

Pediculaster perottii spec. nov. (Acari: Pygmephoridae), phoretic females collected from *Haematobia* (Diptera: Muscidae) in Argentina, South America

by A. M. CAMERIK & S. H. COETZEE

Abstract

Pediculaster perottii spec. n. is described. It was collected from *Haematobia irritans* L. (Diptera: Muscidae, Stomoxynae) in a field at Miramar in the south-eastern part of the Buenos Aires Province in Argentina, South America. The shape of the pharyngeal pumps was used as a taxonomic criterion in addition to the traditional morphological structures. *P. perottii* resembled *P. copridis* CAMERIK & COETZEE 1998, collected from cattle dung in South Africa.

The second author (SHC) collaborated by taking micrographs through the interference contrast optical techniques. However, using these optics, the pharyngeal complex was not always clearly visible or obscured by exoskeletal structures. In addition, the shape of the individual pumps often depended on the angle at which these pumps were viewed.

With the Confocal Laser Scanning Microscope (CLSM) facility on the same Zeiss 410 CLSM, using the correct laser beams, the pumps autofluoresced, which made it possible to optically section them. The sequence stack which was obtained was rendered into a 3D volume, which was rotated through its Y-axis to visualise the pumps' real shape. This rotation around the X-axis disclosed that the pump was not a flat, 2-D structure but that it was thicker around the oesophagus and tapered off in the lateral direction, giving it a biconvex shape.

Key words: Acari, Pygmephoridae, *Pediculaster*, new species, *Haematobia irritans* L., 3-D Laser Scanning images, Argentina, South America.

Résumé

Pediculaster perottii sp. nov. est décrit par l'auteur. Les espèces sont récoltées de *Haematobia irritans* L. (Diptera: Muscidae, Stomoxynae), d'une campagne à Miramar, dans la partie sud-est de la Province de Buenos Aires, Argentina, l'Amérique du Sud.

Mots-clefs: Acari, Pygmephoridae, *Pediculaster*, new species, *Haematobia irritans* L., 3-D Laser Scanning images, Argentina, South America.

Introduction

In a series of articles CAMERIK & UECKERMANN (1995); CAMERIK (1996) and CAMERIK & COETZEE (1997, 1998)

described phoretic females of 6 new species of *Pediculaster* (Acari: Pygmephoridae) collected from cattle and horse dung in South Africa. Recently the senior author received 27 *Pediculaster* specimens for identification, collected by A. PEROTTI from the horn fly, *Haematobia irritans* L. on cattle in South America.

Haematobia irritans L. was recorded for the first time from northern Argentina in 1991 and by 1992 had spread to nearly all cattle farms in the country (PEROTTI, pers. comm.). Previously RACK (1975) described *P. domrowi* from *Haematobia exigua* de Meijere collected in Australia and later MAHUNKA (1981) *P. hematobii*, presumably also from a *Haematobia* species from St. Lucia, an island of the Antilles in Middle America.

Materials and Methods

In autumn 1993, several *Haematobia irritans* L. specimens, carrying a mean of 37 *Pediculaster* specimens per fly, were netted from dairy cattle in a field near Miramar, the south-eastern part of the Province of Buenos Aires. *Pediculaster* specimens collected from these flies were cleared in lactic acid (50%) and mounted in Berlese. The holotype was drawn and examined through a phase-contrast microscope by oil immersion.

The terminology of structures and setal designation used here are those of LINDQUIST (1986) and later applied to Pygmephoridae by CAMERIK & COETZEE (1998).

Photographs of the pharyngeal pump system were taken using a Zeiss 410 Confocal Laser Scanning Microscope under a 40x/1.2 water immersion objective. The structures autofluoresced when struck with the combination of 488/568 laser beams. A pinhole in the back focal plane of the image of the CLSM allowed one to take an optical, in-focus, thin section of the object. The pinhole size determined the section thickness and also cut out all the out-of-focus information. A stepper motor moved the sample towards the objective lens, allowing in-sequence thin optical sections of the autofluorescing pumps to be taken



Figs. 1-2. – *Pediculaster perottii* sp. n. Phoretic female – *Idiosoma*, dorsal view (paratype 2) (1); *Idiosoma*, ventral view (holotype) (2).

without physically cutting sections of the material. These optical sections were then computed into a 3-D image. This 3-D volume was rotated through different angles so as to visualise the real shape of the pumps. To obtain an interference - free image, unwanted frequencies from the emission spectrum of the object were excluded with Long Pass (LP) filters LP 515 or LP 590. These filtered out other autofluorescent structures of wavelengths shorter than 515 nm or longer than 590 nm.

Transmission micrographs, Photographs 1 and 4, were taken with the same microscope through the Differential Interference Contrast (DIC) optic system. Both sets are presented here to allow comparison.

Measurements (in μm) were taken from the holotype and 9 paratypes as described in CAMERIK & UECKERMANN (1995) and CAMERIK (1996). The numbers in parenthesis, following the measurements, are the standard deviations.

Body parts were measured (400x magnification) by means of a Panasonic WV GL Digital video recorder mounted on a Leitz Laborlux phase-contrast microscope connected to a computer using the NEWFIPS programme developed by the CSIR (South Africa). It is important to note that the body width in our measurements comprises the lengths of the strongly sclerotised apodemes II and III between the coxae of legs II and III. Body length excludes the gnathosoma. Beginning at the Y-shaped fork of apodemes I (*apl*) and running over the prosternal apodeme (*appro*), the poststernal apodeme (*appo*) ends at the posterior edge of pseudoanal segment (*Ps*) between the first pseudoanal setae (*ps₁*).

Type material: Holotype and 26 paratypes collected from *Haematobia irritans* L. from a field at Miramar in the south-eastern part of the province Buenos Aires, Argentina. Holotype and 3 paratypes are deposited in Museo Argentino de Ciencias Naturales, coleccion de Entomolo-

gia y Acarologia, Buenos Aires (Argentina), 3 paratypes in the Plant Protection Research Institute (PPRI), Pretoria, South Africa; 3 paratypes in the Zoological Museum Hamburg (ZMH), Germany, 3 paratypes in IRSNB, Brussels, Belgium; 3 paratypes in the US National Museum, Washington, D.C., USA, 3 paratypes in the Natural History Museum, Entomology (Acarology) in London and the remaining specimens in the author's collection.

Pediculaster perottii spec. nov.
(Figs. 1-12; Photos 1-5; Plate 1)

Phoretic female, holotype (Figs. 1-12). Idiosoma, excluding gnathosoma, measured on the ventral side: length 264.28 µm (28.29); width of apodemes 2 (*ap₂*) 63.9 (6.0); *ap₃* 87.1 (8.3).

Exoskeleton strongly sklerotized, punctuate, yellow to light brown in colour. Setae complete, as described for

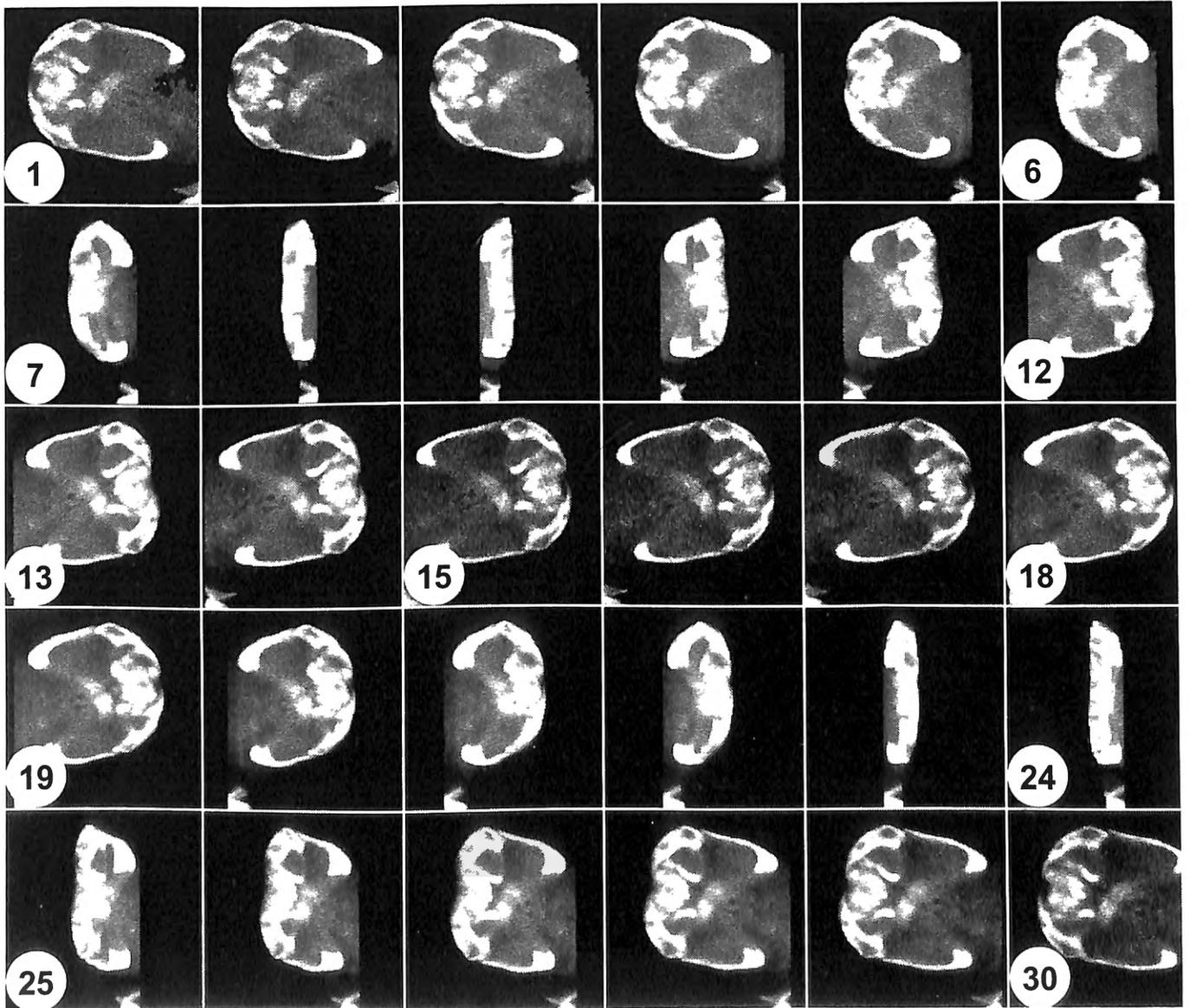
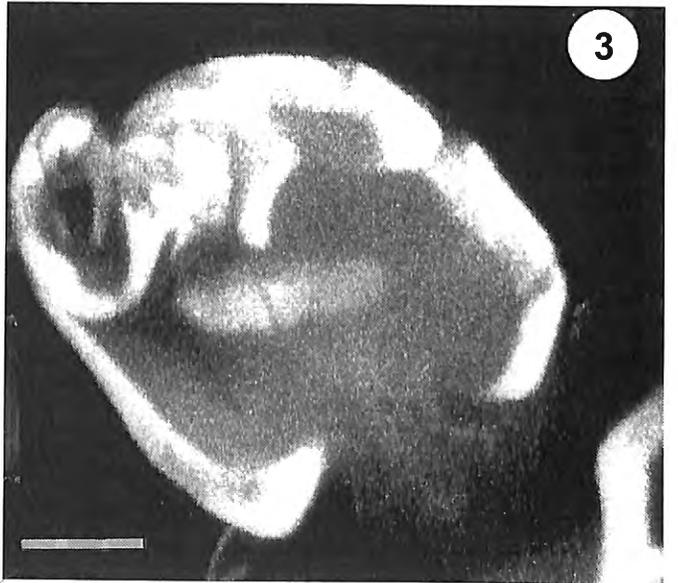
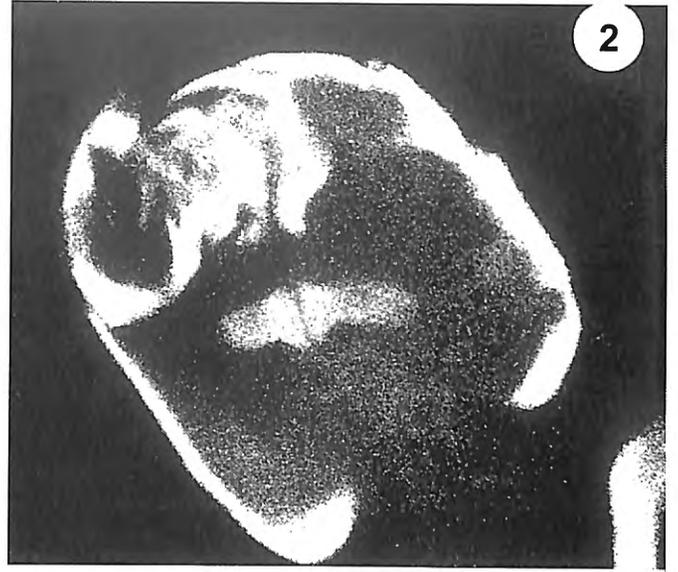
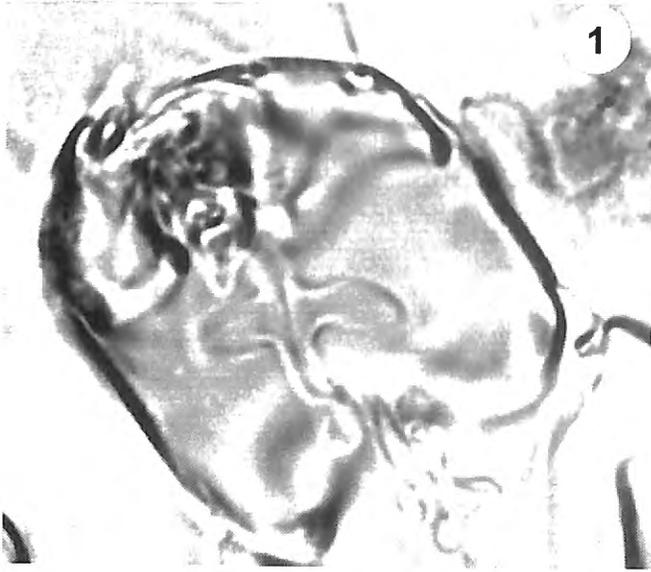


Plate 1. – *P. perottii* sp. n. – Pharyngeal pump 1, CLSM, filter LP 590, rotated in steps of 12° over 360° about the Y-axis.



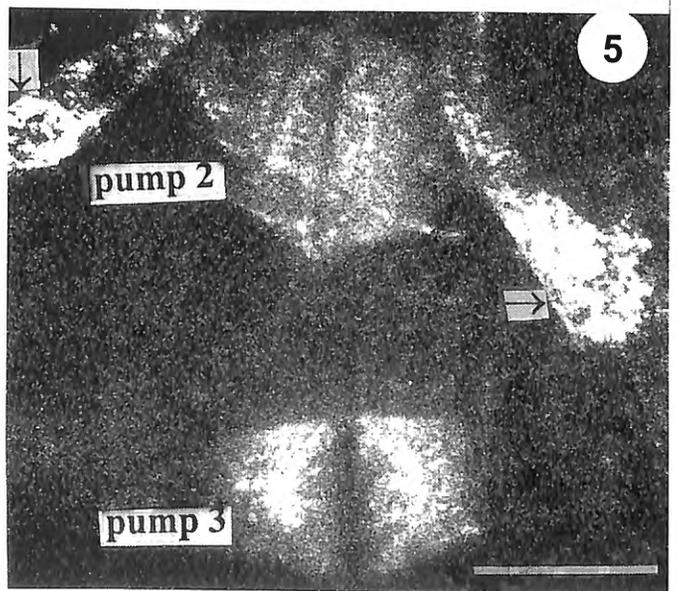
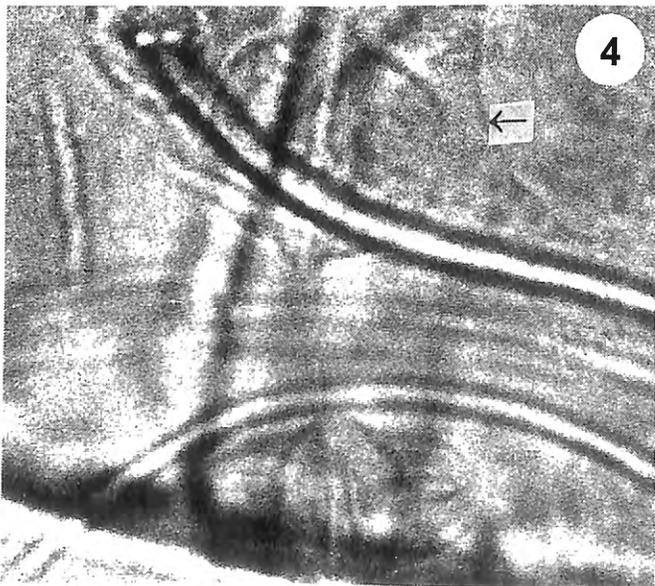
Photograph 1. - *P. perottii* sp. n. - Pharyngeal pump 1. Differential Interference Contrast (DIC).

Photograph 2. - *P. perottii* sp. n. - Pharyngeal pump 1. Confocal Laser Scanning Microscope (CLSM, filter LP 590).

Photograph 3. - *P. perottii* sp. n. - Pharyngeal pump 1, CLSM, filter LP 590, rotated -12° about the Y-axis. Bar provided is $10\mu\text{m}$ for photographs 1-3.

Photograph 4. - *P. perottii* sp. n. - Pharyngeal pumps 2-3. DIC.

Photograph 5. - *P. perottii* sp. n. - Pharyngeal pump 2-3. CLSM, filter LP 515. Bar provided is $10\mu\text{m}$ for photographs 4-5.

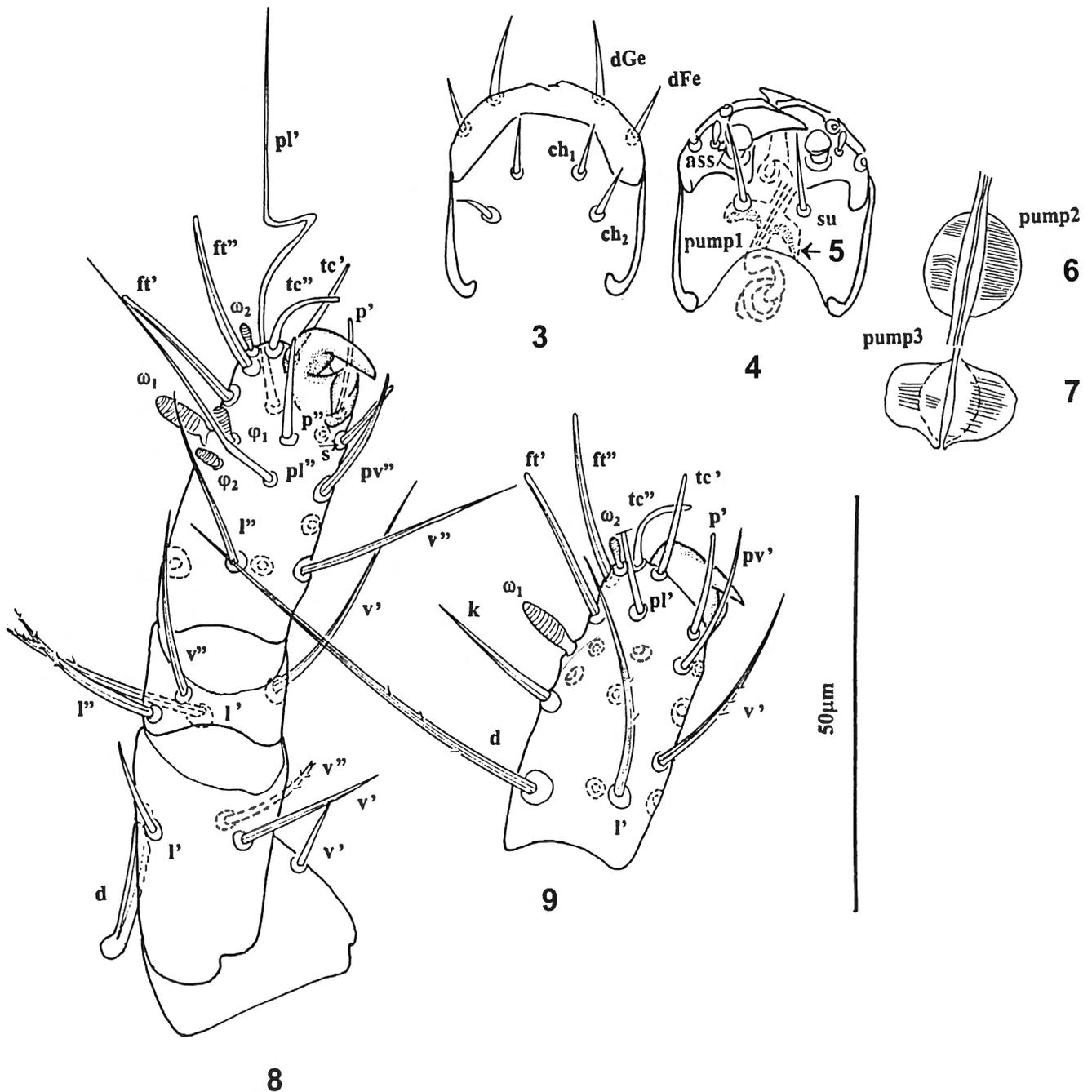


the genus by CAMERIK & COETZEE, 1997. Except for *e* and *h*₂, all dorsal idiosomal setae barbed; ventral setae all smooth.

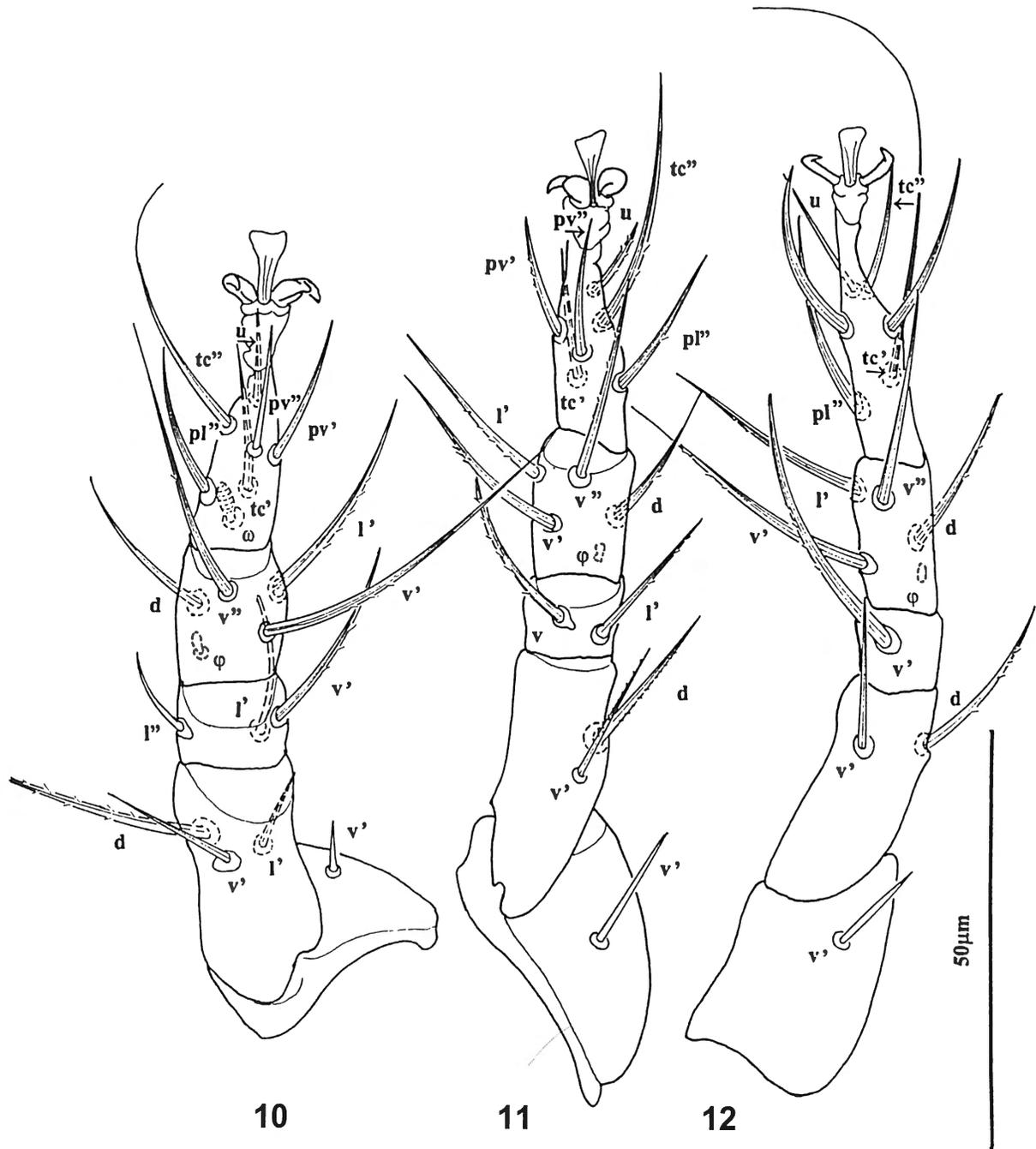
Gnathosoma (Figs. 3, 4): Gnathosomal capsule (*Gn*) 26.5 (2.4) long, 26.5 (2.2) wide.

Dorsal cheliceral setae smooth, *ch*₁ and *ch*₂ equally long, femoral (*dFe*) shorter than genual (*dGe*). Ventral subcapitular seta (*su*) reached beyond accessory setigenous structure (*ass*), which is closely associated with a solenidion.

Pharyngeal pumps (Figs. 5-7; Photos 1-5; Plate 1): all pumps striated; pump 1 (Fig. 5; Photos 1 and 2) situated medio-centrally in the gnathosoma, appearing as a flat, ribbon-shaped structure, that tapered off distally. The left flap though, seemed shorter than the right. It was possible that this flap was bent towards the ventral side. Since Photo 2, even after slight rotation (Photo 3), did not show the flap's distal part, it was thought that this part of the structure was it excluded and the 3-D sectioning incomplete. Another 3-D section stack of a second specimen was compiled and rotated through its Y-axis



Figs. 3 - 12. - *Gnathosoma*, dorsal view (3), *Gnathosoma*, ventral view (4), Pharyngeal pump 1 (in gnathosoma, Fig. 4), pumps 2-3 (paratype 1) (6, 7).
 Leg I, ventro-lateral view (paratype 3) (8) Tibiotarsus leg I in dorso-lateral view (paratype 3) (9); Leg II, ventral view (paratype 3), (10); leg III, ventral view (11); leg IV, ventral view (12).



(Plate 1). The first picture of the sequence showed that the pump was indeed symmetrical and each part convex and rectangular in shape. However, at 180° rotation, pump 1, like pumps 1, 2 and 3 of the closely related *P. copridis* (see Photos 2 and 4 in CAMERIK and COETZEE 1998) was anticipated to show its concave side. Surprisingly the structure was convex once more (Plate 1, picture marked "15" of the sequence). It is therefore suggested that each individual flap of the pump, in cross section, is eccentrically biconvex, with its thickest diameter closest to the oesophagus (Photo 3). A similar biconvex shape is suggested for cross sections through pumps 2 and 3.

Pumps 2 and 3 (Figs. 6 and 7; Photos 4 and 5) are situated under coxisternal plates II (barely visible under transmitted light, Photos 4 and 5); pump 2 hexagonal in shape, the same width or slightly narrower than rectangular pump 3, as depicted in Photos 4 and 5. Pumps 2, 3 (Figs. 6 and 7) were drawn from 2 different specimens (pump 2 from holotype, pump 3 from paratype 2); therefore their relative sizes in the drawings are not representative for the species. The serpentine structures on either side of pump 2 (Photos 4 and 5, see arrows) are the distal endings of the second ringed tube, distad of the tracheal atria (see CAMERIK & UECKERMAN, 1995). The rod across pump 2

in Photo 4 is seta Sc_2 . The dark band on pump 3's posterior end is the shadow of sejugal apodeme (apsej), see Fig. 2.

Idiosomal dorsum (Fig. 1). Prodorsal shield (PdS) rectangular; stigmata close together, anterior to setae v_1 . Setae v_1 22.0 (2.1) slightly shorter than v_2 23.2 (1.6); trichobothrium (Sc_1) capitate, long-stemmed and in round bothridia, measuring 16.6 (1.3); Sc_2 robust, 52.8 (4.5) long. Idiosomal dorsal setae c_1 43.5 (4.5), shorter than c_2 measuring 52.6 (7.3); seta d 41.9 (2.6); seta e 8.9 (1.4), short and closely adjoined to long seta f 41.7 (4.4). Seta h_1 robust 34.9 (3.4) very close to smooth, thin and short seta h_2 8.0 (1.4). Cupules not visible.

Idiosomal venter (Fig. 2) – Apodemes (ap) 1-4 strongly sclerotized; ap_5 are short sclerotized structures at the posterior basis of coxal plates IV. Presternal ($ap\ pr$) and poststernal apodemes ($ap\ po$) incomplete. Coxisternal plates with 4 x (3+3) pairs of short, smooth setae (1-4; a-c); setae 4b the longest. Tegula (Tg) and lateral extensions (La) posteriorly rounded; aggenital plate (Ag) with lyrate posterior edge. Pseudoanal setae (ps 1-3) smooth, ps_2 the longest.

Legs (Figs 8-12) – The distribution of the leg setae as summarised in Table 1 in CAMERIK & COETZEE (1997), with the following corrections: Legs II and III, tibial solenidion being “ ϕ ” instead of “ u ”. Empodia of legs II-IV fan-shaped, longer than claws. Claws I robust, single and fitting into counter piece of fused setae $u-u'$, claws II and III with pads, claws IV simple.

Leg I (Figs. 8-9) – Length 90.7 (6.0); with a fused tibiotarsus. Tibiotarsal ω_1 and ϕ_1 appear to be horizontally aligned. Eupathidia blunt-tipped, except for acute k . Setae v' , l' and d slightly barbed, all other tibiotarsal setae smooth. Genual setae l' and l'' terminally barbed, both v' and v'' smooth. Femoral v'' terminally barbed, other setae smooth. Trochanteral v' smooth.

Legs II (Fig. 10): length 88.2 (6.7) Tarsus: u short and smooth, tc' shorter than whipped tc'' , pv' slightly stouter than pv'' , ω stout, club-shaped;. Tibia: except for d all setae slightly one-sidedly barbed, v' longer than v'' , solenidion ϕ small. Genu: v' one-sidedly barbed, other setae smooth, l'' shortest. Femoral d stout and strongly barbed; v' shorter than d , but longer than l' . Trochanter: v' short and smooth.

Leg III (Fig. 11): Tarsal seta u short and barbed; smooth tc' shorter than one-sidedly barbed tc'' , pv' barbed on one side, slightly shorter than smooth pv'' , pl'' very slightly barbed on one side. Tibial setae all one-sidedly barbed, ϕ small. Genual seta barbed on one side. Femur: d robust, barbed and longer than barbed seta v' . Trochanter: v' smooth.

Leg IV (Fig. 12): Tarsal setae all smooth, tc' whipped and much longer than tc'' , pv' and pv'' of equal length. Except for v'' all tibial setae slightly one sidedly barbed; ϕ small. Genual v' stout and one-sidedly barbed. Femoral v' smooth and shorter than one-sidedly barbed d . Trochanter: v' smooth.

Etymology: The name “perottii” is given in honour of acarologist Alejandra Perottii, who collected the specimens in Argentina.

Discussion

Comparing the CLMS photos of pumps 1-3 in *P. perottii* (Photos 2, 3 and 5 in the present article) with *P. copridis* (Photos 2 and 4 in CAMERIK & COETZEE, 1998), it seems that these structures in the last set of photos are concave when rotated over 180°, while in the first set, these appeared to be biconvex, as was mentioned in the description of them given above. The question is whether this difference is real or an artefactual. It is possible that, at preservation, the supposedly muscular part of the pumps in *P. copridis* was relaxed, while it was contracted in *P. perottii*. Further studies on life specimens could give insight on the movements of these structures and possibly provide an answer to this question.

Pediculaster perottii sp. n. with its very short and smooth setae e and h_2 , size and shapes of pseudo-anal setae ps_{1-3} and tibiotarsal solenidia ω_1 and ϕ_1 in the same horizontal plane, is morphologically like *P. copridis* CAMERIK & COETZEE, 1998. The main differences between the two species are: the first pharyngeal pump (Photo 1), rectangular in the new species, is sickle-shaped in *P. copridis*. Solenidia ω_1 and ϕ_1 are of different lengths, tectals $tc' = tc''$ 14.4 (0.5); fastigials $ft' = ft''$ 20.2 (0.7) relatively long in *P. perottii*, while in *P. copridis* the solenidia are equally long and the mentioned eupathidia $tc' = tc''$ 5.8 (0.2) and $ft' = ft''$ 11.5 (0.3), relatively short. Distance between coxisternal setae $2a$ and $2b$ 15.0 (0.7) and $2b$ and $2c$ 6.7 (0.4) are relatively far apart in the new species and close together in $2a$ and $2b$ 12.0 (0.7) and $2b$ and $2c$ 3.0 (0.2), in *P. copridis*.

Acknowledgements

Dr. A. PEROTTI is thanked for sending the mites and allowing the author to describe the new species. Dr. J. HARRINGTON is gratefully remembered for proof-reading this manuscript and suggesting alterations to improve on the use of the English language. Professor S. H. HANRAHAN of the Zoology Department and Dr. M. J. WITCOMB of the Electron Microscope Unit provided all the facilities needed. Funding for the study was provided by the Research Committee of the University of the Witwatersrand in Johannesburg.

References

- CAMERIK, A.M., 1996. Phoretic females of *Pediculaster gautengensis* sp. n. (Acari: Pygmephoridae) associated with insects collected from dung in South Africa. *Mitteilungen aus dem Hamburgischen Zoologischen Museum und Institut*, 93: 167-176.
- CAMERIK, A. M. and COETZEE, S. H., 1997. The phoretic female of *Pediculaster australis* sp. n. (Acari: Pygmephoridae) from South Africa and new synonyms for *P. morelliae* RACK, 1975. *Bulletin de l'Institut royal des Sciences Naturelles de Belgique*, 76: 33-43
- CAMERIK, A. M. and COETZEE S. H., 1998. Phoretic females of two new species of the genus *Pediculaster* (Acari: Pygmephoridae) from cattle dung in South Africa. *International Journal of Acarology*, 24 (1): 21-31
- CAMERIK A. M. and UECKERMANN, E. A., 1995. *Pediculaster norrbomialis* sp. n. and *P. gracilis* sp. n. (Acari, Heterostigmata: Pygmephoridae) from South Africa, with notes on host and dung preference of their phoretic females. *Mitteilungen aus dem Hamburgischen Zoologischen Museum und Institut*, 92: 73-86.
- LINDQUIST, E. E., 1986. The world genera of Tarsonemidae (Acari: Heterostigmata): A morphological, phylogenetic and systematic revision, with a reclassification of the family-group taxa in Heterostigmata. *Memoirs of the Entomological Society of Canada*, Ottawa 136: 1 - 517.
- MAHUNKA, S., 1981. Milben (Acari) aus St. Lucia (Antillen) I. Tarsonemina, Anoetidae). *Acta Zoologica Academiae Scientiarum Hungaricae*, 27 (3-4): 323-353.
- RACK, G., 1975. Zwei neue Arten der Gattung *Pediculaster* von Australischen Dipteren (Acarina, Tarsonemida, Pygmephoridae). *Acarologia*, 16 (3): 500-505.

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