Systematic revision of the mealybug genus *Delottococcus* Cox & Ben-Dov (Hemiptera: Pseudococcidae)

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A systematic revision of the mealybug genus *Delottococcus* Cox & Ben-Dov is presented. Nine species are treated, including *D. millari* which is described as new. The eight previously described species are: *Delottococcus aberiae* (De Lotto), *D. confusus* (De Lotto), *D. elisabethae* (Brain), *D. euphorbiae* (Ezzat & McConnell), *D. phylicus* (De Lotto), *D. proteae* (Hall), *D. quaesitus* (Brain), and *D. trichiliae* (Brain). Adult females of all species are described and illustrated and a key for their identification is presented. In the past, specimens determined as *D. elisabethae* have been recorded from citrus and other hosts, but these appear to be misidentifications of *D. aberiae. Delottococcus elisabethae* is only known from the original collection. As invasive species, *D. confusus* is reported from California and Hawaii, *D. aberiae* from Spain, and *D. euphorbiae* from France, Italy, and Sicily.

Key words: Coccoidea, Africa, key, taxonomy.

INTRODUCTION

Delottococcus was described by Cox & Ben-Dov (1986) for a series of African species that previously had been placed in several genera, including *Pseudococcus* (Brain 1915), *Planococcus* (Ezzat & McConnell 1956), *Allococccus* (De Lotto 1961, 1977), and *Paracoccus* (Williams 1958). Cox & Ben-Dov characterized the genus as having an anal bar, modified (oral-rim) tubular ducts on dorsum, multilocular disc pores in midregion of venter only, translucent pores on tibia only, anal-lobe cerarii with two conical setae, no circulus, and 9–18 pairs of cerarii. Unfortunately, none of these characters is consistently present in all specimens of each species. For example, several specimens of otherwise typical representatives of *Delottococcus confusus* (De Lotto) apparently lack a definitive anal bar. In some specimens the anal bar is weakly indicated and can only be detected by someone with considerable experience and with very good optics. Similar circumstances occur with the dorsal oral-rim tubular ducts. Many specimens of *Delottococcus* species have large dorsal ducts, but in many instances these ducts lack a distinctive rim and might be called oral collars instead. Other specimens in the same series have well defined rims and clearly qualify as oral-rim tubular ducts. Perhaps the most troublesome variation surrounds the definition and number of pairs of cerarii. For the purposes of this paper a cerarius is defined as any aggregation of two or more setae positioned near the body margin where cerarii normally occur on mealybugs with more definite cerarii. In most instances, but not all, there are one or more basal trilocular pores associated with the aggregated setae. With improved microscopy we now know that translucent pores frequently are present on the hind femur, even though they often are quite inconspicuous. Several species also have multilocular pores in the lateral areas of the venter outside of the mid-region described as characteristic by Cox & Ben-Dov (1986).

Although there is no consistent definition of the genus, it does appear to form a group of species that have similar biological characteristics, such as the production of an unusually large ovisac, and are restricted to the southern areas of the Afrotropical region. Molecular analysis of the genus and its planococcine relatives would be very useful.

As an invasive species, the economic impact of the introduction of a *Delottococcus* species could be substantial. The present study was originally initiated because of the discovery of an unidentifiable introduced species in California nurseries. The present study has clarified its identity as *D. confusus,* a species previously known only in South Africa. It was first discovered in 2003 at a nursery in southern California on *Protea* and has since been recorded on *Leucadendron* and *Protea* at

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several nurseries in central and southern California; on one occasion, *Leucadendron* plants were being defoliated by the infestation. The species is not regarded as established in California, and any infestations found are eradicated. In 2007 *D. confusus* was intercepted for the first time in California on a shipment of cut flowers that originated in Hawaii. Recently it has been detected in Maui on *Protea.* Because *Protea* species are grown commercially for cut flowers, and *Leucadendron* as an ornamental garden plant, this mealybug may cause significant problems in the future.

A second species, *Delottococcus aberiae* (De Lotto), has recently been detected in Spain (Beltrá *et al.* 2010) on citrus and although it has been collected on several hosts, it could be a potential pest of citrus and several ornamental plants. It also has been intercepted at U.S. ports-of-entry on citrus.

A third species, *Delottococcus euphorbiae* (Ezzat & McConnell) is a pest of *Pelargonium* in Italy (Tranfaglia & Marotta 1983; Marotta & Pagano 1997) and also has been collected in France (Matile-Ferrero 1983). It occasionally is taken in quarantine on *Euphorbia* at U.S. ports-of-entry.

A fourth species, *Delottococcus trichiliae,* also could be potentially dangerous since it has been reported to cause serious damage to several ornamental trees in Durban, South Africa (Brain 1915).

MATERIAL AND METHODS

Specimens were mounted in Balsam following the procedures described in McKenzie (1967). Illustrations were made using a camera lucida and are presented in the standard format for most modern scale insect papers with the ventral surface on the right half of the illustration and the dorsal surface on the left. Descriptions are based on detailed examination of 10 specimens from as many different localities and hosts as possible. A significant portion of the specimens used in this study are deposited in the South African National Collection of Insects in Pretoria (SANC). We also studied material from the Natural History Museum, London, U.K. (BMNH) and the U.S. National Museum of Natural History, Beltsville, Maryland (USNM).

Terminology for the designation of cerarii follows that of Gimpel & Miller (1996) with cerarius number one representing the anal lobe pair and cerarius number 18 representing the frontal pair. Cerarius 13 is located laterad of the anterior spiracle near the body margin. The presence or absence of oral-collar tubular ducts in this area is an important diagnostic character. When looking for this character it is important to distinguish between true oral-collar tubular ducts and oral-rim tubular ducts with a weakly defined rim.

Delottococcus aberiae (De Lotto), Figs 1, 2

Allococcus aberiae De Lotto, 1961: 214 (original designation); De Lotto 1977: 16.

Delottococcus aberiae; Cox & Ben-Dov 1986: 488 (comb. n.); Ben-Dov 1994: 112; Millar 2002: 197.

Field characters. Wax covering of the adult female uniformly grey, abdominal segmentation distinct, five or six pairs of caudal filaments become progressively longer posteriorly, with longest only slightly longer than antennae. Cottony ovisac longer than body of adult female, containing pale yellow eggs. All stages, including egg-laying females, present during winter on main root of *Chrysanthemoides monilifera* plants at Vermont, Hermanus, South Africa.

Slide-mounted characters. Mounted 1.4–2.2 mm long, 0.7–1.5 mm wide.

Dorsum. With 17 or usually 18 pairs of definite cerarii, rarely with as few as 15; anallobe cerarius sclerotized, other cerarii weakly sclerotized. Trilocular pores arranged in segmental rows, discoidal pores about half size of triloculars, interspersed with triloculars. Oral-rim tubular ducts usually well developed, in small numbers, arranged in three pairs of longitudinal lines (lateral, medial, and mediolateral), mediolateral line normally absent on thorax and anterior abdomen, segment V with 3–9 ducts, VII with 3–8 ducts, with one duct near frontal cerarius, usually with a duct near position of cerarius 13. Body setae of variable size, longest setae near posterior end of abdomen, longest seta on segment VII 22–48 μm long. Longest anal-ring seta 132–166 μm long, 1.7–2.0 times greatest diameter of ring.

Venter. Multilocular disc pores present on segments IV–VIII, present on anterior margins of segments VII and VIII rarely on VI, with 1–4 on thorax, submarginal pores absent, rarely with one on one side of body. Trilocular and discoidal pores in segmental rows over surface. Oral-rim tubular ducts smaller than on dorsum, with 5–13 on each side of body from anterior spiracle to segment II, without ducts near position of frontal cerarius. Oral-collar tubular ducts of two sizes, larger ducts

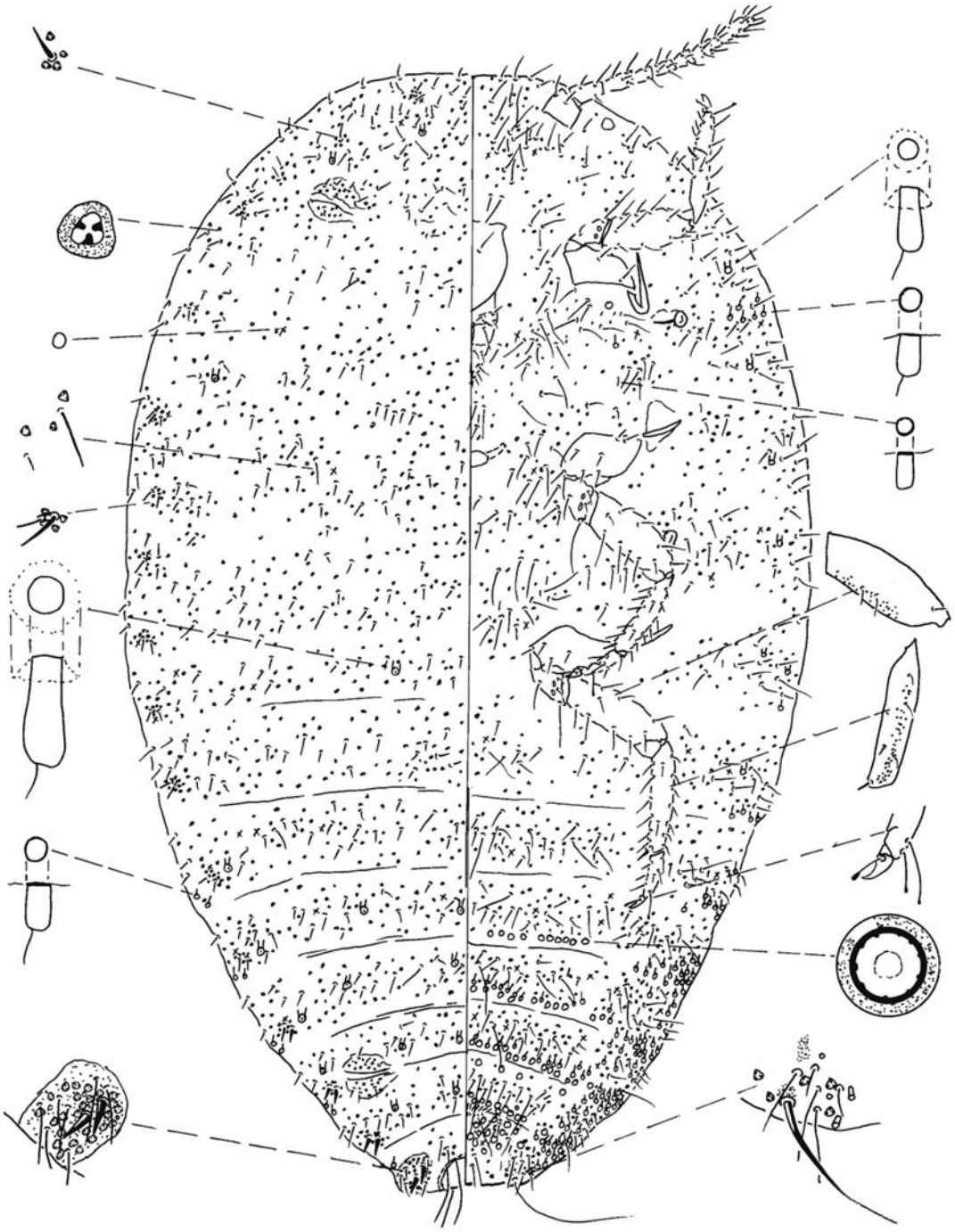

Fig. 1. *Delottococcus aberiae*. Kenya, Nairobi, 24.ii.1954, on *Aberia caffra,* G. De Lotto. Paratype.

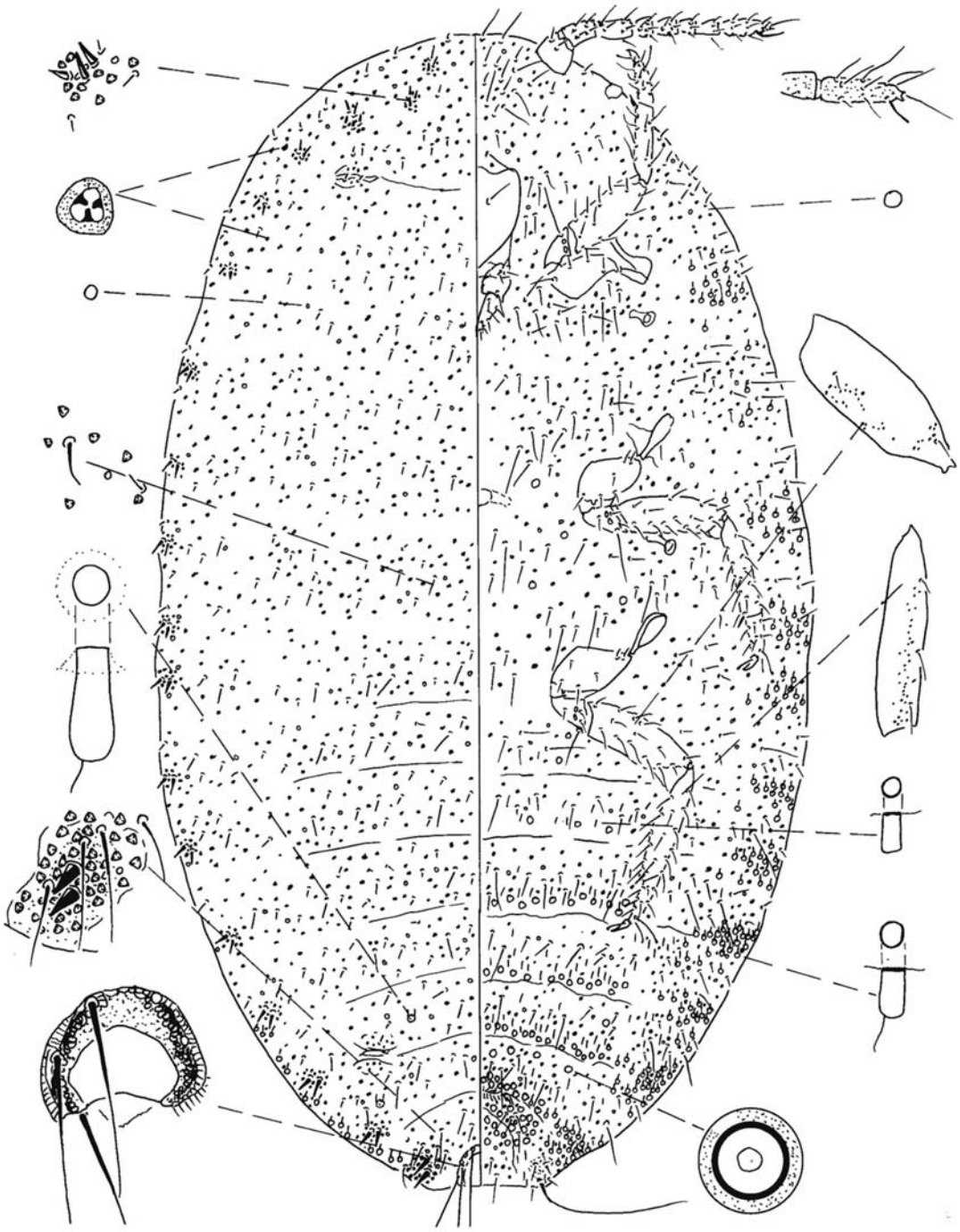

Fig. 2. *Delottococcus aberiae*? South Africa, 24.vii.1984, host and collector unknown. Note small number of dorsal oral-rim tubular ducts.

present in conspicuous clusters near body margin, smaller ducts present in medial and mediolateral areas of thorax and abdomen, absent from head; without oral-collars near cerarius 12, rarely with one, with 0–13 near cerarius 13 (be aware of oral rims with indefinite rims in this area). Labium 150–192 μm long. Antennae 410–560 μm long, 8-segmented, apical segment usually partially divided. Hind femur with 13–24 setae, with 10–40 translucent pores, hind tibia with 21–47 pores, hind tibia usually swollen. Hind tibia 210–325 μm long, hind tarsus 100–128 μm, tibia/tarsus 2.1–2.8 μm.

Notes. This species is most similar to *Delottococcus elisabethae*; for a comparison see the notes section of that species.

There has been considerable confusion about the identity of this species because of extensive variation in the distribution and number of oral-collar tubular ducts and the presence of very small, obscure translucent pores on the hind femur. Oral-collar tubular ducts may be present or absent near cerarius 13 even within specimens from the same collection or on each side of one specimen. Specimens from Zimbabwe (no. 2975) and Mozambique (no. 2968) each have variation of the presence or absence of a small circulus. Specimens recently submitted for identification from Spain have more setae on the hind femur than normal. A specimen intercepted at a U.S. port-of-entry from South Africa has the unusual variation of having only 4 oral-rim tubular ducts on the entire dorsum and many oral-collar tubular ducts near the anterior spiracle. These specimens may represent a different species, but because of the large variation found in these characters throughout the genus we have tentatively included them in *D. aberiae.*

Type material. From the type series we have examined four specimens mounted singly on four slides labelled as paratypes (2 deposited in BMNH, 1 in SANC, 1 in USNM) with the following data; left label 'Coll. No. 1541/ Kenya/ Nairobi: 24.ii.1954/ ex Aberia/ caffra/ Coll.: G. De Lotto'; right label '*Allococcus/ aberiae/* De Lotto/ PARATYPE'. We also have examined three specimens mounted on three slides labelled as paratypes (USNM) with the following: left label 'Coll. No. 1493/ Kenya/ Nairobi: 12.iii.1941/ ex Aberia/ caffra/ Coll.: R. H. Le Pelley/ 600049'; right label '*Allococcus/ aberiae/* De Lotto/ PARATYPE'. We suspect that additional material is in the collection in Kenya and therefore are not designating a lectotype even though De Lotto did not specifically designate a holotype in his original description.

Material examined. All specimens in SANC unless indicated otherwise. AFRICA: Taken in quarantine at Anchorage, Alaska, on safari flowers, W. Fredlund, 18.iii.1986, 1/1 ad. ♀ (Anchorage no. 019572) (USNM); KENYA: Nairobi, on *Aberia caffra,* R.H.Le Pelley, 12.iii.1941, 4/4 ad. ♀ (1493) (USNM); Nairobi, on *Aberia caffra,* G.W. Oloo, 22.iv.1970, 2/2 ad. ♀ (4348); Nairobi, on *Aberia caffra,* G.W. Oloo, 20.ix.1970, 12/12 ad. ♀ (4413); Nairobi, on *Aberia caffra,* G.W. Oloo, 20.viii.1971, 11/11 ad. ♀ (4195); Ruiru, on *Aberia caffra,* H. Baum, 10.iii.1967, 2/2 ad. ♀ (3045); SOUTH AFRICA: *Eastern Cape*: Addo, on *Citrus* sp., W. Hanekom, ?.ii.1963, 3/3 ad. ♀ (1198); Addo, on *Citrus* sp., J. de Villiers, 15.ii.1969, 1/1 ad. ♀ (3575); Alice, on *Acacia* sp., D.P. Annecke, 18.x.1965, 1/1 ad. ♀ (1977); Grahamstown, on *Bobartia orientalis,* P. Lesley, 14.iii.1970, 5/5 ad. ♀ (4357); Humansdorp, on *Citrus* sp., J.F. de Villiers, 8.ii.1971, 2/2 ad. ♀ (4151); Kareedouw, on *Chrysanthemoides monilifera,* S. Neser, 3.i.1979 & 14.i.1979, 2/2 ad. ♀ (5616 & 5709); Middelburg, on *Olea* sp., H. van Ark, 14.x.1963, 4/4 ad. ♀ (753); Port Elisabeth, on *Chrysanthemoides monilifera,* S. Neser, 4.iv.1978, 2/2 ad. ♀ (5588); Gauteng: Silverton, on *Bequaertiodendron* sp., C.J. Chillers, 28.xii.1963, 3/3 ad. ♀ (786). *Free State:* Golden Gate, on *Euclea* sp., J. Munting, 17.x.1967, 2/2 ad. ♀ (2955). *KwaZulu-Natal*: Amanzimtoti, on *Brachylaena discolor,* H. K. Munro, 12.iv.1968, 1/1 ad. ♀ (3030); Durban, on *Trichilia emetica,* G. De Lotto, 24.viii.1964, 3/3 ad. ♀ (886); Durban, on *Chrysanthemoides monilifera,* G. De Lotto, 26.viii.1964, 1/1 ad. ♀ (914, 915); Durban, on *Chaetacme aristata,* G. De Lotto, 27.viii.1964, 1/1 ad. ♀ (892); Kranskop, on *Cussonia spicata,* P. Lesley, 17.xi.1969, 1/1 ad. ♀ (4340); Melmoth, on *Citrus* sp., V. Hattingh, 25.xi.1996, 1/2 ad. ♀ (6547); Nikwalini Valley, on *Citrus* sp., V. Hattingh, 25.xi.1996, 13/20 ad. ♀ (6546); Nikwalini Valley, on *Citrus* sp., V. Hattingh, ?.viii.1997, 2/3 ad. ♀ (6562); Nikwalini, on *Citrus* sp., V. Hattingh, ?.ii.1999, 2/2 ad. ♀ (6614); Oribi Gorge, on *Rapanea melanophloeos,* G.L. Prinsloo, 26.i.1972, 3/3 ad. ♀ (4584); Park Rynie, on *Syzygium cordatum,* P. Lesley, 17.xi.1970, 2/2 ad. ♀ (4310); Umkomaas, on *Eugenia capensis,* A.L. Capener, 9.ix.1968, 1/1 ad. ♀ (3289); *Limpopo*: Louis Trichardt, on *Ficus* sp., J. Munting, 13.xii.1967, 12/12 ad. ♀ (2978); Tzaneen, on *Maytenus mossambicensis,* J.F. de Villiers, 5.iv.1964, 6/6 ad. ♀ (850); Zebediela, on *Citrus* sp., C.J. Cilliers, 22.x.1970, 4/4 ad. ♀ (4401, 4404, 4405); *Mpumalanga:*

Graskop, on *Cliffortia linearifolia,* P. Lesley, 12.iv.1972, 1/1 ad. ♀ (4734); Nelspruit, on *Ficus sycomorus,* G. De Lotto, 2.x.1963, 2/2 ad. ♀ (740, 743); Nelspruit, on *Citrus* sp., G. De Lotto, 2.x.1963, 8/8 ad. ♀ (752); Nelspruit, on *Erythrina* sp., G. De Lotto, 17.vi.1965, 5/5 ad. ♀ (1049); Nelspruit, on *Ficus sycomorus,* S. Swirski, 13.i.1973, 1/1 ad. ♀ (4835); Nelspruit, on *Citrus* sp., E.C.G. Bedford, 28.xi.1974, 2/2 ad. ♀ (5094); Nelspruit, in culture on *Citrus limon* & *Cucurbita moschata,* E.C.G. Bedford, 28.xi.1974, 2/2 ad. ♀ (5094); Nelspruit, on *Citrus* sp., A. Schwartz, 10.i.1975, 5/5 ad. ♀ (5103); Nelspruit, on *Cassia* sp., D.P. Annecke, 8.ix.1977, 1/1 ad. ♀ (5318); Witrivier, on *Citrus* sp., V. Hattingh, 14.i.1998, 1/3 ad. ♀ (6594); *Northwest:* Ottoshoop, on *Olea africana,* S. Neser, 15.viii.1978, (5463); *Western Cape*: Albertinia, on *Passerina* sp., G.L. Prinsloo, 21.xi.1977, 4/4 ad. ♀ (4829); Bergvliet, on *Passerina vulgaris,* R.L. Kluge, 10.xii.1978, 1/1 ad. ♀ (5570); Cape Town, on *Chrysanthemoides monilifera,* S. Neser, 5.ii.1964, 6/6 ad. ♀ (5284); Cape Town, on *Rhus mucronata,* G. De Lotto, 24.xi.1964, 1/1 ad. ♀ (952); Cape Town, on *Chrysanthemoides monilifera,* S. Neser, 7.vi.1974, 1/1 ad. ♀ (5697); Elands Bay, on *Nylandtia spinosa,* S. Neser, 4.x.1978, 1/1 ad. ♀ (5564); Gansbaai, on *Nylandtia spinosa,* S. Nesser & others, 10.x.1978, 1/1 ad. ♀ (5666); Hermanus, on *Orphium frutescens,* P. Lesley, 30.x.1971, 5/5 ad. ♀ (4462); Hout Bay, on *Mundia albiflora,* G. De Lotto, 22.ix.1964, 6/6 ad. ♀ (946); near Sandbaai, on *Nylandtia spinosa,* S. Neser & others, 10.x.1978, 1/1 ad. ♀ (5666); Stellenbosch, on *Olea africana,* S. Neser, 15.x.1978, 1/1 ad. ♀ (5673). SWAZILAND: Ngonini Estate, on *Citrus* sp., S. Kamburov, 16.viii.1988, 1/1 ad. ♀ (6327); ZIMBABWE: Chimanimani, on *Myrica pilulifera,* C.J. Hodgson, 6.vii.1967, 6/6 ad. ♀ (2968); Chimanimani Mountains, on *Garcinia malenjiensis* ?, C.J. Hodgson, 21.ix.1966, 7/7 ad. ♀ (2967); Chimanimani Mountains, on *Protea welwitschii,* C.J. Hodgson, 26.ix.1966, 1/1 ad. ♀ (2926); Nyakupinga Falls, on *Cussonia* spicata, C.J. Hodgson, 25.v.1964, 1/1 ad. ♀ (2957); Nyakupinga Falls, on *Cussonia* sp., C.J. Hodgson, ?.iii.1965, 3/3 ad. ♀ (2931); Myangambe, on *Cussonia signata,* C.J. Hodgson, 25.v.1964, 1/1 ad. ♀ (2971). PALEARCTIC: SPAIN: Faura, near Valencia, on *Citrus reticulata,* A.B. Ivars, 16.vi.2009, 4/7 ad. ♀ (USNM).

Delottococcus confusus (De Lotto), Figs 3, 4, 5

Allococcus confusus De Lotto, 1977: 16 (original designation).

Delottococcus confusus; Cox & Ben-Dov 1986: 488 (comb. n.); Ben-Dov 1994: 114; Millar 2002: 197; Ben-Dov 2010.

Field characters. Body of adult female grey or greyish green, with three or four pairs of lateral filaments, posterior-most pair is longest, about one third the length of the body. Feeding and ovipositing females occur on the undersides of leaves. The ovisac is white covering all but the anterior portion of the head, about three times the length of adult female body. The eggs are bright yellow when first laid but turn orange as they develop.

Slide-mounted characters. Mounted 1.6–4.0 mm long, 0.9–2.3 mm wide.

Dorsum. With 13–18 pairs of definite cerarii, usually with 16–18; anal-lobe cerarius sclerotized, other cerarii weakly sclerotized. Trilocular pores arranged in segmental rows, discoidal pores about one third size of triloculars, interspersed with triloculars. Oral-rim tubular ducts with weakly developed or definite rim, abundant over most of surface, usually absent or rare in medial areas of thorax, segment V with 5–27 ducts, VII with 6–14 ducts, with one or more ducts near frontal cerarius, usually with at least one duct near position of cerarius 13. Body setae variable, longest near posterior end of abdomen, longest seta on segment VII 25–35 μm long. Longest anal-ring seta 189–240 μm long, 1.8–2.8 times greatest diameter of ring.

Venter. Multilocular disk pores present on segments III or IV–VIII, present on anterior margins of segments VII and VIII, rarely on VI, usually absent from thorax, rarely with as many as 10, submarginal pores usually absent. Trilocular and discoidal pores in segmental rows over surface. Oral-rim tubular ducts smaller than on dorsum, with 13–24 on each side of body from anterior spiracle to segment II, often with one or more ducts on head near position of frontal cerarius. Oral-collar tubular ducts of two sizes, larger ducts present in conspicuous clusters near body margin, smaller ducts present in medial and mediolateral areas of thorax and abdomen, absent from head; without oral-collars near cerarius 12 or 13 (be aware of oral rims with indefinite rims in this area). Labium 165–198 μm long. Antennae 467–625 μm long, 8-segmented, apical segment usually partially divided. Hind femur with 19–30 setae, without translucent pores (see notes below for a discussion of two specimens that have translucent pores), hind tibia with 83–128 pores, hind tibia

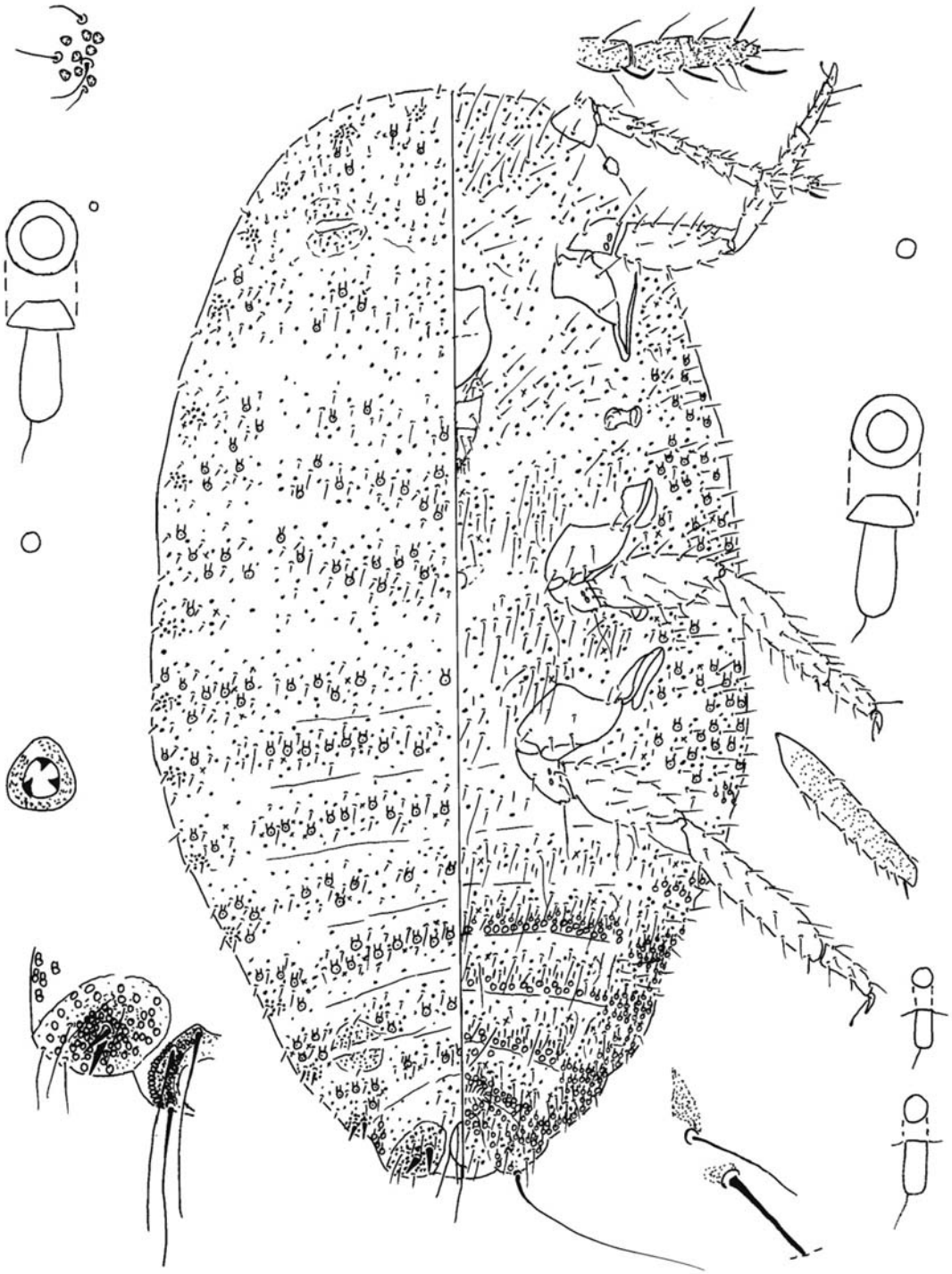

Fig. 3. *Delottococcus confusus.* South Africa, Western Cape Province, Cape Town, 23.xi.1964, on *Leucadendron* sp., G. De Lotto. Holotype.

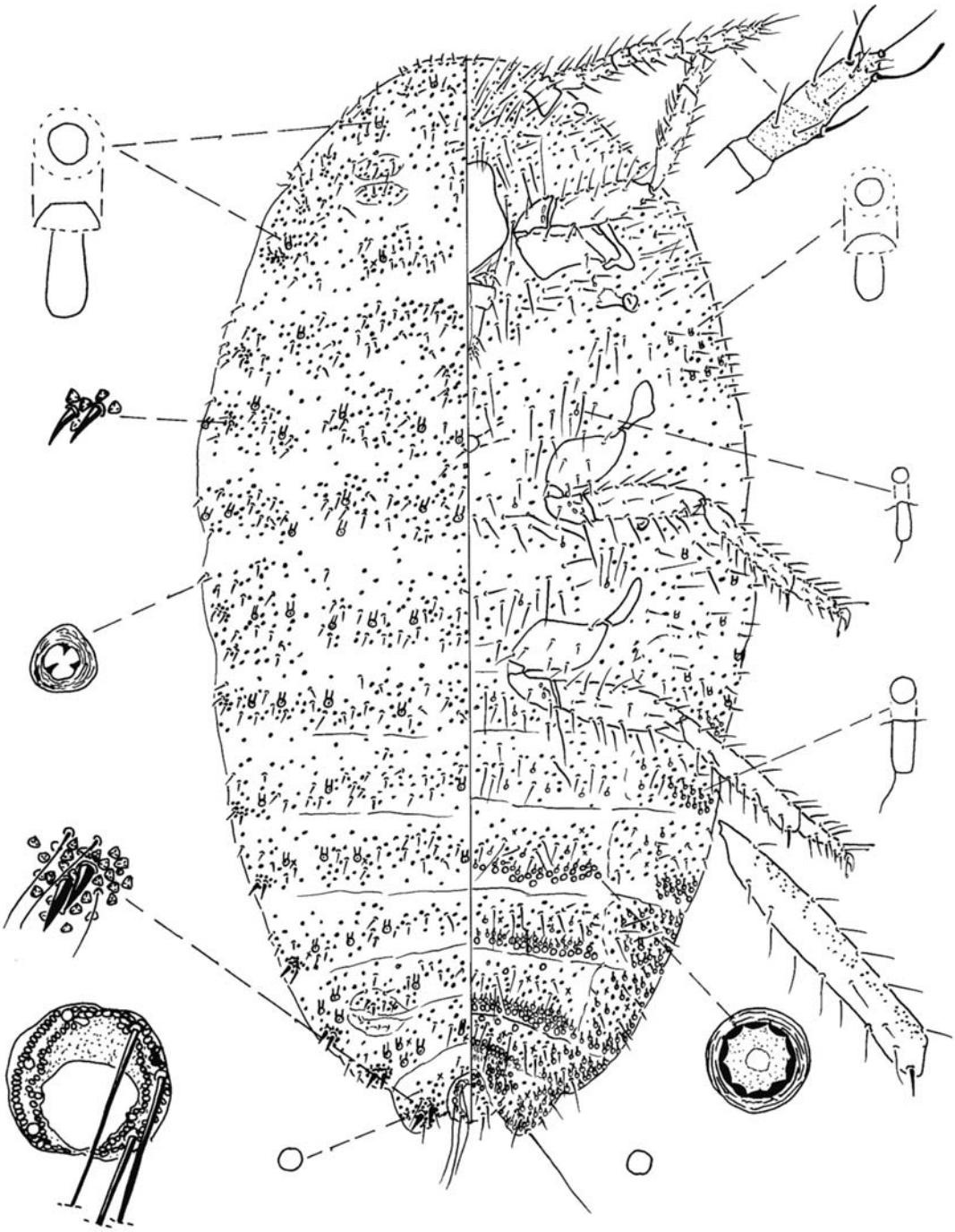

Fig. 4. *Delottococcus confusus*. Taken in quarantine in Miami, Florida, originating from South Africa, 04.ix.1984, on *Protea* sp., R. Diaz. Note small number of oral-rim tubular ducts.

swollen. Hind tibia 305–425 μm long, hind tarsus 102–132 μm, tibia/tarsus 2.8–3.3 μm.

Notes. This species is most similar to *Delottococcus trichiliae,* lacking translucent pores on hind femur, having 19 or more setae on each hind femur, and lacking oral-collar tubular ducts near cerarii 12 and 13. *Delottococcus confusus* differs by having: (characters in brackets are those of *D. trichiliae*) more than 70 translucent pores on hind tibia (fewer than 70); some cerarian setae on head and thorax similar in thickness to dorsal setae (cerarian setae on head and thorax thick and more conical than those on dorsum of thorax).

We have examined two specimens which we initially thought were representatives of a new species similar to *Delottococcus confusus.* They were collected at Cape Point, in the Western Cape Province, South Africa, by G. De Lotto on *Leucadendron* sp. 24.ix.1964. In nearly all aspects they are the same as specimens of *D. confusus* except they have a large number of translucent pores on the hind femur (absent on *D. confusus*) and 24–26 multilocular pores on abdominal segment III (0–6 on *D. confusus*). We attempted to collect more material of this species but were unsuccessful. Because there are only two specimens in the series we have decided to treat them as aberrant specimens of *D. confusus* until more material can be collected. We have included these specimens in the key as *D. confusus*? (Fig. 5).

Type material. We have examined the holotype adult female which is mounted alone on a slide deposited in SANC with the following label data: Left label 'H. C. No. 969/4/ S. A.: Cape Pr./ Cape Town:/ 23.xi.1964/ ex. Leucadendron/ sp./ coll.: G. De Lotto' right label 'Allococcus/ confusus/ De Lotto/ HOLOTYPE.' The envelope holding the holotype is labelled '*confusus* De Lotto 696/ *Leucadendron* sp./ Allococcus 4.' In addition we have examined three paratype slides with the same data as the holotype also in SANC.

Material examined. All specimens in SANC unless indicated otherwise. SOUTH AFRICA: taken in quarantine at Honolulu, Hawaii, on *Protea* sp., J. Fine, 16.x.1964, 9/9 ad. ♀ (Hawaii no. 43655) (CDFA); taken in quarantine at Honolulu, Hawaii, on *Protea* sp., J. Fine, 16. xi.1964, 2/2 ad. ♀ (Hawaii 43663) (CDFA); taken in quarantine at Miami, Florida, on *Protea* sp., R. Diaz & J. Jimenez, 4.ix.2007, 2/3 ad. ♀ (Miami 324700 & 327885) USNM; taken in quarantine at John F. Kennedy Airport, New York, on *Protea* sp., Walck & Markowitz, 18.viii.1992, 1/4 ad. ♀ (JFKIA 047622) (USNM); taken in quarantine at Los Angeles, California, on *Brunia* sp., M. Milad, 12.ix.2007, 1/1 ad. ♀ (LA 211856) (USNM); no specific locality, on *Leucadendron argenteum,* C.K. Brain, 30.x.1914, 3/3 ad. ♀ (B.51.b). *Gauteng*: Pretoria, on *Protea caffra,* G. De Lotto, 15.viii.1963, 9/9 ad. ♀ (1326); Pretoria, on *Protea caffra,* G. De Lotto, 7.i.1970, 2/2 ad. ♀ (4118); *Eastern Cape*: Addo, on *Canthium subovatum,* G. De Lotto, 7.xii.1963, 3 /3 ad. ♀ (783); East London, on *Mimusops caffra,* G. De Lotto, 13.v.1963, 3/3 ad. ♀ (1305); Hogsback, on *Xymalos monospora,* D.P. Annecke, 30.x.1968, 6/6 ad. ♀ (3389). *KwaZulu-Natal*: Durban, on *Trichilia* sp., collector ? (probably C. Fuller), 27.x.1914, 12/16 ad. ♀, 1/many 1st (B.51) (7 slides in USNM); Durban, on *Trichilia emetica,* G. De Lotto, 24.viii.1964, 3/3 ad. ♀ (886); Durban, on *Mimusops caffra* and *Trichilia emetica,* G. De Lotto, 26.viii.1963, 4/4 ad. ♀ (888, 897); Port Edward, on *Mimusops* sp., S. Neser, 6.viii.1974, 4/4 ad. ♀ (5056); Tongaat, on *Carissa* sp., P. Lesley, 17.ix.1970, 2/2 ad. ♀ (4433); Warner Beach, on *Psidium guajava,* P.C. Wentzel, 22.vii.1964, 2/2 ad. ♀ (873). *Western Cape*: Cape Town, Kirstenboch Botanical Gardens, on *Leucadendron argenteum,* J.H. Giliomee & D.R. Miller, 12.xi.2007, 4/16 ad. ♀, 1 3rd ♀, 1 2nd ♀ (USNM); Elands Bay, on *Lycium* sp., P. Lesley, 3.x.1970, 3/3 ad. ♀ (4417); Kleinmond, on *Protea cynarioides,* D. Rust, 21.iii.1969, 1/1 ad. ♀ (3620); Lambert's Bay, on *Lycium tetrandrum,* S. Neser, 2.v.1976, 4/4 ad. ♀ (5166); Riverssonderend, on *Leucadendron argenteum,* M. van Niekerk, 7.vii.1977 1/1 ad. ♀; Stellenbosch, on *Plectranthus* sp., J.H. Giliomee, ?.ii.2008 3/3 ad. ♀ (7034); Saldanha, on *Lycium tetrandrum,* S. Neser, 3.x.1978, 4/4 ad. ♀ (5562). UNITED STATES: *California,* Monterrey Co., Salinas, on *Protea* sp., 18.iii.2003, 1/3 ad. ♀ (PDR1402552). San Diego Co., Carlsbad, on *Protea* sp., Rivas, 22.iii.2005, 1/2 ad. ♀ (PDR 1367761) (CDFA); Green Valley Nursery, San Diego, host ?, 15.iv.2003, 1/4 ad. ♀ (USNM). San Luis Obispo Co., Arroyo Grande, on *Protea* sp., 23.iv.2008 & 30.viii.2004, 3/10 ad. ♀ (PDR 1458700 & 1334139) (CDFA). Santa Cruz Co., Aptos, on *Protea* sp., 15.xi.2005, 2/5 ad. ♀ & 1 3rd ♀ (PDR 1289989) (CDFA). Sonoma Co., Jenner, on *Leucadendron argenteum,* D. Curtin, 9.xi.2006 14/17 ad. ♀, 8 3rd ♀, 2 2nd ♀, 2 2nd ♂, 2 1st, 2 prepupa ♂, 5 pupal ♂, 2 ad. ♂ (PDR 1428445) (CDFA). *Hawaii,* taken in quarantine from Makawao Hawaii at Pebble Beach, Wildcat Canyon Road, California, on unknown host, K. Becker, 7.v.2008, 1/3 ad. ♀ (PDR 1354945)

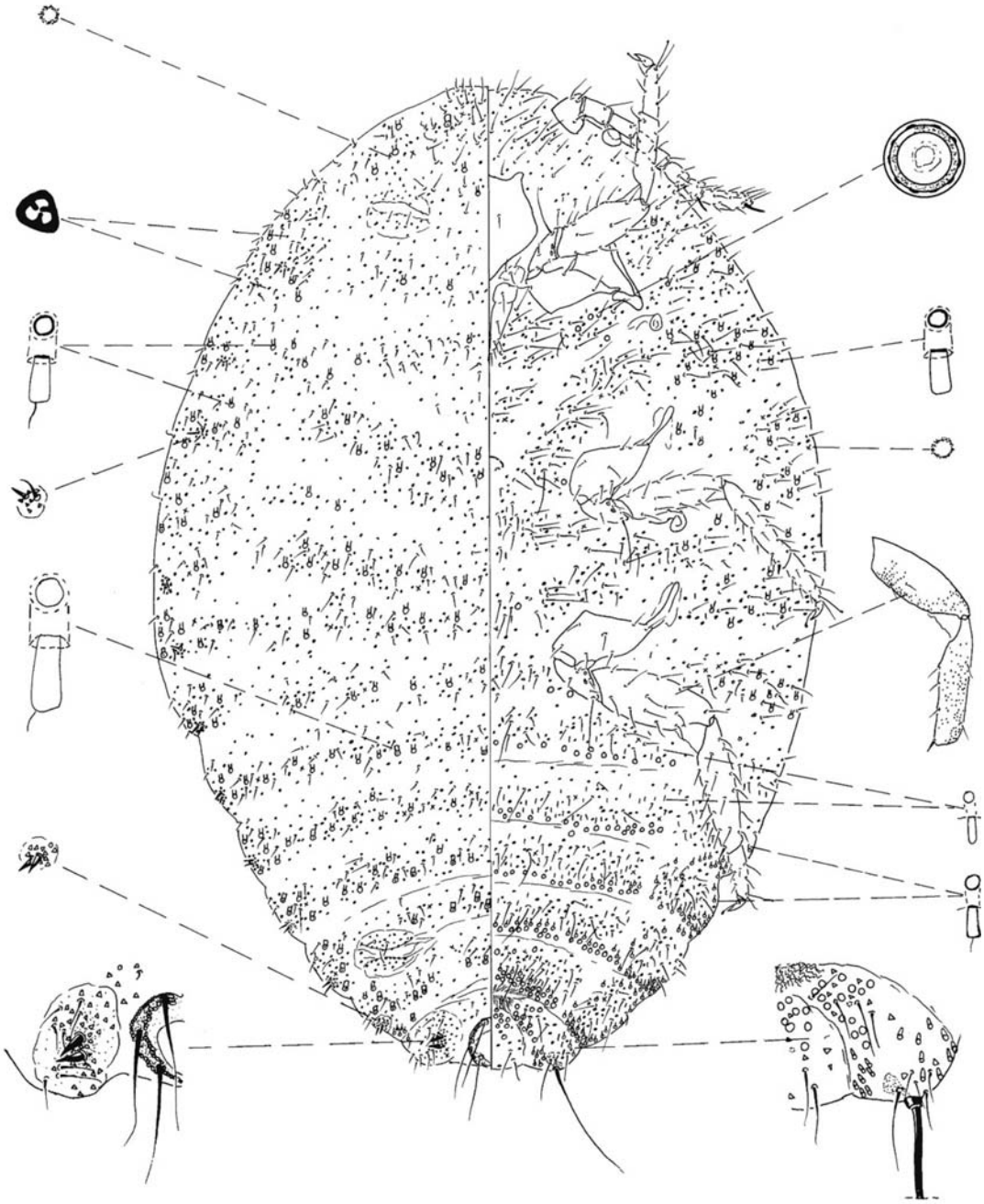

Fig. 5. *Delottococcus confusus*? South Africa, Western Cape Province, Cape Point, 24.xi.1964, on *Leucadendron* sp., G. De Lotto. Note numerous translucent pores on hind femur and abundant multilocular pores on anterior abdomen.

(CDFA); taken in quarantine from Kapaa, Hawaii at San Bernardino Co., on *Leucadendron argenteum,* M. Cochrane, 14.v.2007, 1/1 ad. ♀ (PDR1423774) (CDFA); Kula Experiment Station, Kula, Maui, on *Protea* sp., M. Fukada, 01.vii.2009, 1/3 ad. ♀ (2009-275) (USNM); Kula Experiment Station, Kula, Maui, on *Protea* sp., M. York, 17.vi.2009, 1/1 ad. ♀ (09-MRY-001) (USNM).

Delottococcus elisabethae (Brain)

Pseudococcus elisabethae Brain, 1915: 126 (original designation).

Allococcus elisabethae; De Lotto 1977: 19 (comb. n.).

Delottococcus elisabethae; Cox & Ben-Dov 1986: 488 (comb. n.); Ben-Dov 1994: 114; Millar 2002: 197; Ben-Dov 2010.

Field characters. Brain (1915) wrote 'Ovisac: Loose, cottony, white, usually more or less spherical, sometimes slightly elongate; may attain 3 mm. in length. Ova and larvae pale yellow. Adult ♂ olivaceous-brown with opaque white wings. The two caudal filaments are white, slender, as long as the head and body together…. ♀ (half-grown): about 1.3 mm. long, flesh-pink in colour, with very short lateral filaments and two short caudal ones, which in a few cases reached one-fourth the length of the body. ♀ adult; When living the ♀ is about 2 mm. long, and is pale brown to dark olivaceous-brown in colour'.

Slide-mounted characters. Mounted 1.7–2.0 mm long, 1.0–1.2 mm wide.

Dorsum. With 16–18 pairs of definite cerarii; anal-lobe cerarius weakly sclerotized, other cerarii unsclerotized. Trilocular pores arranged in segmental rows, discoidal pores rare about one third size of triloculars, most abundant in cerarii. Oral-rim tubular ducts with rim indicated by halo, abundant over most of surface, usually absent or rare in medial areas of thorax, segment V with 11–13 ducts, VII with 7–10 ducts, with one or rarely two ducts near each frontal cerarius, with or without a duct near position of cerarius 13. Body setae variable, longest near posterior end of abdomen, longest seta on segment VII 20–25 μm long. Longest anal-ring seta 135–246 μm long, 1.7–2.0 times greatest diameter of ring.

Venter. Multilocular disk pores present on segments IV–VIII, rarely with one or two pores on III, present on anterior margins of segments VII and VIII, with 0–3 on thorax, submarginal pores absent. Trilocular and discoidal pores in segmental rows over surface, discoidal pores rare. Oral-rim tubular ducts smaller than on dorsum, with 6–10 on each side of body from anterior spiracle to segment II, without rim near frontal cerarius. Oral-collar tubular ducts of two sizes, larger ducts present in conspicuous clusters near body margin, smaller ducts present in medial and mediolateral areas of thorax and abdomen, absent from head; without oral-collars near cerarius 12 or 13 (be aware of oral rims with indefinite rims in this area). Labium 132–150 μm long. Antennae 415–435 μm long, 8-segmented, apical segment undivided. Hind femur with 19–23 setae, without translucent pores, hind tibia with 15–43 pores, hind tibia usually slightly swollen. Hind tibia 255–275 μm long, hind tarsus 105–115 μm, tibia/tarsus 2.3–2.5 μm.

Notes. This species is most similar to *Delottococcus aberiae* and has often been confused with it. It is similar to *D. aberiae* by having 16–18 pairs of cerarii, no submarginal multilocular pores, and no oral collars near cerarius 12. *Delottococcus elisabethae* differs by having: (characters in brackets are those of *D. aberiae*) translucent pores absent from hind femur (present on hind femur), antennae shorter than 450 μm (more than 450 μm), femur with 19–23 setae (14–18 setae), no oral-collar tubular ducts near cerarius 13 (present on some specimens).

Specimens in the type series are in poor condition because they were over cooked and are poorly stained. Because of the poor condition of the type series, the anal bar is very difficult to discern.

De Lotto (1958) incorrectly considered this species to be a senior synonym of *Pseudococcus* (= *Delottococcus*) *quaesitus.* In 1977 he resurrected *D. quaesitus* as valid.

Type material. Because the original description of *P. elisabethae* does not mention the word 'type' or 'holotype,' the specimens used for the description are considered to be syntypes and an adult female lectotype is here designated to clarify the status of the species. It is selected from material in SANC that is labelled: right (when specimens heads are pointed down) '*Pseudococcus*/ *rhenosterbosi* Brain/ on Rhenosterbosch/ Newlands, C.P./ Jan. 17, 1915./ 1–3/ – Paratype –' left side of slide has a cover slip with balsam under it and the inscription 'B.85./ C.K.B.' The back of the slide has a label that reads: 'Delottococcus/ elisabethae (Brain)/ LECTOTYPE' with a map giving the location of the lectotype which is one of four adult females and is the speci-

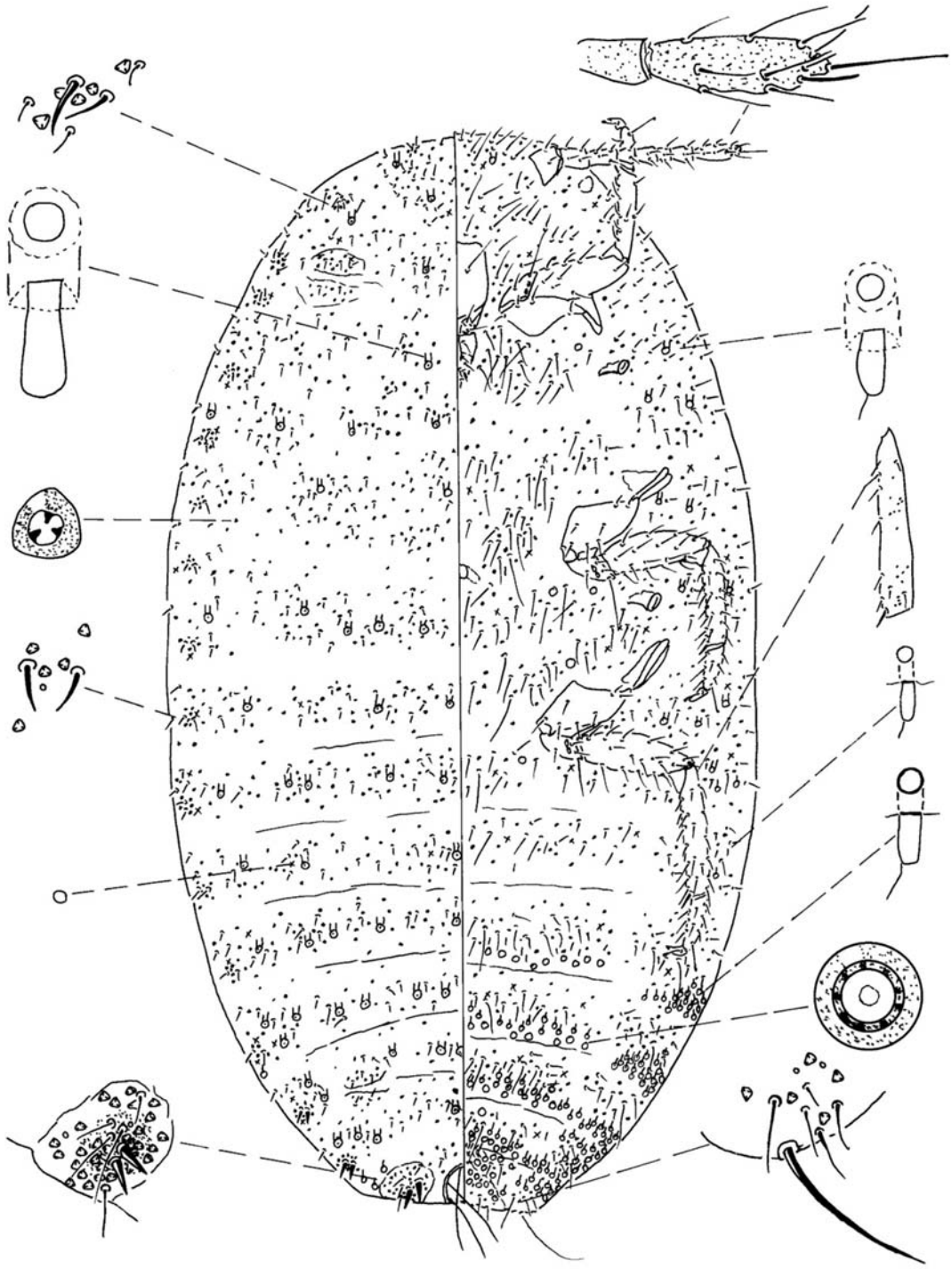

Fig. 6. *Delottococcus elisabethae*. South Africa, Western Cape Province, Newlands, 17.i.1915, on *Elytropappus rhinocerotis,* C.P. van der Merwe.

men farthest to the right nearest the right label. The envelope containing the slide gives the following information '*elisabethae* Brain B:58/ ex. *Elytropappus rhinocerotis*/ Pseudococcus 1–3.' In addition to the three paralectotypes on the lectotype slide there are three other slides containing six paralectotype adult females in SANC and four slides containing ten paralectotype adult females in the USNM.

Apparently Brain changed his mind about the name of the species which he called 'elisabethae' in honor of his mother rather than 'rhenosterbosi' named for the host plant.

Material examined. SOUTH AFRICA: *Western Cape*: Newlands, on *Elytropappus rhinocerotis,* C.P. van der Merwe, 17.i.1915, 3/8 ad. ♀ (no. B.58) (SANC); same data, 4/10 ad. ♀ (B.58) (USNM).

Delottococcus euphorbiae (Ezzat & McConnell) Fig. 7

Planococcus euphorbiae Ezzat & McConnell, 1956: 77 (original designation).

Allococcus meridionalis De Lotto, 1961: 212 (junior synonym); (De Lotto 1977: 19).

Allococcus euphorbiae; De Lotto, 1977: 19 (comb. n.); Tranfaglia 1981: 6; Tranfaglia & Marotta 1983: 53; Tranfaglia 1983: 454; Matile-Ferrero 1983: 253; Tranfaglia & Tremblay 1984: 373; Marotta 1987: 198; Tremblay 1988: 215.

Delottococcus euphorbiae; Cox & Ben-Dov 1986: 488 (comb n.); Pellizzari 1991: 764; Ben-Dov 1994: 113; Mazzeo *et al.* 1994: 201; Longo *et al.*1995: 118; Marotta & Pagano 1997: 99; Russo & Mazzeo 1997: 50; Foldi 2000: 78; Foldi 2001: 304; Millar 2002: 197; Ben-Dov 2010.

Type material. Holotype adult female in USNM. Left label 'on *Euphorbia* 291/ So. Africa: at D.C./ Limber, Coll./ Sept. 20, 1938/ EQ-A49882;' right label 'Planococcus/ euphorbiae/ Ezzat & McC./ Holotype.' We also have examined two paratype slides of the junior synonym *Allococcus meridionalis* (SANC). The holotype of this synonym was not examined; it is deposited in BMNH.

Field characters. The body of the adult female is pinkish, covered with white wax and the abdominal segmentation is apparent. The margin of the body has 18 pairs of filaments that are subequal in size with the exception of the posterior two pairs. The penultimate pair is longer than the anterior pairs but is about half the length of the anal pair which are broad and conspicuous. The ovisac is about 1.5 times the length of the body of the adult female. In heavy infestations the ovisacs coalesce and form a white waxy mass. On geranium, the species prefers to feed on the stems in the vicinity of the nodes at the points of attachment of the leaf stalks. When the infestations are heavy, they occur on all parts of the plants except the roots. Large amounts of honeydew are produced which become contaminated with sooty mold and turn the plant black. Hosts include succulents such as *Stapelia* and geranium (*Pelargonium*) (Tranfaglia & Marotta 1982). In Naples, Italy, this species has four generations a year, overwinters as gravid females, and is biparental. It is considered to be a pest of geraniums (*Pelargonium*), *Stapelia,* and several other succulents (Marotta & Pagano 1997).

Slide-mounted characters. Mounted 1.6–2.8 mm long, 0.7–1.8 mm wide.

Dorsum. With 17 or usually 18 pairs of definite cerarii; anal-lobe cerarius sclerotized, other cerarii weakly sclerotized. Trilocular pores arranged in segmental rows, discoidal pores about one third size of triloculars, interspersed with triloculars. Oral-rim tubular ducts with weakly or well developed rim, abundant over most of surface, usually absent or rare in medial areas of thorax, segment V with 4–8 ducts, VII with 2–4 ducts, usually with 1 duct near each frontal cerarius, usually with a duct near position of cerarius 13. Body setae variable, longest near posterior end of abdomen, longest seta on segment VII 16–20 μm long. Longest anal-ring seta 125–160 μm long, 1.4–2.4 times greatest diameter of ring.

Venter. Multilocular disk pores present medially and submedially on segments II or III–VIII, present submarginally on I or II–VIII, present on anterior margins of segments V or VI –VIII, with 20 or more on thorax, usually with 1–3 associated with cluster of oral collars near cerarius 13. Trilocular and discoidal pores in segmental rows over surface. Oral-rim tubular ducts smaller than on dorsum, with 4–11 on each side of body from anterior spiracle to segment II, without duct on head near position of frontal cerarius. Oral-collar tubular ducts of two sizes, larger ducts present in conspicuous clusters near body margin, smaller ducts present in medial and mediolateral areas of thorax and abdomen, absent from head; without oral-collars near cerarius 12, with 3–7 near cerarius 13. Labium 135–182 μm long. Antennae

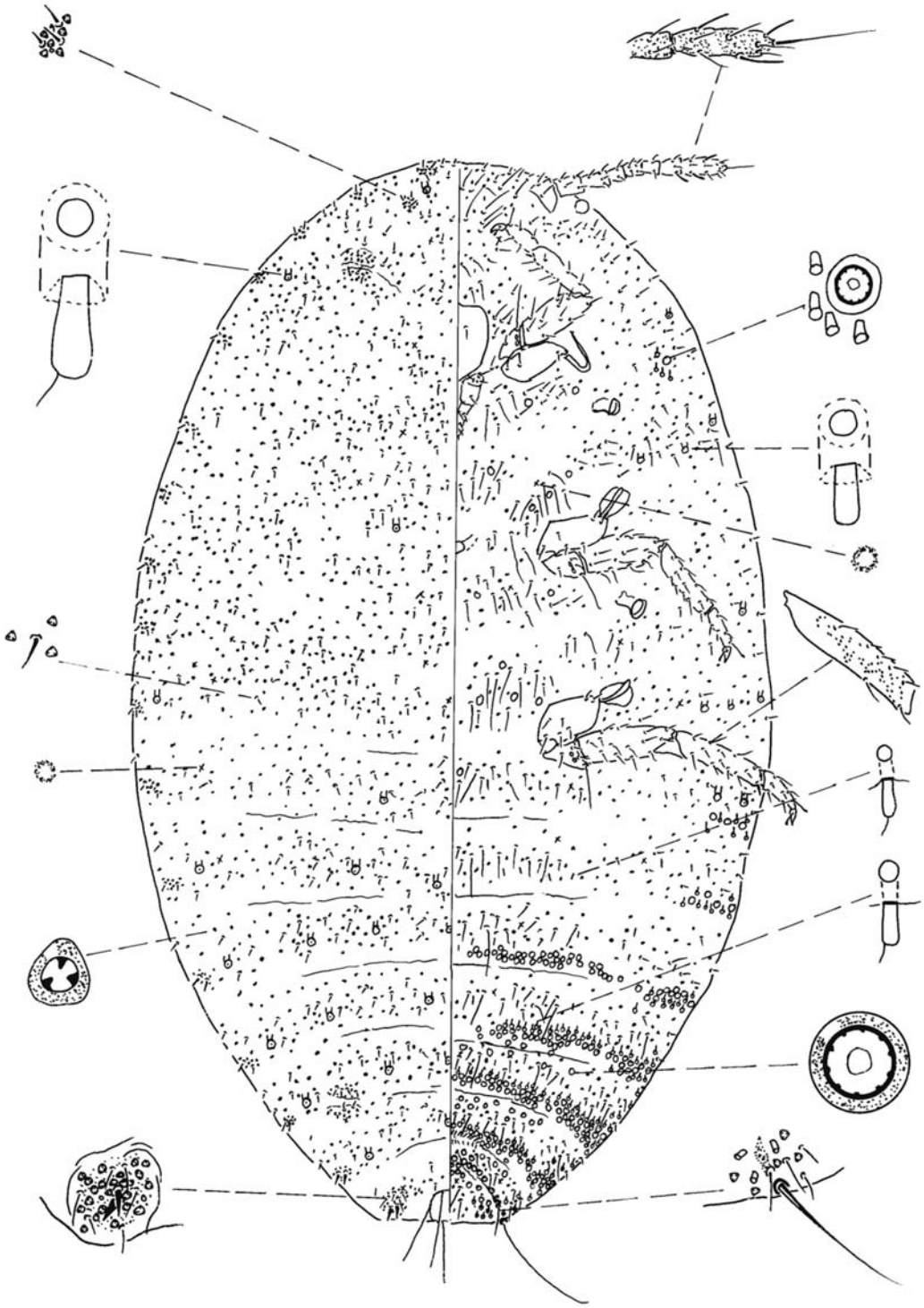

Fig. 7. *Delottococcus euphorbiae.* Taken in quarantine at Los Angeles, California, 10.iv.1979, on succulent, J. Dooley & J. Thaw.

430–505 μm long, 8-segmented, apical segment sometimes partially divided. Hind femur with 14–18 setae, normally without translucent pores, one specimen with 10, hind tibia with 8–49 pores, hind tibia usually slightly swollen. Hind tibia 225–262 μm long, hind tarsus 102–112 μm, tibia/tarsus 2.1–2.4.

Notes. This species is most similar to *Delottococcus quaesitus* by having submarginal multilocular pores and several oral-collar tubular ducts near cerarius 13. *Delottococcus euphorbiae* differs by having: (characters in brackets are those of *D. quaesitus*) submarginal multilocular pores numerous on abdomen with more than 20 on each side of body (few, less than 20), 17 or 18 pairs of cerarii (9–14 pairs); few dorsal oral rims with 2–4 on abdominal segment VII (many with 8–13 oral rims).

In addition to the material listed below the species has been recorded from France, Italy and Sicily from *Aporocactus, Chaetacme, Cotyledon, Crassula, Echinopsis, Echeveria, Euphorbia, Geranium, Opuntia, Pelargonium, Portulaca, Sedum, Sempervivum* and *Stapelia* (Ben-Dov 2010).

Material examined. SOUTH AFRICA: *province*?: Specific locality unknown, taken in quarantine at Washington, D.C., on *Euphorbia,* Limber, 20.ix.1938, 1/1 ad. ♀ (USNM); specific locality unknown, taken in quarantine at Los Angeles, California, on succulent, J. Dooley & J. Thaw, 10.iv.1979, 2/3 ad. ♀ (USNM). Gauteng: Pretoria, on *Pelargonium zonale,* H. van Zoest, 20.xi.1975, 5/5 ad. ♀ (no. 5146) (SANC); KwaZulu-Natal: Durban, on *Chaetacme aristata,* G. De Lotto, 26.viii.1964, 2/2 ad. ♀ (889) (SANC); Western Cape: Bellville, on *Geranium* sp., C.J. Joubert, ?.iii.1931, 2/2 ad. ♀ (642) (SANC); Worcester, on *Stapelia* sp., J. Munting, 2.xii.1964, 3/3 ad. ♀ (950) (SANC).

Delottococcus millari Miller & Giliomee **sp. n.**

Field characters. Unknown.

Slide-mounted characters. Mounted 1.6 mm long, paratypes 1.6–1.8 mm, 0.8 mm wide, paratypes 0.8–0.9 mm.

Dorsum. With 15 or 16 pairs of definite cerarii (paratypes with 14–18 pairs); anal-lobe cerarius sclerotized, other cerarii weakly sclerotized. Trilocular pores arranged in segmental rows, discoidal pores about one third size of triloculars, interspersed with triloculars. Oral-rim tubular ducts with weakly or well developed rim, abundant over most of surface, least abundant on head, segment V with nine ducts (paratypes with 5–12), segment VII with 12 ducts (paratypes with 3–13), with one duct near each frontal cerarius, usually with a duct near position of cerarius 13. Body setae variable, longest near posterior end of abdomen, longest seta on segment VII 30 μm long (paratypes 27–32 μm). Longest anal-ring seta 132 μm long (paratypes 150–155 μm), 1.3 times greatest diameter of ring (paratypes 1.5–1.8 times).

Venter. Multilocular disk pores present on posterior margin of abdominal segments medially and submedially on segments III or IV–VIII, present on anterior margins of segments II–VIII, absent submarginally, with 27 pores on thorax (paratypes with 10–27 pores), without pores near cluster of oral collars near cerarius 13. Trilocular and discoidal pores in segmental rows over surface. Oral-rim tubular ducts smaller than on dorsum, with 4 on each side of body from anterior spiracle to segment II (paratypes with 3–9 ducts), without duct on head near position of frontal cerarius. Oral-collar tubular ducts of two sizes, larger ducts present in conspicuous clusters near body margin, smaller ducts present in medial and mediolateral areas of thorax and abdomen, absent from head; with 0 and two oral collars near cerarius 12 (paratypes with 0–3 oral collars), with four and six oral collars near cerarius 13 (paratypes with 4–13 oral collars). Labium 192 μm long (paratypes 162–192 μm). Antennae 485 μm long (paratypes 470–490 μm), 8-segmented, apical segment sometimes partially divided. Hind femur with 16 and 19 setae (paratypes with 13–22 setae), with 10 and 15 translucent pores (paratypes with 14–49 pores), hind tibia with 41 and 44 pores (paratypes with 17–39 pores), hind tibia sometimes slightly swollen. Hind tibia 255 μm long (paratypes 235–250 μm), hind tarsus 110 μm (paratypes 110–118 μm), tibia/tarsus 2.1 (paratypes 2.1–2.2).

Notes. This species is similar to *Delottococcus aberiae* by having translucent pores on the hind femur and oral collars near cerarius 13. *Delottococcus millari* differs by having: (characters in brackets are those of *D. aberiae*) several multilocular pores on the anterior margin of segments II–VII (usually VII–VIII), and 10–27 multilocular pores on thorax (1–4).

Type material. Holotype adult female mounted singly on a slide and deposited in SANC. Left label 'H.C. No. 5640: 3/ S. Afr.: Strandfontein./ 5.x.1978/ on: Lycium/ tetrandrum/ coll.: S. Neser.' right label 'Delottococcus/ millari/ Miller & Giliomee/

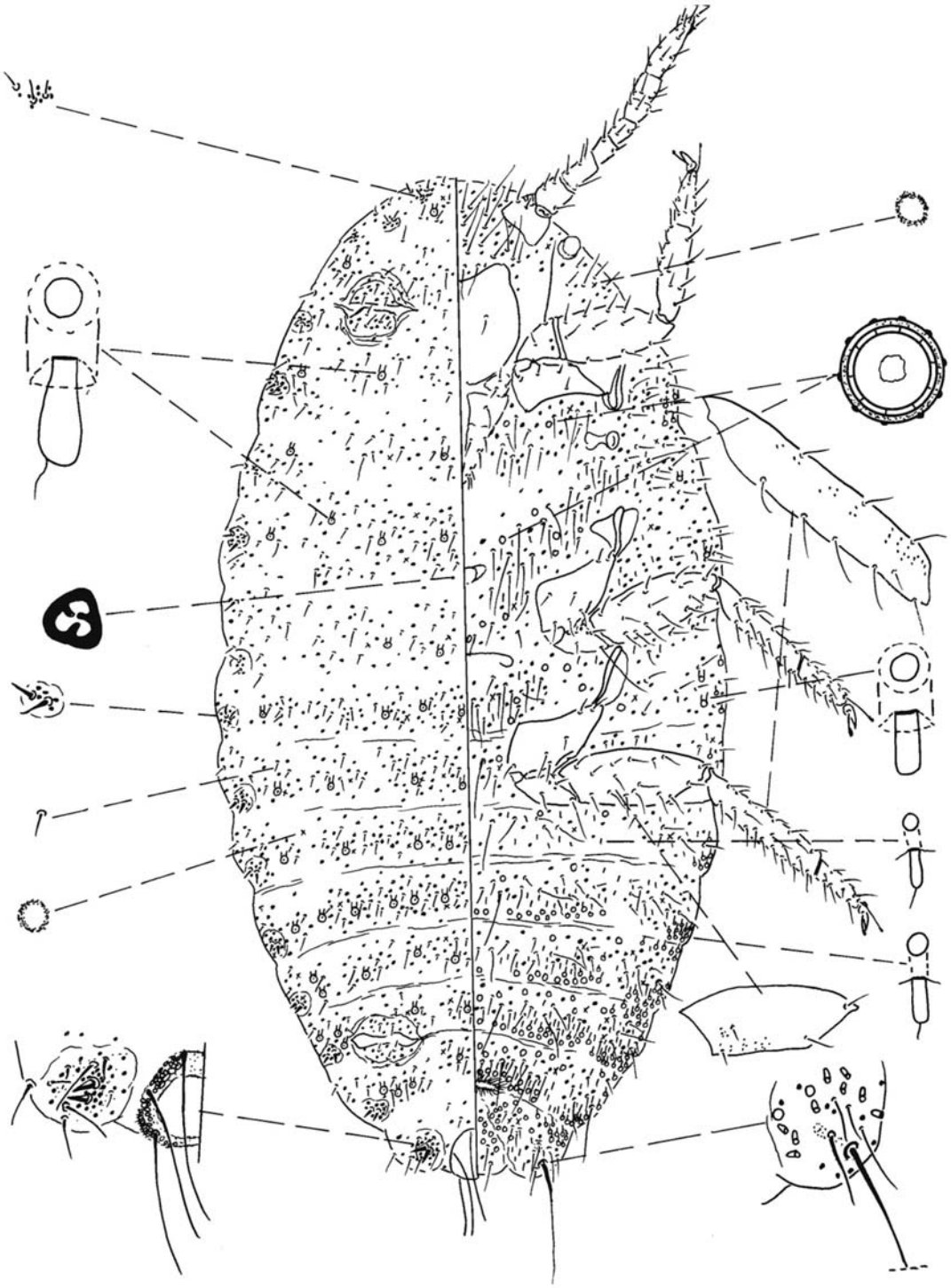

Fig. 8. *Delottococcus millari*. South Africa, Western Cape Province, Strandfontein, 5.x.1978, on *Lycium tetrandrum,* S. Neser.

Holotype.' In addition there are four paratype adult females from the same locality and three paratype adult females from Kareedouw. For details see below.

Material examined. SOUTH AFRICA: *Eastern Cape*: Kareedouw, on *Laurophyllus capensis,* S. Neser, 24.ix.1975, 3/3 ad. ♀ (SANC, USNM). *Western Cape*: Strandfontein, on *Lycium tetrandrum,* S. Neser, 5.x.1978, 5/5 ad. ♀ (SANC, USNM, BMNH).

Etymology. This species is named in honour of Ian Millar, who has spent considerable time and effort helping us prepare this publication.

Delottococcus phylicus (De Lotto), Fig. 9

Allococcus phylicus De Lotto, 1977: 19 (original designation).

Delottococcus phylicus; Cox & Ben-Dov 1986: 488 (comb. n.); Ben-Dov 1994: 113; Millar 2002: 197; Ben-Dov 2010.

Field characters. On leaves and stems of host, ovisac covers body, eggs yellow-orange, body of female lightly covered with white wax, with three or four pairs of short filaments on posterior end of body.

Slide-mounted characters. Mounted 1.2–2.4 mm long, 0.6–1.3 mm wide.

Dorsum. With 8–14 pairs of definite cerarii; anal-lobe cerarius weakly sclerotized, other cerarii without sclerotization. Trilocular pores arranged in segmental rows, discoidal pores uncommon, about half size of triloculars, interspersed with triloculars. Oral-rim tubular ducts with weakly developed rim or rim absent, abundant over most of surface, usually mediolateral bare area on posterior abdominal segments, segment V with 7–10 ducts, VII with 7–10 ducts, with one or more ducts near frontal cerarius, usually with a duct near position of cerarius 13. Body setae variable, longest near posterior end of abdomen, longest seta on segment VII 16–22 μm long. Longest anal-ring seta 112–131 μm long, 1.6–2.0 times greatest diameter of ring.

Venter. Multilocular disk pores present on segments III–VIII, present on anterior margins of segments VIII and sometimes VII, with 1–4 on thorax, submarginal pores usually present, one specimen without. Trilocular and discoidal pores in segmental rows over surface. Oral-rim tubular ducts smaller than on dorsum, with 15–18 on each side of body from anterior spiracle to segment II, without oral rims near frontal cerarius. Oral-collar tubular ducts of two sizes, larger ducts present in conspicuous clusters near body margin, smaller ducts present in medial and mediolateral areas of thorax and abdomen, absent from head; without oral-collars near cerarius 12 or 13 (be aware of oral rims with indefinite rims in this area). Labium 113–150 μm long. Antennae 308–385 μm long, 8-segmented, apical segment usually partially divided. Hind femur with 12–13 setae, with 7–20 translucent pores, hind tibia with 14–39 pores, hind tibia not swollen. Hind tibia 150–205 μm long, hind tarsus 83–92 μm, tibia/tarsus 1.6–2.3.

Notes. This species is similar to *Delottococcus quaesitus* by having a reduced number of cerarii, short anal ring setae, and submarginal multilocular pores. *Delottococcus phylicus* differs by having: (characters in brackets are those of *D. quaesitus*) several multilocular pores on segment III (usually without), oral collars absent near cerarius 13 (present); hind tibia 150–205 μm long (115–288 μm long).

Type material. All type specimens are in SANC. The holotype adult female is labelled as follows: left label 'H.C. No. 3271/3/ S.A.: Stellenbosch:/ 26.ix.1968/ ex.: Phylica/ plumosa/ coll.: A. Redelinghuis' right label 'Allococcus/ phylicus/ De Lotto/ HOLOTYPE.' In addition there are nine paratype slides.

Material examined. All specimens in SANC unless indicated otherwise. SOUTH AFRICA: *Western Cape*: Stellenbosch, on *Phylica pubescens,* G. De Lotto, 24.xi.1964, 6/6 ad. ♀ (no. 977) (paratypes); Stellenbosch, on *Phylica plumosa,* A. Redelinghuis, 26.ix.1968 4/4 ad. ♀ (3271) (holotype & paratypes); Stellenbosch, on *Phylica pubescens,* P. Lesley, 13.x.1969, 7/7 ad. ♀ (4324); Stellenbosch, on *Metalasia muricata,* P. Lesley, 28.x.1969, 1/1 ad. ♀ (4338); Stellenbosch, on unknown host, G.L. Prinsloo, 15.x.1974, 1/1 ad. ♀ (5118); Jonkershoek, near Stellenbosch, on *Phylica pubescens,* J. Giliomee & D.R. Miller, 7.xi.2007, 1/1 ad. ♀ (USNM).

Delottococcus proteae (Hall)

Pseudococcus proteae Hall, 1937: 128 (original designation).

Paracoccus proteae; Williams 1958: 8 (comb. n.).

Allococcus proteae; De Lotto 1977: 21 (comb. n.).

Delottococcus proteae; Cox & Ben-Dov 1986: 488 (comb. n.); Ben-Dov, 1994: 114; Millar 2002: 197; Ben-Dov 2010.

Field characters. Hall (1937) wrote 'A small ovate species in which the brownish colour is obscured by a coating of white pulverulent matter. Four

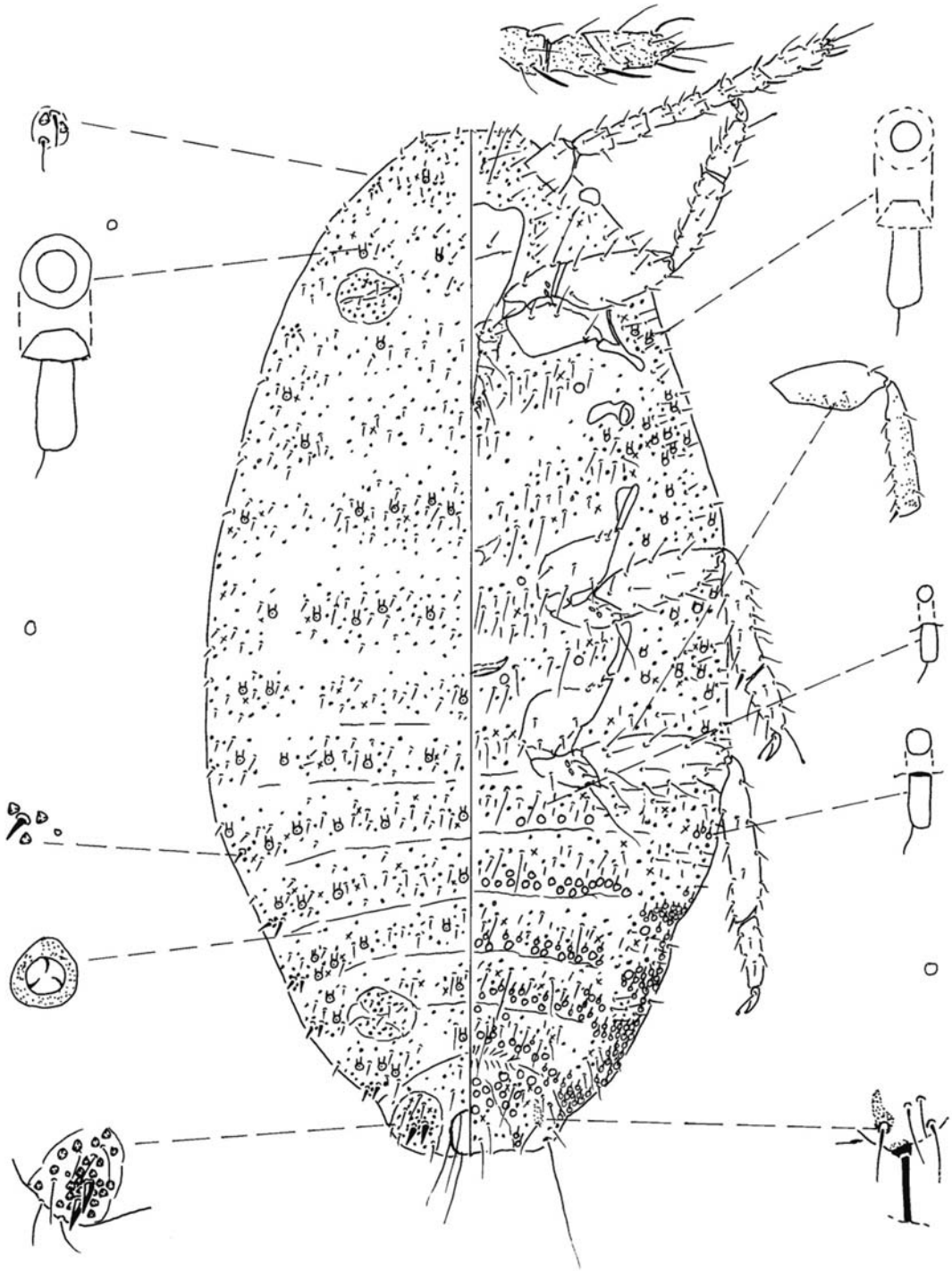

Fig. 9. *Delottococcus phylicus*. South Africa, Western Cape Province, Stellenbosch, 26.ix.1968, on *Phylica plumosa*, A. Redelinghuis.

short and stout caudal filaments; these are 1/3 of the length of the body of the insect. A few successively shorter marginal filaments occur on the abdominal segments, but these are poorly developed in some individuals. Ovisac of indeterminate shape. Eggs very pale brown almost yellow. Found on the terminal shoots either on the main stem or on the under surface of the base of the leaf or of matted earth and fibres and closely attended by ants.'

Slide-mounted characters. Mounted 1.8–2.3 mm long, 1.1–1.5 mm wide.

Dorsum. With 10–14 pairs of definite cerarii, several cerarii on thorax and head with one or two noticeably elongate setae replacing conical setae; anal-lobe cerarius weakly sclerotized, other cerarii unsclerotized. Trilocular pores arranged in segmental rows, discoidal pores about half size of triloculars, interspersed with triloculars. Oral-rim tubular ducts with weakly developed rim (one specimen with distinct rim), uncommon, most abundant along body margin, with medial ducts on segments IV or V to VI or VII, mediolateral ducts rare on thorax and abdomen; ducts near frontal cerarii variable, sometimes present on both sides of body, sometimes entirely absent near frontal cerarii; segment V with 3–4 ducts; segment VII with 3–5 ducts, with or without duct near position of cerarius 13. Body setae variable, longest near posterior end of abdomen, longest seta on segment VII 40–60 μm long. Longest anal-ring seta 112–132 μm long, 1.3–1.6 times greatest diameter of ring.

Venter. Multilocular disk pores present on segments IV–VIII, present on anterior margins of segments VII and VIII, with 0–2 on thorax, submarginal pores usually absent (one specimen with three on one side of body). Trilocular and discoidal pores in segmental rows over surface. Oral-rim tubular ducts smaller than on dorsum, with 6–13 on each side of body from anterior spiracle to segment II, often with duct on head near position of frontal cerarius. Oral-collar tubular ducts of two sizes, larger ducts present in conspicuous clusters near body margin, smaller ducts present in medial and mediolateral areas of thorax and abdomen, absent from head; without oral-collars near cerarius 12, with 0–3 near each cerarius 13. Labium 142–168 μm long. Antennae 400–475 μm long, 8-segmented, apical segment sometimes partially divided. Hind femur with 14–20 setae, with three or four translucent pores, hind tibia with 6–20 pores, hind tibia not swollen. Hind tibia 230–295 μm long, hind tarsus 104–115 μm, tibia/tarsus 2.2–2.8.

Notes. This species is most similar to *Delottococcus quaesitus.* For a comparison of these species see the '*Notes*' section of *D. quaesitus.*

De Lotto (1977) indicated that specimens from Pretoria on *Protea caffra* that he collected in 1963 represent the only series of specimens from South Africa, but they are a misidentification of *D. trichiliae.*

Type material. From the syntype series we have selected and marked as lectotype a single adult female on a slide labelled as follows: 'Inyazura, on Protea, coll. W J Hall, 20/iv/32, CIE' / 'Pseudococcus proteae Hall, D J Williams det (printed on label), BM 1958–578'. A lectotype label has been placed on the slide. The lectotype is chosen to clarify the status of the species and is deposited in BMNH. We have examined two other paralectotype slides containing five adult females that exactly match the data in the original publication. They are labelled as follows: etched on left side 'Pseudococcus/ proteae Hall/ Protea sp./ Inyazura/ WH 20/4/32' labels on right 'Brit. Mus./ 1958–229' and '*PARATYPE*/ W.J. Hall/ 1 & 2/ 31.III.36'. We also have seen three other slides containing one adult female each that have identical data but were collected 24/4/32 (four days later). They were not mentioned in the original description and are not part of the syntype series. Several other slides are present in BMNH.

Material examined. ZIMBABWE: Inyazura, on *Protea* sp., W.J. Hall, 20.iv.32 & 24.iv.32, 6/8 ad. ♀ BMNH; Ruwa, on *Faurea saligna,* J. Bowen, 5.iii.1967, 1/1 ad. ♀ SANC.

Delottococcus quaesitus (Brain)

Pseudococcus quaesitus Brain, 1915: 123 (original designation).

Pseudococcus elisabethae Brain; De Lotto 1958: 105 (incorrect synonymy; see De Lotto 1977: 19)

Pseudococcus trichiliae Brain; De Lotto 1958: 105 (incorrect synonymy; see De Lotto 1977: 24)

Allococcus quaesitus; De Lotto 1977: 22 (comb. n.).

Delottococcus quaesitus; Cox & Ben-Dov 1986: 488 (comb. n.); Ben-Dov 1994: 114; Millar 2002: 197; Ben-Dov 2010.

Because the original description of *P. trichiliae* does not mention the word 'type' or 'holotype,'

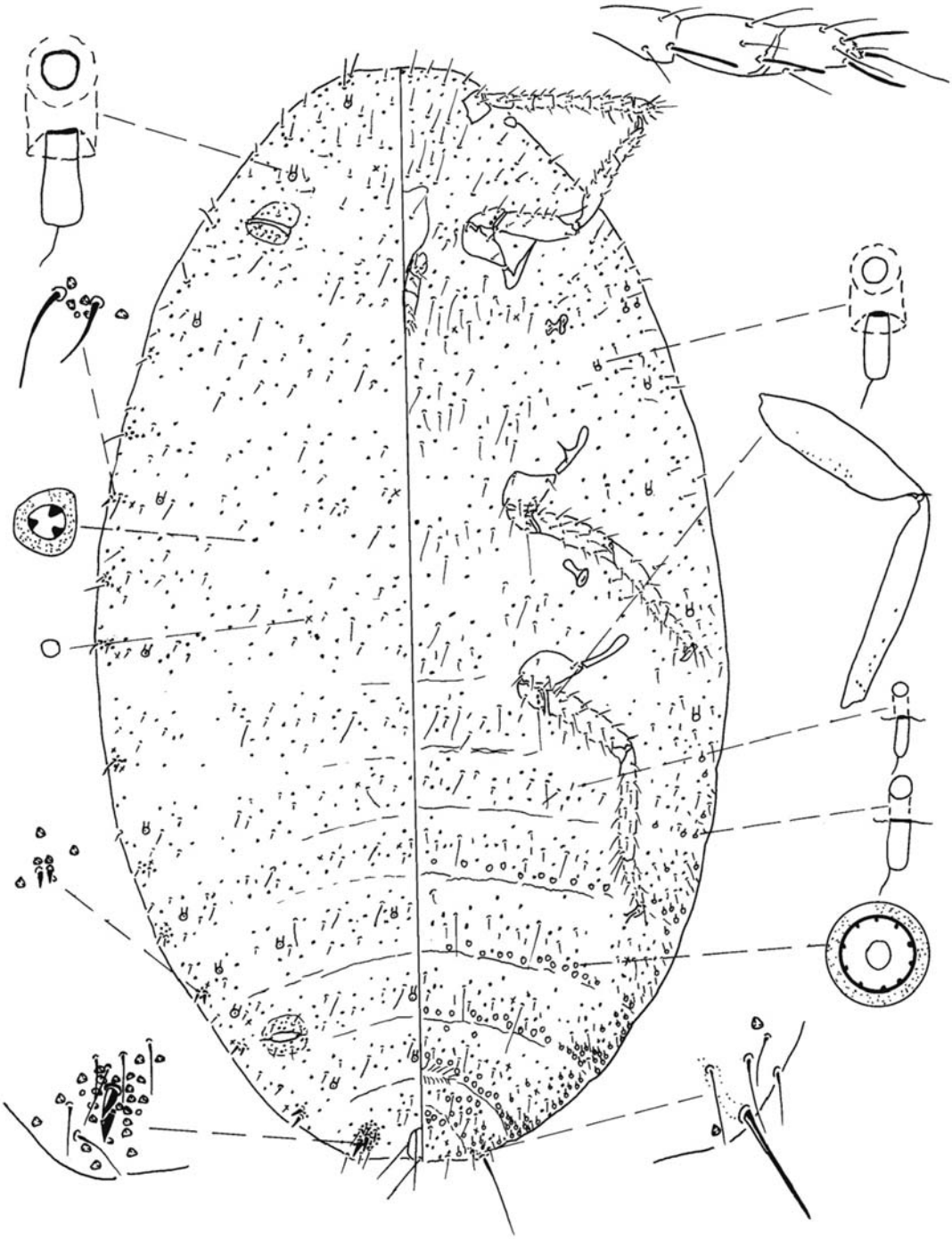

Fig. 10. *Delottococcus proteae*. Zimbabwe, Inyazura, 20.iv.32 and 24.iv.32, on *Protea* sp., W.J. Hall.

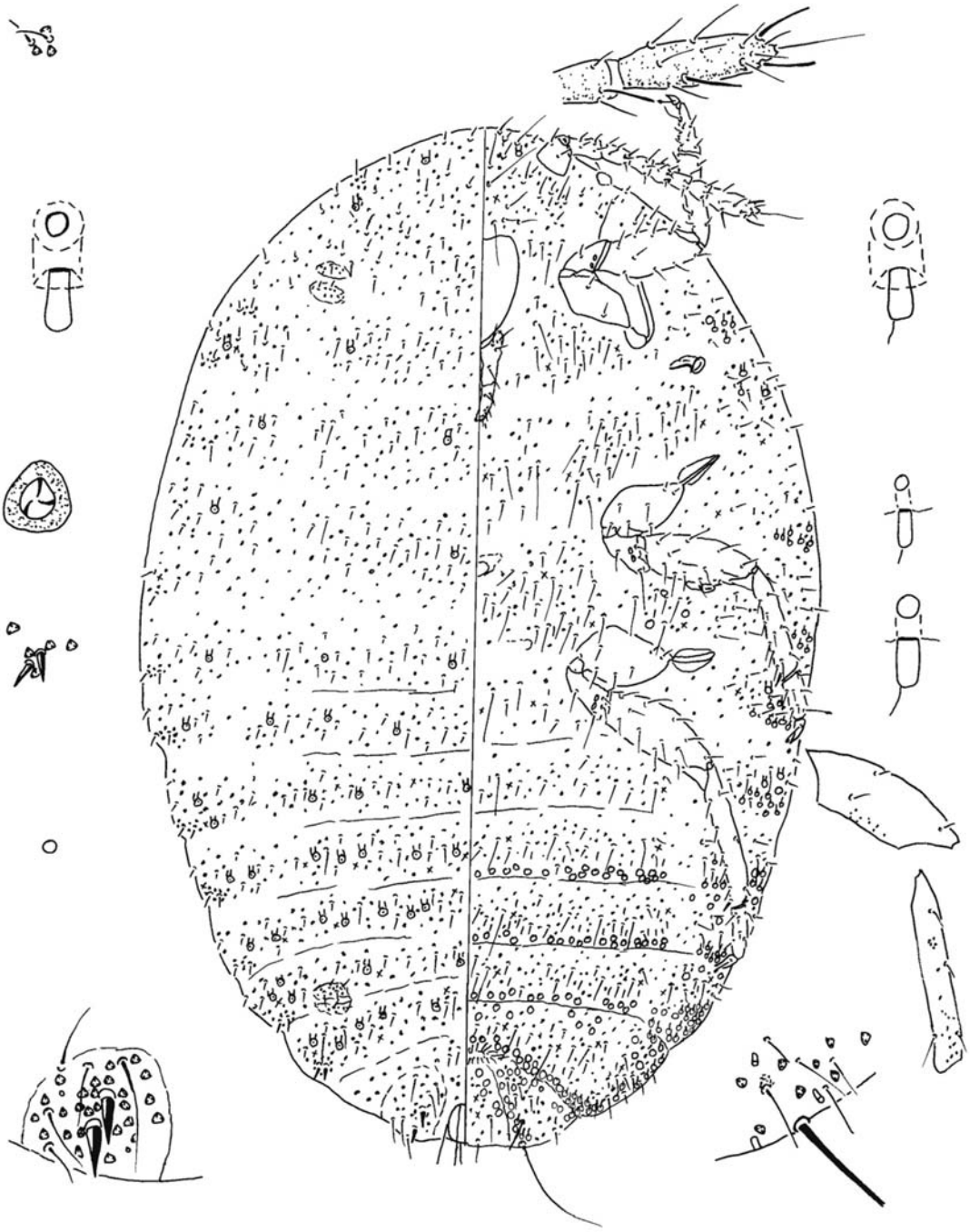

Fig. 11. *Delottococcus quaesitus*. South Africa, Gauteng Province, Pretoria, ?.ix.1914, on *Acacia caffra* and *A. robusta,* C.K. Brain.

the specimens used for the description are considered to be syntypes and a lectotype adult female is here designated to clarify the status of the species. It is selected from material in SANC that is labelled: left label on front of slide 'Pseudococcus/ quaesitus/ Brain/ SYNTYPES' right side of front of slide has '10–11' and a circular coverslip with '60./ C.K.B.' inscribed beneath it. The back of the slide has a label that reads: 'Delottococcus/ quaesitus (Brain)/ LECTOTYPE/ largest spm. on right' and a second label that states 'C.K.B. No. 60/ S. Afr: Transvaal/ Pretoria:/ Sept. 1914/ ex: Acacia/ caffra & robusta/ coll.: C.K. Brain.' The envelope containing the slide gives the following information '*quaesitus* Brain/ 60/ ex. *Acacia caffra* & *robusta*/ *Pseudococcus* 10–11.' In addition to the lectotype and the paralectotype mentioned above there are seven slides containing nine paralectotype adult females, one slide containing an adult male, and two slides with numerous first instar nymphs (the first-instar nymph and male slides with data 'Larvae of/ *Pseudococcus*/ *quaesitus* Brain/ Pretoria: Nov. 1914') and 1 slide containing 2 ad. ♀ with data 'Pink mealybug with/ solitary one C.K.B. 65/ on Acacia sp./ Pretoria, Oct. 15, 1914.' in SANC and six slides containing 10 paralectotype adult females in the USNM. These slides are all part of the Pretoria-collected syntypes. Material from the Grahamstown collection have the left label: '*Pseudococcus*/ *quaesitus* Brain/ Acacia horrida/ Grahamstown/ Jan. 1899./ Dry material.' and includes 3/6 ad. ♀ in SANC and 2/2 ad. ♀ in USNM.

Field characters. Brain (1915) wrote 'The ovisacs are often collected into masses … and present a pinkish tinge.… Seen singly … the ovisacs are usually more or less button-shaped, with straight vertical sides and a rounded top. The largest observed measured approximately 3 mm. in diameter. Ova: bright orange.… Larva at first orange-yellow … later pinkish.… Adult ♀ may reach 4 mm .… pinkish at first and later purplish, with dense, white, powdery secretion. Lateral filaments short and fragile. Caudal filaments two in number, stout, may attain one-third the length of the body. The male puparia are apparently hidden amongst the clusters of ♀ ovisacs. [The adult males] were … with the head brown … but the whole insect was … densely powdered. They have two caudal filaments.' Brain found heavy infestations of the species in holes in acacia trees that were attended by ants. He wrote 'It was remarkable that although there were hundreds of female insects in the holes none were observed on the twigs of the tree itself.'

Slide-mounted characters. Mounted 2.2–2.6 mm long, 1.5–2.2 mm wide.

Dorsum. With 9–14 pairs of definite cerarii; anal-lobe cerarius weakly sclerotized, other cerarii unsclerotized. Trilocular pores arranged in segmental rows, discoidal pores about half size of triloculars, interspersed with triloculars. Oral-rim tubular ducts with weakly developed rim or rim absent, abundant over most of surface, usually absent or rare in medial areas of thorax, segment V with 9–19 ducts, VII with 8–13 ducts, usually with one or more ducts near position of frontal cerarius, with or without duct near position of cerarius 13. Body setae variable, longest near posterior end of abdomen, longest seta on segment VII 24–38 μm long. Longest anal-ring seta 107–124 μm long, 1.2–1.5 times greatest diameter of ring.

Venter. Multilocular disk pores present on segments II, III or IV–VIII, present on anterior margins of segments VII and VIII, with 0–3 on thorax, submarginal pores usually relatively abundant often with more than 20 on each side of body. Trilocular and discoidal pores in segmental rows over surface. Oral-rim tubular ducts smaller than on dorsum, with 6–13 on each side of body from anterior spiracle to segment II, often with duct on head near position of frontal cerarius. Oral-collar tubular ducts of two sizes, larger ducts present in conspicuous clusters near body margin, smaller ducts present in medial and mediolateral areas of thorax and abdomen, absent from head; with 0–1 oral-collar near each cerarius 12, with 2–9 near each cerarius 13. Labium 162–202 μm long. Antennae 394–480 μm long, 8-segmented, apical segment sometimes partially divided. Hind femur with 14–18 setae, with 6–27 translucent pores, hind tibia with 12–40 pores, hind tibia sometimes slightly swollen. Hind tibia 216–288 μm long, hind tarsus 94–111 μm, tibia/tarsus 2.0–2.7.

Notes. This species is most similar to *Delottococcus proteae* by having translucent pores on the hind femur, oral-collar tubular ducts near cerarius 13, and 14 or fewer pairs of cerarii. *Delottococcus quaesitus* differs by having: (characters in brackets are those of *D. proteae*) five or more ventral submarginal multilocular pores on each side of abdomen, usually more than 10 (submarginal multilocular pores normally absent, rarely with up to three), dorsal setae on segment VII 24–38 μm long (40–60 μm), 9–19 oral-rim tubular ducts on

dorsum of abdominal segment V (three or four ducts).

For a comparison of *D. quaesitus* with *D. phylicus* see the comparison section of that species.

Type material. The original description included type material from two localities, *i.e.* Pretoria on *Acacia caffra* and *A. robusta* (Brain no. 60 & 65) and Grahamstown on *A. horrida* (63, mounted from dry material collected in 1899).

Material examined. All specimens in SANC unless indicated otherwise. SOUTH AFRICA: *Eastern Cape*: Grahamstown, on *Acacia horrida,* C.P. Lounsbury, ?.i.1899, 3/6 ad. ♀ SANC, 2/2 ad. ♀ USNM (no. 63). *Gauteng*: Mara, on *Acacia* sp., G.L. Prinsloo, 16.iv.1972, 1/1 ad. ♀ (4729); Pienaarspoort, on *Acacia karoo,* C.J. Cilliers, 17.x.1963 & 14.xi.1963, 5/5 ad. ♀ (803, 805); Pienaarspoort, on *Acacia karoo,* C.J. Cilliers, 20.v.1963, 1/1 ad. ♀ (1314); Pretoria, on *Acacia caffra* & *A. robusta,* C.K. Brain, ?.ix.1914, 5/9 ad. ♀ SANC 6/10 ad. ♀ USNM. (60); Pretoria, on *Acacia* sp, C.K. Brain, 15.x.1914, 1/1 ad. ♀ (65); Pretoria, on *Acacia* sp, C.K. Brain, 14.xi.1914, 1/1 ad. ♂, 2/ numerous 1st instar nymphs (60); Pretoria, on *Acacia* sp., G. De Lotto, 16.i.1957, 1/1 ad. ♀ (654); Pretoria, on *Acacia* sp., G. De Lotto, 16.i.1957, 1/1 ad. ♀ (654); Pretoria, on *Acacia karoo,* G. De Lotto, 17.iii.1964, 2/2 ad. ♀ (822); Pretoria, on *Acacia* sp., G. De Lotto, 11.viii.1963, 3/3 ad. ♀ (1328); Pretoria, on *Acacia* sp., M.J. Mynhardt, 13.xi.1965, 1/1 ad. ♀ (1974); Pretoria, on *Acacia* sp., P. Lesley, 26.iii.1972, 1/1 ad. ♀ (4737); Silverton, on *Acacia* sp., G. De Lotto, 9.xi.1964, 2/2 ad. ♀ (918). *KwaZulu-Natal*: Hluhluwe, on *Acacia* sp., Y. Ben-Dov, 2.iii.1972, 1/1 ad. ♀ (4943). *Limpopo*: Vivo, on *Acacia stuhlmannii,* S.J. von Tonder, 20.xii.1978, 1/1 ad. ♀ (5522); Wolkberg, on *Acacia heteracantha,* C.J. Cilliers, 14.iv.1964, 2/2 ad. ♀ (842). *Mpumalanga*: Barberton, on *Acacia* sp., C.J. Joubert, ?.vi.1927, 2/2 ad. ♀ (641); Barberton, on *Acacia* sp., G. De Lotto, 15.vi.1965, 2/2 ad. ♀ (1074); Barberton, on *Ficus* sp., G. De Lotto, 15.vi.1965, 1/1 ad. ♀ (1061); Mataffin, on *Acacia* sp., C.J. Joubert, ?.iv.1928, 2/2 ad. ♀ (644); Nelspruit, on *Acacia* sp., G. De Lotto, 2.x.1963, 2/2 ad. ♀ (747). *Northern Cape*: Jan Kempdorp, on *Acacia heteracantha,* G.L. Prinsloo, 16.iii.1972, 3/3 ad. ♀ (4943 & 4731).

Delottococcus trichiliae (Brain), Fig. 12

Pseudococcus trichiliae Brain, 1915: 131 (original designation).

Allococcus trichiliae; Ezzat & McConnell 1956: 19 (comb. n.).

Delottococcus trichiliae; Cox & Ben-Dov 1986: 488 (comb. n.); Ben-Dov 1994: 114; Millar 2002: 197; Ben-Dov 2010.

Field characters. Brain (1915) wrote 'Adult ♀ spinning ovisac, approximately 4 mm. long, pale olivaceous in colour, uniformly covered with white meal. Lateral filaments absent. Caudal filaments 2; strong, white, about one-third the length of the body. In removing insects from ovisacs these are usually broken off, so that the majority appear to have no caudal filaments. Half-grown females usually have 4 to 6 caudal filaments, the two median ones longest and thickest. Ovisac: The ovisac, when completed, is an elongate sac, which may attain 6 mm. long. It appears longer owing to the projection of the anterior half of the insect in front. The posterior half of the ♀ is hidden by the ovisac which has parallel sides, is but slightly broader than the insect, and is broadly rounded behind. It is white and cottony, reminding one of the ovisac of a *Pulvinaria.*'

Brain (1915) also commented on the economic importance of the infestation in Durban. He quoted a letter from F.G. Churchill as follows: 'My attention has been drawn to an insect blight on many of the large shady Umkuhlu-trees in the grounds and avenues in Durban — some looked as if seriously injured by it. It begins on the main trunk and works its way up and outwards to the young top shoots, which eventually become white with it.' Brain also quotes Fuller who says that 'the trees, when badly infested, are quite conspicuous, and that predaceous or parasitic insects must become numerous, for the serious infestation of the trees disappears, almost suddenly, about January.'

Slide-mounted characters. Mounted 1.4–4.1 mm long, 0.9–2.3 mm wide.

Dorsum. With 17 or usually 18 pairs of definite cerarii; anal-lobe cerarius sclerotized, other cerarii weakly sclerotized. Trilocular pores arranged in segmental rows, discoidal pores about half size of triloculars, interspersed with triloculars. Oral-rim tubular ducts with weakly developed rim or rim absent, abundant over most of surface, usually absent or rare in medial areas of thorax, segment V with 10–18 ducts, VII with 11–16 ducts, with one or more ducts near frontal cerarius, usually with a duct near position of cerarius 13. Body setae variable, longest near posterior end of abdomen, longest seta on segment VII 24–38 μm long. Longest anal-ring seta 153–246 μm long, 1.3–2.1

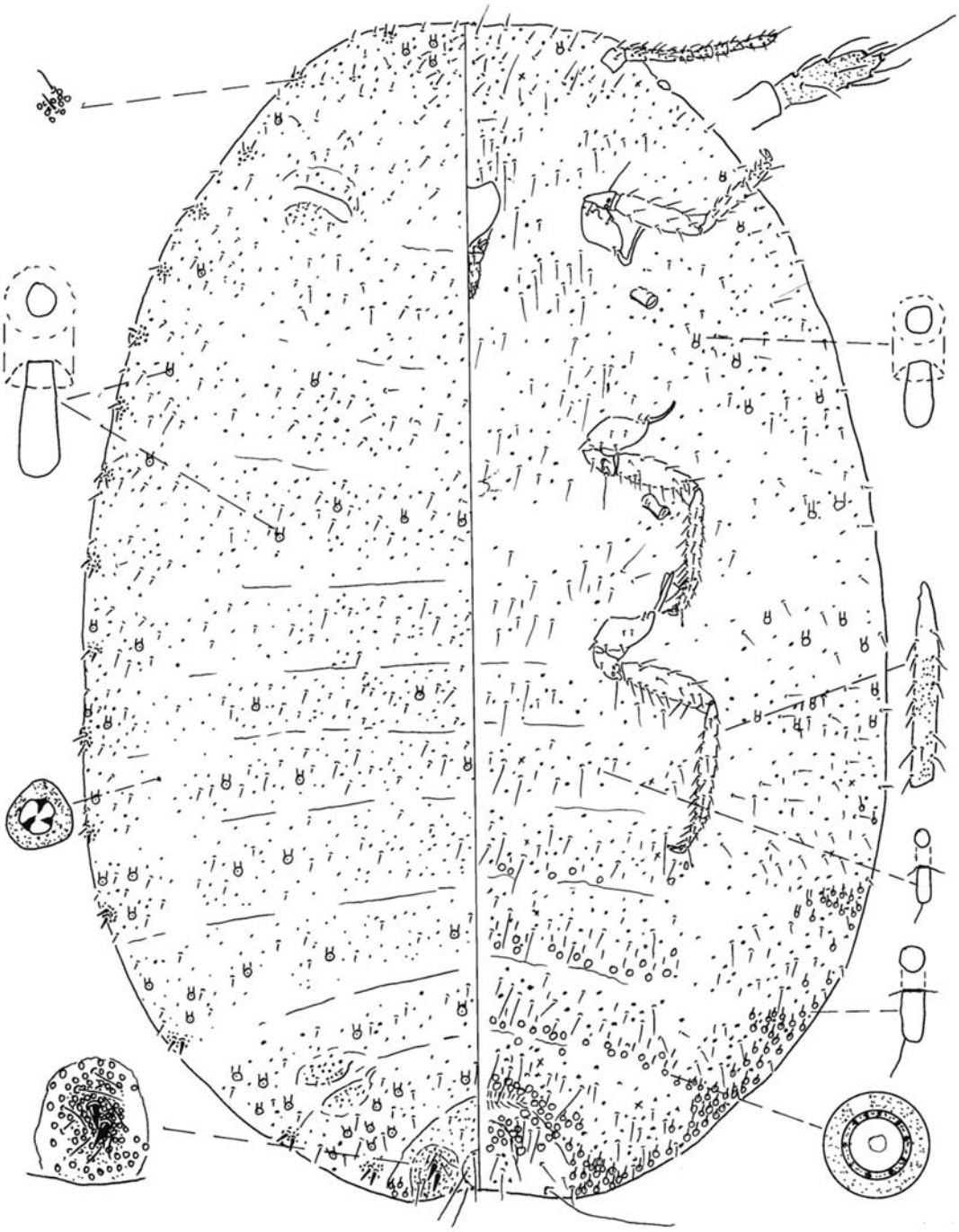

Fig. 12. *Delottococcus trichiliae*. South Africa, KwaZulu-Natal Province, Durban, 27.x.1914, on *Trichilia* sp., collector probably C. Fuller.

times greatest diameter of ring.

Venter. Multilocular disk pores present on segments III or IV–VIII, present on anterior margins of segments VII and VIII rarely on VI, with 0–3 on thorax, submarginal pores usually absent, rarely with 1–2 on each side of body. Trilocular and discoidal pores in segmental rows over surface. Oral-rim tubular ducts smaller than on dorsum, with 15–38 on each side of body from anterior spiracle to segment II, often with one or more ducts on head near position of frontal cerarius. Oral-collar tubular ducts of two sizes, larger ducts present in conspicuous clusters near body margin, smaller ducts present in medial and mediolateral areas of thorax and abdomen, absent from head; without oral-collars near cerarius 12 or 13 (be aware of oral rims with indefinite rims in this area). Labium 150–208 μm long. Antennae 500–675 μm long, 8-segmented, apical segment usually partially divided. Hind femur with 20–26 setae, without translucent pores, hind tibia with 37–56 pores, hind tibia not swollen. Hind tibia 304–410 μm long, hind tarsus 118–140 μm, tibia/tarsus 2.6–2.9.

Notes. This species is most similar to *Delottococcus elisabethae* by lacking translucent pores on the hind femur, with less than 70 translucent pores on the hind tibia, with 17 or 18 pairs of cerarii, and without oral-collar tubular ducts near cerarius 13. *Delottococcus trichiliae* differs by having: (characters in brackets are those of *D. elisabethae*) cerarian setae on head and thorax more conical than dorsal setae (some cerarian setae thin similar to those on dorsum of thorax), antennae longer than 500 μm (less than 500 μm), femur with 20–26 setae (13–20 setae), 15–38 ventral oral-rim tubular ducts on each side of body from anterior spiracle to segment II (6–10 ducts).

Specimens in the type series are in poor condition because they were overcooked and are poorly stained.

De Lotto (1958) incorrectly considered this species to be a junior synonym of *Pseudococcus* (=*Delottococcus*) *quaesitus.*

Type material. The original description included type material from 2 localities, *i.e.* Durban on *Trichilia* and Cape Town on 'silver-leaf tree,' *Leucadendron argenteum.* Although we have been unable to locate the syntype material of the latter, we have examined material collected at the same locality on the same host but on 21 August 1914 rather than 31 October 1914. This material is not *D. trichiliae* but *D. confusus.* De Lotto (1977) noted this discrepancy and considered the silver leaf specimens to belong to *D. confusus.*

Because the original description of *P. trichiliae* does not mention the word 'type' or 'holotype,' the specimens used for the description are considered to be syntypes and an adult female lectotype is here designated to clarify the status of the species. It is selected from material in SANC that is labelled: left label 'Pseudococcus/ trichiliae Brain/ on *Trichilia* sp./ Durban. 27.x.14/ -Paratype-/ PARATYPE/ 2/' right side of slide has a circular coverslip with 'B.51./ C.K.B.' inscribed beneath it. The back of the slide has a label that reads: 'Delottococcus/ trichiliae (Brain)/ LECTOTYPE.' The envelope containing the slide gives the following information '*trichiliae* Brain....B:51/ ex. *Trichilia* sp./ *Pseudococcus* 2.' In addition to the lectotype there are five slides containing seven paralectotype adult females and numerous first instar nymphs in SANC and six slides containing seven paralectotype adult females in the USNM.

Material examined. All specimens in SANC unless indicated otherwise. SOUTH AFRICA: *Gauteng*: Pretoria, on *Protea caffra,* G. De Lotto, 15.viii.1963, 9/9 ad. ♀ (no. 1326); Pretoria, on *Protea caffra,* G. De Lotto, 7.i.1970, 2/2 ad. ♀ (4118); *Eastern Cape*: Addo, on *Canthium subovatum,* G. De Lotto, 7.xii.1963, 3 /3 ad. ♀ (783); East London, on *Mimusops caffra,* G. De Lotto, 13.v.1963, 3/3 ad. ♀ (1305); Hogsback, on *Xymalos monospora,* D.P. Annecke, 30.x.1968, 6/6 ad. ♀ (3389); *KwaZulu-Natal*: Durban, on *Trichilia* sp., collector ? (probably C. Fuller), 27.x.1914, 12/16 ad. ♀, 1/many 1st (B.51) (7 slides in USNM); Durban, on *Trichilia emetica,* G. De Lotto, 24.viii.1964, 3/3 ad. ♀ (886); Durban, on *Mimusops caffra* and *Trichilia emetica,* G. De Lotto, 26.viii.1963, 4/4 ad. ♀ (888, 897); Port Edward, on *Mimusops* sp., S. Neser, 6.viii.1974, 4/4 ad. ♀ (5056); Tongaat, on *Carissa* sp., P. Lesley, 17.ix.1970, 2/2 ad. ♀ (4433); Warner Beach, on *Psidium guajava,* P.C. Wentzel, 22.vii.1964, 2/2 ad. ♀ (873).

KEY TO SPECIES OF *DELOTTOCOCCUS*

(Adult females)

1. Translucent pores present on hind femur (usually small, inconspicuous near posterior margin when femur is oriented as illustrated (Figs 1, 2, 5, 8, 9, 10, 11) 2
— Translucent pores absent from hind femur (Figs 3, 4, 6, 7, 12) 7
2(1) With 1 or more oral-collar tubular ducts laterad of anterior spiracle (ignore oral rims) 4

— Without oral-collar tubular ducts laterad of anterior spiracle 3
3(2) Hind femur with less than 50 translucent pores; usually without multilocular pores on segment III . . . . . *phylicus* (De Lotto)
— Hind femur with 50 or more translucent pores; with many multilocular pores on segment III . . . . *confusus*? (De Lotto) (in part)
4(2) Multilocular pores absent from anterior margin of abdominal segments IV or V; with fewer than 10 multilocular pores on thorax 5
— Multilocular pores present on anterior margin of abdominal segments IV or V; with more than 10 multilocular pores on thorax . . . . . *millari* Miller & Giliomee, sp. n.
5(4) Multilocular pores absent from submarginal areas of abdominal segments 6
— Multilocular pores present in submarginal areas of some abdominal segments . . . . . *quaesitus* (Brain)
6(5) Thoracic and head cerarian setae not unusually elongate; usually with 15–18 pairs of cerarii. . . . . *aberiae* (De Lotto)
— Some of thoracic and head cerarian setae unusually elongate; with 14 or fewer pairs of cerarii . . . . . *proteae* (Hall)
7(1) With fewer than 20 multilocular pores in submarginal areas of abdomen 8
— With more than 20 multilocular pores in submarginal areas of abdomen . . . . . *euphorbiae* (Ezzat & McConnell)
8(7) Less than 70 translucent pores on hind tibia; hind tibia straight sided or slightly swollen 9
— More than 70 translucent pores on hind tibia; hind tibia usually conspicuously swollen . . . . . *confusus* (De Lotto) (in part)
9(8) Antennal length about 500 μm or more; 20–26 setae on hind femur; cerarian setae on head and thorax noticeably more conical than dorsal setae . . . . . *trichiliae* (Brain)
— Antennal length usually about 400 μm or less; 13–20 setae on hind femur; some cerarian setae on head and thorax slender, similar in shape to dorsal setae . . . . . *elisabethae* (Brain)

CONCLUSIONS

As mentioned in the introduction, the large amount of morphological variation in species of *Delottococcus* makes it difficult to diagnose the genus. However, characters that are useful for identification of most specimens are: the presence of an anal bar; presence of oral-rim tubular ducts, often without a definite rim; presence of abdominal cerarii with no more than two conical setae and no auxiliary setae; presence of translucent pores on hind tibia; absence of translucent pores on hind coxa; and absence of a circulus.

This is a difficult group of mealybugs to identify. It would be highly beneficial to develop molecular data that might facilitate the identification process.

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