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TWO NEW GENERA OF THE DIASPIDINI FROM THE INDIAN SUBCONTINENT (HOMOPTERA: COCCOIDEA: DIASPIDIDAE)

By SADAO TAKAGI

Abstract

TAKAGI, S. 2007. Two new genera of the Diaspidini from the Indian Subcontinent (Homoptera: Coccoidea: Diaspididae). *Ins. matsum. n. s.* 63: 67–83, 8 figs.

Keralaspis piperis, gen. et sp. nov., occurring in Kerala, South India, on *Piper* sp. (probably *Piper nigrum*), and *Himalaspis clerodendri*, gen. et sp. nov., occurring in Midland Nepal on *Clerodendron infortunatum* and *C. viscosum*, are described. *Chionaspis caroli* Green, 1919, described from Darjeeling, India, as occurring on tea plant, is transferred to *Himalaspis* on the basis of the original description. *Keralaspis* and *Himalaspis* belong to the tribe Diaspidini, and *Himalaspis* is referred to the subtribe Chionaspidina on the basis of the second-instar male of the type species. *Keralaspis* is isolated, whereas *Himalaspis* is very similar, and probably closely related, to *Lineaspis*. All these genera are provided with widely separated non-zygotic median trullae, and *Keralaspis* and *Lineaspis* are, in addition, characterized by having a pair of gland spines between the median trullae. *Keralaspis* is tentatively referred to the Chionaspidina by analogy with *Himalaspis*-*Lineaspis* context, and supposed to reflect the generalized primitive pattern of the subtribe to a considerable degree.

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Introduction

The higher classification within the family Diaspididae has not yet found general agreement among authors. In a classification, a great part of the family are divided into two subfamilies, the Diaspidinae and Aspidiotinae; the Diaspidinae include two major tribes, the Diaspidini and Lepidosaphidini; and the tribe Diaspidini is a large group composed of diverse forms, which should represent not a few subtribes. However, it is still unknown how many natural groups exist that may be recognized as subtribes under the Diaspidini. Most of the groups proposed by authors and referable to the tribe are open to criticism as to their compositions. Certain groups are utterly unacceptable; for example, the so-called Phenacaspidina are artificial because, above all, the type genus *Phenacaspis* itself has proved to be an artifact. Some groups are acceptable as taxa so far as the genera that form their central conceptions are concerned, but their extents and boundaries are not clear probably owing to modifications caused by specialization, convergence, parallelism, atavism, and so on. Primitive forms of groups, if any, would also make the boundaries obscure.

The second-instar males of the Diaspidini are not uniform, and may be divided into homomorphic and heteromorphic forms, though there are forms intermediate in various degrees. Homomorphic male nymphs are similar to the conspecific adult and second-instar females especially in the pygidial margin. Heteromorphic nymphs exhibit quite different patterns, which are more or less similar to the adult female of the very primitive diaspidid genus *Ulucoccus* Takagi in general body pattern and provided with variously modified ducts in the marginal-submarginal area of the abdomen. In some cases, different types of heteromorphic nymphs have been used in discriminating subtribes. Heteromorphism prevails in the tribe, though homo- and heteromorphic nymphs may sometimes occur in congeneric species and even in a group of species that are closely similar to each other in the adult females. The tests formed by heteromorphic nymphs are quite different from those constructed by the conspecific females in external appearance.

In this paper two new genera based on two new species are described from the Indian Subcontinent: *Keralaspis piperis* occurring in South India on *Piper* and *Himalaspis clerodendri* occurring in Midland Nepal on *Clerodendron*. *Chionaspis caroli*, described from Darjeeling, India, as associated with tea plant, is transferred to *Himalaspis* on the basis of the original description. These genera belong to the Diaspidini, but are not particularly related to each other. *Keralaspis* is isolated, whereas *Himalaspis* is probably related to *Lineaspis* MacGillivray, which is, in common with *Keralaspis*, characterized by having a pair of gland spines between the non-zygotic and widely separated median trullae. *Himalaspis* is referred to the Chionaspidina on the basis of the second-instar male, and the supposedly related *Lineaspis*, too, is referable to the subtribe. *Keralaspis* may also be assigned to the Chionaspidina by analogy with the *Himalaspis*-*Lineaspis* context, and is supposed to reflect the generalized primitive pattern of the subtribe to a considerable degree.

Keralaspis, gen. nov.

Type species: *Keralaspis piperis*, sp. nov.

Adult female. Body elongate, but stout; pygidium broadly rounded marginally. Median trullae non-zygotic, separated from each other by a wide space, divergent, their mesal bases sunken, forming a notch at apex of pygidium; a pair of well-developed gland spines present between the trullae. Gland spines also occurring segmentally on pygidial margin and in prepygidial region. Second and third trullae well represented, bilobulate, the lobules being similar in shape and size. Marginal, submarginal, and submedian dorsal macroducts of pygidium uniform in size; marginal macroducts on abd III–VII, not all of them being well differentiated from submarginal macroducts; submarginal macroducts arranged in segmental rows (occurring along posterior borders of segments) and infrasegmental rows (halfway between borders); submedian macroducts in segmental rows. Anus situated anteriorly to centre of pygidium. Antennae unisetose.

Remarks. This genus has bilobulate lateral trullae and gland spines, and thus it belongs to the subfamily Diaspidinae. It is characterized by the presence of well-developed gland spines between the non-zygotic median trullae in common with many genera of the tribe Lepidosaphidini, but it shows no other features of the lepidosaphidine pattern. The second-instar male of the type species is homomorphic in the structure around the pygidial apex, but possesses dorsal ducts of a modified type and forms an amorphous test fluffy with wax filaments. This supports the view that the genus belongs to the Diaspidini.

The gland spines occurring between the median trullae belong to the ninth abdominal segment, and their presence is a primitive character as compared with their absence or disappearance. In the tribe Diaspidini, the median gland spines occur in many genera (*Daraspis* Hall, *Diaspidistis* Hempel, *Furchadaspis* MacGillivray, and so on) of the subtribe Diaspidina, but only rarely in other groups. *Keralaspis* greatly differs from these genera of the Diaspidina (and other genera of the subtribe) in all the dorsal macroducts of the pygidium uniform in size, in the submarginal macroducts arranged in segmental and infrasegmental rows (marginal and segmental submarginal macroducts tending to form continuous series), and in having no marginal macroduct between the median trullae.

The subtribe Diaspidina is mainly American in distribution and definitely occurs in Africa. It is known also from tropical Asia, where it is represented by a few genera (Takagi, 1989). The possibility that *Keralaspis* belongs to the subtribe, therefore, may not be excluded. However, it is also possible, at least equally, that the differences in the macroducts have a deeper significance and that the genus represents a primitive form of another group. In this paper I adopt the view that *Keralaspis* belongs to the Chionaspidina (see Remarks under *Himalaspis*, gen. nov., and Further remarks).

It seems that *Keralaspis* has no close relatives among the known genera. *Balaspis* Hall, represented by *B. faurei* Hall occurring in South Africa on *Euphorbia*, is mentioned here as a possible relative of *Keralaspis* on the basis of Hall's (1946) description. *B. faurei* is characterized by having the median trullae 'separated by a distance rather less than the width of one, not yoked together at their bases but with a pair of small gland spines between them', the dorsal macroducts uniform in size, and the marginal macroducts not well differentiated from the submarginal macroducts. It differs from *K.*

piperis in the median trullae small and conical and entirely produced beyond the pygidial margin, the second trullae also small, and the third trullae nearly obsolete.

Keralaspis piperis, sp. nov.

Material examined. Collected in the Periyar Tiger Reserve, altitude ca. 900m, Kerala, South India, Bharat, on *Piper* sp. (probably *Piper nigrum*, but growing wild) (Piperaceae), 19 XII 1978 [78IND-402].

Female and male tests occurring on the undersurface of leaves. Female test nearly rounded, moderately convex dorsally, white, with exuvial casts on margin. Male test fluffy with wax filaments. The description of the adult female is based on six specimens, of which four are teneral. Seven other specimens mounted are mummified owing to parasitism, and one of them shows apparently abnormal numbers of macroducts.

Holotype: adult female (teneral), deposited in the collection of the Zoological Survey of India, Kolkata (Calcutta).

Adult female (Figs 1 and 2). Body growing oblong (tending to be fusiform in the mummified specimens), with free segments moderately lobed (in one specimen, apparently full-grown, the cephalothorax is somewhat sclerotized). Median trullae separated from each other by a space as wide as one of them, divergent, elongate, and finely serrate on mesal margin to around apex, each basally with a pair of linear scleroses converging anteriorly. Second and third trullae with lobules similar in shape and size, each lobule much smaller than median trulla but well represented, rounded apically, basally with a pair of slender scleroses converging anteriorly (tending to be obscure on outer lobule of third trulla). Marginal gland spines slender; 2 between median trullae, as long as the trullae; 1 laterally to each of median, second, and third trullae (occurring on each of abd VI–VIII), 2 on abd V, 5–7 on IV. Prepygidial gland spines well represented, conical on anterior segments: 1 or 2 at times present on mesothorax submarginally; 3–10 in a transverse row on metathorax laterally to posterior spiracle; 4–10 on abd I just mesally of lateral lobe; 4–12 on lateral lobe of abd II; 7–11 on lateral lobe of abd III, some of them being on margin and somewhat elongate. Marginal macroducts: 1 just mesally of second trulla (on abd VII), associated with a sharp marginal process as long as the trulla; 2 just mesally of third trulla (on abd VI), the inner one associated with a well-developed marginal prominence; 2 on abd V, each associated with a well-developed prominence; 3–5 on abd IV, associated with a robust prominence and irregularly dentate margin; 2–5 on abd III, associated with a robust prominence. Submarginal and submedian macroducts occurring on abd III–VI; segmental submarginal rows arising just anteriorly to marginal macroducts, composed of 2–4 macroducts on abd VI, 6–11 on V, 8–14 on IV, and 6–21 on III, these rows being partly often irregularly double or, on abd III, multiple; infrasegmental submarginal rows on abd IV–VI, composed of 2–5 macroducts on VI, 1–6 on V, and 2–5 on IV; submedian rows composed of 2–7 macroducts on abd VI, 6–10 on V, 4–9 on IV, and 1–4, at times absent, on III. Lateral macroducts much smaller than dorsal macroducts of pygidium, occurring as follows on each side: 1 or 2 macroducts on ventral surface of prothorax, very small, sometimes absent; 8–18 on mesothorax, mostly on ventral surface; 13–25 on metathorax, 12–22 on abd I, and 9–20 on II, partly on ventral surface and others on the dorsal; 4–10 on III, on ventral surface. Antennae separated from each other by a space narrower than width of mouth-parts, each with a robust, rather short seta. Anterior spiracles each with a compact cluster of about 20 to over 50 3-locular disc pores; posterior spiracles with no disc pores. Perivulvar disc pores absent.

Second-instar female (exuvial cast) (Fig. 3). Fusiform, with 5 marginal macroducts on abd III–VII and 3 submarginal macroducts on abd IV–VI on each side. Apical area of pygidium as in adult female, but with much shorter gland spines between median trullae.

Second-instar male (Fig. 4). Similar to adult female in apical area of pygidium, but median trullae separated from each other by a space much wider than in adult female (and second-instar female); short gland spines occurring between median trullae. Modified dorsal ducts occurring marginally and submarginally on abd III–VII. Ducts of usual type occurring submedially on dorsal surface, forming a longitudinal row through meso- and metathorax and abd I–VI on each side; also scattered in a broad lateral region on cephalothorax and base of abdomen. Antennae each with 1–3 rather short setae. Anterior spiracles each with a small cluster of disc pores.

First-instar female (exuvial cast) (Fig. 3). Broadly ovoid. Head with a pair of enlarged dorsal ducts. Antennae 6-segmented; terminal segment annulate, as long as segments III–V combined; segment III longer than each of II and IV.

Remarks. As stated in the generic diagnosis, the marginal macroducts are not completely differentiated in the adult female. Especially on the third and fourth abdominal segments, the marginal macroducts and the segmental submarginal macroducts form continuous series. On these segments, therefore, the marginal macroducts have been discriminated from the submarginal macroducts rather arbitrarily, and their numbers counted are not stable as given in the description above.

Himalaspis, gen. nov.

Type species: *Himalaspis clerodendri*, sp. nov.

Adult female. Body elongate, rather slender, with pygidium roundish along margin. Median trullae small, pointed apically, notched on each side, separated from each other by a space about as wide as one of them and parallel to each other, basally with no yoke connecting them. Second trullae bilobulate; inner lobule much larger than median trulla, rounded apically, basally with a pair of slender scleroses converging anteriorly and bearing sclerotized patch of derm extending anteriorly; outer lobule smaller than the inner, yet well represented. Gland spines absent between median trullae; extraordinarily long, slender gland spines occurring on pygidial margin, 1 on each of abd V–VIII; short conical gland spines on prepygidial abdominal segments. Marginal macroducts distinct: 1 laterally to median trulla (on abd VII), associated with a slender marginal prominence; 2 on each of abd V and VI; and 1 on laterobasal angle of pygidium (originally belonging to abd IV). Dorsal macroducts arranged in submedian and submarginal rows (in the type species the submarginal macroducts occur in segmental and infrasegmental rows except on the sixth abdominal segment, on which the submarginal macroducts may belong to the infrasegmental row). Anus situated anteriorly to level of vulva. Antennae each with 1 or 2 setae.

Remarks. This genus is very similar to *Lineaspis* MacGillivray but remarkably different from the latter in having extraordinarily elongated marginal gland spines on the pygidium and, in contradiction with this, in lacking gland spines between the median trullae. The anus is situated much anteriorly to the level of the vulva, and this may also be adopted as a diagnostic character.

In Borchsenius' (1966) catalogue, seven species were referred to *Lineaspis*. Danzig (1993) united four of them into one, which is *L. striata* (Newstead), the type species. On this understanding, *L. striata* is broadly variable in the dorsal ducts and occurs widely in

the Mediterranean region on gymnosperms of the families Cupressaceae and Taxaceae. In this paper *Lineaspis* is understood on the basis of the type species alone, and thus it is characterized by the marginal gland spines occurring on the sides of the pygidium poorly developed and, nevertheless, by possessing a pair of gland spines between the median trullae.

The other three species referred to *Lineaspis* in Borchsenius' catalogue are indeed very similar to *L. striata*. Two of them, *L. cupressi* (Coleman) and *L. callitris* (Laing), agree with *L. striata* also in their association with Cupressaceae. However, they occur in U. S. A. and Australia, respectively, so that it may be open to doubt that they are congeneric with each other and with the Mediterranean species, all these species being too remotely separated in distribution. The other species, *L. caroli*, was described from Darjeeling, India, as occurring on tea plant, Theaceae. In the present paper it is removed from *Lineaspis* to the new genus *Himalaspis*.

The second-instar male of *Himalaspis clerodendri* is heteromorphic and of a type found in Chionaspidina, and the genus *Himalaspis* may rightly be referred to this subtribe. It is uncertain whether the similarities among the adult females of all the species mentioned above involve convergence or not. So far as the adult females are concerned, there seems to be no good reason to believe that these species, while differing in the presence or absence of gland spines between the median trullae, belong to quite different groups.

The genus *Himalaspis* as understood in this paper is restricted to a narrow range in distribution, the two species inhabiting Midland hills of the Himalayas.

I have been impressed with a close similarity between *Himalaspis clerodendri* and *Poliaspis media* Maskell, the type species of *Poliaspis* Maskell. The figure of *P. media* presented by Ferris (1938) shows elongate and spiniform marginal gland spines on the pygidium and numerous spinules on the ventral surface of the thorax—characters also possessed by *Himalaspis clerodendri*. However, *Poliaspis* is restricted to the Australian region (Australia and New Zealand) and, so far as based on some other species, should be closely related to *Pseudaulacaspis* MacGillivray, which belongs to the subtribe Fioriniina.

Himalaspis clerodendri, sp. nov.

Material examined. Collected in Nepal on *Clerodendron viscosum* and *C. infortunatum* (Verbenaceae) (identified at Department of Medical Plants, Nepal Government): Dhankuta, Kosi, East Midlands, altitude ca. 1000–1100m, on *C. viscosum*, 21 XI 1983 [83NPL-223] and on *C. infortunatum*, 22 and 23 XI 1983 [83NPL-234 and –243]; on the way from Kaski to Pokhara, altitude ca. 800m, and at Begnas Tal, altitude 630m, Pokhara District, Gandaki, western Central Midlands, on *C. viscosum*, 8 and 11 XII 1983 [83NPL-306 and 335].

Female and male tests occurring on the leaves; female tests more abundant on the upper surface and male tests on the lower surface of the leaves. Female test elongate, convex dorsally, irregularly incised laterally and variously curved owing to dense hairs of the leaves, white, with exuvial casts brown. Male test non-carinate, erect. The body of the adult female is usually distorted, often badly, in accordance with the irregularly shaped test. The description of the adult female is based on about 30 specimens prepared from material collected on *Clerodendron infortunatum* [83NPL-234]; this host plant has the leaves less densely hairy, causing less distortion to the insect body.

Holotype: adult female, mounted from material 83NPL-234, deposited in the

collection of Laboratory of Systematic Entomology, Graduate School of Agriculture, Hokkaidô University, Sapporo, Japan.

Adult female (Figs 5 and 6). Body fusiform, with free abdominal segments moderately lobed laterally; when full-grown, with pygidial margin set back on ventral surface, median and second trullae scarcely projecting, and orifices of marginal macroducts distorted. Median trullae notched once or twice on each side; second trullae with outer lobule blunt or rounded apically. Marginal gland spines slender and spiniform, 1 on each of abd V–VIII (the mesalmost occurring just laterally to median trulla). Small conical gland spines occurring submarginally on ventral surface of prepygidial abdominal segments, forming a group or an irregular transverse row on each segment, their numbers as follows on each side: 3–11 on abd I, 3–8 on II, 5–10 on III, and 4–6 on IV; a few minute gland spines occurring posterolaterally to each posterior spiracle. Marginal macroduct occurring just mesally to second trulla (on abd VII) associated with a slender sharp marginal prominence. Numbers of submedian dorsal macroducts as follows on each side: 2–5 on abd VI, 4–7 on each of III–V; 1–6 submedian dorsal ducts on II, often replaced by microducts; 1–4 submedian dorsal microducts on I. Submarginal dorsal macroducts as follows on each side: 2–7 on abd VI (probably representing infrasegmental row), 3–7 in segmental and 1–4 in infrasegmental row on V (infrasegmental row being situated anteromesally to lateralmost marginal macroduct, which originally belongs to the fourth abdominal segment), 5–10 in segmental and 2–7 in infrasegmental row on IV, 4–11 in segmental and 4–9 in infrasegmental row on III; 11–18 on abd II, scattered or tending to form segmental and infrasegmental rows (a few of infrasegmental macroducts often occurring on ventral surface). Lateral macroducts broadly scattered on abd I and meso- and metathorax; their numbers on each side: 16–28 on abd I, 14–25 on metathorax, and 12–22 on mesothorax. Perivulvar disc pores present in 5 groups; 8–24 (mean 15.0) in median group, 8–27 (20.1) in each anterolateral group, and 14–23 (17.4) in each posterolateral group. Antennae separated from each other by a space narrower than width of mouth-parts, each with a slender seta, sometimes with 2 setae unequal in length. Anterior spiracles each with a compact group of 7–16 3-locular disc pores just anteriorly to peritreme; posterior spiracles each with 1–5 just anteriorly to mesal end of sclerotized plate. Numerous sclerotized spicules densely strewn medially on ventral surface of meso- and metathorax and abd I.

Second-instar female (Fig. 7). Similar to adult female in pygidial margin; outer lobule of second trulla conical. Long marginal gland spines on abd VI–VIII, 1 on each segment. Marginal macroducts on abd I–VII, 1 on each segment. Anus close to base of pygidium.

Second-instar male (Fig. 8). Heteromorphic, with small ducts strewn on abdomen. With small gland spines marginally on pygidium, otherwise with no marginal appendages.

First-instar female (exuvial cast) (Fig. 7). Head with a pair of enlarged dorsal ducts. Antennae 6-segmented, terminal segment not annulate, as long as preceding segments combined.

Remarks. Generally, adult females occurring on *Clerodendron viscosum* have the body irregularly curved owing to the dense hairs of the host plant's leaves, and it is often difficult to count their macroducts exactly. In the numbers of the perivulvar disc pores, about 30 specimens mounted from material 83NPL-335 (collected at Begnas Tal on *C. viscosum*) do not substantially differ from the specimens from *C. infortunatum*.

This species is closely similar to *Himalaspis caroli* (=*Chionaspis caroli* Green). Information available from Green's description and figures of *C. caroli* is limited, but *Himalaspis clerodendri* does not completely agree with them. *H. clerodendri* may be recognizable most easily in having a number of macroducts on the meso- and metathorax, whereas *H. caroli* has macroducts on the thorax only occasionally. Another conspicuous character of *H. clerodendri* is the occurrence of dense spicules on the median ventral surface of the meso- and metathorax and the base of the abdomen; these spicules, being enormous in number, are hard to overlook, whereas Green's description has no mention of such spicules. In *H. clerodendri* the anus overlaps with the median perivulvar disc pores, whereas in *H. caroli* it is situated a little anteriorly to the level of these disc pores. *H. clerodendri* has the perivulvar disc pores tending to be more numerous than in Green's description. Furthermore, the female tests of *H. clerodendri* occur irregularly on the leaf blade, whereas those of *H. caroli* are disposed on the recurved edge of the leaf.

Himalaspis caroli, comb. nov.

Chionaspis caroli Green, 1919: 434 ['On the leaves of tea plant: Darjiling'; 'The female insects disposed along the recurved edge of the leaf; male puparia in small groups on the undersurface of the leaves', 'not carinated'].

Lineaspis caroli: Borchsenius, 1966: 104 [catalogued].

Remarks. Green's description and figures give only a rough image of this species as stated above, while, so far as I am aware, there has been published no further study on it. However, his figure of the pygidium shows main generic characters of *Himalaspis*, and I have no doubt that the species belongs to the genus.

Further remarks

Himalaspis is referable to the Chionaspidina on the basis of the second-instar male of the type species. *Lineaspis* differs from *Himalaspis* especially in having a pair of gland spines between the median trullae. It is very similar to *Himalaspis* in other features and, therefore, probably belongs to the Chionaspidina. On this understanding, primitive Chionaspidina should be provided with widely separated non-zygotic median trullae and a pair of gland spines between these trullae. *Lineaspis*, however, is apparently specialized (in common with *Himalaspis*) in the median trullae that are considerably reduced in size, and have no trace of the third pair of trullae. Thus *Lineaspis* does not faithfully reflect the primitive pattern of the Chionaspidina.

The second-instar male of *Keralaspis piperis* is almost homomorphic and little helpful for finding the taxonomic position of the genus. However, by analogy with the *Himalaspis*-*Lineaspis* context stated above, it is possible to suppose that the genus *Keralaspis*, too, belongs to the Chionaspidina. If this view is correct, the genus should reflect the generalized primitive pattern of the subtribe to a considerable degree. This pattern may be described as follows: median trullae well developed, widely separated from each other and not yoked together basally; lateral trullae also well represented, occurring at least in two pairs, with the lobules similar in size and shape; a pair of well-developed gland spines occurring between the median trullae; marginal macroducts not completely differentiated, tending to form continuous series with submarginal macroducts; submarginal macroducts (and possibly also submedian macroducts) arranged in segmental and infrasegmental rows.

Both *Keralaspis* and *Himalaspis* are provided with six-segmented antennae in the first instar. I am not certain that in the first-instar Diaspidini the six-segmented antenna is primitive in comparison with the five-segmented. The numerical reduction of segments may be a plausible evolutionary trend, but the possibility of reversal is not to be excluded.

I have been fluctuating as to the number of the antennal segments in the Diaspidini and its taxonomic significance. In my very early study I postulated that the antennae in the tribe should have five segments and that apparent more segments should be due to a pronounced infrasegmental constriction or constrictions. In my later studies with more powerful microscopes, and especially with the aid of phase-contrast microscopy, I have been convinced that in a considerable part of the tribe the antennae are definitely six-segmented. However, the number of the antennal segments is not always easily decided according to the condition of specimens. Furthermore, the antennal segmentation may not always be free from abnormalities. The question also remains whether the antennal segmentation is always stable in a genus.

The technical background has also improved our knowledge about the number of loculi on the spiracular disc pores. These pores in the Diaspididae were once supposed to be quinquelocular, but trilocular and quadrilocular pores, too, are known now. The taxonomic significance of these different types of pores is still not completely clear.

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Fig. 1. *Keralaspis piperis*, adult female (teneral): B, antenna; C, pygidial margin. Scales: A, 100µm; B and C, 10µm.

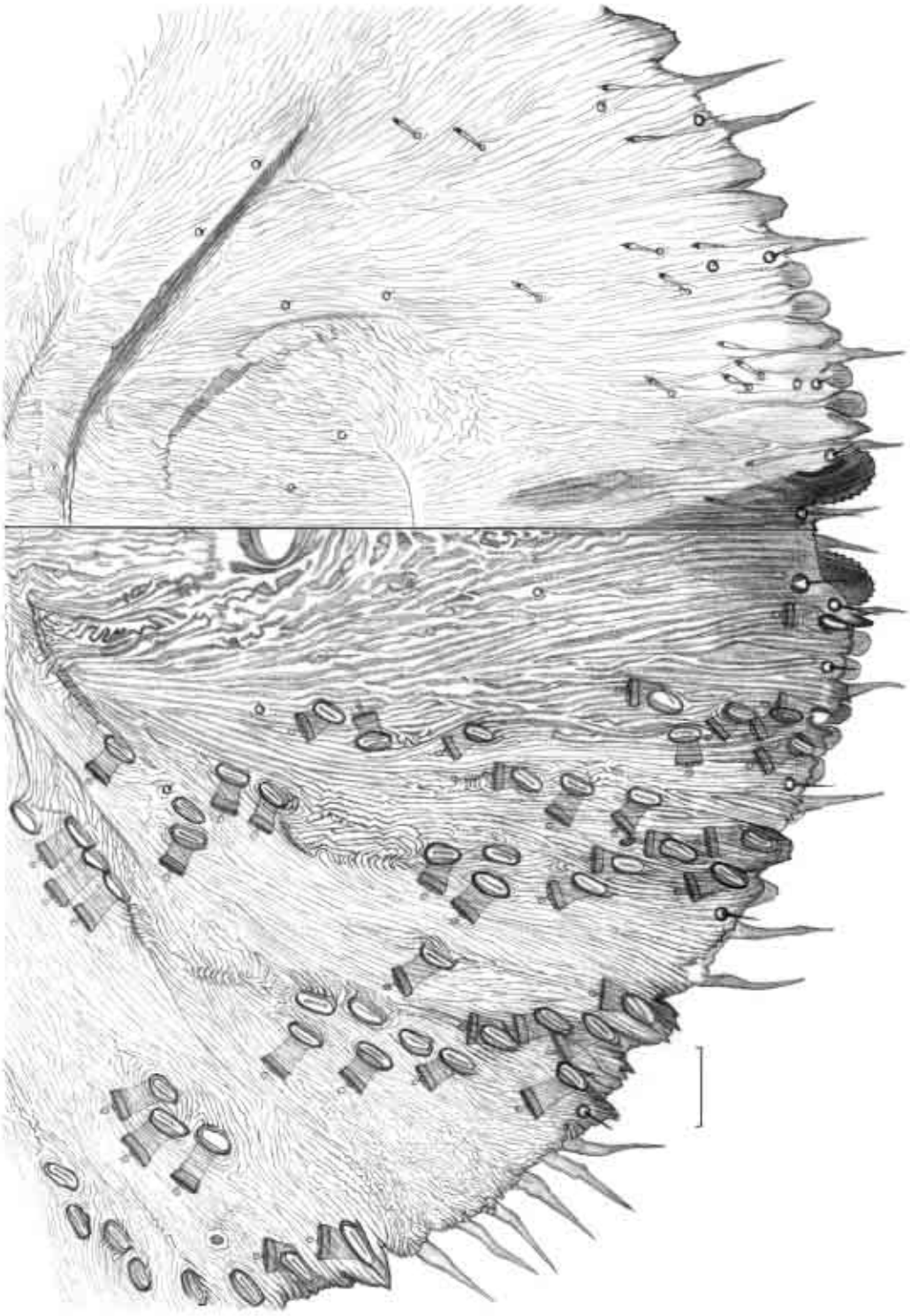

Fig. 2. *Keralaspis piperis*, adult female: pygidium. Scale: 10µm.

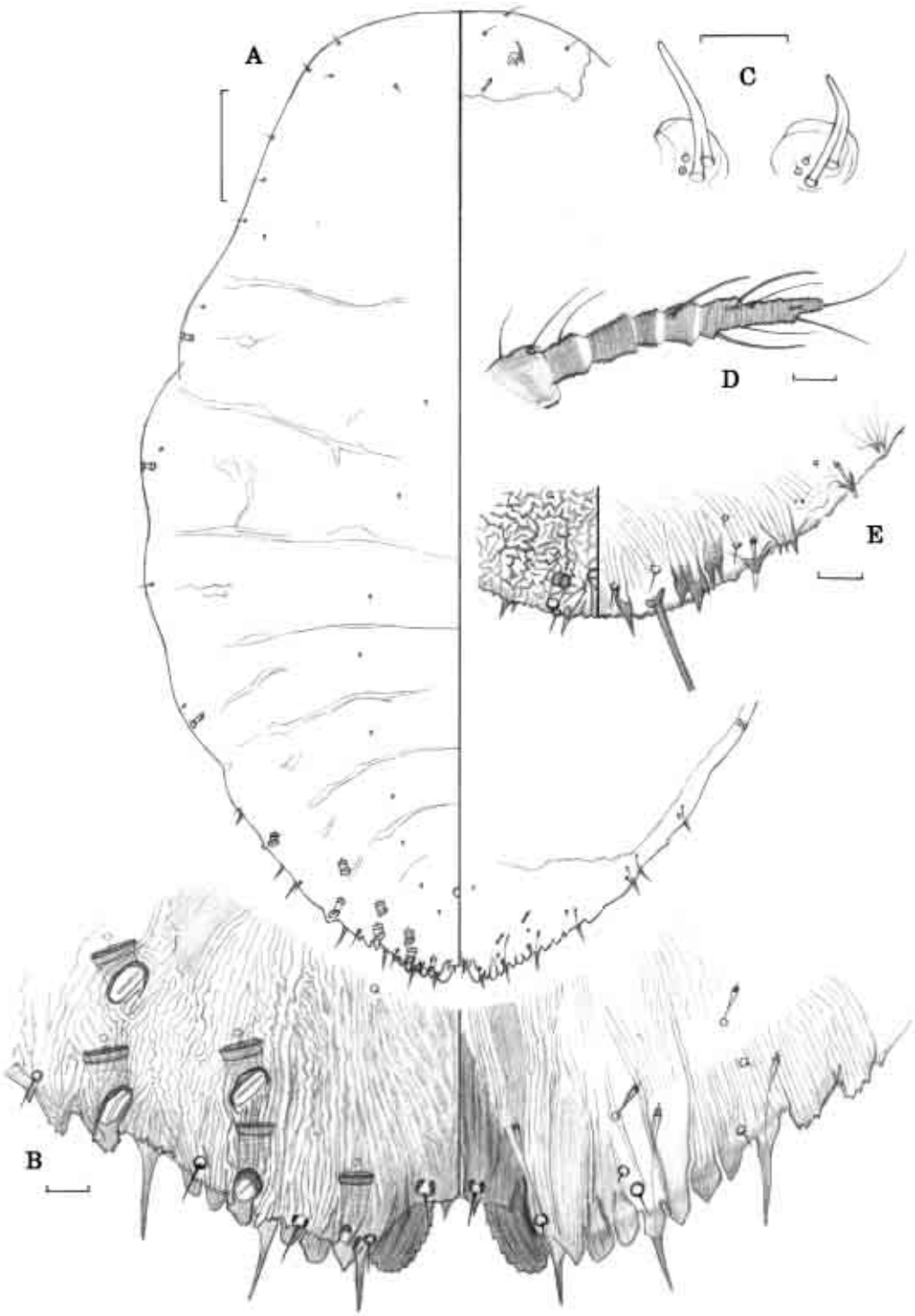

Fig. 3. *Keralaspis piperis*, first- and second-instar females, exuvial casts: A, second-instar female; B, pygidium of second-instar female; C, antennae of second instar female; D, antenna of first-instar female; E, caudal margin of first-instar female. Scales: A, 100µm; B–E, 10µm.

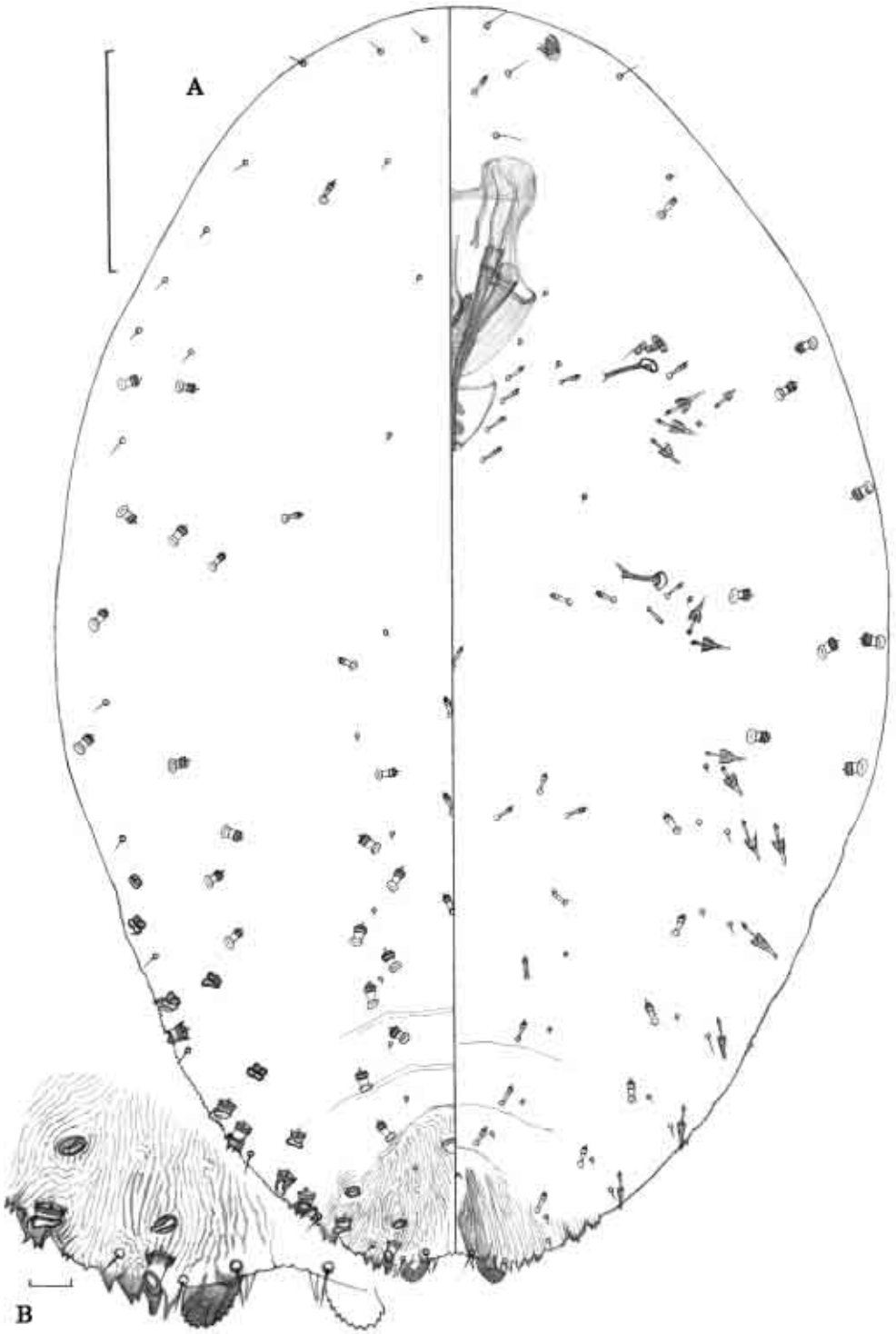

Fig. 4. *Keralaspis piperis*, second-instar male: B, apical area of pygidium, dorsal surface. Scales: A, 100μm; B, 10μm. This figure may not be exact in the positions of some setae and microducts on the prosoma owing to the rather poor condition of the specimen.

Fig. 5. *Himalaspis clerodendri*, adult female (teneral): B, antennae; C, anterior spiracle with secretory organs around; D, posterior spiracle and dense spicules on thorax; E, apical area of pygidium [83NPL-335]. Scales: A, 100µm; B–E, 10µm

Fig. 6. *Himalaspis clerodendri*, adult female: pygidium [83NPL-234]. Scale: 10µm.

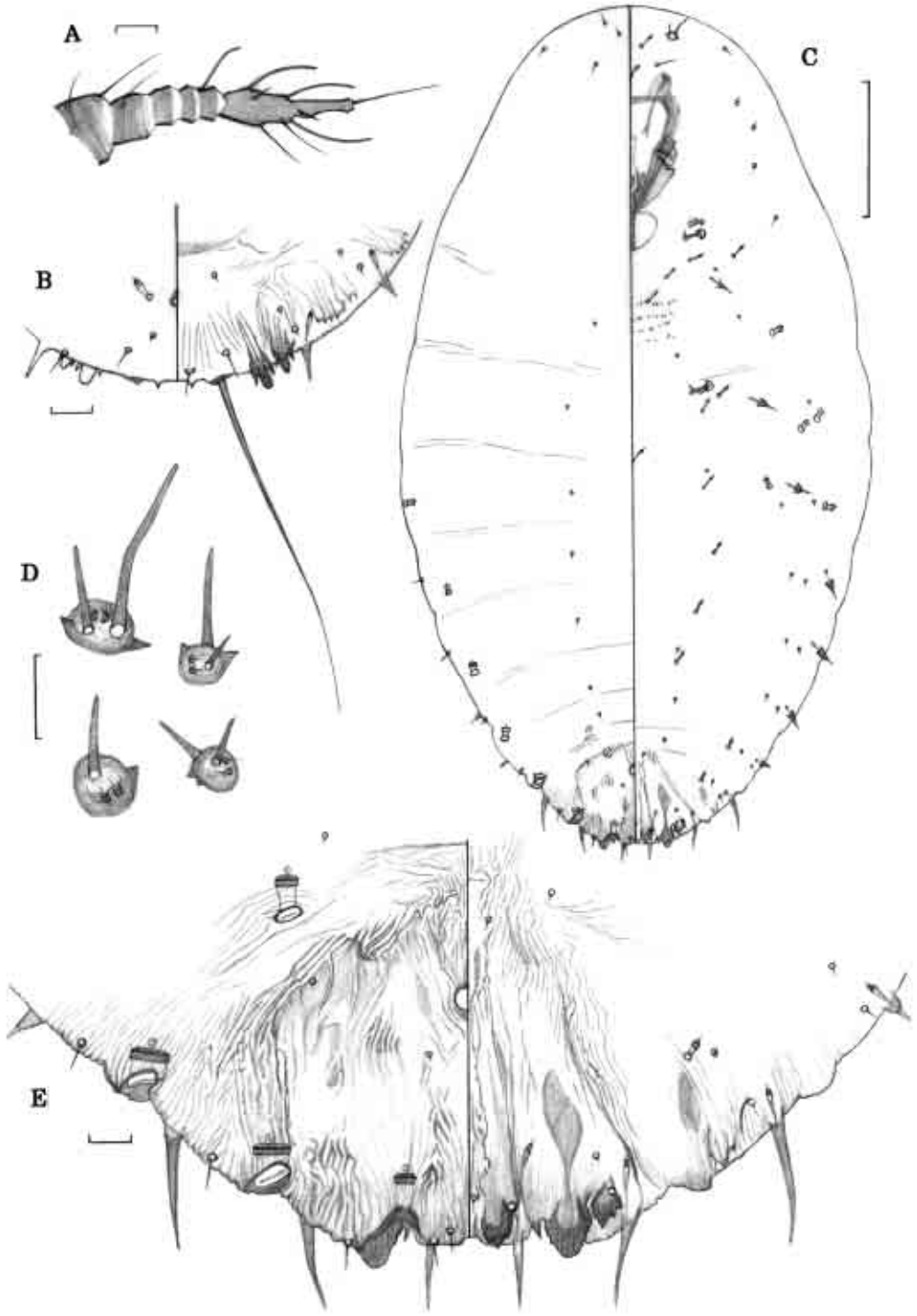

Fig. 7. *Himalaspis clerodendri*, first-instar female, exuvial cast, and second-instar female: A, antenna of first-instar female; B, caudal margin of first-instar female; C, second-instar female; D, antennae of second-instar female; E, pygidium of second-instar female [83NPL-335]. Scales: C, 100µm; A, B, D, and E, 10µm.

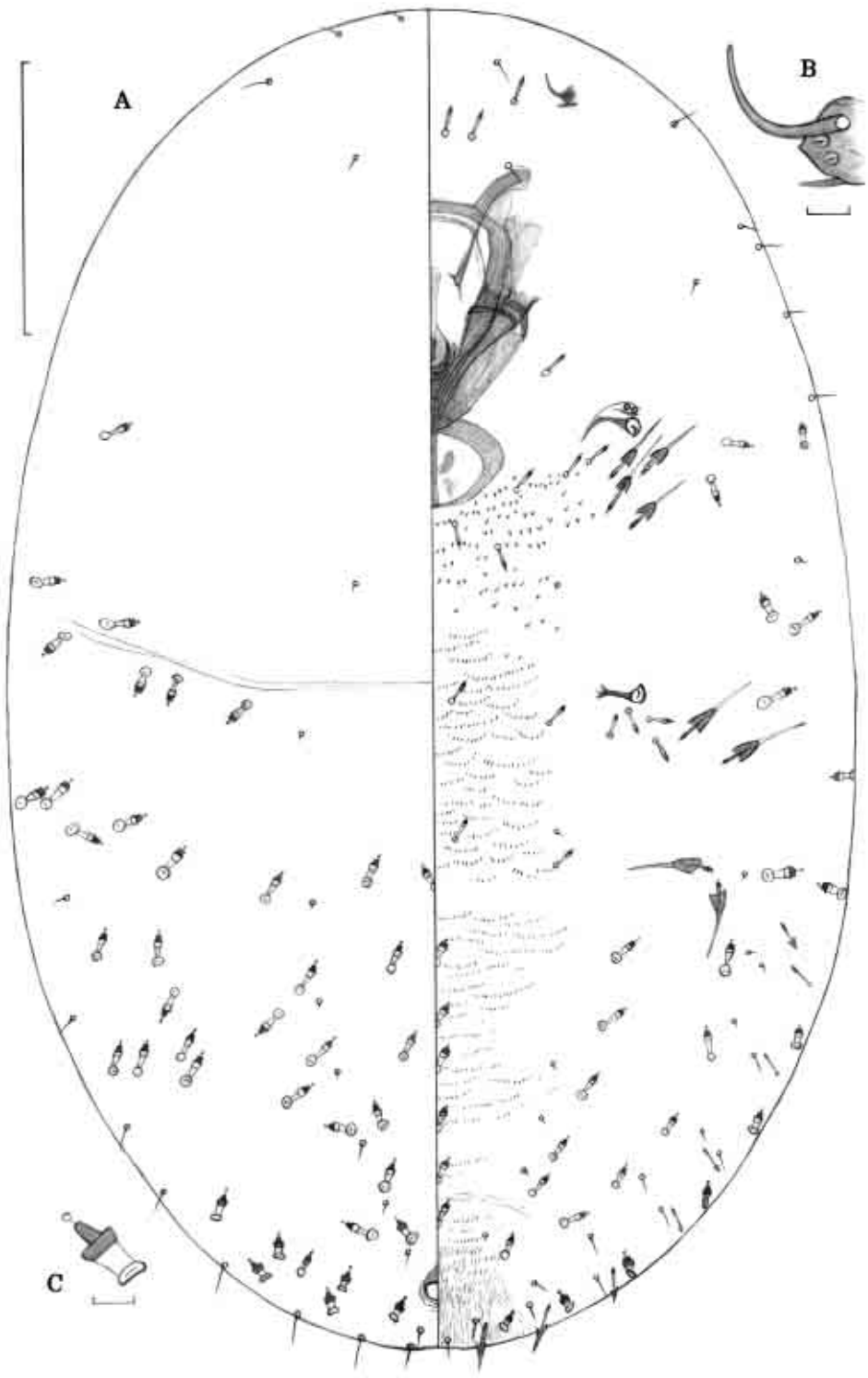

Fig. 8. *Himalaspis clerodendri*, second-instar male: B, antenna; C, modified duct [83NPL-335]. Scales: A, 100µm; B and C, 10µm.