Folsomides arnoldi n. sp. (Isotomidae): a new Collembolan abundant in arid Australia, with a redescription of *Folsomides denisi* (Womersley)

YAYUK R. SUHARDJONO and PENELOPE GREENSLADE

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Folsomides arnoldi sp. n., a species widely distributed in arid and semi-arid areas in Australia, is described and figured. *Astephanus denisi* Womersley is transferred to *Folsomides*, redescribed and a lectotype designated. A check list of the Australian *Folsomides* species is provided, with a table of distinguishing characters.

Y. S. Suhardjono, Museum Zoologicum Bogoriense, Jl. Juanda 9, Bogor 16122, INDONESIA and P. Greenslade, Division of Entomology, CSIRO, GPO Box 1700, Canberra, ACT 2601, AUSTRALIA; *manuscript received 24th March 1992, accepted for publication 23 September 1992.*

KEY WORDS: *Folsomides*, new species, Isotomidae, Australian arid zone.

INTRODUCTION

Folsomides Stach is an almost cosmopolitan genus, occurring on all continents except Antarctica. In Australia it is one of the commonest genera in the arid and semi-arid zones (Greenslade, 1982) and has a wide distribution there. Although only five species have been recorded for the continent, at least a further forty, all undescribed, have been distinguished in collections. Individuals of one of the new species of *Folsomides* have been collected from arid and semi-arid areas in New South Wales, South Australia, and the Northern Territory. It appears to be one of the most common and abundant species in the genus, occurring widely in central Australia although rarely on sandy soils. As it could be considered as a 'key-stone' species of arid zone ecosystems and also a possible indicator of soil type, it is important to provide a name for the species, which is described below.

Our studies of *Astephanus denisi* Womersley show that this species also belongs in *Folsomides*. It is redescribed here and a lectotype designated.

ABBREVIATIONS

Material was deposited in the following museums and collected by the persons listed below.

ANIC: Australian National Insect Collection, Division of Entomology, CSIRO, Canberra, Australia. MZB: Museum Zoologicum Bogoriense, Bogor, INDONESIA. SAMA: South Australian Museum, Adelaide, AUSTRALIA. PG: P. Greenslade. JM: J. Mott. WN: W. Nicholas. RS: R. V. Southcott. YS: Y. R. Suhardjono. IV: I. Valentine.

METHODS

The terminology of Fjellberg (1993) and Deharveng and Oliviera (1990) is used in the descriptions and diagnoses, with the following abbreviations: or: subapical organite (Deharveng, 1981) situated dorsally on antenna IV. os sesta: small seta situated distally

and dorsally on antenna IV. PAO: postantennal organ. sge: external guard s' seta (sensillum) of antennal III distal organ. sgi: internal guard s' seta (sensillum) of antennal III distal organ. sme: external s' seta in middle row of setae on tergite. smi: internal s' setae in middle row of setae on tergite. sml: lateral s' seta in middle row of setae on tergite. smv: ventral s' seta in middle row of setae on tergite. spe: external s' seta in posterior row of setae on tergite. spl: lateral s' seta in posterior row of setae on tergite.

Folsomides Stach, 1922

Type species: *Folsomides parvulus* Stach by original designation.

Diagnosis (Fjellberg, 1993): Body long, slender (compared with *Proisotoma* Börner and *Subisotoma* Stach). Head with ocelli 6 + 6 or fewer. PAO present, large, oval. Maxilla and mandible unmodified, 2 preclypeal (prelabral) setae, 3+3 setae along ventral line of head. Antenna IV without cone, s'setae present on all antennal segments. Not plurichaetotic. Thorax without ventral setae. Tibiotarsus without clavate tenent hairs. Unguis and unguiculus without teeth. All abdominal segments distinctly separated. Numbers of s'setae on thorax II to abdomen V distributed as follows: 33/22224, s' setae on abdomen I-III in midtergite. Ventral tube moderately long, anterior face with 0+0, posterior 2, and lateral flap 3+3 setae. Tenaculum tridentate or quadridentate, with 1 long seta on the corpus. Furcula short, not reaching ventral tube but well developed, manubrium without anterior setae, dens smooth or tuberculate, with maximum of two anterior and six posterior setae, mucro absent or with one or two teeth, no mucronal setae. Abd V, VI elongated, narrow and tapering, flexed ventrally. Reproductive males without modified setae x or B5 on tibiotarsus III.

TABLE 1

Diagnostic characters of described Australian Folsomides; + *denotes presence,* — *denotes absence*

Characters	Species of *Folsomides*					
	arnoldi	*centralis*	*denisi*	*deserticolus*	*parvulus*	*sexophthalmus*
No. of ocelli	5+5	6+6	6+6	6+6	2+2	6+6
No. of setae dens, post/ant	3/1	7/2	3/0	6/1	3/0	6/1
Maxillary outer lobe[1]	bi	bi	bi	bi	bi	bi
B4/5 on tibiotarsus I, II	+	+	+	+	+	+
Mucro present or absent	+	+	—	+	+	+
No. of teeth mucro	2	2	0	2	2	2
Mucro with broad lamella	—	—	—	(+)	—	—
Abd V length spe; ord, seta[2]	L	L	S	S	M	M
No. of micro s' setae	11/111	11/111	11/111	11/111	10/001	11/111
Micro s' reduced, pit insert	+	—	+	+	—	+
Macrosetal type[3]	I	III	II	III	I	III

1. bi, bifurcate maxillary palp, (Fjellberg, 1993).
2. L, s' setae nearly as long as ordinary setae; M, s' setae half the length of ordinary setae; S, s' setae less than half the length of ordinary setae.
3. Type I, all macrosetae, 3 per segment, clear and differentiated; type II, subapical macrosetae only distinct on abd 4-5 median macrochaetae reduced on abd I, clear and erect on abd 2-5; type III, as type II but median macrochaeta also reduced on abd 2-3 (Fjellberg, 1993).

Folsomides arnoldi n. sp.

(Fig. 1; Table 1)

Holotype: ♀ (slide), NEW SOUTH WALES, Lake Mere Stn, 30.15S 144.53E, 38 km N Louth, groved mulga, soil sample, 6-8.ix.1991, PG and YS I 22617 SAMA).

Paratypes: 9 ♀♀ (slides), 10 individuals (alcohol) from the same locality, 6-8.ix.1991,

PG. and YS. Deposited: 5 slides and 10 in alcohol in SAMA, 1 slide (ANIC), 3 slides (MZB).

Other material examined: SOUTH AUSTRALIA, Koonamore, 32.07S 139.22E, mulga leaf litter, 18.iv.1971, PG, 1 slide, mallee leaf litter, 30.v.1971, PG, 2 slides, saltbush and mallee leaf litter, 15.iv.1973, PG, 2 slides, mallee and *Heterodendron* leaf litter, 25-26.vii.1973, PG, 5 slides, 17-18.ii.1974, 2 slides, 30.v.1977, PG, 1 slide, soil under saltbush and bluebush, mulga and *Eremophila*, 3-5.iv.1979, PG, 4 slides, mulga leaf litter, 17.v.1979, PG, 3 slides; Great Victoria Desert, 132k N Cook, 29.33S 130.08E, mallee leaf litter, 28.viii.1980, PG, 2 slides; Vokes Hill Corner, 28.33S 130.40E, leaf litter under mulga and grasses, 9.X.1976, PG, 1 slide; 7 km NW Morgan, 34.02S 139.40E, leaf litter under *Lycium* and bluebush, 18.xii.1976, PG, 2 slides; Mabel Creek, 29.10S 134.15E, soil under mulga and on sand dunes, xi. 1984, PG, 4 slides; Flinders Ranges, Oraparinna, 31.22S 138.43E, under titree and mallee, 20.ix.1971, PG, 2 slides; Anna Creek, 43 km S homestead, 28.57S, 136.10E, *Acacia* leaf litter, 3.x.1978, PG, 1 slide. NEW SOUTH WALES, Mundi-mundi, 31.53S 141.02E, saltbush leaf litter, ii.1973, IV, 1 slide; Kinchega N.P., 32.29S 142.21E, soil, WN, 2 slides; Emmet Vale, 10 km N Wanganella, 35.13S 144.46E, ii.1973, saltbush leaf litter, IV, 2 slides; Fowler's Gap, 2.5 km N of homestead, under River Red Gum, 31.05S 141.42E, xi. 1979, PG. NORTHERN TERRITORY, Alice Springs, Kunoth Paddock, 23.31S 133.35E, 27.x.1974, PG, 1 slide; S.W. Katharine, Manbulloo, 14.31S 132.12E, soil, i.1981, JM, 3 slides. All specimens deposited in SAMA.

Description. Body length *ca* 0.7 mm, white, covered with long smooth setae. Macrochaetae fairly well developed, with subapical, median and lateral macrochaetae distinct on all thoracic and abdominal segments; ratio length abdomen V median macrochaetae:adjacent ordinary setae = 4:3. Ratio of head:thorax:abdomen = 0.7:1:1.9. Cuticle finely reticulate. Ratio of antenna: diagonal of head = 1:1. Ratio of antennal segments I:II:III:IV = 1.0:1.38:1.5:2.5; antenna I with 11 setae, including 1 curved and 1 blunt s'setae, and 2 basal microsetae; antenna II with 13 setae and 1 s'seta; antenna III with 17 setae, antenna III organ consisting of 2 small pegs and two accompanying rods; apex of antenna IV with or and os-setae, and *ca* 9-13 curved s-setae of unequal size. Ocelli 5+5, equal in size, situated on two dark patches, close together. PAO elliptical to broadly elliptical, not constricted at the middle, about three times longer than diameter of the eye, with 3-4 setae at posterior margin. Maxillary palp bifurcate, 3+3 sublobals. Tibiotarsi I, II, and III with 20, 20, 22 setae respectively, seta B 4/5 present. Ratio of length of unguis: unguiculus = 1.6:1. Ratio of abdominal segments I:II:III:IV:V:VI = 7.5:7.5:7.0:9.0:5.0:3.5. Axial seta thorax II to abdomen VI are 6,4/3,3,3,5,2 plus 1 unpaired, 2 and 2 unpaired. Distribution of microsensilla from thorax to abdomen III as 11/111. All microsensilla set in cup-like depressions and appearing as small hooks. Thorax II and III with smi, sml, smv thin, small, 0.7-0.8 times shorter than ordinary setae. Abdomen I-IV with smi and smv slightly shorter, smi more posterior on abdomen IV. Abdomen V with 1 long, curved, very thick (spe), and 1 straighter (spl) s'-setae in p-row, similar in length to adjacent setae; 2 thin s'-seta (smi and sme) in m-row, almost the same length as ordinary setae, 2 setae between the two smi, and 1 seta between smi and sme and spe and spl. Rami tenaculum with 3 + 3 teeth, one seta on corpus. Furcal subcoxa with 9 (7-11)/4-5 setae. Manubrium with 9 + 9 setae. Dens with 3-4 setae. Furcula with mucro not well separated from dens, with only a small constriction on the dorsal side. Ratio of manubrium:dens:mucro = 5:3:1. Posterior manubrial surface with 12 setae in a symmetrical arrangement, dens with 3 (rarely 4 setae) on posterior and 1 constant seta on anterior side (4/1 or 3/1), with 15% of specimens having 3/1 setae. Mucro bidentate.

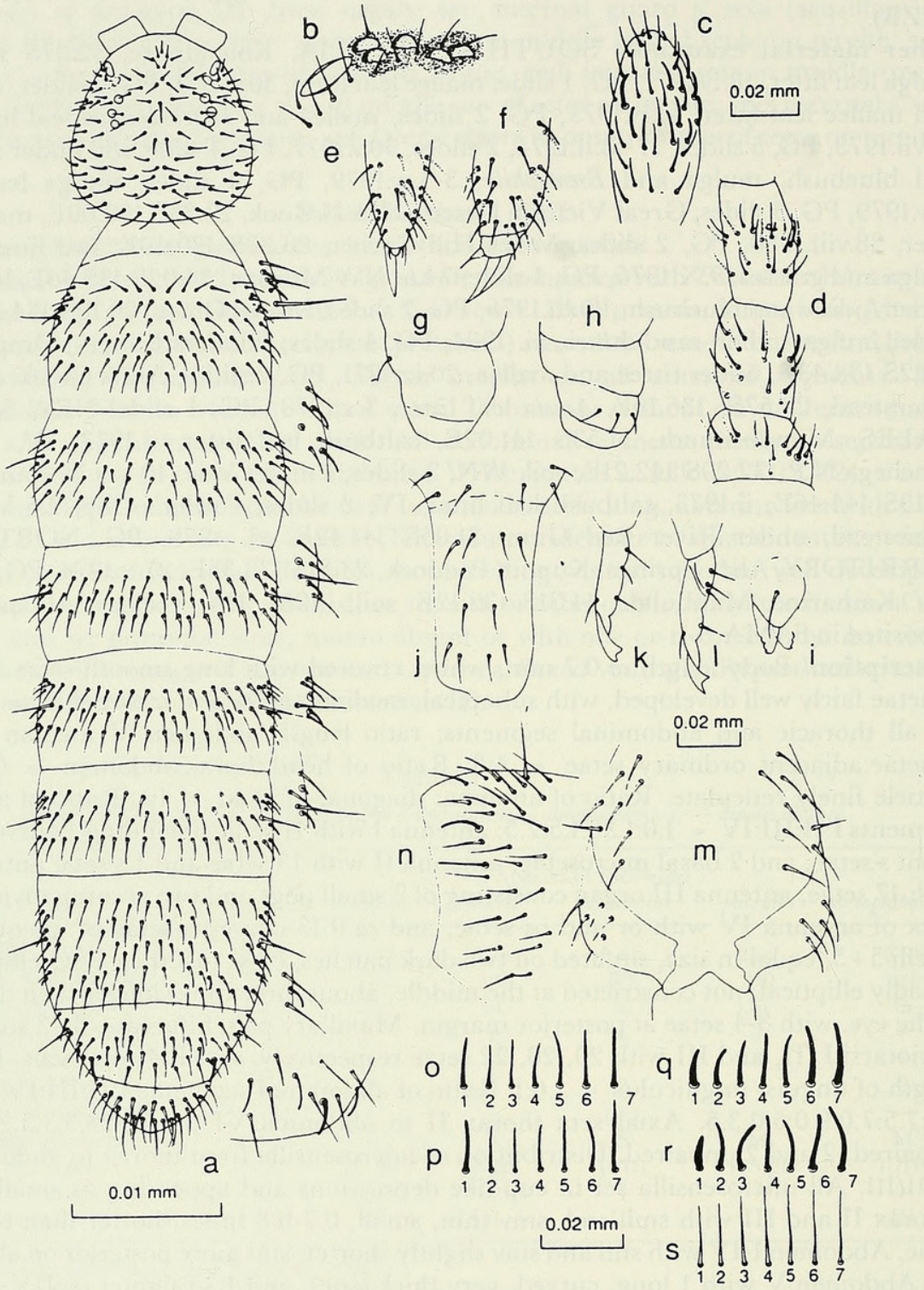

Fig. 1. Folsomides arnoldi n. sp., paratype ♀: a, dorsal chaetotaxy, with enlargements of lateral, ventral and posterior s' setae (sl, sv, sp); b, ocelli and PAO, scale as c; c, antenna IV dorsal view; dens, antenna segments I, II and III, dorsal view, scale as c; e, ventral chaetotaxy of tibiotarsus III, scale as c; f, anterior chaetotaxy of tibiotarsus III, scale as c; g, ventral tube, lateroposterior view, scale as c; h, ventral tube, lateral view, scale as c; i, tenaculum, ventral view, scale as c; j, manubrium ventral view, scale as c; k, dens and mucro, lateral view showing normal chaetotaxy of 3 dorsal and 1 ventral setae, scale as c; l, dens and mucro lateral view showing variation in chaetotaxy of 4 dorsal and 1 ventral setae, scale as c; m, furcal subcoxa, ventral view; n, chaetotaxy of abdomen V, lateral view, scale as m; o-s', variation in length and shape of s' setae and ordinary setae on abdomen V of specimens from different localities, o, smi, p, sme, q, spi, r, spe, s, ordinary setae; localities: 1. Katharine, 2. Alice Springs, 3. Lake Mere, 4. Mundi-mundi, 5. Koonamore, 6. Morgan, 7. Emmett Vale.

Variation: Length of s²setae (smi, sme, spi, spe) are variable in this species (Fig. 1). The variability appears to show a cline with latitude; low latitude specimens have s²setae shorter than specimens from higher latitudes (Fig. 1 o-s).

Distribution: Arid, semi-arid areas of N.S.W., S.A., N.T.

Comments: *Folsomides arnoldi* differs from all other *Folsomides* species described from Australia in having 5 + 5 ocelli, 4 (or 3) + 1 dental setae, and s'seta as long as ordinary setae on abdomen V. The combination of these characters is unique to this species.

It is found sometimes in leaf litter but predominantly soil, under a range of arid zone shrubs and trees belonging to the genera, *Atriplex*, *Maireana*, *Acacia*, *Eucalyptus*, *Eremophila* and *Heterodendron*.

The Australian *Folsomides* differ from their European congeners (Fjellberg, 1993), in invariably possessing 11/111 microsensilla on the body and in the form of these microsensilla, each being reduced to a minute spine inserted in a large pit. The closest European species of *F. arnoldi* is *F. portucalensis* Gama. Several differences between *F. portucalensis* and *F. arnoldi* can, however, be found apart from the differences in form of microsensilla. *F. portucalensis* has sp-setae on abdomen V slightly shorter than sm-setae, and not thicker, a mucro sharply set off from dens, with a distinct lateral lamella running from subapical tooth to anterior base, a variable chaetotaxy to the dens, posterior side with 2-6 setae, anterior seta rarely absent and manubrial chaetotaxy variable. *Folsomides arnoldi* has abdomen V with sp-setae longer and thicker than sm-setae, mucro not well separated from dens or separated by a constriction on dorsal side, mucro without lamella, chaetotaxy of dens not very variable, posterior side with 3-4 setae, 1 constant anterior seta and manubrial chaetotaxy not variable.

Folsomides denisi (Womersley) comb. nov.

(Fig. 2)

Lectotype hereby designated: ♀, on slide, Victoria, Fishfalls, Wartook, in moss, 30.xii.34, RS (labelled 'cotype') (SAMA I 22315).

Paralectotypes: 17 specimens, on two slides, same locality data and date.

Description. Body length 0.65 mm, grey, covered with short smooth setae. Macrochaetae fairly well developed, subapical macrochaeta only distinct on abdomen 4-5, median macrochaeta reduced on abdomen I but clear and erect but short on abdomen II-V; ratio length abdomen V macrochaeta: ordinary setae = 1.4:1. Ratio of head: thorax:abdomen = 1:1.4:2.6. Cuticle very finely reticulate. Ratio of antenna:diagonal of head = 1:1.2. Ratio of antennal segments I:II:III:IV = 1:1.1:1.28:2.2; antenna I with 11 setae, 1 curved and 1 blunt s²setae, and 2 micro-setae. Antennal II with 13 setae and 1 s²seta. Antennal III with 17 setae, antenna III organ consisting of 2 small pegs with a further one ventrally and two short accompanying rods (sgi and sge). Apex of antenna IV with or and os-setae, and at least 9 curved s'-setae. Ocelli 6 + 6, equal in size, on 3 small darkly pigmented eye spots. PAO with slight median constriction and with 3 adjacent setae. Maxillary palp simple with three sublobal setae. Tibiotarsi I, II, and III with 20, 20, 22 setae respectively, seta B4/5 present. Ratio of abdomen I:II:III:IV:V:VI = 2.4:2.2:2.2:2.8:2.2:1. Axial setae from thorax II to abdomen VI 6,4/3,3,3,4,2 = 1 unpaired setae, 1 + 2 unpaired setae. Microsensilla arranged from thorax to abdomen as 11/111, in form of a tiny spine in small pit. Thorax II to abdomen IV with smi, sml, smv (only on thorax) cylindrical, short, 0.4 times shorter than ordinary setae. Abdomen I-IV with smi very slightly longer, being half length of ordinary setae on abdomen IV. Abdomen V with two short, curved, cylindrical (spe spl) s'-setae in p-row, just under half the length of adjacent ordinary setae; 2 thinner s'-seta, (smi and sme) in m-row, about half length of ordinary setae; 1 seta between the two smi setae, and 1 set between smi and sme and spe and spl. Rami tenaculum with 3 + 3 teeth + 1 seta. Furcal

subcoxa with 5-6 anterior and 3 posterior setae. Ratio of manubrium:dens = 2.2:1. Posterior manubrium normally with 10 or 11 setae (rarely 12). Dens lacking mucro and with 2 posterior and 1 anterior setae. S' setae on abdomen V cylindrical, about half ordinary seta in length, spi and spe both in m row and spv in p row, spv slightly thicker.

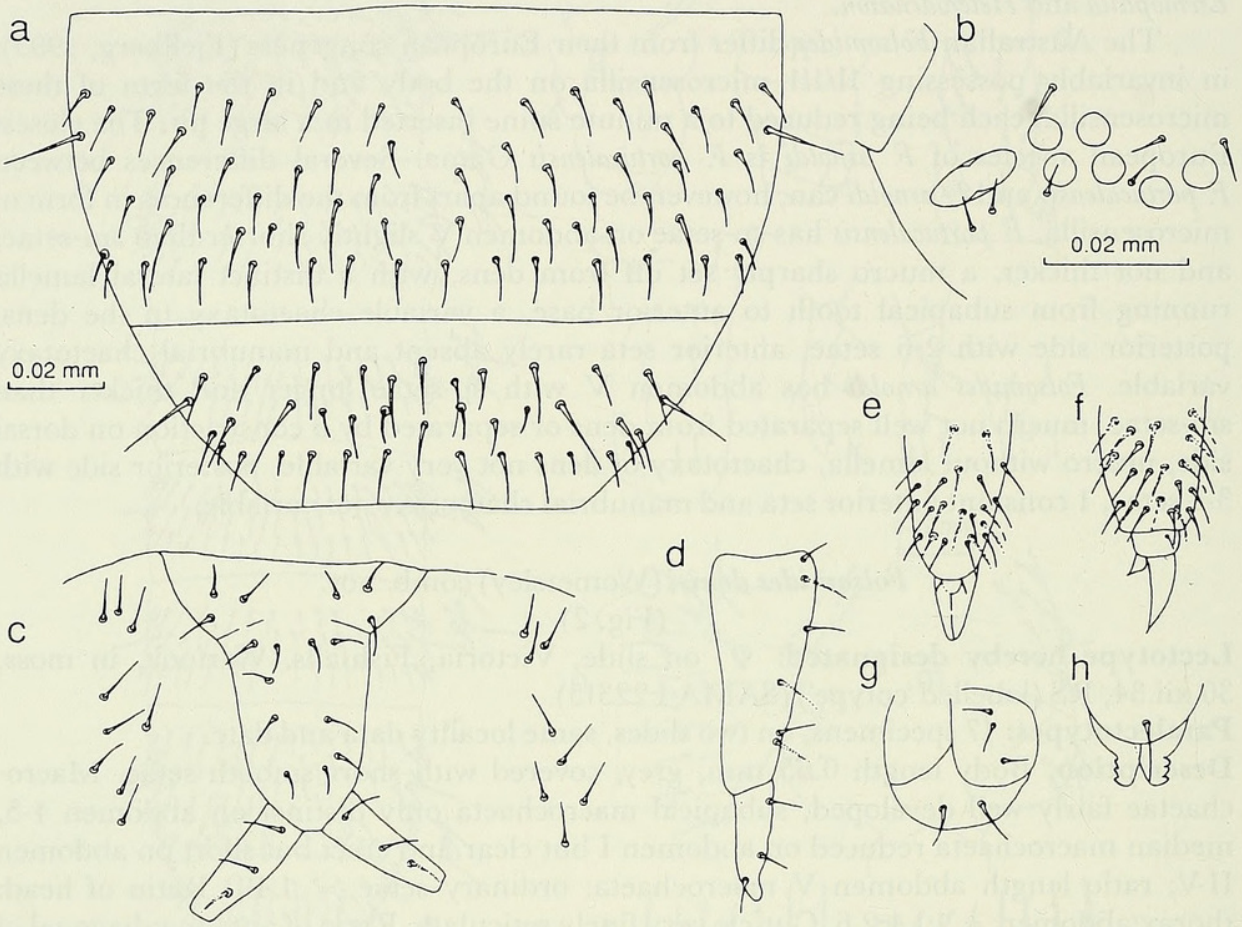

Fig. 2. Folsomides denisi (Womersley). lectotype ♀ and paralectotype ♂: a, abdomen IV and V dorsal chaetotaxy; b, ocelli and PAO; c, furcal and furcal subcoxae, ventral view, scale as a; d, furca, lateral view, scale as a; e, tibiotarsus III, ventral view, scale as b; f, tibiotarsus III, lateral view, scale as b; g, ventral tube, ventral view, scale as a; h, tenaculum, ventral view, scale as a b.

Comments: This species conforms in all details of arrangement and position of s-setae, tibiotarsal setae, furcal, antenna and preclypeal setae with those of *Folsomides* and is hereby transferred to that genus. Species in the genus *Astephanus* have a different chaetotaxy and cuticle. *Folsomides denisi* differs from all other known Australian *Folsomides* in the loss of the mucro. Fjellberg (1993) records and describes six species lacking a mucro but none have the same combination of 6 + 6 ocelli, 11/111 micro s'setae and 2/1 setae on dens as *F. denisi*. In addition, in *F. denisi* the micro s'setae are reduced to a small spine and inserted into a deep pit, as for all Australian species apart from *F. centralis* and *F. parvulus*.

CHECK LIST OF AUSTRALIAN *FOLSOMIDES* SPECIES

Folsomides arnoldi Suhardjono and Greenslade	N.S.W., S.A., N.T.
Folsomides centralis (Denis) *Proisotoma centralis* Denis, 1931: 111 *Folsomides centralis* Suhardjono, 1989	Qld, N.S.W., N.T.
Folsomides denisi (Womersley) nov. comb. *Astephanus denisi* Womersley, 1935: 215	Vic.
*Folsomides deserticolus** Wood *Folsomides deserticola* Wood, 1970: 79	S.A.
Folsomides parvulus Stach *Folsomides parvulus* Stach, 1922: 17	Qld, N.S.W., Vic., S.A., N.T.
Folsomides sexophthalmus (Womersley) *Proisotoma sexophthalma* Womersley, 1934: 100 *Folsomides sexophthalma,* * Wood 1970: 82	W.A.

* Wood (1970) considered *Folsomides* as feminine although it was erected by Stach (1922) unambiguously as masculine.

Characters to distinguish the species are given in Table 1.

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