World Crop Pests, 1A

SPIDER MITES THEIR BIOLOGY, NATURAL ENEMIES AND CONTROL

Volume 1A

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Spider Mites. Their Biology, Natural Enemies and Control. Volume 1A
Edited by W. Helle and M.W. Sabelis

1.1.4 Systematics

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INTRODUCTION

Considerable progress has been made in the systematics of Tetranychidae since 1955, the date of publication of the revision of the family carried out by Pritchard and Baker. This work also provides the first modern definition of this group, as well as its division into two large sub-families. The number of known genera which, before 1955, totalled 20, has now risen to 63, while the number of valid species has increased from 185 to almost 900. Numerous species, however, are still to be discovered. In 1979 Baker estimated that approximately 70% of the world fauna was still unnamed.

After a period during which most descriptions were unclear, valuable progress was made in 1913 by Ewing, who pointed out the taxonomic value of the male genital armature. This character was used by McGregor, particularly in one of his last publications (McGregor, 1950), but previously many authors had neglected this piece of information, just as Grandjean's basic work (Grandjean, 1948) had also gone unnoticed.

The economic significance of red spider mites was the reason why research on them was approached from a practical angle. For a considerable length of time, taxonomists limited investigations and bibliography to their immediate geographical region. This happened to such an extent that a cosmopolitan species like *Tetranychus urticae* Koch managed to end up with more than 50 different names.

Nowadays, there is greater communication between scientists, and the number of features recorded by taxonomists has increased. Gradually, a phase of synthesis, integrating factors from several disciplines, is being reached. Also, attempts are being made to formulate phylogenetic hypotheses for a number of tribes. There is now a strong possibility of a transition from a phenetic classification, which attributes equal value to available characters, to a cladistic classification based on phylogeny.

PECULIARITIES AND TRENDS IN THE SYSTEMATICS OF SPIDER MITES

Ideally, the systematics of tetranychid mites should be based on excellent descriptions. The descriptions should be potentially extensive enough to replace the examination of the type material. This demand is even more crucial and delicate than in insects because of the transient nature of acarine preparations. Microscopic slides will degenerate and are likely to break down after a relatively short period of time. A large number of old slides have disappeared and are no longer usable. An additional difficulty interfering

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with the study of the type material is that collections are scattered throughout the world. The Berlese collection, for example, may only be consulted on the spot in Florence.

There are other drawbacks, related to the bad practices of workers in tetranychid systematics. Most descriptions are based on drawings made from specimens flattened out between slide and cover-slide, which give little idea of the actual physical appearance of the mite and of the relative position of the setae. This is particularly important for those groups which are differentiated by the latter character. It would therefore be preferable to make such descriptions from specimens prepared in cavity slides.

Another point to mention here concerns the stases studied. Whereas academic research includes all stases in the mite's life-cycle, systematicists actually working on red spider mites generally only use the adult stase.

As is the case for many other animal groups, the papers of first authors allow identification of tetranychid mites at genus level only. Descriptions should now be extended to include the largest possible number of features and scientists should not be satisfied with a mere drawing of an aedeagus or dorsum, even if these elements seem to be sufficient to identify a species at the time of its discovery. This attitude will make future research a more complicated matter. Systematic studies should include clearly drawn plates, presented uniformly to increase legibility. For example, right-sided tibiae and tarsi should always be drawn from the outer side, as Pritchard and Baker did in 1955, as well as in later publications. Likewise, the aedeagus should always be drawn in perfect profile, with the distal end towards the right.

Since morphological criteria are often small in number and the differences between them often subtle, there is an increasing tendency to call on several other disciplines to complete this data:

— Biological information is the most simple to note and from the beginning, authors have given the name of the host plant. The latter should always be indicated by its latin name, not by its common name. Although most economic species are polyphagous, a certain number are restricted to a single botanical species or family. One may be even more specific in noting also the preferential position occupied by the mites on the plant (upper or lower surface of the leaf) and by describing the damage done. It is also of interest to indicate the colour of adults and to provide information on the structure and appearance of the webs spun, as well as on the shape and position of eggs, and position of exuviae and faeces. Without going into a detailed study, it is sometimes possible to note the existence of quiescent or diapausing stages (eggs or adults), under the effect of climatic factors (photoperiod, cold or drought).

— A considerable amount of data have been collected on the cytogenetics of Tetranychidae, in particular by Helle and Bolland, in a series of papers published since 1967. The diversity of the results obtained is promising and by cross-checking these data against other morphological and biological information, it is possible to make a certain number of comparisons between species.

— The assessment of reproductive barriers between species usually represents important information. However, the interpretation of data on the genetic affinities may sometimes pose problems for the student. It has been shown for the *T. urticae* complex that morphologically indistinguishable populations having the same colour may exhibit complete reproductive barriers (see Chapter 1.3.3). On the other hand, gene flow could be demonstrated between certain green and carmine-coloured populations of this complex (Dupont, 1979).

— Further developments may be anticipated by studies on enzyme

polymorphism in tetranychid mites (see Chapter 1.3.2 and Ward et al., 1982). Zymograms may reveal patterns of relationships between members of the large genera, such as *Eotetranychus* Oudemans and *Tetranychus* Dufour, which possibly will be of significance for systematic studies.

RELATIVE IMPORTANCE OF CHARACTERS

The division of tetranychid mites into sub-families, tribes and genera is based mainly on the examination of females, in which the morphology of empodium, the chaetotaxy of the dorsum and the position of duplex setae have been studied. The first 2 characters are clearly of phylogenetical importance. The shape of the empodium is linked to the mite's life type and the nature of the surface on which it moves (stalk, upper or lower surface of leaves) or marks an adaptation to locomotion along silken strands or on a web that is of varying density (see evolution of the ambulacrum in Chapter 1.1.5).

The hypothesis may be put forward that the position, length and shape of dorsal setae is connected with the protection of the mites from predators, especially in non-spinning species (most Bryobiinae Berlese) and in species secreting only little silk (Tenuipalpoidini Pritchard and Baker, Eurytetranychini Reck). In certain genera, as in *Eutetranychus* Banks, for instance, the length of dorsal setae may vary from one specimen to another. Saito and Takahashi (1980) found that in the case of *Schizotetranychus celarius* (Banks) a correlation exists between the length of some dorsal setae and the height of the web above the leaf surface.

In the tribe Tetranychini Reck, it would be interesting to know whether or not the lengthening of the solenidia of the duplex setae can be linked to web spinning. In these species, which often live in dense colonies, the lengthening of the solenidia may also be correlated with the frequency of social contacts.

Other features used in distinguishing genera and sub-genera appear to constitute nothing more than a convenient method of separating groups and species. Such is the case for the pattern of dorsum and dorsal striation of the female opisthosoma. The division of the genus *Oligonychus* Berlese into separate sub-genera based solely on this last criterion seems to conform less to phylogeny, than to a classification based on the form of the empodial claw or of the aedeagus (Gutierrez et al., 1979).

As for the division into species, the study of females must be complemented by that of males, if and when they exist. This study is often indispensable, e.g. for the identification of members of the tribe Tetranychini, where the females are morphologically very similar within each genus.

Besides those characters which have led to the determination of the genus, the following are also studied: (1) the shape of the male aedeagus; (2) the chaetotaxy of legs; (3) the shape of the peritreme (which may end in a simple bulb, a distal hook or an anastomosing system); (4) the shape of the spinning eupathidium of the palpal tarsus; (5) the aspect of the dorsal integument and the dorsal striation pattern of the female opisthosoma; (6) the ventral chaetotaxy of the body. The characteristics of the integumental striae on and just anterior to the genital flap are also considered, especially in the genus *Eotetranychus* (Pritchard and Baker, 1955).

Hopes were held of distinguishing the green and red forms of the *T. urticae* complex by examining the form of the lobes on the dorsal cuticular ridges of the female mites. However, the significance of this character for the distinction of 'the' red species in this species complex is questionable (Dupont, 1979).

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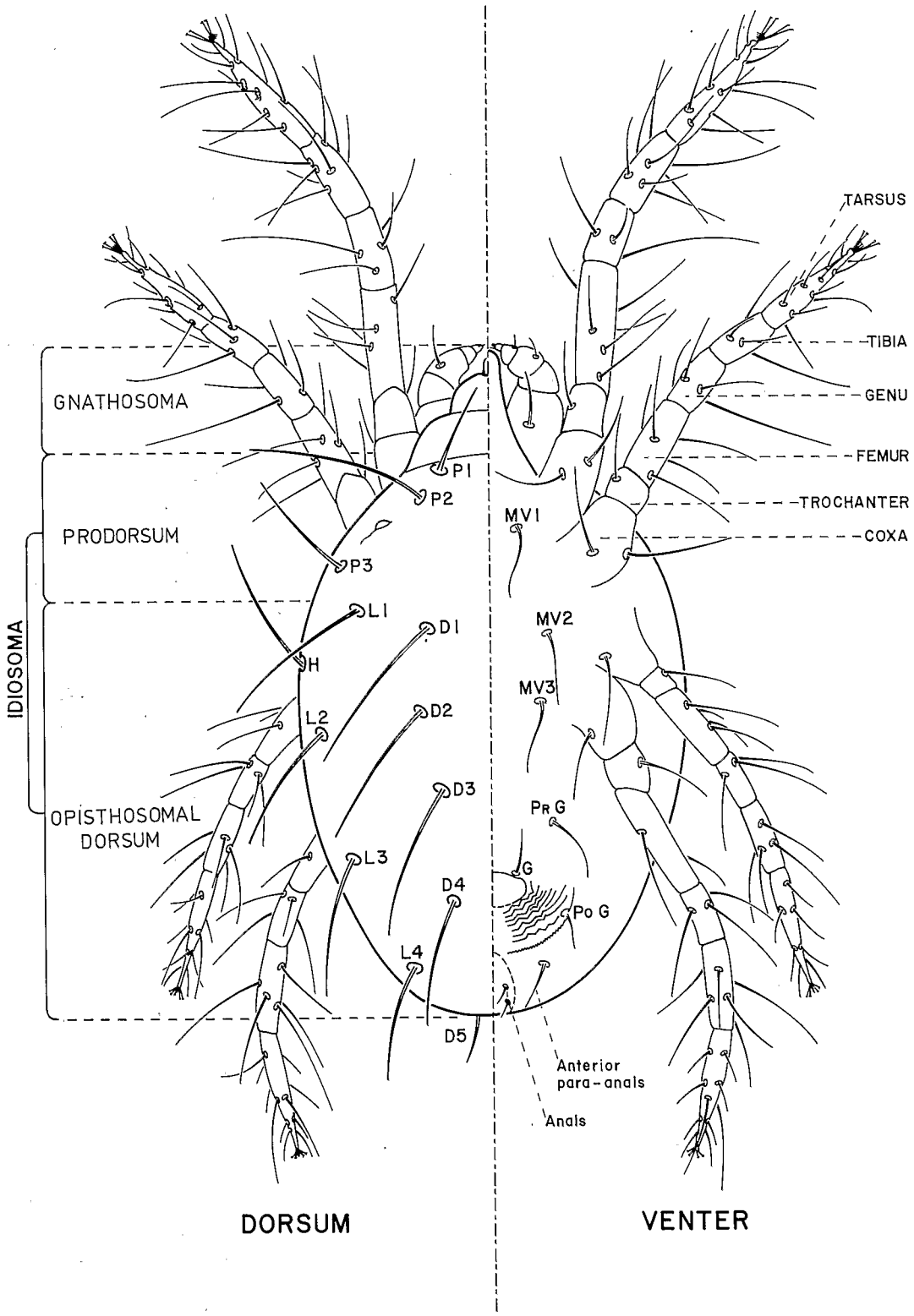

Fig. 1.1.4.1. *Tetranychus urticae* Koch: dorsoventral aspect of the female showing the nomenclature of body setae.

NOMENCLATURE OF THE PHANERES STUDIED IN TAXONOMY

The nomenclature of phaneres often varies from one author to another; consequently it has become necessary to update the terms used in this field in order to facilitate the reading of determination keys. In the present paragraph, a brief survey is given of the terms used.

Body setae

Figure 1.1.4.1, which represents a dorsoventral aspect of the female of *Tetranychus urticae*, shows the system most commonly used to designate setae.

Dorsum

In the Tetranychinae Berlese, the prodorsum generally bears 3 pairs of setae (P_1, P_2, P_3). Their designation according to Grandjean's notation is still uncertain because of the strong reduction in their original number (L. van der Hammen, personal communication, 1984).

The opisthosomal dorsum has 5 pairs of dorsal setae (D_1, D_2, D_3, D_4, D_5), 4 pairs of lateral setae (L_1, L_2, L_3, L_4) and 1 pair of humeral setae (H). In Grandjean's notation, the dorsals should be named c_1, d_1, e_1, f_1, h_1, the laterals c_2, d_2, e_2, f_2, and the humerals c_3.

D_1, D_2 and D_3 are also termed dorsocentral hysterosomals; L_1, L_2 and L_3, dorsolateral hysterosomals; D_4 and L_4, inner and outer sacrals; D_5, clunals. Reck (1959) and Mitrofanov (1971a) named the dorsal setae as follows: parietals (P_1), oculars (P_2, P_3), scapulars (D_1, L_1, H), prelumbals (D_2, L_2), lumbals (D_3, L_3), sacrals (D_4, L_4) and caudals (D_5).

In the Bryobiinae Berlese, another pair of inner setae may occur together with P_1, the former pair occasionally being reduced to a single seta (genus *Septobia* Zaher et al.). L_2 and L_3 are also often doubled, resulting in 12 pairs of dorsal hysterosomal setae instead of 10. D_4 may be set further back to occupy a marginal position. In rare cases, the number of opisthosomal setae may be as few as 6 pairs (genus *Marainobia* Meyer), or as many as 34 pairs (genus *Dasyobia* Strunkova) owing to replacement of several dorsal setae by tufts of 4 setae (neotrichy).

Venter

In the females of Tetranychinae, there are generally 3 pairs of medioventral setae (Mv_1, Mv_2, Mv_3), 1 pair of pregenitals (Pr G), 1 pair of genitals (G), 1 pair of post-genitals (Po G), 2 pairs of anals and 2 pairs of para-anals (anterior and posterior para-anals). The males have 4 pairs of genito-anal setae.

According to Grandjean's notation, the medioventrals should be named 1a, 3a, 4a, the pregenitals ag_1, the genitals g_1, the post-genitals ag_2, the anals (or pseudanals) ps_1, ps_2 and the para-anals h_1, h_2.

Reck (1959) and Wainstein (1960) named the para-anal setae as post-anals.

In 5 genera (*Eurytetranychoides* Reck, *Oligonychus*, *Hellenychus* Gutierrez, *Atrichoproctus* Flechtmann and *Tetranychus*), the posterior para-anals are absent. There is only 1 pair of anal setae in the genera *Aponychus* Rimando, *Paraponychus* Gonzalez and Flechtmann, *Acanthonychus* Wang, *Palmanychus* Baker and Pritchard, and *Atrichoproctus*.

In the Bryobiinae, the females have 3 pairs of anal setae and the males 5 pairs of genito-anal setae.

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The para-anals may be in a dorsal position in the genera *Bryobiella* Tuttle and Baker, and *Edella* Meyer. There are 2 pairs of pregenital setae instead of 1 in *Strunkobia pamirica* Livshitz and Mitrofanov. Instead of the usual medioventral and pregenital setae, about 19 pairs of plumose setae may be present in *Neotrichobia* Tuttle and Baker.

Phaneres of legs and palps

The chaetotaxy of legs and palps of several species of Tetranychidae has been studied in detail by Grandjean (1948), Wainstein (1958), Mitrofanov (1971b), then Robaux and Gutierrez (1973). These works, based on the study of all stases under the polarizing microscope, enables a distinction to be made between anisotropic phaneres (ordinary setae, bothridial setae and eupathidia) and isotropic phaneres (solenidia). However, most authors have used the nomenclature popularized by Pritchard and Baker (1955), which is based on the observation of the adult stase under an ordinary microscope. This system uses only the terms sensory setae, tactile setae and duplex setae. The tactile setae are in fact anisotropic phaneres, while the sensory setae are solenidia. The duplex setae are composed of 1 proximal ordinary seta and 1 distal solenidion.

Legs

Figure 1.1.4.2 represents the tibiae and tarsi I and II of *Tetranychus neocaledonicus* André, each phanere being named according to the notation of Grandjean.

Anisotropic phaneres. Ordinary setae are named according to the file and the verticil to which they belong. The file may be: dorsal (d), laterodorsal (l' and l''), or lateroventral (v' and v''). The verticil is indicated by a number. The whole is followed by the name of the particular stase after the larval stase (L), at which the seta appeared: N_1, N_2 or adult (Ad). When no stase is mentioned, the base level is larval.

For the setae on the distal end of the tarsus, specific terms are used: prorals (p), unguinals (u), tectals (tc), fastigials (ft) and primiventrals (pv).

There is only 1 bothridial seta on tibia I: db.

The legs I and II each have 3 eupathidia: $p'\zeta$, $p''\zeta$ and $pv'\zeta$.

Isotropic phaneres. There are solenidia represented by the greek letters ω for the tarsi and φ for the tibiae. Males often have additional solenidia represented by $\omega\delta$ and $\varphi\delta$.

With the exception of a few species which have already been studied in depth, it would be impossible in practice to undertake such a detailed description of each taxon. Nonetheless, Grandjean's research should be taken into consideration. The differences between various 'tactile setae' should be indicated and the term 'sensory setae' replaced by solenidia, especially since the exact role of these setae is unknown. The term 'duplex setae', used by systematists and retained in the present study should be replaced by the term 'coupled phaneres' (L. van der Hammen, personal communication, 1984).

Palps

Taxonomists basically use the chaetotaxy of palpal tarsus. According to Pritchard and Baker (1955), 7 setae occur on this segment: 3 tactile setae and 4 sensory setae. In the latter 'the proximal is fusiform, 2 are tapering, the

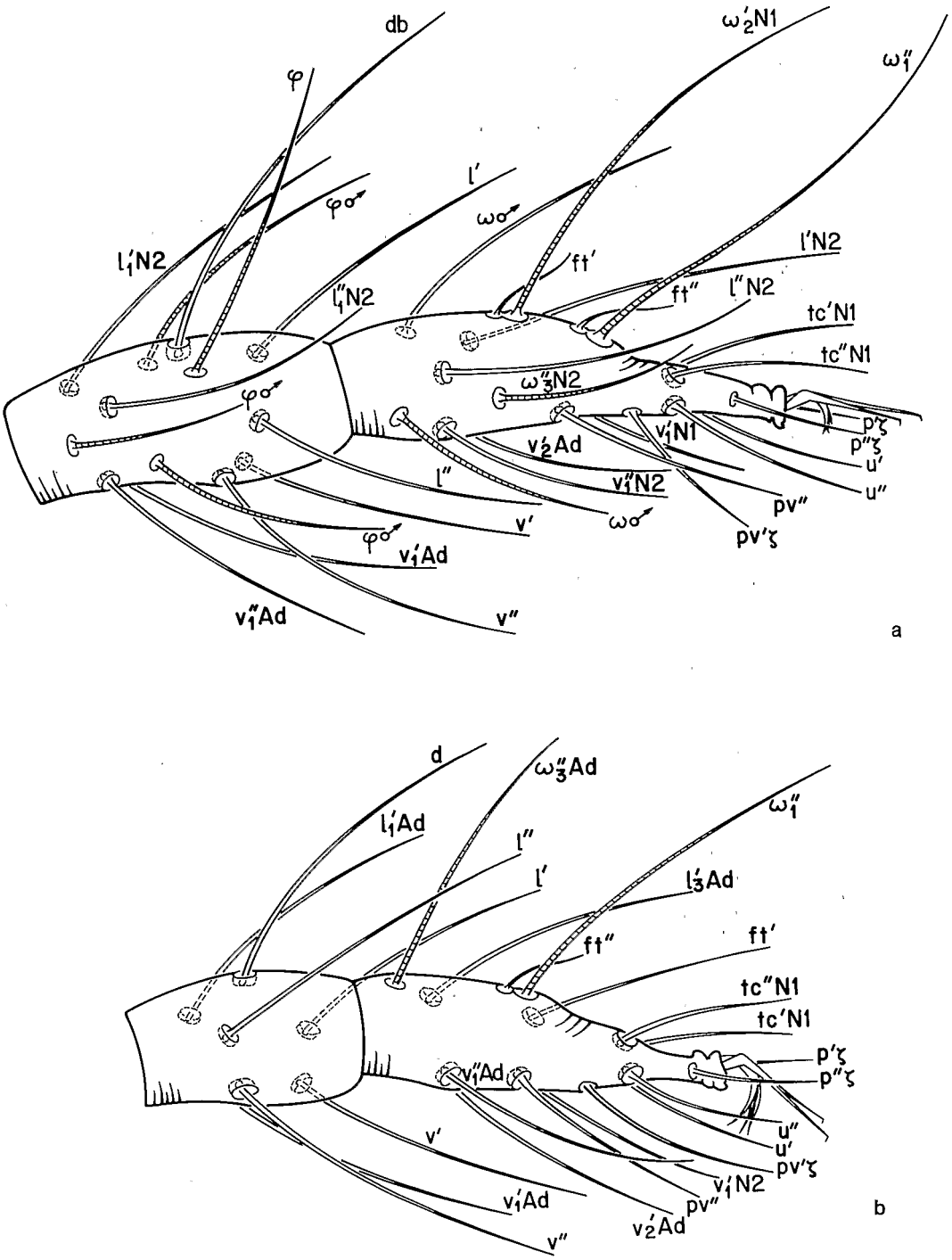

Fig. 1.1.4.2. *Tetranychus neocaledonicus* André, male, designation of setae according tc Grandjean's nomenclature. (a) Tibia and tarsus I; (b) tibia and tarsus II.

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terminal sensillum is usually well developed and rounded at the tip'. In fact, as shown by Grandjean's research, the palpal tarsus does bear 3 ordinary setae, but the 4 sensory setae must not be interpreted as such. The 'fusiform sensory seta' is, in fact, a solenidion, whereas the 3 others are eupathidia. The 'terminal sensillum' is, in fact, in the Tetranychinae a spinning eupathidium. At the tip of this seta are several tiny orifices through which flow the secretion from the silk gland. The size of this eupathidium varies considerably from one species to another and also according to sex.

DIVISION OF THE TETRANYCHIDAE INTO SUB-FAMILIES, TRIBES AND GENERA

After having distinguished between the 2 sub-families of Tetranychidae, several keys lead to 6 tribes and 63 present genera. The following system has been set up using the work of Smith Meyer (1974) and that of Jeppson et al. (1975). The system has been revised and completed with the addition of 12 new genera recently described: *Acanthonychus* Wang, 1982; *Atetranychus* Tuttle et al., 1974; *Crotonella* Tuttle et al., 1974; *Eremobryobia* Strunkova and Mitrofanov, 1982; *Lindquistiella* Mitrofanov, 1976; *Meyernychus* Mitrofanov, 1977; *Paraponychus* Gonzalez and Flechtmann, 1977; *Septobia* Zaher et al., 1982; *Sonotetranychus* Tuttle et al., 1976; *Strunkobia* Livshitz and Mitrofanov, 1972; *Tenuipalponychus* Channabasavanna and Lakkundi, 1977; *Yezonychus* Ehara, 1978. Moreover, *Eurytetranychoides* Reck, 1950, has been restored.

McGregorella Baker and Tuttle, 1972 has been considered to be a synonym of *Beerella* Wainstein, 1961, since these 2 taxa have the same

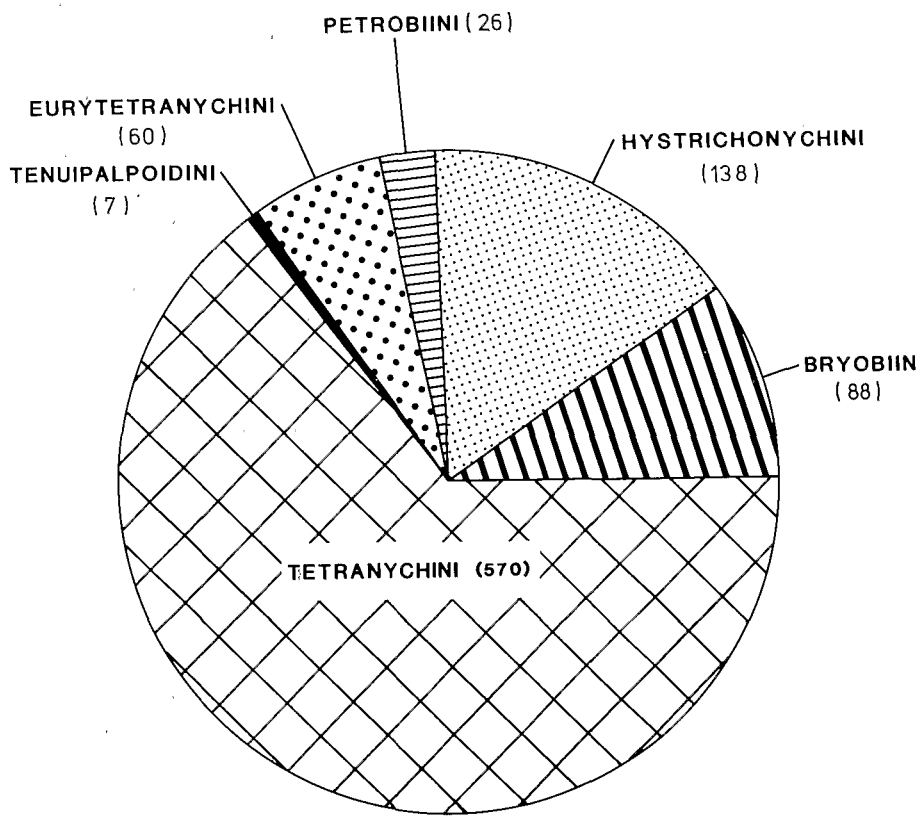

Fig. 1.1.4.3. Distribution of the number of species presently known, between the 6 tribes of Tetranychidae.

characters (prodorsum with 3 pairs of setae; opisthosoma with 9 pairs of dorsal setae; dorsocentral setae set on strong tubercles, the 5th being absent).

Georgiobia Wainstein, 1960 has been considered to be a synonym of *Aplonobia* Womersley, 1940 since the distinguishing characters between these 2 groups (D_2, D_3 and D_4 contiguous or well-separated) are not clear enough.

Sinotetranychus Ma and Yuan, 1980 and *Chinotetranychus* Ma and Yuan, 1982 have been considered to be synonyms of *Aponychus* Rimando, 1966, since slight differences in the length of dorsal setae, in the present author's opinion, is not a sufficient criterion for the separation of genera of Eurytetranychini. In this tribe, the length of dorsal setae is unreliable even for species separation.

For practical considerations, the genus *Bryocopsis* Meyer with lack of hooked claws, has been transferred to the tribe Hystrichonychini Pritchard and Baker, although the dorsal aspect of the female is similar to that of the members of *Bryobia* Koch in the Bryobiini Reck.

Several genera have been reduced in sub-generic rank: *Reckia* Wainstein, *Langella* Wainstein, *Anaplonobia* Wainstein, *Brachynychus* Mitrofanov and Strunkova, *Tylonychus* Miller and *Bakerina* Chaudhri. The division into sub-genera of the genus *Petrobia* Murray, made by Wainstein (1960), has been restored.

Figure 1.1.4.3 shows the relative size of the 6 tribes: the Tetranychini alone, with 570 species, comprise more than half of the members of the family, whereas the Tenuipalpoidini have only 7 known species.

The different genera are also extremely varied in size: 38 genera, of which 34 date from after 1955, include less than 5 species. Figure 1.1.4.4 indicates the number of species for the genera with more than 20 known members; only 3 genera have more than 100 species: *Eotetranychus*, *Oligonychus* and *Tetranychus*.

Within each tribe, the use of dichotomic keys has not permitted the presentation of genera according to sequences in line with current phylogenetic hypotheses. Thus, for example, in the genera of Bryobiini with 8 setae on the prodorsum, instead of the series *Marainobia*, *Bryobia*, *Pseudobryobia*, *Strunkobia*, one should have the sequence *Bryobia*, *Pseudobryobia*, *Strunkobia*, *Marainobia*. For the last 4 genera of Tetranychini, instead of the series *Tetranychus*, *Atrichoproctus*, *Oligonychus*, *Hellenychus*, one should have the sequence *Oligonychus*, *Hellenychus*, *Tetranychus*, *Atrichoproctus*.

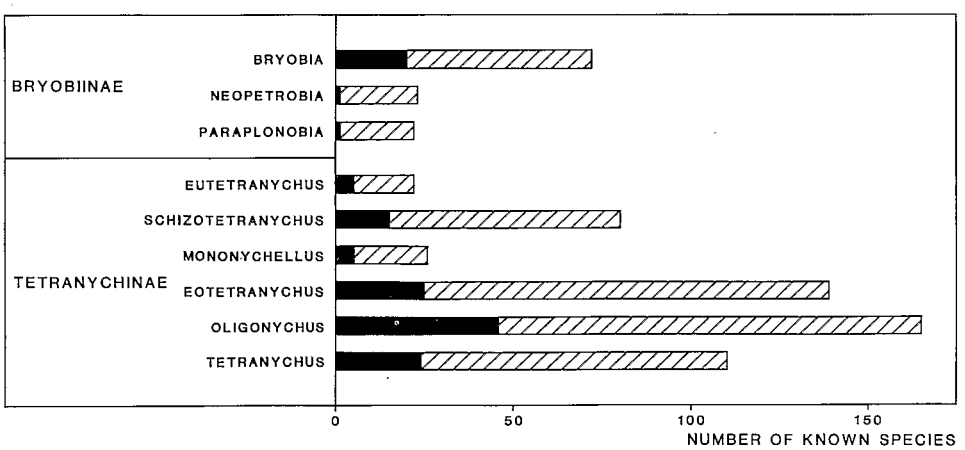

Fig. 1.1.4.4. Number of species of the genera represented by more than 20 known taxa. The fraction indicated in black corresponds to the number of species described before 1955.

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KEYS

TETRANYCHIDAE Donnadieu

Tetranycidés Donnadieu, 1875: 9.
Tetranychidae Murray, 1877: 93; Pritchard and Baker, 1955: 4; Tuttle and Baker, 1968: 1.

Key to the sub-families

— Empodium with tenent hairs; females with 3 pairs of anal setae and males with 5 pairs of genito-anal setae ..... BRYOBIINAE Berlese
— Empodium absent, or if present without tenent hairs; females with 1 or 2 pairs of anal setae and males with 4 pairs of genito-anal setae .....
..... TETRANYCHINAE Berlese

1. BRYOBIINAE Berlese
Bryobiini Berlese, 1913: 17
Bryobiinae Reck, 1950: 122; Pritchard and Baker, 1955: 12.

Key to the tribes

1 — True claws uncinate, empodium pad-like ..... BRYOBIINI Reck
— True claws pad-like, empodium pad-like or uncinate 2
2 — Claws and empodium pad-like .....
..... HYSTRICHONYCHINI Pritchard and Baker
— Claws pad-like and empodium uncinate ..... PETROBIINI Reck

1.1 BRYOBIINI Reck
Bryobiinae Reck, 1952: 423.
Bryobiini Reck, Pritchard and Baker, 1955: 14.

Key to the genera based on the females

1 — Prodorsum with 8 setae (4 pairs) 2
— Prodorsum with 6 or 7 setae 5
2 — Opisthosoma with 12 pairs of dorsal setae 3
— Opisthosoma with 6 pairs of dorsal setae ..... MARAINOBIA Meyer
3 — Prodorsum with prominent lobes over the gnathosoma. BRYOBIA Koch
— Prodorsum without prominent lobes over the gnathosoma 4
4 — Venter with 1 pair of setae on the mentum and 1 pair of pregenitals .....
..... PSEUDOBRYOBIA McGregor
— Venter with 2 pairs of setae on the mentum and 2 pairs of pregenitals...
..... STRUNKOBIA Livshitz and Mitrofanov
5 — Prodorsum with 6 setae (3 pairs) 6
— Prodorsum with 7 setae ..... SEPTOBIA Zaher et al.
6 — Opisthosoma with 12 pairs of dorsal setae 7
— Opisthosoma with 10 pairs of dorsal setae .....
..... EREMOBRYOBIA Strunkova and Mitrofanov.
7 — Tarsus I without duplex setae, para-anal setae dorsal .....
..... BRYOBIELLA Tuttle and Baker
— Tarsus I with 2 duplex setae, para-anal setae in ventral position .....
..... HEMIBRYOBIA Tuttle and Baker

1.2 HYSTRICHONYCHINI Pritchard and Baker
Hystrichonychini Pritchard and Baker, 1955: 35.

Key to the genera based on the females

1 — Prodorsum with 4 pairs of setae 2
— Prodorsum with 3 pairs of setae 4
2 — With 4 prominent lobes over the gnathosoma. . . . BRYOCOPSIS Meyer
— Without prominent lobes over the gnathosoma. 3
3 — Opisthosoma with 12 pairs of dorsal setae .....
..... TETRANYCOPSIS Canestrini
— Opisthosoma with 9 pairs of dorsal setae ..... NOTONYCHUS Davis
4 — Opisthosoma with 10 or more pairs of dorsal setae. 5
— Opisthosoma with 8 to 9 pairs of dorsal setae. 14
5 — Body at least twice as long as broad; prodorsum with lobes over the gnathosoma more or less developed 6
— Body not elongate; prodorsum without lobes over the gnathosoma . . .8
6 — Prodorsal lobes well developed 7
— Prodorsal lobes poorly developed ..... DOLICHONOBIA Meyer
7 — Prodorsum with 3 lobes over the gnathosoma. .....
..... MONOCERONYCHUS McGregor
— Prodorsum with 2 lobes over the gnathosoma. .....
..... MESOBRYOBIA Wainstein
8 — D4 in normal position. 9
— D4 in marginal position or nearly so ..... NEOPETROBIA Wainstein[1]
9 — Dorsum with 12 pairs of opisthosomal setae. .....
..... HYSTRICHONYCHUS McGregor
— Dorsum with 10 pairs of opisthosomal setae. 10
10 — Two sets of duplex setae on tarsus I 11
— Four sets of duplex setae on tarsus I. .....
..... PARAPETROBIA Meyer and Ryke
11 — D1, D2, D3 and D4 located on cushion-like plates. .PELTANOBIA Meyer
— Opisthosoma without plates 12
12 — Coxal formula not exceeding 4—3—2—2. 13
— Many ventral and coxal setae . . TAURIOBIA Livshitz and Mitrofanov
13 — Some or all dorsal setae set on strong tubercles .....
..... APLONOBIA Womersley
— Dorsal setae not set on strong tubercles. . .PARAPLONOBIA Wainstein[2]
14 — Opisthosoma with 9 pairs of dorsal setae; dorsocentral setae set on strong tubercles ..... BEERELLA Wainstein
— Opisthosoma with 8 pairs of dorsal setae 15
15 — Humeral setae contiguous with L_1; dorsal body setae set on strong tubercles and mostly contiguous. ..... PORCUPINYCHUS Anwarullah
— Humeral setae and other dorsal body setae well separated and set on small tubercles ..... AFRONOBIA Meyer

1.3 PETROBIINI Reck

Petrobiinae Reck, 1952: 423.
Petrobiini Reck, Pritchard and Baker, 1955: 42; Wainstein, 1960: 131; Tuttle and Baker, 1968: 71.

Key to the genera based on the females

1 — 3 pairs of medioventral body setae 2
— Many medioventral body setae . . . . NEOTRICHOBIA Tuttle and Baker[3]
2 — 1 set of duplex setae on tarsus I . . . . SCHIZONOBIELLA Beer and Lang
— 2 or more sets of duplex setae on tarsus I. 3
3 — Prodorsum with 3 prominent lobes over the gnathosoma. .....
..... MEZRANOBIA Athias-Henriot
— Prodorsum without prominent lobes over the gnathosoma. 4

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4 — Empodium with 2 rows of ventrally directed tenent hairs 5
— Empodium with a single pair of tenent hairs.....
..... SCHIZONOBIA Womersley
5 — Dorsum with not more than 15 pairs of dorsal body setae 6
— Dorsum with many dorsal body setae.....DASYOBIA Strunkova
6 — True claws without hair-like processes 7
— True claws with 2 short hair-like processes.....
..... LINDQUISTIELLA Mitrofanov
7 — Para-anal setae in dorsal position, empodium with a strong medioventral claw .....EDELLA Meyer
— Para-anal setae in ventral position, empodium curved distally.....
..... PETROBIA Murray[4]

2. TETRANYCHINAE Berlese
Tetranychini Berlese, 1913: 17
Tetranychinae Reck, 1950: 123; Pritchard and Baker, 1955: 96.

Key to the tribes

1 — Empodium claw-like when present, tarsus I with loosely 'associated setae' or with 1 pair of duplex setae; when 2 pairs of duplex setae on tarsus I then no pairs on tarsus II .....EURYTETRANYCHINI Reck
— Empodium claw-like or split distally, tarsus I with 2 pairs of duplex setae and tarsus II with 1 pair.....2
2 — Opisthosoma with D_4 in marginal position or absent .....
..... TENUIPALPOIDINI Pritchard and Baker
— Opisthosoma with D_4 in normal position ..... TETRANYCHINI Reck

2.1 TENUIPALPOIDINI Pritchard and Baker
Tenuipalpoidini Pritchard and Baker, 1955: 97; Wainstein, 1960: 145—146; Tuttle and Baker, 1968: 83.

Key to the genera based on the females

1 — D_4 in marginal position.....2
— D_4 absent .....EONYCHUS Gutierrez
2 — Empodium a simple claw 3
— Empodium split distally ..... CROTONELLA Tuttle et al.
3 — Tarsus II with distal member of duplex setae a short solenidion.....
..... TENUIPALPOIDES Reck and Bagdasarian
— Tarsus II with distal member of duplex setae a long solenidion .....
..... TENUIPALPONYCHUS Channabasavanna and Lakkundi

2.2 EURYTETRANYCHINI Reck
Eurytetranychinae Reck, 1950: 123; Wainstein, 1960: 223.
Eurytetranychini Pritchard and Baker, 1955: 100; Tuttle and Baker, 1968: 81.

Key to the genera based on the females

1 — Tarsus I with or without 'associated setae', or with 2 pairs of duplex setae.....2
— Tarsus I with 1 pair of duplex setae. . . ATETRANYCHUS Tuttle et al.
2 — Tarsus I with or without 1 pair of 'associated setae' 3
— Tarsus I with 2 pairs of 'associated setae' or 2 pairs of duplex setae 9

3 — Empodial claw large . . . . . SYNONYCHUS Miller
— Empodial claw small or absent 4
4 — Empodial claw small. 5
— Empodial claw apparently absent 6
5 — 2 pairs of para-anal setae. . . . . EURYTETRANYCHUS Oudemans
— 1 pair of para-anal setae . . . . . EURYTETRANYCHOIDES Reck
6 — 2 pairs of anal setae 7
— 1 pair of anal setae 8
7 — Opisthosoma with 10 pairs of dorsal setae . . EUTETRANYCHUS Banks
— Opisthosoma with 9 pairs of dorsal setae (L_1 absent) . . . . . MEYERNYCHUS Mitrofanov
8 — Opisthosoma with 10 pairs of dorsal setae . . . . .APONYCHUS Rimando
— Opisthosoma with 9 pairs of dorsal setae (H absent). . . . . PARAPONYCHUS Gonzalez and Flechtmann
9 — Empodium claw long and slender . . . . ANATETRANYCHUS Womersley
— Empodium apparently absent. . . . . .DUPLANYCHUS Meyer

2.3 TETRANYCHINI Reck

Tetranychinae Reck, 1950: 123.
Tetranychini Pritchard and Baker, 1955: 124; Wainstein, 1960: 223; Tuttle and Baker, 1968: 83.

Key to the genera based on the females

1 — 2 pairs of para-anal setae. 2
— 1 pair of para-anal setae 14
2 — Empodium claw-like. 3
— Empodium split distally or ending in tuft of hairs 9
3 — Empodium a single claw-like structure 4
— Empodium split into 2 claw-like structures, usually with appendant hairs 8
4 — Empodium without proximoventral hairs. 5
— Empodium with proximoventral hairs 7
5 — Empodial claw much longer than the pads of the true claws. 6
— Empodial claw very short, about as long as the pads of the true claws . . . . . BREVINYCHUS Meyer
6 — Empodial claw strong; dorsal setae stout; integument forming reticulate pattern . . . . . MIXONYCHUS Meyer and Ryke[5]
— Empodial claw thin; dorsal setae fine; integument with simple striations . . . . . SONOTETRANYCHUS Tuttle et al.
7 — Empodial claw as long or longer than proximoventral hairs, which are at right angles to the claw. . . . . PANONYCHUS Yokoyama
— Empodial claw shorter than proximoventral hairs, which are at less than right angles to the claw. . . . . ALLONYCHUS Pritchard and Baker
8 — Opisthosoma with 10 dorsal setae. .SCHIZOTETRANYCHUS Trägårdh
— Opisthosoma with 9 dorsal setae (L_4 absent) . . . YEZONYCHUS Ehara
9 — Empodium split distally; dorsal body setae set on tubercles 10
— Empodium split near the middle into 3 pairs of hairs 11
10 — 2 pairs of anal setae . . . . . .NEOTETRANYCHUS Trägårdh
— 1 pair of anal setae . . . . . ACANTHONYCHUS Wang
11 — Opisthosoma with longitudinal striae between the D_3 setae; dorsal body setae serrate . . . . . MONONYCHELLUS Wainstein
— Opisthosoma with transverse striae. 12
12 — Dorsal body setae much shorter than the intervals between their bases . . . . . PLATYTETRANYCHUS Oudemans
— Dorsal body setae as long or longer than the intervals between their bases. 13

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13 — 2 pairs of anal setae .....EOTETRANYCHUS Oudemans
— 1 pair of anal setae .....PALMANYCHUS Baker and Pritchard
14 — Empodium claw-like with proximoventral hairs; duplex setae of tarsus I distal and adjacent 15
— Empodium split distally, usually into 3 pairs of hairs; duplex setae of tarsus I well separated ..... TETRANYCHUS Dufour[6]
15 — 2 pairs of anal setae 16
— 1 pair of anal setae ..... ATRICHOPROCTUS Flechtmann
16 — All the legs or most of them with empodial claws as long or longer than the proximoventral hairs..... OLIGONYCHUS Berlese[7]
— All the legs of most of them with empodial claws nearly as long as the proximoventral hairs..... HELLENYCHUS Gutierrez

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[1] It is proposed to divide the genus *Neopetrobia* Wainstein into 3 sub-genera, separated according to the presence or absence of tubercles on the dorsum of females and the aspect of the dorsal setae:
Neopetrobia Wainstein: type species *Neopetrobia dubinini* Wainstein, 1956.
Reckia Wainstein: type species *Mesotetranychus samgoriensis* Reck, 1960.
Langella Wainstein: type species *Aplonobia dyschima* Beer & Lang, 1958.

1 — Integument with tuberculate pattern..... *Reckia*
— Integument without tuberculate pattern.....2
2 — Dorsal setae generally flattened or foliate..... *Langella*
— Dorsal setae rounded or spindle-shaped .....*Neopetrobia s.str.*

[2] It is proposed to divide the genus *Paraplonobia* Wainstein into 3 sub-genera recognizable by the number of coxal setae and the aspect of peritremes:
Paraplonobia Wainstein: type species *Aplonobia (Paraplonobia) echinopsili* Wainstein, 1960.
Anaplonobia Wainstein: type species *Aplonobia calame* Pritchard and Baker, 1955.
Brachynychus Mitrofanov & Strunkova: type species *Brachynychus cousiniae* Mitrofanov and Strunkova, 1971.

1 — Coxal formula not exceeding 3—3—1—1.....2
— Coxal formula 4—3—2—2 ..... *Brachynychus*
2 — Anastomosing peritremes ..... *Anaplonobia*
— Simple peritremes ..... *Paraplonobia s.str.*

[3] Tuttle and Baker (1968) proposed the name Neotrichobiini as a new tribe for the monospecific genus *Neotrichobia*, but the present author does not agree and considers *Neotrichobia arizonensis* Tuttle and Baker, 1968 as a case of plethotrichy, a phenomenon which, in other Acari, is generally regarded as of secondary importance inside a genus.

[4] The genus *Petrobia* Murray was divided by Wainstein (1960) into 3 sub-genera namely *Petrobia* Murray, *Mesotetranychus* Reck and *Tetranychina* Banks.

1 — Some or all the body setae set on tubercles.....*Tetranychina*
— Dorsal body setae not set on tubercles.....2
2 — Anastomosing peritremes ..... *Petrobia s.str.*
— Simple peritremes ..... *Mesotetranychus*

[5] It is proposed to divide the genus *Mixonychus* Ryke and Meyer into 3 sub-genera separated according to the aspect of the dorsal integument:
Mixonychus Ryke and Meyer: type species *Mixonychus acaciae* Ryke and Meyer, 1960.
Tylonychus Miller: type species *Tylonychus tasmaniensis* Miller, 1966.
Bakerina Chaudhri: type species *Bakerina lepidus* Chaudhri, 1971.

1 — Dorsum with lumps, forming a reticulate pattern.....*Mixonychus s.str.*
— Dorsum without lumps, with striae only.....2
2 — Dorsal striae with spinules.....*Tylonychus*
— Dorsal striae without spinules .....*Bakerina*

[6] The genus *Tetranychus* Dufour was divided by Tuttle and Baker (1968) into 7 sub-genera: *Tetranychus* Dufour, *Polynychus* Wainstein, *Armenychus* Wainstein, *Pentanychus* Wainstein, *Septanychus* McGregor, *Pseudonychus* Wainstein, *Amphitetranychus* Oudemans.

[7] The genus *Oligonychus* Berlese was divided by Tuttle and Baker (1968) into 6 subgenera: *Oligonychus* Berlese, *Wainsteiniella* Tuttle and Baker, *Homonychus* Wainstein, *Metatetranychus* Wainstein, *Reckiella* Tuttle and Baker, *Pritchardinychus* Wainstein.

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