

# A review of the genus *Cheyletus* LATREILLE, 1776 (Acari: Cheyletidae)

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## Summary

The genus *Cheyletus* LATREILLE, 1776 is redefined and revised, and a key to its 29 valid species is provided. The holotypes of most valid species were examined. One new species, *Cheyletus volgini* sp. nov., from the nest of *Pteromys volans* in the far East, is described and 28 species are synonymised. Fifteen poorly described and rarely reported species, whose types are lost, are considered to be *inquirendae*. Three species, i.e. *C. funisciuri* (FAIN, 1972) comb. nov., *C. tanzaniensis* (FAIN, 1972) comb. nov. and *C. kivuensis* (FAIN, 1972) comb. nov. are transferred from the genus *Eucheyletia* to *Cheyletus*, and one species described in *Cheyletus* is transferred to the genus *Cheletophyes*, i.e. *Cheletophyes venator* (VITZTHUM, 1920) comb. nov. All species of *Cheyletus* are predators and most are associated with nests of vertebrates or grain stores; their distribution and habitats are listed.

The reconstruction of the phylogeny of *Cheyletus* was effectuated by a cladistic method with the software PAUP 3.1. Representatives of 27 from 29 valid species have been examined. The analysis was based on 17 morphological female characters. The obtained majority 50% consensus tree has included three principal clusters or species groups, *eruditus*, *trouessarti* and *nidicolus*. Each of these groups has been divided each into two subgroups: *eruditus* and *zumpti*, *trouessarti* and *linsdalei*, *nidicolus* and *funisciuri*, respectively. The supported synapomorphies of these subgroups allow to considered them as monophyletic units. Furthermore, all subgroups and the group species *trouessarti* correspond to the geographical distribution of their respective species.

**Key words:** *Cheyletus*, Cheyletidae, systematics, mites, predators

## Résumé

Le genre *Cheyletus* LATREILLE, 1776 est révisé. Après cette révision le genre englobe actuellement 29 espèces. Toutes les espèces de ce genre sont des prédateurs et la plupart vivent dans des nids de vertébrés ou dans des réservoirs à grains. Les holotypes de la plupart des espèces valides ont été examinés. Une nouvelle espèce, *Cheyletus volgini* sp. nov. est décrite du nid de *Pteromys volans*, de Russie Orientale, et 28 espèces sont placées en synonymie. En outre, 17 espèces, insuffisamment décrites et rarement récoltées et dont les types sont perdus sont considérées ici comme des espèces *inquirendae*. Trois espèces décrites dans le genre *Eucheyletia* sont transférées dans le genre *Cheyletus*, il s'agit de *C. funisciuri* (FAIN, 1972) comb. nov., *C. tanzaniensis* (FAIN, 1972) comb. nov. and *C. kivuensis* (FAIN, 1972) comb. nov. Une espèce décrite dans le genre *Cheyletus* est transférée dans le genre *Cheletophyes*, il s'agit de *Cheletophyes venator* (VITZTHUM, 1920) comb. nov. Le genre *Cheyletus* est redéfini et une clé est proposée. Les habitats et la distribution géographique des différentes espèces sont précisés.

La phylogénie du genre *Cheyletus* est reconstruite par une méthode cladistique utilisant le logiciel PAUP 3.1. Des représentants de 27 espèces valides, sur les 29 existantes ont été examinés. L'analyse était basée sur 17 caractères morphologiques de la femelle. La majorité 50%

consensus cladogramme englobait les 3 principaux groupes d'espèces: *eruditus*, *trouessarti* et *nidicolus*. Ces trois groupes ont été subdivisés chacun en deux sous-groupes: *eruditus* et *zumpti*, *trouessarti* et *linsdalei*, *nidicolus* et *funisciuri*. Les synapomorphies de tous ces sous-groupes attestent de leur caractère monophyletique. En outre, tous les sous-groupes et le groupe *trouessarti* présentent la même distribution géographique et cela confirme leur monophilie.

**Mots clés:** *Cheyletus*, Cheyletidae, systématique, acariens, prédateurs

## Introduction

The genus *Cheyletus* LATREILLE, 1776 occupies a central position in the family Cheyletidae (Acari). This genus consists of predacious species mostly associated with nests of vertebrates or grain stores. These mites play an important role in the control of agricultural pests and some species are common components of the house dust acarofauna.

In his revision of this genus, VOLGIN (1969) listed 29 species. Only regional studies dealing with the systematics of *Cheyletus* were published after this revision, i.e. SUMMERS and PRICE (1970) for North America, FAIN (1982) for the Afrotropical Region and Madagascar, FAIN and NADCHATRAM (1980) for the Oriental Region and CORPUZ-RAROS (1988) for the Philippines. More recently, GERSON *et al.* (1999) provided a new list of the species totalling 68 species. A key for the determination of all these described species was however still lacking and urgently needed.

There are two other important problems in the systematics of *Cheyletus*. The first is the polymorphism of the males. Several species of *Cheyletus* are known only from their heteromorphic males and on the other hand many species have been described only from females. The second problem is the progressive degradation in the quality of the descriptions and the figures of cheyletid mites by some authors insufficiently prepared for such work. A large part of the responsibility of this situation lies with the editors of the reviews who accept for publication such papers, without previous reviews by qualified acarologists. Several authors have studied the varia-

bility of some characters in the species of this genus (SUMMERS *et al.*, 1972, REGEV, 1974; SUMMERS, 1975). The number of teeth on the palpal claw, the number of the tines on comb-like setae and the number of the peritremal segments are variable in the females whilst the length of the palpal femur is the most variable character in males. Some authors, i.e. QAYYUM and CHAUDHRI (1977), AKBAR *et al.* (1988) and others have completely neglected this variability in their descriptions of new species.

The present paper is a revision of the species of *Cheyletus*. It includes a key to the females and males of all valid species.

## Material and methods

### Material

The list of the species of *Cheyletus*, given by GERSON *et al.* (1999), should be modified as follows: *C. pyriformes* BANKS, 1904 has been transferred into the genus *Cheyletia* by BAKER (1949) and more recently into the genus *Paracheyletia* by VOLGIN (1969). The species *C. venator* VITZTHUM, 1920 is transferred here into the genus *Cheletophyes* (*Cheletophyes venator* comb. nov.) and three other species, described in the genus *Eucheyletia* (*E. funisciuri*, *E. tanzaniensis* and *E. kivuensis*) by FAIN (1972), are transferred here into *Cheyletus*. Finally, four species, i.e. *C. zaheri* HASSAN et RAKHA, 1982, *C. morinus* BARILO, 1986, *C. rafiquiensis* FAROOQ *et al.*, 2000 and *C. miansensis* FAROOQ *et al.*, 2000 should be added to the list of the described species. After these corrections and additions this list totals 73 species.

The following species were poorly described, rarely recorded and/or their type specimens were lost. Therefore, the possibility of identifying these species is practically inexistent and we propose to consider them as species *inquirendae*: i.e. *C. acer* OUDEMANS, 1904, *C. alacer* OUDEMANS, 1904, *C. audax* OUDEMANS, 1904, *C. intrepidus* OUDEMANS, 1903, *C. promptus* OUDEMANS, 1904, *C. rapax* OUDEMANS, 1903, *C. saevus* OUDEMANS, 1904, *C. ferox* TROUËSSART, 1889, *C. burmiticus* COCKERELL, 1917, *C. clavispinus* BANKS, 1902, *C. digitarsus* SIGIMOTO, 1942, *C. nigripes* MOLA, 1907, *C. parumsetosus* KARPELLES, 1884 and *C. patagiatus* NORDENSKIÖLD, 1900.

The species *C. crassus* QAYYUM et CHAUDHRI, 1977 was described from a single female from Pakistan, but the figure given by these authors represents a male (QAYYUM and CHAUDHRI, 1977: p. 88, fig. 1). This species is very poorly described and was not available for our study (the holotype is deposited in the Department of Entomology, University Agriculture Lyallpur, Pakistan). Therefore we consider it as a species *inquirenda*.

For this study we have re-examined the collections of

*Cheyletus* deposited in the five following Institutions: **IRSNB** – Institut royal des Sciences naturelles de Belgique, Bruxelles, Belgium.

**NMNH** – collection of OUDEMANS deposited in the National Museum of Natural History (Leiden, the Netherlands)

**USNM** – Smithsonian Institution National Museum of Natural History, Washington, USA

**MRAC** – Musée royal de l'Afrique Centrale, Tervuren, Belgium.

**ZIN** – Zoological Institute, Russian Academy of Sciences, St. Petersburg, Russia.

On the whole we have now 35 species of *Cheyletus*, of which only 29 are recognized here as valid species (see tables 3 and 4).

### Methods

In our descriptions we have used the nomenclature of the idiosomal chaetotaxy proposed by FAIN (1979), FAIN *et al.*, (1997) and that of the leg chaetotaxy of GRANDJEAN (1944). All the measurements are given in micrometers ( $\mu\text{m}$ ).

A cladistic analysis based on numerical parsimony was used for the study of the phylogenetic relationships between the species of the genus *Cheyletus*. This analysis included all valid species of the genus, except *C. mafekingensis* and *C. pseudomalaccensis*, which have lost the *d* setae in all specimens. Males are still unknown in most of *Cheyletus* species and therefore we used only female characters. On the whole, the basic data matrix includes 27 ingroup species and 17 binary morphological characters, all of which were equally weighted. We excluded from the analysis autapomorphic characters and variable characters such as the number of teeth on palpal claw, the number of tines on the inner and outer comb-like setae of palpal tarsus, the number of peritremal links etc...

The species *Cheletophyes vizthumi* OUDEMANS, 1915 was chosen as an outgroup.

The software PAUP 3.1 (SWOFFORD, 1993) and MacClade 3.02 (MADDISON and MADDISON, 1992) were used for the phylogenetic reconstruction and for the analysis of character distribution, respectively. The data were calculated by the heuristic method of tree computation, because other search algorithms permit no more than 20 taxa. The search used the tree-bisection-reconnection (TBR) branch-swapping algorithm, which kept all minimal trees (MULTPARS option). We used also the stepwise additions option, with 100 random replicates, for reducing the chances of hitting local optima. The character optimisation was made by DELTRAN algorithm (Delayed transformation) because homoplasies for mites are, probably, more common than reversions.

The list of characters and data matrix are given in the Tables 1 and 2, respectively.

Table 1. Characters of females of the genus *Cheyletus* used in the cladistic analysis

<ol style="list-style-type: none"> <li>1. Dorsomedian setae absent</li> <li>2. Dorsomedian setae present but abnormal.</li> <li>3. Propodosomal shield with 1 pair of setae (for species with dorsomedian setae of normal shape).</li> <li>4. Neotrichial setae present.</li> <li>5. Setae <i>h</i> lanceolate.</li> <li>6. Setae <i>h</i> fan-like.</li> <li>7. Setae <i>d3</i> absent (in species with dorsomedian setae of normal shape).</li> <li>8. Setae <i>d2</i> absent (in species with dorsomedian setae of normal shape).</li> <li>9. Peritremes Π-shaped.</li> <li>10. Peritremes M-shaped.</li> <li>11. Dorsal seta of palpal femur lanceolate or fan-like.</li> <li>12. Dorsal seta of palpal genu lanceolate or fan-like.</li> <li>13. Dorsal shields with strong ornamentation.</li> <li>14. Dorsal shield with fine longitudinal striations</li> <li>15. Guard seta (<i>ft</i>) shorter than solenidion <math>\omega 1</math>.</li> <li>16. Setae <i>l2</i> situated off the propodosomal shield</li> <li>17. Femur IV with 1 seta.</li> </ol> <p><i>Character for outgroup comparison</i></p> <ol style="list-style-type: none"> <li>18. Eyes absent.</li> </ol>
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### Systematic part

#### FAMILY CHEYLETIDAE LEACH, 1815

#### TRIBE CHEYLETINI LEACH, 1815

#### Genus *Cheyletus* LATREILLE, 1776

#### Definition:

Female: *Gnathosoma*. Palpal tarsi with 4 setae and a short ventral solenidion: 2 dorsal comb-like setae with numerous teeth and 2 sickle-like ventral setae. Palpal claw with 1-6 basal teeth. Palpal tibia with 3 hair-like setae. Palpal genu with 2 setae. Palpal femur with 3 setae. Peritremes variable in shape, with 5-15 pairs of segments. *Idiosoma*. Romboid, about 2 times longer than gnathosoma. *Dorsum*: Eyes absent. Propodosomal and hysterosomal shields present. Propodosoma bearing lateral setae *vi*, *ve*, *sci*, *sce*, *h*, median setae *d1* and neotrichial setae (not more than 3 pairs) present or absent. Hysterosoma bearing setae *ll-15*, *d4*, *d5*, median setae *d2-d4* present or absent, neotrichial setae, if present, not more than 5 pairs. *Venter*: Setae *ic1*, *ic3*, *ic4*, *pg1-pg3*, *g1*, *g2* and *a1-a3* hair-like. Setae *a2*, *a3* always barbed, setae *a1* nude or barbed. *Legs*. All legs well developed, tarsi with claws and empodium. Tarsus I-II, tibia I and genu I with solenidia. Guard seta of solenidion  $\omega 1$  variable in length, hair-like. Apical tarsal knobs and claws angles absent.

Table 2. Data matrix

Characters	123456789012345678 111111111
Species	
<i>vitzthumi</i>	000000000000000100
<i>eruditus</i>	100000000100001001
<i>malaccensis</i>	100000000100001011
<i>malayensis</i>	100000000100001011
<i>philippinensis</i>	100000000100000011
<i>bidentatus</i>	100000000100001011
<i>pluridens</i>	100000000100001011
<i>rwandae</i>	100000000100000011
<i>zumpti</i>	100000000100010011
<i>gerbillicola</i>	100010000100010011
<i>carnifex</i>	010010001000000011
<i>morinus</i>	010010001000000011
<i>cacahuamilpensis</i>	010010001010000011
<i>linsdalei</i>	010100000100000011
<i>volgini</i>	010100000100001011
<i>trouessarti</i>	010010000100000011
<i>trux</i>	010000000100000011
<i>schneideri</i>	010000000100000011
<i>misonnei</i>	001001001011100011
<i>funisciuri</i>	001001000111101001
<i>tanzaniensis</i>	001001000111100011
<i>kivuensis</i>	001001000100100011
<i>kuznetzovi</i>	001001101000000011
<i>attiahi</i>	001010111000000011
<i>vivatus</i>	001000100100000011
<i>punctulatus</i>	001000111000100011
<i>nidicolus</i>	001000100100100111
<i>legendrei</i>	001000100100100111

Outer seta of coxae III serrate. Chaetotaxy: tarsi 9 (+ solenidion  $\omega$ )-7-7-7, tibia 5 (+ solenidion  $\phi$ )-4-4-4, genu 2 (+ solenidion  $\sigma$ )-2-2-2, femur 2-2-2-1 (2), trochanter 1-1-2-1, coxae 2-1-2-2.

Male: *Gnathosoma*. Palpal tarsi with 4 setae and short solenidion: 2 dorsal comb-like setae with numerous teeth and 2 sickle-like ventral setae. Palpal femur variable in length, sometimes hypertrophied. Palpal claw with 1-3 basal teeth. Rostral shield with ornamentation. Peritremes variable in shape. *Idiosoma*. Romboid, about 1.7-2 times longer than gnathosoma. *Dorsum*: Eyes absent. Propodosomal and hysterosomal shields present. Propodosoma

bearing laterally setae *vi*, *ve*, *sci*, *sce*, *h* and median setae *d1*, 1 pair of neotrichial median setae present or absent. Hysterosoma bearing setae *l1-l5* and *d2*. *Venter*: Setae *ic1*, *ic3*, *ic4*, *g1*, *g2* and *a1-a3* all hair-like. Some species have a pseudosternal shield. *Legs*. As in female, but femur IV always bears 1 seta.

*Type species*: *Acarus eruditus* SCHRANK, 1781.

### 1. *Cheyletus eruditus* (SCHRANK, 1781)

(Figs. 1-5)

*Acarus eruditus* SCHRANK, 1781: 513  
*Eutarsus cancriformis* HESSLING, 1852  
*Cheyletus seminivorus* PACKARD, 1870: 665  
*Cheyletus eburneus* HARDY, 1867  
*Cheyletus strenuus* OUDEMANS, 1904b: 161 **syn. nov.**  
*Cheyletus rabiosus* ROHDENDORF, 1940: 86  
*Cheyletus butleri* HUGHES, 1948: 106-107  
*Cheyletus doddi* BAKER, 1949: 279-280  
*Cheyletus mortelmansi* FAIN, 1972: 37-38 **syn. nov.**  
*Cheyletus desitus* QAYYUM et CHAUDHRI, 1977: 90-92 **syn. nov.**

This species was described from Austria (SCHRANK, 1781), and redescribed by HUGHES (1961), VOLGIN (1969) and by SUMMERS and PRICE (1970). The variability of the females was investigated by SUMMERS *et al* (1972) and by SUMMERS (1975). The type material of *C. eruditus* is lost and no neotype has been described until now. Variability of the gnathosoma in males of *C. eruditus* is shown in Figs. 1-4.

*Type material*: Female holotype and 1 female paratype of *C. mortelmansi*, Zoo Anvers, 11. VI. 1965 (Coll. A. FAIN) (IRSNB). Female holotype of *C. doddi*, Cornell Univ., Ithaca, 23-27. IX (Coll. C.R. CROSBY) (USNM). Male holotype of *C. rabiosus*, Uralsk, Kazakhstan (Coll. B. ROHDENDORF) (ZIN). Female lectotype of *C. strenuus* from the house dust, Arnhem, The Netherlands (Coll. A. OUDEMANS) (NMHN).

*Additional material*: Ten females from the nest of *Passer montanus*, Holland, 1972 (Coll. J. VAN BRONSWIJK). Ten females from the nest of grey squirrel, England, 1978 (Coll. MOLYNEUX). Ten females and 10 males from the nest of *Delichon urbica*, Minsk Prov., Belorussia (Coll. G. EFREMOVA). Ten females from the nest of *Cecropis daurica*, Butare, Rwanda, 16. VIII. 1969 (Coll. F. AUR-ELIEN). Five females from *Sorex vagrans*, Corvallis, Oregon, U.S.A., 12. VII. 1981 (Coll. DON GETTINGER).

*Distribution*: Cosmopolitan.

*Habitats*: Nests of birds and mammals, grain stored, house dust and sometimes in soil and plant debris.

*Remarks*: (i) The species *C. mortelmansi* FAIN, 1972 differs from *C. eruditus* only by the situation of setae *l4*

off the female hysterosomal shield instead of on that shield of the latter species. However, we observed that this character is variable within populations of *C. eruditus*. Therefore, we consider *C. mortelmansi* as a junior synonym of *C. eruditus*.

(ii) In the original description, the species *C. desitus* QAYYUM et CHAUDHRI, 1977 was compared with *C. malaccensis* OUDEMANS, 1903 but not with *C. eruditus* (QAYYUM and CHAUDHRI, 1977). Actually, *C. desitus* is identical in all its characters to *C. eruditus* and therefore we consider it as a junior synonym of the former species.

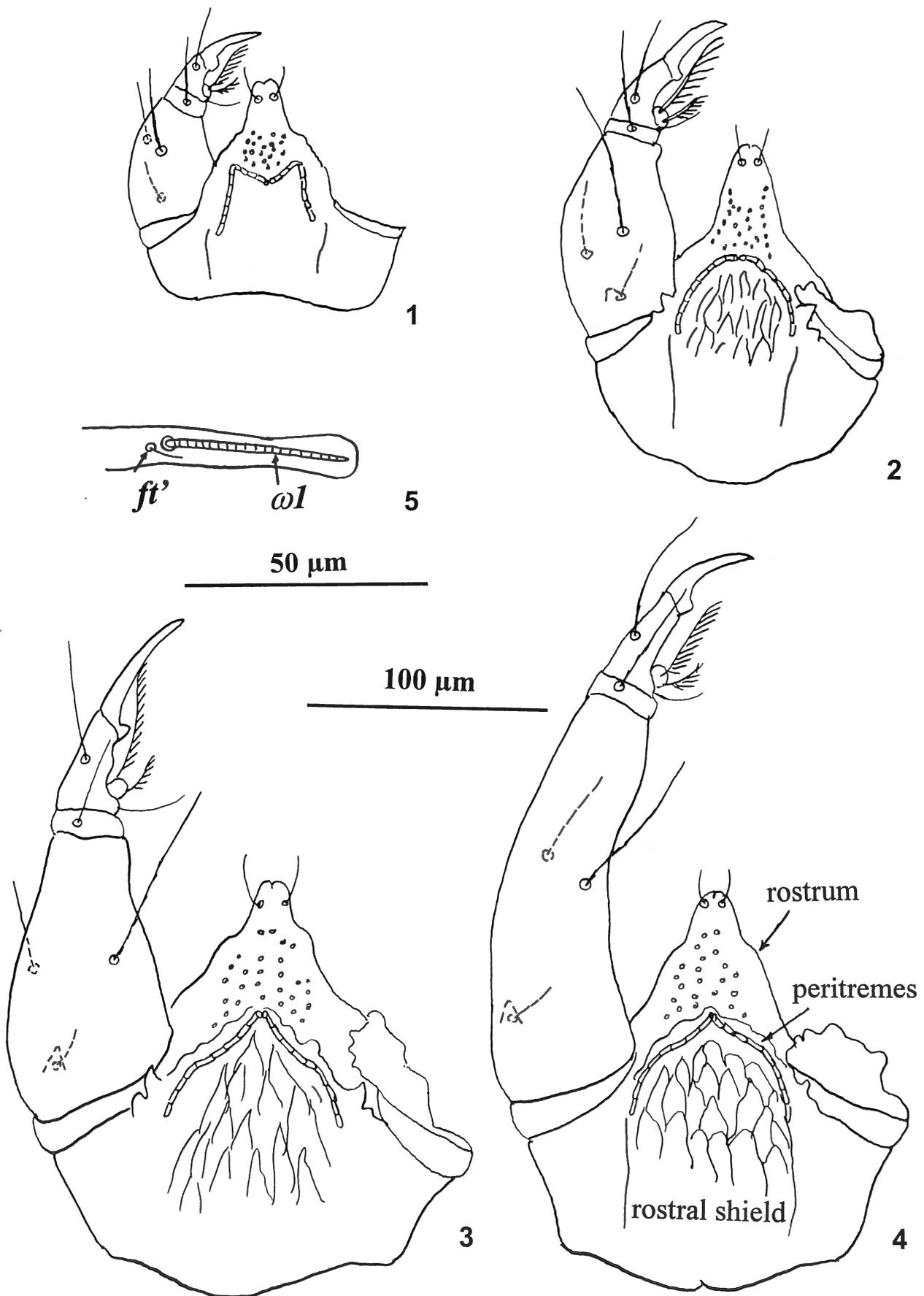
(iii) We re-examined the type specimen of *C. strenuus* OUDEMANS, 1904 (female), and it is not separable from *C. eruditus*.

### 2. *Cheyletus malaccensis* OUDEMANS, 1903

*Cheletes malaccensis* OUDEMANS, 1903b: 84  
*Cheletes vorax* OUDEMANS, 1903b: 84 **syn. nov.**  
*Cheletes fortis* OUDEMANS, 1904b: 161 **syn. nov.**  
*Cheyletus munroi* HUGHES, 1948  
*Cheyletus polymorphus* VOLGIN, 1949: 584-586 **syn. nov.**  
*Cheyletus rohdendorfi* ZACHVATKIN, 1949: 290 **syn. nov.**  
*Cheyletus caucasicus* ZACHVATKIN, 1949: 288-290  
*Cheyletus ugandanus* LAWRENCE, 1954: 65-67  
*Cheyletus egypticus* ELBADRY, 1969: 157-162 **syn. nov.**  
*Cheyletus avidus* QAYYUM et CHAUDHRI, 1977: 89-90 **syn. nov.**  
*Cheyletus baridos* AKBAR, RAHI et CHAUDHRI, 1988: 5-7 **syn. nov.**  
*Cheyletus ayyazi* AKBAR, AHEER et CHAUDHRI, 1993: 293-294 **syn. nov.**  
*Cheyletus infensus* AKBAR, AHEER et CHAUDHRI, 1993: 295-296 **syn. nov.**  
*Cheyletus phantosis* AKBAR et AHEER, 1994: 342-343 **syn. nov.**  
*Cheyletus wahndoensis* AKBAR et AHEER, 1994: 343-345 **syn. nov.**  
*Cheyletus mianiensis* FAROOQ, AKBAR et QURESHI, 2000 (not *mianiensis*): 257-259 **syn. nov.**  
*Cheyletus rafiquiensis* FAROOQ, AKBAR et QURESHI, 2000: 259-261 **syn. nov.**

*C. malaccensis* was described by OUDEMANS (1903) from *Psittinus cyanurus* in Malaysia. Later on it was redescribed by SUMMERS and PRICE (1970) and by CORPUZ-RAROS (1988).

*Type material*: A female, in poor condition, from the type series from the skin of birds in Columbia, 1902 (Coll. E. TROUSSERT) (NMNH). Female, in poor condition, from the type series of *C. fortis*, from a parrot in New Guinea (Coll. E. TROUSSERT) (NMNH). Male holotype from a bat from Marianan Islands (Coll. E. TROUSSERT) (NMNH). Female holotype of *C. polymorphus*, Smolensk Prov., Russia (Coll. V. VOLGIN) (ZIN). Female holotype of *C. ugandanus* from the nest of a bird occupied by *Galago senegalensis*, Karamoja, Uganda (Coll. F. ZUMPT)



Figs. 1-5 – *Cheyletus eruditus-Gnathosoma* of male in dorsal view: homeomorphic form (1), mesomorphic form (2), heteromorphic form, with short palpal femur (3), heteromorphic form, with long palpal femur (4); part of tarsus I in dorsal view (5). Scale lines 100 μm (1-4), 50 μm (5).

(South African Institute for Medical Research, Johannesburg).

*Additional material:* Four females, Berlin, Germany, II. 1975 (Coll. H. SCHMIDT). Ten females and 10 males from the nest of *Rattus turkestanicus*, Tadjikistan, 12. VII. 1951 (Coll. E. SOSNINA). Ten females and 3 males, China, II. 1979. Five females and 3 males, Tokyo, Japon (Coll. E. NAKADA). Five females from rice straw, India, 20. 09. 1945 (Coll. U.R. KUHN). Three females, 105, Lorong, 27, Desa Jaya, Kepong, Kuala Lumpur, Malaysia, 3. III. 1978 (Coll. M. NADCHATRAM). Four females and 2 males from the nest of *Callosciurus caniceps*, Mt. Brinchang, Pahang, Malaysia, 20. IV. 1979 (Coll. M. NADCHATRAM). Ten females and 10 males from the nest of *Hirundo angolensis*, Butare, Rwanda, 24. VII. 1967 (Coll. F. AURELIEN). Two females ex cacao, Venezuela, 15. VII. 1981. Four females and 2 males from house dust, Lima, Peru, 1972 (Coll. A. FAIN).

*Distribution:* Cosmopolitan.

*Habitats:* Nests of birds and mammals, grain stores, house dust and sometimes in soil and plant debris.

*Remarks:* (i) The original description of *C. malaccensis* by OUDEMANS (1903, 1906) contained inaccuracies which led VOLGIN (1949), who had not seen the type specimens, to describe the new species *C. polymorphus* VOLGIN, 1949. A comparative examination of the type specimens has revealed that these species are identical.

(ii) The species *C. fortis* OUDEMANS, 1904 differs from *C. malaccensis* only by the presence of the single large tooth at the base of the palpal claw in the female, instead of 2-4 teeth in the latter species. NAKADA (1975) and SUMMERS *et al.* (1975) observed that in cultures of *C. malaccensis*, the palpal claw in the females may present either one or two basal teeth. We examined specimens of this species from different regions and think that this character is geographically variable. The form with one tooth on the palpal claw is observed mostly in the Oriental region, while the form with 2-4 teeth is cosmopolitan. We consider therefore *C. fortis* as a junior synonym of *C. malaccensis*.

(iii) The lectotype of *C. vorax* OUDEMANS, 1903 (heteromorphic male) does not present significant differences from *C. malaccensis*. We consider it as a junior synonym.

(iv) The species *C. rohdendorfi* ZACHVATKIN, 1949 is known only by the original description of ZACHVATKIN (1949) and its type specimens are lost. From the original description and figures this species is not separable from *C. malaccensis*.

(v) The description and figures of *C. egypticus* ELBADRY, 1969 correspond completely to *C. malaccensis*. The differential characters given by ELBADRY (1969) do not allow a separation these species. We consider this species as a junior synonym of *C. malaccensis*.

(vi) The species *C. avidus* QAYYUM *et* CHAUDHRI, 1977, *C. baridos* AKBAR *et al.*, 1988, *C. ayyazi* AKBAR,

*et al.*, 1993, *C. infensus* AKBAR *et al.*, 1993, *C. phantosis* AKBAR *et* AHEER, 1994, *C. wahndoensis* AKBAR *et* AHEER, 1994 and *C. rafiquiensis* FAROOQ *et al.*, 2000 differ from each other and from *C. malaccensis* only by small, insignificant characters, e.g. the number of teeth on palpal claw or of segments on peritremes and therefore we consider them as junior synonyms of *C. malaccensis*.

(vii) The species *C. mianiensis* FAROOQ *et al.*, 2000 is based on a teleonymph of *C. malaccensis*. The figures given by the authors (FAROOQ *et al.*, 2000: fig. 1, p. 258) undoubtedly correspond to this species.

### 3. *Cheyletus malayensis* CUNLIFFE, 1962

*Cheyletus malayensis* CUNLIFFE, 1962: 201-202.

This species was described from the nest of *Lonchura malacca* in Malaysia (CUNLIFFE, 1962). The holotype female of this species was later redescribed by SUMMERS and PRICE (1970), by FAIN (1980), and more recently by CORPUZ-RAROS (1988), who redescribed the females and males from the Philippines.

*Type material:* Female holotype from the nest (n° 187) of *Munia atricapilla* (now *Lonchura malacca*), Rantau Panjang, 5 m. N. of Klang, Selangor, Malaysia, 26. IV. 1960 (USNM).

*Additional material:* Fifteen females from the nest of *Sciurus vulgaris*, Sakhalin Island, Russia, 22. IX. 1955 (Coll. N. VILOVICH).

*Distribution:* Sakhalin (Russia), Hawaii, Malaysia and the Philippines.

*Habitats:* Nests of birds and mammals.

### 4. *Cheyletus bidentatus* FAIN *et* NADCHATRAM, 1980 (Figs. 6-7)

*Cheyletus bidentatus* FAIN *et* NADCHATRAM, 1980: 194-195

This species was described from the nest of *Hylopetes spadicus* in Malaysia (FAIN and NADCHATRAM, 1980).

*Type material:* Female holotype, 3 female paratypes and 4 male paratypes from the nest of *Hylopetes spadicus*, Bukit Lanjan Forest Reserve, Selangor, 12. IX. 1970 (Coll. M. NADCHATRAM) (IRSNB). One female paratype and 1 male paratype from the nest of the same host species, from Segamat, Labis Forest Reserve, Johore, Malaysia, 20. X. 1970 (Coll. M. NADCHATRAM).

*Distribution:* Malaysia.

*Habitats:* Nests of mammals.

### 5. *Cheyletus pluridens* FAIN et NADCHATRAM, 1980

*Cheyletus pluridens* FAIN et NADCHATRAM, 1980: 195.

This species was described from *Rhinosciurus laticaudatus* in Malaysia (FAIN and NADCHATRAM, 1980).

*Type material*: Female holotype from *Rhinosciurus laticaudatus* from a forest, near Kuantan, Pahang, Malaysia, 24. VI. 1957 (Coll. M. NADCHATRAM) (IRSNB) Two female paratypes from the same host from Ulu Langat Forest Reserve, Selangor, Malaysia, 27. II. 1965 (Coll. M. NADCHATRAM).

*Distribution*: Malaysia

*Habitats*: Nests of mammals

*Remark*: The male of this species is unknown.

### 6. *Cheyletus philippinensis* CORPUZ-RAROS, 1988

*Cheyletus philippinensis* CORPUZ-RAROS, 1988: 328-329.

This species was described from the feathers of a bird in the Philippines (CORPUZ-RAROS, 1988).

*Distribution*: The Philippines

*Habitats*: Nest of birds.

*Remark*: We have not examined the holotype of this species (which is deposited in the University of the Philippines at Los Banos Museum of Natural History), but the detailed description of the female of *C. philippinensis* (male unknown) allows its easy separation from the other *Cheyletus* species.

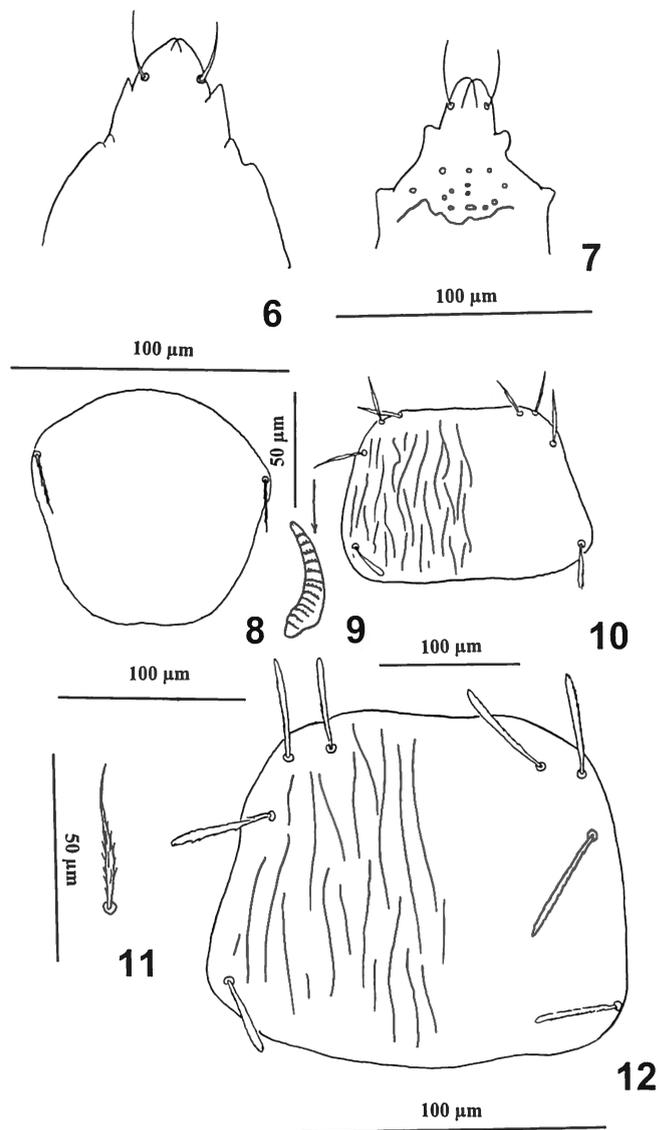
### 7. *Cheyletus rwandae* FAIN, 1972 (Figs. 8-9)

*Cheyletus rwandae* FAIN, 1972: 38

This species was briefly described from *Tachyoryctes ruandae* in Rwanda (FAIN, 1972), and later described in detail and depicted by FAIN (1979a).

*Type material*: Female holotype and female paratype from *Tachyoryctes ruandae*, Butare, Rwanda, XII. 1954 (Coll. A. FAIN) (MRAC).

*Additional material*: Two females and 15 males from the nest of the same host species, Igmore, Rwanda. 14. II. 1968 (Coll. A. FAIN). Fifteen females from the nest of the same species, Kamusihe, Rwanda, 27. II. 1967 (Coll. A. FAIN). Ten females and 10 males from the nest of the same species, Kahungu, Burhimanwa, Rwanda, 28. II. 1968 (Coll. A. FAIN).



Figs. 6-12 – *Cheyletus bidentatus*, rostrum in dorsal view – Female (6), male (7); *Cheyletus rwandae* – Hysterosomal shield of female (8), palpal claw of male (9); *Cheyletus zumpti*, female – propodosomal shield (10); – seta vi (11); *Cheyletus gerbillicola*, female, propodosomal shield (12).

*Distribution*: Rwanda.

*Habitats*: Nests of mammals.

### 8. *Cheyletus zumpti* FAIN, 1972 (Figs. 10-11)

*Cheyletus zumpti* FAIN, 1972: 38.

This species was described from *Tatera* sp. in Zaire (FAIN, 1972), and described in detail and depicted (FAIN, 1979b).

*Type material:* Female holotype and 1 female paratype from *Tatera* sp. (n° 2734, MRAC), Garamba, Zaire (Coll. A. FAIN) (MRAC).

*Additional material:* One female from *Tatera afra angolae*, Carisso, Angola, 23. VIII. 1967. (Coll. MACHADO). One female with the same data, 12. XII. 1967. One female from *Tatera leucogaster*, Skukuza, Park Kruger, Transvaal, X. 1969 (Coll. F. ZUMPT). One female from the same species, de Rooderplaat, Pretoria, III-VI. 1970 (Coll. F. ZUMPT). One female from the same species, de Mafeking, Cape Province, X. 1969 (Coll. F. ZUMPT). One female from *Tatera kempii*, Tsarchaga, N. Nigeria, 10. I. 1967 (Coll. F. ZUMPT). Eight females from *Saccostomys campestris*, Ndumu, Zululand, 16. V. 1971 (Coll. F. ZUMPT). One female from *Rattus natalensis*, W. Nigeria, 10. II. 1966 (Coll. A. FAIN). Four females and 5 males from a rat, Binza, Kinshasa, Zaire, 10. II 1966 (Coll. A. FAIN). One female from *Gerbillus boehmi*, Butare, Rwanda, 1955 (Coll. A. FAIN).

*Distribution:* Tropical and South Africa.

*Habitats:* Nests of rodents.

#### 9. *Cheyletus gerbillicola* FAIN et LUKOSCHUS, 1981 (Fig. 12)

*Cheyletus gerbillicola* FAIN et LUKOSCHUS, 1981: 6

This species was described from *Gerbillus paeba* in South Africa (FAIN and LUKOSCHUS, 1981).

*Type material:* Female holotype and 1 female paratype from *Gerbillus paeba*, Askhan, South of Kalahari region, South Africa, 02. XI. 1980 (IRSNB).

*Distribution:* South Africa.

*Habitats:* Nests of gerbils.

*Remark:* The male of this species is still unknown.

#### 10. *Cheyletus carnifex* ZACHVATKIN, 1935 (Figs. 13-16)

*Cheyletus carnifex* ZACHVATKIN, 1935: 27

*Cheyletus aversor* ROHDENDORF, 1940: 86-87 **syn. nov.**

*Cheyletus beauchampi* BAKER, 1949: 282-283.

*Cheyletus acarophagus* ZAHER et SOLIMAN, 1967: 25-26 **syn. nov.**

*Cheyletus allactaga* FAIN et LUKOSCHUS, 1981: 122 **syn. nov.**

*Cheyletus zaheri* HASSAN et RAKHA, 1982: 89-90 **syn. nov.**

This species was described from a single male specimen

in Moscow, Russia (ZACHVATKIN, 1935). There are no other records of *C. carnifex* since the original description.

*Type material:* Female holotype of *C. aversor* ex grain, Voroshilovsk, Tadjikistan (ZIN). Female holotype of *C. allactaga* and female paratype from *Allactaga sibirica*, Bulgan gol, Mongolia, 28. V. 1974 (Coll. F. LUKOSCHUS) (Museum für Naturkunde, Humboldt-Universität, Berlin). Two female paratypes from the same species, Chovd-gol, Mongolia, 02. VI. 1975 (Coll. F. LUKOSCHUS). Five female paratypes from the same species, Conocharychn-gol, Mongolia, 06. VI. 1975 (Coll. F. LUKOSCHUS).

*Additional material:* Twenty females, Zoo Anvers, 06. X. 1967 (Coll. A. FAIN). Six females and 3 males from the nest of *Spermatophilus pygmaeus*, Poltava Distr., Ukraine (Coll. S. SKLAR). Fifteen females ex grain, Uzbekistan. Thirty females and 8 males ex grain, Isfara, Tadjikistan. Twenty females from *Allactaga sibirica*, Issik-Kul lake, Kirghizia, 10. VIII. 1988 (Coll. P.A. CHIROV).

*Distribution:* Holarctic region.

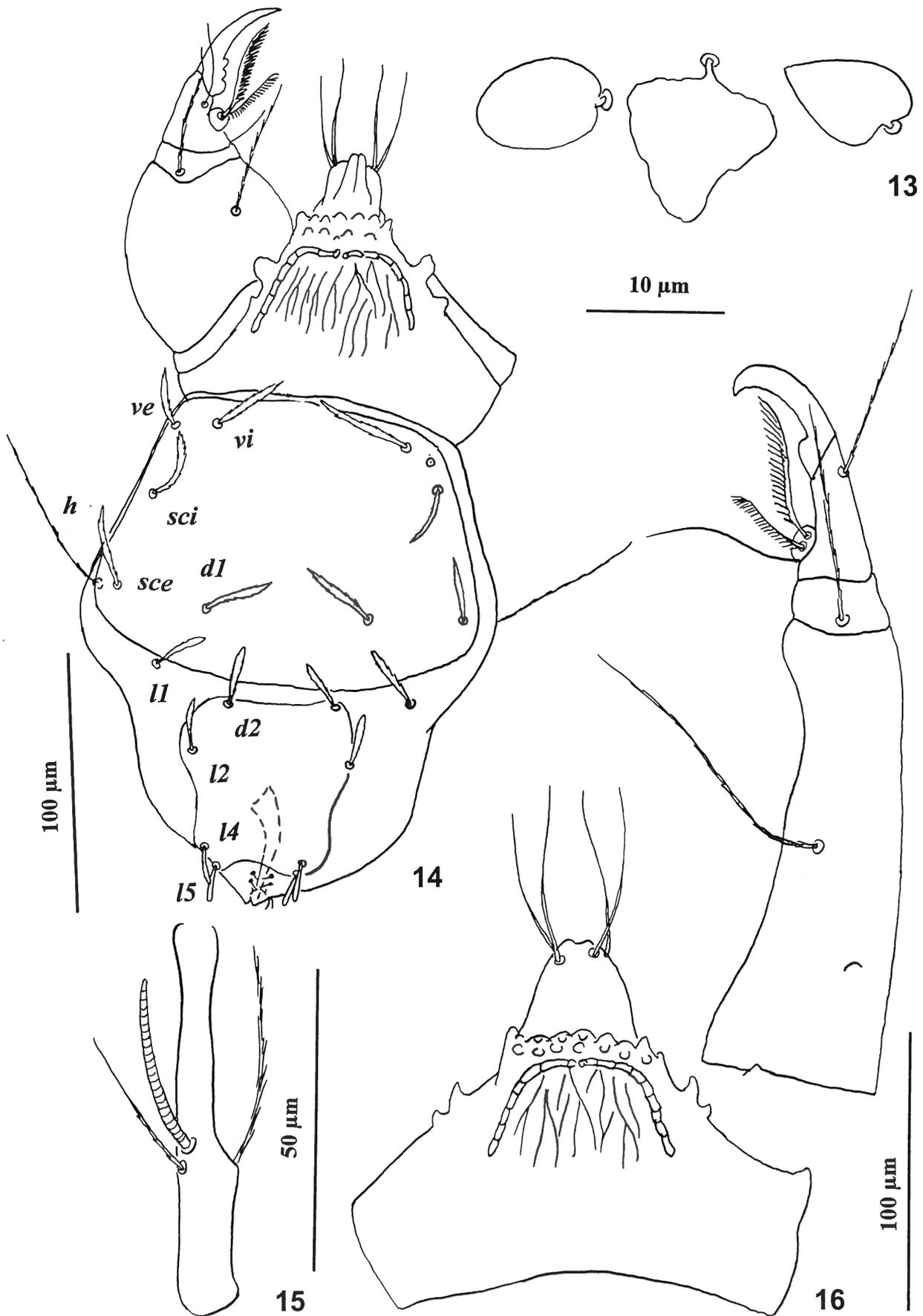
*Habitats:* Nests of rodents, grain stores.

*Remarks:* (i) The type specimen of *C. carnifex* ZACHVATKIN, 1935 is lost. However, the conspecificity of this species with *C. aversor* has become obvious after we discovered the male of *C. aversor* (Figs. 14-16). The female of *C. aversor* was described by ROHDENDORF (1940) and later redescribed by VOLGIN (1969) and by SUMMERS and PRICE (1970). A neotype has not yet been described for this species.

(ii) The species *C. acarophagus* ZAHER et SOLIMAN, 1967 was poorly described and depicted (ZAHER et SOLIMAN, 1967). A differential diagnosis for this species was not given and its holotype is not available, but by some characters i.e. the shape of peritremes, the length-ratio between solenidion  $\omega 1$  and guard seta ( $ft'$ ), the shape of the dorsal idiosomal setae and others *C. acarophagus* cannot be separated from *C. carnifex*.

(iii) In its original description (FAIN and LUKOSCHUS, 1981), *Cheyletus allactaga* FAIN et LUKOSCHUS, 1981 compared this species only with the Belgian population of *C. aversor* (= *carnifex*). The comparison of numerous specimens of this species from different regions and the study of additional material of *C. allactaga* have revealed that they are identical.

(iv) The species *C. zaheri* HASSAN et RAKHA, 1982 bears one pair of dorsomedian setae on the hysterosoma and differs from *C. carnifex* only by the absence of dorsomedian setae on the propodosomal shield. However, these setae are always present in the *Cheyletus* species if the median hysterosomal setae are present. These setae are frequently broken or almost invisible in *C. carnifex*. Therefore we surmise that these setae or their vestiges are present in *C. zaheri* and think that *C. zaheri* is a junior synonym of *C. carnifex*.



Figs. 13-16 – *Cheyletus carnifex* – Variability of dorsomedian setae in female (13); male: heteromorphic form, with short palpal femur in dorsal view (14), tarsus I in dorsal view (15), gnathosoma of heteromorphic form, with long palpal femur in dorsal view (16).

### 11. *Cheyletus morinus* BARILO, 1986

*Cheyletus morinus* BARILO, 1986: 27-28.

This species was described from females from Uzbekistan (BARILO, 1986).

*Distribution:* Uzbekistan

*Habitats:* ? Soil.

*Remark:* We did not examine the holotype of this species (deposited in the University of Samarkand, Uzbekistan),

but the detailed description of the female by BARILO (1986) (male unknown) allows to separate it easily from all the other known species of *Cheyletus*.

### 12. *Cheyletus cacahuamilpensis* BAKER, 1949

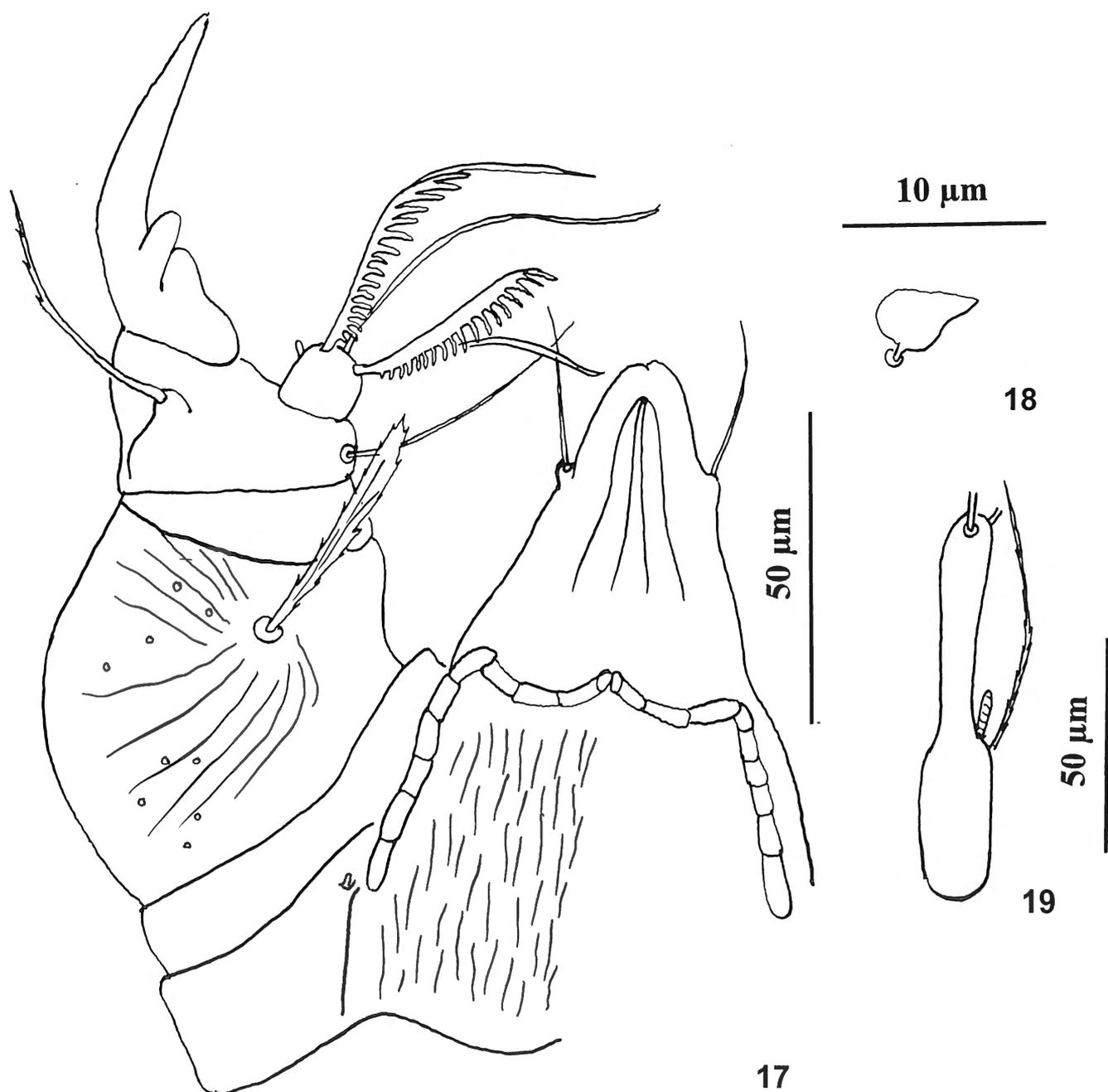
(Figs. 17-19)

*Cheyletus cacahuamilpensis* BAKER, 1949: 282.

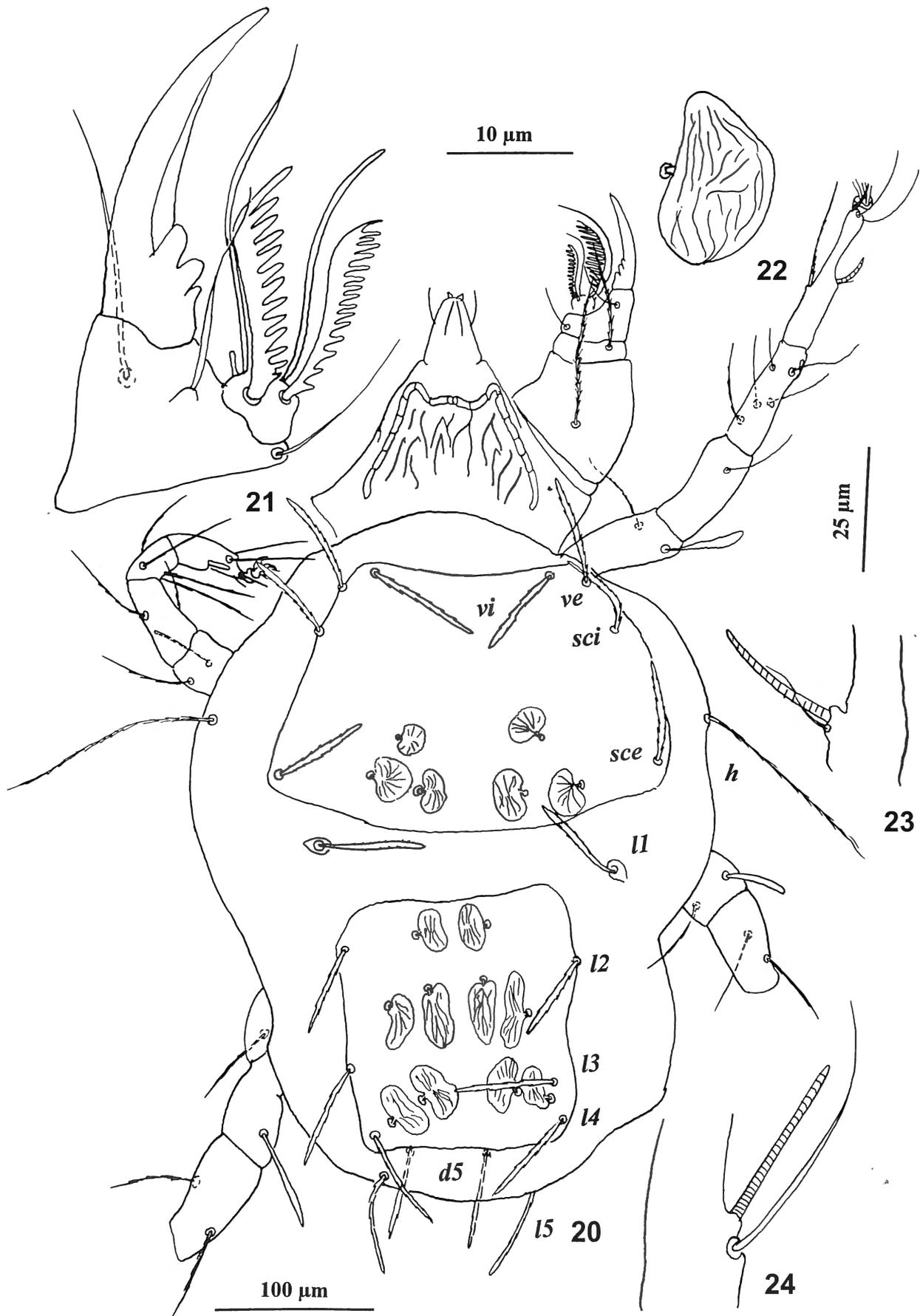
*Eucheyletia mungeri* MCGREGOR, 1956: 24

*Cheyletus baloghi* VOLGIN, 1969: 116-119 *syn. nov.*

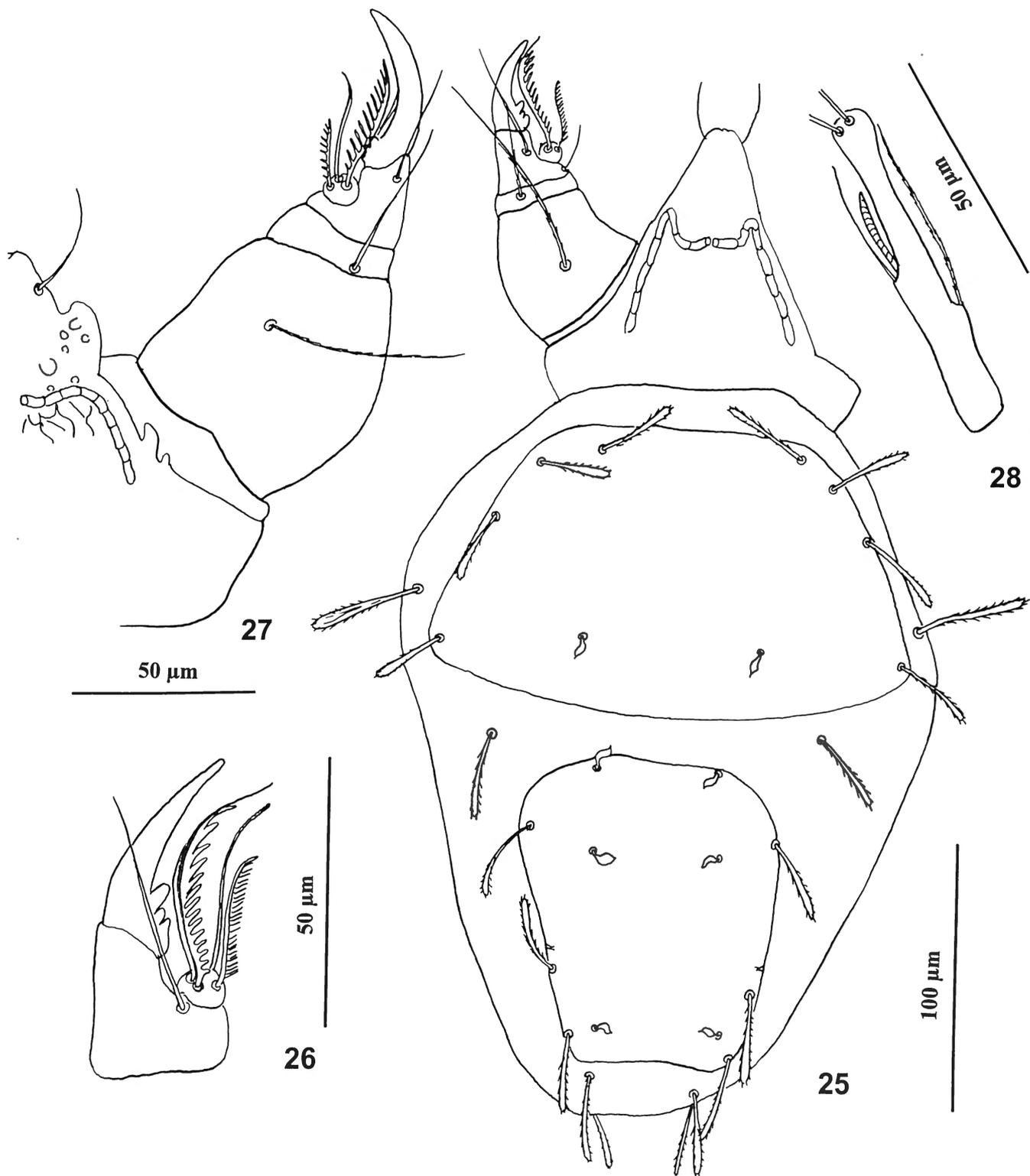
This species was described from bat guano in Mexico



Figs. 17-19 – *Cheyletus cacahuamilpensis*, female-Gnathosoma in dorsal view (17), dorsomedian seta (18), tarsus I in dorsal view (19).



Figs. 20-24 – *Cheyletus volgini*, female-Dorsal view (20), palpal tibia and tarsus in dorsal view (21), dorsomedian seta (22), solenidion  $\omega 1$  and guard seta (23). *Cheyletus linsdalei*, female – Solenidion  $\omega 1$  and guard seta (24). Scale lines 100  $\mu\text{m}$  (20), 25  $\mu\text{m}$  (23, 24), 10  $\mu\text{m}$  (21, 22).



Figs. 25-28 – *Cheyletus trouessarti* – Female: dorsal view (25), palpal tibia and tarsus in dorsal view (26), tarsus I in dorsal view (27); gnathosoma of male in dorsal view (28).

(BAKER, 1949). Later on it was redescribed by SUMMERS and PRICE (1970). The male was described by SUMMERS (1975).

*Type material:* Female holotype ex bat guano, Cueva de Cacahuamilpa Gro., Mexico, 15. XII. 1939 (Coll. BONET) (USNM). Female holotype, 10 female paratypes and 1 male paratype of *C. baloghi* from the nest of *Spermophilus pygmaeus*, Sevastopol, Crimea, Ukraine, 17. VII. 1958 (Coll. I. SELEDTSOV) (ZIN).

*Additional material:* One female from Algeria (Coll. ATHIAS). One female from the nest of *Cynictis penicillata*, Mafeking, S. Africa, XI. 1969 (Coll. F. ZUMPT). One female from house dust, Lima, Peru, 18. IV. 1974 (Coll. A. FAIN).

*Distribution:* Cosmopolitan.

*Habitats:* Nests of mammals, house dust.

*Remark:* We examined type specimens of *Cheyletus cacahuamilpensis* BAKER, 1949 and of *Cheyletus baloghi* VOLGIN, 1969 and were unable to separate them.

### 13. *Cheyletus volgini* sp. nov. (Figs. 20-23)

*Type material:* Female holotype (T-Ch-62, ZIN) and 20 female paratypes from the nest of *Pteromys volans*, Sudsukhinskij Reservation, Far East, Russia, 12. VI. 1962. Holotype and 18 female paratypes in ZIN, 2 female paratypes in IRSNB.

#### *Description:*

Female (holotype, Figs. 20-23): *Gnathosoma* 190 long and 185 wide. Palpal femur 90 long and 60 wide. Dorsal seta of palpal femur 100 long, hair-like. Palpal claw with 3 teeth (2-3 in paratypes). Outer comb-like seta of palpal tarsus with 12 tines, inner seta with 15 tines. Peritremes M-shaped, with 8 pairs of segments (7-9 pairs in paratypes). Rostral shield almost without ornamentation. *Idiosoma* 430 long and 335 wide. *Dorsum:* Shields without ornamentation. Distance between propodosomal and hysterosomal shields about 35. Lateral setae narrow lanceolate, about 70 long, setae *h* hair-like, barbed, about 130 long. Median neutrichial setae cloud-like (Fig. 22). Propodosomal shield 165 long and 250 wide, it bears setae *vi*, *ve*, *sci*, *sce* and 3 pairs of median setae. Hysterosomal shield 185 long and 150 wide, it bears setae *l2-l4* and 5 pairs of median setae. Setae *l1*, *l5* and *d5* situated off hysterosomal shield. *Legs.* Shape of setae as in Fig. 20. Solenidion  $\omega 1$  about 30 long, guard seta nude, shorter than solenidion, about 20 long.

Male: Unknown.

*Differential diagnosis:* The new species differs from *C. linsdalei* by the following characters. In *C. volgini*

sp. nov. the solenidion  $\omega 1$  is 1.5 time longer than the guard seta, setae *h* is 1.9 time longer than other lateral setae and about 130 long. In *C. linsdalei* solenidion  $\omega 1$  is 1.3 time shorter than the guard seta, setae *h* is 1.3 time longer than other lateral setae and about 85 long.

*Etymology:* This species is named in honour of the late prominent Russian acarologist Dr. V.I. VOLGIN.

### 14. *Cheyletus linsdalei* BAKER, 1949 (Fig. 24)

*Cheyletus linsdalei* BAKER, 1949: 281

This species was described from female specimens collected from *Spermophilus beecheyi* in USA (BAKER, 1949). Later on, the female was redescribed by SUMMERS and PRICE (1970).

*Type material:* Female holotype from *Citellus* (now *Spermophilus*) *beecheyi*, Monterey, California, U.S.A., 28. I. 1943 (Coll. J.M. Linsdale) (USNM).

*Additional material:* Two females from the nest of *Neotoma lepida*, Castle Gliff, Utah, U.S.A., 27. XI. 1989 (Coll. J. KUCERA).

*Distribution:* North America.

*Habitats:* Nests of rodents.

*Remark:* The male of this species is unknown.

### 15. *Cheyletus trouessarti* OUDEMANS, 1903 (Figs. 25-28)

*Cheyletus trouessarti* OUDEMANS, 1903a: 16

*Cheyletus furibundus* ROHDENDORF, 1940: 85 syn. nov.

*Cheyletus praedabundus* KUZIN, 1940: 85 syn. nov.

*Cheyletus davisii* BAKER, 1949: 283-284.

*Cheyletus truculentus* VOLGIN, 1949: 586 syn. nov.

*Cheyletus woodroffeii* JEFFREY, 1979: 47-53 syn. nov.

This species was described from Holland (OUDEMANS, 1903a). Later it was redescribed by SUMMERS and PRICE (1970, female), and SUMMERS (1975, male). The type specimens of *C. trouessarti* were redescribed by FAIN *et al* (1980).

*Type material:* Female lectotype, 3 females and 1 male paralectotypes from food of canary, 10. VII. 1895 (Coll. A. OUDEMANS) (NMNH). Male holotype of *C. furibundus* from grain, Kirgach, Vladimir Prov., Russia, 22. VII. 1934 (ZIN). Male holotype of *C. praedabundus* from grain, Rostov-na-Donu, Russia (ZIN). Female holotype of *C. davisii* from onions from Italy, collected in Boston, U.S.A., 06. VII. 1956 (Coll. DAVIS and FREEMAN)



Figs. 29-32 – *Cheyletus trux* – Female gnathosoma in dorsal view (29), male gnathosoma in dorsal view (30), variability of dorsomedian setae in female (31). *Cheyletus schneideri*, female – Gnathosoma in dorsal view (32). Scale lines 100 μm (29, 30, 32), 10 μm (31).

(USNM). Male holotype of *C. truculentus* from grain, Karaganda, Russia (ZIN).

*Additional material:* One male from straw, Azerbaijan, 03. VII. 1969 (Coll. ABDULLAEVA). One female from barn dust, Poland, I. 1978 (Coll. CHMIELEWSKI).

*Distribution:* Cosmopolitan.

*Habitats:* Grain, straw, bark, but guano, house dust, nests of mammals and birds.

*Remarks:* (i) The original description of *C. trouessarti* given by OUDEMANS (1903a, 1906) contained some inaccuracies. ROHDENDORF (1940), therefore, who did not see the type specimens, overlooked it and described his new species *C. furibundus* ROHDENDORF, 1940. Besides, ROHDENDORF (1940) and VOLGIN (1949) were not aware of the polymorphism in the males of cheyletid mites, and described the homeomorphic and heteromorphic forms of males as separate species (e.g. *C. praedabundus* KUZIN, 1940 and *C. truculentus* VOLGIN, 1949, respectively). Our re-examination of the type specimens and the data given by SUMMERS (1975) indicate that *C. praedabundus*, *C. furibundus* and *C. truculentus* are homeo- and heteromorphic males of *C. trouessarti*.

(ii) *C. woodroffei* JEFFREY, 1979 differs from *C. trouessarti* only by the shape of the solenidion of tibia I ( $\phi$ ). We think that this single character is insignificant and cannot be used to separate these species, an opinion based on our personal experience gathered in our study of numerous species of *Cheyletus*. Moreover, SUMMERS *et al.* (1972), studying the morphology of five species of *Cheyletus*, including *C. trouessarti*, did not use the shape of the solenidion of tibia I as a specific character. Consequently we consider here that *C. woodroffei* is a junior synonym of *C. trouessarti*.

## 16. *Cheyletus trux* ROHDENDORF, 1940

(Figs. 29-31)

*Cheyletus trux* ROHDENDORF, 1940: 87-88

*Cheyletus hendersoni* BAKER, 1949: 279 **syn. nov.**

*Cheyletus tenuipilis* FAIN, FELDMAN-MUHSAM et MUMCUOGLU, 1980: 35-42 **syn. nov.**

This species was described from grain in Russia (ROHDENDORF, 1940). It was redescribed, but not depicted by VOLGIN (1969).

*Type material:* Female holotype from grain, Ivanovo, Russia, 1. VIII. 1935 (ZIN). Female holotype of *C. tenuipilis*, 5 female paratypes and 3 male paratypes from house dust, La Louviere, Belgium, XI. 1965 (Coll. A. FAIN) (IRSNB). Five female of *C. hendersoni* from the type series (lectotype not designated, all type specimens are opaque and difficult to study) from a mummy, Ar-

kansas cave, U.S.A., 16. VII. 1935 (Coll. W.C. HENDERSON) (USNM).

*Additional material:* Three females from house dust, Switzerland, 1972 (Coll. Y. MUMCUOGLU). Ten females and 10 males from grain, Khabarovsk Prov., Russia, 05. IX. 1963 (Coll. V. VOLGIN). Ten females and 10 males from the nest of *Delichon urbica*, Minsk, Belorussia (Coll. G. EFREMOVA). Ten females and 10 males from the nest of *Sciurus vulgaris*, Zakarpatie, Ukraine, 16. VIII. 1959 (Coll. S. VISOCKAJA). Ten females and 10 males from house dust, Bishkek, Kirghizia, 24. VI. 1988 (Coll. ADIEVA). Ten females and 10 males from house dust, Israel (Coll. B. FELDMAN-MUHSAM). Two females and 1 male from the nest of *Neotoma fuscipes*, San Luis Obispo, California, U.S.A., IV. 1981 (Coll. DON GETTINGER). Two females from the nest of *Colaptes cafer*, Cache la Poudre River, 2.5 miles E. of Fort Collins, U.S.A.

*Distribution:* Holarctic region.

*Habitats:* Nests of birds and mammals, house dust, grain supplies.

*Remark:* *C. trux* is a common species, found in nests of vertebrates, house dust and grain stores. The original description given by ROHDENDORF (1940) contained some inaccuracies, which may explain that BAKER (1949) overlooked this species and described a new species *C. hendersoni* BAKER, 1949. SUMMERS and PRICE (1970) redescribed the latter species from specimens collected in the nest of *Colaptes cafer*, Fort Collins, USA. According to their description, the female of *C. hendersoni* bears two pair of median setae on the hysterosomal shield. FAIN *et al.* (1980) described a new species *C. tenuipilis* FAIN *et al.*, 1980 which differs from *C. hendersoni* by the presence of three pairs of median setae on the hysterosomal shield. We re-examined the specimens described by SUMMERS and PRICE (1970), and they bear three pairs of median setae on the hysterosomal shield, as in *C. tenuipilis*. The comparative examination of the type specimens of *C. trux*, *C. tenuipilis* and *C. hendersoni* (type specimens and specimens from Fort Collins, Colorado, U.S.A.) has shown that these species are not separable from each other.

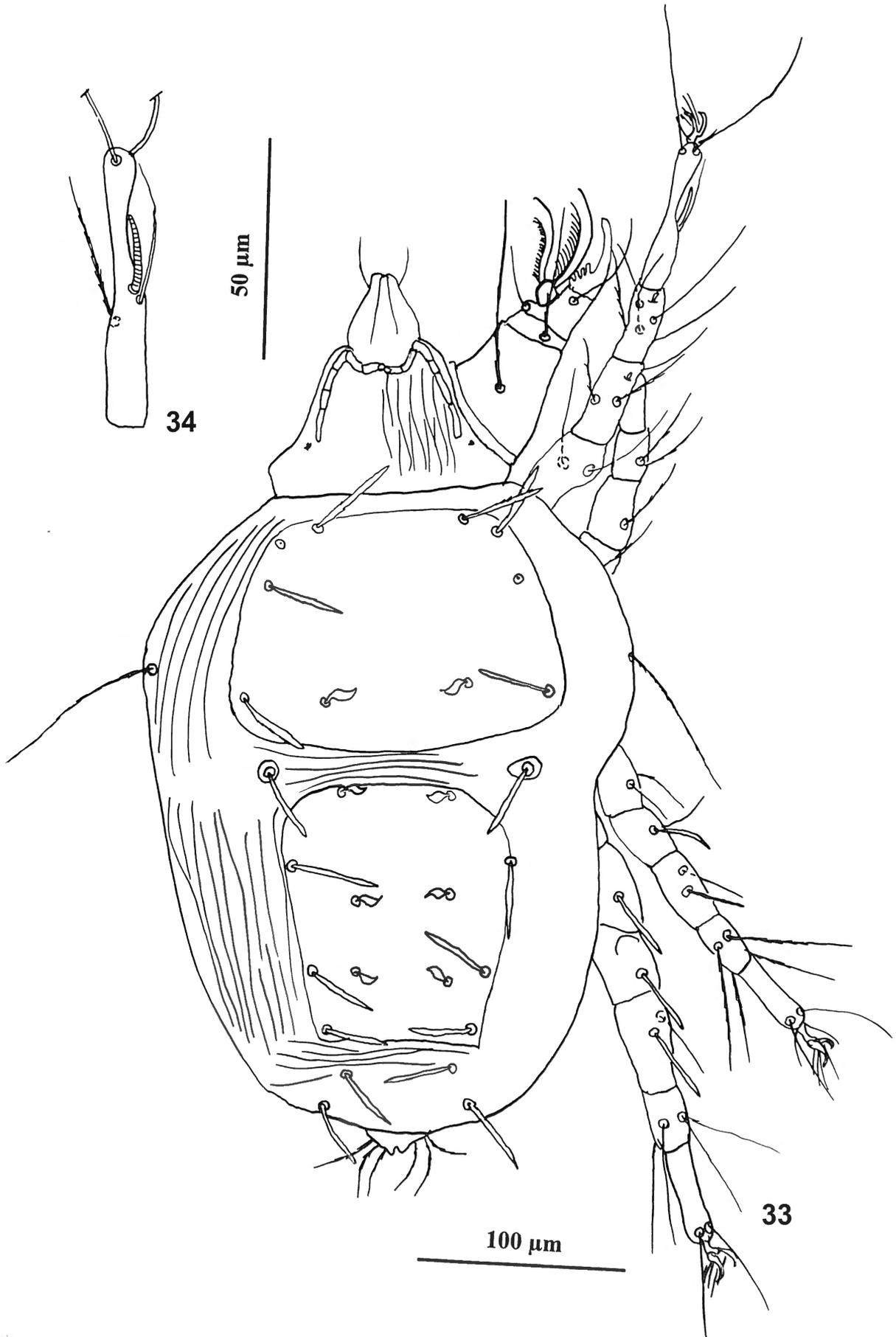
## 17. *Cheyletus schneideri* OUDEMANS, 1902

(Figs. 32-34)

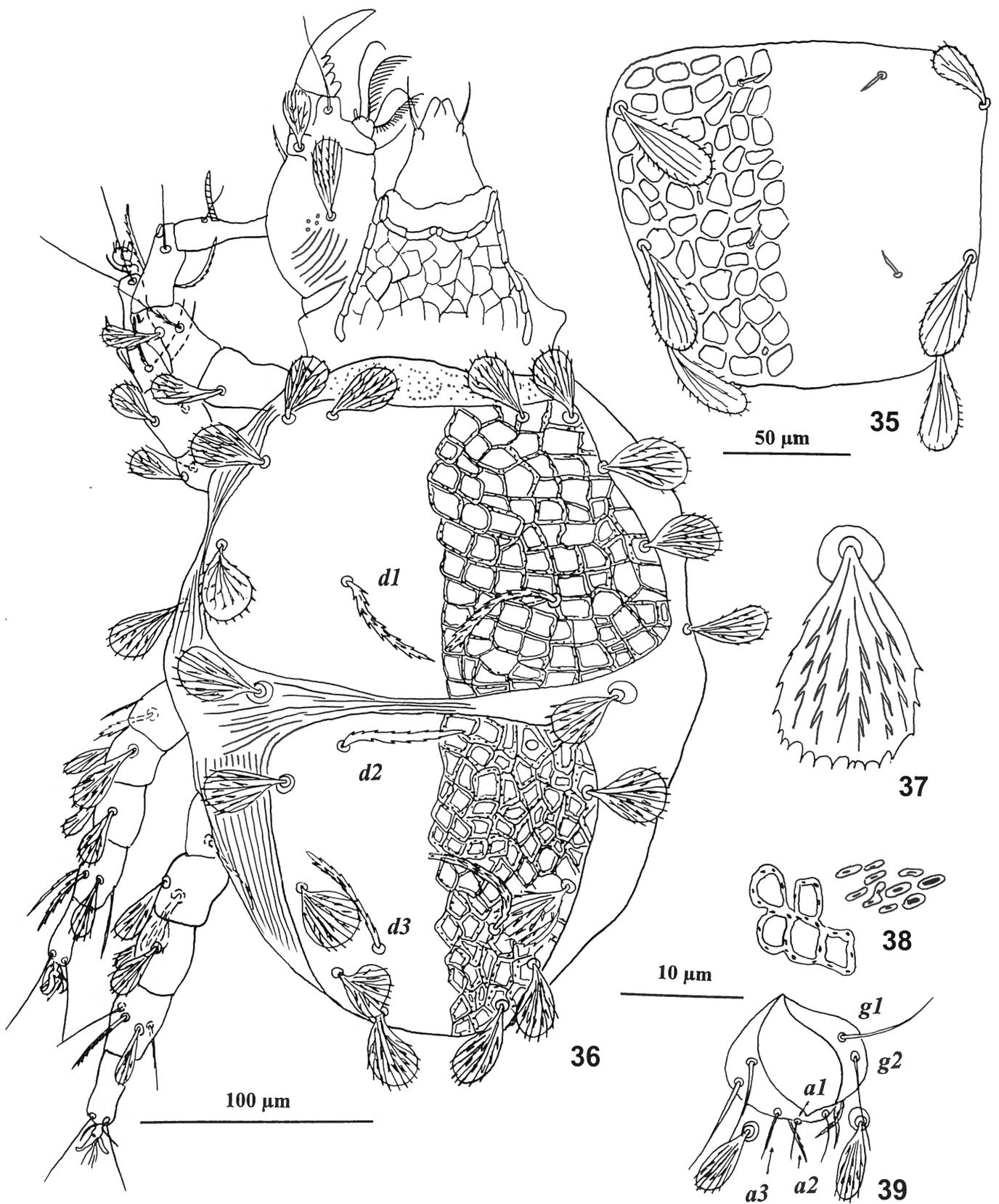
*Cheletes schneideri* OUDEMANS, 1902: 15.

This species was described from the female, from decaying leaves, in Italy (OUDEMANS, 1902), and never been recorded again since its original description. Some structures are in bad condition in the lectotype and we prefer to redescribe this species from material collected in Belgium.

*Type material:* Female lectotype from decaying leaves,



Figs. 33-34 – *Cheyletus schneideri*, female – Dorsal view (33), tarsus I in dorsal view (34).



Figs. 35-39 – *Cheyletus misonnei*, female – Hysterosomal shield (35). *Cheyletus funisciuri*, female – Dorsal view (36), lateral seta (37), variability of ornamentation of dorsal shields (38), vulvar region (39). Scale lines 100 μm (36, 39), 50 μm (35), 10 μm (37, 38).

San-Remo, Italy, III. 1900 (Coll. SCHNEIDER) (NMNH).

ADDITIONAL MATERIAL. One female from barn near Rance, Belgium, 20. X. 1977 (Coll. A. CENTNER). One female, Grande abbaye, Chimay, Belgium, 25. V. 1975 (Coll. A. FAIN).

*Distribution:* Europe

*Habitats:* ? Decaying leaves. Dust from barn.

*Description:*

Female (Fig. 32-34): *Gnathosoma* 200 long and 170 wide. Palpal femur 85 long and 75 wide. Dorsal seta of palpal femur 110 long, hair-like. Palpal claw with 4 teeth. Outer comb-like seta of palpal tarsus with 12 tines, inner seta with 18 tines. Peritremes M-shaped, with 6 pairs of segments. Rostral shield almost without ornamentation. *Idiosoma* 365 long and 280 wide. *Dorsum*: Shields without ornamentation. Lateral setae narrow lanceolate, about 50 long, setae *h* hair-like, barbed, about 100 long. Median neotrichial setae small and transparent, as in Fig. 33. Propodosomal shield 175 long and 245 wide, it bears setae *vi*, *ve*, *sci*, *sce* and 1 pair of median setae. Hysterosomal shield 185 long and 150 wide, it bears setae *l2-l4* and 3 pairs of median setae. Setae *l1*, *l5* and *d5* situated off hysterosomal shield. *Legs*. Shape of setae as in Fig. 33. Solenidion  $\omega 1$  about 20 long, guard seta nude, longer than solenidion, about 35 long.

Male: Unknown.

**18. *Cheyletus misonnei* FAIN et LUKOSCHUS, 1981**  
(Fig. 35)

*Cheyletus misonnei* FAIN et LUKOSCHUS, 1981b: 1-4

This species was described from *Tatera* sp. in South Africa (FAIN et LUKOSCHUS, 1981b).

*Type material:* Female holotype and 8 female paratypes from *Tatera* sp., Aminuis, Namibia, South Africa, 30. X. 1980 (Coll. F. LUKOSCHUS) (MRAC).

*Distribution:* South Africa

*Habitats:* Nests of mammals.

*Remark:* The male of this species is unknown.

**19. *Cheyletus funisciuri* (FAIN, 1972) comb. nov.**  
(Figs. 36-42)

*Eucheyletia funisciuri* FAIN, 1972: 38-39.

This species was shortly described from the nest of *Funisciurus carruthersi* in Rwanda (FAIN, 1972).

*Type material:* Female holotype and 11 female paratypes from nest of *Funisciurus carruthersi*, Rwanda, 10. IV. 1956 (Coll. A. FAIN) (MRAC).

*Additional material:* Fourteen females and seven males from the sciurid nest, Mayidi, near Kinshasa, Congo, II. 1966 (Coll. A. FAIN). Seven females and 5 males from the nest of a sciurid, Kimuenza, near Kinshasa, Congo, 09. II. 1966. (Coll. A. FAIN).

*Distribution:* Tropical Africa.

*Habitats:* Nests of Sciuridae.

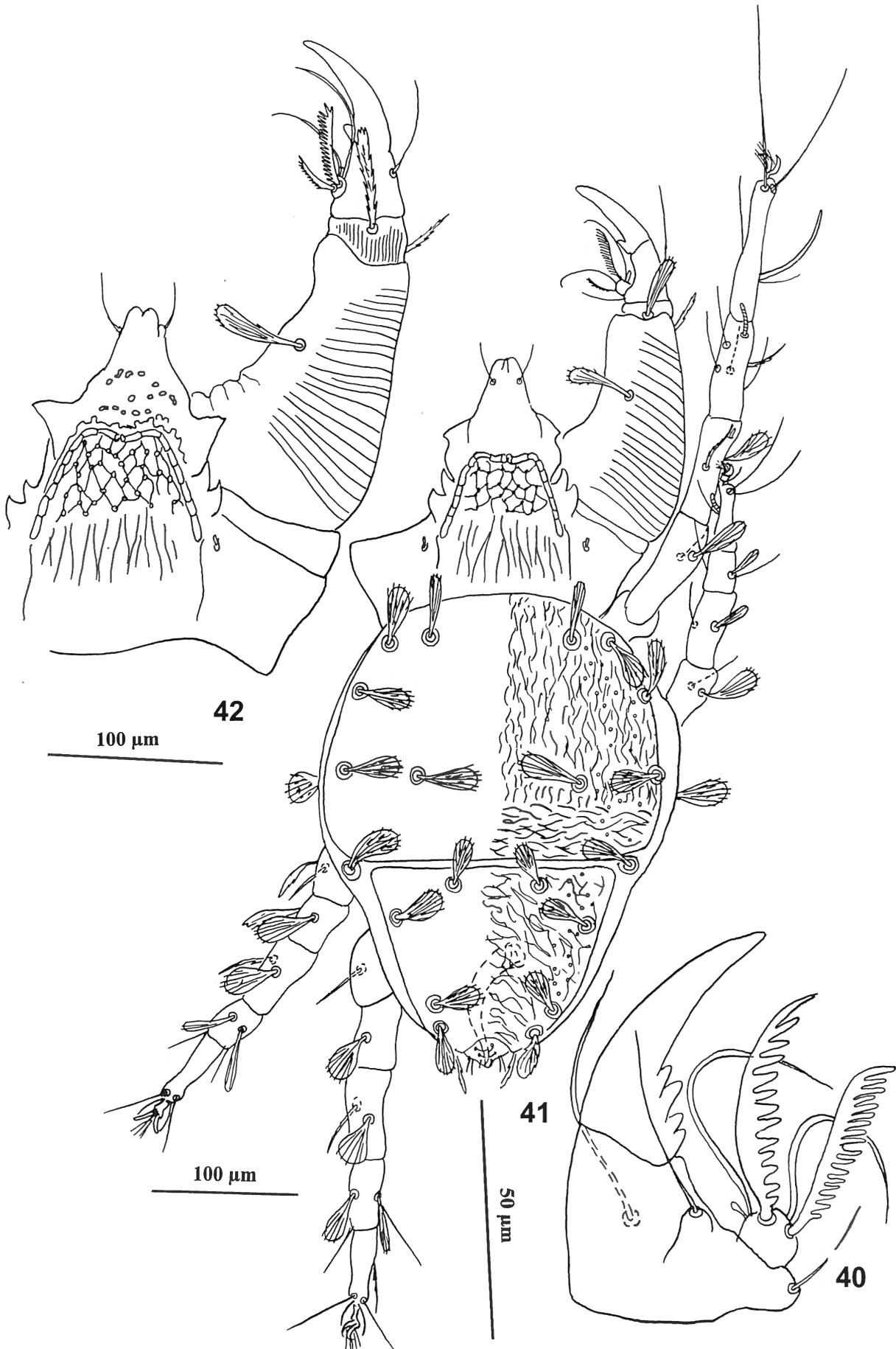
*Description:*

Female (holotype, Figs. 36-40): *Gnathosoma* 166 long and 140 wide. Palpal femur 65 long and 58 wide. Dorsal seta of palpal femur fan-like, 40 long and 20 wide. Dorsal seta of palpal genu fan-like. Palpal claw with 4 teeth. Outer comb-like seta of palpal tarsus with 12 tines, inner seta with 16 tines. Peritremes M-shaped, with 8-9 pairs of segments. Rostral shield covered by a network pattern. *Idiosoma* 315 long and 275 wide. *Dorsum*: Shields covered by network pattern in type specimens or strongly punctated in specimens from Mayidi. Lateral setae, including *h*, fan-like, about 40 long and 20 wide. Median setae lanceolate, about 60 long. Propodosomal shield 160 long and 250 wide, it bears setae *vi*, *ve*, *sci*, *sce* and 1 pair of median setae *d1*. Hysterosomal shield about 165 long and 160 wide, it bears setae *l2-l5* and 2 pairs of median setae *d2* and *d4*. Setae *l1* and *d5* situated off the hysterosomal shield, *d5* situated ventrally, fan-like, about 40 long and 10 wide. *Legs*. Shape of setae as in Fig. 36. Solenidion  $\omega 1$  about 30 long, guard seta nude, shorter than solenidion, about 15 long. Femur IV with 2 setae.

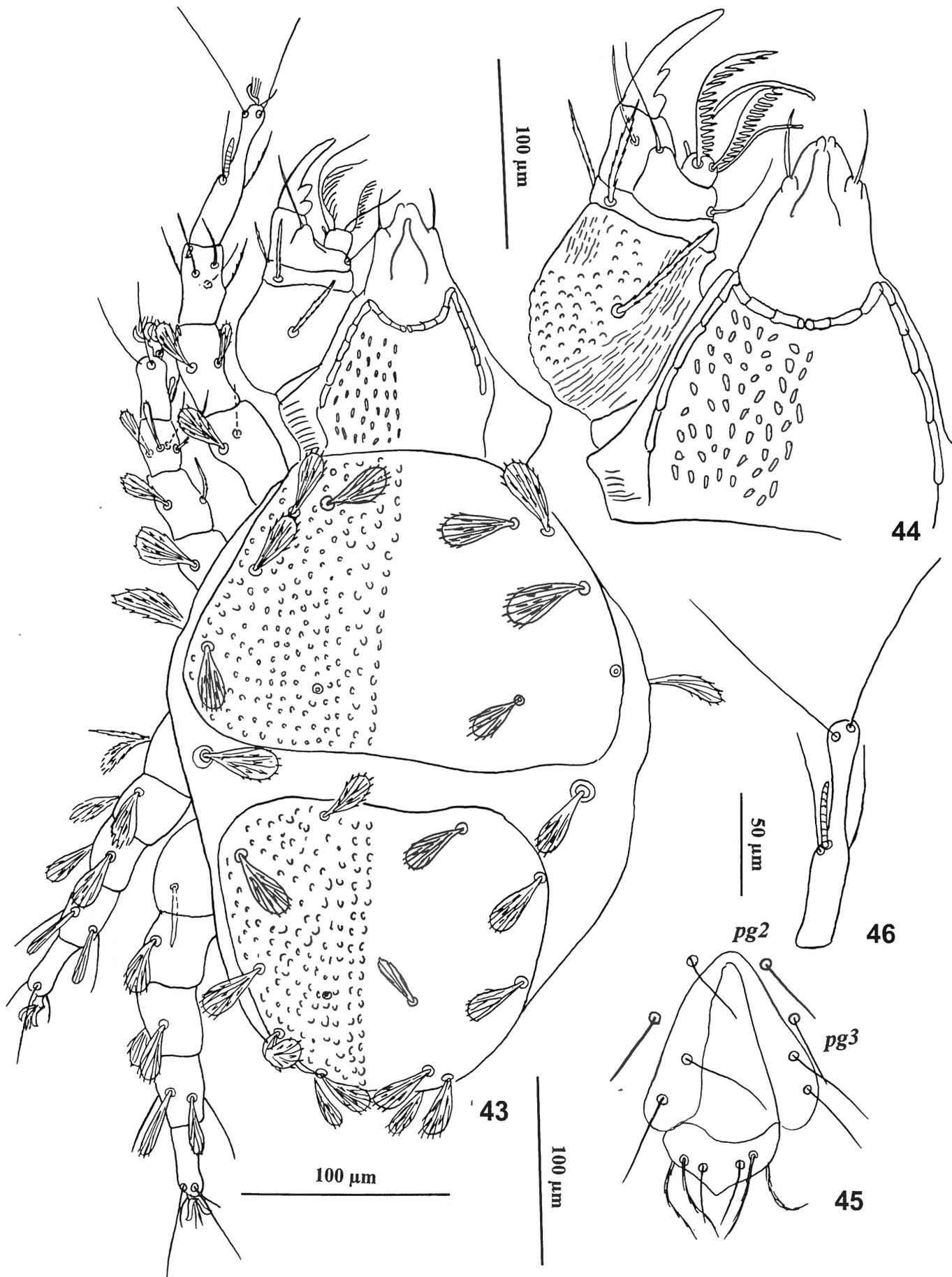
Male (Figs. 41-42): *Gnathosoma* in midline 200 long and 195 wide. Palpal femur 140 long and 75 wide. Dorsal seta of palpal femur narrow fan-like 40 long. Palpal claw with 1 tooth. Outer comb-like seta of palpal tarsus with 16 tines, inner seta with 9 tines. Peritremes M-shaped, with 8 pairs of segments. Rostral shield with network pattern. *Idiosoma* 300 long and 230 wide. *Dorsum*: Shields covered by ornamentation as in Fig. 41. All setae, including *h*, fan-like, about 35 long and 17 wide, excluding *vi* 45 long and 10 wide, *l4* 25 long and 8 wide and *l5* narrow lanceolate 20 long. Propodosomal shield 175 long and 200 wide, it bears setae *vi*, *ve*, *sci*, *sce* and 1 pair of median setae *d1*. Hysterosomal shield 125 long and 135 wide, it bears setae *l2-l5* and 1 pair of median setae *d2*. Setae *l1* situated off the hysterosomal shield. Penis about 80 long. *Legs*. Shape of setae as in Fig. 41. Solenidion  $\omega 1$  about 50 long, guard seta nude, 2 times shorter than solenidion.

**20. *Cheyletus kivuensis* (FAIN, 1972) comb. nov.**  
(Figs. 43-46)

*Eucheyletia kivuensis* FAIN, 1972: 39.



Figs. 40-42 – *Cheyletus funisciuri*-Female palpal tibia and tarsus in dorsal view (40); male dorsal view (41), gnathosoma in dorsal view (42). Scale lines 100 μm (41, 42), 50 μm (40).



Figs. 43-46 – *Cheyletus kivuensis*, female – Dorsal view (43), gnathosoma in dorsal view (44), vulva (45), tarsus I (46). Scale lines 100 μm (43), 50 μm (44-46).

*Type material:* Female holotype from a rodent, Kivu, Zaire, 21. III. 1958 (Coll. A. FAIN) (MRAC).

*Distribution:* Zaire.

*Habitats:* Nests of rodents.

*Description:*

Female (holotype, Fig. 43-46): *Gnathosoma* 165 long and 105 wide. Palpal femur 65 long and 50 wide. Dorsal seta of palpal femur thickened, barbed, 35 long. Dorsal seta of palpal genu thickened, barbed. Palpal claw with 2 teeth. Outer comb-like seta of palpal tarsus with about 15 tines, inner seta with about 18 tines. Peritremes M-shaped, with 8 pairs of segments. Rostral shield covered by small tubercles. *Idiosoma* 330 long and 250 wide. *Dorsum:* Shields covered by small tubercles. Lateral setae, including *h*, fan-like, about 30 long and 10 wide. Median setae *d1* and *d3* similar to size and shape to lateral ones, setae *d4* 25 long and 10 wide. Propodosomal shield 135 long and 215 wide, it bears setae *vi*, *ve*, *sci*, *sce* and 1 pair of median setae *d1*. Hysterosomal shield about 150 long and 185 wide, it bears setae *l2-l5* and 2 pairs of median setae *d2* and *d3*. Setae *l1* and *d5* situated off the hysterosomal shield, *d5* slightly shorter and narrower than lateral setae. *Legs.* Shape of setae as in Fig. 47. Solenidion  $\omega 1$  about 16 long, guard seta nude, 1.5 times longer than solenidion, about 25 long.

Male: Unknown.

**21. *Cheyletus tanzaniensis* (FAIN, 1972) comb. nov.**  
(Figs. 47-50)

*Eucheyletia tanzaniensis* FAIN, 1972: 39.

This species was shortly described from *Coleura gallarum* in Tanzania (FAIN, 1972).

*Type material:* Female holotype from *Coleura gallarum* from Tanganyika, Tanzania (Coll. A. FAIN) (MRAC).

*Additional material:* Two females from the nest of *Dasymys incomtus*, Butare, Rwanda, 03. V. 1955 (Coll. A. FAIN). One female from the nest of *Dendromus* sp. 1955 (Coll. A. FAIN). One female from the nest of *Pelomys walambae*, Butare, Rwanda, 10. V. 1955 (Coll. A. FAIN). One female from the nest of *Aethomys chrysophilus*, Roo-derplaat, Pretoria, South Africa, 03. VIII. 1970. One female from the nest of *Textor* sp., Butare, Rwanda, 29. IV. 1955 (Coll. A. FAIN). One female from the nest of *Lagonosticta senegallus*, Rwanda, 19. V. 1955 (Coll. A. FAIN).

*Distribution:* Tropical Africa.

*Habitats:* Nests of mammals and birds.

*Description:*

Female (holotype, Fig. 47-52): *Gnathosoma* 185 long and

160 wide. Palpal femur 83 long and 75 wide. Dorsal seta of palpal femur narrow lanceolate, 50 long. Dorsal seta of palpal genu thickened, barbed. Palpal claw with 3 teeth. Outer comb-like seta of palpal tarsus with about 14 tines, inner seta with about 20 tines. Peritremes M-shaped, with 7-8 pairs of segments. Rostral shield punctated. *Idiosoma* 350 long and 270 wide. *Dorsum:* Shields punctated. Lateral setae, including *h*, fan-like, about 40 long and 16 wide. Median setae short about 15-20 long and thin, as in Fig. 43. Propodosomal shield 135 long and 215 wide, it bears setae *vi*, *ve*, *sci*, *sce* and 1 pair of median setae *d1*. Hysterosomal shield about 135 long and 150 wide, it bears setae *l2-l5* and 2 pairs of median setae *d2* and *d3*. Setae *l1* and *d5* situated off the hysterosomal shield, *d5* slightly shorter and narrower than lateral setae. *Legs.* Shape of setae as in Fig. 43. Solenidion  $\omega 1$  about 20 long, guard seta nude. Twice as long as solenidion, about 40 long.

Male: Unknown.

**22. *Cheyletus kuznetzovi* BOCHKOV et KHAUSTOV, 1999**

*Cheyletus kuznetzovi* BOCHKOV et KHAUSTOV, 1999: 116

This species was described from females in Turkmenia (BOCHKOV and KHAUSTOV, 1999).

*Type material:* Female holotype and 3 female paratypes from ant-hill, Dagskij Reservation, Turkmenia, V. 1993 (Coll. KHIDIROV) (ZIN).

*Distribution:* Turkmenia.

*Habitats:* ? Ant-hills.

*Remark:* The male of this species is unknown.

**23. *Cheyletus punctulatus* FAIN et LUKOSHUS, 1981**  
(Figs. 51-52)

*Cheyletus punctulatus* FAIN et LUKOSHUS, 1981a: 121-122.

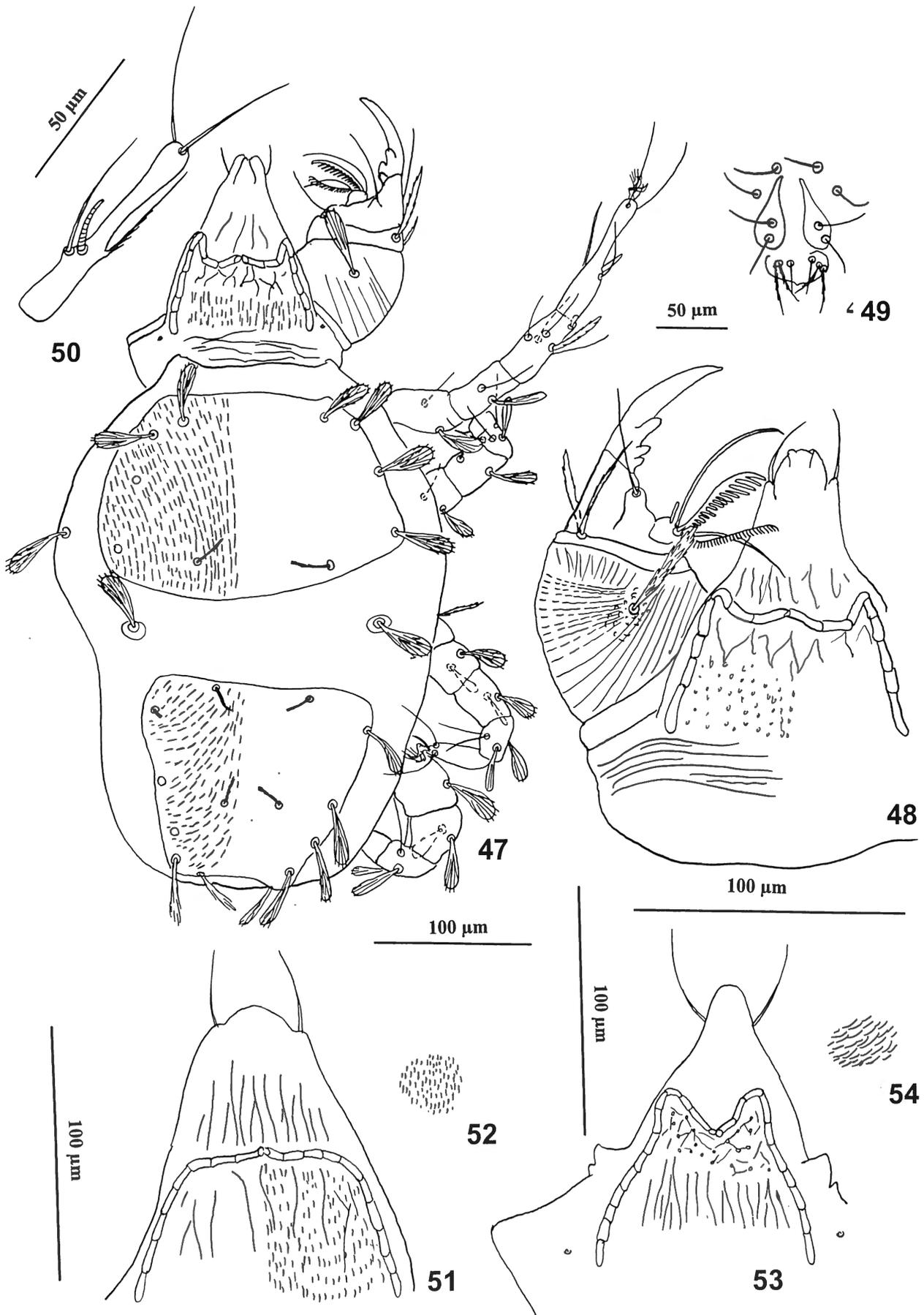
This species was described from a single female specimen, from *Gerbillus pyramidum* in Morocco (FAIN and LUKOSHUS, 1981a).

*Type material:* Female holotype from *Gerbillus pyramidum*, 20 km N. of Ouerd Draa, Southern Morocco, 28° 40' N, 10° 50' W, 27. III. 1975. The gerbil was collected by G. RHEINWALD, the mite by F. LUKOSCHUS. The holotype is deposited in the Museum Alexander Koenig, Bonn, Germany.

*Distribution:* Morocco.

*Habitats:* Nests of rodents.

*Remark:* The male of this species is unknown.



Figs. 47-54 – *Cheyletus tanzaniensis*, female – Dorsal view (47), gnathosoma in dorsal view (48), vulva (49), tarsus I in dorsal view (50). *Cheyletus punctulatus*, female – Rostrum in dorsal view (51), ornamentation of dorsal shield (52). *Cheyletus nidicolus* – Rostrum in male (53), ornamentation of dorsal shields in female (54).

**24. *Cheyletus attiahi* YOUSEF et ISSA, 1972**

*Cheyletus attiahi* YOUSEF et ISSA, 1972: 42-43.

This species was described from a single female, from manure in Egypt (YOUSEF and ISSA, 1972).

*Distribution*: Egypt.

*Habitats*: ? Manure.

*Remarks*: (i) This species requires a redescription; its holotype (deposited in the National Research Centre, Dokki, Cairo, Egypt) was not available for study. It is possible that setae *d5* are actually present on the hysterosomal shield of *C. attiahi* female and that they are broken in the holotype. In this case, *C. kuznetzovi* would be a junior synonym of *C. attiahi*.

**25. *Cheyletus nidicolus* FAIN, 1972**  
(Figs. 53-54)

*Cheyletus nidicolus* FAIN, 1972: 37.

This species was briefly described from nests of vertebrates in Rwanda (FAIN, 1972) and later redescribed and depicted (FAIN, 1979b).

*Type material*: Female holotype, 1 female paratype and 2 male paratypes from the nest of *Cinnyris venustissimus falkensteini*, Butare, Rwanda, 13. VII. 1967 (Coll. A. FAIN) (MRAC).

*Additional material*: One female and 2 males from the nest of *Nectarinia kilimensis*, Butare, Rwanda, 08. III. 1970 (Coll. A. FAIN). Twelve females and 5 males from the nest of *Spermestes cucullatus*, Butare, Rwanda, 03. IV. 1971 (Coll. A. FAIN). Three females from the nest of *Textor cucullatus*, Butare, Rwanda, 07. I. 1969 (Coll. A. FAIN). One female and 1 male from the nest of *Colius striatus*, Butare, Rwanda, 08. II. 1971 (Coll. FAIN). Four females from the nest of *Lonchura cucullata*, Butare (Coll. A. FAIN). One female from the nest of *Grammomys surdaster*, Butare, Rwanda, 09. XI. 1968 (Coll. A. FAIN).

*Distribution*: Tropical Africa.

*Habitats*: Nests of birds, more rarely of mammals.

**26. *Cheyletus legendrei* FAIN, 1982**

*Cheyletus legendrei* FAIN, 1982: 83-86.

This species was described from the nest of *Foudia madagascariensis* in Madagascar (FAIN, 1982).

*Type material*: Female holotype and 1 female paratype

from the nest of *Foudia madagascariensis*, Tananarive, Madagascar, V. 1965 (Coll. R. LEGENDRE) (MRAC).

*Distribution*: Madagascar.

*Habitats*: Nests of birds.

*Remark*: The male of this species is unknown.

**27. *Cheyletus vivatus* QAYYUM et CHAUDHRI, 1977**

*Cheyletus vivatus* QAYYUM et CHAUDHRI, 1977: 92-93  
*Cheyletus spatiosus* QAYYUM et CHAUDHRI, 1977: 94-95  
**syn. nov.**  
*Cheyletus tutela* QAYYUM et CHAUDHRI, 1977: 95-97  
**syn. nov.**

This species was described from females in Pakistan (QAYYUM and CHAUDHRI, 1977).

*Distribution*: Pakistan.

*Habitats*: ? Straw.

*Remarks*: (i) This species (known only from females) requires a redescription; its holotype (deposited in the Department of Entomology, University Agriculture Lyallpur, Pakistan) was not available for this study. It differs from *C. kuznetzovi* by the shape of setae *h* (hair-like, instead of fan-like in *C. kuznetzovi*) and the situation of setae *d2*, off the hysterosomal shield (situated on the hysterosomal shield in *C. kuznetzovi*).

(ii) The species *C. spatiosus* QAYYUM et CHAUDHRI, 1977 and *C. tutela* QAYYUM et CHAUDHRI, 1977 were described from Sheikhpura as *C. vivatus*. They differ from each other and from the latter species mostly by variable characters. Other differential characters, for example the "simple" anal setae in *C. tutela* are obviously inaccuracies in the description of these authors, because all *Cheyletus* spp. always have two pairs of barbed anal setae.

**28. *Cheyletus pseudomalaccensis* FAIN, 1982**

*Cheyletus pseudomalaccensis* FAIN, 1982: 86-89

This species was described from *Plocepasser mahali* in South Africa (FAIN, 1982).

*Type material*: Female holotype and 1 female paratype from *Plocepasser mahali*, Transvaal, South Africa, 04. V. 1953 (Coll. F. ZUMPT) (Museum of Natural History, London, England).

*Distribution*: South Africa.

*Habitats*: Nests of birds.

*Remark:* The male of this species is unknown.

### 29. *Cheyletus mafekingensis* FAIN, 1982

*Cheyletus mafekingensis* FAIN, 1982: 86

This species was described from *Philetarius socius* in South Africa (FAIN, 1982).

*Type material:* Female holotype and 1 female paratype from *Philetarius socius*, Mafeking, South Africa, 15. III. 1970 (Coll. F. ZUMPT) (MRAC).

*Distribution:* South Africa.

*Habitats:* Nests of birds.

*Remark:* The male of this species is unknown.

#### Cladistic analysis

Five trees have been obtained; the 50% majority consensus tree has the following general indices: length 31 steps, consistency index (CI) 0.52, retention index (RI) 0.78 and rescaled consistency index (RC) 0.41 (Fig. 55). Three general clusters can distinctly be recognised in the consensus tree. According to this basal split of the cladogram, we established three informal species groups i.e. *eruditus*, *trouessarti* and *nidicolus*. Each of these three clusters is supported by only one, but a very important character with CI 1: the absence of dorsomedian setae (1) (*eruditus* group), the presence of abnormal dorsomedian setae (2) (*trouessarti* group) and the presence of single pair of normal dorsomedian setae (3) (*nidicolus* group).

It should be noted that such a character as the disappearance of the median setae in the species of the *eruditus* group could arise independently in several species of the genus. Therefore there is a possibility that the *eruditus* group is a polyphyletic unit. The *trouessarti* group is probably monophyletic, owing to the presence of dorsomedian setae which constitutes an unique structure. The monophily of the *nidicolus* group needs confirmation.

The *eruditus* group split in two subclusters and in two ungrouped species. The first subcluster corresponds to the *malaccensis* group established by FAIN and NADCHATRAM (1980) and it is weakly supported by the character 15 (guard seta shorter than solenidion). The character 15 has a low CI 0.33 and it is possible that it appears also independently in different *Cheyletus* species i.e. *C. funisciuri* and *C. volgini*. However, the males of all the species belonging to this subcluster have an unique character, i.e. the presence of an additional pair of setae on the propodosomal shield. This character strongly supports the monophily of this subcluster. Therefore we consider that the subgroup species *eruditus* is a natural one. The second subcluster includes the two species, *C. zumpti* and *C.*

*gerbillicola*, and it is supported by the character 14 (dorsal shield covered by fine longitudinal striations). For these two species we created the subgroup *zumpti*.

Among the ungrouped species, *C. philippinensis* resemble closely the species of the *eruditus* subgroup. The male of this species is unknown, but the female is quite similar to those of *C. malaccensis* and *C. malayensis*. Therefore we provisionally included this species into the *eruditus* subgroup. Males are known for *C. rwandae*, the second ungrouped species. In common with the males of *C. zumpti* (male unknown in *C. gerbillicola*) these males have a peculiar character consisting in the presence on the palpal claws of numerous transversal rows of small teeth. Therefore we also included this species in the subgroup *zumpti* and considered the structure of palpal claw in males as a character of this group.

The second group, *trouessarti*, includes two subclusters and two ungrouped species. Two distinctive species, *C. linsdalei* and *C. volgini*, belong to the first subcluster, which is strongly supported by the character 4 (presence of cloud-like neotrichial setae, CI 1). Therefore we created the subgroup *linsdalei* for these two species. The second subgroup includes four species and is weakly supported by the character 5 (setae *h* lanceolate, CI 0.33). There is a high probability that this character has appeared independently. Therefore we included the species of this subcluster, together with two ungrouped species, in the subgroup *trouessarti*.

The third group, *nidicolus*, is divided into two subclusters. The first subcluster includes four African species and is supported by the two characters 6 (setae *h* fan-like, CI 1) and 13 (dorsal shields covered by strong ornamentation CI 0.25). For the species of this subcluster we created the species subgroup *funisciuri*. The relationships between the six species of the second subcluster are not clear for two reasons. The first is that *C. attiahi* and *C. vivatus* have been poorly described and need a redescription, the second being that the male is known only in *C. nidicolus*.

Finally, two species, *C. mafekingensis* and *C. pseudomalaccensis*, were not included in the cladistic analysis. The main reason is that all the median dorsal setae in these species are broken in all our specimens. However, the bases of a single pair of median setae are well visible on the propodosomal shield. As in the species of the *trouessarti* group the hysterosomal median setae are always present. Therefore we surmise that these two species belong to another, *nidicolus* species group. Within that group *C. mafekingensis* and *C. pseudomalaccensis* strongly differ from the species of the *funisciuri* subgroup, and therefore we included them, provisionally in the *nidicolus* subgroup.

#### Geographical distribution of the species of the genus *Cheyletus*

Species of the genus *Cheyletus* show a variable geographical distribution. Some are cosmopolitan whilst others

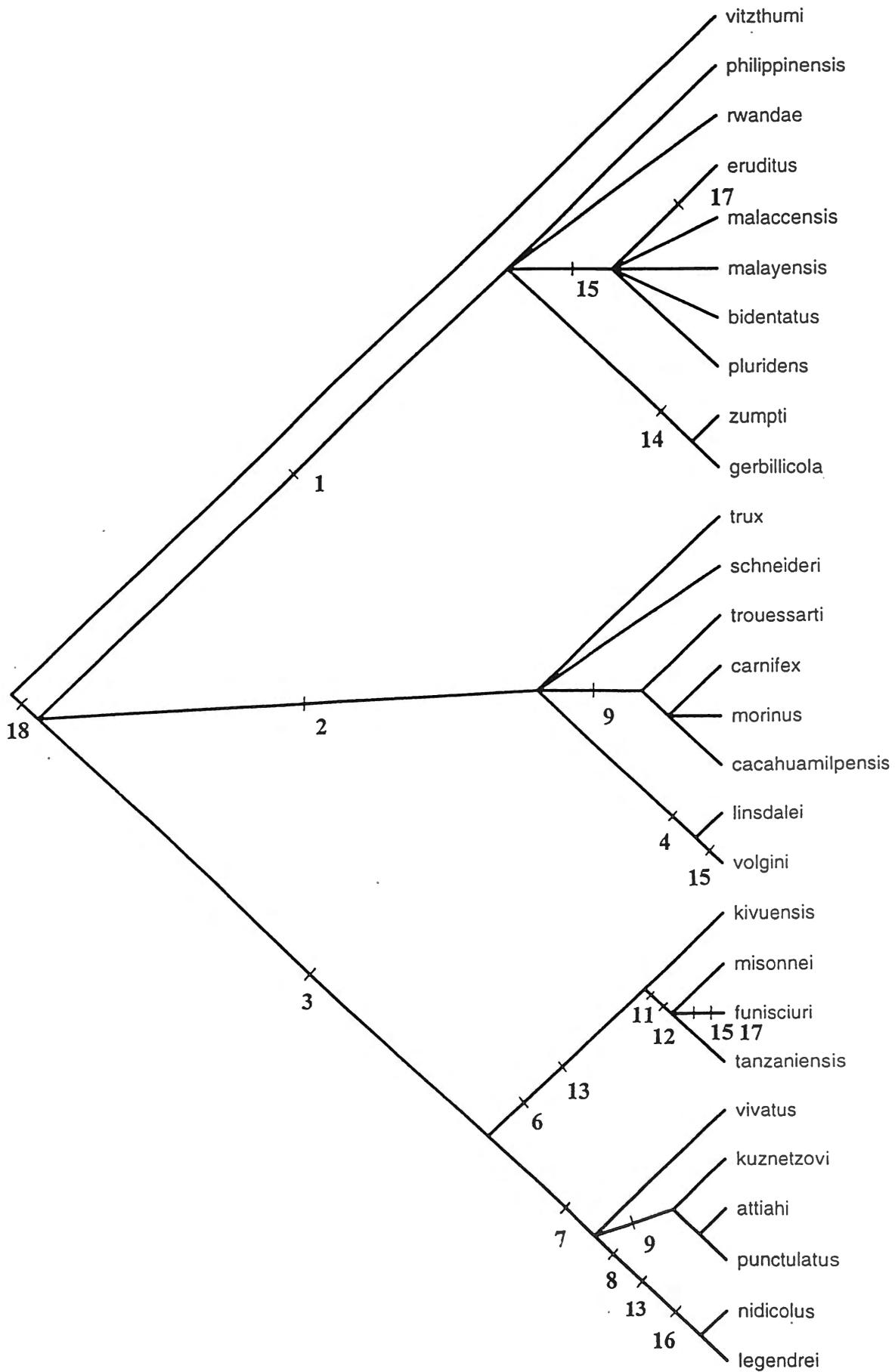


Fig. 55 – PAUP 3.1 – 50% majority consensus tree for 5 trees: length 31 steps, consistency index (CI) 0.52, retention index (RI) 0.78 and rescaled consistency index (RC) 0.41. *Cheletophyes vitzthumi* is the outgroup.

are endemic and confined to restricted geographical areas. The monophily of the group *trouessarti* and of all the subgroup species obtained in our cladistic study is confirmed by the narrow correspondence existing in the geographical distribution of these groups and of their respective species (see Table 3 for distribution of the *Cheyletus* species and Table 4 for their habitats).

The subgroup *eruditus* includes the cosmopolitan and

the Oriental species. Only a single record of *C. malayensis* is known from Sakhalin island. The subgroup *zumpti* obviously has an African origin. It is represented by two Afrotropical species, *C. zumpti* and *C. rwandae* and by the South African species, *C. gerbillicola*. The group *trouessarti* includes two cosmopolitan species, *C. trouessarti*, *C. cacahuamilpensis* and six Holarctic species. Among these, species of the subgroup *linsdalei* are re-

Table 3. Geographical distribution of the species of the genus *Cheyletus*

Group species	Subgroup species	Species	Distribution of species	Distribution of subgroup
Group <i>eruditus</i>	Subgroup <i>eruditus</i>	<i>C. eruditus</i>	Cosmopolitan	
		<i>C. malaccensis</i>		
		<i>C. malayensis</i>	Oriental Region	Oriental Region
		<i>C. bidentatus</i>	Malaysia	
		<i>C. pluridens</i>	Malaysia	
		<i>C. philippinensis</i>	The Philippines	
	Subgroup <i>zumpti</i>	<i>C. zumpti</i>	Tropical and South Africa	South and Tropical Africa
		<i>C. rwandae</i>	Tropical Africa	
		<i>C. gerbillicola</i>	South Africa	
Group <i>trouessarti</i>	Subgroup <i>trouessarti</i>	<i>C. trouessarti</i>	Cosmopolitan	
		<i>C. cacahuamilpensis</i>		
		<i>C. morinus</i>	Uzbekistan	Holarctic Region
		<i>C. carnifex</i>	Holarctic Region	
		<i>C. trux</i>	Holarctic Region	
		<i>C. schneideri</i>	Europe	
	Subgroup <i>linsdalei</i>	<i>C. volgini</i>	Far East (Russia)	
		<i>C. linsdalei</i>	N. America	
Group <i>nidicolus</i>	Subgroup <i>nidicolus</i>	<i>C. nidicolus</i>	Tropical Africa	Africa
		<i>C. attiahi</i>	Egypt	
		<i>C. punctulatus</i>	Morocco	
		<i>C. legendrei</i>	Madagascar	
		<i>C. pseudomalaccensis</i>	South Africa	
		<i>C. mafekingensis</i>	South Africa	
		<i>C. kuznetzovi</i>	Turkmenia	Asia
		<i>C. vivatus</i>	Pakistan	
	Subgroup <i>funisciuri</i>	<i>C. funisciuri</i>	Tropical Africa	South and Tropical Africa
		<i>C. misonnei</i>	South Africa	
		<i>C. tanzaniensis</i>	Tropical Africa	
		<i>C. kivuensis</i>	Zaire	

Table 4. Habitats of the species of the genus *Cheyletus*

Ecological groups	Species	Nests of birds	Nests of mammals	Grain supplies	House dust	Other habitats
Species associated with nests of vertebrates (mammals and birds)	<i>C. eruditus</i>	+	+	+	+	+
	<i>C. malaccensis</i>	+	+	+	+	+
	<i>C. trouessarti</i>	+	+	+	+	+
	<i>C. trux</i>	+	+	+	+	+
	<i>C. malayensis</i>	+	+			
	<i>C. nidicolus</i>	+	+			
	<i>C. tanzaniensis</i>	+	+			
Species associated with nests of mammals	<i>C. kivuensis</i>	+				
	<i>C. bidentatus</i>	+				
	<i>C. pluridens</i>	+				
	<i>C. zumpti</i>	+				
	<i>C. rwandae</i>	+				
	<i>C. gerbillicola</i>	+				
	<i>C. carnifex</i>	+		+	+	
	<i>C. cacahuamilpensis</i>	+			+	
	<i>C. linsdalei</i>	+				
	<i>C. volgini</i>	+				
	<i>C. punctulatus</i>	+				
	<i>C. funisciuri</i>	+				
	<i>C. misonnei</i>	+				
Species associated with nests of birds	<i>C. philippinensis</i>		+			
	<i>C. legendrei</i>		+			
	<i>C. pseudomalaccensis</i>		+			
	<i>C. mafekingensis</i>		+			
Species with poorly known ecology	<i>C. morinus</i>					+
	<i>C. schneideri</i>					+
	<i>C. vivatus</i>					+
	<i>C. kuznetzovi</i>					+
	<i>C. attiahi</i>					+

stricted to North America (*C. linsdalei*) and the Far East (*C. volgini*). The subgroup *funisciuri* probably has an African origin, because it includes three Afrotropical species and one South African species, *C. misonnei*. The last subgroup *nidicolus* includes African and Asiatic species, i.e. *C. punctulatus* and *C. attiahi* from North Africa, *C. legendrei*, from Madagascar, *C. nidicolus*, from Tropical Africa, *C. mafekingensis* and *C. pseudomalaccensis*, from South Africa. Two other species, *C. kuznetzovi* and *C. vivatus* are known from Asia, i.e. Turkmenian and Pakistan respectively.

### Diagnoses of the species groups and subgroups

#### Group *eruditus*

*Female*: Dorsomedian setae absent. Peritremes M-shaped.

#### Subgroup *eruditus*

*Female*: Guard seta shorter than solenidion (longer in *C. philippinensis*).

*Male:* Propodosomal shield with 2 pairs of median setae. Palpal claws without transversal rows of small teeth.

*Included species:* *C. eruditus*, *C. malaccensis*, *C. malayensis*, *C. bidentatus*, *C. pluridens*, *C. philippinensis*.

### Subgroup *zumpti*

*Female:* Guard seta longer than solenidion. MALE: Propodosomal shield with 1 pair of median setae. Palpal claws with transversal rows of small teeth.

*Included species:* *C. zumpti*, *C. rwandae*, *C. gerbillicola*.

### Group *trouessarti*

*Female:* Dorsomedian setae present, transparent and flag-like or cloud-like. Peritremes M-shape or Π-shaped.

### Subgroup *trouessarti*

*Female:* Dorsomedian setae small and flag-like. Dorsal shield with 1 pair of median setae. Hysterosomal shield with 1-3 pairs of median setae. Peritremes M-shaped or Π-shaped.

*Included species:* *C. trouessarti*, *C. trux*, *C. schneideri*, *C. carnifex*, *C. morinus*, *C. cacahuamilpensis*.

### Subgroup *linsdalei*

FEMALE: Dorsomedian setae cloud-like. Dorsal shield with 3 pair of median setae. Hysterosomal shield with 5 pairs of median setae. Peritremes M-shaped.

*Included species:* *C. linsdalei*, *C. volgini*.

### Group *nidicolus*

*Female:* Dorsomedian setae setiform, of normal structure. Peritremes M-shaped or Π-shaped.

### Subgroup *nidicolus*

*Female:* Setae *h* lanceolate (almost fan-like in *C. kuznetzovi*). Dorsal shields without ornamentation (punctated in *C. nidicolus*).

*Included species:* *C. nidicolus*, *C. legendrei*, *C. attiahi*, *C. punctulatus*, *C. pseudomalaccensis*, *C. mafekingensis*, *C. vivatus*, *C. kuznetzovi*.

### Subgroup *funisciuri*

*Female:* Setae *h* fan-like. Dorsal shields with strong ornamentation.

*Included species:* *C. funisciuri*, *C. misonnei*, *C. tanzaniensis*, *C. kivuensis*.

### Key to the species of the genus *Cheyletus*

#### Females

1. Dorsal shields without median setae ..... *eruditus* group 21
- Dorsal shields with median setae ..... 2
2. Median setae modified, very small, transparent flag-like or cloud-like. Propodosomal shield with 1-3 pairs of median setae ..... *trouessarti* group 14
- Median setae not modified, setiform, sometimes very short, rod-like. Propodosomal shield with 1 pair of median setae. Hysterosomal shield with 1-3 pairs of median setae ..... *nidicolus* group 3
3. Setae *h* fan-like or lanceolate ..... 8
- Setae *h* hair-like ..... 4
4. Peritremes M-shaped. Guard seta (*ft'*) smooth, shorter or not more than 1.3 times longer than solenidion  $\omega 1$ . Dorsal setae of idiosoma hair-like. Setae *l3* not less than 2 times longer than *l4* ..... 5
- Peritremes Π-shaped. Guard seta (*ft'*) serrate, not less than 3 times longer than solenidion  $\omega 1$ . Dorsal setae of idiosoma spatulate. Setae *l3* and *l4* subequal ... *C. vivatus*
5. Setae *d2* present. Setae *l1* and *vi*, *ve* subequal .. 6
- Setae *d2* absent. Setae *l1* more than 2 times longer than *vi*, *ve* ..... *C. legendrei*
6. Guard seta (*ft'*) shorter than solenidion  $\omega 1$ . Setae *l4* situated on the hysterosomal shield. Setae *sce* 1.7 times longer than *l1*. Setae *h* 1.6 times longer than *sce* (setae *sce* broken in *C. mafekingensis*) ..... 7
- Guard seta (*ft'*) longer than solenidion  $\omega 1$ . Setae *l4* situated off the hysterosomal shield. Setae *sce* 2.5 times longer than *l1*. Setae *h* and *sce* subequal ... *C. nidicolus*
7. Peritremes with 9-10 links. Setae *l2* situated on the hysterosomal shield ..... *C. pseudomalaccensis*
- Peritremes with 5-6 links. Setae *l2* situated off the hysterosomal shield ..... *C. mafekingensis*
8. Dorsal shields covered by strong ornamentation .. 10
- Dorsal shields without ornamentation 9
9. Setae *d2* absent ..... *C. attiahi*
- Setae *d2* present ..... *C. kuznetzovi*
10. Dorsal setae fan-like. Setae *d2* present ..... *misonnei* subgroup 11
- Dorsal setae spatulate, setae *d2* absent ..... *C. punctulatus*
11. Dorsomedian setae much shorter than lateral setae ..... 13

- Dorsomedian setae not shorted than lateral setae 12
  - 12. Dorsomedian setae fan-like, similar in shape to the fan-like lateral setae (Fig. 43). Setae *d3* absent. Guard seta longer than solenidion  $\omega 1$ . Femur IV with 1 seta. Dorsal seta of palpal femur thickened .. *C. kivuensis*
  - Dorsomedian setae narrowly lanceolate, with a different shape than the fan-like lateral setae (Fig. 36). Setae *d3* present. Guard seta (*ft'*) shorter than solenidion  $\omega 1$ . Femur IV with 2 setae. Dorsal seta of palpal femur fan-like ..... *C. funisciuri*
  - 13. Peritremes M-shaped. Dorsomedian setae setiform (Fig. 47) ..... *C. tanzaniensis*
  - Peritremes  $\Pi$ -shaped. Dorsomedian setae rod-like (Fig. 35) ..... *C. misonnei*
  - 14. Median setae flag-like. Propodosomal shield with 1 pair of median setae. Hysterosomal shield with 1-3 pairs of median setae .... *trouessarti* subgroup 16
  - Median setae cloud-like. Propodosomal shield with 3 pairs of median setae. Hysterosomal shield with 5 pairs of median setae ..... *linsdalei* subgroup 15
  - 15. Solenidion  $\omega 1$  1.5 time longer than guard seta (*ft'*). Setae *h* 1.9 time longer than the other lateral setae, about 130 long ..... *C. volgini*
  - Solenidion 1.3 time shorter than guard seta (*ft'*). Setae *h* 1.3 time longer than other lateral setae, about 85 long ..... *C. linsdalei*
  - 16. Setae *h* lanceolate. Hysterosomal shield with 1-3 pairs of median setae ..... 18
  - Setae *h* hair-like. Hysterosomal shield with 3 pairs of median setae ..... 17
  - 17. Dorsolateral setae spatulate. Setae *ve* and *sci* subequal ..... *C. schneideri*
  - Dorsolateral setae hair-like. Setae *sci* 1.5 times longer than *ve* ..... *C. trux*
  - 18. Setae *ll* situated off the hysterosomal shield .. 19
  - Setae *ll* situated on the hysterosomal shield ..... *C. cacahuamilpensis*
  - 19. Hysterosoma dorsally with 1 pair of median setae. Peritremes  $\Pi$ -shaped ..... 21
  - Hysterosoma dorsally with 3 pairs of median setae. Peritremes M-shaped ..... *C. trouessarti*
  - 20. Hysterosomal shield represented by 2 small lateral shields ..... *C. morinus*
  - Hysterosomal shield well developed .. *C. carnifex*
  - 21. Guard seta (*ft'*) longer than solenidion  $\omega 1$  .... 26
  - Guard seta (*ft'*) 2 times or more shorter than solenidion  $\omega 1$  ..... 22
  - 22. Femur IV with 1 seta ..... 23
  - Femur IV with 2 setae ..... *C. eruditus*
  - 23. Propodosomal and hysterosomal shields subequal in length. Distance between these shields less than 1/2 of *ll* length. Setae *l2* situated far behind the anterior margin of hysterosomal shield ..... 24
  - Propodosomal shield 1.5 or more longer than hysterosomal shield. Distance between these shields and length of setae *ll* almost subequal. Setae *l2* situated almost on anterior margin of hysterosomal shield .. ..... *C. malaccensis*
  - 24. Setae *vi* and *sci* subequal; setae *ll*, *l2* and *l3* subequal ..... 25
  - Setae *sci* more than 2 times longer than *vi*; setae *l2* and *l3* more than 2 times longer than *ll* ..... *C. pluridens*
  - 25. Rostrum with a pair of lateral teeth (Fig. 6) ..... *C. bidentatus*
  - Rostrum without lateral teeth ..... *C. malayensis*
  - 26. Hysterosomal shield rectangular, well developed. Setae *l3* situated on shield. Setae *l2* and *l3* about 2 times shorter than *vi* ..... 27
  - Hysterosomal shield reduced, ovoid (Fig. 8). Setae *l3* situated far behind shield. Setae *vi*, *l2* and *l3* subequal ..... *C. rwandae*
  - 27. Setae *vi*, *ve* and *sci* subequal. Dorsal shields with weak longitudinal striations (Figs. 10, 12). Dorsal hysterosomal setae spatulate ..... 28
  - Setae *sci* 2 times longer than *vi* and *ve*. Dorsal shields without ornamentation. Dorsal hysterosomal setae hair-like ..... *C. philippinensis*
  - 28. Dorsal propodosomal setae spatulate. (Fig. 11). Distance between these shields less than half the length of setae *ll* ..... *C. gerbillicola*
  - Dorsal propodosomal setae hair-like (Fig. 12). Distance between these shields subequal to the length of setae *ll* ..... *C. zumpti*
- ### Males
1. Propodosomal shield with 1 pair of median setae 5
  - Propodosomal shield with 2 pairs of median setae ..... *eruditus* subgroup 2
  2. Dorsal idiosomal setae hair-like ..... 3
  - Dorsal idiosomal setae spatulate ..... 4
  3. Distance *d2-d2* 1.3 times longer than *d1-d1*. In heteromorphic male the peritremes are  $\Pi$ -shaped. Rostrum with a pair of lateral teeth. Solenidion  $\omega 1$  1.4 times shorter than distance between its base and base of pretarsus ..... *C. bidentatus*
  - Distance *d2-d2* and *d1-d1* subequal. In heteromorphic male peritremes M-shaped. Rostrum without lateral teeth. Length of solenidion  $\omega 1$  and distance between its base and base of pretarsus subequal ... ..... *C. eruditus*
  4. Distance between dorsal shields more than 1/2 of *ll* length. Setae *l2* situated on anterior margin of hysterosomal shield ..... *C. malaccensis*
  - Distance between dorsal shields less than 1/2 of *ll* length. Setae *l2* situated far behind anterior margin of hysterosomal shield ..... *C. malayensis*
  5. Palpal claws without transversal rows of small teeth ..... 7
  - Palpal claws with transversal rows of small teeth (Fig. 9) ..... *zumpti* subgroup 6
  6. Most of dorsal idiosomal setae lanceolate. Dorsal seta of palpal femur lanceolate ..... *C. zumpti*
  - All dorsal idiosomal setae hair-like. Dorsal seta of palpal femur hair-like ..... *C. rwandae*
  7. Setae *h* lanceolate or fan-like ..... 10

- Setae *h* hair-like . . . . . 8
- 8. Peritremes II-shaped. Anterior part of rostral shield with longitudinal striations. Rostrum in front of peritremes with numerous tubercles . . . . . 9
- Peritremes M-shaped. Anterior part of rostral shield with network pattern. Rostrum in front of peritremes without tubercles . . . . . *C. nidicolus*
- 9. Dorsal idiosomal setae spatulate. Rostral tubercles distributed in 2 transversal rows. Setae *sci* and *vi* subequal . . . . . *C. carnifex*
- Dorsal idiosomal setae hair-like. Rostral tubercles situated without any order. Setae *sci* about 1.5 times longer than *vi* . . . . . *C. trux*
- 10. Setae *h* lanceolate. Dorsal seta of palpal femur hair-like. Rostral shield without network . . . . . 11
- Setae *h* fan-like. Dorsal seta of palpal femur lanceolate. Dorsal shield with network . . . . . *C. funisciuri*
- 11. With 2 small lateral hysterosomal shields. Guard seta (*ft'*) 2 times longer than solenidion  $\omega 1$  . . . . .  
. . . . . *C. cacahuamilpensis*
- With a large median hysterosomal shield. Guard seta (*ft'*) subequal in length to solenidion  $\omega 1$  or not more than 1.5 times longer . . . . . *C. trouessarti*

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