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THE MITE GENUS LARDOGLYPHUS OUDEMANS, 1927 (= HOSHIKADANIA SASA AND ASANUMA, 1951)

by

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Lardoglyphus zacheri Oudemans and *L.* (= *Hoshikadania*) *konoi* (Sasa and Asanuma) were sent to me by Mr. D. A. Griffiths of the Infestation Control Division of the Ministry of Agriculture. They were found in butcher's offal ("gut greaves"), used in the manufacture of fertiliser, on premises near Chesterfield. In this particular case the offal was obtained locally, though it can also be imported from the Argentine; possibly the mites were orginally introduced into this country on empty uncleaned sacks obtained from other manufacturers.

The purpose of this paper is to provide a more complete description of *L. zacheri* Oudemans, and also to clear up some confusion in nomenclature.

Lardoglyphus zacheri Oudemans, 1927 (figs. 1-5)

Female (fig. 1). Length of idiosoma of six individuals: 450-600 μ. The body is spindle-shaped, widest between the second and third pairs of legs and tapering towards either end; the posterior edge is concave. The body cuticle is smooth and cream-coloured, the legs, apodemes, and chelicerae are of a darker shade; the propodosoma lacks a dorsal shield and is clearly separated by a transverse groove from the hysterosoma.

The setae of the idiosoma are smooth and slightly pectinate. The vertical internals (v. i) arise close together and project forward over the gnathosoma without reaching its extremity; the vertical externals (v. e) orginate from the same level, they are pectinate and curve towards the base of the chelicerae; behind them are the pseudostigmatic organs — small, curved and serrated — which lie in a depression above the base of leg I and are encircled by a lateral sclerite; at the anterior end of this sclerite is Grandjean's organ, a triangular fold of cuticle.

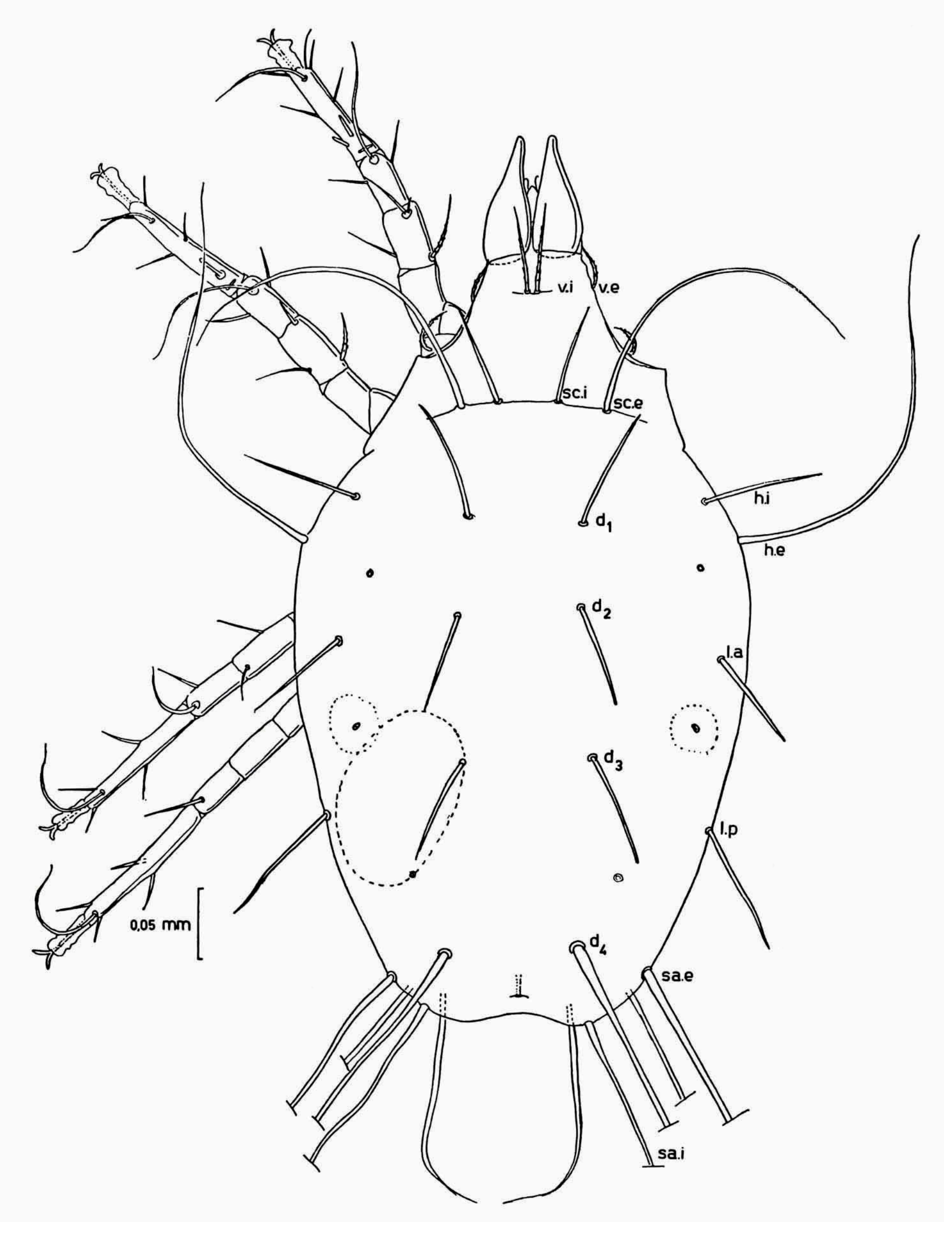

Fig. 1. *Lardoglyphus zacheri* Oudemans, ♀, dorsal view; v.i and v.e, internal and external vertical setae; sc.i and sc.e, internal and external scapulars; h.i and h.e, internal and external humerals; l.a and l.p, anterior and posterior laterals; d_1 to d_4, dorsals; sa.i and sa.e, internal and external sacrals.

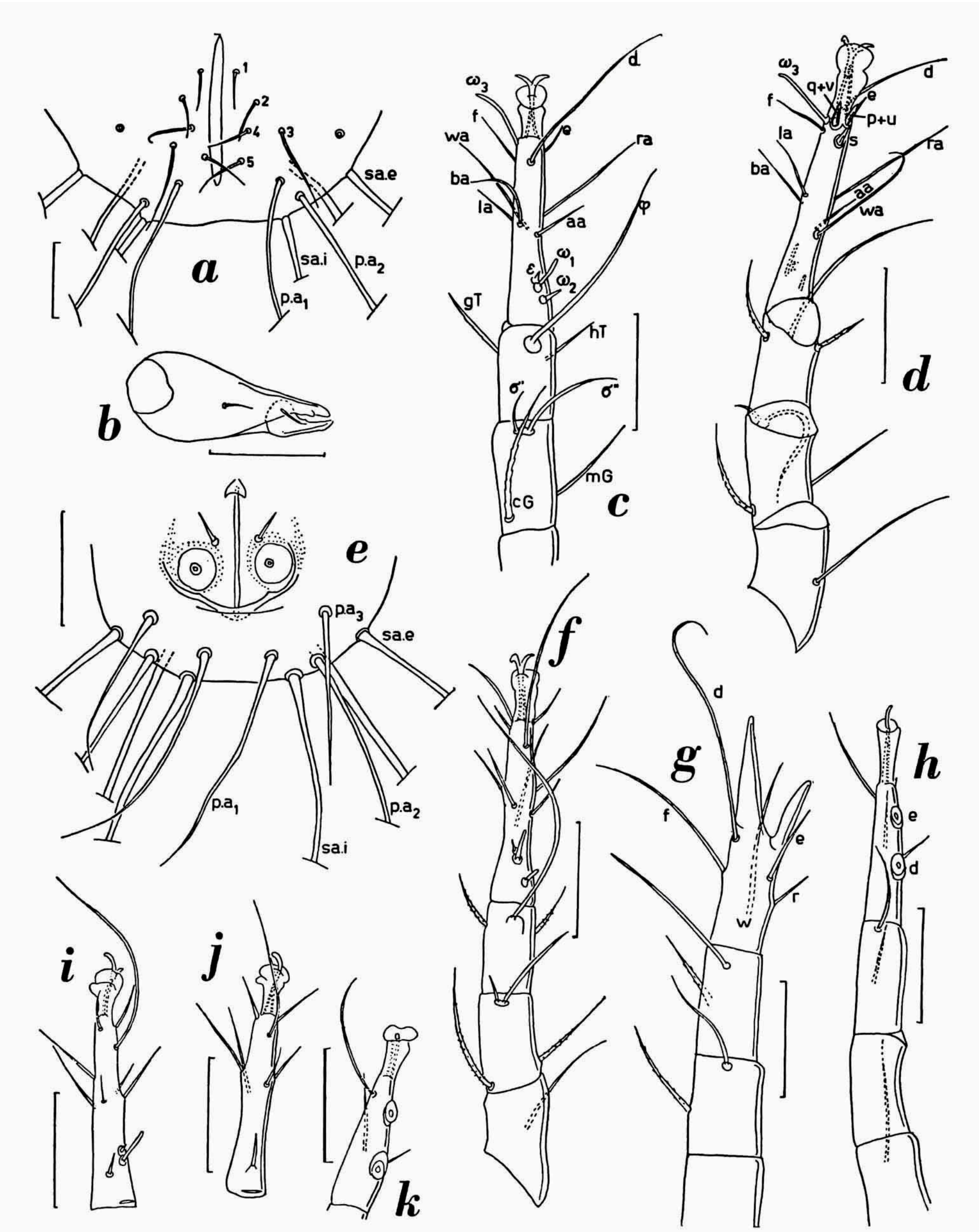

Fig. 2. *Lardoglyphus zacheri* Oudemans. *a,* ♀, ventral view of anal region; 1 to 5, anal setae; sa.i and sa.e, internal and external sacrals; p.a$_1$ and p.a$_2$, post-anals. *b,* ♀, internal view of left chelicera. *c,* ♀, dorsal view of right leg I; ω_1, ω_2, ω_3, φ, σ', and σ'', solenidia; ε, famulus; d, e, f, aa, ba, la, ra, wa, gT, hT, cG, mG, setae. *d,* ♀, ventro-lateral view of left leg I; v + q, p + u, and s, spines; ω_3, solenidion; d, f, la, ba, aa, ra, wa, setae. *e,* ♂, ventral view of anal region; sa. i and sa. e, internal and external sacral setae; p. a$_1$ to p. a$_3$, post-anals. *f,* ♂, dorsal view of right leg I. *g,* ♂, dorsal view of right leg III; d, e, f, r, and w, setae. *h,* ♂, dorso-lateral view of right leg IV; d and e, suckers. *i,* ♂, dorsal view of abnormal claw of left leg I. *j,* ♂, dorsal view of abnormal claw of left leg II. *k,* ♂, dorsal view of abnormal claw of right leg IV. Each measuring-line represents 0.05 mm.

The bases of the two pairs of scapular setae (sc. e and sc. i) form a transverse line on a level with leg II, sc. i is less than one quarter the length of sc. e. Three pairs of humerals are present; of these the internal and the ventral (h. i and h. v) are less than one quarter the length of the external (h. e). The three anterior dorsals (d_1, d_2 and d_3) and anterior and posterior laterals (l. a and l. p) are of nearly the same length as sc. i, but d_4 and the internal and external sacrals (sa. i and sa. e) are more than three times as long. Besides the openings of the latero-abdominal glands, two pairs of chitinous rings are also present external to d_1 and d_2, and to d_3 and d_4; they resemble the bases of setae.

On the ventral surface the usual two pairs of coxal and three pairs of genital setae are present; the anus (fig. *2a*), which does not reach the posterior end of the body, is flanked by two rows of four anal setae of equal length and with their bases equidistant from each other; a fifth anal seta (3) — slightly longer than the others — arises externally to anal seta 4. Of the two pairs of postanal setae, p. a_1 extends well beyond the posterior edge of the body and p. a_2 is more than half the length of the idiosoma. A chitinous ring, similar to those on the dorsal surface, lies external to anal seta 3.

The gnathosoma is slender and mobile, the chelicerae (fig. 2b) are of the normal chelate pattern, the shears feebly toothed.

The legs are long and slender, each terminates in a well-developed praetarsus ensheathing a slender "stalk" to which is articulated a bifid claw. The chaetotaxy of the legs is very similar to that described by F. Grandjean (1939) for *Forcellinia wasmanni*. Of the distal group of setae on tarsus I (fig. *2c, d*), d is the longest and extends well beyond the end of the claw, e and f are external and internal in position, whilst v + q, p + u are represented by conspicuous ventral spines. The solenidion ω_3 is unusually well-developed and reaches almost to the end of the praetarsus. The median region of the tarsus is encircled by the setae aa, ba, la, ra, and wa, the dorsal basal part of the joint bearing the solenidia ω_1, ω_2, and the famulus ε. ω_1 is a slightly curved rod arising close to ε.

The chaetotaxy of tarsi II to IV shows the progressive simplification that is characteristic of other acarid mites. On the remaining joints of the legs, the solenidion φ of the tibia is long and whip-like; on genu I, σ'' is twice as long as σ'. The setae gT, hT on tibia I and cG on genu I are slightly pectinate.

The epimera are well-developed chitinous struts, those of leg I meeting to form a short sternum. The ventral edges of acetabula I and II are also well-cuticularised, uniting with the epimeres and epimerites of these legs.

The genital opening is a longitudinal slit lying between coxae III and IV́ and concealed by paired genital folds; from the underside of these arise the

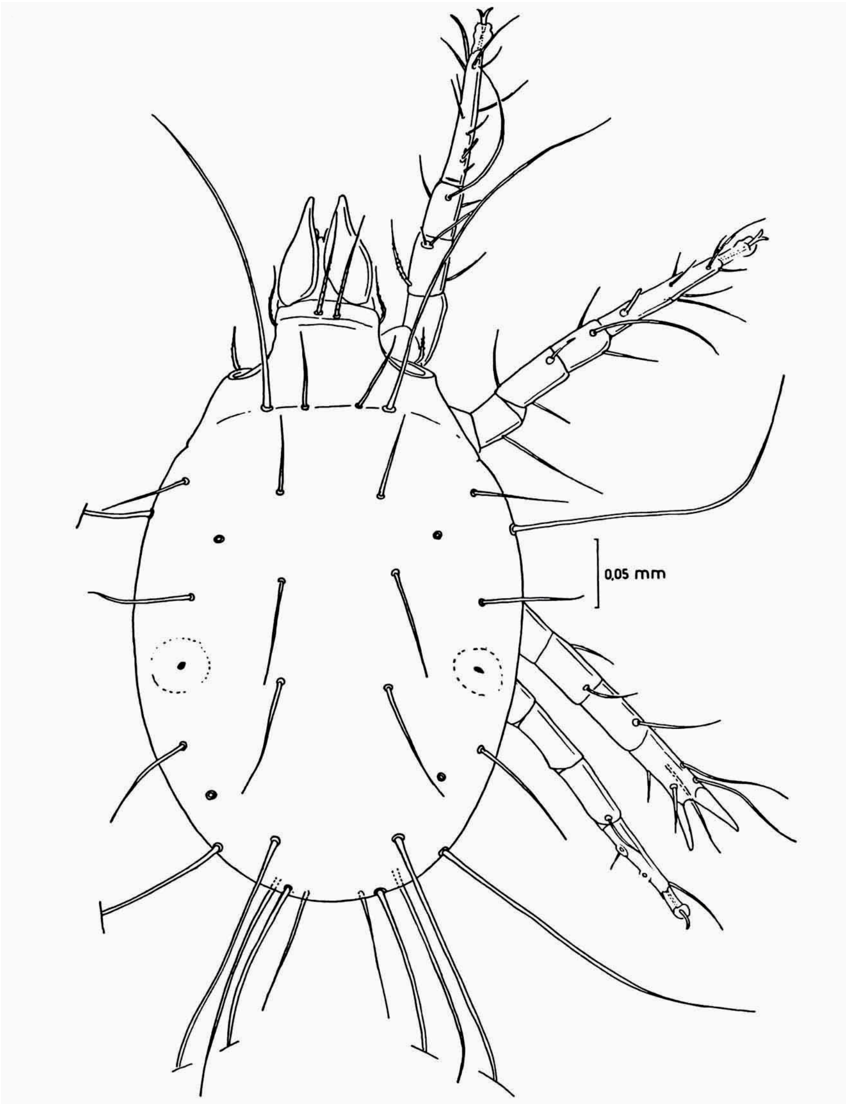

Fig. 3. *Lardoglyphus zacheri* Oudemans, ♂, dorsal view.

two pairs of "suckers". Through the transparent folds can be seen the wrinkled wall of the oviduct. The bursa copulatrix opens by a small aperture on the dorsal posterior end of the idiosoma.

Male (fig. 3). Length of idiosoma of six specimens: 430-550 μ. Only the heteromorphic ♂ was found and it seems possible that the homeomorphic one is rarely or never developed.

The shape of the idiosoma differs from that of the ♀ in being more rounded at the posterior end. The arrangement of setae on the dorsal surface is essentially the same. The anal opening is bordered by two circular suckers (fig. 2 *e*) whose posterior edge is encircled by a curved sclerite; in front of each sucker a seta is placed. Three pairs of postanal setae (p. a_1—p. a_3) arise behind the anus, all extending well behind the posterior border of the body; of these p. a_2 are the longest and exceed half the length of the idiosoma. Just as in the ♀, tarsi I and II each terminate in a praetarsus bearing a stalked bifid claw (fig. 2 *f*), but on the third leg, which is dragged along the ground during walking, the ambulacrum is replaced by two spine-like structures (fig. 2 *g*). On this leg the seta d arises at the base of the largest of the spines and e, f, r and w are more medial in position. Tarsus IV (fig. 2 *h*) terminates in an unbranched claw and d and e are replaced by suckers occupying a central position on the tarsus. The claws vary in structure in the different specimens: sometimes one limb on tarsi I or II is longer than the other (fig. 2 *i*), sometimes it is single (fig. 2 *j*) or even vestigial (fig. 2 *k*).

Ventrally the epimeres and epimerites are heavily cuticularised, whilst the apodemal plates are more clearly defined than in the ♀. The genital duct terminates in a short penis, concealed by genital folds and lying between coxae IV. The normal three pairs of genital setae and two pairs of suckers are present.

Immature stages. The hypopus (fig. 4) is freely formed in this species; it is 230-300 μ in length and almost circular in outline. The dorsal surface — pinkish brown in colour — is arched and covered anteriorly with a propodosomal shield ornamented with a faint scale-like pattern, posteriorly with a hysterosomal shield; the anterior edge of the last mentioned shield is concave and its surface finely reticulate. Beneath the narrow posterior edge and middle of the shield are dark-coloured thickenings of the cuticle; this area of the body is bent ventrally and, with the fourth pair of legs, dragged along the ground in walking.

From the anterior edge of the propodosoma the two pairs of vertical setae arise; the four scapulars are arranged in a curved line across its posterior limit; sc. i are shorter than sc. e. On the hysterosomal shield are four pairs of dorsal setae and three pairs of laterals which are slightly thicker than the more anterior humerals.

The ventral surface of the body (fig. 5 *a*) is concave and well-cuticularised; epimeres I unite to form a short sternum, but epimeres II to IV end freely in the mid-line. The internal edges of the acetabula are also thickened and those of leg III curve backwards and medially to meet epimeres IV. On coxal fields I and III and also between II and III are

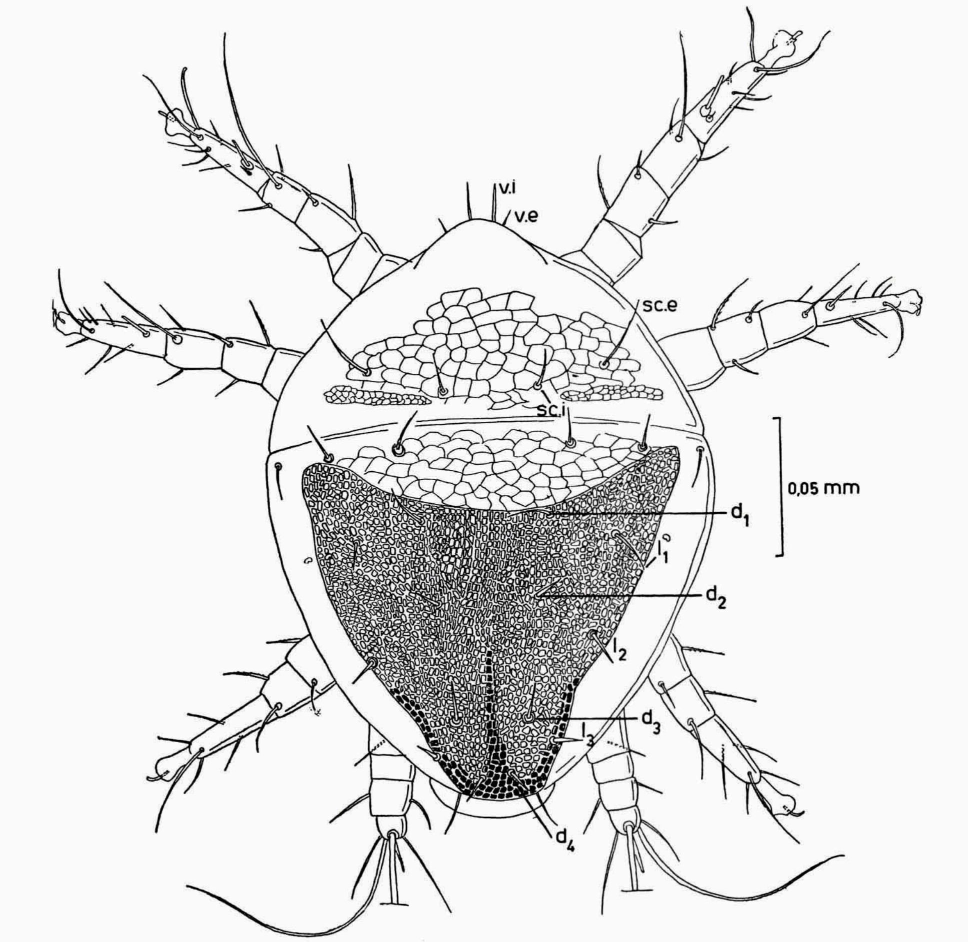

Fig. 4. *Lardoglyphus zacheri* Oudemans, hypopus, dorsal view; v. i and v. e, internal and external vertical setae; sc. i and sc. e, internal and external scapulars; d_1 to d_4, dorsals; l_1 to l_3, laterals.

three pairs of chitinous rings similar to those found in the adult. Three pairs of setae are also present, between coxae II and III, internal to epimeres IV, and on either side of the genital opening.

The sucker plate (fig. 5 *d*) is bounded posteriorly by a colourless margin, the edge of which is visible when the animal is viewed dorsally. On the plate two large central suckers are arranged, posteriorly encircled by four smaller

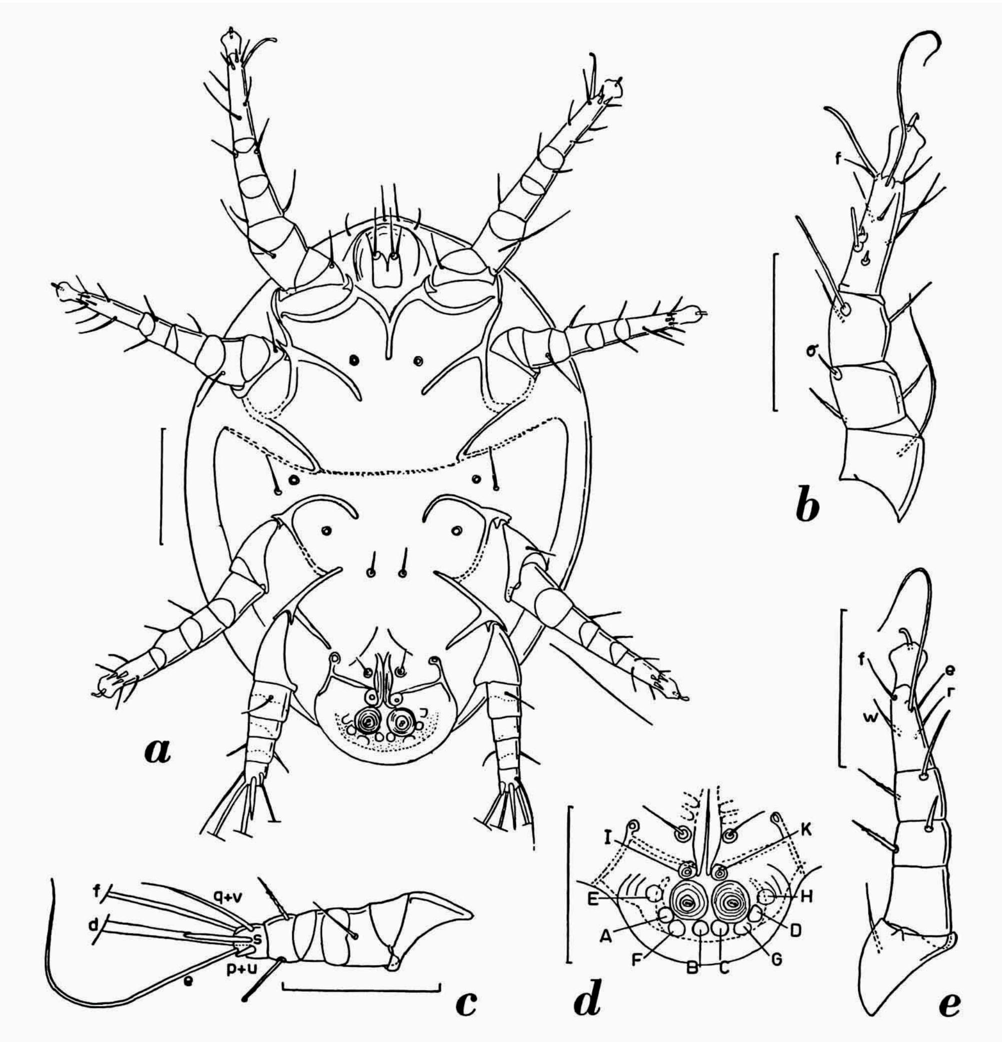

Fig. 5. *Lardoglyphus zacheri* Oudemans, hypopus. *a*, ventral view. *b*, dorsal view of right leg I; σ, solenidion; f, seta. *c*, ventral view of right leg IV; d, e, f, p + u, q + v, s, setae. *d*, ventral view of sucker plate; A to D, suckers; E to H, auxiliary suckers; I, K, anterior suckers. *e*, dorsal view of right leg III; e, f, r, w, setae. Each measuring-line represents 0.05 mm.

(A-D), four auxiliary (E-H), and two anterior suckers (I, K); the auxiliary suckers are ill-defined.

As in the nymphal and larval stages, the tarsus terminates in a membranous praetarsus bearing an unbranched claw. The chaetotaxy of leg I (fig. 5 *b*) is the same as in the adult, except that on the tarsus the seta ba is missing and on the genu only one solenidion σ is present. Legs II and III (fig. 5 *e*) also closely resemble those of the adult. The fourth leg (fig. 5*c*) is, however, considerably shortened and the praetarsus and claw are replaced by trailing setae; of these the three dorsal may represent the setae d, e, and f, d being by far the longest, while the three ventral ones occupy the same position as the spines q + v, p + u, and s.

The two nymphal stages and larva resemble the ♀. In the protonymph and telonymph, d_4 and sa. e are more than twice as long as d_3; in the larva, "Bruststiele" are present on either side of the coxal setae.

Life-history. Isolated specimens of *L. zacheri* were kept on dried heart muscle and the length of the life history determined. At a relative humidity of 87% (controlled by means of a saturated solution of KCl) and a temperature of 23° C, each stage took the following time —

Egg	3 days
Larva	2 days
Resting larva	12-24 hours
Protonymph	1 day
Resting protonymph	1 day
Telonymph	2 days
Resting telonymph	12-24 hours.

Under these conditions the life history can be completed in ten to eleven days. The thirty-two eggs obtained from one mated ♀ were used, and of these none passed through the hypopial stage. Hypopi appeared only when one cell was left untouched, and on account of this may have become overcrowded or lacking in food.

The hypopi fixed themselves with great readiness to the long "hairs" on the larvae of the hide beetle, *Dermestes maculatus*; from here they made their way on to the body and attached themselves to the intersegmental membranes by means of the sucker plate, the gnathosoma pointing backwards. The majority tended to congregate near the host's head, possibly so as to migrate easily on to the next larva after moulting; no hypopi were ever found on the dermestid cast larval skins.

A dermestid larva, carrying twenty-five newly attached hypopi, was kept by itself; in three days active *Lardoglyphus* nymphs were found in the cell and the last hypopus remained attached for thirteen days before moulting. There is considerable variation, therefore, in the length of time that the hypopi remain attached.

The hypopi showed no inclination to attach themselves to the adult *Dermestes,* although this stage is considerably more active than the larva and therefore more likely to be an effective dispersal agent. The hypopi would also cling on to adults of their own species and also to larvae of the beetle *Necrobia rufipes,* but they tended to get brushed off by overhanging debris as the intersegmental membranes of the last mentioned species are not overhung and protected by the preceding tergum.

Lardoglyphus konoi (Sasa and Asanuma, 1951) (figs. 6-9)

All stages of this mite have been fully described by M. Sasa and K. Asanuma (1951). Below are listed the characters in which it differs from *L. zacheri.*

Adult stages. Both ♀ (fig. 6) and ♂ (fig. 8) are smaller than *L. zacheri,* i.e. the length of the idiosoma of 6 specimens of *L. konoi* ♀ is 400-550 μ, of the ♂ 300-440 μ. In both sexes d_4, sa. e and p. a (fig. 7 *a, e*) are equal in length to d_3 instead of being more than twice as long.

Whilst all the claws of the ♀ are bifid (fig. 7 *b, d*), tarsi I (fig. 7 *g*), II and IV (fig. 7 *h*) of the ♂ bear undivided claws. Some ♀ ♀ were found, however, with an undivided claw (fig. 7 *c*).

The tarsus of leg III of the ♂ (fig. 7 *f*) is shorter than the corresponding joint in *L. zacheri* and the setae are terminal.

The chelicera (fig. 7 *i*) has several small teeth on both fixed and movable joints.

The chitinous sclerite encircling the anal suckers in the ♂ (fig. 7 *e*) is bent more sharply towards the posterior end of the body; the postanal setae (p. a_1 and p. a_3) are considerably shorter, and the anal (a) lie on either side of the anterior end of the anus instead of midway along its length. In the ♀ the opening of the bursa copulatrix is strengthened by sclerites (fig. 6).

Immature stages. In the hypopus (length of idiosoma of six specimens: 215-260 μ), the setae arising from the hysterosomal shield are thickened to form spines (fig. 9 *a*). Ventrally (fig. 9 *b*) a posterior projection of epimeres III extends as far back as the setae between epimeres IV.

The margin of the sucker plate (fig. 9 *d*) is wider than in *L. zacheri,* and the two central suckers are smaller. The encircling suckers A and D are replaced by horn-like projections, and the auxiliary suckers are transpa-

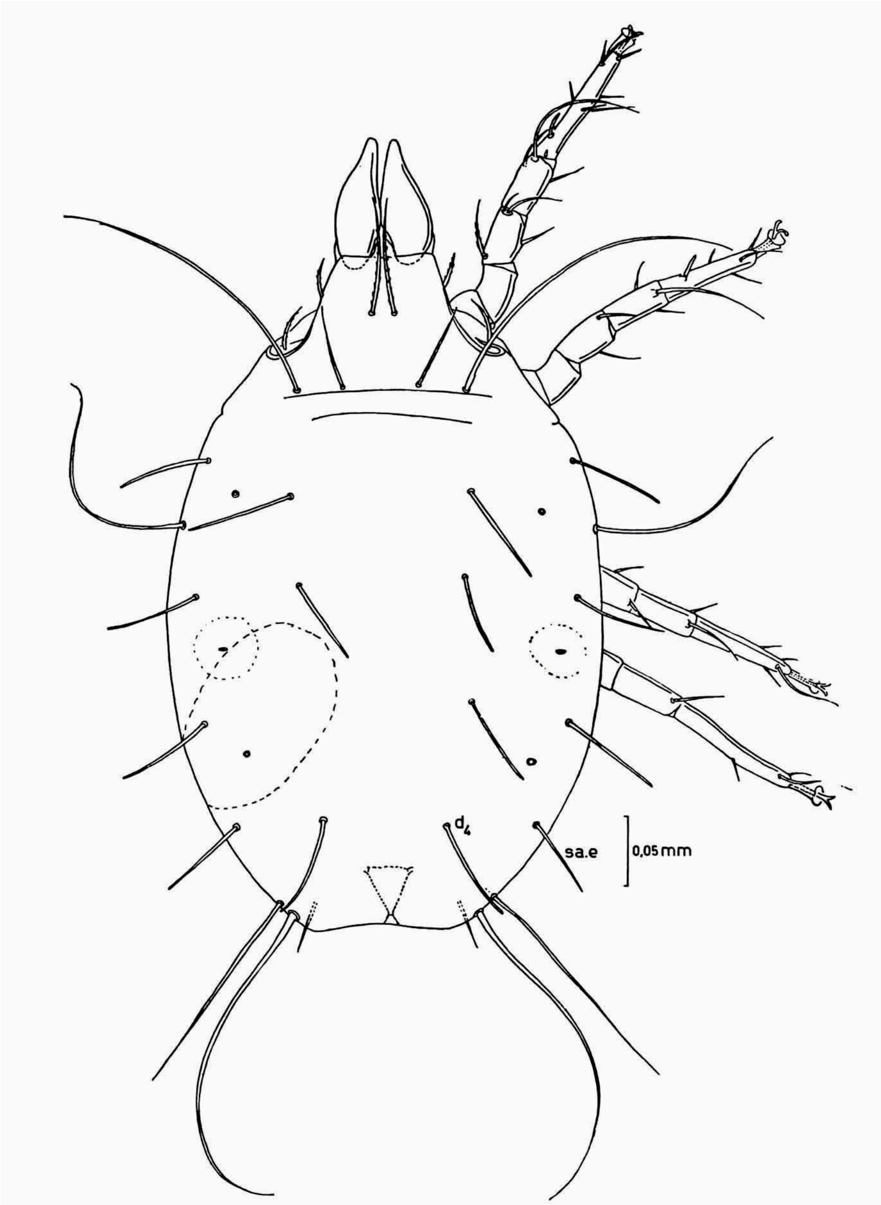

Fig. 6. *Lardoglyphus konoi* (Sasa & Asanuma), ♀, dorsal view; d4, dorsal seta; sa. e, external sacral.

rent. The anterior suckers I and K vary in position and are frequently asymmetrically arranged.

The praetarsi of legs I to III (fig. 9 *e, f*) are longer and more slender in *L. konoi*. On tarsi I and II the seta f is leaf-shaped instead of being simple, and on tarsi III (fig. 9 *f*) all the setae except d are expanded

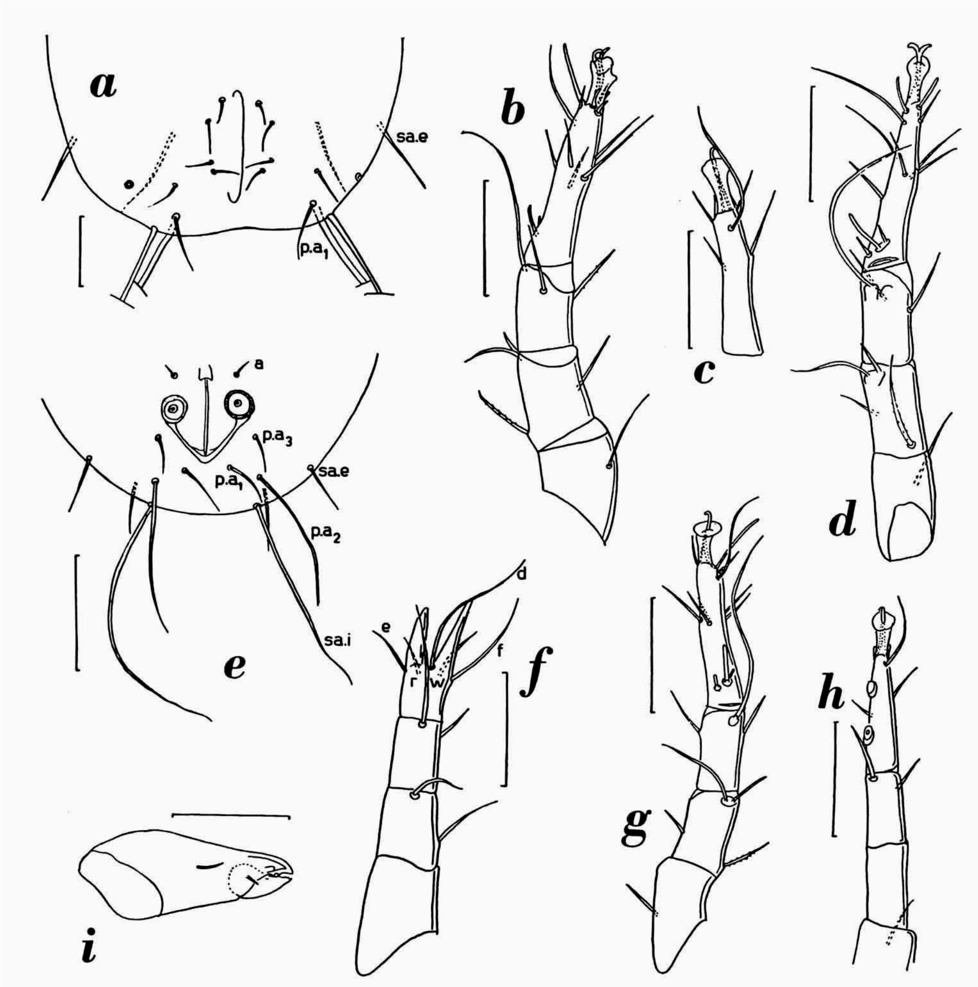

Fig. 7. *Lardoglyphus konoi* (Sasa & Asanuma). *a*, ♀, ventral view of anal region; sa. e, external sacral seta; p. a1, post-anal. *b*, ♀, ventro-lateral view of left leg I. *c*, ♀, dorsal view of abnormal claw of right leg III. *d*, ♀, dorsal view of left leg I. *e*, ♂, ventral view of anal region; sa. i and sa. e, internal and external sacral setae; p. a1 to p. a3, post-anals; a, anal. *f*, ♂, dorsal view of left leg III; d, e, f, r, and w, setae. *g*, ♂, dorsal view of left leg I. *h*, ♂, dorsal view of left leg IV. *i*, internal view of left chelicera. Each measuring-line represents 0.05 mm.

distally into transparent laminae. Tarsus IV (fig. 9 *c*) bears two similar leaflike structures (e and p + u) and an additional seta rw is also present.

The nymphs can easily be distinguished by the reduced lengths of sa. e and d_4, which are almost equal to d_3.

Life history. The life history is very similar to that of *L. zacheri,* being completed in 9 to 11 days under the same conditions. Attempts to cross ♂♂ of *L. zacheri* with ♀♀ of *L. konoi* and vice versa were unsuccessful and neither species is parthenogenetic.

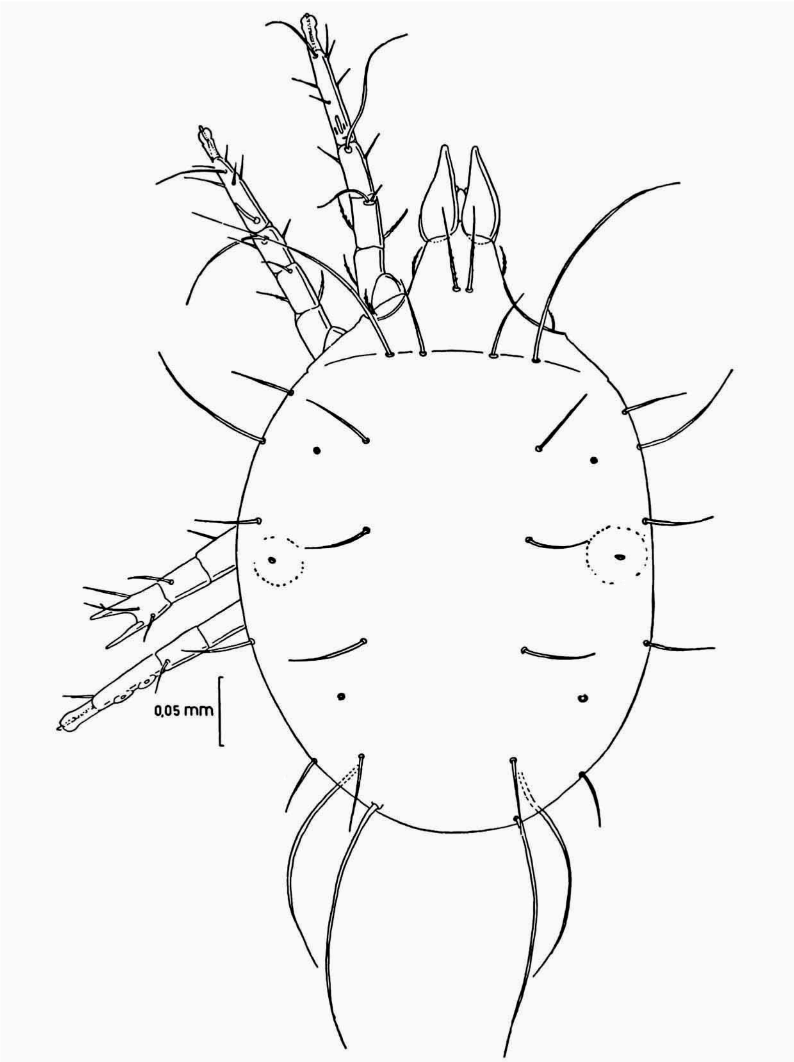

Fig. 8. *Lardoglyphus konoi* (Sasa & Asanuma), ♂, dorsal view.

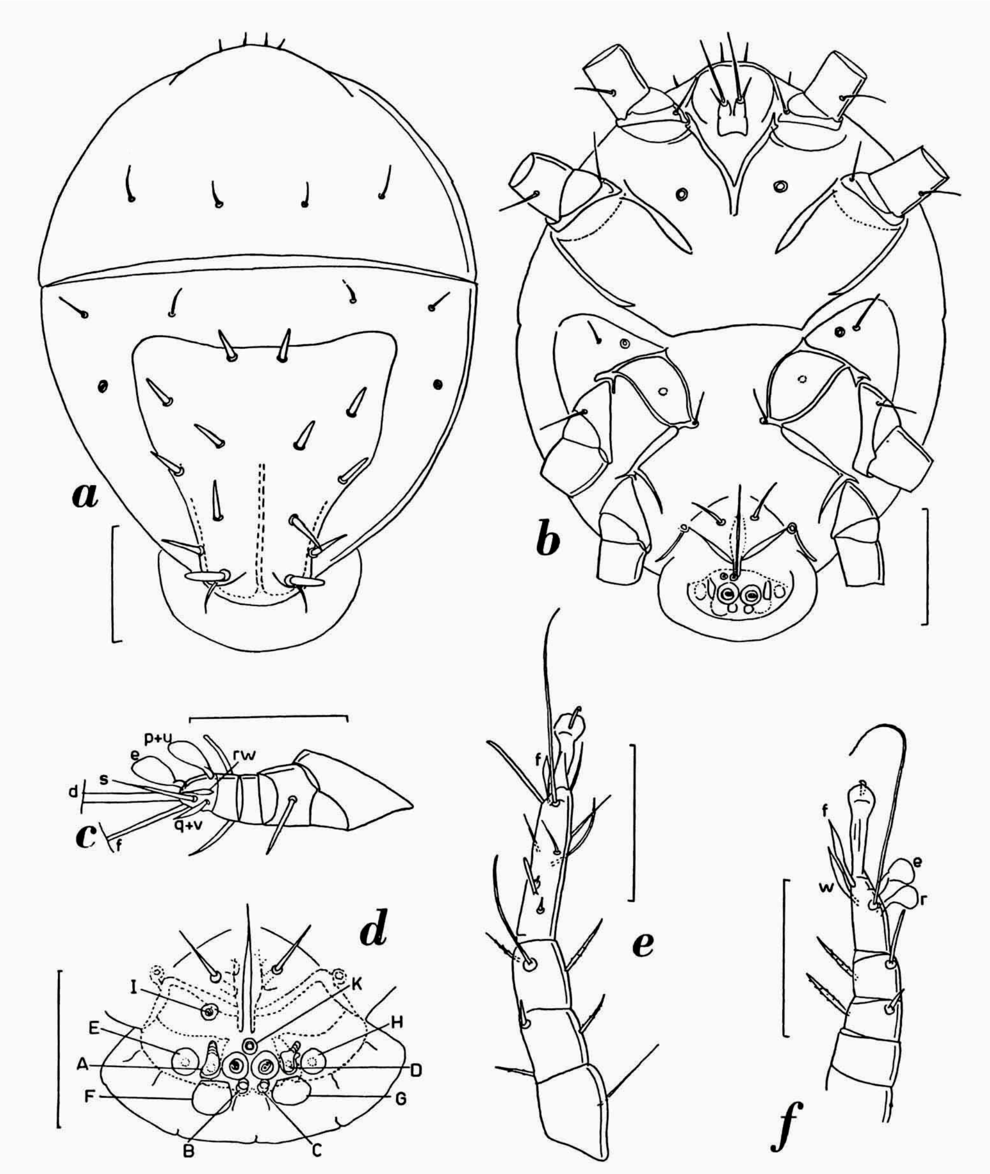

Fig. 9. *Lardoglyphus konoi* (Sasa & Asanuma), hypopus. *a,* dorsal view. *b,* ventral view. *c,* ventral view of right leg IV; d, e, f, p + u, q + v, s, rw, setae. *d,* ventral view of sucker plate; A to D, suckers; E to H, auxiliary suckers; I, K, anterior suckers. *e,* dorsal view of right leg I; f, seta. *f,* dorsal view of right leg III; e, f, r, and w, setae. Each measuring-line represents 0.05 mm.

Distribution

L. zacheri was first found by Dr. Zacher in a culture of *Dermestes lardarius* on hides in S. America, and sent to Dr. Oudemans in Holland. *L. konoi* is especially common on dried fish in Japan and I have also had it sent to me by Mr. Parameswaran Pillai from S. India where it is a pest of dried shellfish. This paper is the first record of its occurrence in Europe.

Systematic position

The genus *Lardoglyphus* was placed by A. C. Oudemans (1927) in a separate family — Lardoglyphidae — of the cohort Diacotricha (Supercohort Acaridiae); A. A. Zachvatkin (1941) united the majority of free-living genera of the Acaridiae into three families, using the structure of the ambulacrum, the presence of a suture between propodosoma and idiosoma, and the setal structure as diagnostic characters. The presence of a stalked claw, the chaetotaxy of the legs, the transverse suture between propodosoma and hysterosoma, the presence of tarsal and anal suckers in the ♂, and the simple nature of the setae are all characters common to the genus *Lardoglyphus* and the family Acaridae (= Tyroglyphidae). The anterior position of v. e, the presence of a normal number of dorsal setae, and the well-developed praetarsi suggest that it should be included in the subfamily Acarinae (= Tyroglyphinae) of the family Acaridae.

Acknowledgements

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