

## Taxonomic revision of the South African mealybug genus *Octococcus* Hall (Hemiptera: Pseudococcidae)

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A taxonomic revision of the South African mealybug genus *Octococcus* Hall is presented. Most species of this genus feed on plants in the Asteraceae. Six species are treated, namely, *O. barbarae*, *O. gullanae*, and *O. warniae* which are described as new. The three previously described species are: *Octococcus africanus* (Brain), *O. minor* De Lotto, and *O. pentziae* Hall. *Octococcus salsolicola* (Priensner & Hosny), which was described originally as *Ripersia salsolicola*, is treated as a *nomen dubium*. Adult females of all species are described and illustrated and a key for their identification is presented. Illustrations and descriptions are also presented of first-instar nymphs of *Octococcus africanus*, *O. minor*, and *O. warniae* and a key for their identification is presented. Descriptions and illustrations are also given for a second-instar nymph of *O. africanus* and a third-instar nymph of *O. warniae*.

**Key words:** *Octococcus*, Pseudococcidae, mealybugs, immatures, new species, South Africa.

### INTRODUCTION

*Octococcus* was described by Hall (1939) for *O. pentziae*, which he described as new, and for *Puto africanus* Brain, both from South Africa on plants in the daisy family (Asteraceae). Hall used the name 'octo' for the eight setae associated with the anal ring, a character state that is atypical of mealybugs, which generally have six anal-ring setae. Hall recognised that the posterior pair was not a true anal-ring seta but thought that its close association with the anal ring was unusual enough to name the new genus *Octococcus* for the eight setae on or near the anal ring. The posteriormost setae are what Ezzat & McConnell (1956) called suranal setae. Earlier, Brain (1915) was persuaded that the four pairs of setae associated with the anal ring in combination with the presence of nine-segmented antennae were sufficient for him to place the species that is now *Octococcus africanus* (Brain) in the genus *Puto*. Ferris (1918) did not agree with this placement, but did not transfer it to another genus. *Puto africanus* was redescribed and reillustrated by De Lotto (1958) based on two poorly prepared type specimens. He described the species again (De Lotto 1977) based on better-prepared type specimens deposited in the Smithsonian's U.S. National Museum of Natural History and based on additional material collected in

South Africa. In 1962 Ezzat transferred *Ripersia salsolicola* Priensner & Hosny to *Octococcus* based on examination of the only known specimen in The Natural History Museum in London. De Lotto (1969) described a fourth species in the genus (*Octococcus minor* De Lotto). He agreed with Williams (1958) and Hall (1939) that the extra pair of setae associated with the anal ring were not true anal-ring setae but pointed out that the unusual structure of the large-sized oral-rim tubular ducts warranted maintaining the genus as valid.

### MATERIAL AND METHODS

Specimens are mounted in Canada 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.

Letter designations on the illustrations are as follows: a = antenna, b = trilocular pore, c = small tubular duct, d = dorsal seta, e = lanceolate or conical seta, f = anal-lobe cerarius, g = anal ring, h = multilocular pore, i = leg, j = large tubular duct, k = discoidal pore, l = second cerarius, m = ventral seta, n = fourth cerarius, o = pores near hind coxae, p = unusual sclerotisation.

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(present in *Trabutina*); having normal eighth abdominal segment (enlarged); few long setae around anal ring (many); complete anal ring (incomplete); clubbed tarsal digitules (simple); oral-rim tubular ducts present (absent); oral-collar tubular ducts absent, replaced by oral rims (present). *Octococcus* also is similar to *Hypogeococcus* Rau in the adult female by having a reduced number of cerarii; conical or lanceolate setae on the posterior dorsum of the abdomen; eye normally located on the dorsum; and setae on the anterior margin of the antennae are enlarged. *Octococcus* differs (character states given in brackets are those of *Hypogeococcus*) by having trilocular pores (usually absent); anterior ostioles usually absent (present); anal ring of normal size for a pseudococcid (greatly enlarged); and circulus absent (usually present). *Octococcus* also is similar to *Hypogeococcus* (Miller 1983) and *Trabutina* (Danzig & Miller 1996) in the immature instars by having tubular ducts on all but the first instar.

Newly moulted adult females of *Octococcus* are surprisingly small; many of the specimens studied were of a size that in most mealybugs would be immature. Immature stages were difficult to locate in the field, at least when collecting *O. warniae* at two different times of the year. Based on this evidence, we suspect that female specimens of *Octococcus* develop to adults very quickly.

It is unclear exactly when the thick white sac is formed, but it appears that at least the second- and third-instar females and second-instar males develop this sac, in addition to the adult female. We suspect that the oral-rim tubular ducts are important in the formation of the sac and since they occur in all but the first instar, this is supporting evidence for the sac-forming hypothesis in the immatures. Species of both *Hypogeococcus* and *Trabutina* also possess tubular ducts in the immature stages excluding the first-instar nymph and most likely also produce a wax covering similar to the adult female. It is likely that other members of the *Trabutini* have similar habits and morphology.

In most pseudococcids the second-instar male can be distinguished from other immature instars by having tubular ducts present at least on the dorsum. These ducts are important in forming the sac that encloses the second-instar male, prepupa, and pupa during their development. In the case of *Octococcus*, we have been unable to find differences in the second-instar males and females. Unfortunately, we have a small series of second-instar

nymphs but all have conspicuous tubular ducts arranged in a similar pattern. We have examined seven specimens from two localities collected at different times of the year that are in the process of moulting from the first to second instar and all seem to possess the same arrangement of tubular ducts. It is possible, but unlikely, that all of the second-instar specimens examined are male.

#### ***Octococcus africanus* (Brain), Figs 1–4, Plate 1**

*Puto africanus* Brain, 1915: 151 (original designation); Ferris, 1918: 62; De Lotto, 1958: 115.

*Octococcus africanus*; Hall 1939: 93 (change of combination); Afifi 1968: 151 (misidentification of *O. minor*; we have examined adult females associated with the males described by Afifi and conclude that they are representatives of *O. minor*); De Lotto 1977: 30; Ben-Dov 1994: 258; Millar 2002: 201, 219; Hardy *et al.* 2008: 57 (partial misidentification; Hardy *et al.* accepted the incorrect determination of the adult male of Afifi (1968) and used the characteristics of the adult male in their character matrix; the character states given for the adult female and first-instar nymph pertain to *O. africanus*).

*Type material.* The original description does not mention a type or holotype, so a lectotype is here designated. We have selected as lectotype an adult female mounted on a slide with one other adult female (specimen nearest slide label is the lectotype) that was labelled as 'Paratypes' by Brain. Left label '*Puto africanus* Brain/ on *Tamarix articulata*/ Vahl./ Cape Town./ Jan. 1898./ -Paratype-'. Right label under separate small slide cover '1-2' and under large slide cover 'B. 70. C. K. B.' A 'Lectotype' label has been placed on the slide, which is deposited in SANC. In addition there are three other paralectotype slides in SANC each containing one adult female, and four paralectotype slides are in USNM, two containing two adult females and two containing one adult female. All specimens are from the same series.

*Additional material examined.* SOUTH AFRICA: Northern Cape: Kamiesberg, NW of Doornkraal, Langkloof Pass, 30°32'S 18°08'E, 750 m, on *Elytropappus rhinocerotis*, 7.x.2005, P.J. Gullan, 4/4 ad. fem. (SANC); Western Cape: Albertinia, on *Stoebe vulgaris*, 9.iii.1970, P. Insley, 7/7 ad. fem. (SANC 4123 1–7); Bonnievale, Merwesfont Farm, on *E. rhinocerotis*, 12.ii.2006, J.H. Giliomee, 3/3 ad. fem. (SANC); Cederberg Mountains, 1.5 km S. of

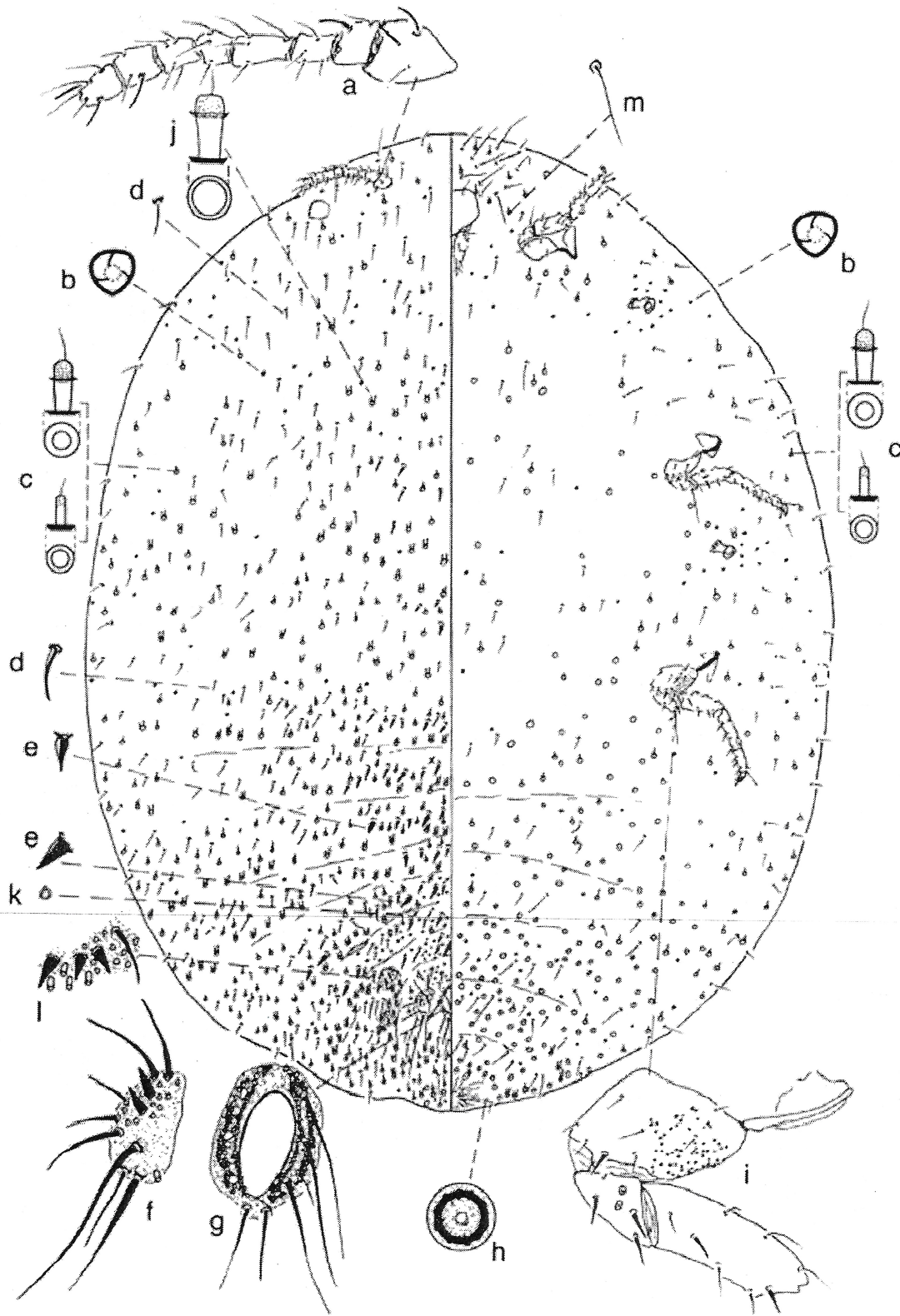
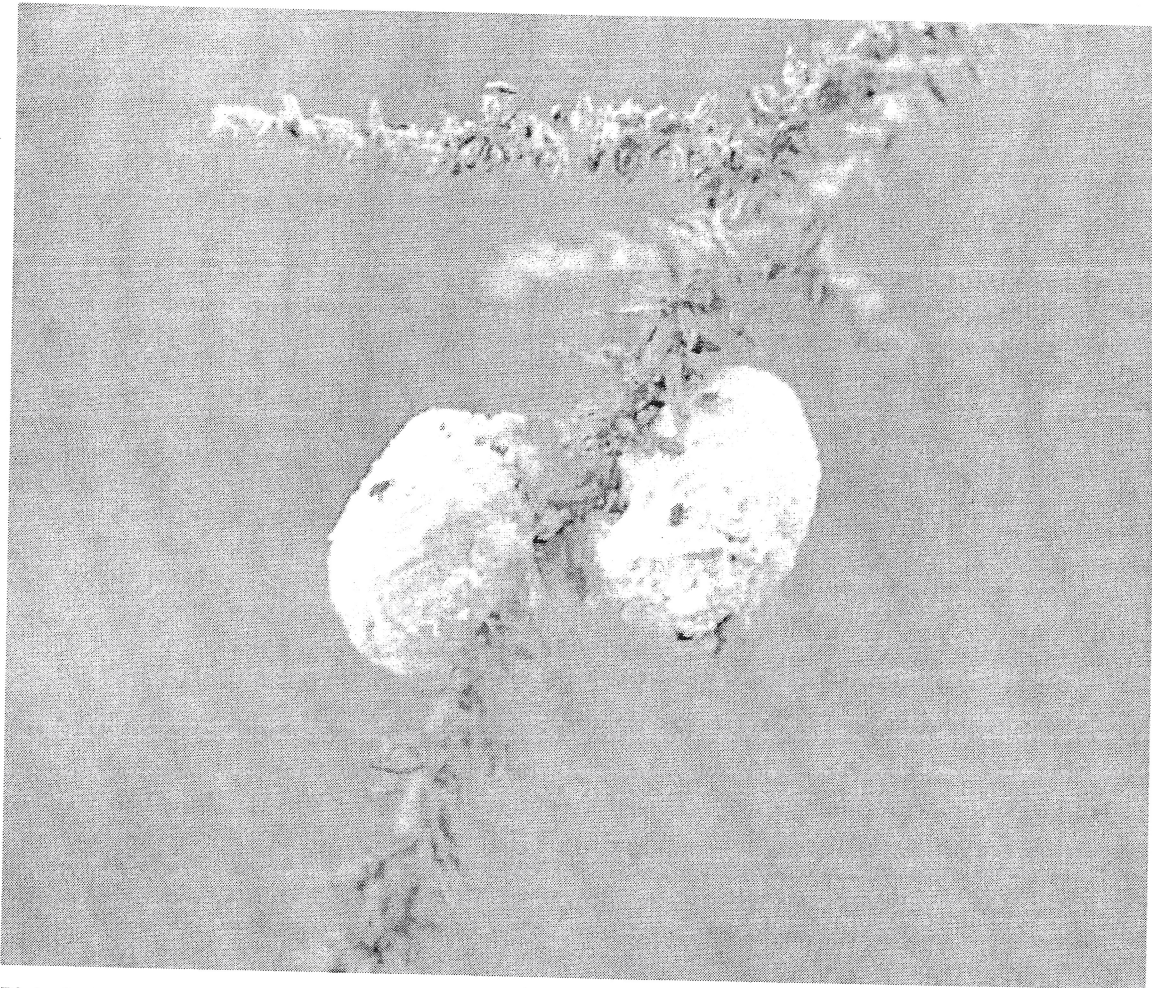


Fig. 1. *Octococcus africanus*. Fully mature adult female. Cape Town, Western Cape, South Africa, ?i.1898, on *Acacia articulata*, C.K. Brain.



**Plate 1.** *Octococcus africanus*. Two adult females in white waxy sacs and first-instar nymphs on host. Du Toit's Kloof, Western Cape, South Africa, 9.i.2004, on *Stoebe plumosa* stem, P.J. Gullan & J.H. Giliomee. [Photograph by P. Gullan.]

partially divided. Hind coxa with 10–85 small translucent pores, zero to six pores on femur, zero to three pores on hind tibia; femur with five to 12 setae, tibia with six to 16 setae; coxa with one to three setae noticeably larger than other leg setae, trochanter with three such setae, femur with four such setae; tarsal and claw digitules with slightly enlarged apices; apices of tibial digitules on front leg variable, sometimes with one seta with enlarged apex and other seta without acute apex, other times both digitules with enlarged apex. Hind trochanter + femur 150–242  $\mu\text{m}$  long, tibia 100–180  $\mu\text{m}$ , hind tarsus 72–112  $\mu\text{m}$ , tibia/tarsus 1.6–1.8. Without small pores on derm adjacent to hind coxa.

*Notes.* This species is most similar to *Octococcus barbarae* and *O. minor* by possessing dorsal lanceolate setae on the posterior abdominal segments.

*Octococcus barbarae* differs (character states in brackets are those of *O. africanus*) by having dorsal multilocular pores present (absent) and by possessing more than three conical setae in the anal-lobe cerarius (two or three in *O. africanus*). *Octococcus minor* differs by having dorsal multilocular pores present (absent) and by having the large-sized dorsal oral-rim tubular ducts in small numbers, generally restricted to a medial and two lateral longitudinal lines on the abdomen (large-sized dorsal oral-rim tubular ducts numerous, forming transverse rows across the abdominal segments, not restricted to medial and lateral areas).

*Octococcus africanus* is quite variable; at one point we hypothesised that it included two species, but we were unable to find characters that would consistently separate the species. Two populations (De Doorns and Kamiesberg) usually have small

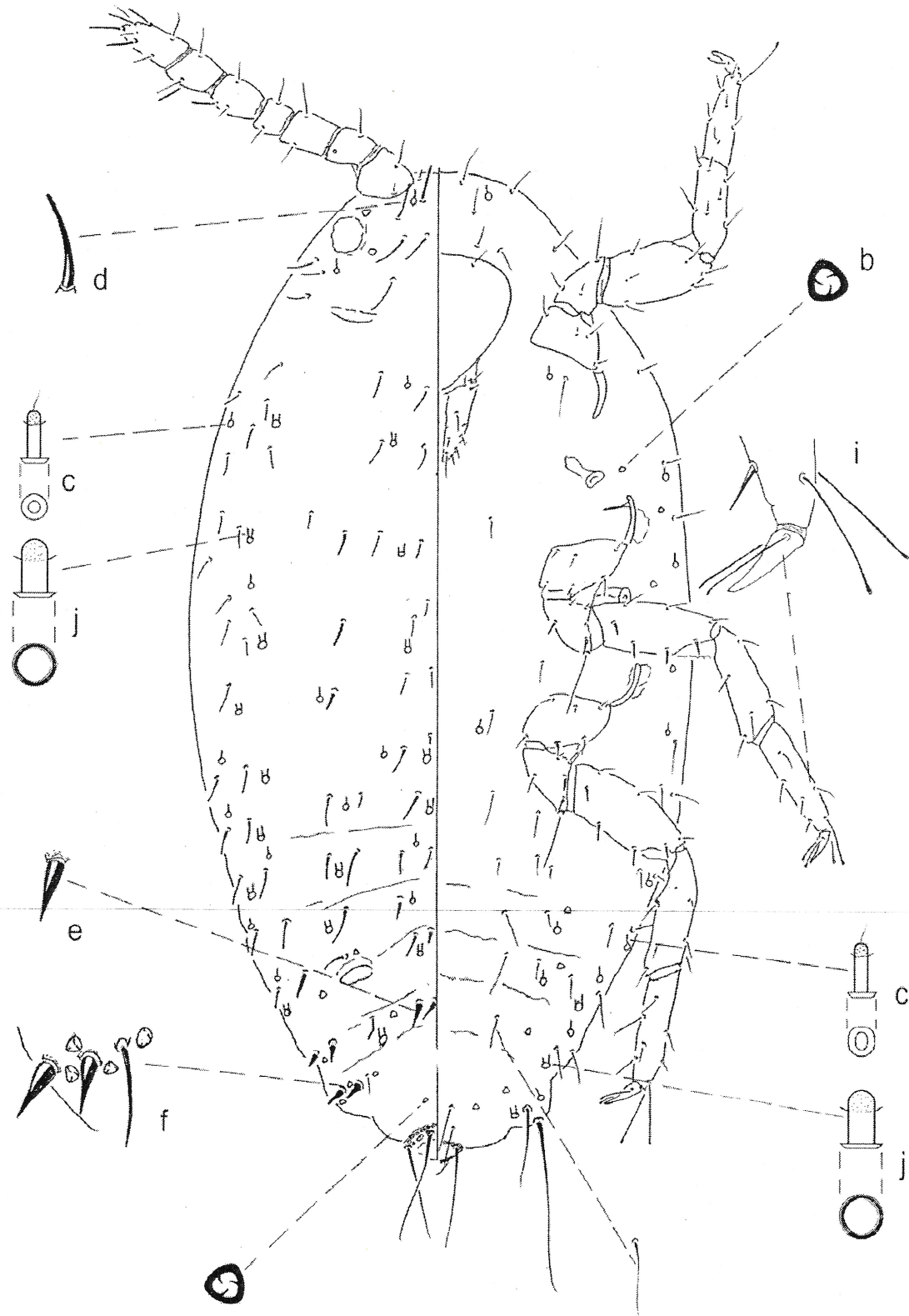


Fig. 3. *Octococcus africanus*. Second-instar female. Du Toit's Kloof, Western Cape, South Africa, 9.i.2004, on *Stoebe plumosa* stem, P.J. Gullan & J.H. Gillomee.

anal ring white, longer than lateral wax filaments.

*Slide-mounted characters.* Mounted 0.4–0.6 mm long, 0.2–0.4 mm wide.

*Dorsum.* Body with posterior segments normal, not folded; cerarii near body margin, not displaced medially; anal-lobe area at apex of abdomen. With two pairs of definite cerarii, additional six pairs of elongate setae present forward to anterior abdominal segment; anal-lobe cerarius unsclerotised, not on prominence, with two conical setae, one seta often shorter and thinner, no auxiliary seta, usually with one basal trilocular pore, sometimes absent. Penultimate cerarius in line with anal-lobe cerarius, without basal sclerotisation, not protruding, with two conical setae, one seta often shorter and thinner, no auxiliary setae, and with or without one basal trilocular pore. Suranal setae near apex of abdomen, longest close to, but not touching anal ring, with four setae. Trilocular pores usually present in submedial area of segment VIII, submedial area of prothorax, and laterally on head, sometimes present submedially on segment I, metathorax, and mesothorax, laterally on mesothorax, prothorax, and head. Discoidal pores absent. Oral rims absent. Unusual sclerotisations absent. Enlarged setae of one shape, more elongate and thinner than conical setae in cerarii, becoming shorter and less enlarged anteriorly, not forming conspicuous medial cerarii, longest conical seta on segment VI 9–16  $\mu\text{m}$  long; with enlarged setae only, without elongate setae. With four setae on segment VI between lateral margins of posterior ostioles. Longest anal-ring seta 52–65  $\mu\text{m}$  long, 1.1–1.5 times greater than width of anal ring. Posterior ostioles inconspicuous, with one seta and no trilocular pores on anterior lip; anterior ostioles absent. Eyes smaller than basal antennal segment, located on body margin.

*Venter.* Without multilocular pores. Trilocular pores usually present submarginally on segments VII and III, near anterior end of clypeus, and near anterior and posterior spiracles, sometimes also present submarginally on segments II, IV, V, and VIII; with two to four near each spiracle. Discoidal pores absent or present in submarginal line near lateral setae. Unusual sclerotisations absent. Anal-lobe area at apex of abdomen on venter (not on dorsum as in adult female), with two setae including anal-lobe seta; anal-lobe seta 88–120  $\mu\text{m}$  long. Labium 60–76  $\mu\text{m}$  long. Antenna 142–170  $\mu\text{m}$  long, eight-segmented. Legs without translucent pores, femur with seven to nine setae, tibia with seven to nine setae; coxa with one seta noticeably

more enlarged than other setae, trochanter with three such setae, femur with three or four such setae; tarsal and claw digitules with slightly enlarged apices, tarsal digitules on front leg with only one clubbed seta; claw without denticle. Hind femur + trochanter 75–98  $\mu\text{m}$  long, tibia 50–68  $\mu\text{m}$  long, hind tarsus 58–70  $\mu\text{m}$ , tibia/tarsus 0.8–1.0. Without pores on derm near hind coxa.

*Notes.* This description is based on 90 specimens from four localities. It is most similar to *O. warniae* by having two pairs of cerarii, but differs by having a nearly complete marginal line of trilocular pores, whereas *O. africanus* either lacks marginal trilocular pores or has them restricted to segments VII and VIII in the cerarii.

***Octococcus barbarae* Miller & Giliomee, sp. n.,**

Fig. 5

*Etymology.* The specific epithet is named in honour of Barbara D. Denno in recognition of her hundreds of hours of volunteer work on ScaleNet, including management of the web site, troubleshooting, and data entry. She also helps the first author with various areas of information technology, assists with fieldwork, collection management, and general encouragement.

*Type material.* Holotype adult female is mounted alone and is deposited in SANC. Left label '4303: 1/ S. Afr: Cape Pr./ Caledon: ? 23.x.1969/on: Eroeda/ latifolia/ coll.: P. Insley' right label 'Octococcus/ barbarae/ Miller &/ Giliomee HOLOTYPE.' There are no other specimens. The correct name of the host plant is *Oedera inbricata* and the province is the Western Cape. This species is known only from the holotype.

*Field characters.* No information is available

**Adult female (Fig. 5)**

*Slide-mounted characters.* Mounted 1.8 mm long, 1.2 mm wide.

*Dorsum.* Body not fully distended but posterior segments partially folded on slide-mounted specimens so that anal ring and anal lobes located forward from posterior end of body; cerarii near body margin, not displaced medially; anal-lobe area placed on dorsal surface rather than normal position on venter. With two pairs of cerarii; anal-lobe cerarius sclerotised, on prominence, with nine conical setae, without elongate setae, cluster of 12 or 13 basal trilocular pores. Penultimate cerarius in line with anal-lobe cerarius, unsclerotised, definition of cerarius not clear, with seven conical setae

about same size as anal-lobe conical setae, without auxiliary setae, and basal cluster of two trilobular pores. Without additional cerarii. Anal-lobe area sclerotised, contiguous with anal-lobe cerarius, with four setae, longest about 155  $\mu\text{m}$  long. Suranal setae near apex of abdomen, none touching sclerotisation of anal ring, with six setae. Multilobular pores present in medial areas of mesothorax to segment III, present laterally on segments IV–VII. Discoidal pores absent. Trilobular pores uncommon, scattered over surface, most abundant in cerarii and near base of dorsomedial conical setae. Oral rims usually with weakly developed rim, of two or three intergrading sizes: larger sizes distinct, with thin, heavily sclerotised rim, most abundant posteromedially on segments III–VI, also laterally on segments VII and VIII, absent elsewhere, with 20 ducts present on segment IV; smaller size with broad rim and narrow tube, abundant over surface except absent from medial areas of segments VII and VIII. Lanceolate setae present in medial areas from segments II–VII, about same size as cerarian setae, distributed in rows, not forming medial cerarii, longest conical seta on segment VI 28  $\mu\text{m}$  long. Body setae of variable size, all setae on posterior abdominal segments enlarged, with 21 setae on segment VI between lateral margins of posterior ostioles. Longest anal-ring seta 125  $\mu\text{m}$  long, 1.2 times longer than width of anal ring. Posterior ostioles with two or four setae on anterior lip and four or six trilobular pores, with three trilobular pores on posterior lip; anterior ostioles absent. Eye diameter about same size as length of second antennal segment, located on dorsum along with antenna.

*Venter.* Vulva in holotype located in normal position for mealybugs. Multilobular pores abundant on abdomen, rare on thorax, absent from head and anterior thorax, submarginal pores abundant. Trilobular pores uncommon, scattered over surface, most abundant in lateral areas of thorax near spiracles. Discoidal pores absent. Oral rims similar to those on dorsum, larger size in small numbers on posterior abdomen, smaller sizes in clusters on marginal areas of posterior abdominal segments, scattered elsewhere. Labium 100  $\mu\text{m}$  long. Antenna 208  $\mu\text{m}$  long, seven- or eight-segmented, basal segment and second segment each with one or two enlarged setae. Hind coxa with 60 and 80 small translucent pores, with similar pores on derm adjacent to hind coxa, without pores on hind femur or tibia; femur with nine setae, tibia with

seven and nine setae; coxa with two setae noticeably larger than other leg setae, trochanter with two such setae, femur with four such setae; tarsal and claw digitules with slightly enlarged apices; one of tibial digitules on front leg without enlarged apex. Hind trochanter + femur 115 and 122  $\mu\text{m}$ , tibia 78 and 70  $\mu\text{m}$  long, hind tarsus 52 and 55  $\mu\text{m}$ , tibia/tarsus 1.3 and 1.5. With small pores on derm adjacent to hind coxa.

*Notes.* This species is most similar to *Octococcus minor* by having dorsal lanceolate setae on the posterior abdominal segments, small pores adjacent to the hind coxa, and dorsal multilobular pores; it differs (character states of *O. minor* are given in brackets) by having nine enlarged setae in the anal-lobe cerarii (two or three), seven enlarged setae in the penultimate cerarii (two or three), and more than 10 large-sized oral-rim tubular ducts on segment IV (less than nine).

***Octococcus gullanae* Miller & Giliomee sp. n.,**

Fig. 6

*Etymology.* The specific epithet is named in honour of Penny Gullan in recognition of her many significant contributions to scale insect systematics and for making several collections of *Octococcus* in South Africa, mounting them on slides, sending them to us for this revision, and providing a thoughtful and careful review of the manuscript.

*Type material.* Holotype adult female mounted singly on a slide and deposited in SANC. Left label 'H.C. No. 664/1/S.A.: Cape Prov. [now Northern Cape] Nieuwoudtville: / 11.vii.1961/ex.: Lampranthus/sp./ coll.: J.H. Giliomee' right label 'Octococcus/ gullanae Miller & /Giliomee/ HOLOTYPE.' In addition there is one paratype adult female from the same series (USNM) and one paratype adult female from Oudtshoorn. [Western Cape Province] on 'mesem' [*Mesembryanthemum*], collector unknown, ?.iii.1979, 1/1 ad. fem. (SANC 5702-1). *Lampranthus* is a mesemb and belongs to the ice-plant family, Aizoaceae.

*Field characters.* No information; however, based on the morphology of the slide-mounted adult female we suspect that there are four or five lateral wax filaments.

Adult female (Fig. 6)

*Slide-mounted characters.* Numerical values are given for the holotype first and the paratypes in brackets. Mounted 3.1 mm long, 2.4 mm wide (1.4 and 3.5 mm long, 0.8 and 2.7 mm wide).

*Dorsum.* Body greatly enlarged in mature specimens; posterior segments folded only on older females; cerarii not near body margin on older females, displaced medially, present near body margin on young female; anal-lobe area placed on dorsal surface on older females, in normal position on young female. With four or five pairs of cerarii; anal-lobe cerarius sclerotised, on prominence, with four and six conical setae (three or four), zero and two auxiliary setae (three to five), cluster of seven (11–12) trilocular pores. Penultimate cerarius not forming line with other cerarii, displaced medially, weakly sclerotised, on small prominence, with three conical setae (three or four), two auxiliary setae (one or two), and cluster of 12 (five to 14) trilocular pores. Third cerarius weakly sclerotised, on small prominence, with three or four conical setae (three or four), without auxiliary setae (zero to two), with cluster of 11 (five to 10) trilocular pores. Fourth cerarius weakly sclerotised, on small prominence, with two or three conical setae (two), without auxiliary setae (zero or one), with cluster of four (two to four) trilocular pores. Fifth cerarius when present represented by one conical seta (one), one or two more elongate setae, no basal sclerotisation or trilocular pores. Anal-lobe area sclerotised, contiguous with anal-lobe cerarius, with four or five (four to six) long setae. Discoidal pores absent. Trilocular pores scattered over surface, most abundant in cerarii and near base of dorso-medial conical setae. Large-sized oral rims with narrow rim and narrow tube (broad tube normally present on other species, absent on this species). Oral rims usually with weakly developed rim, of three intergrading sizes: larger size most abundant posterolaterally on posterior abdominal segments, scattered elsewhere, uncommon on head, with 32 (22 and 36) ducts on segment IV; smaller two sizes abundant over surface. Lanceolate setae present in medial areas of segments IV–VIII, about same size as cerarian setae, forming medial cerarii with basal trilocular pores and slight sclerotisation. Body setae of one variable size, longest setae near posterior end of abdomen, longest seta on segment VII about 60  $\mu\text{m}$  long (38 and 60), with 18 (13 and 17) setae on segment VI between lateral margins of posterior ostioles. Longest anal-ring seta 152  $\mu\text{m}$  long (105 and 152), 1.3 (0.9 and 1.2) times longer than width of anal ring. Posterior ostioles when present with zero to three loosely associated trilocular pores on anterior lip; anterior ostioles absent. Eye diameter about same size as

length of second segment of antenna, located on dorsum along with antenna.

*Venter.* Vulva located near posterior apex of abdomen on mature specimens. Multilocular pores present from prothorax to posterior apex of abdomen, submarginal pores absent. Trilocular pores uncommon, present in lateral areas of anterior abdominal segments and thorax. Discoidal pores absent. Oral rims similar to those on dorsum, larger size in small numbers on abdomen and thorax, smaller size in clusters on marginal areas of posterior abdominal segments, scattered elsewhere. Suranal setae near apex of abdomen, with six setae (five to seven). Labium 135  $\mu\text{m}$  long (150). Antenna 370  $\mu\text{m}$  long (310–345), eight-segmented (seven or eight), third segment completely or partially divided. Hind coxa with 23 and 74 translucent pores (21–37), femur with nine setae (eight and nine), some slightly enlarged; tarsal and claw digitules with slightly enlarged apices. Hind trochanter + femur 270  $\mu\text{m}$  long (215); hind tibia 175  $\mu\text{m}$  long (162 and 168); hind tarsus 92 and 95  $\mu\text{m}$  (88 and 90); tibia/tarsus 1.9 (1.8 and 1.9). Leg setae on ventral surface of coxa, trochanter, femur, and tibia larger than setae on dorsum of each segment and on tarsus. Without small pores on derm adjacent to hind coxa.

*Notes.* This species is most similar to *Octococcus africanus* (character states of *O. africanus* given in brackets) but differs by having four or five pairs of cerarii (two), each cerarius with more than two conical setae (two), cerarii set away from body margin (near body margin), rims of oral-rim tubular ducts inconspicuous (conspicuous)

#### ***Octococcus minor* De Lotto, Figs 7–8**

*Octococcus minor* De Lotto, 1969: 16 (original designation); Ben-Dov, 1994: 258; Millar, 2002: 201.

*Octococcus africanus*; Afifi, 1968: 151 (misidentification); Hardy *et al.* 2008: 57 (misidentification of adult male in character matrix)

*Type material.* We have examined the holotype and three paratypes with the following data: left label 'H. C. No. 839/9/S. A. Cape Pr./ Middelburg:/ 7.v.1964/ ex. Nestlera/ humilis/ coll. C.H. Buitendag' right label 'Octococcus/ minor/ De Lotto/ HOLOTYPE.' The holotype and nine paratypes are in SANC and one paratype is in each of the USNM and BMNH. The current name of the host plant is *Rosenia humilis* (Asteraceae).

*Additional material examined, SOUTH AFRICA:*



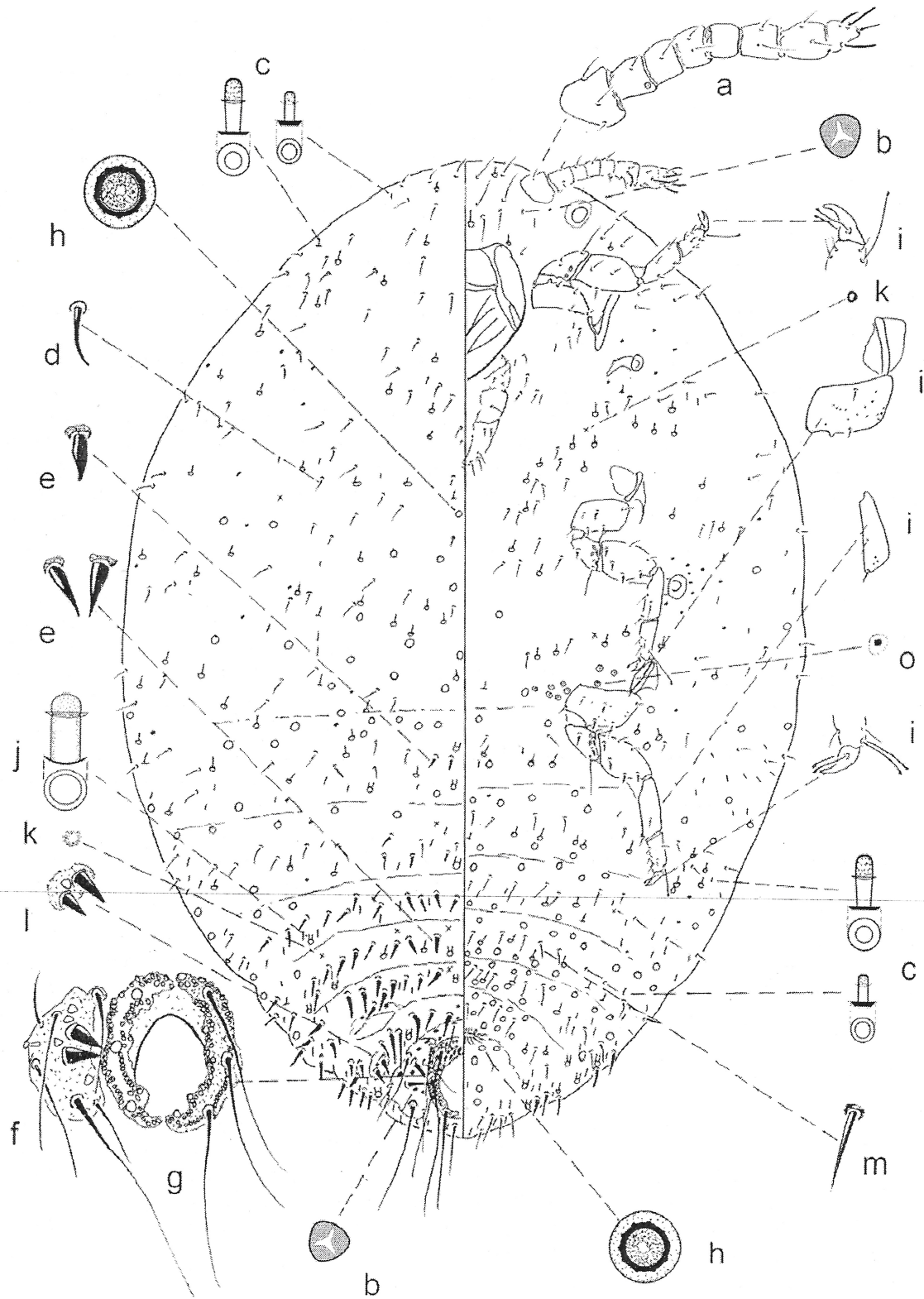


Fig. 7. *Octococcus minor*. Adult female. Bloemfontein, Free State, South Africa, 13.vi.1951, on *Chrysocoma tenuifolia*, H. Gleimius,

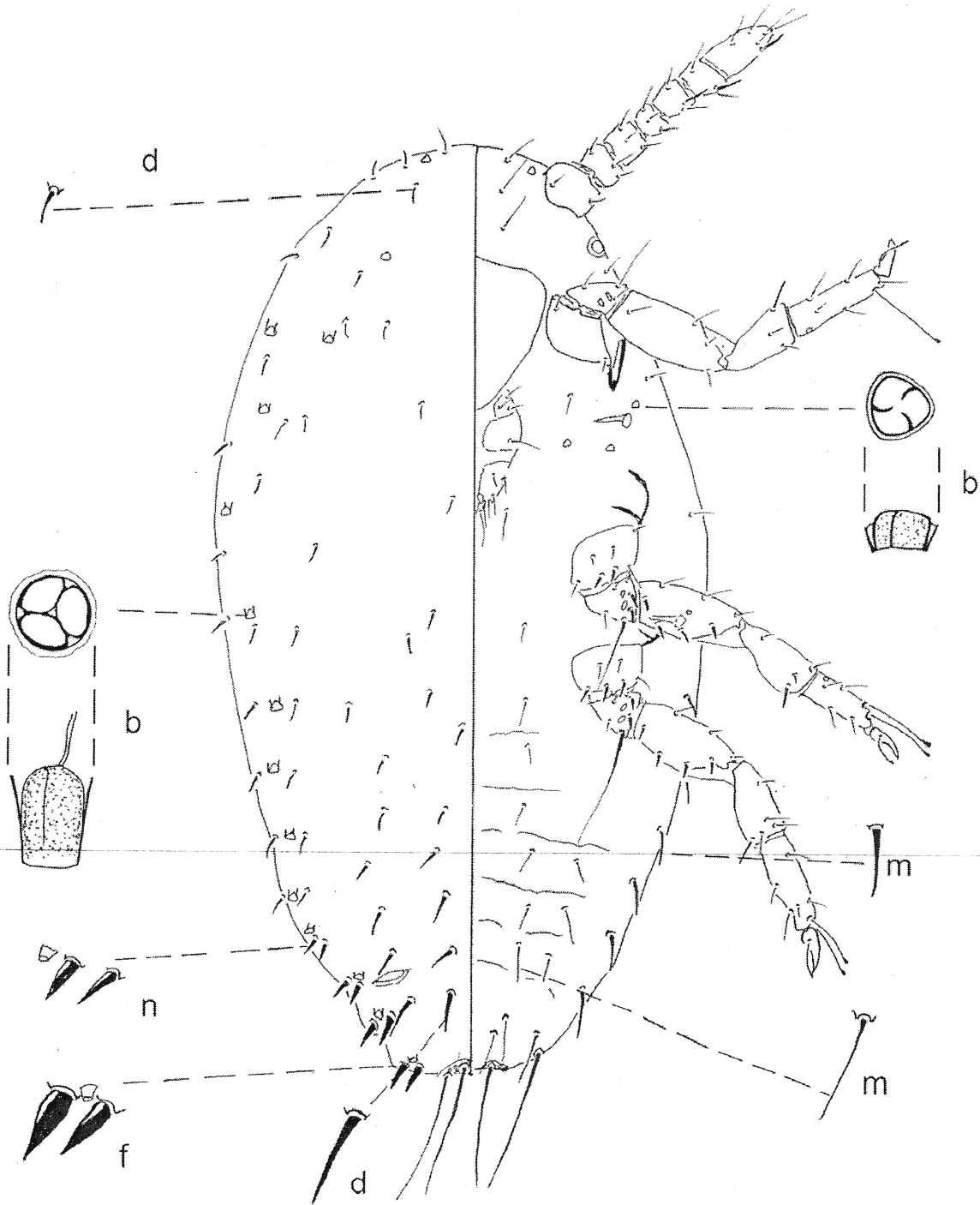


Fig. 8. *Octococcus minor*. First-instar embryo. Colesberg Bridge, Northern Cape, South Africa, 26.ix.1952, on *Nolletia* sp., O.W. Richards.

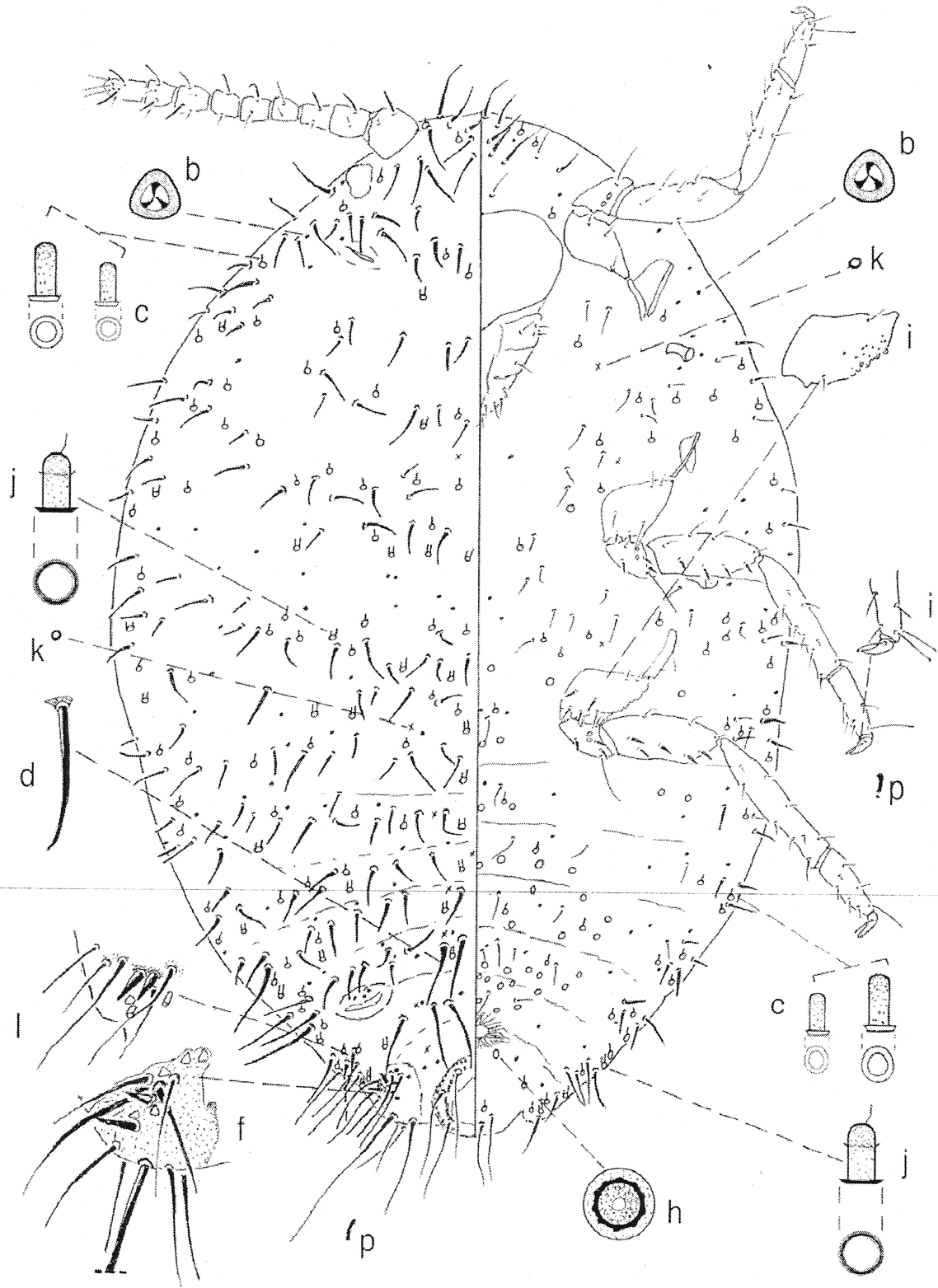


Fig. 9. *Octococcus pentziae*. Adult female. Middelburg, Mpumalanga, South Africa, 9.iv.1963, on *Chrysocoma tenuifolia*, P. Hugo.

*Athanasia trifurcata*, C.J. Joubert, 1/1 ad. fem. not a paratype (USNM); Stellenbosch, 27.vii.1937 & 10.viii.1938, on *Athanasia trifurcata*, T.G. Morris & C.J. Joubert, 6/6 ad. fem. (SANC 676 1–2 & 692 1–4); Stellenbosch, 28.xi.1964, on *Pentzia* sp., J. Munting, 1/1 ad. fem. (SANC 949-1); Stellenbosch, 20.v.1977, on *Metalasia* sp., S. Nesper, 1/1 ad. fem. (SANC 5283).

*Field characters.* On the foliage and flower heads of the *Metalasia* host, a shrub in the Asteraceae. Adult female dark grey or black, enclosed in a white sac. First instars are the same colour as the adult female; with one pair of filaments equal in length to about quarter the length of the body; posterior medial wax projection from anal ring about the same length as the filaments; posterior four segments with white wax, the rest of the body is bare.

#### Adult female (Fig. 10)

*Slide-mounted characters.* Mounted 1.5 mm long, 1.1 mm wide (1.3–1.5 mm long, 0.9–1.2 mm wide).

*Dorsum.* Body with posterior segments slightly folded on slide-mounted specimens; cerarii near body margin, not displaced medially; except in very small specimens, anal-lobe area placed on dorsal surface rather than normal position on venter. With two pairs of cerarii; anal-lobe cerarius sclerotised, on prominence, with two conical setae, six (seven or eight) more elongate setae, cluster of 11 (seven to 13) basal trilocular pores. Penultimate cerarius in line with anal-lobe cerarius, with patchy basal sclerotisation, not protruding, with two conical setae, three (three or four) more elongate setae, and basal cluster six (three to five) trilocular pores. Anal-lobe area normally on dorsum but at apex of venter on small specimens, sclerotised, contiguous with anal-lobe cerarius, with four (five to eight) long setae, longest about 170 (158–178)  $\mu\text{m}$  long. Suranal setae near apex of abdomen, longest sometimes touching anal ring, with 10 (seven to 12) setae of various lengths. Trilocular pores scattered over surface, most abundant in cerarii and near base of dorsomedial enlarged setae. Discoidal pores uncommon, when present located in medial areas of thorax and anterior abdominal segments. Oral rims of three sizes, larger size distinct, medium and small sizes intergrading: larger size barrel-shaped with narrow rim, present laterally from head or prothorax to segments VII or VIII, present in medial areas from prothorax to segments VI or VII, forming distinct transverse rows across abdominal segments, with

18 (12–19) ducts on segment IV; medium and small ducts narrow and elongate, with large rim, of same distribution pattern as large ducts, but abundant on head. Unusual sclerotisations present over surface that look like deformed ducts but much smaller with no consistent shape. Enlarged setae conspicuously longer and narrower than conical setae in cerarii, often curved, becoming shorter and less enlarged anteriorly, not forming medial cerarii. Without clearly differentiated body setae, longest seta on segment VII about 80 (57–88)  $\mu\text{m}$  long, with 12 (11–14) setae on segment VI between lateral margins of posterior ostioles. Longest anal-ring seta 160 (138–175)  $\mu\text{m}$  long, 1.6 (1.3–1.6) times greater than width of anal ring. Ostioles small and inconspicuous, posterior ostioles with three (two to four) loosely associated trilocular pores on anterior lip; without anterior ostioles. Eye diameter about same size as length of second antennal segment, located on dorsum along with antenna.

*Venter.* Vulva located in normal position. Multilocular pores present from prothorax or mesothorax to posterior apex of abdomen, submarginal pores absent. Trilocular pores uncommon, rare in medial areas, more abundant laterally. Discoidal pores present near legs. Oral rims similar to those on dorsum; larger size in lateral areas of segments VI, VII, and VIII; medium and smaller size rare or absent in medial areas of posterior abdominal segments, scattered elsewhere. Unusual sclerotisations present over most of surface. Labium 115 (112–115)  $\mu\text{m}$  long. Antenna 285 (260–300)  $\mu\text{m}$  long, eight-segmented. Hind coxa with 53 (41–65) translucent pores, tibia with three (zero to five) translucent pores; femur with nine (eight or nine) setae, tibia with eight (seven or eight) setae; coxa with two (one to three) setae noticeably larger than other leg setae, trochanter with three (two or three) such setae, femur with four (three or four) such setae; tarsal and claw digitules with slightly enlarged apices, tarsal digitules on front leg with only one clubbed seta; claw usually without denticle, rarely with slight swelling near apex. Hind femur + trochanter 190 (170–190)  $\mu\text{m}$  long, tibia 125 (118–135)  $\mu\text{m}$  long, hind tarsus 85 (78–85)  $\mu\text{m}$  long, tibia/tarsus 1.5 (1.4–1.7). Without small pores on derm adjacent to hind coxa.

*Notes.* This species is most similar to *O. pentziae*; for a comparison of these species see the notes section of *O. pentziae*. This is the only species that has been intercepted at United States ports-of-

entry. Because the *Metalasia* host is a member of the Asteraceae and because this plant family contains many environmentally and economically important plants, it is important to be vigilant about keeping this mealybug from becoming established outside of its normal geographic range.

#### Third-instar female (Fig. 11)

*Slide-mounted characters.* Mounted 0.8 mm long, 0.6 mm wide.

*Dorsum.* Body with posterior segments normal, not folded on slide-mounted specimens; cerarii near body margin, not displaced medially; anal-lobe area at apex of abdomen mostly on dorsal surface. With two pairs of cerarii; anal-lobe cerarius sclerotised, on prominence, with two conical setae, four more elongate setae, cluster of four or five basal trilocular pores. Penultimate cerarius in line with anal-lobe cerarius, with basal sclerotisation, not protruding, with two conical setae, two more elongate setae, and basal cluster of two trilocular pores. Anal-lobe area at apex of abdomen, contiguous with anal-lobe cerarius, with three long setae, longest 120  $\mu\text{m}$  long. Suranal setae near apex of abdomen, longest not touching anal ring, with seven setae. Trilocular pores scattered over surface, most abundant posteriorly. Discoidal pores absent. Oral rims of two or three sizes, larger size distinct, medium and small sizes intergrading; larger size barrel-shaped with narrow rim, present laterally from head to segments VII, present in medial areas from prothorax to segment VI, with eight ducts on segment IV; medium and small ducts narrow and elongate, with large rim, of same distribution pattern as large ducts, but rare on head and posterior abdominal segments. Unusual sclerotisations present over surface that look like deformed ducts but much smaller with no consistent shape. Enlarged setae conspicuously longer and narrower than conical setae in cerarii, often curved, becoming shorter and less enlarged anteriorly, not forming medial cerarii. Without clearly differentiated body setae, longest seta on segment VII about 45  $\mu\text{m}$  long, with six setae on segment VI between lateral margins of posterior ostioles. Longest anal-ring seta 120  $\mu\text{m}$  long, 2.2 times greater than width of anal ring. Posterior ostioles small and inconspicuous, with one seta and two or three loosely associated trilocular pores on anterior lip; anterior ostioles absent. Eyes about same size as basal antennal

segment, located on dorsum along with antenna.

*Venter.* With one multilocular pore present on segment VI. Trilocular pores scattered over surface, rare or absent in medial areas of thorax. Discoidal pores absent. Oral rims similar to those on dorsum, larger size in lateral areas of segments VII, medium and smaller size rare or absent in medial areas of posterior abdominal segments, scattered elsewhere, absent from head. Unusual sclerotisations most abundant near body margin. Labium 88  $\mu\text{m}$  long. Antenna 198  $\mu\text{m}$  long, seven-segmented. Legs without translucent pores, femur with nine setae, tibia with seven setae, coxa with two setae noticeably larger than other leg setae, trochanter with three such setae, femur with four such setae, tarsal and claw digitules with slightly enlarged apices, tarsal digitules on front leg with only one clubbed seta, claw without denticle. Hind femur + trochanter 118  $\mu\text{m}$  long, tibia 68  $\mu\text{m}$  long, hind tarsus 68  $\mu\text{m}$ , tibia/tarsus 1.0. Without small pores on derm adjacent to hind coxa.

*Notes.* This description is based on two specimens from one locality.

#### First-instar nymph (Fig. 12)

*Slide-mounted characters.* Mounted 0.5 mm long, 0.3 mm wide.

*Dorsum.* Body with posterior segments normal, not folded; cerarii near body margin, not displaced medially; anal-lobe area at apex of abdomen, mostly on dorsal surface. With two pairs of definite cerarii, additional five or six pairs of elongate setae present forward to anterior abdominal segment; anal-lobe cerarius sclerotised, not on prominence, with two conical setae about equal in size, no auxiliary seta, with one basal trilocular pore. Penultimate cerarius in line with anal-lobe cerarius, with basal sclerotisation, not protruding, with two conical setae about equal in size, no auxiliary setae, and with one basal trilocular pore. Suranal setae near apex of abdomen, longest close to anal ring, with four setae. Trilocular pores present in submedial area of mesothorax, metathorax, segments I, VII, and VIII, in marginal or submarginal areas of head, prothorax, mesothorax, and segments II–VIII. Discoidal pores absent. Oral rims absent. Unusual sclerotisations absent. Enlarged setae of one size, more elongate and thinner than conical setae in cerarii, becoming shorter and less enlarged anteriorly, not forming conspicuous medial cerarii, longest conical seta on segment VI 28  $\mu\text{m}$  long; with enlarged setae only,

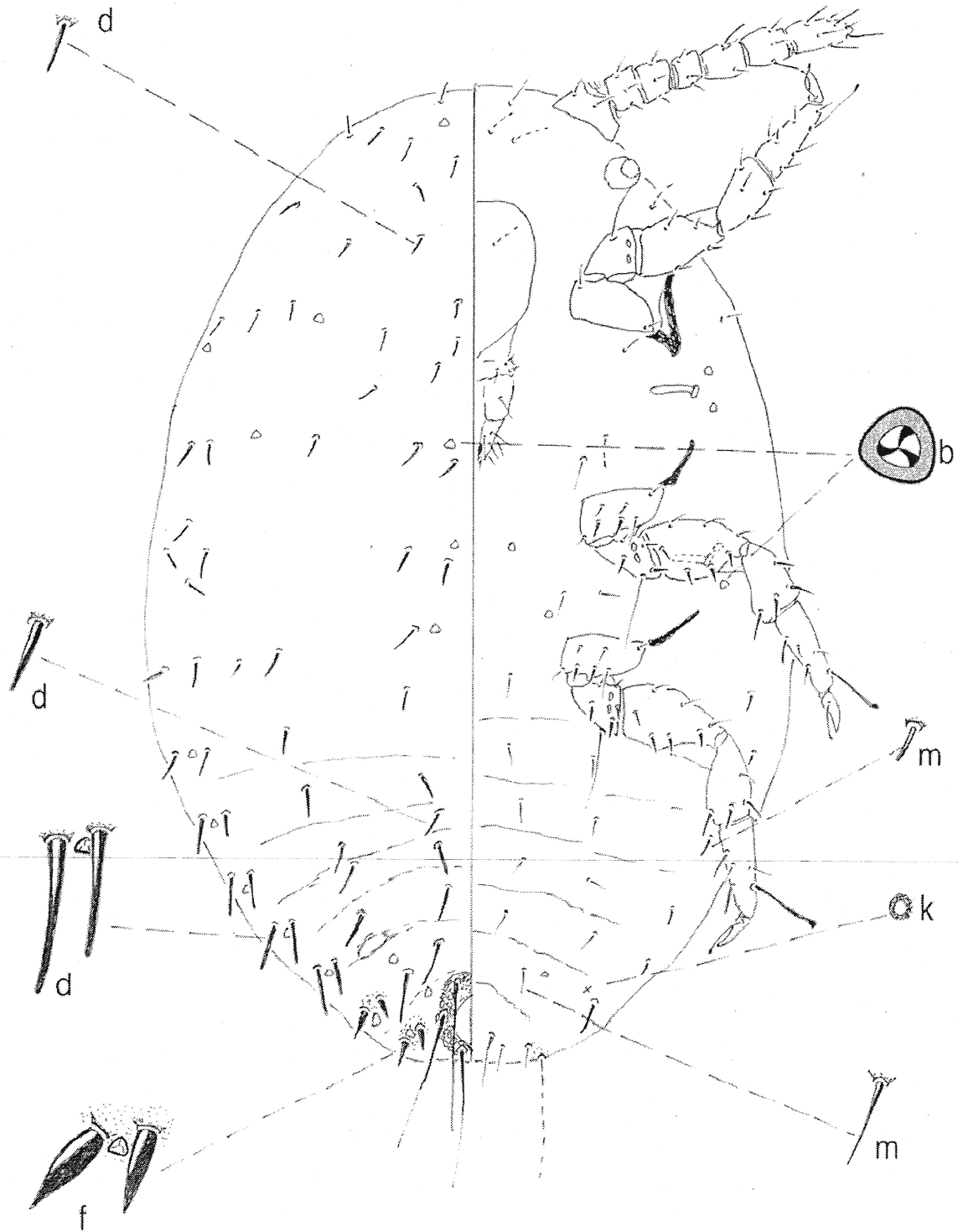


Fig. 12. *Octococcus warniae*. First instar. Betty's Bay, Western Cape, South Africa, 14.iii.2014, on leaves of *Metalasia* sp., J.H. & W. Giliomee, B.D. Denno & D.R. Miller.

- With more than two pairs of cerarii; often with dorsomedial cerarii  
..... *gullanae* Miller & Giliomee
- 5(4) More than 10 large-sized oral-rim tubular ducts on abdominal segment IV; seven to 10 suranal setae .. *warniae* Miller & Giliomee
- Less than nine large-sized oral-rim tubular ducts on abdominal segment IV; three to five suranal setae ..... *pentziae* Hall

#### Key to species of *Octococcus* (first-instar nymphs)

- 1 Dorsal abdominal trilocular pores present in submarginal line ..... 2
- Dorsal abdominal trilocular pores absent or restricted to cerarii ..... *africanus* (Brain)
- 6(1) Four pairs of cerarii; cerarian trilocular pores tubular, longer than wide  
..... *minor* De Lotto
- Two pairs of cerarii; cerarian trilocular pores sessile, wider than long  
..... *warniae* Miller & Giliomee

#### CONCLUSIONS

Many more collections of *Octococcus* mealybugs have been made since work on this genus by De Lotto (1958, 1969, 1977). In the present study, all available specimens of *Octococcus* have been examined, allowing the recognition of three new species that are described and illustrated herein. Three of the four named species (*O. africanus*, *O. minor* and *O. pentziae*) are redescribed and illustrated. The status of *O. salsolicola* is reassessed. Several immature stages are described for the first time and keys to species are provided.

It is of interest that all immatures of *Octococcus*, with the exception of the first-instar nymph, possess tubular ducts. It is reasonable to believe that each of these life stages produces a thick waxy covering similar to the covering of the adult female. Species of both *Hypogeococcus* and *Trabutina* also possess tubular ducts in the immature stages, excluding the first-instar nymph, and most likely also produce a wax covering similar to the adult female. It is likely that other members of the *Trabutini* have similar habits and morphology.

It is surprising that the known first-instar nymphs of *Octococcus* species all have seven-segmented antennae. We looked at the first-instar nymphs of several other members of the *Trabutini* based

on Hardy *et al.* (2008) (including *Amonostherium*, *Antonina*, *Balanococcus*, *Nipaecoccus*, *Melanococcus*, *Miscanthococcus* and *Peridiococcus*), but found none that have seven-segmented antennae.

A summary of the distribution and host information is as follows: *O. africanus* Northern Cape and Western Cape on *Elytropappus* (Asteraceae), *Stoebe* (Asteraceae), and *Tamarix* (Tamaricaceae); *O. barbarae* Western Cape on *Oedera* (Asteraceae); *O. gullanae* Northern Cape and Western Cape on *Lampranthus* (Aizoaceae) and 'mesem' (Aizoaceae); *O. minor* Free State, Mpumalanga, Northern Cape, and Western Cape on *Chrysocoma* (Asteraceae), *Nolletia* (Asteraceae), *Pteronia* (Asteraceae), *Rosenia* (Asteraceae), and *Stoebe* (Asteraceae); *O. pentziae* Eastern Cape, Mpumalanga, and Northern Cape on *Chrysocoma* (Asteraceae), *Pentzia* (Asteraceae), and *Ursinia* (Asteraceae); *O. warniae* Eastern Cape and Western Cape on *Athanasia* (Asteraceae), *Metalasia* (Asteraceae), and *Pentzia* (Asteraceae).

All species of *Octococcus* are restricted to South Africa and all but one is recorded on hosts in the Asteraceae. The *Tamarix* record of *O. africanus* is strongly suspected to be a misidentification of *Elytropappus*. *Octococcus gullanae* is the one species that is not found on the Asteraceae being restricted to the succulent family Aizoaceae. Of all the species in *Octococcus*, *O. gullanae* seems to be the most distinct with dorsomedial cerarii, more than two pairs of cerarii, and no distinct large-sized enlarged oral-rim tubular ducts. Geographically some species seem to be more prevalent in certain parts of South Africa than in others. *Octococcus africanus*, *O. barbarae*, and *O. gullanae* are mostly western; *O. minor* tends to be more northern but there is one record from the southern part of the Western Cape; *O. pentziae* is more widespread; and *O. warniae* is restricted to the southern provinces.

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