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New observations on the chaetotaxy and the solenidiotaxy in the Cheyletidae (Acari: Prostigmata)

by A. FAIN, R.L. SMILEY & U. GERSON

Summary

The chaetotaxy and solenidiotaxy of over 60 species, belonging to 44 genera in the family Cheyletidae were studied. Reduction of chaetotaxy and neotrichy were analysed. For the study of the idiosomal chaetotaxy a system of nomenclature, proposed previously is used. The importance of these characters in the systematic of this family of mites is emphasized. In addition, new information concerning some poorly known species of Cheyletidae is provided; new definitions and a key are given for the subfamilies of the family Cheyletidae, and two new tribes are proposed in the subfamily Ornithocheyletiinae, i.e. Apodichelini n. tr. (type genus *Apodicheles* FAIN, 1979) and Neocheyletiellini n. tr. (type genus *Neocheyletiella* BAKER, 1949).

Résumé

La chétotaxie et la solenidiotaxie sont étudiées chez plus de 60 espèces de Cheyletidae, faisant partie de 44 genres. Néotrichie et réduction de la chétotaxie sont observées et analysées. Dans leur étude de la chétotaxie idiosomale les auteurs ont utilisé un système de nomenclature décrit précédemment. L'importance de ces caractères dans la systématique de cette famille est soulignée. En outre, les auteurs apportent de nouvelles informations concernant certains genres ou espèces de Cheyletidae encore mal connus; ils donnent des nouvelles définitions et une clé pour les sous-familles de la famille Cheyletidae et décrivent deux nouvelles tribus dans la sous-famille Ornithocheyletiinae: Apodichelini n. tr. (genre type *Apodicheles* (FAIN, 1979) et Neocheyletiellini n. tr. (genre type *Neocheyletiella* BAKER, 1949).

Introduction

FAIN (1963) proposed a new system of nomenclature for the idiosomal chaetotaxy of several families of Astigmata, especially the Psoroptidae, Pyroglyphidae, Glycyphagidae, Acaridae, etc... Later, this system was adapted successfully, but after minor modifications, to the Prostigmata, i.c. Ereynetidae, Myobiidae (FAIN, 1973), Cheyletidae (FAIN, 1979c) and Harpyrhynchidae (FAIN, 1994). These studies have shown that in all these families the chaetotaxy of the idiosoma is basically the same.

The usefulness of such nomenclature is obvious. It simplifies descriptions, facilitates comparisons between genera and species and finally leads to a better comprehension of the development and the phylogeny of the species. Following our first paper on the chaetotaxy in the Cheyletidae, other authors have emphasized the importance of this nomenclatural system and the frequency of neotrichy in the Cheyletidae (YOUSEF *et al.*, 1980; SMILEY & WHITAKER, 1981).

KETHLEY (1990) proposed a somewhat different segmentally-based method of setal signatures, and one of us (GERSON, 1994) tried to apply it to the Australian Cheyletidae. However, the prevalence of neotrichy in the family places large obstacles in the application of Kethley's signatures to the Cheyletidae; we thus prefer to use the present system.

This paper is devoted to the study of the chaetotaxy and solenidiotaxy of over 60 species of Cheyletidae belonging to 44 genera, and we add observations on some little-known species and describe two new tribes in the subfamily Ornithocheyletiinae.

The measurements are in micrometers.

Material examined

We have examined a total of 64 species of Cheyletidae belonging to 44 genera. These include the 38 species and 19 genera described by the late V.I. VOLGIN, whose types are deposited in the Zoological Institute, St Petersburg, Russia. Through the courtesy of Dr H.V. DUBININA and Dr A.V. BOCHKOV we were able to examine these specimens.

We give here a list of the material that we have examined. We agree with the synonymies proposed by SUMMERS and PRICE (1970) for the three following genera of this list i.e. *Myrmicocheyla* VOLGIN (1963) synonymized with *Hoffmannita* PELAEZ (1962), *Dendrocheyla* VOLGIN (1969) synonymized with *Hemicheyletia* VOLGIN (1969) and *Bothrocheyla* VOLGIN (1964) synonymized with *Neoeucheyla* RADFORD, 1950. In addition,

the subgenus *Neoeucheyla (Cunliffella)* VOLGIN, 1969 has been elevated to the genus rank. Among the VOLGIN's species, FAIN (1980b) has synonymized *Neocheyletiella oudemansi* VOLGIN, 1969, with *N. microrhyncha* (BERESE and TROUESSART, 1889) (see further).

List of the genera and species of Cheyletidae studied in this paper

(Abbreviations: H = holotype; P = paratype; VC = from the VOLGIN Collection, FC = from FAIN Collection)

CHEYLETINAE LEACH, 1815
Acaropsella VOLGIN, 1969: *A. rohdendorfi* VOLGIN, 1962 (P) (VC)
Alliea YUNKER, 1960: *A. laruei* YUNKER, 1960 (P ; Allotype)
Bak YUNKER, 1961: *B. furcatus* GERSON & FAIN, 1991 (H)
Bothrocheyla VOLGIN, 1964: *B. pavlovskyi* VOLGIN, 1964 (PP) (VC)
Cheletacarus VOLGIN, 1961: *C. raptor* VOLGIN, 1961 (VC)
Cheletogenes OUDEMANS, 1905: *C. ornatus* (CANESTRINI & FANZAGO, 1876) (FC)
Cheletoides OUDEMANS, 1904: *C. chirunduensis* FAIN, 1979e (H)
Cheletonella WOMERSLEY, 1941: *C. caucasica* VOLGIN, 1955 (VC)
Cheletophyes OUDEMANS, 1914: *C. clavipilis* FAIN, LUKOSCHUS & NADCHATRAM, 1980 (H,P)
Cheyletia HALLER, 1884: *C. aradiphila* VOLGIN, 1966 (P) (VC)
Cheyletus LATREILLE, 1796: *C. baloghi* VOLGIN, 1969 (VC); *C. eruditus* (SCHRANK, 1781) (FC); *C. malaccensis* OUDEMANS, 1903 (FC); *C. rwandae* FAIN, 1972 (P); *C. tenuipilis* FAIN *et al.*, 1980 (H, P); *C. trouessarti* OUDEMANS, 1902 (P); *C. truculentus* (H) (VC)
Cunliffella VOLGIN, 1964: *C. tuberculicoxa* (VOLGIN, 1964) (P) (VC)
Dendrocheyla VOLGIN, 1969: *D. bregetovae* VOLGIN, 1969 (P) (VC)
Dubininiola VOLGIN, 1969: *D. polylepis* VOLGIN, 1969 (H) (VC)
Eucheyletia BAKER, 1949: *E. asiatica* VOLGIN, 1955 (H,P); *E. bothrophila* VOLGIN, 1963 (H,P); *E. eoa* VOLGIN, 1963 (VC); *E. pavlovskyi* VOLGIN, 1963 (VC); *E. sibirica* VOLGIN, 1963 (P) (VC); *E. sinensis* (P) (VC); *E. taurica* VOLGIN, 1963 (H) (VC); *E. harpyia* ROHDENDORF, 1940 (H,P) (VC)
Eutogenes BAKER, 1949: *E. frater* VOLGIN, 1958 (H) (VC)
Hemicheyletia VOLGIN, 1969: *H. asiatica* VOLGIN, 1978 (H) (VC)
Hylopecheyla FAIN, 1972: *H. bunguranensis* FAIN, 1972 (FC)
Hypopicheyla VOLGIN, 1969: *H. elongata* VOLGIN, 1969 (P) (VC); *H. mirabilis* (VOLGIN, 1955) (P) (VC)
Lepidocheyla VOLGIN, 1963: *L. caucasica* VOLGIN, 1973 (H) (VC); *L. gracilis* VOLGIN, 1963 (H) (VC)
Metacheletoides FAIN, 1979e: *M. numidae* FAIN, 1979e (H)
Microcheyla VOLGIN, 1966: *M. parvula* VOLGIN, 1966 (P) (VC)
Myrmicocheyla VOLGIN, 1963: *M. clavipes* VOLGIN, 1963 (P) (VC)
Neoacaropsis VOLGIN, 1962: *N. granulatus* VOLGIN, 1962 (P) (VC)
Neoeucheyla RADFORD, 1950: *N. mumai* VOLGIN, 1969 (H) (VC); *N. bulgarica* (VOLGIN, 1955) (P) (VC)
Nodele MUMA, 1964: *N. superba* KUZNETSOV, 1977 (P) (VC)
Paracheyletia VOLGIN, 1955: *P. samsinaki* VOLGIN, 1966 (Nymph) (VC)
Samsinakia VOLGIN, 1965: *S. volgini* FAIN, 1972, 1980a (H)

CHELONOTINAE VOLGIN, 1969
Chelonotus BERLESE, 1893: *C. selenirhynchus* BERLESE, 1893 (FC)
Muricheyla FAIN, 1972: *M. sicista* FAIN, 1972 (H)
Promuricheyla FAIN, 1972: *P. lukoschusi* FAIN, 1979 (H)

TEINOCHEYLINAE FAIN, 1974
Teinocheylus FAIN, 1974: *T. longissimus* FAIN, 1974 (H)

METACHEYLETIINAE FAIN, 1980a
Metacheyletia FAIN, 1972: *M. obesa* FAIN, 1972, 1980a (H)

ORNITHOCHEYLETIINAE VOLGIN, 1969
Apodicheles FAIN, 1979a: *A. cypsiurus* FAIN, 1979a (H)
Bakericheyla VOLGIN, 1966: *B. chanayi* (BERLESE & TROUESSART, 1889) (FC)
Neocheyletiella BAKER, 1949: *N. media* FAIN, 1972, 1980b (P), *N. microrhyncha* (BERLESE & TROUESSART, 1889) (= *N. oudemansi* VOLGIN, 1969) (P) (VC)
Ornithocheyletia VOLGIN, 1964: *O. dubinini* VOLGIN, 1964 (P) (VC); *O. psittaci* FAIN, 1972, 1981 (H); *O. smileyi* FAIN, 1972, 1981 (H)

CHEYLETIELLINAE VOLGIN, 1961
Bicheyletiella FAIN, 1972: *B. romerolagi* FAIN, 1972, 1979f (H)
Cheyletiella CANESTRINI, 1886: *C. parasitivorax* (MEGNIN, 1878) (FC)
Eucheyletiella VOLGIN, 1969: *E. johnstoni* SMILEY, 1965 (H); *E. ochotonae* (VOLGIN, 1960) (P) (VC)

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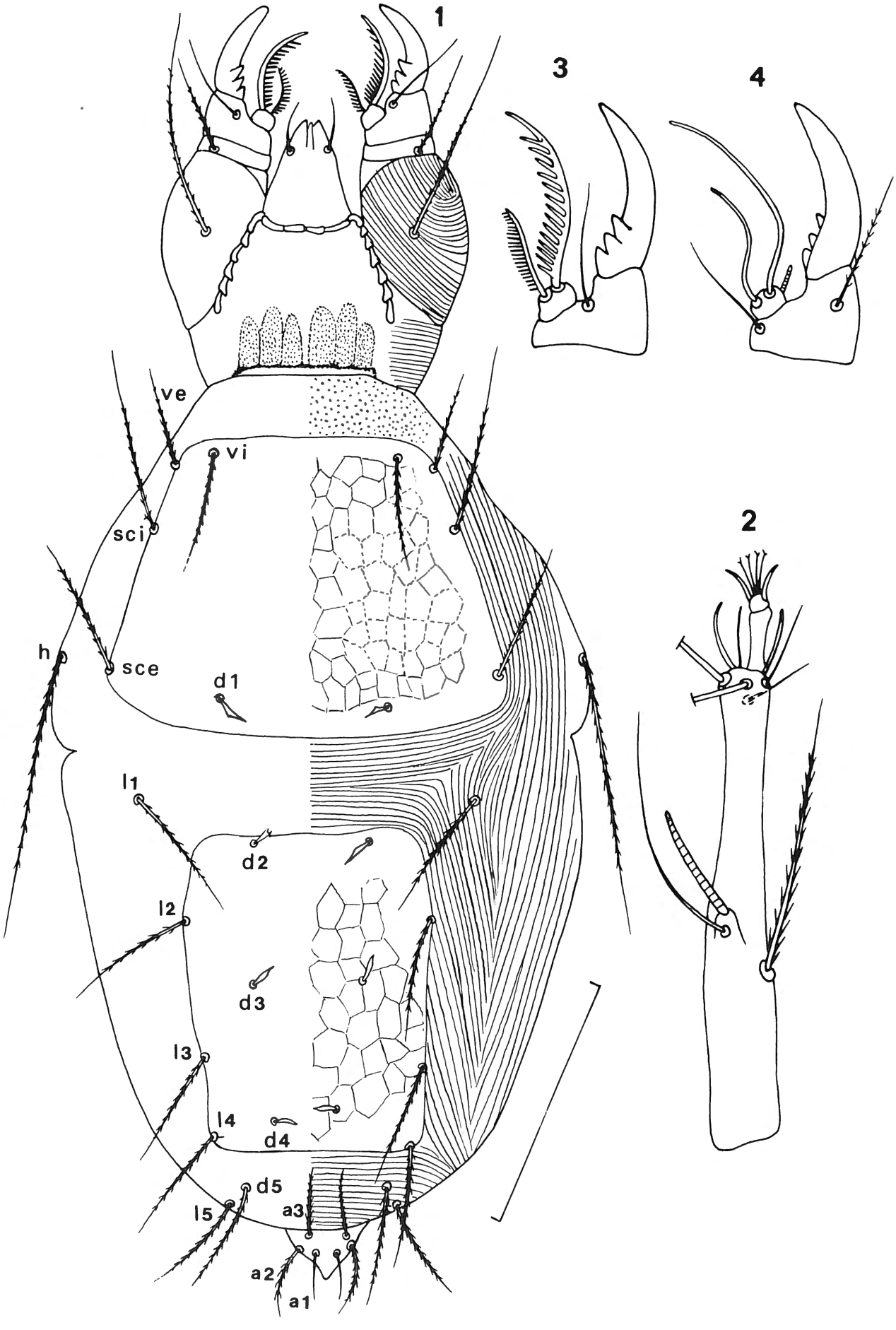
Figs 1-4. – *Cheyletus tenuipilis* FAIN *et al.* Holotype female in ventral view (1); tarsus I dorsally (2); palpal tarsus and palpal tibia in ventral view (3) and dorsal view (4). Scale line 100 µm (fig. 1).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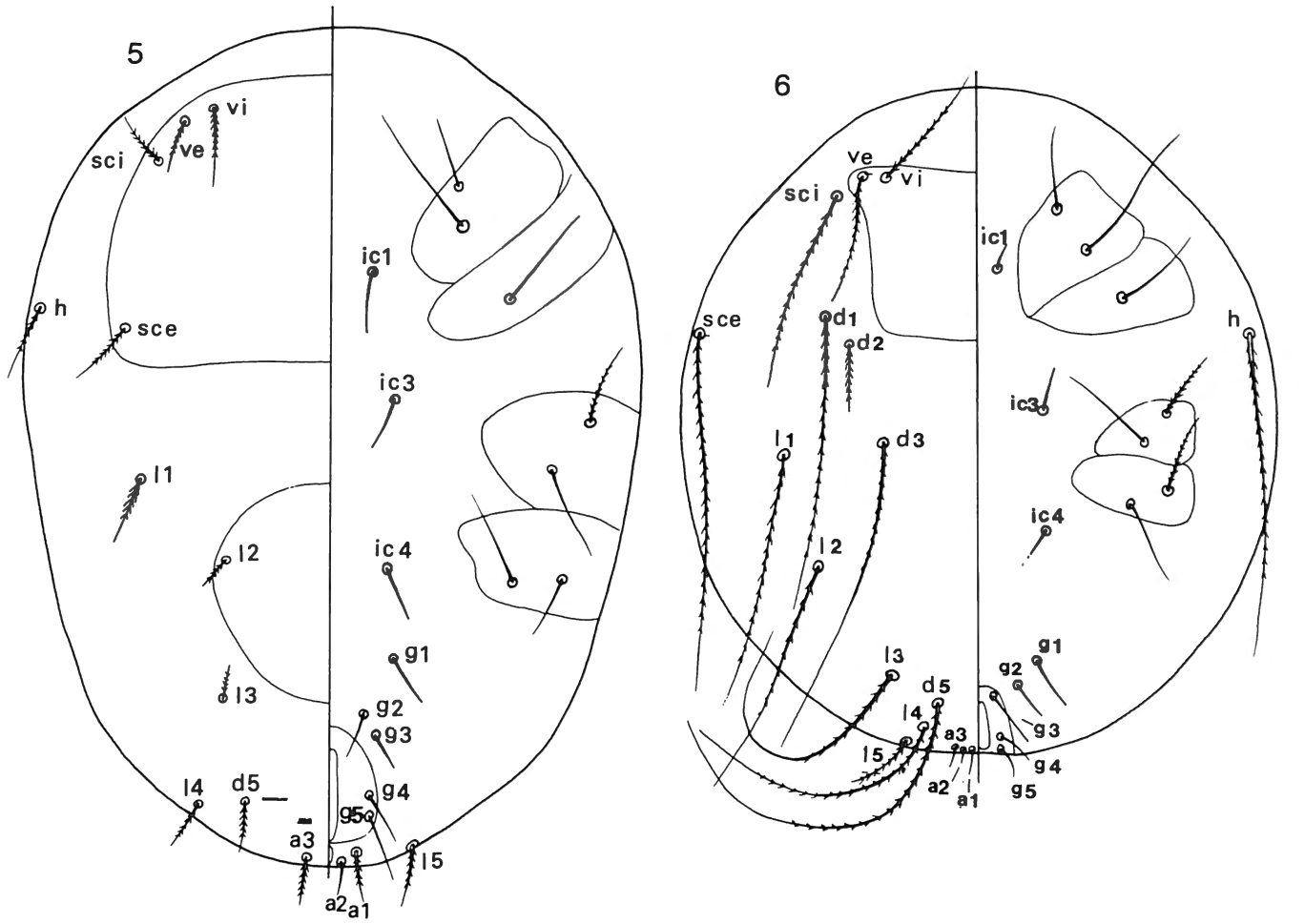


Figs 5-6. – *Cheyletus rwandae* FAIN. Paratype female (5); *Metacheletoides numidae* FAIN. Holotype female (6). (Published in International Journal of Acarology, vol. 5 (1979)).

NIHELIINAE SMILEY, 1977
Galagocheles FAIN, 1979d: *G. lemuricola* (LAWRENCE, 1948) (FC)
Nihelia DOMROW & BAKER, 1960: *N. curvidens* (LAWRENCE, 1948) (FC)
Smileycheles FAIN, 1979d: *S. camerounensis* FAIN, 1979d (H)

CRIOKERONTINAE SMILEY, 1977
Criokeron VOLGIN, 1966: *C. quintus* (DOMROW & BAKER, 1963)

Idiosomal chaetotaxy of the female in the Cheyletidae

Basic chaetotaxy of the idiosoma (Table 3)

In some genera of Cheyletidae the identification of the basic dorsal setae may be more difficult than in other families, owing to the frequency of neotrichy. Actually, these additional setae are nearly always located in the middle region of the dorsum (the "dorso-medians" of SUMMERS and PRICE, 1970) and they are generally easily recognized. The "dorso-laterals" of these authors, i.e. the scapulars, verticals and humerals, belong to the basic setae and they are constant.

The males in some genera also present neotrichy but it is always less marked than in females.

The basic idiosomal pattern in the female Cheyletidae includes the following setae: *Dorsum*: *Propodonotum*: two pairs of verticals (internal (*vi*) and external (*ve*)); two pairs of scapulars (internal (*sci*) and external (*sce*)). These setae are located in the anterolateral regions of the dorsum, except for the *sce* which may be more posterior, often at the level of the humerals. The latter consisting of one pair (*h* setae) situated laterally and slightly more dorsal than ventral. The median region bears the first pair (*d1*), more rarely the first two pairs of dorsal setae (*d1* and *d2*). *Hysteronotum*: the five pairs of lateral setae (*l1* to *l5*) are much more constant than the dorsals. The median region bears the remaining dorsal setae (*d2* to *d5*, or *d3* to *d5*). Basically there are five pairs of dorsals but frequently one or several pairs are missing. In total there are 15 pairs of setae on the dorsal surface, i.e. *vi, ve, sci, sce, h, l1* to *l5*

Table 1. – Leg solenidiotaxy in female Cheyletidae

Abbreviations: d = dorsal, v = ventral and av = antero-ventral solenidia. St = stellate seta replacing the solenidion σ of genu I; 0 = absence of solenidion. H = holotype; P = paratype.

Mite genus and species	Leg I			Leg II	
	Tarsus	Tibia	Genu	Tarsus	Tibia
CHEYLETINAE					
Acaropsella					
rohdendorfi (P)	d	d	d	v	d
Alliea					
laruei	d	d	d	v	?
Bak					
furcatus (H)	d	d	d	v	0
Cheletacarus					
raptor (P)	d	d	d	d	d
Cheletogenes					
ornatus	d	d	d	av	0
Cheletoides					
chirunduensis (H)	d	d	d	v	0
Cheletonella					
caucasica (H)	d	d	d	v	0
Cheletophyes					
clavipilis (H)	d	d	d	av	0
Cheyletia					
aradiphila (P)	d	d	d	av	0
Cheyletus					
baloghi (P)	d	d	d	v	0
eruditus	d	d	d	v	0
malaccensis	d	d	d	v	0
rwandae (P)	d	d	d	v	0
tenuipilis (H)	d	d	d	v	0
trouessarti	d	d	d	v	0
Cunliffella					
tuberculicoxa (P)	d	d	d	v	0
Dubininiola					
polylepis (H)	d	d	d	?	0
Eucheyletia					
asiatica	d	d	d	av	0
bothrophila (H)	d	d	d	v	0
eoa	d	d	d	v	0
pavlovskyi	d	d	d	v	0
sibirica (P)	d	d	?	v	0
sinensis (P)	d	d	d	v	0
taurica (H)	d	d	d	av	0
Eutogenes					
frater (H)	d	d	d	v	0
Hemicheyletia					
asiatica (H)	d	d	d	v	d
bregetovae (P)	d	d	d	d	d
Hoffmannita					
clavipes	d	d	d	–	–
Hylopecheyla					
bunguranensis	d	d	d	av	0
Hypopicheyla					
mirabilis (P)	d	d	d	v	0
elongata (P)	–	–	–	v	0
Lepidocheyla					
caucasica (H)	d	d	d	av	0
gracilis (H)	d	d	d	av	0
Metacheletoides					
numidae (H)	d	d	d	av	0
Microcheyla					
parvula (P)	d	d	d	?	?

Mite genus and species	Leg I			Leg II	
	Tarsus	Tibia	Genu	Tarsus	Tibia
Neoacaropsis					
granulatus (P)	d	d	d	d	d
Neoeucheyla					
mumai (H)	d	d	d	av	0
pavlovskyi (P)	d	d	d	av	0
Nodele					
superba (P)	d	d	d	v	0
Paracheyletia					
samsinaki (P)	d	d	d	d	d
Samsinakia					
volgini (H)	d	d	d	v	0
CHELONOTINAE					
Chelonotus					
selenirhynchus	d	d	d	v	0
Muricheyla					
sicista (H)	d	d	d	v	0
Promuricheyla					
lukoschusi (H)	d	d	d	v	0
TEINOCHEYLINAE					
Teinocheylus					
longissimus (H)	d	d	d	av	0
METACHEYLETIINAE					
Metacheyletia					
obesa (H)	d	d	d	d	0
ORNITHOCHEYLETIINAE					
Apodicheles					
cypsiurus (H)	d	0	d	d	0
Bakericheyla					
chanayi	d	d	d	d	0
Neocheyletiella					
microrhyncha	d	?	d	d	0
media (P)	d	d	d	d	0
Ornithocheyletia					
dubinini (P)	d	d	d	d	0
smileyi (H)	d	d	d	d	0
psittaci (H)	d	d	d	d	0
CHEYLETIELLINAE					
Bicheyletiella					
romerolagi (H)	d	0	d	v	0
Cheyletiella					
parasitivorax	d	0	d	v	0
Eucheyletiella					
johnstoni (H)	d	0	d	v	0
ochotonae (P)	d	0	d	v	0
NIHELIINAE					
Galagocheles					
lemuricola	d	d	St	av	0
Nihelia					
curvidens	d	d	St	v	0
Smileycheles					
camerounensis (H)	d	d	St	av	0
CRIOKERONTINAE					
Criokeron					
quintus	d	d	St	v	0

and *d1* to *d5*. *Venter*: basically the coxae I to IV bear 2-1-2-2 pairs of setae (cxI to cxIV). The median region between the coxae bears the three pairs of intercoxals: *ic1, ic3* and *ic4*; there are no *ic2*. These setae are followed by five pairs of genital setae (*g1* to *g5*) of which one or two pairs are situated in front of the vulva and three or four pairs on the vulvar lips. More posteriorly there are basically three pairs of anal setae, situated close to the anus (figs 1-6).
The setae *g1* to *g5* are very rarely lacking (*g5* is lacking in *Bakfurcatus*); the *ic1* and *ic3* are constant; the *ic4* may be absent (in *Neocheyletiella* spp. and in *Metacheyletia obesa*). The anal setae are reduced, in some genera, to two pairs, in *Apodicheles* they are reduced to one pair or they are completely absent (table n° 3).
The basic pattern of the coxal setae is 2-1-2-2. In the most evolved genera, hence the most regressed (e.g. *Apodicheles* and *Neocheyletiella*), the coxal formula is 2-1-1-1 or even 1-0-0 (in *Metacheyletia obesa*, which lacking the legs IV) (table 3; figs 11, 13).

Neotrichy and reduction of the chaetotaxy

In some genera or species the medio-dorsal region of the female bears additional (neotrichial) setae, often in great number (up to 50 pairs).
These additional setae are either normal in shape and in size and identical to the basic lateral setae or normal in shape but slightly smaller than the latter, or modified in shape, often considerably. In this last case the basic dorsal setae (*d* series) may disappear completely, except the *d5* which is lacking exceptionally. These modified neotrichal setae are nearly always confined to the dorsal shields, inside the basic lateral setae, which remain always normal in shape.
In genus *Cheyletus* neotrichy is absent in the female but reduction in the *d* series is frequent. In *Ch. malaccensis d1* to *d4* are lacking; in *Ch. eruditus d1* to *d3* are lacking; in *Ch. nidicolus* FAIN *d2, d3* and *d4* are lacking. In *Ch. tenuipilis* FAIN *et al. d1* to *d4* are represented by very short lanceolate-foliate setae, the *d5* being normal (figs 1-4).
In genus *Nihelia* (Niheliinae) the total number of dorsal paired setae is 18, of which 13 pairs are basic and five pairs neotrichial. These neotrichials are not modified and they are inserted along a longitudinal line between the more median *d* setae and the lateral setae (fig. 15). In *Galagocheles* the situation is similar but there are only 16 pairs of setae on the dorsum, of which three pairs are neotrichials and inserted as in *Nihelia* (two on anterior shield and one on posterior shield) (fig. 16). The reduction of the *d* and *l* setae is the most marked in genus *Smileycheles* whose dorsum bears only 13 pairs of setae of which four pairs of antero-laterals (*ve, sci, sce, h*), one pair of antero-median (*vi*), three pairs of *d* setae (*d1, d2* and *d5*), three pairs of *l* setae (*l1, l2, l5*) and two pairs of neotrichials (N), one between *d1* and *sce* and one between *d2* and *l1* (figs 26-27). In *Smileycheles* the setae *d5* and *l5* are present only at one side. From this comparative study, it appears that both regression of setae and neotrichy may coexist in the same species.

Leg solenidiotaxy in the Cheyletidae

In females (Table n° 1)

In all the species that we have examined the tarsi I and II bear a solenidion. This solenidion is always dorsal on tarsus I (ω*I*) and ventral or antero-ventral on tarsus II (ω*II*), except in *Neoacaropsis granulatus*, in *Metacheletia obesa* and in the four genera of Ornithocheyletiinae where ω*II* is dorsal. Tarsi III and IV are always devoid of solenidia.
Tibiae I always carries a dorsal solenidion (φ*I*) except in *Apodicheles cypsiurus* and in the genera *Cheyletiella* and *Eucheyletiella* (Cheyletiellinae) which lack this solenidion. Tibiae II with φ*II* in seven genera of Cheyletinae; in all the other genera that we have seen this solenidion is lacking. Tibiae III-IV without solenidia.
Genu I bears a dorsal solenidion (σ*I*) in all the species except in the Niheliinae (four genera) and in *Criokeron*, where this solenidion is replaced by a very short seta which bears apically a crown of short diverging rays (seta *St*). This specialized seta resembles closely the "stellate seta" described by STRANDTMANN (1978, p. 126-127) on the tarsus I of some *Eupodes* species (Eupodidae). To recall this resemblance we use here the signature *St* for this seta (table n° 1). The genua II to IV lack this *St* seta (figs 19-20, 24-25).

In males (Table n° 2)

Solenidia of tarsi and tibiae I and II and of genua I are as in the females. Contrarily to the females, the males may bear solenidia on tarsi or on both tarsi and tibiae III and IV (VOLGIN, 1969). In some species these solenidia, especially those of legs III, are relatively long, often only a little shorter than the respective leg segment. These solenidia have been observed only in the Cheyletinae, never in the other subfamilies. These posterior tarsal solenidia are always ventral whilst the posterior tibial ones are always dorsal. YUNKER (1960), in his description of the male of *Alliea laruei*, noted the presence of a sensory rod on the ventral surface of tarsus III. SMILEY and WHITAKER (1981) provided good figures of the solenidia of tarsi and tibiae III and IV in the male of *Camincheyletus glaucomys* (figs 10 and 12).

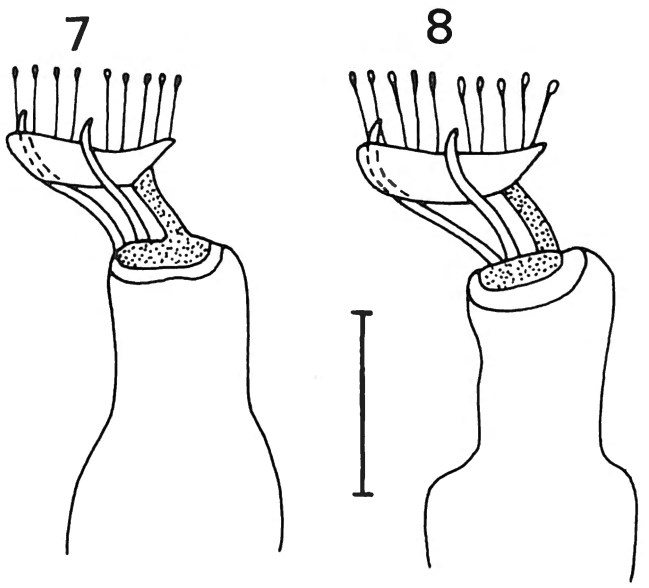
Notes on some genera or species of Cheyletidae

1. Genus *Hylopecheyla* FAIN, 1972
(Tables 1-5)

The type species, *H. bunguranensis* FAIN, 1972, was briefly described from a male and a nymph collected

from a sciurid, *Hylopetes everetti*, in Bunguran Islands (Natunas Is). This description was completed by FAIN (1979f). In 1980, this author received from Dr F. LUKOSCHUS, a male and several female specimens collected from *Hylopetes sagitta*, from Java. The male was identical to the holotype of *H. bunguranensis*; the female was briefly described (FAIN & NADCHATRAM, 1980). In the same paper, these authors described *Hylopecheyla malayi* FAIN & NADCHATRAM, 1980, a new species collected from *Tupaia glis* from Malaysia.

We give here a description of a female of *H. bunguranensis*. This specimen is 270 long (idiosoma) and 195 wide; propodonotal shield 120 long and 150 wide; hysteronotal shield trapezoidal in shape, 120 long and 148 wide (maximum). Gnathosoma: palpal tarsus with an internal comblike seta bearing seven very short teeth, external comb-like seta with nine longer teeth; palpal tibial claw with 4-5 basal teeth. Peritreme as in *H. malayi*, M-shaped and with the posterior segment abruptly bent at 90° inside. Dorsum bearing only one pair of dorsals (*d5*), setae *d1* to *d4* replaced by four pairs of very small granulations (diameter 1,2). A fifth pair of such granulations is present near the posterior border of the anterior shield. All the legs bear a pair of claws. On legs I the claws are unequal and distinctly smaller than on legs II-IV. The female of *H. bunguranensis* differs from that of *H. malayi* by the following characters: hyteronotal shield wider than long and distinctly trapezoidal, setae *d1* to *d4* lacking; internal comb-like setae with seven very short teeth. In *H. malayi* the hysteronotal shield is longer than wide, almost rectangular, and it bears setae *d2* and *d3*; the internal comb-like setae bears 18-20 long teeth.



Figs 7-8. – *Microcheyla parvula* VOLGIN. Paratype female: apical extremities of tarsi III (7) and IV (8). Scale line 5 µm.

2. *Microcheyla parvula* VOLGIN, 1966 and 1969
(Figs 7-8)

VOLGIN, in his description, mentions the presence on all the legs of very small claws. According to SUMMERS and PRICE (1970) there is a multirayed empodium on all the legs but no claws. The senior author (A. F.) has reexamined a paratype female of that species and found the presence on all tarsi, of two very thin, relatively long and lightly curved claws, separated by a relatively voluminous multirayed empodium.

3. *Neocheyletiella microrhyncha* (BERLESE & TROUESSART, 1889)

FAIN (1980b) synonymized *Neocheyletiella oudemansi* VOLGIN (1969) with *Neocheyletiella microrhyncha* BERLESE & TROUESSART, 1889. Both species were described from European swallows, i.e. *Hirundo rustica* for *microrhyncha* and *Delichon urbica* and *Riparia riparia* for *N. oudemansi*.

BAKER (1949) surmized that the host of *N. microrhyncha* was unknown but he recognized "that the original description could not be found".

VOLGIN (1969), also overlooked the paper of BERLESE and TROUESSART. FAIN (loc. cit.) examined the two existing typical slides of *N. microrhyncha* containing a female, a nymph and a larva. He designated the female as the lectotype of this species. He was unable to find any

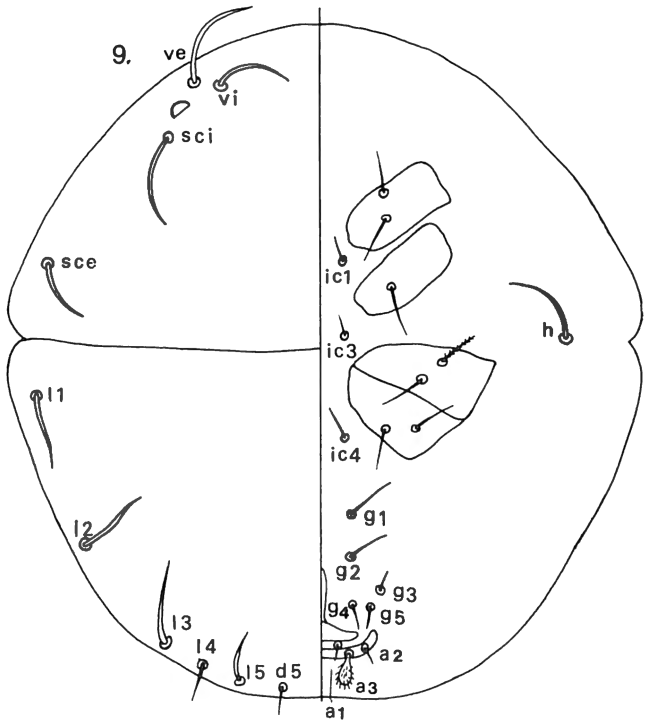


Fig. 9. – *Samsinakia volgini* FAIN. Holotype female. (Published in International Journal of Acarology, vol. 5 (1979)).

Table 2. – Leg solenidiotaxy in male Cheyletidae

Mite genus and species	Leg I			Leg II		Leg III		Leg IV	
	Tarsus	Tibia	Genu	Tarsus	Tibia	Tarsus	Tibia	Tarsus	Tibia
CHEYLETINAE									
Alliea									
laruei	d	d	d	v	0	v	0	v	0
Cheletacarus									
raptor	d	d	d	d	d	d	0	d	0
Cheletophyes									
clavipilis (P)	d	d	d	v	0	v	0	0	0
Cheyletus									
eruditus	d	d	d	v	0	0	0	0	0
malaccensis	d	d	d	v	0	0	0	0	0
truculentus (H)	d	d	d	v	0	0	0	0	0
Eucheyletia									
asiatica	d	d	d	v	d	v	d	v	0
bothrophila	d	d	d	v	d	v	d	v	0
eoa (P)	d	d	d	v	d	v	d	v	0
pavlovskyi (P)	d	d	d	av	d	v	d	v	0
harpyia (H, P)	d	d	d	v	0	0	0	0	0
Hoffmannita									
clavipes (P)	d	d	d	v	d	av	d	v	d
Hylopecheyla									
bunguranensis (H)	d	d	d	v	0	0	0	0	0
Neoeucheyla									
pavlovskyi (P)	d	d	d	v	?	v	0	v	0
METACHEYLETIINAE									
Metacheyletia									
obesa (P)	d	d	d	d	0	0	0	–	–
ORNITHOCHEYLETIINAE									
Ornithocheyletia									
smileyi (P)	d	d	d	d	0	0	0	0	0
Neocheyletiella									
oudemansi	d	d	d	d	?	0	0	0	0
Apodicheles									
cypsiurus (P)	d	0	d	0	0	0	0	0	0
CHEYLETIELLINAE									
Cheyletiella									
parasitivorax	d	0	d	v	0	0	0	0	0
Eucheyletiella									
ochotonae (P)	d	0	d	v	0	0	0	0	0
NIHELIINAE									
Nihelia									
curvidens	d	d	St	v	0	0	0	0	0
Galagocheles									
lemuricola	d	d	St	av	0	0	0	0	0
CRIOKERONTINAE									
Criokeron									
quintus	d	d	St	av	0	0	0	0	0

significant difference between this lectotype and the description of *N. oudemansi*. SMILEY (1970) described *N. callawaye* from *Hirundo rustica* in the U.S.A. but, in 1977, synonymised this species with *N. oudemansi*. *N. microrhyncha* has also been recorded from *Cecropis abyssinicus unitatis* and *Psalidoprocne albiceps*, both from Rwanda (FAIN, 1980b).

4. *Neocheyletiella media* FAIN, 1972, 1980b
(Table 3; fig. 11)

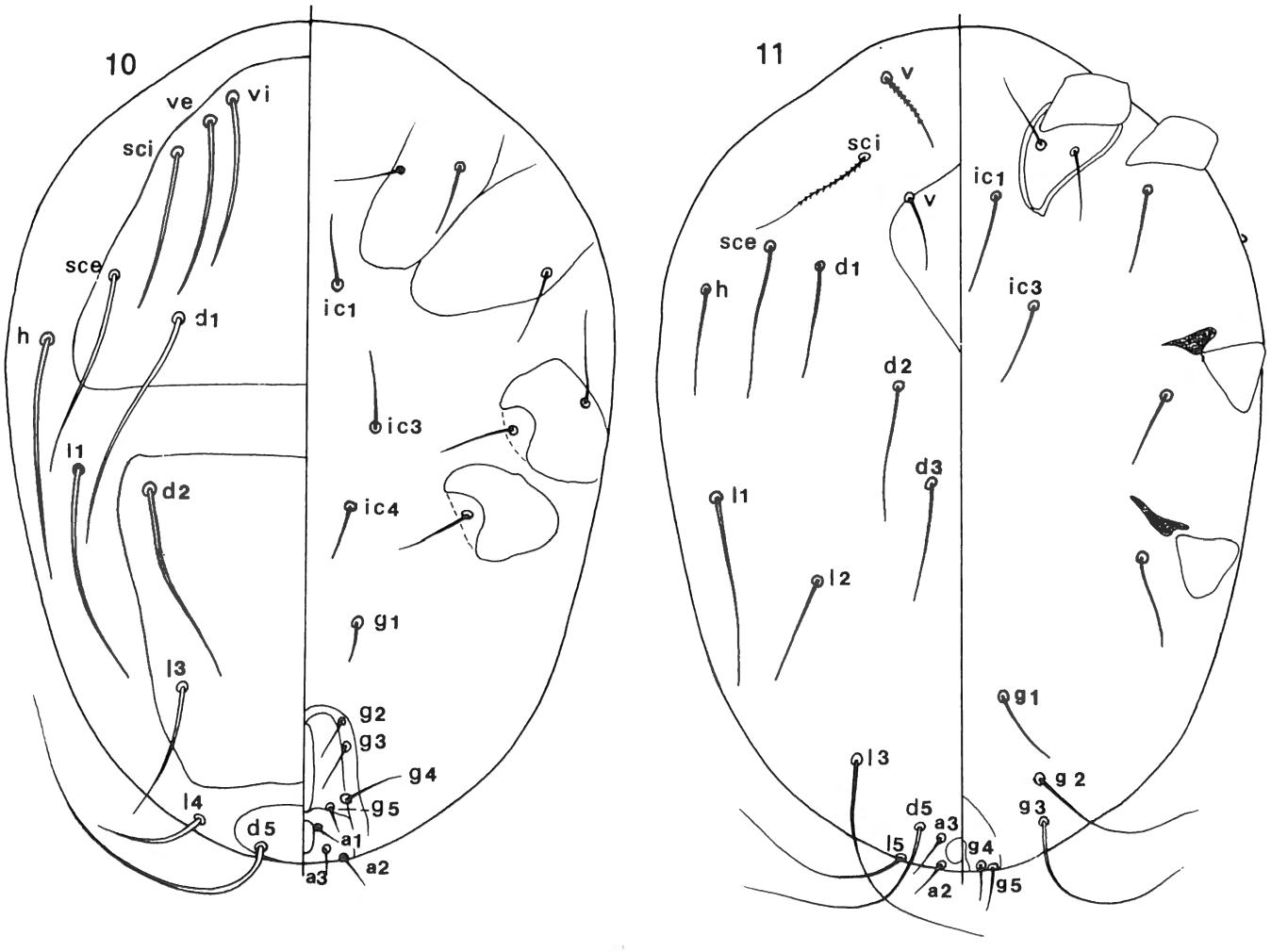
In his redrescription of this species, FAIN (1980b) had overlooked the anal setae which were replaced by *l* and *d* setae. Actually in the figure n°6 of this paper, the setae *d5*, *g5* and *l4* should be replaced by *a2*, *a1* and *d5* respectively and in the figure n°8 the setae *ic4*, *g1*, *g2*, *g3* and *g4* and a more posterior not numbered, should become *g1*, *g2*, *g3*, *g4* and *g5* respectively. Setae *ic4* are always lacking in the genus *Neocheyletiella*. A new corrected figure is provided (fig. 11)

5. Genus *Ornithocheyletia* VOLGIN, 1964, 1969
(Fig. 10)

FAIN (1981) stated that the species of this genus have three pairs of anals but no *d5*. We think now that the third pair of anals, always dorsal and removed from the anus, actually represents the *d5*. This modification is more in accordance with our interpretation of the chaetotaxy of the other genera of Ornithocheyletiinae.

6. *Alliea laruei* YUNKER, 1960 and *Dubininiola polylepis* VOLGIN, 1969
(Tables 3-4)

FAIN reexamined the allotype female (incomplete because the gnathosoma is lacking) and a paratype male of *A. laruei*. The female is close to the holotype of *Dubininiola polylepis* VOLGIN, 1969 except for the presence of eyes in *D. polylepis*. We have not seen eyes in the two specimens of *A. laruei*, however these specimens are



Figs 10-11. – *Ornithocheyletia psittaci* FAIN. Holotype female (10); *Neocheyletiella media* FAIN. Paratype female (11). (Published in International Journal of Acarology, vol. 5 (1979)).

Table 3. – Idiosomal chaetotaxy in female Cheyletidae

Mite genus and species	Dorsum											Venter									
	Basic number of setae										Additional neotrichial setae (M): modified	Number of setae on coxae I to IV				Inter-coxal setae			Anal setae		
	Dorsals (d1 - d5)					Laterals (l1 - l5)															
	1	2	3	4	5	1	2	3	4	5	Setae	I	II	III	IV	ic1	ic3	ic4	a1	a2	a3
CHEYLETINAE																					
Acaropsella																					
rohdendorfi (P)	+	+	+	+	+	+	+	+	+	+	2 pairs	1	1	2	2	+	+	+	+	+	+
Alliea																					
laruei	+	+	+	+	+	+	+	+	+	+	17 pairs	1	1	2	2	+	+	+	+	+	+
Bak																					
furcatus (H)	0	+	+	+	+	0	0	+	0	0	0	2	1	2	1	+	+	+	+	+	+
Cheletacarus																					
raptor (P)	+	+	+	+	+	+	+	+	+	+	3 pairs	2	1	2	2	+	+	+	+	+	+
Cheletogenes																					
ornatus	+	+	+	+	+	+	+	+	+	+	1 pair	2	1	2	2	+	+	+	+	+	+
Cheletoides																					
chirunduensis (H)	+	+	+	0	+	+	+	+	+	+	0	2	1	2	2	+	+	+	+	+	+
Cheletonella																					
caucasica (H)	+	+	+	+	+	+	+	+	+	+	0	2	1	2	2	+	+	+	+	+	+
Cheletophyes																					
clavipilis (H)	+	+	+	+	+	+	+	+	+	+	1 pair	2	1	2	2	+	+	+	+	+	+
Cheyletus																					
baloghi (P)	+	+	0	0	+	+	+	0	0	+	0	2	1	2	2	+	+	+	+	+	+
eruditus	0	0	0	+	+	+	+	+	+	+	0	2	1	2	2	+	+	+	+	+	+
malaccensis	0	0	0	0	+	+	+	+	+	+	0	2	1	2	2	+	+	+	+	+	+
rwandae (P)	0	0	0	0	+	+	+	+	+	+	0	2	1	2	2	+	+	+	+	+	+
tenuipilis (H)	+	+	+	+	+	+	+	+	+	+	0	2	1	2	2	+	+	+	+	+	+
trouessarti	+	+	0	+	+	+	+	+	+	+	0	2	1	2	2	+	+	+	+	+	+
Cunliffella																					
tuberculicoxa (P)	0	0	0	0	+	+	+	+	+	+	14 pairs (M)	2	1	2	2	+	+	+	+	+	+
Dubininiola																					
polylepis (H)	+	+	+	+	+	+	+	+	+	+	17 pairs	2	1	2	2	+	+	+	+	+	+
Eucheyletia																					
asiatica	0	0	0	0	+	+	+	+	+	+	16 pairs (M)	2	1	2	2	+	+	+	+	+	+
bothrophila (H)	0	0	0	0	+	+	+	+	+	+	16 pairs (M)	2	1	2	2	+	+	+	+	+	+
eoa	0	0	0	0	+	+	+	+	+	+	16 pairs (M)	2	1	2	2	+	+	+	+	+	+
pavlovskyi	0	0	0	0	+	+	+	+	+	+	16 pairs (M)	2	1	2	2	+	+	+	+	+	+
sibirica (P)	0	0	0	0	+	+	+	+	+	+	16–18 pairs (M)	2	1	2	2	+	+	+	+	+	+
sinensis (P)	0	0	0	0	+	+	+	+	+	+	16–18 pairs (M)	2	1	2	2	+	+	+	+	+	+
taurica (H)	0	0	0	+	+	+	+	+	+	+	16 pairs (M)	2	1	2	2	+	+	+	+	+	+
Eutogenes																					
frater (H)	+	+	+	+	+	+	+	+	+	+	7 pairs	2	1	2	2	+	+	+	+	+	+
Hemicheyletia																					
asiatica (H)	+	+	0	0	+	+	+	+	+	+	0	2	1	2	2	+	+	+	+	+	+
bregetovae (P)	0	0	0	0	+	+	+	+	+	+	5–6 pairs (M)	2	1	2	2	+	+	+	+	+	+
Hoffmannita																					
clavipes	0	0	0	0	+	+	+	+	+	+	15 pairs (M)	2	1	2	2	+	+	+	+	+	+
Hylopecheyla																					
bunguranensis	0	0	0	0	+	+	+	+	+	+	0	2	1	2	2	+	+	+	+	+	+
Hypopicheyla																					
mirabilis (P)	0	0	0	0	+	+	+	+	+	+	17 pairs (M)	2	1	2	2	+	+	+	+	+	+
elongata (P)	0	0	0	0	+	+	+	+	+	+	?16 (M)	2	1	2	2	+	+	+	+	+	+
Lepidocheyla																					
caucasica (H)	+	+	+	+	+	+	+	+	+	+	3 pairs	2	1	2	2	+	+	+	+	+	+
gracilis (H)	+	+	+	+	+	+	+	+	+	+	3 pairs	2	1	2	2	+	+	+	+	+	+
Metacheletoides																					
numidae (H)	+	+	+	0	+	+	+	+	+	+	0	2	1	2	2	+	+	+	+	+	+

Table 3. – Idiosomal chaetotaxy in female Cheyletidae (continued)

Mite genus and species	Dorsum											Venter									
	Basic number of setae										Additional neotrichial setae (M): modified	Number of setae on coxae I to IV				Inter–coxal setae			Anal setae		
	Dorsals (d1 – d5)					Laterals (l1 – l5)															
	1	2	3	4	5	1	2	3	4	5	Setae	I	II	III	IV	ic1	ic3	ic4	a1	a2	a3
Microcheyla parvula (P)	0	0	0	0	+	+	+	+	+	+	3 pairs (M)		?			+	+	+		?	
Neoacaropsis granulatus (P)	+	+	+	+	+	+	+	+	+	+	0	2	1	2	2	+	+	+	+	+	+
Neoeucheyla mumai (H)	+	+	+	+	+	+	+	+	+	+	3 pairs	2	1	2	2	+	+	+	+	+	+
pavlovskyi (P)	+	+	+	+	+	+	+	+	+	+	7 pairs (M)	2	1	2	2	+	+	+	+	+	+
Nodele superba (P)	+	+	+	+	+	+	+	+	+	+	1 pair	2	1	2	2	+	+	+	+	+	+
Paracheyletia samsinaki (P)	0	0	+	0	+	0	+	+	+	+	14 pairs (M)	2	1	2	2	+	+	+	+	+	+
Samsinakia volgini (P)	0	0	0	0	+	+	+	+	+	+	50 pairs (M)	2	1	2	2	+	+	+	+	+	+
CHELONOTINAE																					
Chelonotus selenirhynchus	0	0	0	0	+	+	+	+	+	+	0	2	1	2	2	+	+	+	+	+	+
Muricheyla sicista (H)	0	0	0	0	+	+	+	+	+	+	0	2	1	2	2	+	+	+	+	+	+
Promuricheyla lukoschusi (H)	0	0	0	0	+	+	+	+	+	+	0	2	1	2	2	+	+	+	+	+	+
TEINOCHEYLINAE																					
Teinocheylus longissimus (H)	+	+	+	+	+	+	+	+	+	+	4 pairs (M)	2	1	2	2	+	+	+		2 pairs	
METACHEYLETIINAE																					
Metacheyletia obesa (H)	+	+	0	0	+	0	0	+	+	+	0	1	0	0	–	+	+	0		2 pairs	
ORNITHOCHEYLETIINAE																					
Apodicheles cypsiurus (H)	+	+	0	0	+	+	+	+	+	+	0	2	1	1	1	+	+	+		0 or 1 pair	
Bakericheyla chanayi	+	+	0	0	0	+	+	+	+	+	0	2	1	2	2	+	+	+		2 pairs	
Neocheyletiella microrhyncha	+	+	+	0	0	+	+	+	0	+	0	2	1	1	1	+	+	0		2 pairs	
media (P)	+	+	+	0	+	+	+	+	0	+	0	2	1	1	1	+	+	0		2 pairs	
Ornithocheyletia dubinini (P)	+	+	+	0	+	+	0	+	+	0	0	2	1	2	1	+	+	+		2 pairs	
smileyi (H)	+	+	0	0	+	+	+	+	0	+	0	2	1	2	1	+	+	+		3 pairs	
psittaci (H)	+	+	0	0	+	+	0	+	+	+	0	2	1	2	1	+	+	+		3 pairs	
CHEYLETIELLINAE																					
Cheyletiella parasitivorax	+	+	+	+	+	+	+	+	+	+	0	2	1	2	2	+	+	+	+	+	+
Eucheyletiella ochotonae (P)	+	0	0	+	+	+	0	0	0	+	0	2	1	2	2	+	+	+		2 pairs	
NIHELIINAE																					
Galagocheles lemuricola	+	+	+	+	0	+	+	+	+	+	3 pairs	2	1	2	2	+	+	+	+	+	+
Nihelia curvidens	+	+	+	+	0	+	+	+	+	0	5 pairs	2	1	2	2	+	+	+	+	+	+
Smileycheles camerounensis (H)	+	+	0	0	+	+	+	0	0	+	2 pairs	2	1	2	2	+	+	+	+	+	+
CRIOKERONTINAE																					
Criokeron quintus	+	+	+	+	+	+	+	+	+	+	0	2	1	2	2	+	+	+	+	+	+

much flattened and their cuticle is in poor condition, so that the absence of eyes cannot be ascertained. The dorsal chaetotaxy is identical in the females of both species, it consists of a total of 32 pairs of squamiform setae, including the 15 pairs of basic dorso-median and lateral setae. The number of neotrichial setae is therefore 17 pairs (see table n° 3). All these setae are identical except that the dorso-medians are slightly smaller than the laterals. The number of leg setae differs only by the presence of four setae on tibia I of *D. polylepis*, instead of five setae in *A. laruei* and of eight setae on tarsus I of *D. polylepis*, instead of nine setae in *A. laruei*. The difference between the two species is more marked in the number of squamiform setae on the legs; these setae are more numerous and mixed with barbed setae in *D. polylepis*. It is worthy of note that in the holotype of *D. polylepis* the palpal tarsus bears two comb-like setae (an internal with about 40 very thin and relatively long teeth and an external with about 20 long and thicker teeth), two sickle-like setae and a solenidion. The original description of *D. polylepis* mentions only "one pectinate seta, two piliform and one thickened with hamate apex, without processes".

In the paratype male of *A. laruei*, the dorsum bears the same kind of setae as the female but there are only 21 pairs, of which six are neotrichials. Leg chaetotaxy as in the female, except that the genua II bear one squamiform and one simple smooth setae, instead of two squamiform setae in the female. The tarsi III and IV bear a long ventral solenidion, which are absent in the female. The peritreme in the male is in an inverted-U and apparently devoid of internal segmentation, but owing to the bad condition of the cuticle it is possible that this segmentation has become invisible. The palpal tarsus is devoid of comblike setae, but it bears a thick ovoid spine with a pointed apex. It is worthy of note that both species have been found in association with rodents: *A. laruei* was taken from *Rattus norvegicus* in Florida and *D. polylepis* was found in the burrow of an unidentified rodent in Turkmenia SSR.

The subfamilies of the family Cheyletidae

Review of the literature

OUDEMANS (1906) and BAKER (1949), in their important monographs on the Cheyletidae did not attempt to divide this family into subfamilies or tribes.

VOLGIN (1961, 1969) recognized two subfamilies in the Cheyletidae: the subfamily Cheyletinae LEACH, mainly composed of free living predators, and the new subfamily Cheyletiellinae VOLGIN, 1961, including species parasitic on mammals and birds. In the first group he created ten new tribes, and in the second two new tribes (Cheyletiellini VOLGIN, 1961 and Ornithocheyletiini VOLGIN, 1969). This splitting of the Cheyletidae was not accepted by SUMMERS and PRICE (1970). These authors assumed that "no distinct morphological cleavage is apparent between the free-living Cheyletinae and those associated with birds and mammals".

SMILEY (1970) elevated the subfamily Cheyletiellinae to family rank. He included in the Cheyletiellidae VOLGIN (1961) the following genera: *Cheyletiella, Eucheyletiella, Criokeron, Nihelia* and three genera that VOLGIN (1969) had included in his tribe *Ornithocheyletiini*, i.e. *Ornithocheyletia, Bakericheyla* and *Neocheyletiella* (= *Ornithocheyla* LAWRENCE).

A new tribe, Teinocheylini was created by FAIN (1974) in the Cheyletidae for the new genus and species *Teinocheylus longissimus* FAIN, 1974.

SMILEY (1977) created in the family Cheyletiellidae, two new subfamilies, Criokerontinae (type genus *Criokeron* VOLGIN) and Niheliinae (type species *Nihelia* DOMROW and BAKER, 1960), and elevated the tribes Teinocheylini FAIN and Ornithocheyletiini VOLGIN, 1969 to the subfamily rank.

FAIN (1979d) proposed to restrict the Cheyletiellidae to the genera *Cheyletiella, Bicheyletiella* and *Eucheyletiella*, and to maintain the other genera in the Cheyletidae. He described two new genera, *Galagocheles* FAIN (type species *Hemicheyletus lemuricola* LAWRENCE, 1948) and *Smileycheles* FAIN (type species *Smileycheles camerounensis* FAIN). The genus *Hemicheyletus* LAWRENCE, 1948 was not valid because the author had omitted to designate a type species (DOMROW and BAKER, 1963).

FAIN (1979f) elevated the tribe Chelonotini VOLGIN (1969) to subfamily rank and included into it the genera *Chelonotus* VOLGIN, *Muricheyla* FAIN and *Promuricheyla* FAIN. In 1980, FAIN and NADCHATRAM noted that the genus *Thewkachela* IDE and KETHLEY (1977) is closely related to *Muricheyla* and should probably be included in the Chelonotinae.

In 1985, FAIN and LUKOSCHUS proposed a key to the subfamilies Niheliinae and Criokerontinae and elevated the subgenus *Nihelia (Sciurocheyla)* VOLGIN (1969) to genus rank. Herein we recognize eight subfamilies in the family Cheyletidae; their definitions are preceded by a key.

Key to the subfamilies of the family Cheyletidae (based on females*)

1. Body with four pairs of well-developed legs . . 2

   - Body with three pairs of well-developed legs; legs IV vestigial or absent . . . . Metacheyletiinae FAIN

2. Tarsi II with paired claws and rayed empodia; tarsi III and IV either with claws and rayed empodia or only with empodia; tarsus I with or without paired

* The genera *Alliea* YUNKER and *Thryonomycheyla* FAIN have been excluded from this key. The former because only a male and an incomplete female (without gnathosoma) were available, the latter because only the male is known. The genera *Cheletoides* OUDEMANS, *Metacheletoides* FAIN and *Atarsacheylus* THEWKE are provisionally included in the subfamily Cheyletinae.

claws and empodia; tibia I with solenidion φ (except *Apodicheles,* which lacks this seta) 3

- Tarsi I-IV without claws but with featherlike empodia; tibia I without solenidion φ .... Cheyletiellinae VOLGIN (fig. 14)

3. Tarsi II-IV with paired claws and rayed empodia; dorsum with or without one or two median shields; idiosoma distally without lobelike projections . 4

- Tarsi III-IV with empodia but without claws; dorsum with three median shields; idiosoma distally with lobelike projections . Teinocheyletinae FAIN

4. Idiosoma without contiguous dorsal shields covering or overlapping part of the ventral hysterosoma 5

- Idiosoma with very large contiguous dorsal shields covering or overlapping part of the ventral hysterosoma ..... Chelonotinae VOLGIN

5. Gnathosoma modified, with ventral basal hooks and/or lateral hooks on palpal segments, or palpal segments reduced; solenidion σI on genu I replaced by a stellate seta 6

- Gnathosoma unmodified; without basal hooks (except in *Apodicheles,* Ornithocheyletiinae, which has ventral hooks at the base of the gnathosoma); palpal segments normal, never reduced; genu I with solenidion σI 7

6. Gnathosoma with very large lateral hooklike processes; palpi small, narrow, their tibiae and tarsi fused, forming a short segment with a thick comblike seta; idiosoma and legs without processes; dorsum without neotrichial setae .... Criokerontinae SMILEY

- Gnathosoma not as above, palpal tibiae and tarsi developed, ending with a strongly recurved hooklike organ; without comblike setae; processes present on gnathosomal base and on palpi; dorsum with neotrichial setae . . Niheliinae SMILEY (figs 15-25)

7. Palpal tarsus without comblike setae 8

- Palpal tarsus with one or two comblike setae ... . Cheyletinae VOLGIN (part)

8. Gnathosoma poorly developed; palpal claw strongly curved, edentate . Ornithocheyletiinae VOLGIN

- Gnathosoma well developed; palpal claw moderately curved, with or without teeth 9

9. Eyes present ..... Cheyletinae VOLGIN (part)

- Eyes absent 10

10. Palpal claw with teeth; body ovoid; dorsum with one dorsal median shield and several ultralong setae 11

- Palpal claw edentate; body fusiform; without dorsal median shields, without ultralong setae .... *Atarsacheylus* THEWKE

11. Palpal claw with a single tooth; palpal tarsus with a single stiff seta bearing vestigial teeth .... *Cheletoides* OUDEMANS

- Palpal claw with 2-7 basal teeth; stiff seta on palpal tarsus without vestigial teeth .... *Metacheletoides* FAIN

Definitions of the subfamilies (based on females)

We give here short definitions of the eight subfamilies recognized in the family Cheyletidae (females) and keys to the genera.

I. METACHEYLETIINAE FAIN, 1972 (Tables 1-4)

Definition: Body with three pairs of well-developed legs; legs IV vestigial or absent. One small median punctate shield (on propodonotum). Gnathosoma small, palpal claw with one basal tooth, palpal tarsus without comblike setae. All the legs with two very small claws and a rayed empodium. Eyes lacking. Idiosomal and leg chaetotaxy drastically reduced: coxals 1-0-0; intercoxals 1-1-0; only two pairs of anals; trochanters devoid of setae.

This subfamily is only represented by the type genus and two species, both parasitizing the quills of Psittacidae: *Metacheyletia obesa* FAIN, 1972, 1980a and *M. longisetosa* ATYEO, KETHLEY & PEREZ, 1984.

II. TEINOCHEYLINAE FAIN, 1974 (Tables 1, 3-4)

Definition: Body very elongate, about five times as long as wide, strongly narrowed posteriorly, and ending into two small lobes, each bearing 3 long bipectinate setae. Dorsum with three median striated shields bearing four pairs of neotrichial foliate setae. Gnathosoma small, with median part projecting anteriorly beyond the palps. Palps small, palpal claw devoid of teeth, palpal tarsi without comblike setae. Legs I and II with two small claws and a rayed empodium; legs III and IV without claws but with a rayed empodium. Previously we had erroneously mentioned the presence of claws on legs III. Eyes lacking.

Table 4. – Leg chaetotaxy in female Cheyletidae

Mite genus and species	Trochanters				Femora				Genua				Tibiae				Tarsi			
	I	II	III	IV	I	II	III	IV	I	II	III	IV	I	II	III	IV	I	II	III	IV
CHEYLETINAE																				
Acaropsella																				
rohdendorfi	1	1	2	1	2	2	2	1	2	2	2	2	5	4	4	4	8	7	7	7
Alliea																				
laruei	1	1	2	1	2	2	2	2	2	2	2	2	5	4	4	4	9	7	7	7
Bak																				
furcatus	1	1	1	1	2	2	1	1	2	2	2	2	4	4	4	4	8	7	7	7
Cheletacarus																				
raptor	1	1	2	1	2	2	2	1	2	2	2	2	5	4	4	4	8	7	7	7
Cheletogenes																				
ornatus	1	1	2	1	2	2	2	1	2	2	2	2	4	4	4	4	4	7	7	7
Cheletoides																				
chirunduensis	1	1	2	1	2	2	1	1	2	2	2	2	4	4	4	4	9	7	7	7
Cheletonella																				
caucasica	1	1	2	1	2	2	2	1	2	2	2	2	4	4	4	4	9	7	7	7
Cheletophyes																				
clavipilis	1	1	2	1	2	2	2	1	2	2	2	2	5	4	4	4	8	7	7	7
Cheyletus																				
baloghi	1	1	2	1	2	2	2	1	2	2	2	2	5	4	4	4	9	7	7	7
eruditus	1	1	2	1	2	2	2	2	2	2	2	2	5	4	4	4	9	7	7	7
malaccensis	1	1	2	1	2	2	2	1	2	2	2	2	5	4	4	4	9	7	7	7
rwandae	1	1	2	1	2	2	2	1	2	2	2	2	5	4	4	4	9	7	7	7
tenuipilis	1	1	2	1	2	2	2	1	2	2	2	2	5	4	4	4	9	7	7	7
trouessarti	1	1	2	1	2	2	2	1	2	2	2	2	5	4	4	4	9	7	7	7
Cunliffella																				
tuberculicoxa	1	1	2	1	2	2	2	1	2	2	2	2	5	4	4	4	9	7	7	7
Dubininiola																				
polylepis	1	1	2	1	2	2	1	1	2	2	2	2	4	4	4	4	8	7	7	7
Eucheyletia																				
asiatica	1	1	2	1	2	2	2	2	2	2	2	2	5	4	4	4	9	7	7	7
bothrophila	1	1	2	1	2	2	2	2	2	2	2	2	5	4	4	4	8	7	7	7
eoa	1	1	2	1	2	2	2	2	2	2	2	2	5	4	4	4	10	7	7	7
pavlovskyi	1	1	2	1	2	2	2	2	2	2	2	2	5	4	4	4	9	7	7	7
sibirica	1	1	2	1	2	2	2	2	2	2	2	2	5	4	4	4	9	7	7	7
sinensis	1	1	2	1	2	2	2	2	2	2	2	2	4	4	4	4	9	7	7	7
taurica	1	1	2	1	2	2	2	2	2	2	2	2	5	4	4	4	9	7	7	7
Eutogenes																				
frater	1	1	1	1	2	2	2	1	2	2	2	2	4	4	4	4	5	7	7	7
Hemicheyletia																				
asiatica	1	1	2	1	2	2	2	1	2	2	2	2	4	4	4	4	8	7	7	7
bregetovae	1	1	2	1	2	2	2	1	2	2	2	2	5	4	4	4	8	7	7	7
Hoffmannita																				
clavipes	1	1	2	1	2	2	2	1	2	2	2	2	5	4	4	4	8	7	7	7
Hylopecheyla																				
bunguranensis	1	1	2	1	2	2	2	1	2	2	2	2	5	4	4	4	9	7	7	7
Hypopicheyla																				
elongata	1	1	2	1	2	2	2	1	2	2	2	2	5	4	4	4	9	7	7	7
Lepidocheyla																				
caucasica	1	1	2	1	2	2	2	1	2	2	2	2	5	4	4	4	9	7	7	7
gracilis	1	1	2	1	2	2	2	1	2	2	2	2	5	4	4	4	9	7	7	7
Metacheletoides																				
numidae	1	1	2	1	2	2	1	1	2	2	2	2	4	4	4	4	9	7	7	7
Microcheyla																				
parvula	1	1	?	?	2	1	2	1	2	2	2	2	5	4	4	4	7	4	4	4

Table 4. – Leg chaetotaxy in female Cheyletidae (continued)

Mite genus and species	Trochanters				Femora				Genua				Tibiae				Tarsi			
	I	II	III	IV	I	II	III	IV	I	II	III	IV	I	II	III	IV	I	II	III	IV
Neoacaropsis granulatus	1	1	2	1	2	2	2	1	2	2	2	2	4	4	4	4	9	7	7	7
Neoeucheyla mumai	1	1	2	1	2	2	2	1	2	2	2	2	4	4	4	4	9	7	7	7
pavlovskyi	1	1	2	1	2	2	2	1	2	2	2	2	5	4	4	4	9	7	7	7
Nodele superba	1	1	2	1	2	2	2	1	2	2	2	2	5	4	4	4	9	7	7	7
Paracheyletia samsinaki	1	1	2	1	2	2	2	1	2	2	2	2	5	4	4	4	9	7	7	7
Samsinakia volgini	1	1	2	1	2	2	1	1	2	2	2	2	4	4	4	4	8	7	7	7
CHELONOTINAE																				
Chelonotus selenirhynchus	1	1	2	1	2	2	2	2	2	2	2	2	5	4	4	4	9	7	7	7
Muricheyla sicista	1	1	2	1	2	2	2	2	2	2	2	2	5	4	4	4	9	7	7	7
Promuricheyla lukoschusi	1	1	2	1	2	2	2	2	2	2	2	2	5	4	4	4	9	7	7	7
TEINOCHEYLINAE																				
Teinocheylus longissimus	1	1	2	1	2	2	2	1	2	2	2	2	5	4	4	4	9	7	7	7
METACHEYLETIINAE																				
Metacheleytia obesa	0	0	0	–	2	2	1	–	1	1	1	–	4	4	4	–	8	5	5	–
ORNITHOCHEYLETIINAE																				
Apodicheles cypsiurus	1	1	1	0	2	2	0	0	2	2	1	0	4	4	3	3	9	6	6	6
Bakericheyla chanayi	1	1	2	1	2	2	1	1	2	2	2	2	4	4	3	3	9	7	7	7
Neocheyletiella microrhyncha	1	1	1	1	2	2	1	1	2	2	1	0	4	4	3	3	9	7	7	7
media	1	1	2	1	2	2	1	1	2	2	1	0	4	4	3	3	9	7	7	6
Ornithocheyletia dubinini	1	1	0	0	2	2	1	1	2	2	2	1	4	4	3	3	9	7	7	7
smileyi	1	1	0	0	2	2	1	1	2	2	2	1	4	4	4	4	9	7	7	7
psittaci	1	1	0	0	2	2	1	1	2	2	2	1	4	4	3	3	9	7	7	7
CHEYLETIELLINAE																				
Bicheyletiella romerolagi	1	1	2	1	2	2	2	1	2	2	2	2	5	4	4	4	9	7	7	7
Cheyletiella parasitivorax	1	1	2	1	2	2	2	1	2	2	2	2	5	4	4	4	9	7	7	7
Eucheyletiella ochotonae	1	1	2	1	2	2	2	1	2	2	2	2	5	4	4	4	9	7	7	7
NIHELIINAE																				
Galagocheles lemuricola	1	1	2	1	2	2	2	1	2	2	2	2	5	4	4	4	9	7	7	7
Nihelia curvidens	1	1	2	1	2	2	2	1	2	2	2	2	5	4	4	4	7	5	5	5
Smileycheles camerounensis	1	1	2	1	2	2	2	1	2	2	2	2	5	4	4	4	7	7	7	7
CRIOKERONTINAE																				
Criokeron quintus	1	1	2	1	2	2	2	1	2	2	2	2	5	4	4	4	9	7	7	7

This subfamily is represented by one genus and two species: *Teinocheylus longissimus* FAIN, 1974 and *T. gundii* FAIN *et al.*, 1982. *Hosts:* African rodents of the family Ctenodactylidae.

III. CHELONOTINAE VOLGIN, 1969
(Tables 1, 3-4)

Definition: Well sclerotized mites. Processes present, in some genera, on base of gnathosoma or on tarsi III and IV. Idiosoma with two large to very large median dorsal shields (one propodonotal and one hysteronotal) either contiguous or separated by a few striations. In strongly compressed specimens the shields may be more widely separated. Dorsum lacking neotrichial setae. Gnathosoma well developed. Palpal tarsus with either one or two comblike setae bearing thick teeth. In the genera with only one comb the internal comb is replaced by a conical spine directed inside. Palpal tibia with a thick "claw" either edentate or with one or two basal teeth. Tarsi I with two long prepical barbed setae; all tarsi with two strong claws and a rayed empodium. Eyes lacking.

This subfamily forms a natural group, it includes four genera: *Chelonotus* BERLESE, 1893, *Muricheyla* FAIN, 1972, *Promuricheyla* FAIN, 1979f and *Thewkacheyla* IDE and KETHLEY, 1977. *Hosts:* Oriental squirrels and East-European birch mice (Zapodidae).

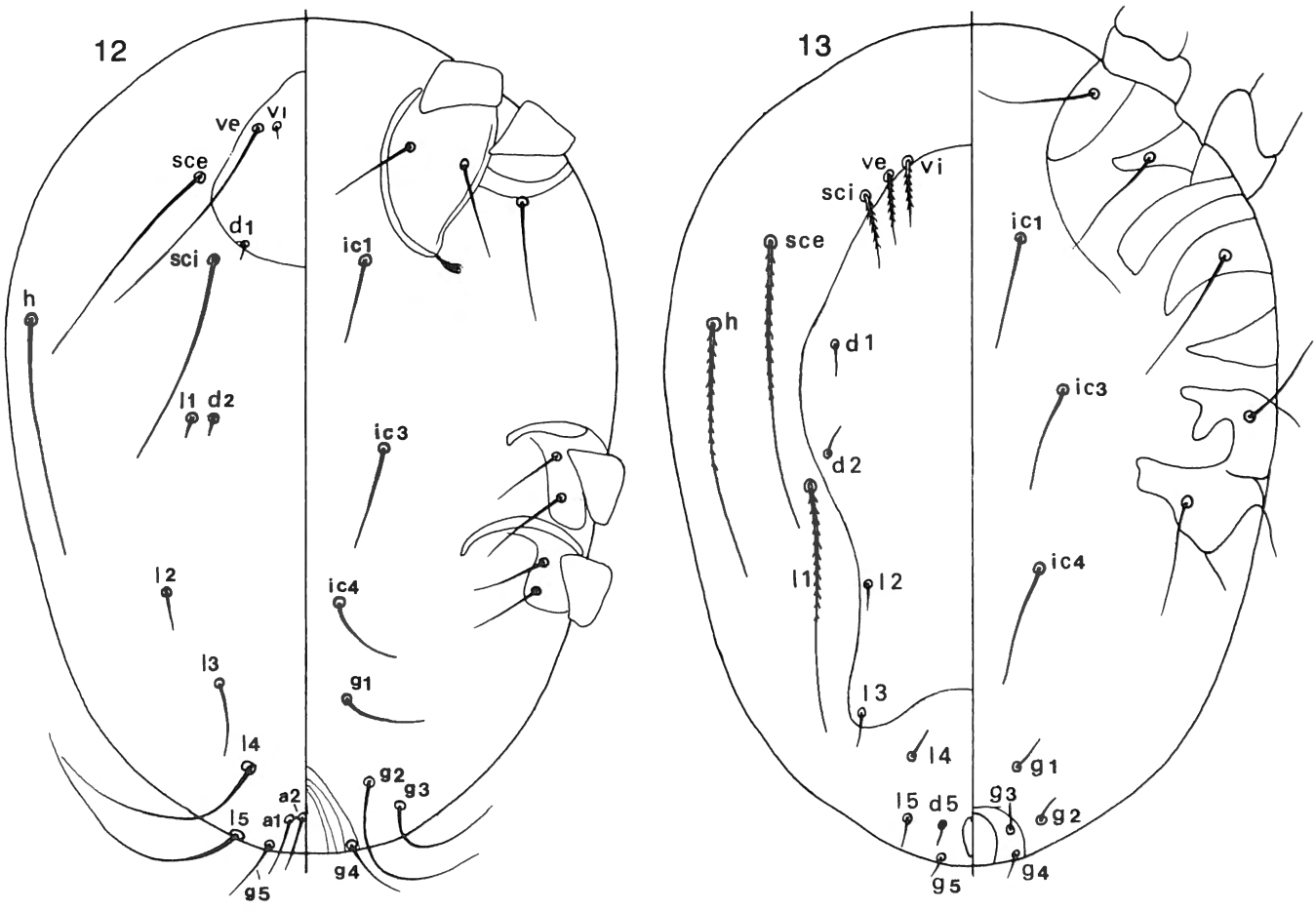
Key to the Chelonotinae (females)

1. Palpal claw with one basal tooth. Palpal femur abnormally large and wider than long. Dorsal shields contiguous. Hysteronotal shield extending on ventral surface. No processes on gnathosoma or on tarsi III-IV ..... *Chelonotus*

   Palpal claw either edentate or with two basal teeth. Palpal femur moderately inflated, longer than wide. Dorsal shields separated by a few striations. With processes on gnathosoma or on tarsi III-IV. Hysteronotal shield not extending on ventral surface of body 2

2. Palpal tarsus with two comb-like setae. Palpal claw with two teeth ..... *Promuricheyla*

   Palpal tarsus with one comb-like seta (the external), the internal comb-like seta is replaced by a thick conical spine directed inside 3



Figs 12-13. – *Bakericheyletia chanayi latior* FAIN. Paratype female (12); *Apodicheles cypsiuri* FAIN. Holotype female (13). (Published in International Journal of Acarology, vol. 5 (1979)).

3. Tarsi III and IV with two dorsal triangular processes. Absence of hooks on gnathosoma. No lobes on coxae II. Palpal claw with two teeth ..... *Muricheyla*

   Tarsi III-IV without processes. A pair of hooks on the base of gnathosoma. With lobes on coxae II. Palpal claw edentate ..... *Thewkacheyla*

IV. Ornithocheyletiinae Volgin, 1969
(Tables 1-4; Figs 10-13)

Definition: Gnathosoma usually small with palps poorly developed. Absence of processes on idiosoma, gnathosoma, palps or legs except in genus *Apodicheles* where there are 2 pairs of retrorse triangular processes on ventral surface of palpfemora. In *Ornithocheyletia* heteromorphic males may have flange-like structures on the palpfemora. Palpal tarsi lacking comblike setae. Dorsal shields variable: with either one long median shield covering large parts of propodonotum and hysteronotum, or with two median shields (a propodonotal and hysteronotal) or with only one small propodonotal shield. Coxae either forming two separate groups (an anterior with coxae I + II and a posterior with coxae III + IV), or with coxae I and II contiguous and coxae III and IV widely separate. All the legs with two apical claws and a rayed empodium. Eyes lacking. Dorsum without neotrichial setae. Chaetotaxy on idiosoma and legs reduced. Tibia I with a solenidion except in *Apodicheles* which lacks this solenidion.

This subfamily includes four genera: *Ornithocheyletia* Volgin, 1964, *Bakericheyla* Volgin, 1966, *Neocheyletiella* Baker, 1949 (= *Ornithocheyla* Lawrence, 1959) and *Apodicheles* Fain, 1979a. *Hosts:* on birds.

The Ornithocheyletiinae forms a less homogenous group than the Chelonotinae and we proposed to divide it into the three following tribes, i.e. Ornithocheyletiini Volgin, including the genera *Ornithocheyletia* (type genus) and *Bakericheyla*, Apodichelini n. tr. (with genus *Apodicheles* as type genus) and Neocheyletiellini n. tr. (with genus *Neocheyletiella* as type genus).

Key to the Ornithocheyletiinae (females)

1. Dorsum bearing a long median poorly-sclerotized shield extending from setae *vi* and *ve* to setae *l3* and *d4*. Gnathosoma well developed with very strong and abruptly bent palpal claws. Palpal femora with two pairs of retrorse triangular ventral processes. Anal setae either reduced to one pair or lacking. Absence of solenidion on tibia I ..... *Apodicheles*

   Dorsum with either one or two median shields. Gnathosoma and palps small. Palpal femur without ventral processes. With two or three pairs of anal setae. Tibia I with a solenidion 2

2. Dorsum with two large punctate, rarely striate, median shields (a propodonotal and an hysteronotal). Trochanters III and IV lacking setae. Coxae III and IV with two and one pairs of setae respectively ..... *Ornithocheyletia*

   Dorsum with only one median shield (the propodonotal) 3

3. Coxae I and II contiguous with long sclerotized epimera, coxae III and IV widely apart with very short epimera. Setae *ic4* lacking. Coxae III and IV with one pair of setae ..... *Neocheyletiella*

   Coxae III and IV contiguous. Setae *ic4* present. Coxae III and IV with 2 pairs of setae ..... *Bakericheyla*

V. Cheyletiellinae Volgin, 1966
(Tables 1-4; Fig. 14)

Definition: Coxae I with a pair of retrorse processes. Dorsum either with one median shield (the propodonotal) or two median shields (propodonotal and hysteronotal). Gnathosoma well developed. Palpal tarsus without comb-

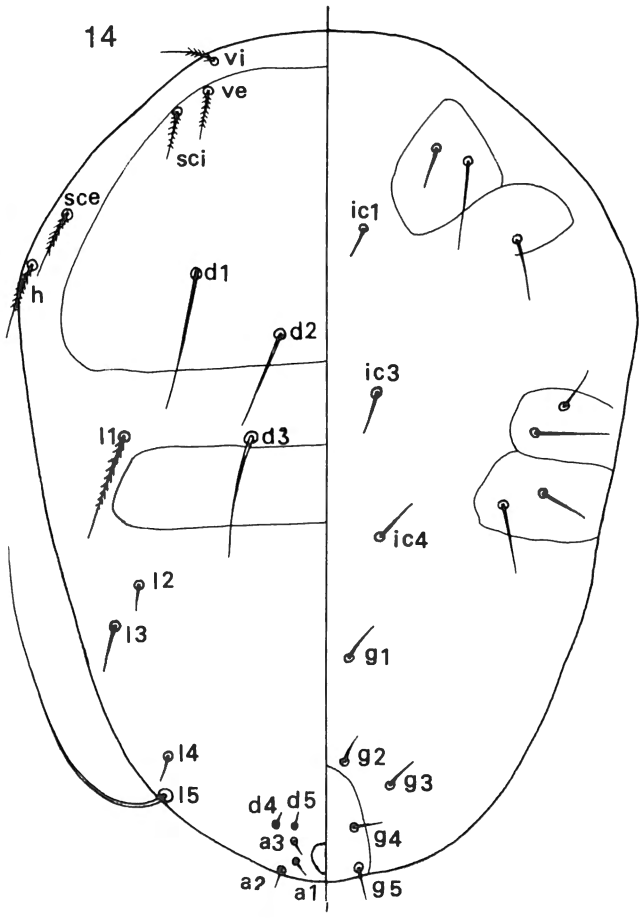
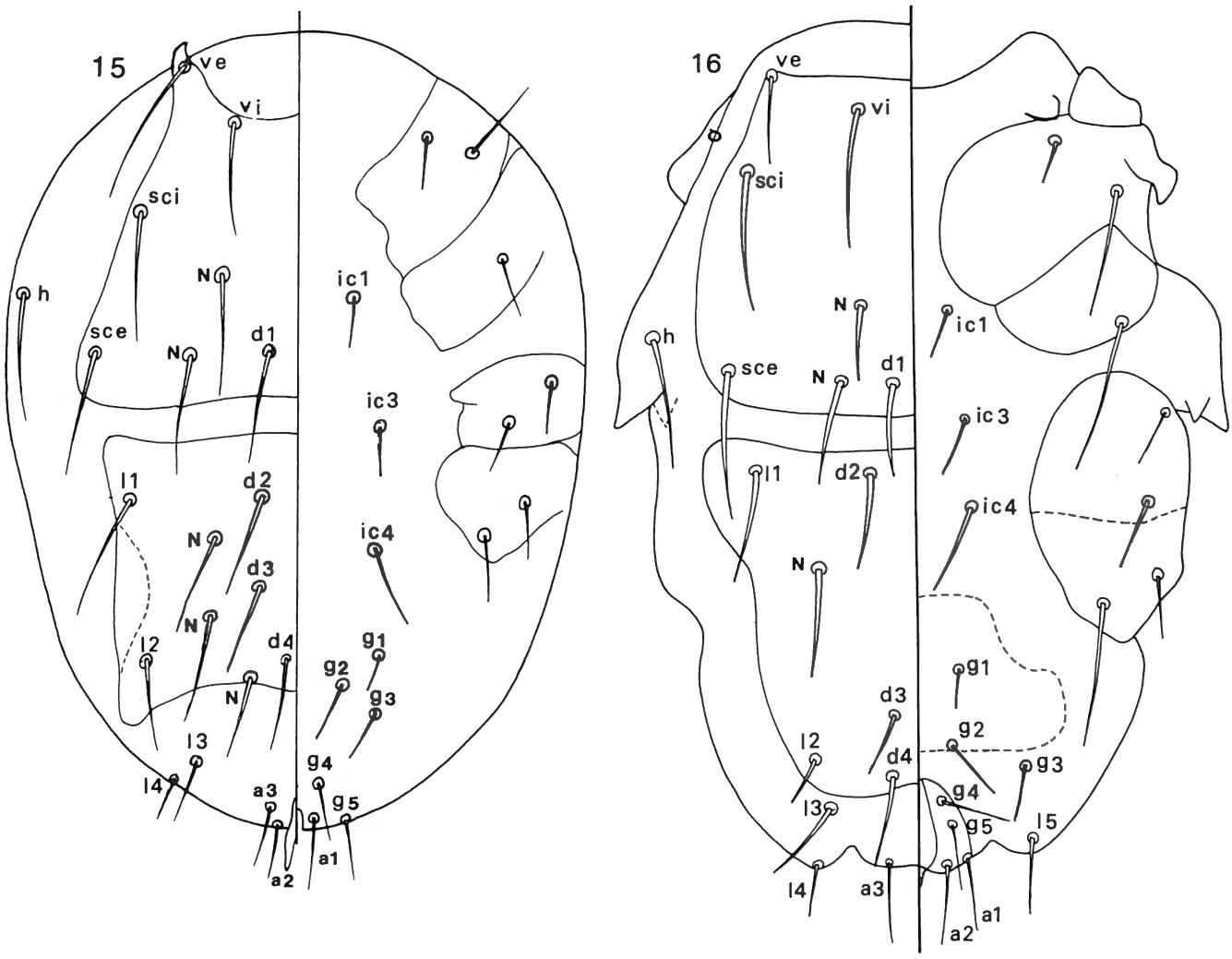


Fig. 14. – *Bicheyletiella romerolagi* Fain. Holotype female: idiosoma. (Published in International Journal of Acarology, vol. 5 (1979)).



Figs 15-16. – *Nihelia curvidens* (LAWRENCE). Female: idiosoma (Fig. 15). *Galagocheles lemuricola* (LAWRENCE). Female: idiosoma (16) (N= neotrichial setae). published in International Journal of Acarology, vol. 5 (1979)).

like setae. Palpal claw long, curved downward, with fine ventral striations. Tarsi I-IV without claws but with a strong rayed empodium. Eyes lacking. With either one or two pairs of anal setae. Absence of neotrichial setae on dorsum. Solenidiotaxy: tibia I without a solenidion. This subfamily includes three genera: *Cheyletiella* CANESTRINI, 1886, *Bicheyletiella* FAIN, 1972 and 1979f and *Eucheyletiella* VOLGIN, 1969. *Hosts:* Parasitic on various mammals: rabbits, dog, domestic cat, rodents (Pika).

Key to the Cheyletiellinae (females)

1. Dorsum with only one median shield (the propodonotal). Setae *l3* either long and barbed or lacking 2

   Dorsum with two median shields (a propodonotal an a hysteronotal). Setae *l3* short and smoooth . . . . . *Bicheyletiella*

2. Dorsal shield as long as or longer than wide, bearing only three pairs of barbed setae. With two pairs of anal setae. Setae *l2, l3, l4* lacking . . . . . *Eucheyletiella*

   Dorsal shield much wider than long, bearing four to five pairs of setae. With three pairs of anal setae. Setae *l1* to *l5* present . . . . . *Cheyletiella*

VI. NIHELIINAE SMILEY, 1977
(Tables 1-4; Figs 15-27)

Definition: Processes always present but variably developed either on idiosoma, gnathosoma, palps or legs. Dorsum with two large median shields (on propodo- and hysteronotum). Additional neotrichial setae (either homeomorphic or heteromorphic) present on dorsal shields. Genu and femur of the palps fused; tibia relatively long and apparently fused with the apical claw, forming a curved grasping organ; palpal tarsus reduced,

lacking in one genus, without comblike setae. Eyes lacking. In all the genera (*Sciurocheyla* has not been examined), the solenidion σ (of genu I) is lacking and replaced by a very small "stellate seta" (figs 19-21, 24-25).
This subfamily includes four genera: *Nihelia* DOMROW and BAKER, 1963, *Galagocheles* FAIN, 1979d, *Smileycheles* FAIN, 1979d and *Sciurocheyla* VOLGIN, 1969 (type species: *Nihelia squamosa* DOMROW and BAKER, 1960). *Hosts:* Mangooses, Primates, Rodents (Anomaluridae) and Sciuridae.

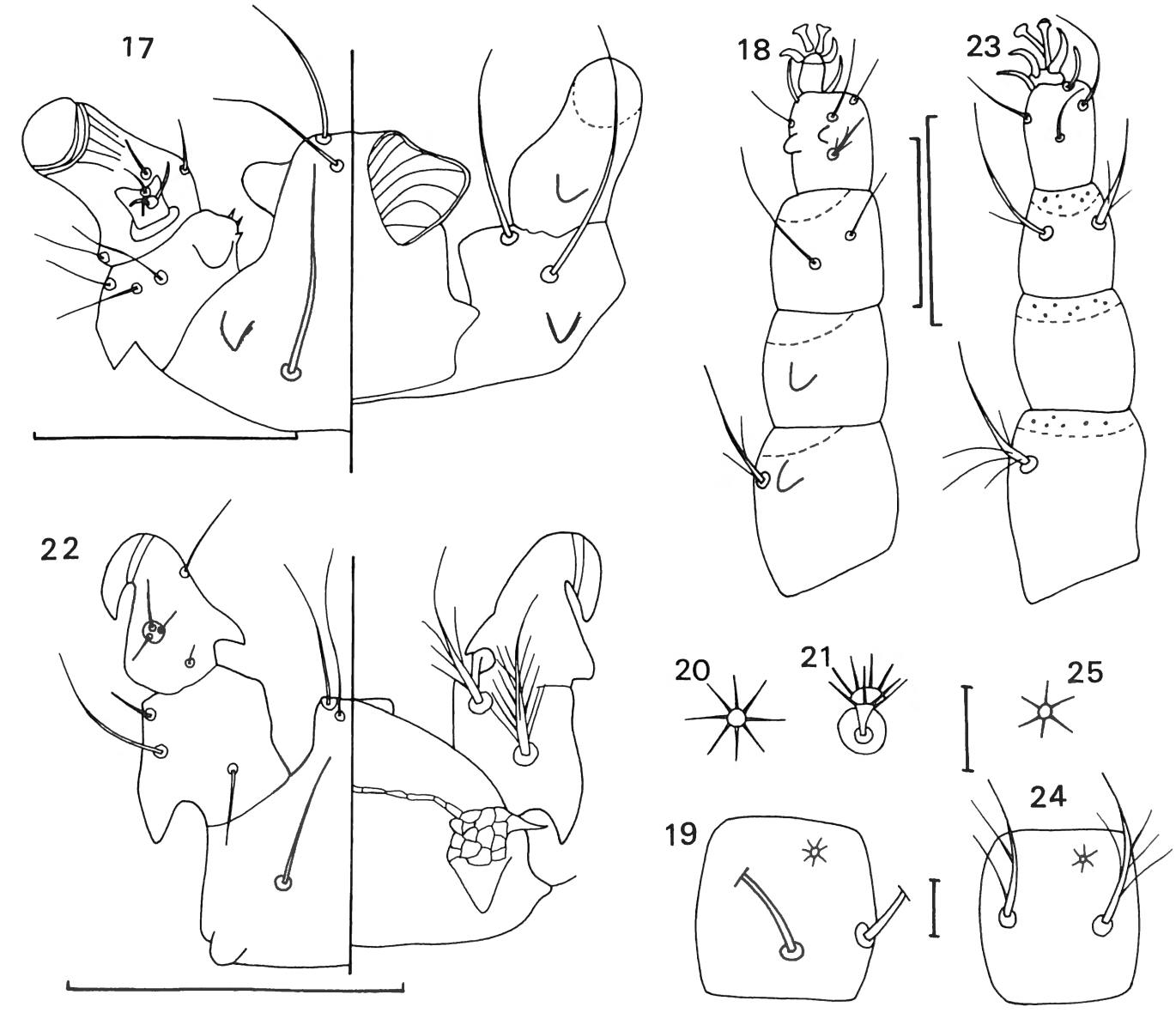
Key to the Niheliinae (females)

1. Dorsal shields with five pairs of squamose setae. Palps relatively short, strongly bent at apex; palpal femur dorsally with a pair of barbed setae and on posterior border a process. Coxae I with a retrorse process . . . . . *Sciurocheyla*

   Dorsal shield bearing only simple setae 2

2. Peritremes strongly inflated, with numerous elongated cells or cavities. Well-developed processes well developed on gnathosoma, palps, idiosoma and legs 3

   Peritremes bead-like, in an inverted-U. Processes poorly developed, confined to palpal femur and coxae



Figs 17-25. – *Galagocheles lemuricola* (LAWRENCE). Female: gnathosoma (17); leg I latero-ventrally (18); genu I dorsally (19); *Stellate seta* in apical view (20) and in lateral view (21); *Nihelia curvidens* (LAWRENCE). Female: gnathosoma (22); leg I ventrally (23); genu I dorsally (24); *Stellate seta* in apical view (25). Scale lines 100 μm (figs 17 and 22); 50 μm (figs 18 and 23); 10 μm (figs 20, 21, 25).

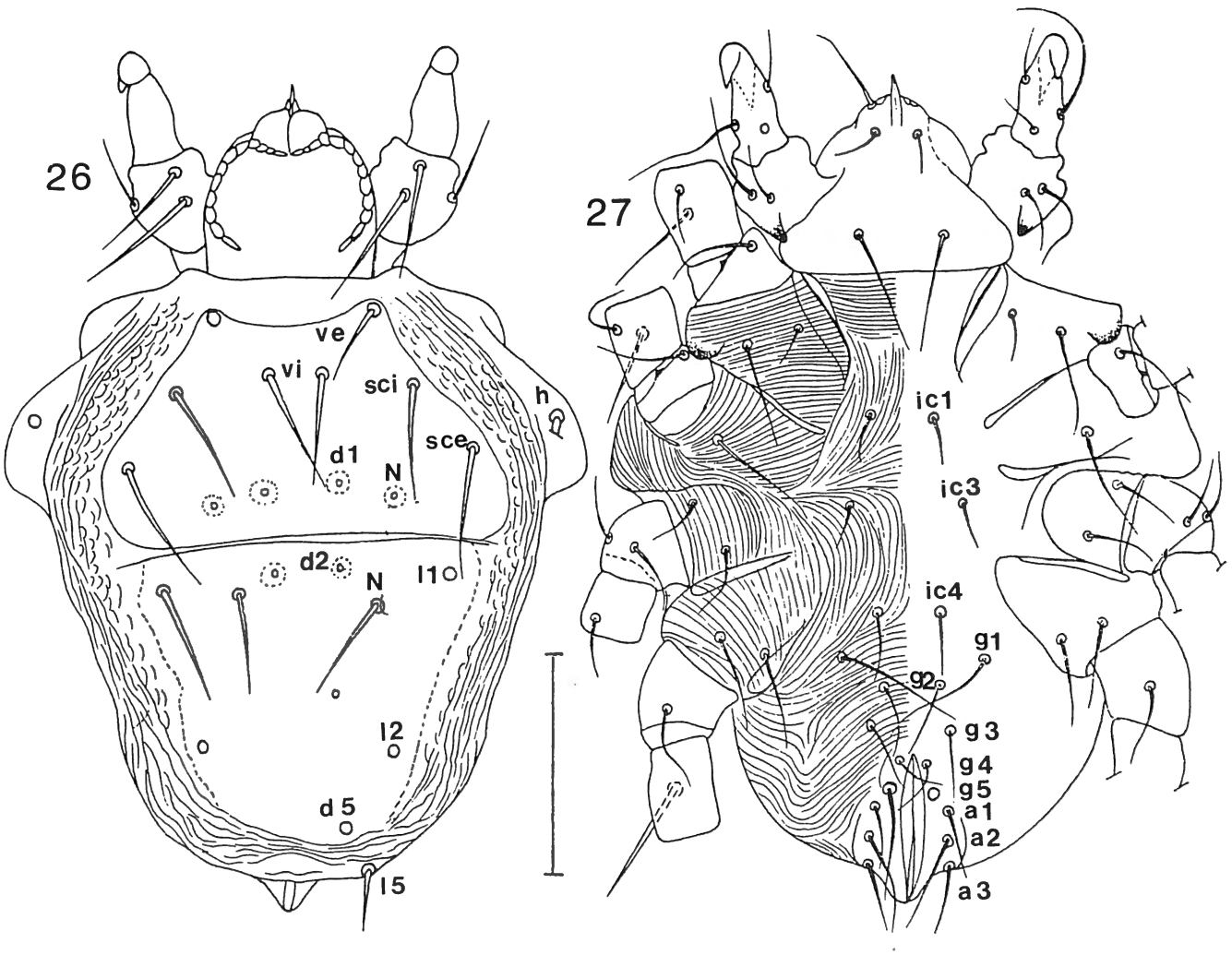
I. Palpal tibia long and narrow; palptarsus lacking . . . . . *Smileycheles*

3. Palpal tarsus relatively well developed and inequally bifid apically. Tibial claw flattened apically. Peritreme, with elongate cells, situated in anterior half of gnathosoma and extending laterally beyond the gnathosoma. Idiosoma with two pairs of processes on lateral margins (between coxae II and III) and one pair in front of coxae I. Base of gnathosoma with a pair of ventral processes. Legs I-II with ventral processes on tarsi, genua and femora . . . . . *Galagocheles*

Palpal tarsus rounded, very small.. Palpal tibia ending into a conical spine. Dilated part of peritreme situated in postero-lateral half of gnathosoma and containing numerous cavities. Idiosoma and legs I-II without processes. Base of gnathosoma with a pair of dorsal and a pair of ventral processes . . . . . *Nihelia*

VII. CRIOKERONTINAE SMILEY, 1977
(Tables 1-4)

Definition: Dorsum with two large median shields. Neotrichial setae variable. In *Criokeron quintus* the dorsum bears only the normal number of piliform basic setae, whilst in *C. thailandicus* there is one additional, neotrichial, pair of setae on the anterior shield. Gnathosoma very large. *Palps* small and narrow, tibia and tarsus fused forming a short segment wider than long and bearing inside a comblike seta with thick teeth, and more externally a rather long cylindrical shortly barbed seta, a short solenidion and a short cylindrico-conical seta. There is no tibial claw; the genu is incompletely fused with the femur. Base of gnathosoma prolonged laterally by a very strong retrorse process. Peritremes dilated with numerous elongate cells. Solenidiotaxy (table 1): genu I lacking a solenidion (σ), which is replaced by a "stellate seta" (as in the Niheliinae). Eyes lacking. All legs with two claws and a rayed empodium. This subfamily includes one genus *Criokeron* VOLGIN, 1966 and two species: *C. quin-*



Figs 26-27. – *Smileycheles camerounensis* FAIN. Holotype female in dorsal (26) and ventral (27) view (N= neotrichial setae). Scale line 100 μm.

tus (DOMROW and BAKER, 1963) and *C. thailandicus* FAIN and LUKOSCHUS, 1985. *Host: Tupaia glis.*

Key to the species of Criokeron (females)

1. Propodonotal shield with 5 pairs of setae; tibia I with a thick, relatively long, spoonlike ventral seta; peritremes very wide, not bifid posteriorly . . *C. quintus*

   Propodonotal shield with 6 pairs of setae; tibia I without a spoonlike seta; peritremes much smaller, bifid posteriorly . . . . . *C. thailandicus*

VIII. CHEYLETINAE LEACH, 1815
(Tables 1-4; Figs 1-9)

This subfamily includes *ca* 60 genera, in contrast to a total of 18 genera for the seven other subfamilies together.

It is very difficult to give an exact definition of this subfamily owing to the great diversity existing in the morphological characters of this group of mites. This heterogeneity is probably in relationship with the wide range of habitats occupied by these mites. Most of the Cheyletinae are free-living predators feeding on micro-arthropods, especially mites and collembolans. They occur on plants and in leaf-litter, or in granaries and warehouses inhabited by diverse micro-arthropods. Species of the genus *Cheyletus* and some other genera are common in the nests of birds or mammals or on the body of their hosts. Their role in the latter habitat is not known. VOLGIN (1969) provided a detailed account on the various habitats of the Cheyletinae.

In these free-living predators the pedipalps are nearly always strongly enlarged and they act as a raptor organ. The palpal tibia is prolonged by a large curved spine (also called claw). This segment is usually strongly developed and it serves to catch the prey. The palpal tarsus, always small, bears two comblike setae, several other setae and a solenidion. The three basal segments are unequally developed, the femur is the largest segment of the palps, the trochanter the smallest.

Other characters of the free-living Cheyletinae are the great development of the dorsal chaetotaxy with frequent neotrichy (at least in some genera) and the modification in the shape of certain dorsal setae.

These setae have received several names: squamate (or squamiform), flabellate, shelllike, clamshell-like, spatulate etc... The function of these modified setae is not known.

Some of these characters, however, are not constant and they may vary according to the genus to which the species belongs. Actually there are many forms intermediate between the free-living Cheyletinae and the obligate-parasites included in the other subfamilies of Cheyletidae. We think, however, that the division of the Cheyletidae based on both morphological and ecological criteria may be beneficial and will lead to a better comprehension of the whole group. The present study shows that some of the subfamilies retained here actually constitute true natural groups, i.e. the Chelonotinae and the Niheliinae, and part of the Ornithocheyletiinae.

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