

THE GENUS *BLOMIA* OUDEMANS (ACARI : GLYCYPHAGIDAE)
II. COMPARISON OF ITS SPECIES

BY

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In the first part of this study (BRONSWIJK, COCK & OSHIMA 1973) we described the new species *B. tropicalis* from house dust. This description made it necessary to study the relationships among all species of the genus.

HISTORY

The genus *Blomia* was erected by OUDEMANS in 1928 to contain *Glycyphagus tjibodas*, a species he described in 1910 (giving additions in 1914) from house dust of Java. His original drawings — unpublished until now — can be seen in Fig. 1.² Five species have been added to the genus: *B. thori* Zakhvatkin 1936, *B. kulagini* Zakhvatkin 1936, *B. freemani* Hughes 1948, *B. khalilovae* Zakhvatkin 1949 and *B. tropicalis* Bronswijk, Cock & Oshima 1973.

The study of the genus is hampered by the loss or dislocation of the type material of *B. kulagini* and *B. khalilovae* (V. I. VOLGIN, personal communication).

The most extensive definition of the genus was given by ZAKHVATKIN (1936). We adopted his definition with some additions and modifications:

“ Small mites (230-465 μ); the body almost globular in shape, broad across the scapular region and tapering towards its posterior end; no suture between propodosoma and hysterosoma; cuticle rough; on the dorsal surface 2 pairs of vertical, 2 pairs of scapular, 5 pairs of dorsal, 5 pairs of lateral and 1 pair humeral setae, all long and pectinated except for d_2 ; 6 pairs of anal setae in the female; no dorsal shield or crista metopica; ve and vi inserted near the anterior margin of the idiosoma; pseudostigmatic organ shaped like a pectinate rod; male and female genital

1. Supported by grant no 48 of the Dutch Asthma Foundation, Leusden, The Netherlands. Present address: Department of Dermatology, State University, Utrecht, The Netherlands.

2. Due to the courtesy of Dr. L. v. D. HAMMEN we are able to reproduce this unpublished material, of which the original is present in the Museum of Natural History, Leiden, The Netherlands.

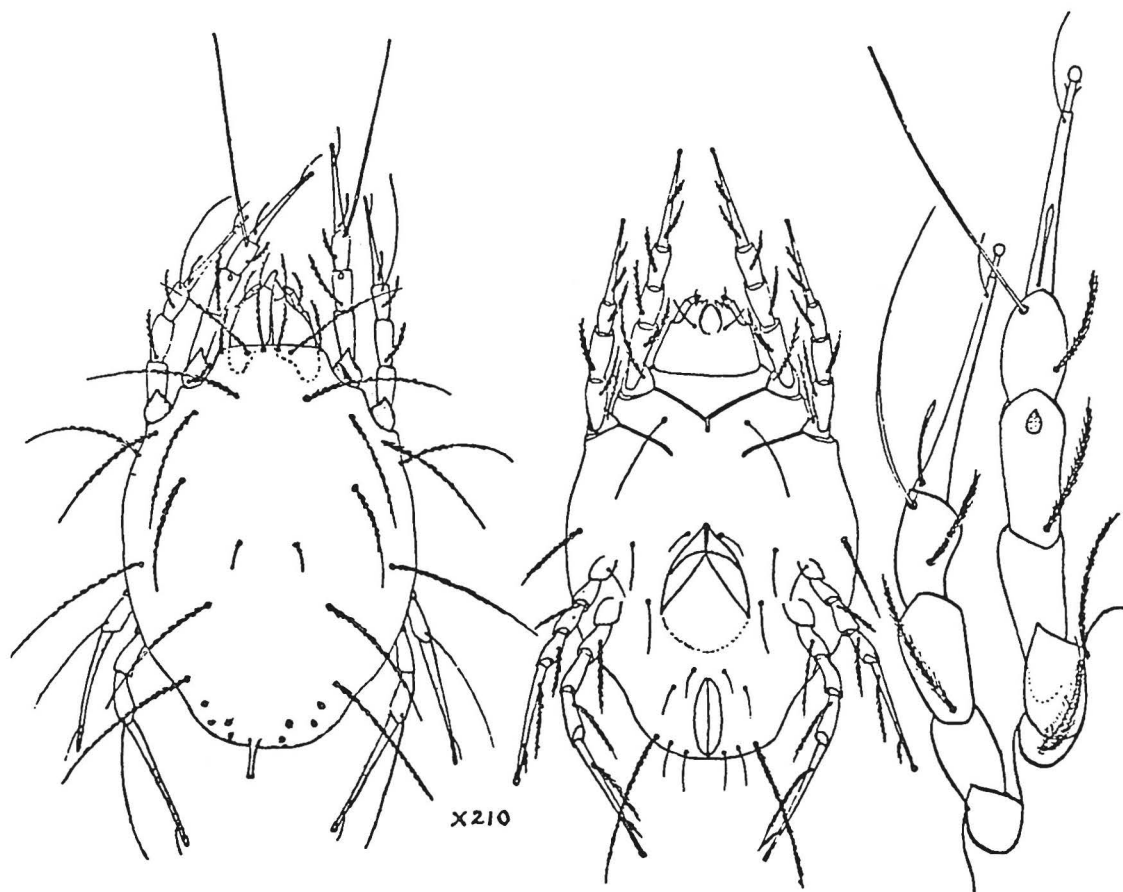


FIG. 1. — Original drawings of Oudemans of *Blomia tjobodas*, showing dorsal and ventral side and details of legs I and II (The following note was written on the drawing: "On the legs I and II there is another dorsal hair which I did not draw".)

openings between coxae III and IV, in the male the opening is largely concealed by 2 folds, in the female these folds are reduced; epigynum and epiandrum absent; female with copulatory tube; no anal or tarsal suckers in the male; legs long and slender with small pretarsi and no claws visible; one short solenidion on genu I and II; in the male the tarsal tibial joint of leg IV has a large arthrodial membrane on the posterior-dorsal surface, so that this joint can bend sharply to the anterior-ventral side.

Type species: *Glycyphagus tjobodas* Oudemans 1910.

BIOLOGY

As can be seen in table 1 the genus *Blomia* is essentially a stored food feeder. Only two species are found in houses: *B. tjobodas* and *B. tropicalis*. The distribution over the world is shown in Fig. 2. Unfortunately the details known are very fragmentary.

Of *B. freemani* it is known further that it can live in association with *Acarus siro* L. 1758 and *Glycyphagus destructor* (Schrank 1758).

The biology of *B. tropicalis* was discussed in the first part of this study.

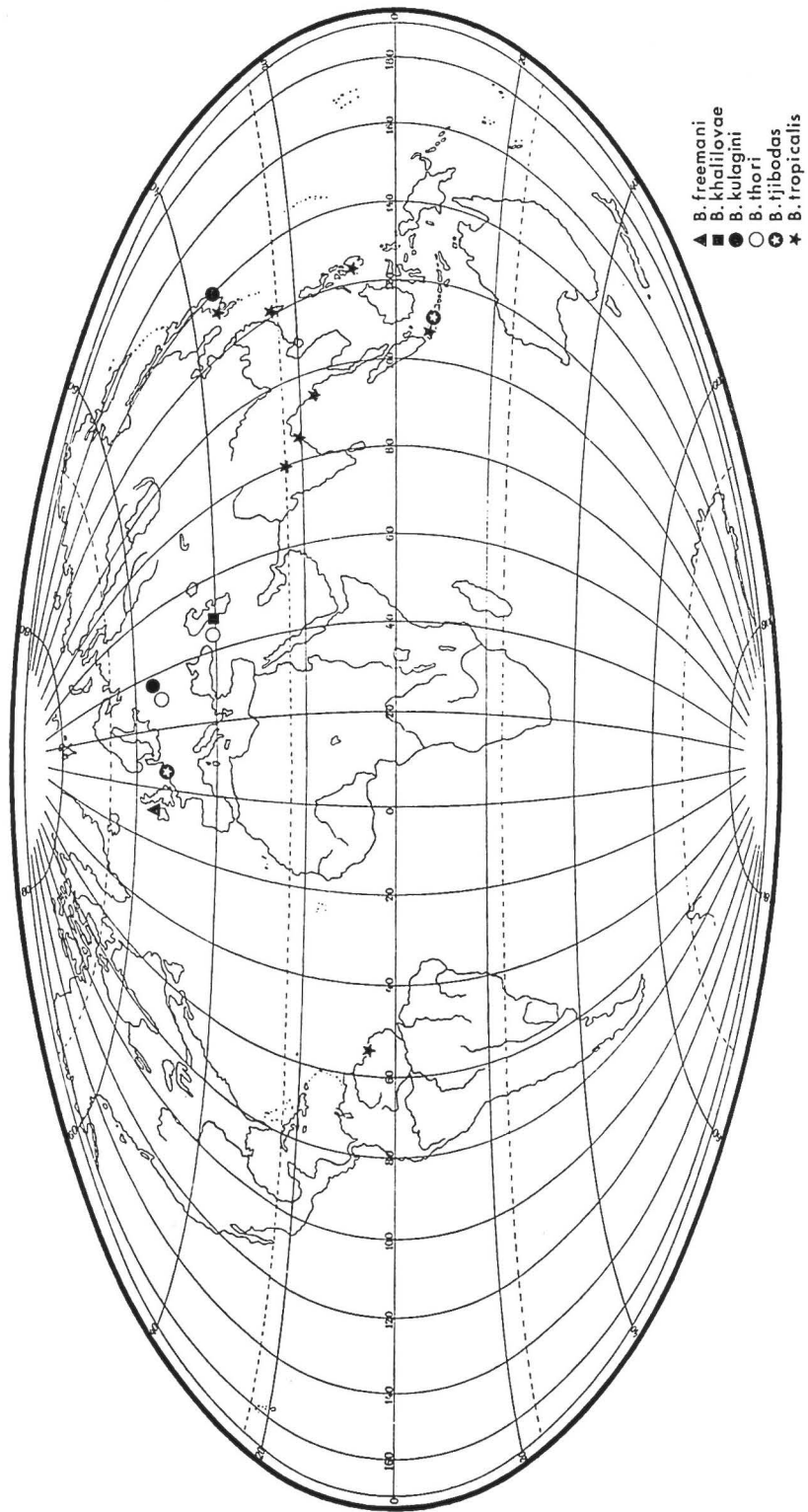


FIG. 2. — World distribution of *Blomia*.

TABLE 1 : Habitat of *Blomia*.

species	habitat	references
<i>B. freemani</i>	stored wheat	Hughes 1948
<i>B. khalilovae</i>	stored barley stored millet	Zakhvatkin 1949
<i>B. kulagini</i>	stored wheat ?house dust	Zakhvatkin 1942 present paper
<i>B. thori</i>	stored flax seed grain products	Zakhvatkin 1942 Kadzhaya 1970
<i>B. tjibodas</i>	house dust stable	Oudemans 1910, 1914 & unpublished. present paper
<i>B. tropicalis</i>	house dust dust of tobacco factory stored rice	Bronswijk, Cock & Oshima 1973

SPECIMENS EXAMINED

a. *B. tjibodas* (Oudemans 1910)

By courtesy of dr. L. V. D. HAMMEN we could obtain on loan 8 slides from the collection of Oudemans in the " Rijksmuseum voor Natuurlijke Historie ", Raamsteeg 2, Leiden. These slides contained the following material :

- slide no 1. female type, ex house Tjibodas, April, 1905, coll. dr. J. J. C. Loman.
- slide no 2. female, ex house dust, Arnhem, Februari 1914, coll. A. C. Oudemans.
- slide no 3. protonymph, ex house, Arnhem, July 1914, coll. A. C. Oudemans.
- slide no 4. larva, ex house dust, Arnhem, July 1923, coll. A. C. Oudemans.
- slide no 5. female, ex house dust, Arnhem, October 1923, coll. A. C. Oudemans.
- slide no 6. 2 males, ex house dust, Arnhem, October 1923, coll. A. C. Oudemans.
- slide no 7. larva, ex house dust, Arnhem, November 1925, coll. A. C. Oudemans.
- slide no. 8 female, ex stable, Friesland, December 1824, coll. ?.

When examining (2-10-71) a house-dust sample from Den Helder (The Netherlands) the first author found 2 females, 1 male and 1 tritonymph that could not be separated from this species.

b. *B. kulagini* Zakhvatkin 1936.

As mentioned before the type material of this species has most likely been lost. No other reference to this species could be found.

We found several males, females and 2 tritonymphs in crevices in the floor of a gymnasium of a girls school in Yokohama (Japan) on June 8th 1961 and July 19th 1962 that were very similar to the description of this species.

The following differences with ZAKHVATKIN (1936, 1942) could be noted :

1. ZAKHVATKIN mentioned that the genital pappillae were absent. We found (Fig. 3, 11) comparatively large but very feebly sclerotised ones. The smaller but more sclerotised pappillae



FIG. 3. — *Blomia kulagini* Zakhvatkin, female, venter.

of *B. thori* (Fig. 11) were noticed by ZAKHVATKIN. It is very improbably, moreover, for a member of the family Glycyphagidae to have no genital pappillae. We think that Zakhvatkin's optical equipment did not allow him to see this detail.

2. The specimens of Yokohama tend to have longer dorsal setae than the specimens of Zakhvatkin (Table 2). Seta I₁, moreover, is not shorter than h (which is a point in the description of ZAKHVATKIN). However, as will be discussed below, the lengths of body setae are not consistent.
3. In the material from Yokohama the copulatory tube of the female is longer than genu I. ZAKHVATKIN described them as presenting the same length. This in contrast with *B. thori*, where the tube is considerably shorter than the genu. Study of Zakhvatkins material of *B. thori* revealed that the tube is only considerably shorter than genu I when it is measured from the posterior margin of the body and not from its insertions. If we measure *B. kulagini* from Yokohama in the same way Zakhvatkins statement holds.

TABLE 2 : Length of dorsal idiosomal setae in percentage of idiosomal length in the female of *B. kulagini*.

name of seta	female type of Zakhvatkin	illustrated female from Yokohama
vi	27	33
ve	21	27
sci	31	35
sce	33	33
h	30	33
l 1	23-24	35
l 2	50	57
l 3	75	75
l 4	80	87
l 5	75	94
d 1	36	39
d 2	4	3
d 3	50	54
d 4	80	91
d 5	90	100

In other characters, for instance, the structure of the supracoxal setae, the solenidia ω and σ , the posterior protrusions (Fig. 3) of the idiosoma of the female, and the form of the copulatory tube, the penis and genital hairs of the male, the anal setation, no difference could be found between our material and the description and illustration of Zakhvatkin.

In view of this evidence we classify our material provisionally within the species *B. kulagini* Zakhvatkin and postpone the final decision until more material, preferably from the type habitat and locality, has been studied.

The illustrations labelled *B. kulagini* in this paper were made from the Yokohama material and are no copies of Zakhvatkins drawings.

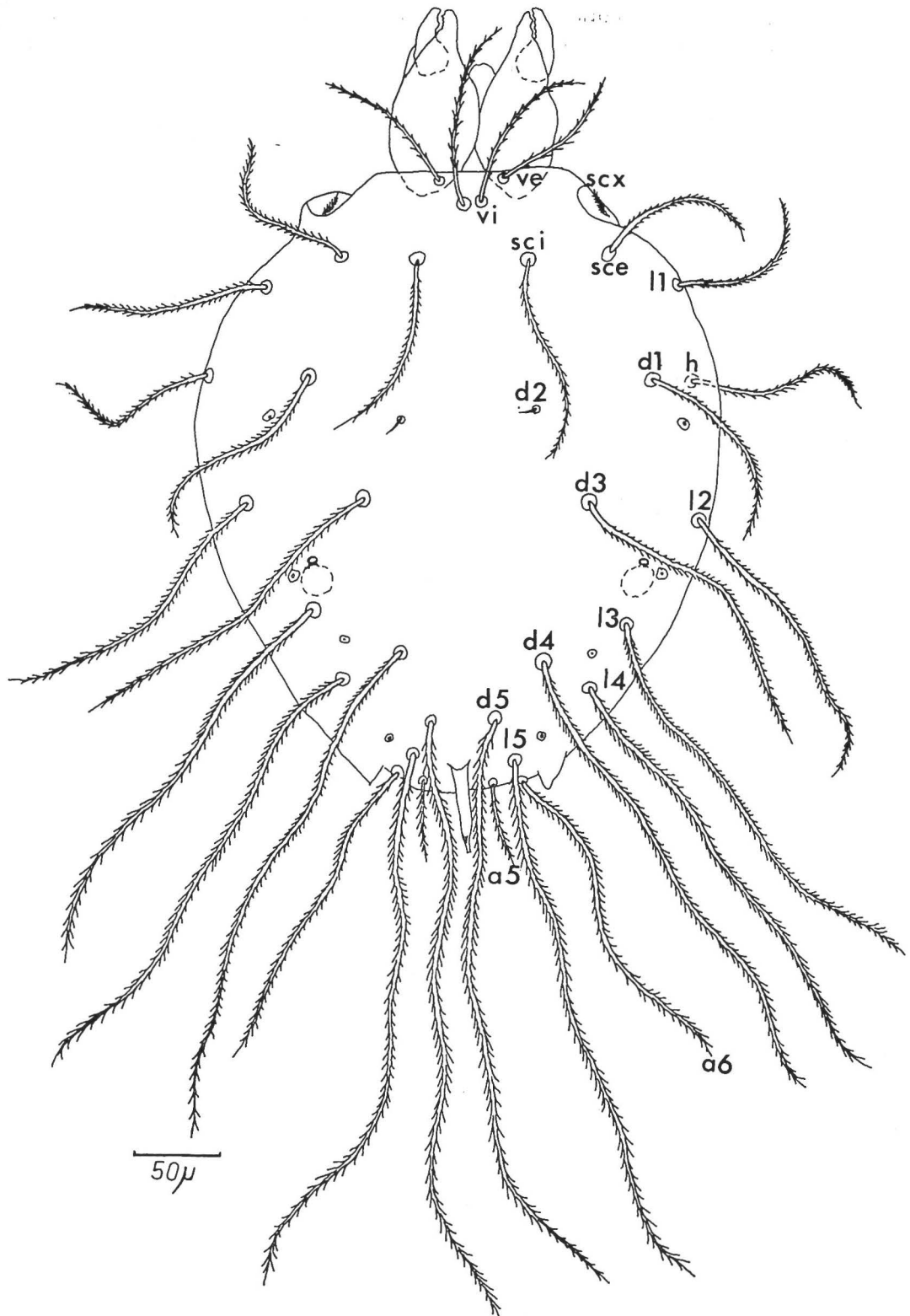


FIG. 4. — *Blomia kulagini* Zakhvatkin, female, dorsum.

c. *B. thori* Zakhvatkin 1936

By courtesy of Dr. K. SAMŠINÁK, Entomological Institute of the Czechoslovak Academy of Sciences, Prague, Czechoslovakia, we could obtain on loan four slides of this species. The material is not identified as types and consist of the following :

- "Blomia thori A. Z. ♀ / Region of Smolensk. Flaxseed no. 956 "
"Blomia thori A. Z. ♀ / Region of Smolensk. Flaxseed no. 956 "
"Blomia thori A. Z. ♀ / Region of Smolensk. Flaxseed no. 959 "
"Blomia thori A. Z. ♂♀ / "

(the right hand side of the last slide was damaged).
According to Dr. SAMŠINÁK this is the type series.

d. *B. freemani* Hughes 1948.

By courtesy of Dr. A. M. HUGHES we obtained a slide containing a female and labelled "Secumby wheat, N. Ireland, 30-1-45, Crawham, M 45.3 ". Locality as well as habitat coincide with the type material as reported.

e. *B. tropicalis* Bronswijk, Cock & Oshima 1973.

The material of this species was described in the first part of this study. Holotype and paratypes have been deposited in "Het Rijksmuseum voor Natuurlijke Historie", Raamsteeg 2, Leiden, The Netherlands. Paratypes are also present in :

Zoological Institute of the Academy of Sciences, Leningrad B-164, U.S.S.R.

Entomological Institute of the Czechoslovak Academy of Sciences, Prague, Czechoslovakia

Yokohama City Institute of Health, 2-17, Takigashira 1 Chome, Isogo-ku, Yokohama, 235 Japan.

Zoölogisch Laboratorium, Katholieke Universiteit, Toernooiveld, Nijmegen, Nederland.
Universiteitskliniek voor Huidziekten, Catharijnesingel, Utrecht, Nederland.

TAXONOMIC CHARACTERS

1. *Solenidiotaxy and chaetotaxy of the legs.*

This was described in detail in the case of *B. tropicalis* (see the first part of this study). The material of the other species did not show any difference.

2. *Anal setation in the adults*

It is a generic character that all females have 6 pairs of anal setae. Differences occur in the nude or pectinated aspect of these setae. The hairs a₁ and a₂ always are nude (under oil immersion of the phase contrast microscope). The anals 3 to 6 are pectinated in *B. kulagini* and *B. tropicalis*. In *B. tjibodas* and *B. thori* a₄ and a₅ are nude, and in *B. freemani* a₅ and a₆. For *B. khilovae* these details are not known.

The anal setation of the males could be studied in specimens of *B. tjibodas*, *B. thori*, *B. kulagini* and *B. tropicalis*. They all have three pairs of anal setae. The first pair (a₁) are nude, the others pectinated.

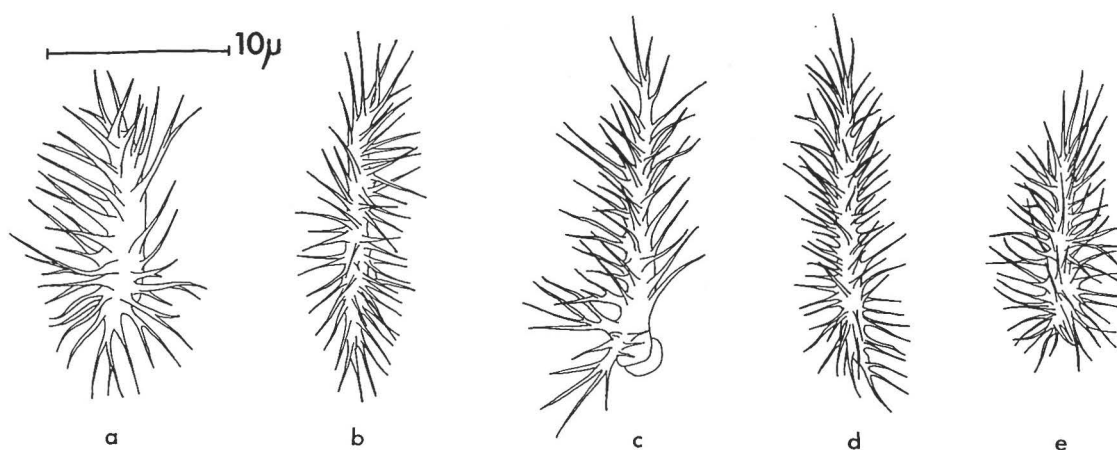


FIG. 5. — Supracoxal setae in females of *Blomia*.
a. *B. freemani*, b. *B. tjibodas*, c. *B. kulagini*, d. *B. thori*, e. *B. tropicalis*.

3. The cupulae

Only in the case of *B. tropicalis* the cupulae could be studied in all live stages. Four pairs of cupulae are present among the lateral setae in the female, male, tritonymph and protonymph. The larva has three pairs of cupulae. The material of the other species did not show any difference. The number of cupulae could be a generic character.

4. The insertion of *ve* and *vi*

The vertical setae are implanted in about a straight line in *B. tjibodas* (Fig. 1) and the female of *B. thori*. In the other species the implantation marks are situated in a trapezium (Fig. 4). The male of *B. thori* is difficult to classify in this respect, but only one specimen was seen.

5. Supracoxal seta

There is a slight but consistent variation in the relative lengths of the pectinations of this sensory organ (Fig. 5). Unfortunately no details are known of *B. khalilovae*.

6. Length of and distance between setae

The lengths of and distances between setae are well known as characters for discrimination among species. It appears, however, that in this genus these measurements are highly variable within the species. Even the shortest dorsal hair (d2) shows very large fluctuations (Table 3). GRIFFITHS (1970) showed that the seta measurements vary greatly with the suitability of the environmental conditions in a species of the genus *Acarus*. The variation we observed among different populations (Table 3) has probably such a cause.

Only general expressions like d5 and l5 less than half the length of the idiosoma (female *B. thori*) versus d5 and l5 longer than the idiosoma (adults *B. freemani*) can be valid in this genus.

7. The solenidia ω

As demonstrated in table 3 the length of $\omega 1$ is very variably within one species. Form and structure are constant. In *B. tjibodas* (male and female) and *B. tropicalis* (male) $\omega 1$ on tarsus I is more or less club-shaped (Fig. 6 & 7), while in the other cases this solenidion is shaped like

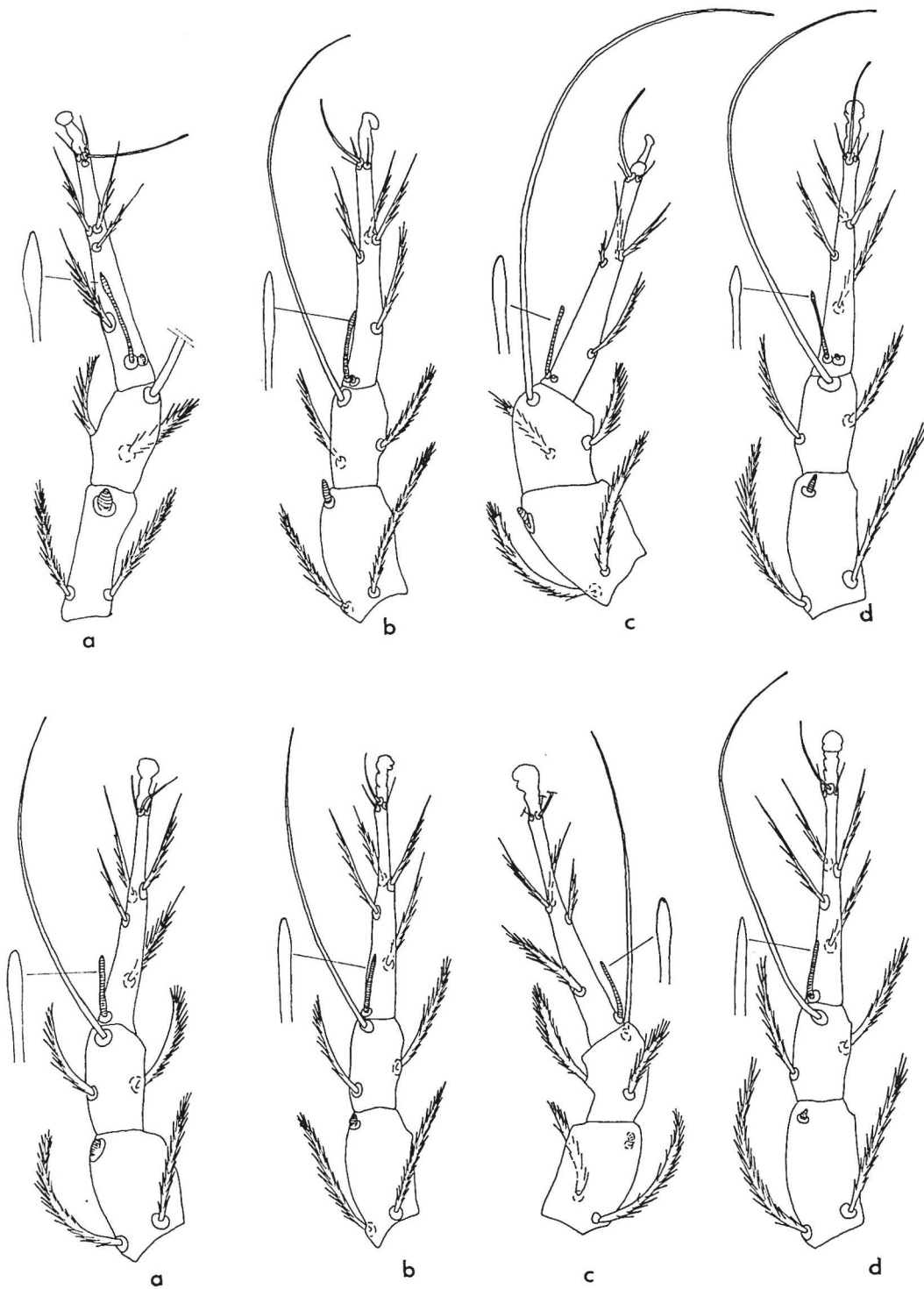


FIG. 6. — Dorsal view on legs in the male of *Blomia*, first row leg I, second row leg II.
(a. *B. tjibodas*, b. *B. kulagini*, c. *B. thori*, d. *B. tropicalis*).

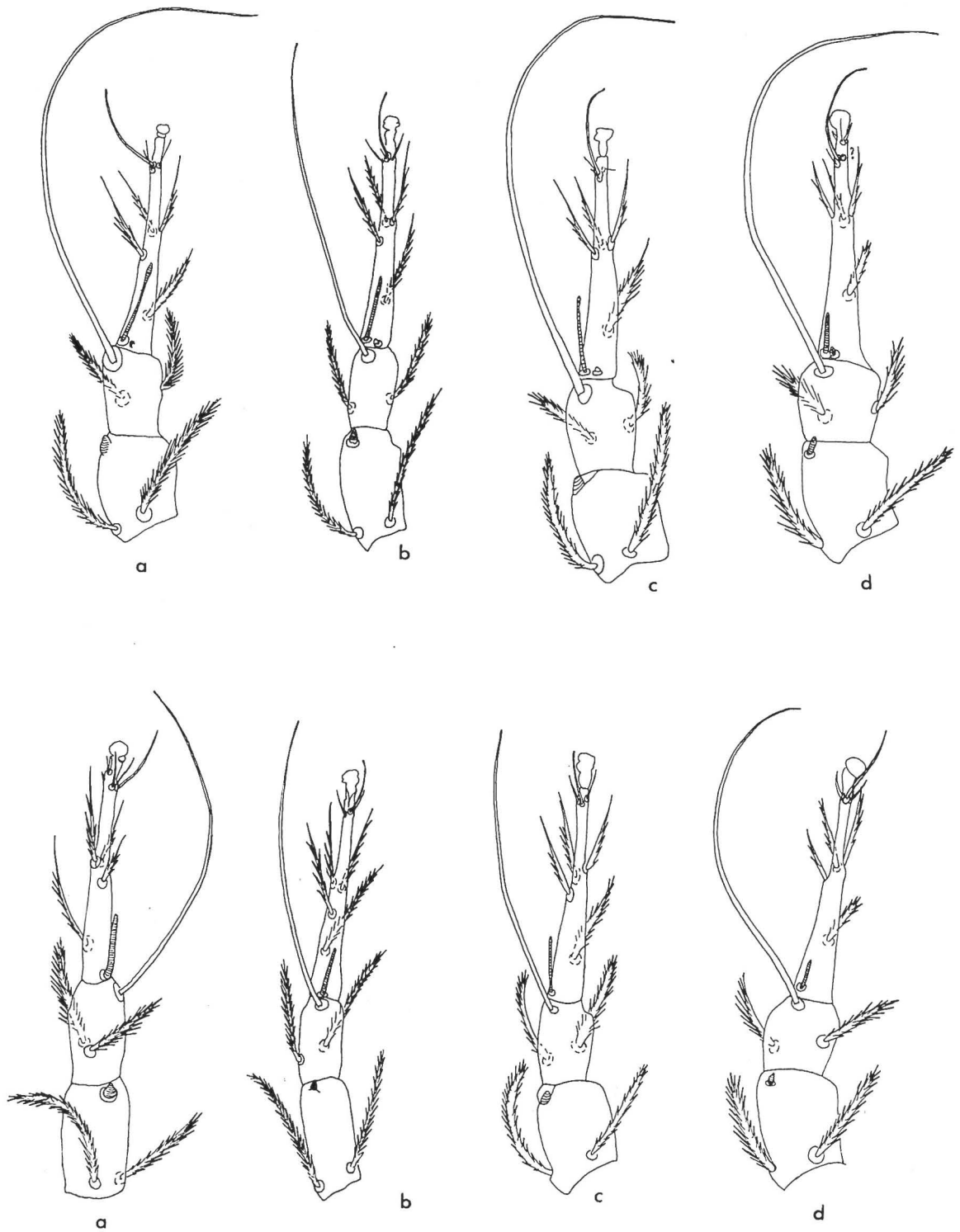


FIG. 7. — Dorsal view on the legs of the female of *Blomia*, first row leg I, second row leg II.
(a. *B. tjibodas*, b. *B. kulagini*, c. *B. thori*, d. *B. freemani*).

a straight rod. The solenidion $\omega 2$ on tarsus I is a very small rod or blob inserted at the same distance from the anterior rim of the tarsus as $\omega 1$, except in *B. khalilovae* where $\omega 2$ is inserted more distally.

The solenidion ω on tarsus II is a straight rod in all species studied. In *B. tjibodas* it is thicker than $\omega 1$ on tarsus I.

The solenidia in the immature stages can differ from those in the adult stages which are described here (compare Fig. 8 with Fig. 6 & 7).

8. The solenidion σ

TABLE 3 : Variation in size (in μ) in different populations of *Blomia tropicalis*
(5 females measured in every population).

detail measured	origin of population			
	Bandung	Daro	Paramaribo	Rangoon
length idiosoma	321-426	364-404	252-311	230-294
width idiosoma	247-343	292-332	199-250	176-222
length d_2	11-19	11-13	8-12	12-16
distance d_2 - d_3	56-77	55-81	39-67	55-62
$\omega 1$ on leg I (length)	20-27	19-22	18-21	17-18
$\omega 1$ on leg II (length)	15-20	15-19	16-18	12-16

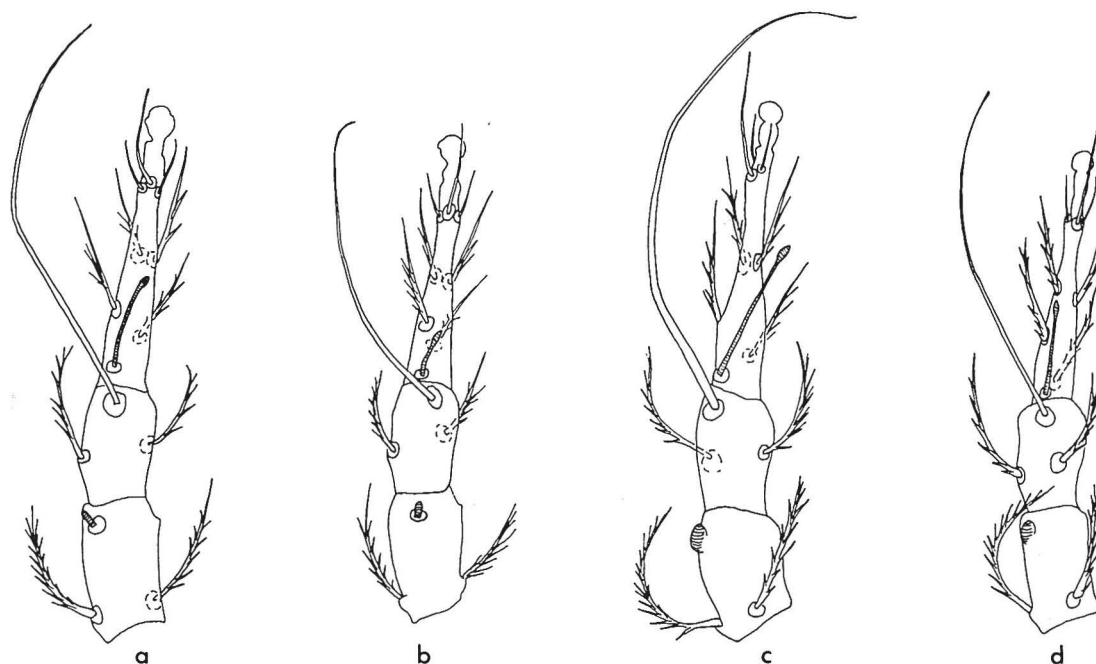


FIG. 8. — Dorsal view on the right legs of the larva of *B. tropicalis* (a Leg I, b Leg II) and *B. tjibodas* (c Leg I, d Leg II).

This solenidion on genu I and II is shaped like a protuding blod in *B. tjibodas* and *B. thori*. The other species present a rod. This rod is usually smaller on genu II than on genu I (Fig. 6, 7, 8).

9. *The genital pappillae*

The genital pappillae of *B. tjibodas* and *B. thori* are smaller (but more sclerotised) then those of *B. freemani*, *B. kulagini* and *B. tropicalis* (Fig. 11).

10. *Posterior protrusions on the idiosoma of the female*

In *B. kulagini* two wart-like sclerotized excrences occur on the posterior border of the body. No such structures are known from the other species.

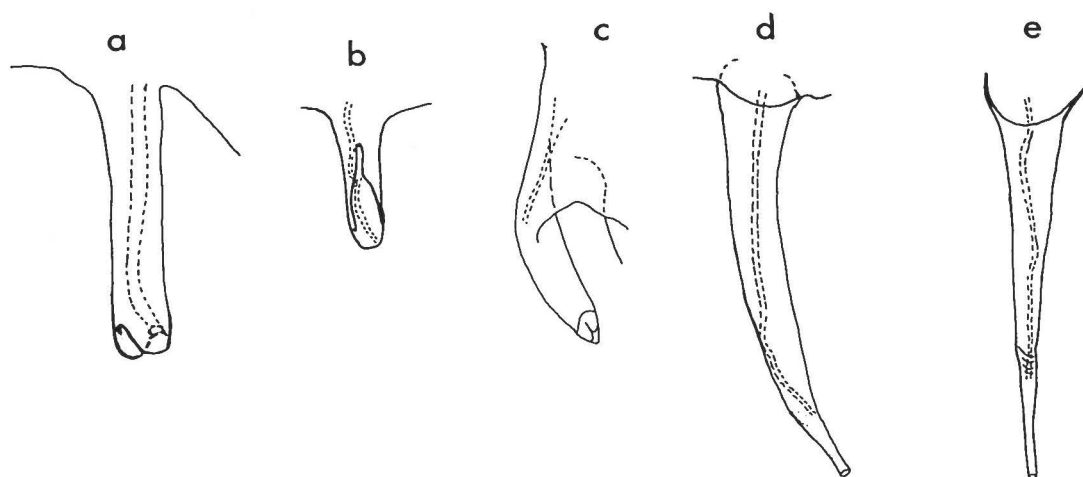


FIG. 9. — Copulatory tube of the female in *Blomia*.
a. *B. freemani*, b. *B. tjibodas*, c. *B. thori*, d. *B. kulagini*, e. *B. tropicalis*.

11. *Copulation apparatus of the female*

The copulatory tube can be straight and its posterior portion cleft (*B. freemani*) or more or less bent and its posterior portion pointed (other species). In *B. tjibodas*, *B. khalilovae* and *B. thori* the tube is more bent than in the case of *B. kulagini* and *B. tropicalis*. (Fig. 9) Mounting can cause overstressing of this feature.

There is also some variation in the structure that connects the oviduct to the spermatheca (Fig. 10). In *B. tjibodas* and *B. thori* these are wineglass shaped. In *B. kulagini* and *B. tropicalis* the stalks of the "wineglasses" are much shorter, while in *B. freemani* the structures are trumpet-shaped. This detail is not known from *B. khalilovae*.

12. *Copulation apparatus of the male*

The penis is a short curved tube in all species (Fig. 11). In all species, except for *B. freemani*, the genital setae are arranged in the same order as in *B. tropicalis* (Fig. 4 part I). In *B. freemani* gm is inserted at the place of gp, while gp is implanted between the anus and the genital apparatus.

The peculiar fourth leg, as mentioned in the generic diagnosis is a secondary sexual character. These legs were seen to be used in grasping the female in the case of *B. tropicalis*.

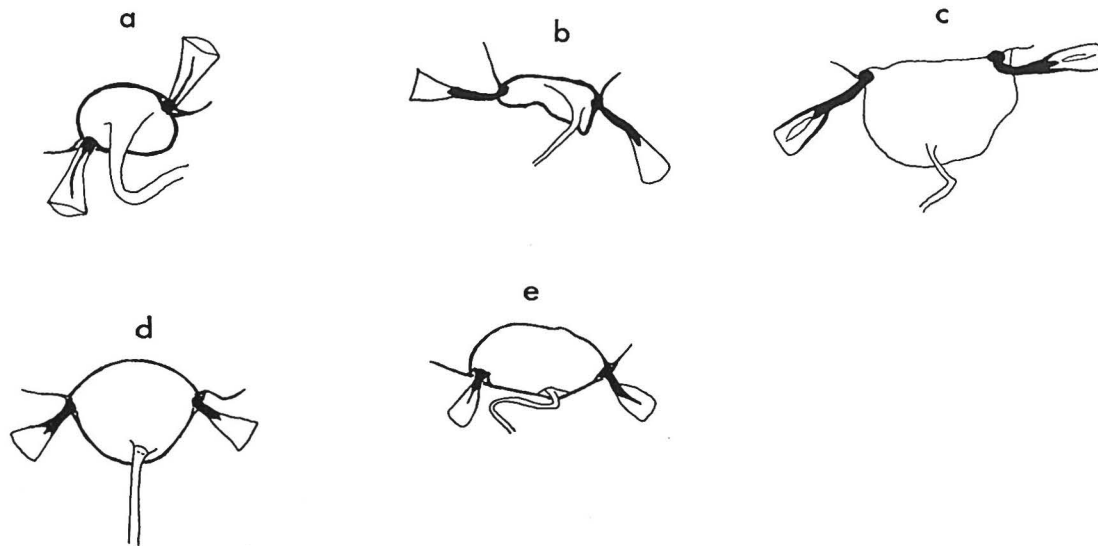


FIG. 10. — Spermatheca and entrance to oviduct in *Blomia*.
a. *B. freemani*, b. *B. tjibodas*, c. *B. thori*, d. *B. kulagini*, e. *B. tropicalis*.

13. Post embryonic development of some taxonomic characters

In the course of the postembryonic development the mites grow considerably (Table 1 of part I). Most of the body setae become longer both absolutely and relatively (compared with the idiosomal length). There are two exceptions: the setae d2 and the solenidion ω . These are relatively longer in the larvae than in the adults (Fig. 8, Table 1 of part I).

KEY TO THE SPECIES OF THE GENUS *BLOMIA* (adults only)

1. On tarsus I ω_1 and ω_2 inserted at the same distance from the base of the tarsus..... 2
— on tarsus I ω_2 inserted more distally than ω_1 *Blomia khalilovae* Zakhvatkin
2. Genital papillae small (Fig. 11 a, c); in the female copulatory tube more or less sharply bent (Fig. 9 b, c); ve and vi inserted on almost a straight line in the female (Fig. 1)..... 3
— genital papillae larger (Fig. 11 b, d); in the female copulatory tube slightly bent or straight (Fig. 9 a, d, e); ve and vi bases arranged in a trapezium (Fig. 4)..... 4
3. Solenidion ω_1 on tarsus I strongly clubshaped (Fig. 6 a, 7 a); copulatory tube sharply pointed (Fig 9 b).
Blomia tjibodas (Oudemans)
— solenidion ω_1 on tarsus I slightly or not clubshaped (Fig. 6 c, 7 c); copulatory tube bluntly pointed (Fig. 9 c)..... *Blomia thori* Zakhvatkin
4. Copulatory tube of female slightly bent and pointed (Fig. 9 d, e); in the male no genital setae present in between the anus and the genital apparatus..... 5
— copulatory tube of female straight and cleft (Fig. 9 a); in the male one pair of genital setae placed close together between anus and genital apparatus..... *Blomia freemani* Hughes
5. in the female "wrats" present on the posterior part of the idiosoma (Fig. 3, 4); in the male gm long (Fig. 11 b)..... *Blomia kulagini* Zakhvatkin
— no "wrats" present in the female; in the male gm short (Fig. 11 d).....
Blomia tropicalis Bronswijk, Cock, Oshima

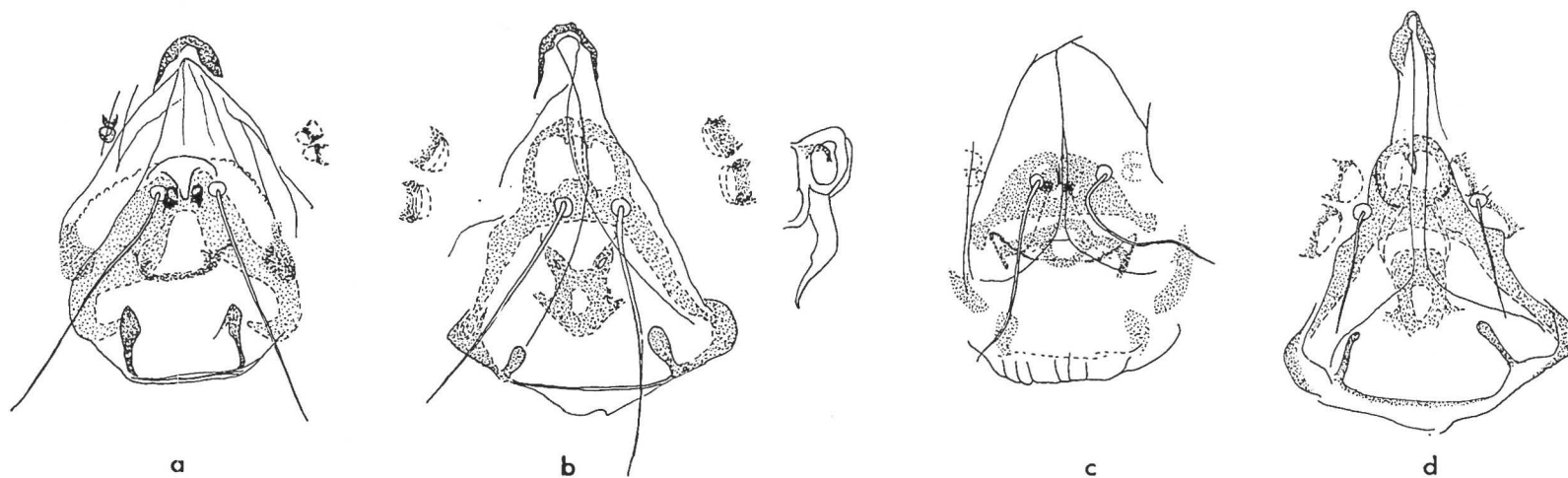


FIG. 11. — Genital region in the male of *Blomia*.
a. *B. tjibodas*, b. *B. kulagini* (with lateral view of penis and surrounded structures to the left), c. *B. thori*,
d. *B. tropicalis*.

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