

Supplementary description of *Dolicheremaeus distinctus* Aoki, 1982 (Acari: Oribatida: Tetracondylidae) on the basis of Indian specimens

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Abstract. The oribatid mite species, *Dolicheremaeus distinctus* Aoki, 1982, is redescribed in details, on the basis of specimens from India. This species is recorded for the first time from India and the Oriental region. An identification key to the Indian *Dolicheremaeus* is given.

Keywords. Oribatida, *Dolicheremaeus*, *D. distinctus*, redescription, key, India

INTRODUCTION

In the course of taxonomic identification of Indian oribatid mites (Acari: Oribatida), we have found three females and one male of the species *Dolicheremaeus distinctus* Aoki, 1982 (Tetracondylidae). This species was described by Aoki (1982) from Southern Japan. Earlier, *D. distinctus* has only been reported from the type locality, consequently this is the first record from India as well as from the Oriental region.

The original description of *D. distinctus* was based on a single holotype, and hence it is incomplete and brief (lacking information on the measurements of morphological structures, leg setation and solenidia, morphology of gnathosoma; only dorsal view of idiosoma and sensillus were illustrated). The main goal of our work is to present a detailed description and illustration of *D. distinctus* on the basis of the Indian specimens found. The second goal of our paper is to present an identification key to the 14 so far recorded Indian *Dolicheremaeus* species (Haq 1978; Chakrabarti *et al.* 1981; Mondal & Kundu 1986;

Sanyal & Bhaduri 1986; Sanyal 1990, 1992, 2000; Sengupta *et al.* 1997; Mondal *et al.* 1999; Subías 2004).

MATERIALS AND METHODS

Material examined. Four adult specimens (three females, one male): India, 28°19'32"N 95°57'31"E, Arunachal Pradesh, Hunli vicinity, 1300 m a.s.l., soil, collected by L. Dembický and O. Šauša in 01.06.2012.

Specimens were studied in lactic acid, mounted in temporary cavity slides for the duration of the study, and then stored in 70% alcohol in vials. All body measurements are presented in micrometers. Body length was measured in lateral view, from the tip of rostrum to the posterior edge of ventral plate. Notogastral width refers to the maximum width in dorsal aspect. Formulae of leg setation are given according to the sequence trochanter–femur–genu–tibia–tarsus (famulus included). Formulae of leg solenidia are given (in square brackets) according to the sequence genu–tibia–tarsus.

Terminology used in this paper follows that of Aoki (1965a, 1967), Wallwork (1962a), Norton & Behan-Pelletier (2009).

TAXONOMY

Genus *Dolicheremaeus* Jacot, 1938

Dolicheremaeus distinctus Aoki, 1982

(Figures 1–19)

Diagnosis. Body size: 498–564 × 265–282. Body surface microgranulate; genital and anal plates with large granules. Rostrum truncated. Prodorsum with longitudinal medial ridge. Interlamellar and notogastral setae of medium length. Sensilli clavate; sensillar head weakly lanceolate. All prodorsal and notogastral condyles present. Apodemes 1 developed. Distance between adanal setae ad_3 – ad_3 shorter than ad_2 – ad_2 . Lyrifissures *iad* located in paraanal position. Formula for leg setae *u*: L–S–S–S.

Measurements. Body length: 498–564 (four specimens). Notogaster width: 265–282 (four specimens).

Integument. Body color yellow-brownish. Surface of body with microgranules (diameter less than 1). Genital and anal plates with larger granules (diameter up to 2). Surface of notogaster and anogenital region foveolate (diameter up to 10).

Prodorsum. Rostrum narrowly truncated (visible in dorso-anterior and ventral views). Anterior part of prodorsum with strong, longitudinal medial ridge (*r*). Rostral (*ro*) and lamellar (*le*) setae long, similar in length (82–90), setiform, thickened, barbed unilaterally. Interlamellar setae (*in*) shorter (32–36), thinner than rostral and lamellar setae, slightly barbed, inserted between bothridia (*bo*). Sensilli (*ss*, 69–77) with bacilliform stalk and weakly lanceolate, indistinctly barbed head. Exobothridial setae (*ex*) shortest on prodorsum (10), straight, thin, smooth, inserted on tubercles antero-laterally to bothridial openings. Medial (*co.pm*) and lateral (*co.pl*) prodorsal condyles rounded distally, located separately.

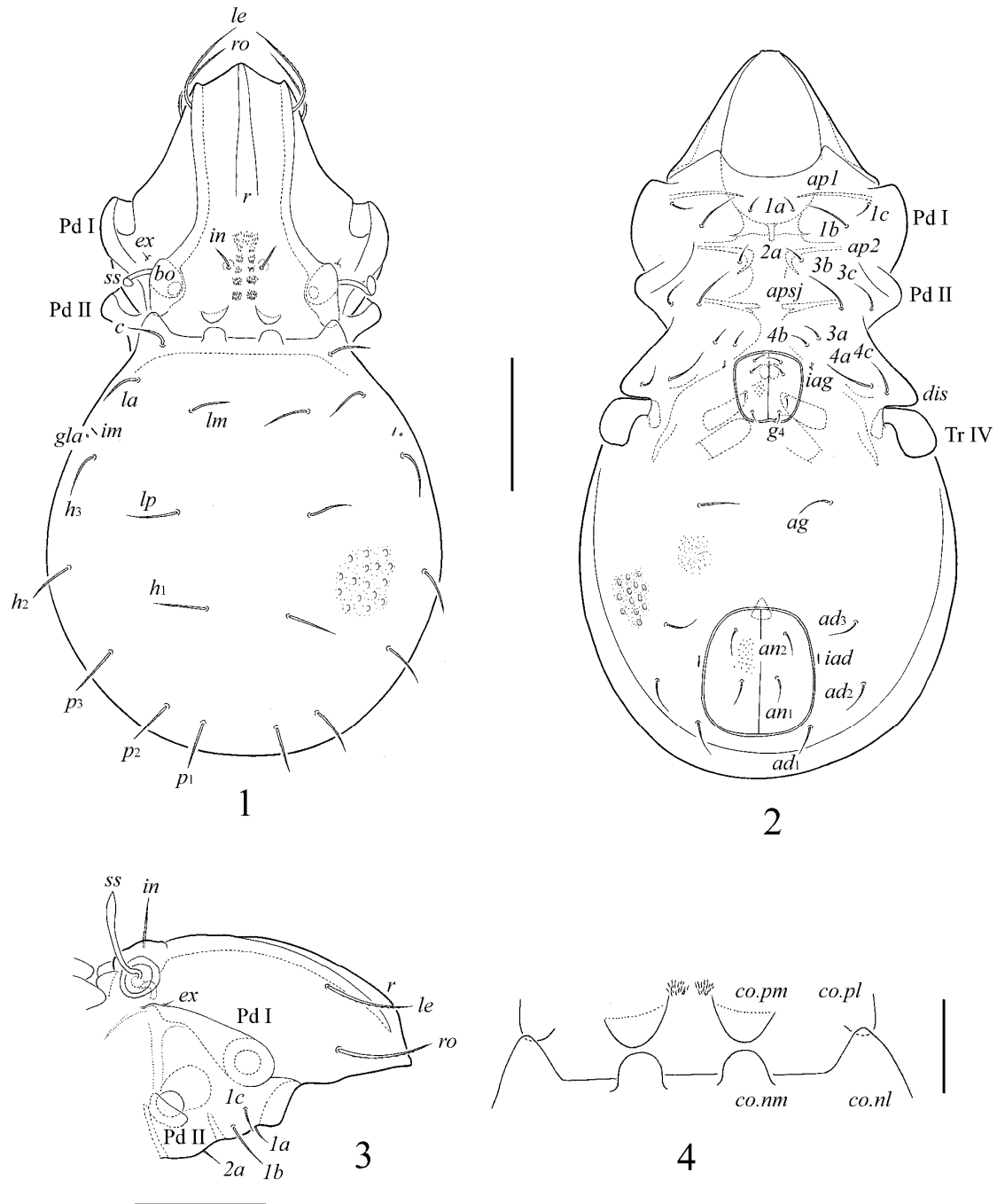
Notogaster. Medial notogastral condyles (*co.nm*) rectangular, weakly rounded distally, located separately. Lateral notogastral condyles (*co.nl*) triangular, blunt-ended. Notogaster with 10 pairs of setae of medium length (102–110), setiform, slightly barbed (visible under high magnification). Distance between setae p_1 – p_2 shorter than p_2 – p_3 . Lyrifissures (*ia*, *im*, *ip*, *ih*, *ips*) and opisthonotal gland openings (*gla*) developed in typical arrangement for *Dolicheremaeus* (see Aoki 1967; Ermilov *et al.* 2010).

Gnathosoma. Subcapitulum longer than wide (102 × 86). Subcapitular setae (*h*, *m*, *a*) similar in length (20), setiform, smooth. Adoral setae and their alveoli not evident. Palps (61) with setation 0–2–0–3–8(+1 ω). Solenidion pressed to the palp-tarsus surface in basal part and distal seta in medio-distal part. Chelicerae (106) with dorsal tooth (*t*) and two barbed setae; *cha* (32) longer than *chb* (16). Trägårdh's organ (Tg) short, conical.

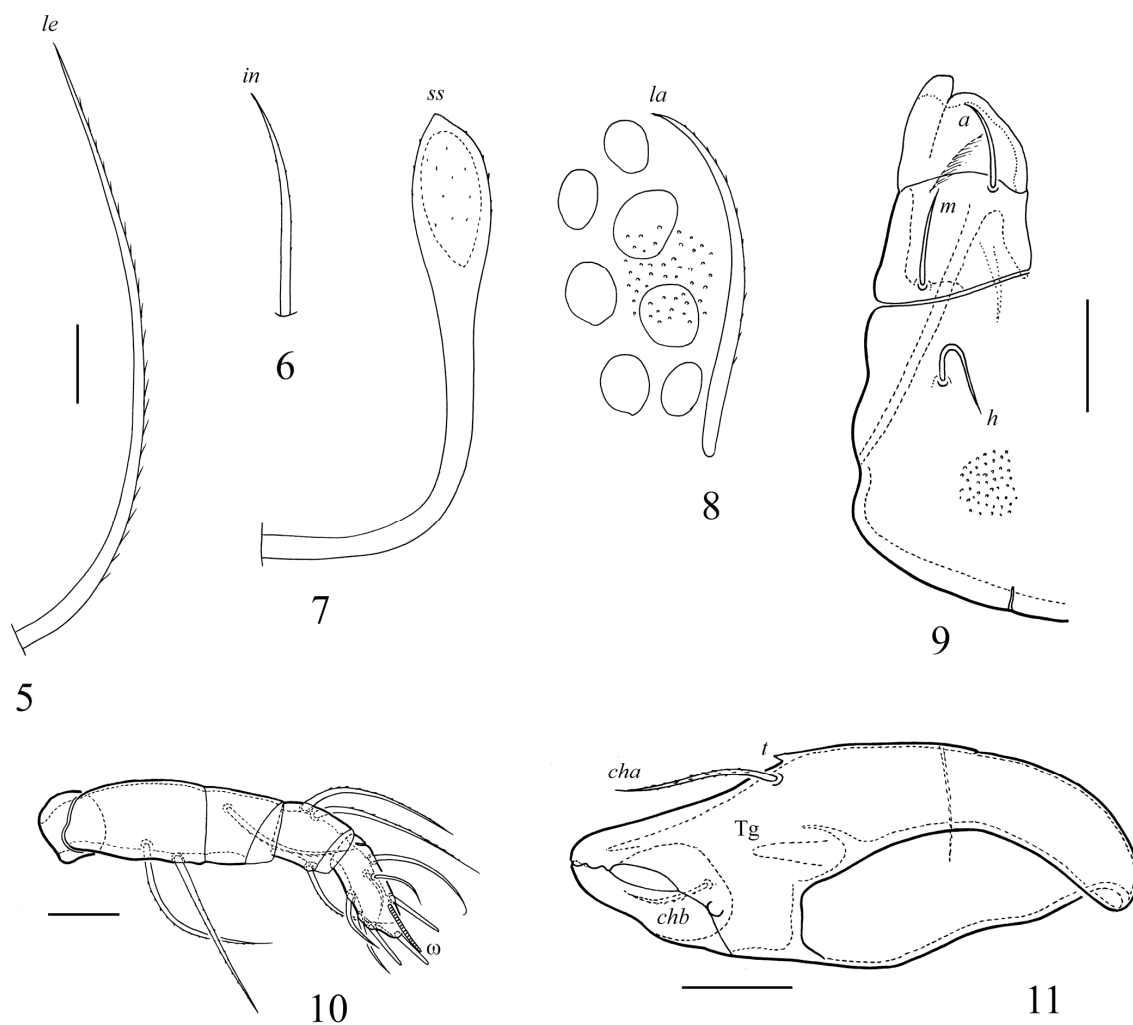
Epimeral and lateral podosomal regions. Apodemes 1 (*ap1*), 2 (*ap2*) and sejugal (*apsj*) distinct, transversally developed. Apodemes 3 absent. Epimeral setal formula: 3–1–3–3. All setae setiform, slightly barbed. Setae *1a*, *1c*, *2a*, *3a*, *4b* (20) shorter than *3c*, *4c* (26–28) and *1b*, *3b*, *4a* (41–45). Pedotecta I (Pd I) and II (Pd II) developed typically for *Dolicheremaeus* (see Wallwork 1962a, Aoki 1967). Discidia (*dis*) triangular, widely blunt-ended.

Anogenital region. Four pairs of genital (g_1 – g_4 , 8–12), one pair of aggenital (*ag*, 24–28), three pairs of adanal (ad_1 – ad_3 , 22–26) and two pairs of anal (an_1 , an_2 , 16–20) setae setiform, slightly barbed. Aggenital lyrifissures (*iag*) clearly visible. Adanal setae ad_1 inserted postero-laterally to the anal plates. Distance between setae ad_3 – ad_3 shorter than ad_2 – ad_2 . Lyrifissures *iad* short, located in paraanal position nearly to anal aperture. Ovipositor (126 × 49) with three lobes (57) and cylindrical distal part (69). Four setae of each lobe setae similar in length (18), thorn-like, smooth. Six coronal setae minute (4).

Legs. Claw of each tarsus smooth. Tarsi without teeth. Morphology of leg segments typical for many *Dolicheremaeus* (see Ermilov *et al.*



Figures 1–4. *Dolicheremaeus distinctus* Aoki, 1982. 1 = Body dorsally (legs not illustrated), 2 = body ventrally (gnathosoma and legs except trochanters IV not illustrated), 3 = prodorsum laterally (gnathosoma and legs I, II not illustrated), 4 = condyles. Scale bar (1–3) 100 μ m, (4) 50 μ m.



Figures 5–11. *Dolicheremaeus distinctus* Aoki, 1982. 5 = Lamellar seta, 6 = interlamellar seta, 7 = sensillus, 8 = notogastral seta *la*, 9 = subcapitulum ventrally, right half, 10 = palp, 11 = chelicera. Scale bar (5–8, 10) 10 μ m, (9, 11) 20 μ m.

Table 1. Leg setation and solenidia of *Dolicheremaeus distinctus* Aoki, 1982.

Leg	Trochanter	Femur	Genu	Tibia	Tarsus
I	v'	$d, (l), bv''$	$(l), v', \sigma$	$(l), (v), \varphi_1, \varphi_2$	$(ft), (tc), (it), (p), (u), (a), s, (pv), e, \omega_1, \omega_2$
II	v'	$d, (l), bv''$	$(l), v', \sigma$	$l', (v), \varphi$	$(ft), (tc), (it), (p), (u), (a), s, (pv), \omega_1, \omega_2$
III	l', v'	d, l', ev'	l', σ	$(v), \varphi$	$(ft), (tc), (it), (p), (u), (a), s, (pv)$
IV	v'	d, ev'	d, l'	$(v), \varphi$	$ft'', (tc), (p), (u), (a), s, (pv)$

Roman letters refer to normal setae (*e* – famulus), Greek letters refer to solenidia. One apostrophe (') marks setae on anterior and double apostrophe (") setae on posterior side of the given leg segment. Parentheses refer to a pair of setae.

2010). Formulae of leg setation and solenidia: I (1-4-3-4-16) [1-2-2], II (1-4-3-3-15) [1-1-2], III (2-3-1-2-15) [1-1-0], IV (1-2-2-2-12) [0-1-0]; homology of setae and solenidia indicated in Table 1. Setae and solenidia simple. Famulus (*e*) straight, blunt-ended. Leg setae *u* setiform (L-type) on tarsi I and thorn-like (S-type) on tarsi II-IV.

Remarks. The present Indian specimens of *D. distinctus* are morphologically and in general appearance similar to the Japanese specimens (Aoki 1982). The only slight difference is in the notogastral setae which are poorly barbed in the Indian specimens (versus smooth in Japanese specimens). We believe these differences represent intraspecific (perhaps geographical) variability.

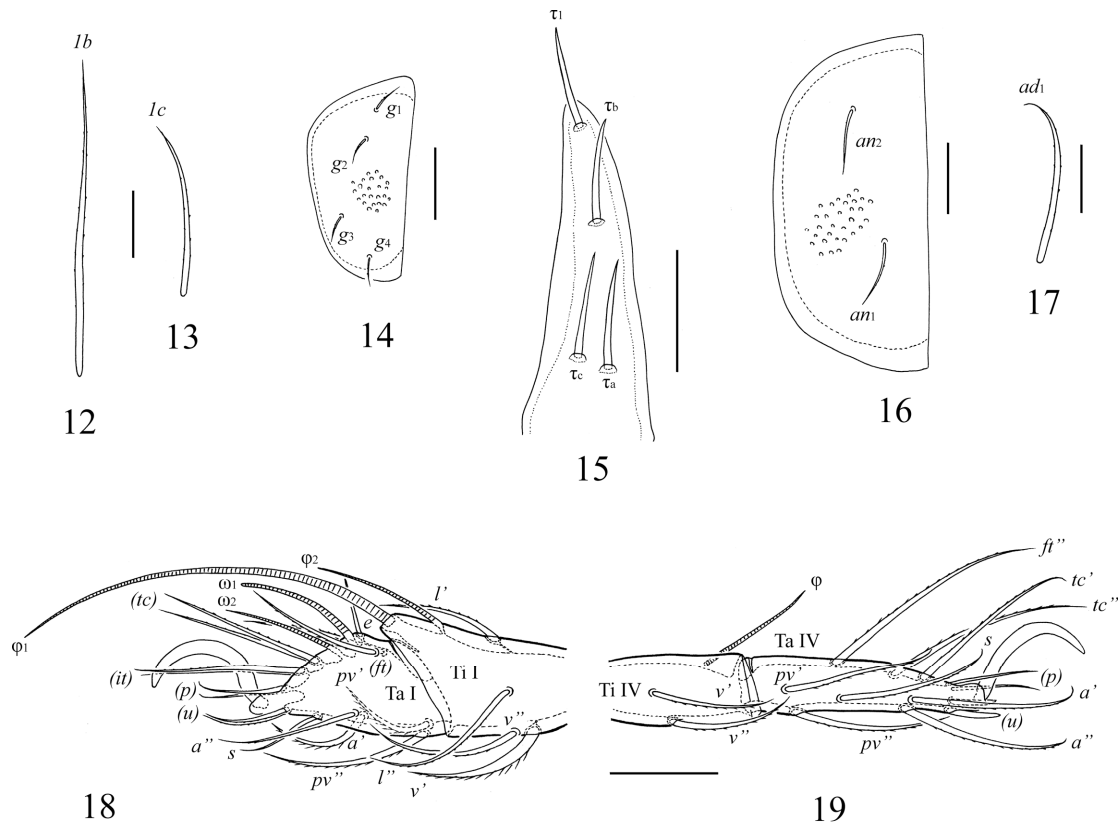
Key to the Indian species of *Dolicheremaeus**

1. Medial prodorsal condyles absent ----- 2
– Medial prodorsal condyles present ----- 3
2. Medial notogastral condyles present; notogastral setae *p*₁ shorter than *p*₂; body length: 877–981; distribution: India ----- *D. geminus* Mondal & Kundu, 1986
– Medial notogastral condyles absent; notogastral setae *p*₁ and *p*₂ of same length; body length: 1050; distribution: India ----- *D. bengalensis* Sanyal, 1992
3. Medial notogastral condyles absent or very small, poorly visible ----- 4
– Medial notogastral condyles present, well developed ----- 6
4. Notogaster with 14 pairs of setae; sensilli rod-like; body length: 940–1060; distribution: Himalaya ----- *D. nepalensis* Aoki, 1967 (see Aoki 1967)
– Notogaster with 10 pairs of notogastral setae; sensilli with distinctly developed head ----- 5
5. Sensillar head rounded distally; medial notogastral condyles absent; body length: 550; distribution: Malaysia, India ----- *D. bruneiensis* Aoki, 1967 (see also Mahunka 1991)
– Sensillar head pointed distally; medial notogastral condyles very small, poorly visible; body length: 445–518; distribution: Malaysia, India ----- *D. sabahnnus* Mahunka, 1988
6. Interlamellar and notogastral setae short, *lm* considerably shorter than distance between insertions of *lm* and *lp* ----- 7
– Interlamellar and notogastral setae long or of medium size, *lm* longer or little shorter than distance between insertions of *lm* and *lp* ----- 8
7. Prodorsum with longitudinal medial ridge; distance between insertions of the adanal setae *ad*₃–*ad*₃ shorter than *ad*₂–*ad*₂; body length: 498–564; distribution: Japan, India ----- *D. distinctus* Aoki, 1982

- Prodorsum without longitudinal medial ridge; distance between insertions of the adanal setae *ad*₃–*ad*₃ longer than *ad*₂–*ad*₂; body length: 456–476; distribution: India ----- *D. coronarius* Chakrabarti, Bhaduri & Kundu, 1981
- 8. Sensillar head bifurcate, with two long branches; antero-medial part of notogaster with two short longitudinal ridges; body length: 809; distribution: India ----- *D. renukae* Sanyal, 1990
– Sensillar head of other morphology; antero-medial part of notogaster without ridges ----- 9
- 9. Sensilli spindle-form, with elongate, pointed apex ----- 10
– Sensilli clavate, without elongate, pointed apex ----- 12
- 10. Notogastral setae *h*₁ and *p*₂ with flagellate tip; insertions of notogastral setae *lm* and *h*₃ located nearly to each other; body length: 945; distribution: India ----- *D. keralensis* Sanyal, 1990
– Notogastral setae *h*₁ and *p*₂ without flagellate tip; insertions of notogastral setae *lm* and *h*₃ removed from each other ----- 11
- 11. Notogastral setae *p*₁ shorter than *p*₂; body length: 770–986; distribution: Ghana, India ----- *D. cuspidatus* (Wallwork, 1962)
– Notogastral setae *p*₁ and *p*₂ of same length; body length: 780–884; distribution: India ----- *D. indicus* Haq, 1978
- 12. Medial notogastral condyles located postero-laterally to medial prodorsal condyles; body length: 540–560; distribution: India ----- *D. russiae* Mondal, Kundu & Roy, 1999
– Medial notogastral condyles located posteriorly to medial prodorsal condyles ----- 13
- 13. Formula for leg setae *u*: L–S–S–S; genital plates striate; body length: 770; distribution: Indonesia, India ----- *D. hammerae* Corpuz-Raros, 2000 (= *D. lineolatus* Hammer, 1981)
– Formula for leg setae *u*: L–L–L–L; genital plates not striate; body length: 1067–1088; distribution: India ----- *D. himalayensis* Chakrabarti, Bhaduri & Kundu, 1981

*Two species of *Dolicheremaeus*, which also were found in India, *D. auritus* (Aoki, 1965) and *D. speciosus* (Pearce, 1906) are not included in this key, because both have the large pedotectae II (see Aoki 1965b and Pearce 1906), which is not a typical character for *Dolicheremaeus*. In our opinion, further research is needed to establish the taxonomical position of these species.

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Figures 12–19. *Dolicheremaeus distinctus* Aoki, 1982. 12 = Epimeral seta *Ib*, 13 = epimeral seta *Ic*, 14 = genital plate, right, 15 = lobe of ovipositor, 16 = anal plate, right, 17 = adanal seta *ad*₁, 18 = tarsus and anterior part of tibia of leg I, left, antiaxial view, 19 = tarsus and anterior part of tibia of leg IV, left, antiaxial view.
Scale bar (12, 13, 17) 10 μ m, (14–16, 18, 19) 20 μ m.

REFERENCES

- AOKI, J. (1965a): A preliminary revision of the family Otocepeidae (Acari, Cryptostigmata). I. Subfamily Otocepeinae. *Bulletin of the National Museum of Natural Science, Tokyo*, 8(3): 259–341.
- AOKI, J. (1965b): Oribatiden (Acarina) Thailand. I. *Nature and Life in Southeast Asia*, 4, 129–193.
- AOKI, J. (1967): A preliminary revision of the family Otocepeidae (Acari, Cryptostigmata). II. Subfamily Tetracondylinae. *Bulletin of the National Museum of Natural Science, Tokyo*, 10(3): 297–359.
- AOKI, J. (1982): New species of oribatid mites from the southern island of Japan. *Bulletin Institute of Environmental Science and Technology, Yokohama National University*, 8: 173–188.
- CHAKRABARTI, D. K., BHADURI, A. K. & KUNDU, B. G. (1981): Two new species of the genus *Dolicheremaeus* Jacot (Acari: Oribatei) from West Bengal, India. *Mitteilungen aus dem Zoologischen Museum in Berlin*, 57(1): 15–21.
- ERMILOV, S. G., SIDORCHUK, E. A. & RYBALOV, L. B. (2010): A new species of *Dolicheremaeus* (Acari: Oribatida: Tetracondylidae) from Ethiopia. *Systematic and Applied Acarology*, 15(3): 235–243.
- HAQ, M. A. (1978): *Some aspects of the taxonomy of oribatid mites from the soil of Kerala*. In: EDWARDS, C. A. & VEERESH, G. K. (eds.) *Soil biology and ecology in India*. University of Agricultural Sciences, Hebbal, Bangalore, Technical series 22, p. 117–134.
- HAMMER, M. (1981): On some oribatid mites from Java. Part I. *Acarologia*, 22(1): 81–99.

- MAHUNKA, S. (1988): New and interesting mites from the Geneva Museum LXI. Oribatids from Sabah (East Malaysia) III (Acari: Oribatida). *Revue suisse de Zoologie*, 95(3): 817–888.
- MAHUNKA, S. (1991): New and interesting mites from the Geneva Museum LXVIII. Oribatids from Sabah (East Malaysia) IV (Acari: Oribatida). *Revue suisse de Zoologie*, 98(1): 185–206.
- MONDAL, B. K. & KUNDU, B. G. (1986): A new species of Otocepheidae (Acari: Oribatei) from Darjeeling, India. *Records of the Zoological Survey of India*, 83(1–2): 91–96.
- MONDAL, B. K., KUNDU, B. G. & ROY, S. (1999): A new species of *Dolicheremaeus* (Acari: Oribatei: Otocepheidae) from Darjeeling, India. *Records of the Zoological Survey of India*, 97(1): 187–194.
- NORTON, R. A. & BEHAN-PELLETIER, V. M. (2009): *Oribatida*. Chapter 15. In: KRANTZ, G. W. & WALTER, D. E. (eds.) *A Manual of Acarology*. Texas Tech University Press, Lubbock, p. 430–564.
- PEARCE, N. D. F. (1906): On some Oribatidae from the Sikkim Himalaya. *Journal of the Royal Microscopical Society*, 26: 269–273.
- SANYAL, A. K. (1990): On a collection of Oribatei (Acari: Cryptostigmata) from Silent Valley, Kerala (India) with descriptions of six new species. *Records of the Zoological Survey of India*, 86(3–4): 467–483.
- SANYAL, A. K. (1992): *Oribatid Mites (Acari)*. In: GHOSH, A. K. (ed.). *Fauna of West Bengal. Part 3 (Arachnida and Acari)*. Zoological Survey of India, Calcutta, p. 213–356.
- SANYAL, A. K. (2000): Oribatid mites (Acari: Oribatei). *Zoological Survey of India, State Fauna Series 7: Fauna of Tripura*, 2: 33–112.
- SANYAL, A. K. & BHADURI, A. K. (1986): Checklist of oribatid mites (Acari) of India. *Records of the Zoological Survey of India*, 83: 1–79.
- SENGUPTA, D., SANYAL, A. K. & CHAKRABARTI, S. (1997): List of oribatid (Acari, Oribatei) mites from the Indian Himalaya along with some notes. *Hexapoda*, 8(1): 19–35.
- SUBÍAS, L. S. (2004): Listado sistemático, sinonímico y biogeográfico de los ácaros oribátidos (Acari-formes: Oribatida) del mundo (excepto fósiles). *Graellsia*, 60(número extraordinario): 3–305.
- WALLWORK, J. A. (1962a): Some Oribatei from Ghana VIII. The genus *Tetracondyla* Newell 1956 (1st series). *Acarologia*, 4(2): 274–291.
- WALLWORK, J. A. (1962b): Some Oribatei from Ghana IX. The genus *Tetracondyla* Newell 1956 (2nd series). *Acarologia*, 4(3): 440–456.