pores present in single row only..... | 3 |
| -- | Perivulvar pores present in at least 2 rows..... | 6 |
| 3(2) | Perivulvar pores present anterior to vulva | 4 |
| -- | Perivulvar pores absent anterior to vulva..... <i>intercepta</i> Williams & Miller, n. sp. | |
| 4(3) | Gland tubercles absent from metathorax (rarely with 1 present)..... | 5 |
| -- | Gland tubercles abundant on metathorax | <i>biformis</i> (Cockerell) |
| 5(4) | Submarginal setae on thorax with enlarged basal collars | |
| | <i>peruviana</i> Williams & Miller, n. sp. | |
| -- | Submarginal setae on thorax with thin basal collars | <i>bromeliae</i> Hempel (in part) |
| 6(2) | Spiracular pores predominantly with 5 loculi..... | 8 |
| -- | Spiracular pores predominantly with 3 loculi..... | 7 |
| 7(6) | Gland tubercles abundant on meso- and metathorax..... | |
| | <i>glandulosa</i> Williams & Miller, n. sp. | |
| -- | Gland tubercles present on mesothorax only, absent from metathorax (rarely with 1) | |
| | <i>bromeliae</i> Hempel (in part) | |
| 8(6) | Eyes each with 2-4 spurs..... | 9 |
| -- | Eyes without spurs | <i>andamanensis</i> (Green) |
| 9(8) | Eyes often protruding from body margin. Paraphyses noticeably longer than median lobes. Perivulvar pores close together, in 2 semicircles around vulva..... | |
| | <i>exophthalma</i> Williams & Miller, n.sp. | |
| -- | Eyes not protruding from body margin. Paraphyses either same length as median lobes or shorter. Perivulvar pores scattered in 2 semicircles around vulva | |
| | <i>haematochroa</i> Cockerell | |
| 10(1) | With 2 or 3 plates between median lobes. Space between median lobes without a notch | 11 |

- With more than 3 plates between median lobes. Space between median lobes with a notch *dominicae* Williams & Miller, n.sp.
- 11(10) With at least 1 pore near anterior spiracle, usually more. Second lobes single, not bilobed13
- Without pores near anterior spiracles. Second lobes bilobed12
- 12(11) Paraphyses conspicuously longer than lobes. Lobes each a little longer than wide, nearly quadrate *cladii* (Maskell)
- Paraphyses only about as long as lobes. Lobes each about twice as long as wide, conspicuously narrow..... *tasmanica* Williams & Miller, n.sp.
- 13(11) Spiracular pores predominantly with 3 loculi.....18
- Spiracular pores predominantly with 5 loculi.....14
- 14(13) Plates present anterior to third lobes15
- Plates absent anterior to third lobes *oceanica* Lindinger
- 15(14) With 1 plate anterior to each third lobe. Plates about same length as lobes.....16
- With 2 plates anterior to each third lobe. Plates noticeably longer than lobes.....17
- 16(15) Projections immediately anterior to each third lobe attached basally to lobe
..... *aequatorialis* Williams & Miller, n.sp.
- Projections immediately anterior to each third lobe not attached basally to lobe.....
..... *taquarae* Fonseca
- 17(15) Gland tubercles present on venter of mesothorax. Lateral areas of thorax sclerotized
..... *cyphokentiae* Williams & Miller, n.sp.
- Gland tubercles absent from venter of mesothorax. Lateral areas of thorax
membranous..... *matileae* Williams & Miller, n.sp.
- 18(13) Pygidium posterior to line drawn between setae representing abdominal segment 4 or
5 without heavily sclerotized and clearly defined area21
- Pygidium posterior to line drawn between setae representing abdominal segment 4 or
5 heavily sclerotized and clearly defined area19
- 19(18) With 3 pairs of distinct lobes. Without plates in space anterior to lobe 320
- With 4 pairs of distinct lobes. With 3 plates in space anterior to lobe 3.....
..... *proteae* Brain
- 20(19) Prepygidial abdominal segments strongly lobed laterally forming prominences
..... *mauritiana* (Newstead)
- Prepygidial abdominal segments moderately lobed, not forming prominences.....
..... *scleropygma* Williams & Miller, n. sp. (in part)
- 21(18) Spiracular pores in a compact group next to each anterior spiracle or with a single
pore.....22
- Spiracular pores scattered laterally and anteriorly next to each anterior spiracles
..... *charmoyi* Brain

- 22(21) Gland tubercles present in distinct groups (ignore 1 or 2 on prothorax)23
 -- Gland tubercles absent entirely except for 1 or 2 sometimes present on prothorax ...26
- 23(22) Gland tubercles present on prothorax24
 -- Gland tubercles absent from prothorax25
- 24(23) Pygidium with a single plate anterior to each third lobe. Submarginal ventral pygidial setae filamentous, not cone shaped *oaxacae* Williams & Miller, n. sp.
 -- Pygidium without a single plate anterior to each third lobe. Submarginal ventral pygidial setae cone shaped *capensis* (Walker)
- 25(23) With more than 3 perispiracular pores near each anterior spiracle
 *palmaria* Williams & Miller, n. sp.
 -- With 3 or fewer perispiracular pores near each anterior spiracle
 *plana* Hempel (in part)
- 26(22) With a single plate present anterior to each third lobe27
 -- Without a plate anterior to each third lobe29
- 27(26) Lobes rounded. Dorsal pygidial setae demarking abdominal segments 5 and 6 about as long as lobes28
 -- Lobes pointed. Dorsal pygidial setae demarking abdominal segments 5 and 6 noticeably longer than lobes *paxilliloba* Williams & Miller, n. sp.
- 28(27) Lobes conspicuously longer than wide; with reticulate pattern anterior of anal opening *plana* Hempel (in part)
 -- Lobes quadrate, only slightly longer than wide; with longitudinal line pattern anterior of anal opening *mexicana* Williams & Miller
- 29(26) Median and second lobes tapering towards distal end. Ventral submarginal pygidial setae slender *sibuyanensis* Williams & Miller
 -- Median and second lobes quadrate or wider distally than at bases. Ventral submarginal pygidial setae cone shaped30
- 30(29) Interlobular paraphyses conspicuously longer than lobes
 *scleropymna* Williams & Miller, n.sp. (in part)
 -- Interlobular paraphyses shorter than lobes *rufa* Lindinger

PHYLOGENETIC ANALYSIS

METHODS

Taxon sampling and tree rooting. The central goal of this study was to assess the monophyly of the genus *Furcaspis* and the phylogenetic relationships of the included species. The putative ingroup sample included all species of *Furcaspis* as defined in this paper. *Melanaspis obscura*, *Crenulaspidotus portoricensis*, and *Hemigymnaspis brayi* were chosen as putative outgroups because they share several character states with species of *Furcaspis*. All produce thick, convex scale covers and have thick ventral covers. They also have plates that lack fringing but possess distinct paraphyses. *Melanaspis* has dorsal sclerotized areas and narrow macroducts.

Crenulaspidotus has dorsal sclerotized areas, narrow macroducts, and gland tubercles. *Hemigymnaspis* has dorsal sclerotized areas, narrow macroducts, several setae on the antennae, and gland tubercles. *Aspidiotus destructor* was selected to root the analysis because it definitely lies outside of *Furcaspis*; it does not share most of the characters mentioned above.

Character sampling and coding. A total of 28 morphological characters (Appendix 1) were combined in a quantitative phylogenetic analysis. We included characters that seemed independent and informative at the genus level. Characters were coded for the analysis as either binary (75%) or qualitative multistate (35%). Multistate characters were treated as unordered.

Tree search. All analyses were performed using PAUP 4.0 (Swofford 2000).

We analyzed the data set under the parsimony criterion, using unweighted parsimony, and successive weighting (Farris, 1969) by Farris' rescaled consistency index (Farris, 1988). Tree search was heuristic, using tree-bisection-reconnection branch swapping with 100 random taxon addition sequences. Multistate taxa for one or more characters were treated as polymorphic. Confidence for unweighted analysis was measured with 10 random taxon addition sequences and 100 bootstrap replicates. Consistency-indices reported for optimal trees do not include uninformative characters.

The data matrix contained 33 exemplar species and of the 28 morphological characters included, 25 were parsimony-informative.

RESULTS

The tree chosen to represent the phylogenetic relationships of the species of *Furcaspis*, obtained with successive weighting, is represented in Fig. 29. This tree is compatible with the trees obtained with unweighted characters, with one exception: the clade ((*F. proteae* + *F. paxilliloba*) + (*F. peruviana* + *F. charmoyi*)), obtained under unweighted parsimony, is not present in the analysis employing successive weighing. As expected, resolution was higher when successive weighting was applied. Analysis under unweighted parsimony resulted in 1,327 most parsimonious (MP) trees (124 steps, Consistency-index 0.37, Retention index 0.59), the *strict consensus* resolved only 6 groups out of 31 possible. Analysis after successive weighting (third iteration) resulted in 646 most parsimonious (MP) trees (19.07 steps, Consistency-index 0.56, Retention index 0.80), the *strict consensus* resolved 24 groups out of 31.

The major results supported by our analyses are as follows: the genus *Furcaspis*, based on our rooting, is monophyletic. Within the genus, the following clades were consistently recovered (bootstrap support, when higher than 70%, indicated in parentheses): *F. paxilliloba* + *F. peruviana* (Neotropical), *F. mauritiana* + *F. proteae* (Afrotropical), *F. cyphokentiae* + *F. matileae* (82%) and *F. exophthalmia* + *F. haematochroa* (Oceania).

Given that weighting against apparent homoplasy (i.e., disagreement with other characters) provided increased tree resolution that was generally compatible with groupings supported without such weighting (see exception noted above), we will center our discussion on the trees found after successive weighting (Fig. 29).

The monophyly of the genus *Furcaspis* is supported by 5 unambiguous synapomorphies (see Fig. 29 and Appendix 3), one of which is non-homoplasious: the first 3 pairs of lobes are similar in size and shape and have no notches (character 6, state b). Other characters that support monophyly of this genus (albeit homoplasious) are as follows: plates present, bifurcate (rarely trifurcate and with no fringing) (character 8, state b); without perivulvar pores (character 16, state a); perispiracular pores present, predominately with 3 loculi (character 17, state b). Three groups of species are supported by at least one non-homoplasious synapomorphy. The first group, composed of the Australian species *F. cladii* and *F. tasmanica*, is unique by having the second lobe with two lobules (character 25, state b). Additionally, *F.*

cladii and *F. tasmanica* share the following (homoplasious) synapomorphies: cicatrices absent (character 20, state b); perispiracular pores secondarily absent (character 17, state b); and second space with two plates (character 11, state a). The second group (above node 56, see Fig. 29) includes a mixture of Neotropical and Afrotropical species, and is supported by the presence of marginal enlarged setae (character 14, state b). The third group, including the Neotropical species *F. aequatorialis*, *F. taquarae*, *F. palmaria*, *P. plana*, and *F. mexicana*, is supported by the presence of sclerotized spots on segments 4 and 5 (character 22, state b). Other groups of species are generally supported by one to a few homoplasious characters.

These results delineate 3 of 5 groups within *Furcaspis* that are consistent with distribution information, i.e., the Neotropical + Mexican group above node 43, the Oceanic + Oriental group above node 48, and the Australian group above node 56. The placement of *F. sibuyanensis* and the aggregation of Afrotropical and Neotropical groups above node 56 require more study.

A pervading feature of the present study is that support for most groupings is limited by extensive homoplasy. For this reason, most of the conclusions reached here must be regarded as provisional. A more definitive resolution of the phylogenetic relationships of the species of *Furcaspis* will undoubtedly require exploration of new character systems, including DNA sequence analysis.

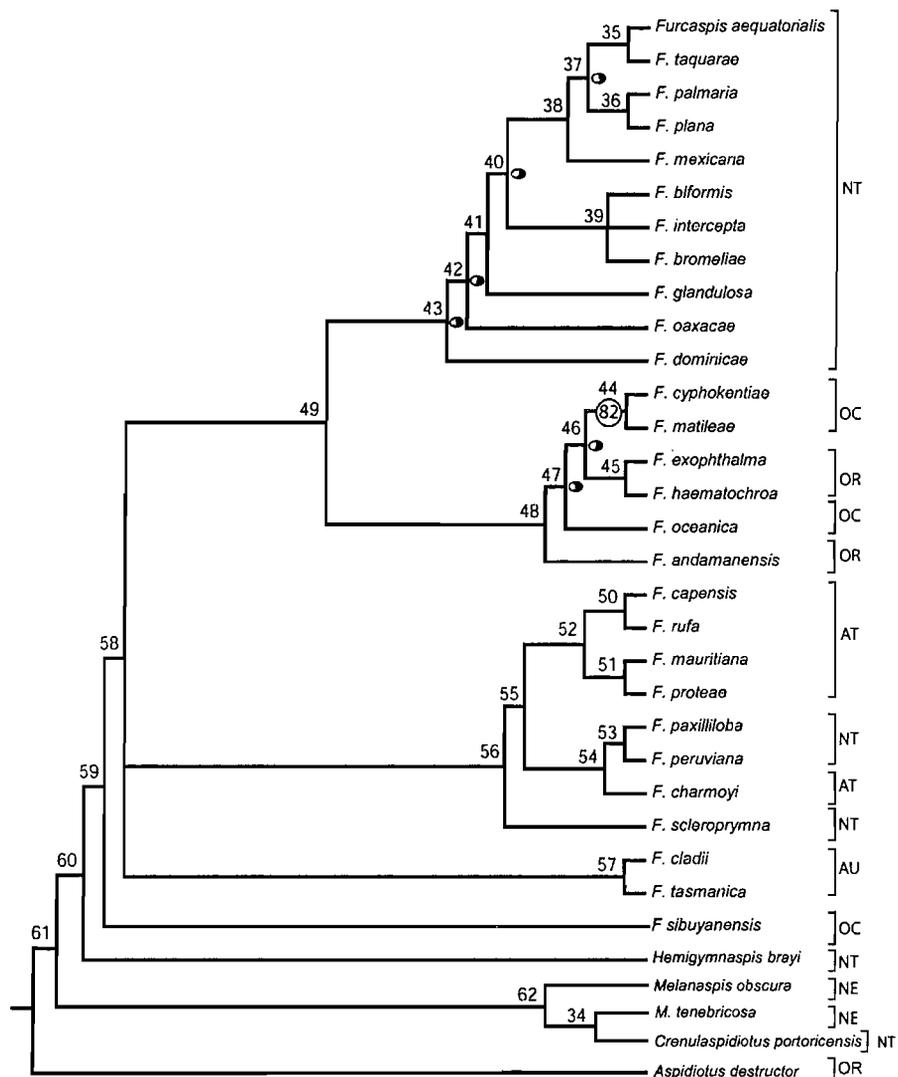


Figure 29. Tree chosen to represent the hypothesized phylogenetic relationships of the species of *Furcaspis*, obtained with unordered characters, successive weighting. Under unweighted parsimony, the tree has 127 steps, Consistency-index of 0.37 and Retention index of 0.59. The strict consensus cladogram of the 646 trees obtained with successive weighting (19.07 steps, Consistency index 0.56, Retention index 0.80) lacks resolution as indicated by the black circles. The numbers on the nodes correspond to those given in the list of apomorphies (Appendix 3). Abbreviations: AT: Afrotropical region; AU: Australia; NE: Nearctic region; NT: Neotropical region; OC: Oceania; OR: Oriental region.

CONCLUSIONS

The genus *Furcaspis* includes 28 species and is found in all but the Palearctic and Nearctic regions (with the exception of the invasive species *F. biformis* which apparently is introduced into the U.S. and Japan). Predominant hosts include Arecaceae (9 species - Oceanic, Neotropical, Oriental, and Afrotropical), Bromeliaceae (6 species - all Neotropical), Cyperaceae (3 species - Australasian), Orchidaceae (2 species - Neotropical), Myrtaceae (2 species - Neotropical), Aloaceae (2 species - Afrotropical and Australasian), and Pandanaceae (2 species - Oceanic and Oriental).

Examination of the placement of the genera recognized by other authors on the phylogenetic tree seems to validate our synonymies. Recognition of *Paraonidiella* (*cladii* and probably *tasmanica*) would require that *Furcaspis sibuyanensis* be placed in a separate monotypic genus or make *Furcaspis* polyphyletic. A similar situation would occur with the recognition of *Neofurcaspis*. Species in the genera *Tollaspidiotus* and *Separaspis* are components of a single clade, but their recognition would make *Furcaspis* paraphyletic and *Separaspis* would be polyphyletic.

An alternative strategy for classification of the group could be to include all taxa within clade 43 in *Furcaspis* (a Neotropical group), all those in clade 48 in *Neofurcaspis* (an Oceanic and Oriental group), those in clade 56 in either *Tollaspidiotus* or *Separaspis* (an Afrotropical and Neotropical group), and those in clade 57 in *Paraonidiella* (an Australasian group). Placement of *F. sibuyanensis* would not be clear but it could be a monotypic genus. Because the phylogenetic arrangement that we have presented is not strongly supported, and because this reorganization would require considerable redefinition of genera, we think it is best to await more definitive phylogenetic evidence before redefining generic concepts.

ACKNOWLEDGMENTS

We thank Greg Evans, Plant Protection and Quarantine, Animal and Plant Health Inspection Service, U. S. Department of Agriculture, Beltsville, MD, and John Brown and Gary Miller, Systematic Entomology Laboratory, for their comments, suggestions, and criticism of this manuscript. We are grateful to the following for loan of specimens. Ray Gill, California Department of Food and Agriculture, Sacramento, CA for specimens of *Furcaspis capensis*, *F. cladii*, and a series of undetermined specimens; Steve Heydon and Penny Gullan, University of California, Davis, CA for material of *Furcaspis cladii*, *F. charmoyi*, *F. haematochroa*, *F. mauritiana*, *F. mexicana*, and undetermined specimens; Sergio Ide, Instituto Biológico, Centro de Sanidade Vegetal, Coleção Entomológica Adolph Hempel, São Paulo, Brasil for specimens of *F. bromeliae*, *F. plana*, and *F. taquarae*; Ian Millar, Plant Protection Research Institute, Pretoria, Queenswood, South Africa for specimens of *F. capensis*; Ireneo Lit, University of the Philippines Los Banos, College, Laguna, Philippines for specimens of *F. haematochroa*; Professor Dr. H. Strümpel, Universität Hamburg, Zoologisches Institut und Zoologisches Museum, Germany for specimens of *F. rufa*. We thank Rosa Henderson, Landcare Research, 120 Mt. Albert Road, Auckland, New Zealand for looking for syntypes of *F. cladii*, and Laurence Mound, Australian National Insect Collection, Canberra, Australia for scouring the ANIC for specimens of *F. cladii*; we are grateful to Penny Gullan for arranging for the loan of specimens of *F. cladii* from the ANIC. We are especially thankful to Danièle Matile, Muséum national d'Histoire naturelle, Paris, France for providing us with specimens of *F. matileae* and allowing us to include the species in our revision. We thank Takumasa (Demian) Kondo, Department of Entomology, University of California, Davis for collecting specimens of *F. biformis* in Jamaica so that they can be used for molecular analysis.

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APPENDICES

Appendix 1. List of characters.

1. Number of lobes: 0) 4; 1) 3
2. Marginal projections anterior of seta marking segment 4: 0) no; 1) yes
3. Prepygidial lobes: 0) absent; 1) moderate in size; 2) large and conspicuous
4. Paraphyses: 0) absent; 1) present
5. Longest paraphysis length compared to length of median lobe: 0) = or longer; 1) = or shorter
6. Notches on lobes: 0) present; 1) absent
7. Lobes shape: 0) different in shape; 1) about same shape
8. Plates bifurcate: 0) no; 1) yes
9. Plate length relative to median lobe: 0) = or shorter; 1) = or longer
10. Number of plates in first space: 0) 0; 1) 1; 2) 2; 3) 3
11. Number of plates in second space: 0) 2; 1) 3; 2) >3
12. Number of plates in third space: 0) 0; 1) 1; 2) 2; 3) 3; 4) >4
13. Number of plates between median lobes: 0) 0; 1) 2; 2) 4 of more
14. Submarginal setae: 0) not enlarged; 1) enlarged
15. Length of seta on segment 3: 0) on average less than 50 μ ; 1) on average more than 50 μ
16. Perivulvar pores: 0) absent; 1) present in 1 row; 2) present in 2 rows
17. Perispiracular pores: 0) absent; 1) present predominantly 3 loculi; 2) present predominantly 5 loculi
18. Eyes: 0) absent; 1) present, without spurs; 2) present with spurs or projections
19. Conspicuous antennal spurs: 0) 1; 1) >1
20. Cicatrices: 0) present; 1) absent
21. Sclerotized areas on pygidium: 0) absent; 1) present
22. Sclerotized spots on segments 4 and 5: 0) absent; 1) present
23. Median lobes longer than wide: 0) no; 1) yes
24. Gland tubercles: 0) absent; 1) present
25. Second lobe with 2 lobules: 0) no; 1) yes
26. Median lobes recessed: 0) no; 1) yes
27. Posterior sclerotized area on pygidium: 0) absent; 1) present
28. Median lobe shape: 0) rounded; 1) pointed

Appendix 2: Matrix. Character states are represented by numbers 1-4. Multistate characters are represented by the following letters: 0/1=A; 1/2=B; 0/1/2=C; 2/3=D.

M. obscura	0	0	0	1	0	0	0	0	0	0	0	2	0	0	0	1	0	A	0	0	1	0	0	0	0	0	0	0	
M. tenebricosa	0	0	0	1	0	0	0	1	0	1	0	3	1	0	0	0	0	1	0	0	1	0	0	0	0	0	0	0	1
H. brayi	0	0	1	1	1	0	0	0	0	2	2	4	1	0	0	1	0	1	1	0	1	0	0	1	0	0	1	0	
F. portoricensis	0	0	2	1	0	0	0	0	2	1	3	1	0	0	0	2	0	0	1	0	0	0	0	0	0	0	0	1	
O. destructor	1	0	0	0	-	0	1	0	1	2	1	3	1	0	0	1	0	1	0	0	0	0	1	0	0	1	0	0	
F. aequatorialis	1	1	1	1	1	1	1	0	2	1	1	1	0	0	0	B	0	1	0	1	1	1	1	0	0	0	0		
F. andaman	1	0	1	1	0	1	1	1	0	2	1	C	1	0	0	2	2	1	1	0	0	0	1	0	0	0	0		
F. biformis	1	0	1	1	1	1	1	1	0	2	1	1	1	0	0	1	1	0	0	1	0	1	0	1	1	0	0	0	
F. bromeliae	1	1	1	1	1	1	1	0	2	1	1	1	0	0	B	1	0	1	0	1	0	1	1	0	0	0	0		
F. capensis	1	0	0	1	1	1	1	0	2	1	0	1	1	0	0	1	0	1	0	0	0	1	1	0	0	0	0		
F. charmoyi	1	0	1	1	1	1	1	0	2	0	0	1	1	1	0	1	1	1	1	0	0	1	0	0	0	0	0		
F. cladii	1	0	1	1	0	1	1	1	0	2	0	0	1	0	1	0	0	1	1	1	0	0	1	0	1	0	0		
F. cyphokentiae	1	0	1	1	1	1	1	1	2	1	2	1	0	1	0	2	1	1	0	0	0	1	1	0	1	0	1	0	
F. dominicae	1	0	2	1	0	1	1	1	A	3	A	D	2	0	0	0	1	1	1	1	0	0	0	1	0	0	0		
F. exophthalma	1	0	0	1	0	1	1	1	0	2	1	2	1	0	1	2	2	2	1	1	0	0	A	1	0	0	0	0	
F. glandulosa	1	0	1	1	0	1	1	1	0	2	1	1	1	0	0	2	1	1	1	0	1	0	1	1	0	0	0	0	
F. haematochroa	1	0	1	1	1	1	1	0	2	1	1	1	0	1	1	2	2	2	1	0	0	0	1	1	0	0	0	0	
F. intercepta	1	0	0	1	1	1	1	0	2	1	1	1	0	1	1	1	0	1	0	1	0	1	0	1	1	0	1	0	
F. matileae	1	0	1	1	1	1	1	1	2	1	2	1	0	1	0	2	1	1	0	0	0	1	1	0	1	0	0	0	
F. mauritiana	1	0	2	1	1	1	1	1	0	2	0	0	1	1	0	0	1	1	1	0	0	0	1	0	0	0	1	0	
F. mexicana	1	0	1	1	0	1	1	1	0	2	1	1	1	0	0	0	1	1	0	1	1	0	1	1	0	0	1	0	
F. oaxacae	1	0	1	1	0	1	1	1	0	2	1	1	1	0	0	0	1	1	1	0	0	0	1	1	0	1	0	0	
F. oceanica	1	0	1	1	0	1	1	1	0	2	A	0	1	0	1	0	2	1	1	0	0	0	1	1	0	0	0	0	
F. palmaria	1	1	2	1	1	1	1	1	0	2	1	1	1	0	0	0	1	1	1	0	1	1	1	1	1	0	0	0	
F. paxilliloba	1	0	1	1	1	1	1	0	1	D	1	B	1	1	0	1	1	1	0	0	0	1	0	0	1	0	0	0	
F. peruviana	1	1	2	1	1	1	1	0	1	2	1	1	1	1	1	1	1	1	1	0	0	0	1	1	0	1	0	0	
F. plana	1	1	0	1	1	1	1	0	0	2	A	1	1	0	0	0	1	1	0	1	1	1	1	1	0	0	1	0	
F. proteae	0	0	2	1	1	1	1	1	0	2	1	3	1	1	0	0	1	1	1	1	0	0	1	0	0	0	1	0	
F. rufa	1	0	2	1	1	1	1	1	0	2	1	0	1	1	0	0	1	1	1	0	1	0	1	1	0	0	0	0	
F. scleropymna	1	1	1	1	0	1	1	1	0	2	1	0	1	1	0	0	1	1	1	0	0	0	0	0	0	0	0	1	0
F. sibuyanensis	0	0	1	1	0	1	0	1	0	2	1	0	1	0	0	0	1	1	1	0	0	0	1	0	0	1	0	1	0
F. taquarae	1	1	1	1	1	1	1	0	2	1	1	1	0	0	0	2	0	1	0	1	1	1	1	0	0	0	0	0	

Appendix 3. List of apomorphies for cladogram in Fig. 29. Characters optimized using Accelerated transformation (ACCTRAN). Single arrows (1-->) denote ambiguous changes, double arrows (==>) denote unambiguous changes.

Branch	Character	CI	Change	Branch	Character	CI	Change
node_61 --> node_62	1	0.333	1-->0	node_59 --> node_58	16	0.375	1==>0
	4	1.000	0-->1		17	0.600	0==>1
	7	0.500	1-->0		1	0.333	0==>1
	9	0.500	1-->0		7	0.500	0==>1
node_62 --> node_34	26	0.143	1-->0	node_58 --> node_49	12	0.583	0-->2
	16	0.375	1==>0	24	0.200	0==>1	
	21	0.250	0-->1	node_43 --> node_42	12	0.583	2-->1
	23	0.333	1-->0	node_42 --> node_41	21	0.250	0==>1
node_61 --> node_60	28	0.500	0==>1	node_41 --> node_40	5	0.143	0-->1
	1	0.333	1-->0	node_40 --> node_38	22	1.000	0==>1
	3	0.200	0==>1	node_38 --> node_37	2	0.250	0==>1
	4	1.000	0-->1	node_37 --> node_35	17	0.600	1-->2
	7	0.500	1-->0	18	0.429	1==>0	
	9	0.500	1-->0	node_37 --> node_36	3	0.200	1-->0
node_60 --> node_59	12	0.583	3-->0	node_40 --> node_39	16	0.375	0==>1
	19	1.000	0==>1	18	0.429	1==>0	
	26	0.143	1-->0	node_49 --> node_48	17	0.600	1==>2
	6	1.000	0==>1	node_48 --> node_47	15	0.250	0==>1
	8	0.167	0==>1	node_47 --> node_46	5	0.143	0-->1

Branch	Character	CI	Change
node_46 --> node_44	9	0.500	0 ==> 1
	26	0.143	0 ==> 1
node_46 --> node_45	16	0.375	0 ==> 2
	18	0.429	1 ==> 2
node_58 --> node_56	14	1.000	0 ==> 1
node_56 --> node_55	5	0.143	0 ==> 1
node_55 --> node_52	3	0.200	1 ==> 2
node_52 --> node_50	24	0.200	0 ==> 1

Branch	Character	CI	Change
node_52 --> node_51	27	0.250	0 ==> 1
node_55 --> node_54	15	0.250	0 ==> 1
node_54 --> node_53	8	0.167	1 ==> 0
	9	0.500	0 ==> 1
node_58 --> node_57	12	0.583	0 ==> 1
	26	0.143	0 ==> 1
	11	0.556	1 ==> 0
	17	0.600	1 ==> 0
	20	0.200	0 ==> 1
	25	1.000	0 ==> 1

Appendix 3. (continuation)

Branch	Character	CI	Change
<i>M. obscura</i>	10	1.000	2 ==> 0
	11	0.556	1 --> 0
	12	0.583	3 ==> 2
	13	1.000	1 ==> 0
	21	0.250	0 --> 1
<i>M. tenebricosa</i>	23	0.333	1 --> 0
	8	0.167	0 ==> 1
	10	1.000	2 ==> 1
<i>C. portoricensis</i>	11	0.556	1 --> 0
	3	0.200	0 ==> 2
	18	0.429	1 ==> 2
	5	0.143	0 ==> 1
<i>H. brayi</i>	11	0.556	1 ==> 2
	12	0.583	0 --> 4
	21	0.250	0 --> 1
	23	0.333	1 --> 0
	24	0.200	0 ==> 1
<i>F. palmaria</i>	27	0.250	0 ==> 1
	3	0.200	0 --> 2
<i>F. plana</i>	8	0.167	1 ==> 0
	27	0.250	0 ==> 1
	5	0.143	1 --> 0
<i>F. mexicana</i>	24	0.200	1 ==> 0
	26	0.143	0 ==> 1
<i>F. bromeliae</i>	2	0.250	0 ==> 1
<i>F. intercepta</i>	3	0.200	1 ==> 0
	15	0.250	0 ==> 1
	26	0.143	0 ==> 1
<i>F. glandulosa</i>	16	0.375	0 ==> 2
<i>F. oaxacae</i>	26	0.143	0 ==> 1

Branch	Character	CI	Change
<i>F. dominicae</i>	3	0.200	1 ==> 2
	10	1.000	2 ==> 3
	13	1.000	1 ==> 2
	20	0.200	0 ==> 1
<i>F. exophthalma</i>	23	0.333	1 ==> 0
	3	0.200	1 ==> 0
	5	0.143	1 --> 0
<i>F. haemato</i>	20	0.200	0 ==> 1
	12	0.583	2 ==> 1
<i>F. oceanica</i>	12	0.583	2 --> 0
<i>F. andaman</i>	16	0.375	0 ==> 2
	23	0.333	1 ==> 0
	3	0.200	2 ==> 0
<i>F. capensis</i>	8	0.167	1 ==> 0
	18	0.429	1 ==> 0
<i>F. rufa</i>	21	0.250	0 ==> 1
<i>F. mauritiana</i>	11	0.556	1 ==> 0
<i>F. proteae</i>	1	0.333	1 --> 0
	12	0.583	0 ==> 3
	20	0.200	0 ==> 1
<i>F. charmoyi</i>	11	0.556	1 ==> 0
	20	0.200	0 ==> 1
<i>F. peruviana</i>	2	0.250	0 ==> 1
	3	0.200	1 ==> 2
	16	0.375	0 ==> 1
	24	0.200	0 ==> 1
<i>F. scleropry.</i>	2	0.250	0 ==> 1
	23	0.333	1 ==> 0
	27	0.250	0 ==> 1
<i>F. cladii</i>	15	0.250	0 ==> 1
<i>F. tasmanica</i>	5	0.143	0 ==> 1
	8	0.167	1 ==> 0
	18	0.429	1 ==> 0
<i>F. sibuyanensis</i>	26	0.143	0 ==> 1
	28	0.500	0 ==> 1

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