A REVIEW OF THE SPECIES OF PHYTOSEIIDAE (ACARI : GAMASINA) DESCRIBED BY A. C. OUDEMANS.

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TAXONOMY
SEIULUS
TYPHLODROMUS
ZERCON
OUDEMANS'
SPECIES
REVISED

ABSTRACT : OUDEMANS described 18 new species of Phytoseiidae. He also redescribed *Zercon similis* Koch but ultimately relegated it to the status of a " *nomen nudum.* " Seven of the 18 species have been redescribed and their identities established by various authors : *Typhlodromus aberrans*, *T. cucumeris*, *T. foenilis*, *T. reticulatus*, *T. rhenanus*, *T. tiliae* and *T. tiliarum*. *Typhlodromus elongatus* and *T. vitis* have been designated as junior synonyms of *T. aberrans*. *Seiulus spoofi*, which has been regarded as a junior synonym of *Phytoseius macropilis* (Banks), is now restored as a separate species and is redescribed. The identities of *T. heveae* and *S. finlandicus* are established and redescribed, and the suspected conspecificity of *T. pruni* with *S. finlandicus* is confirmed. The identities of five other species remain either uncertain or unknown : *T. hevearum*, *T. musci*, *T. tiliacolus*, *T. dahliae* and *S. truncatus*.

TAXONOMIE
SEIULUS
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RÉVISION
DES ESPÈCES
D'OUDEMANS

RÉSUMÉ : OUDEMANS a décrit 18 espèces nouvelles de Phytoseiidae. Il a également redécrit *Zercon similis* Koch pour ensuite la reléguer au statut de " *nomen nudum* ". Subséquemment, sept des 18 espèces furent redécrites de même qu'identifiées par différents auteurs : *Typhlodromus aberrans*, *T. cucumeris*, *T. foenilis*, *T. reticulatus*, *T. rhenanus*, *T.tiliae* et *T. tiliarum*. *Typhlodromus elongatus* et *T. vitis* furent désignées synonymes juniors de *A. aberrans*. *Seiulus spoofi*, considérée auparavant comme synonyme junior de *Phytoseius macropilis* (Banks), est maintenant rétablie espèce distincte et redécrite. Les identités de *T. heveae* et *S. finlandicus* sont établies et redécrites. La conspécificité soupçonnée entre *T. pruni* et *S. finlandicus* est confirmée. L'identité de cinq espèces demeure incertaine ou inconnue : *T. hevearum*, *T. musci*, *T. tiliacolus*, *T. dahliae* et *Seiulus truncatus*.

INTRODUCTION

OUDEMANS described 18 new species of mites and redescribed *Zercon similis* Koch, all of which have been assigned to the family Phytoseiidae Berlese by other authors. In 1910 OUDEMANS assigned all mites that are predaceous on phytophagous mites to the family Laelapidae Berlese ; he later (1936) reaffirmed this concept. Prior to 1929, he had assigned these species to the genus *Seiulus* Berlese, but in 1929 and subsequent years he assigned them to the genus *Typhlodromus* Scheuten. OUDEMANS' concept of the genus *Typhlodromus* was much wider than the family Phytoseiidae as we presently conceive it : it included species such as *T. amboinensis* Oudemans, *T. mali* Oudemans and *T. pomorum* Oudemans, for example. BERLESE (1913) was the first to recognize a group that comprised species that are included in the family Phytoseiidae by most modern authors and proposed the tribe Phytoseiini in the family Laelapidae to accommodate these species. Similarly, all but one genus in VITZTHUM's (1943)

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concept of the subfamily Phytoseiinae, which he also placed in the family Laelapidae, are included in our present concept of the Phytoseiidae. BAKER and WHARTON (1952) were the first to raise the rank of this group to the family level. However, their concept of the family included the subfamily Podocininae Berlese and also placed genera such as *Ameroseius* Berlese and *Lasioseius* Berlese in the subfamily Phytoseiinae.

The identities and taxonomic status of many of OUDEMANS' 19 species, including *Z. similis* sensu Oudemans, have been problematic due to insufficient information in the original descriptions. Seven of these species have been redescribed and their identities established by other authors : *Typyhlodromus aberrans* (BEGLYAROV, 1958), *T. cucumeris* (SCHUSTER and GONZÁLEZ, 1963), *T. reticulatus* (KOLODOCHKA, 1988), *T. foenilis* (EVANS and MOMEN, 1988), *T. rhenanus* (EVANS and MOMEN, 1988), *T. tiliae* (CHANT and YOSHIDA-SHAUL, 1987) and *T. tiliarum* (NESBITT, 1951). Two species, *T. elongatus* and *T. vitis*, have been designated as junior synonyms of *T. aberrans* (CHANT, 1955). Nevertheless, confusion has persisted over some of these species as well as over the remaining 10 species.

The main objective of the present paper is to settle this confusion by reexamining and clarifying the identities and the taxonomic status of OUDEMANS' phytoseiid species, including *Z. similis*. A brief historic review, and discussion where necessary, is provided for each of the 19 species. The reviews are organized in the chronological order in which OUDEMANS described the species. References to genera and subgenera to which each species has been assigned by various authors are provided : for species with large numbers of references, only those in which a species was assigned to a genus/subgenus for the first time are provided. Three species, *Seiulus finlandicus*, *S. spoofi* and *T. heveae*, are redescribed in detail and their identities established. Setal nomenclature in the descriptions follows that of ROWELL et al. (1978), the designation of setal patterns those of CHANT and YOSHIDA-SHAUL (1989b, 1991, 1992) and the formulae for leg chaetotaxy those of EVANS (1963). The methods used were described by CHANT and YOSHIDA-SHAUL (1984). All measurements are in micrometres.

All specimens examined for this study, except that of *Phytoseius macropilis* (Banks), are deposited in the Rijksmuseum van Natuurlijke Historie, Leiden, the Netherlands.

REVIEW OF THE TAXONOMIC STATUS OF OUDEMANS' 19 SPECIES

Seiulus rhenanus Oudemans

Seiulus rhenanus OUDEMANS, 1905, p. 78 ; OUDEMANS, 1915b, pp. 156-158, Figs. 101-105.
Typhlodromus (*Neoseiulus*) *rhenanus* (Oudemans), NESBITT, 1951, pp. 38-39, Figs. 13, 20, 27, Pls. XIV, XV.
Typhlodromus (*Typhlodromus*) *rhenanus* (Oudemans), CHANT, 1959, pp. 62-63, Figs. 78-79, 279-280.
Typhlodromella rhenana (Oudemans), MUMA, 1961, p. 299.
Typhlodromus rhenanus (Oudemans), CARMONA, 1962, pp. 16-17.
Anthoseius rhenanus (Oudemans), WAINSTEIN and KOLODOCHKA, 1974, p. 628.
Anthoseius (*Amblydromellus*) *rhenanus* (Oudemans), KOLODOCHKA, 1978, pp. 63-64, Fig. 32.
Anthoseius tortor BEGLYAROV, 1981, pp. 26-27, Fig. 29. (Type : ? All-Union Research Institute of Phytopathology, Bolshie Vyazemy, Leningrad, Russia)

OUDEMANS' original description of *S. rhenanus* was based on a single adult male specimen collected on rotting leaves near Bonn, Germany. Although many descriptions of adult females attributed to this species have been published, the true female form was not established until EVANS and MOMEN (1988) provided an unequivocal diagnosis for it. Their study also showed that *T. foenilis* (Oudemans) is not synonymous with *S. rhenanus*, as proposed by NESBITT (1951), and they restored the former to a distinct species in its own right. They designated *Anthoseius tortor* Beglyarov as a junior synonym of *S. rhenanus*.

CHANT (1959) designated *T. kazachstanicus* Wainstein as a junior synonym of *S. rhenanus* but HIRSCHMANN (1962) disputed this. Our examination of the holotype of *T. kazachstanicus* confirms that the two are not conspecific. It is clear from this confusion that many references to *S. rhenanus* in the literature should be reviewed and specimens reexamined.

Seiulus truncatus Oudemans

Seiulus truncatus OUDEMANS, 1905, p. 8 ; 1915b, pp. 151-159, Figs. 106-116.

OUDEMANS' description of *S. truncatus* was based on an adult female collected from *Chamaecyparis lawsoniana* in Naarden, Meersen, North Holland, the Netherlands. When OUDEMANS (1930b) redescribed *Zercon similis* he designated *S. truncatus* together with *Z. ovalis* Koch, *Z. pallens* Koch and *Z. obtusus* Koch as junior synonyms, and referred to his 1915 description of *S. truncatus* for the description of the adult female of *Z. similis*. However, OUDEMANS later (1936) concluded that all of KOCH's species, including *Z. similis*, should be relegated to the status of " *nomina nuda.* " This left the taxonomic status of *S. truncatus* unclear : OUDEMANS did not indicate whether or not this species was restored as a taxon in its own right. OUDEMANS' drawings of *S. truncatus* show clearly that this species belongs to the genus *Amblyseius* Berlese.

The slide of *S. truncatus* we borrowed contained only a chelicera and apparently no other material of this species has survived. Hence, it is unlikely that the true identity of *S. truncatus* can ever be established and, therefore, this is regarded as a " *nomen dubium.* "

Seiulus finlandicus Oudemans
(Figs. 1-6)

Seiulus finlandicus OUDEMANS, 1915a, pp. 183-184.
Typhlodromus pruni OUDEMANS, 1929b, pp. 32-33. (Type : Rijksmuseum van Natuurlijke Historie, Leiden, Netherlands)
Typhlodromus finlandicus (Oudemans), OUDEMANS, 1929b, p. 50.
Typhlodromus (*Typhlodromus*) *finlandicus* (Oudemans), CUNLIFFE and BAKER, 1953, p. 19, figs.
Amblyseius finlandicus (Oudemans), ATHIAS-HENRIOT, 1958, pp. 34, 36.
Typhlodromus (*Amblyseius*) *finlandicus* (Oudemans), CHANT, 1959, p. 67, Figs. 94-95.
Typhlodromus (*Typhlodromopsis*) *finlandicus* (Oudemans), DE LEON, 1959, pp. 113-114.
Amblyseius (*Typhlodromalus*) *finlandicus* (Oudemans), MUMA, 1961, p. 288.
Amblyseius (*Amblyseius*) *finlandicus* (Oudemans), WAINSTEIN, 1962, p. 15.
Amblyseius (*Euseius*) *finlandicus* (Oudemans), WAINSTEIN and VARTAPETOV, 1973, p. 103.
Euseius finlandicus (Oudemans), LEHMAN, 1982, p. 223, Figs. 112-115.

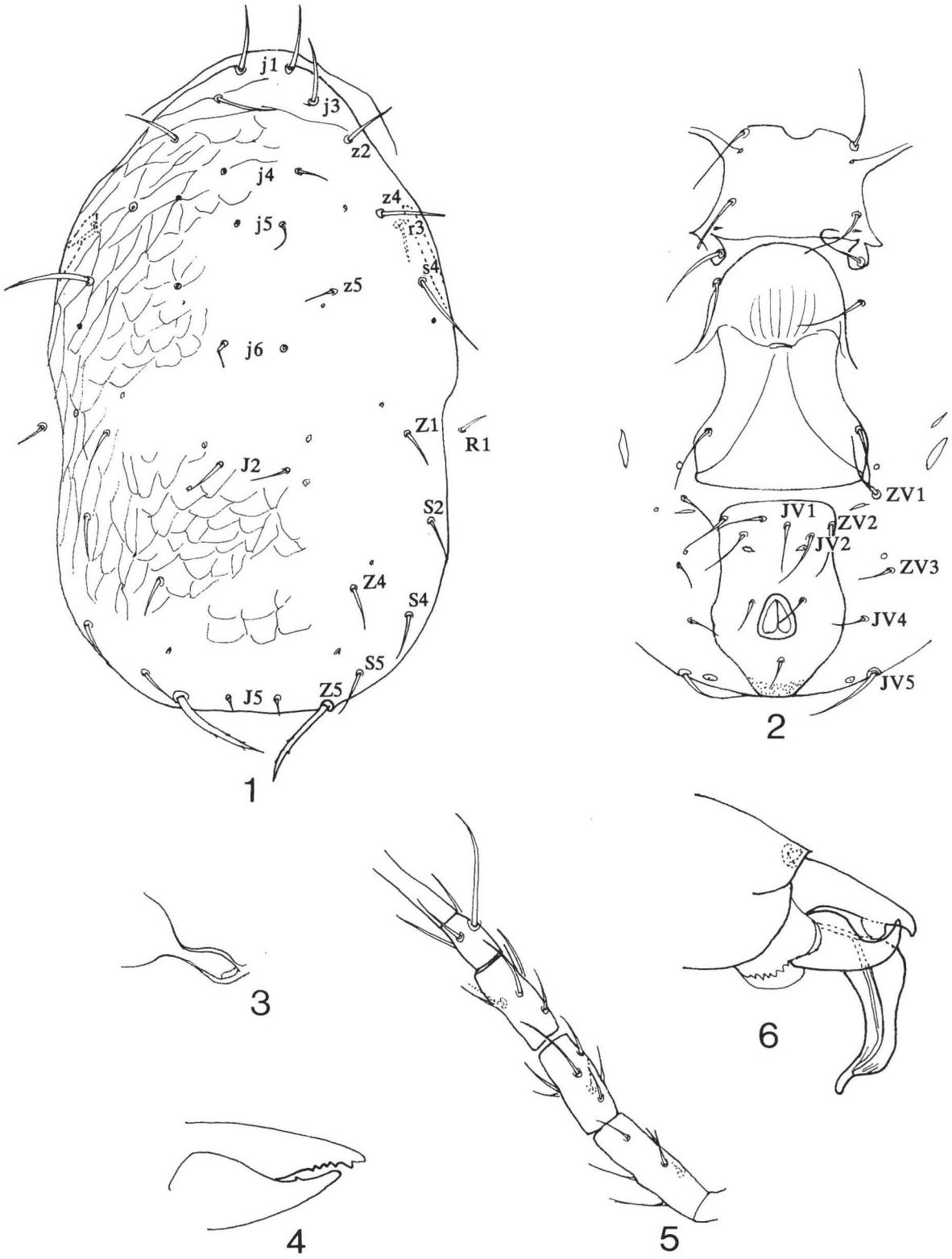
OUDEMANS' original description of *S. finlandicus* was based on an adult female collected from *Salix caprea* in Åbo, Finland. OUDEMANS (1930a) designated *T. pruni* Oudemans as a junior synonym of this species. Our examination of the type specimens of both species confirms that they indeed are conspecific.

Although OUDEMANS (1930a) noted a possible close relationship between *T. tiliacolus* and *T. pruni*, he was uncertain, as indicated in his note accompanying the drawing of the female of the former, if the female and male specimens of *T. tiliacolus* themselves were conspecific. OUDEMANS' illustration of the male of this species indeed suggests similarities to *S. finlandicus*. However, there appears to be an extra pair of setae on the opisthoscutum in his illustration that cannot be accounted for, and, as NESBITT (1951) noted, the ventrianal shield lacks a pair of distinct solenostomes. As for OUDEMANS' illustration of an adult female, the dorsal setation, the relative lengths of the dorsal setae and the macrosetae on leg IV, again, seem to concur with those of *S. finlandicus*. Since we were unable to borrow the specimens of *T. tiliacolus*, the true identities of the female and male of this species remain uncertain.

NESBITT (1951) noted the possible synonymy of *T. tiliacolus* Oudemans with *S. finlandicus*, but this cannot be confirmed without type material of the former, which was not available to us.

Following is a redescription of *S. finlandicus* based on type specimens.

Adult female (measurements based on two specimens) - Idiosomal setal pattern, 10A:9B/JV-3:ZV. Dorsal shield lightly reticulated throughout : length 344, 330 ; width at level of *S2* 210, 210. Dorsal setal pattern 10A :9B : podosoma with setae *j1, j3, j4, j5, j6, z2, z4, z5, s4* and *r3* ; opisthosoma with setae *J2, J5, Z1, Z4, Z5, S2, S4, S5* and *R1* (Fig. 1). Six pairs of small but distinct solenostomes on dorsal shield : mediad to *z4* ; posterolaterad to *s4* ; posteromediad



FIGS. 1-6 : *Seiulus finlandicus,* adult female.

1. — Dorsal view ; 2. — Ventral view ; 3. — Spermatheca ; 4. — Chelicera ; 5. — Genu, tibia and basitarsus of leg IV. *Adult male* ; 6. — Spermatodactyl (from OUDEMANS, 1915a).

to *z5* ; anterolaterad to *Z4* ; and anteromediad each to *Z1* and *Z5*. Sublateral setae *r3* and *R1* on lateral integument. All dorsal and sublateral setae smooth, except *Z5* which is sparsely serrated ; short to medium length. Measurements of dorsal and sublateral setae as follows : *j1* 33, 33 ; *j3* 36, 35 ; *j4* 16, 15 ; *j5* 17, 17 ; *j6* 17, 12+ ; *J2* 18, 18 ; *J5* 8, 7 ; *z2* 26, 27 ; *z4* 32, 30 ; *z5* 16, 16 ; *Z1* 18, 20 ; *Z4* 20, 22 ; *Z5* 51, 52 ; *s4* 42, 40 ; *S2* 25, 24 ; *S4* 23, 23 ; *S5* 24, 25 ; *r3* 19, 21 ; *R1* 12, 13.

Sternal shield smooth with three pairs of setae, with third pair inserted on hooked extensions, and two pairs of pores ; metasternal setae free on integument. Length of sternal shield 60, 56 ; width 76, 74. Genital shield smooth ; width 92, 88. Ventrianal shield longer than wide, with setae *JV1, JV2* and *ZV2* and a pair of crescentic solenostomes immediately posteromediad to *JV2* (Fig. 2). Length of ventrianal shield 98, 98 : width at level of *ZV2* 60, 56 ; at level of waist 56, 52 ; and at level of anus 66, 66. Setae *ZV1, ZV3, JV4* and *JV5* on integument surrounding ventrianal shield. Seta *JV5* smooth, 33, 36. Caudoventral pattern, 9:JV-3:ZV. Length of primary metapodal plate 25, 21 ; width 4, 5.

Shape of cervix of spermatheca as shown in Fig. 3 ; length 10, 8. Chelicera stubby. Fixed digit of chelicera multidentate ; movable digit unidentate, 22, 21 (Fig. 4). Chaetotactic formulae of leg segments as follows : femur I 2-5/3-2 ; genu I 2-2/1, 2/1-2 ; tibia I 2-2/1, 2/1-2 ; femur II 2-5/2-1 ; genu II 2-2/0, 2/0-1 ; tibia II 1-1/1, 2/1-1 ; femur III 1-3/1-1 ; genu III 1-2/1, 2/0-1 ; tibia III 1-1/1, 2/1-1 ; femur IV 1-3/1-1 ; genu IV 1-2/1, 2/0-1 ; tibia IV 1-1/1, 2/0-1. Measurements of legs and palp as follows : leg I 354, 370 ; leg II 302, 346 ; leg III 318, 328 ; leg IV 418, 398 ; palp 142, 140. Genu, tibia and basitarsus of leg IV with macrosetae, with tips tapered : 35, 36 ; 35, 35 ; and 60, 55 respectively (Fig. 5). Peritreme extending anteriorly to level of *r3*.

Adult male (based on the male specimen of *A. pruni*) - Idiosomal setal pattern, nature of dorsal shield and dorsal setae as in female. Length of dorsal shield 256 ; width 180. Sublateral setae *r3* and *R1* inserted on dorsal shield. Measurements of dorsal and sublateral setae as follows : *j1* broken ; *j3* 27 ; *j4* 12 ; *j5* 12 ; *j6* broken ; *J2* 14 ; *J5* 6 ; *z2* 20 ; *z4* 23 ; *z5* 12 ; *Z1* 15 ; *Z4* 15 ; *Z5* 40 ; *s4* 32 ; *S2* 20 ; *S4* 18 ; *S5* 19 ; *r3* 15 ; *R1* 12.

Sternogenital shield smooth, with five pairs of setae and three pairs of pores : length 110, width 70. Ventrianal shield with setae *JV1, JV2* and *ZV2* and a pair of crescentic solenostomes mediad to *JV2*. It is not clear whether or not the ventrianal shield is connected to the posterior extremities of the peritremal shields. Length of ventrianal shield 96 ; width not measurable. Setae *JV5* on integument surrounding ventrianal shield : smooth, 27. Caudoventral setal pattern, 6:JV-3,4:ZV-1,3.

Spermatodactyl not discernible (see OUDEMANS' drawing, Fig. 6). Chaetotaxy of leg segments as in female. Measurements of legs and palp as follows : leg I 304 ; leg II 220 ; leg III 232 ; leg IV 316 ; palp not measurable. Genu IV and basitarsus IV with macrosetae, with tips tapered : 33 and 48 respectively. Macroseta on tibia IV not measurable.

TYPE — The monobasic female type was collected on *Salix caprea*, Åbo, Finland, August 11, 1923, by Dr. A. R. SPOOF.

REMARKS — Additional records for *S. finlandicus* are an adult female and an adult male of *T. pruni* collected on *Prunus domesticus*, Åbo, Finland, October, 1923, by Dr. A. R. SPOOF. Because the female specimen collected on *P. domesticus* is in better condition than the type specimen, the present illustrations are based on the former.

Seiulus finlandicus and other related species are characterized foremost by the arrangement of the preanal setae on the ventrianal shield. Seta *JV1* is not inserted on the anterior margin of the shield as on other phytoseiids and it is at the same level as or below the level of *ZV2* (Fig. 2). Seta *JV2* also is inserted closer to *ZV2* than in other phytoseiids. Essentially, the three pairs of preanal setae on the shield appear to be clustered on the anterior quarter of the shield, forming a downward arc or a straight line on both females and males.

UECKERMANN and LOOTS (1988) noted some discrepancies in the characters of *S. finlandicus* described by various authors.

Seiulus finlandicus is a cosmopolitan species that has been recorded from many parts of the world : Europe, northern Africa, the Middle East, Asia,

North America, Central America, South America and Australia. Its host plants cover a wide range : fruit trees (e.g. apple, citrus, avocado), deciduous trees (e.g. maple, linden, oak), bramble, vines and herbs (e.g. *Impatiens*, *Urtica*). This species has been recorded as a predator of tetranychoids, eryophyoids and other small mites.

Seiulus spoofi Oudemans
(Figs. 7-11)

Seiulus spoofi Oudemans, 1915*a*, p. 184 ; OUDEMANS, 1915b, pp. 161-165, Figs. 120-127 ; NESBITT, 1951, p. 57, Pls. 31, 32.
Typhlodromus spoofi (Oudemans), OUDEMANS, 1930c, pp. 98-99 ; SELLNICK, 1958, p. 28.
Phytoseius (*Dubininellus*) *spoofi* (Oudemans), WAINSTEIN, 1975, pp. 921-922 ; ARUTUNJAN, 1977, p. 61, Fig. 114.

OUDEMANS' original description of *S. spoofi* was based on specimens collected from *Salix caprea* in Åbo, Finland. CUNLIFFE and BAKER (1953), based on their specimens from Florida, considered *Phytoseius macropilis* (Banks) to be conspecific with this species. DENMARK (1966) showed that the specimens examined by CUNLIFFE and BAKER were not conspecific with *P. macropilis* ; however, he still considered *S. spoofi* to be a junior synonym of *P. macropilis*. WAINSTEIN (1975) was the first to cast doubt on the synonymy of these two species when he recorded *S. spoofi* from Yaroslavl district. His conclusion was based on the examination of " a specimen of *P. macropilis* from America. " Unfortunately, his account does not indicate if it was the type of *P. macropilis* he examined nor do his discussion and description provide sufficient information on the differences between the two species. ARUTUNJAN (1977) also described *S. spoofi* based on specimens from Armenia. BEGLYAROV (1981) noted the discrepancies in the descriptions of this species by WAINSTEIN (1975) and ARUTUNJAN (1977). However, he was not certain which of the two represented *S. spoofi*. Based on the literature, it is difficult to confirm if the specimens on which both or either of these descriptions are based indeed are conspecific with this species. BEGLYAROV also queried the relationship between *S. spoofi* and *P. salicis* Wainstein and Arutunjan because of the negligible differences between the two. He supported WAINSTEIN's view of considering *S. spoofi* and *P. macropilis* as two separate entities.

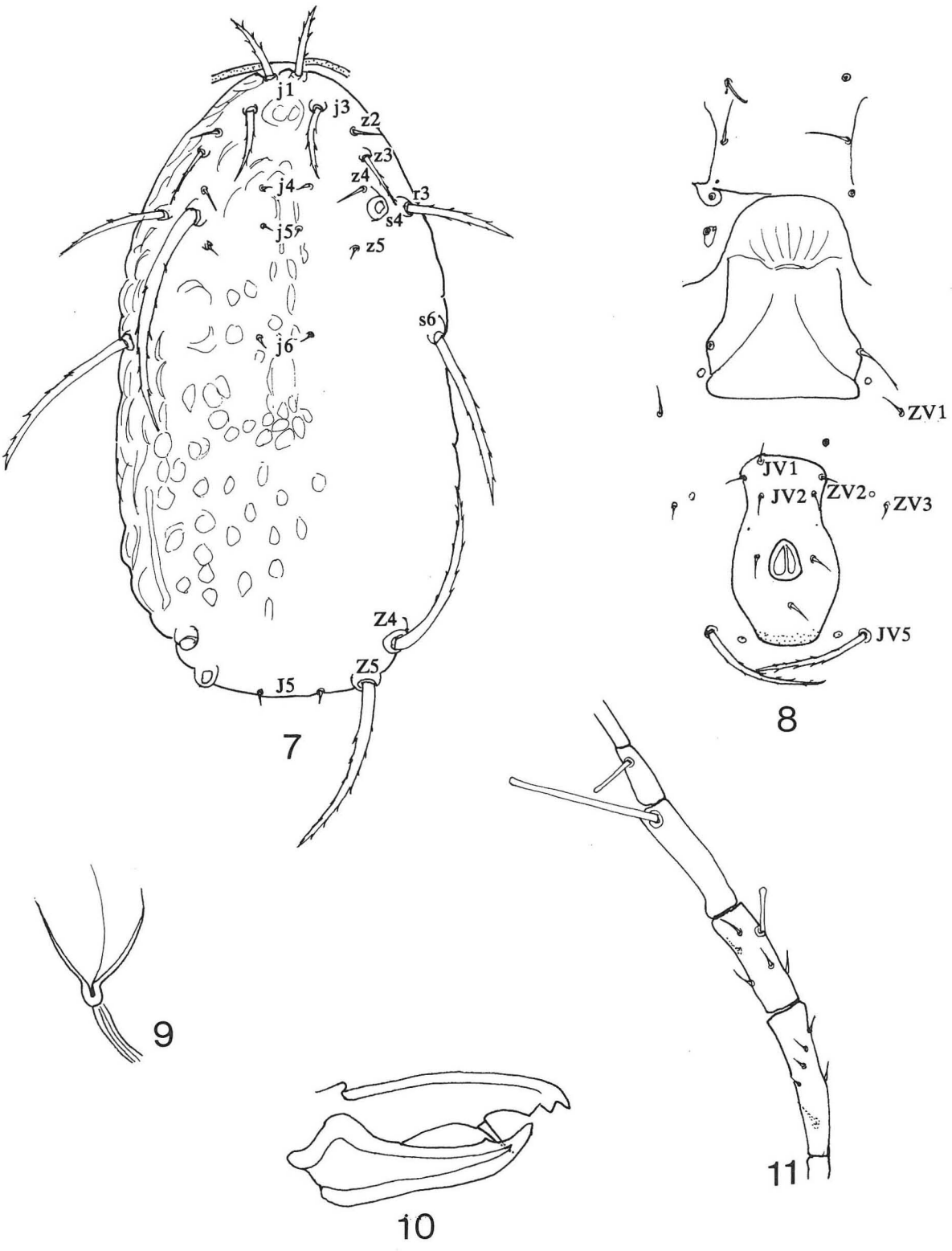
Our examination of the type material of *S. spoofi* and of *P. macropilis*, which is deposited in the Museum of Comparative Zoology, Harvard University, Cambridge, Massachusetts, U. S. A., shows these to be separate taxa. Therefore, we propose the restoration of *S. spoofi* as a species in its own right. In view of this, many references to *P. macropilis* in the literature should be reviewed and specimens attributed to this species reexamined.

Following is a redescription of *S. spoofi*, based on type specimens.

Adult female (range of measurements based on three specimens on the type slide) - Idiosomal setal pattern, 12A:3A/JV-3,4:ZV. Dorsal shield rugose throughout, stronger on lateral margins : length 326-336 ; width 182-196. Dorsal setal pattern 12A :3A : podosoma with setae *j1, j3, j4, j5, j6, z2, z3, z4, z5, s4, s6* and *r3* ; opisthosoma with *J5, Z4* and *Z5* (Fig. 7). Solenostomes not discernible on dorsal shield. Sublateral seta *r3* inserted on the podoscutum. Setae *j1, j3, z3, s4, s6, r3, Z4* and *Z5* strongly serrated, medium to long ; remaining setae smooth, short. Measurements of dorsal and sublateral seta as follows : *j1* 36-43 ; *j3* 41 (one specimen) ; *j4* 5-6 ; *j5* 5 ; *j6* 5 ; *J5* 5-6 ; *z2* 14-15 ; *z3* 35-37 ; *z4* 16-17 ; *z5* 5 ; *Z4* 94-99 ; *Z5* 91-98 ; *s4* 118-124 ; *s6* 96-97 ; *r3* 57-60.

Sternal shield weakly sclerotized, apparently with three pairs of setae and two pairs of pores. Metasternal setae on platelets, each accompanied by a pore. Genital shield smooth ; width 78-83 µm. Ventrianal shield smooth, longer than wide ; with setae *JV2, ZV2* and with one or both *JV1* and a pair of minute solenostomes on lateral margins posterior to *JV2* (Fig. 8). Length of ventrianal shield 84 (one specimen) ; width at level of *ZV2* 38-50, at level of waist 39-53 and at level of anus 40-56. Setae *ZV1, ZV3, JV5* and one or both of *JV1* on integument surronding ventrianal shield. Seta *JV5* distinctly serrated ; 80. Caudoventral setal pattern, 8:JV-3,4:ZV. Metapodal plates absent.

Cervix of spermatheca cup-shaped (Fig. 9), 10. Fixed digit of chelicera with two teeth and pilus



FIGS. 7-11 : *Seiulus spoofi,* adult female.

7. — Dorsal view ; 8. — Ventral view ; 9. — Spermatheca ; 10. — Chelicera ; 11. — Genu, tibia and basitarsus of leg IV.

dentilis ; movable digit unidentate, 24-25 (Fig. 10). Chaetotactic formulae of leg segments as follows : femur I 2-5/3-2 ; genu I 2-2/1, 2/1-2 ; tibia I 2-2/1, 2/1-2 ; femur II 2-5/2-1 ; genu II 2-2/0, 2/0-1 ; tibia II 1-1/1, 2/1-1 ; femur III 1-3/1-1 ; genu III 1-2/0, 2/0-1 ; tibia III 1-1/1, 2/1-1 ; femur IV 1-3/1-1 ; genu IV 1-2/1, 2/0-1 ; tibia IV 1-1/1, 2/0-1. Measurements of legs and palp as follows : leg I 354-368 ; leg II 294-308 ; leg III 302-312 ; leg IV 470-490 ; palp 174-176. Genu, tibia and basitarsus of leg IV with macrosetae, tips slightly bulbous (Fig. 11 ; some setae on genu and tibia not discernible on the specimen illustrated) : 28-29, 88-89 and 26-31 respectively. Peritreme extending anteriorly to level of *j1*.

Adult male — Described by OUDEMANS (1915a, 1915b, 1930c).

TYPE — Three adult females on the same slide, collected on *Salix caprea*, Åbo, Finland, August 23, 1911, by Dr. A. R. SPOOF. An adult male with identical collection data has been lost.

REMARKS — Based on additional information from a study of *P. macropilis* (in preparation), the differences between *S. spoofi* (type specimens) and *P. macropilis* are that : (1) setae *z2, z4* and *J5* are smooth in *spoofi* whereas they are serrated in *macropilis* ; (2) the lengths of the macrosetae on genu IV and basitarsus IV of *spoofi* are equal whereas the macroseta on genu IV of *macropilis* is shorter than that on basitarsus IV by at least 10 µm ; (3) both setae *JV1* are inserted on the ventrianal shield in two of three type specimens of *spoofi* (with the third specimen, one of the *JV1* pair is inserted off the shield), whereas *JV1* setae are inserted off the shield of all *macropilis* specimens examined ; and (4) seta J5 (*14* µm) is longer and setae *s6* (76 µm) and *JV5* (58 µm) shorter on *macropilis* than on *spoofi*.

We also tested the relationship between *macropilis* and *spoofi* by performing Principal Component Analysis, using morphometric measurements. This analysis showed *S. spoofi* clearly separated from the cluster of *P. macropilis* specimens. This supports the view that these two species are separate taxa.

Because *S. spoofi* has been considered a junior synonym of *P. macropilis*, its geographical distribution, plant hosts and associated mites are known only from the type specimens. Reexamination of specimens originally identified as *P. macropilis*, especially those from Europe, may add records for this species.

Typhlodromus tiliae Oudemans

Typhlodromus tiliae OUDEMANS, 1929a, pp. 14-15 ; OUDEMANS, 1929*b*, p. 51.
Typhlodromus (*Typhlodromus*) *tiliae* Oudemans, SCHUSTER and SMITH, 1960, p. 184, Fig. 8.

OUDEMANS' original description of *T. tiliae* was based on a single adult female collected from *Tilia* sp. in Berchtesgaden, Germany. However, subsequent authors erroneously referred to another specimen that OUDEMANS collected from *Tilia platyphyllos* in Arnhem as the holotype. Moreover, many authors (e.g. CHANT, 1959 ; DOSSE, 1961) regarded *T. tiliae* and *T. pyri* as conspecific. ABBASOVA (1970) proposed the restoration of these two as separate taxa, but acarologists outside the former U.S.S.R. seem to have been unaware of this. This situation was aggravated by the erroneous assignment of North American specimens to *T. pyri* (CHANT *et al.* 1974). These specimens subsequently were found to belong to neither *T. pyri* nor *T. tiliae*. CHANT and YOSHIDA-SHAUL (1987) and EVANS (1988) clarified the identity of *T. tiliae* based on the specimen from Berchtesgaden, and they also concurred in the reidentification of the specimens from Arnhem as *T. pyri* Scheuten. CHANT and YOSHIDA-SHAUL (1987) also noted that the specimens ABBASOVA (1970) used for the redescription of *T. tiliae* are not conspecific with this species.

OUDEMANS (1929a) also described an adult male as *T. tiliae* based on a specimen with the same collection data as the female holotype, but he later (1929b) reidentified this male as *A. tiliacolus*.

Typhlodromus musci Oudemans

Typhlodromus musci OUDEMANS, 1929b, p. 31.

OUDEMANS described this species based on a single protonymph collected from moss in a barn,

Utrecht, the Netherlands. NESBITT (1951), CHANT (1959) and MORAES *et al.* (1986) considered *T. musci* as a " *species dubia* " because of insufficient information. With only a protonymph as a specimen, it is impossible even to identify whether it belongs to the Phytoseiidae or to another family. Therefore, we consider this to be a " *nomen nudum.* "

Typhlodromus pruni Oudemans

Typhlodromus pruni OUDEMANS, 1929b, pp. 32-33.

OUDEMANS (1929b) described this species based on an adult female and an adult male collected from *Prunus domesticus* in Åbo, Finland. However, he later (1930a) concluded that *T. pruni* is conspecific with *S. finlandicus*. Our examination of the type specimens of both species confirms this conclusion, and, therefore, we consider *T. pruni* a junior synonym of *S. finlandicus*.

Typhlodromus tiliacolus Oudemans

Typhlodromus tiliacolus OUDEMANS, 1929b, pp. 33-34.
Typhlodromus (*Neoseiulus*) *tiliacolus* Oudemans, NESBITT, 1951, pp. 40-41.

OUDEMANS (1929b) described this species on the basis of an adult male specimen from *Tilia* sp., Berchtesgaden, Germany, which he had originally attributed to *T. tiliae* (1929a). He himself queried the identity of an adult female specimen he had provisionally assigned to this species, which he never described. NESBITT (1951) was uncertain of the identities of these specimens. The specimens of *T. tiliacolus* were not available to us and, hence, the identity of this species remains uncertain.

Typhlodromus aberrans Oudemans

Typhlodromus aberrans OUDEMANS, 1930a, pp. 48-49, Pl. 1.
Typhlodromus elongatus OUDEMANS, 1930a, p.53, Pl. 28. (Type : Rijksmuseum van Natuurlijke Historie, Leiden, the Netherlands.)
Typhlodromus vitis OUDEMANS, 1930c, p. 99. (TYPE : Rijksmuseum van Natuurlijke Historie, Leiden, the Netherlands.)
Kampimodromus elongatus (Oudemans), NESBITT, 1951, p. 53, Pl. 27.
Amblyseius aberrans (Oudemans), ATHIAS-HENRIOT, 1958, p. 36.
Typhlodromus (*Amblyseius*) *aberrans* Oudemans, CHANT, 1959, p. 101, Figs. 240-241.
Paradromus aberrans (Oudemans), MUMA, 1961, p. 286.
Amblyseius (*Kampimodromus*) *aberrans* (Oudemans), PRITCHARD and BAKER, 1962, p. 294.
Kampimodromus aberrans (Oudemans), MUMA and DENMARK, 1968, p. 234.

OUDEMANS' original description of *T. aberrans* was based on one specimen each of the protonymphal, female deutonymphal and male deutonymphal instars and an adult male, all of which were collected from *Tilia platyphyllos* in Arnhem, the Netherlands. NESBITT (1951) noted the possible conspecificity of *T. vitis* Oudemans, collected on *Vitis vinifera* in Buré (Meurthe et Moselle), France, with *T. aberrans*. However, the type specimen of the former already had been lost at that point. CHANT (1955), based on his extensive collections as well as OUDEMANS' specimens, concluded that *T. elongatus* Oudemans, collected on *Tilia platyphyllos*, Arnhem, Netherlands, and *T. vitis* represent seasonal morphs of *T. aberrans* and proposed their synonymy. He also provided a description of the adult male. BEGLYAROV (1958) provided the first detailed description of the adult female of this species.

Our examination of the type specimen of *T. elongatus* showed that setae *R1* are inserted on the dorsal shield instead of on the lateral integument, but because all other characters concur with those of *T. aberrans*, this character state is regarded as an aberration at this point.

Typhlodromus tiliarum Oudemans

Typhlodromus tiliarum OUDEMANS, 1930a, pp. 51-52.
Typhlodromus formosus WAINSTEIN, 1958, pp. 206-207. (Type : Institute of Zoology, Academy of Sciences of the Ukraine, Kiev, Ukraine)
Typhlodromus (*Typhlodromus*) *tiliarum* Oudemans, CHANT, 1959, p. 65, Figs. 84-85.
Typhloctonus tiliarum (Oudemans), MUMA, 1961, p. 299.

Typhlodromus (*Nesbitteius*) *tiliarum* Oudemans, WAINSTEIN, 1962, p. 23, Fig. 31.
Seiulus (*Typhloctonus*) *tiliarum* (Oudemans), BEGLYAROV, 1981, p. 19.
Seiulus tiliarum (Oudemans), MIEDEMA, 1987, p. 45-47, Fig. 24.

OUDEMANS' original description of *T. tiliarum* was based on two adult females collected from *Tilia* sp. in Dahlem, Germany. NESBITT (1951) included OUDEMANS' original drawings of the species, which aided in establishing its identity unequivocally. CHANT (1959) suggested the possible conspecificity of *T. formosus* Wainstein and *T. tiliarum*, and KOLODOCHKA (1986) formally designated the former as a junior synonym of the latter. CHANT and YOSHIDA-SHAUL (1989a) provided a redescription of this species based on the holotype specimen.

Typhlodromus cucumeris Oudemans

Typhlodromus cucumeris OUDEMANS, 1930b, pp. 69-70.
Typhlodromus thripsi MACGILL, 1939, pp. 309-317. (Type : The Natural History Museum, London, England)
Typhlodromus (*Typhlodromus*) *cucumeris* Oudemans, CUNLIFFE and BAKER, 1953, p. 15.
?*Typhlodromus bellinus* WOMERSLEY, 1954, pp. 177-179, Fig. 4. (Type : South Australian Museum, Adelaide, Australia)
Typhlodromus (*Amblyseius*) *cucumeris* Oudemans, CHANT, 1959, p. 78, Figs. 136-137.
Typhlodromus (*Typhlodromopsis*) *cucumeris* Oudemans, DE LEON, 1959, p. 113.
Amblyseius (*Typhlodromopsis*) *cucumeris* (Oudemans), MUMA, 1961, p. 287.
Amblyseius (*Amblyseius*) *cucumeris* (Oudemans), WAINSTEIN, 1962, p. 15, Fig. 14.
Amblyseius cucumeris (Oudemans), SCHUSTER and GONZÁLEZ, 1963 : 185-188 ; Figs. 1-4.
Amblyseius coprophilus KARG, 1970, pp. 289-290, Figs. 1a, 2a, 10a. (Type : Deutschen Akademie der Landwirtschaftswissenschaften zu Berlin, Kleinmachnow, Germany)
Neoseiulus cucumeris (Oudemans), MCMURTRY and BOUNFOUR, 1989, p. 17.

OUDEMANS' original description of *T. cucumeris* was based on a specimen collected from *Cucumis melo* " among numerous *Tetranychus* " in Buré (Meurthe et Moselle), France. NESBITT (1951) provided illustrations using other specimens as well as OUDEMANS' in his review. EVANS (1952), based on the holotype specimen, designated *T. thripsi* MacGill as a junior synonym of *T. cucumeris*. Our examination of the type material of both species confirms this. DOSSE (1957) proposed *T. bellinus* Womersley as a junior synonym of *T. cucumeris* based on the similarity in the shape of the spermathecae. However, there had been confusion over the identity of *T. cucumeris* itself : different forms had been attributed to this species by various authors. SCHUSTER and GONZÁLEZ (1963) redescribed and finally established the identity of this species based on the type specimen. They also reidentified Californian specimens that were attributed to *T. bellinus* by WOMERSLEY (1954) as conspecific with *T. cucumeris*. Despite SCHUSTER and GONZÁLEZ (1963) and SCHICHA's (1976) redescriptions of *T. cucumeris*, different forms have been attributed to this species by other authors. Therefore, references to this species in the literature should be reviewed and specimens reexamined.

KARG (1970) described *Amblyseius coprophilus* but the following year (1971) he designated it as a junior synonym of *T. cucumeris*. SCHICHA (1976) considered *T. cucumeris* and *T. bellinus* to be separate taxa whereas other authors consider them to be conspecific. Comparison of the type specimens of *T. cucumeris* and *T. thripsi*, both of which we examined, with SCHICHA's (1976) illustration of the type specimen of *T. bellinus* shows no appreciable differences.

Some character states that cannot be observed in the holotype specimen of *T. cucumeris* owing to its poor condition can be supplemented by those of the holotype specimen of *T. thripsi*.

Typhlodromus foenilis Oudemans

Typhlodromus foenilis OUDEMANS, 1930b, p. 70.
Typhlodromella foenilis (Oudemans), EVANS and MOMEN, 1988, pp. 213-215, Figs. 17-33.

OUDEMANS (1930b) described *T. foenilis* based on a female specimen collected from a hayloft in Franekar, the Netherlands. Since NESBITT (1951) designated this species as a junior synonym of *T.*

rhenanus, only a few acarologists in the former U.S.S.R. have regarded this species as a separate taxon. However, EVANS and MOMEN (1988) reexamined the type specimens of both species and confirmed the status of *T. foenilis* as a separate taxon. They provided a redescription of this species.

Typhlodromus reticulatus Oudemans

Typhlodromus reticulatus OUDEMANS, 1930b, pp. 70-71.
Typhlodromus (*Neoseiulus*) *reticulatus* Oudemans, NESBITT, 1951, pp. 37-38, Pl. 13.
Amblyseius reticulatus (Oudemans), ATHIAS-HENRIOT, 1959, p. 145.
Typhlodromus (*Amblyseius*) *reticulatus* Oudemans, CHANT, 1959, p. 76, Figs. 128-129.
Cydnodromus reticulatus (Oudemans), MUMA, 1961, p. 290.

OUDEMANS' original description of *T. reticulatus* was based on a female specimen collected on *Calluna vulgaris* in Wageningen, the Netherlands. Although NESBITT (1951) provided a translation of OUDEMANS' description and the original illustrations of this species, different forms have been attributed to it by other authors. KOLODOCHKA (1988) provided a redescription of this species based on the holotype specimen. As he noted, many references to this species in the literature need to be reviewed and specimens reexamined.

Zercon similis Koch *sensu* Oudemans

Typhlodromus similis (Koch), OUDEMANS, 1930b, pp. 71-73.
Seiulus truncatus OUDEMANS, 1905, p. 8. (Type : Rijksmuseum van Natuurlijke Historie, Leiden, the Netherlands)
Amblyseius similis (Koch), KUENEN, 1945, pp. 303-312.
Typhlodromus (*Amblyseius*) *similis* (Koch), CHANT, 1959, p. 93, Figs. 212-213.
Amblyseius (*Typhlodromopsis*) *similis* (Koch), MUMA, 1961, p. 287.
Amblyseius (*Amblyseius*) *similis* (Koch), EHARA, 1966, p. 23.

OUDEMANS (1930b) redescribed *Zercon similis* Koch based on contemporary specimens in his collection, including larva, protonymph, deutonymph, adult female and adult male. OUDEMANS initially concluded that his specimens were conspecific with *Z. similis* and that *Z. ovalis, Z. pallens, Z. obtusus* and *S. truncatus* were junior synonyms of this species, but later (1936) he designated *Z. similis* as well as the other three *Zercon* species as "*nomina nuda.*"

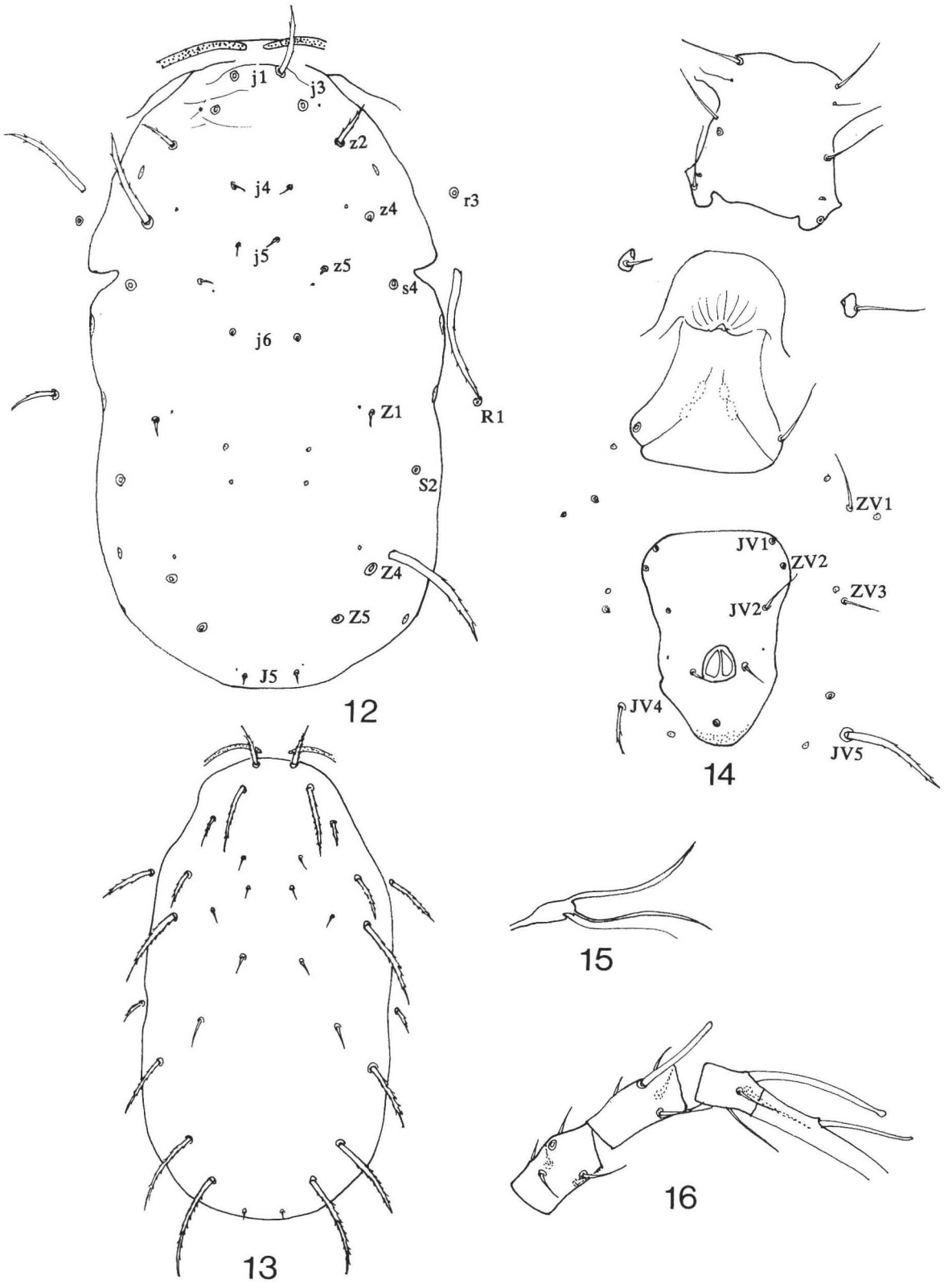
It is not known on what basis OUDEMANS concluded that all these species were conspecific. All of KOCH's specimens were lost long ago and his descriptions and illustrations are not adequate for identification. OUDEMANS' specimens of immature instars identified as *Z. similis* are in poor condition and an adult female specimen assigned to this species, originally identified as *S. truncatus*, is now represented only by a chelicera. Under these circumstances, it is reasonable to accept OUDEMANS' designation of *Z. similis* as a "*nomen nudum.*" Therefore, specimens attributed to this species should be reexamined and references to it in the literature reviewed.

We also examined the male specimens OUDEMANS attributed to *Z. similis*. They provide sufficient information for identification. All relevant characters and measurements of these concur with those of the males of *A. andersoni* (Chant). The three male specimens, mounted on the same slide, were collected from *Heliotropicus corymbosum* in Wageningen, the Netherlands, where *A. andersoni* is common. Based on this evidence, the male of *Z. similis sensu* OUDEMANS is reidentified as *A. andersoni.*

Typhlodromus heveae Oudemans

(Figs. 12-16)

Typhlodromus heveae OUDEMANS, 1930c, p. 97.
Kampimodromus heveae (Oudemans), NESBITT, 1951, p. 54, Pl. 29.
Typhlodromus (*Amblyseius*) *heveae* Oudemans, CHANT, 1959, pp. 101-102, Figs. 242-243.
Amblyseiulella heveae (Oudemans), MUMA, 1961, pp. 276-277.
Amblyseius (*Asperoseius*) *heveae* (Oudemans), PRITCHARD and BAKER, 1962, p. 295.
Phytoseiulus (*Kampimoseius*) *heveae* (Oudemans), WAINSTEIN, 1962, p. 19.
Amblyseius heveae (Oudemans), KE, 1986, pp. 796-797, Fig. 19-5-28.



FIGS. 12-16 : *Typhlodromus heveae,* adult female.

12. — Dorsal view ; 13. — Dorsal view (from OUDEMANS, 1930c) ; 14. — Ventral view ; 15. — Spermatheca ; 16. — Genu, tibia and basitarsus of leg IV.

OUDEMANS' original description of *T. heveae* was based on a female specimen collected on *Hevea* sp. in Medan, Deli, Sumatra. NESBITT (1951) reviewed this species based on the original description and illustrations.

Our examination of the type specimen showed that there is a pair of small solenostomes on the ventrianal shield, which was overlooked in the original description. Many of the dorsal setae are missing from the type specimen, probably as a result of remounting, but because OUDEMANS' original drawing provides sufficient information on the nature and relative lengths of the setae, redescription of this species is provided in the present paper.

Following is a redescription of this species based on the type specimen.

Adult female — Idiosomal setal pattern, 10A: 6D/JV-3:ZV. Dorsal shield without reticulation : length 358 ; width at level of waist 190, at level posterior to *s4* 206. Dorsal setal pattern, 10A:6D : podosoma with setae *j1, j3, j4, j5, j6, z2, z4, z5*, s4 and *r3* ; opisthosoma with setae *J5, Z1, Z4, Z5, S2* and *R1* (Figs. 12, 13). Five pairs of solenostomes on dorsal shield : laterad to *j3* ; anteromediad each to *z4* and *Z1* ; anterior to *Z4* ; and posteromediad to *z5*. Sublateral setae *r3* and *R1* on lateral integument. All setae on lateral margins of dorsal shield and sublateral setae distinctly serrated (based on OUDEMANS' illustration, Fig. 13) ; remaining setae short, smooth. Measurements of dorsal and sublateral setae as follows : *j1* 39 ; *j3* broken ; *j4* 6 ; *j5* 7 ; *j6* broken ; *J5* 6 ; *z2* 24 ; *z4* 52 ; *z5* 8 ; *Z1* 12 ; *Z4* 71 ; *Z5* broken ; *s4* 74 ; *S2* broken ; *r3* 54 ; *R1* 25.

Sternal shield smooth, with three pairs of setae and two pairs of pores ; metasternal setae on platelets each accompanied by a pore. Length of sternal shield 90 ; width 70. Genital shield smooth ; width 88. Ventrianal shield longer than wide, smooth ; with setae *JV1, JV2* and *ZV2* and a pair of small, circular solenostomes on lateral margins, at level of anus (Fig. 14). Length of ventrianal shield 120 ; width at level of *ZV2* 86 and at level of anus 66. Setae *ZV1, ZV3, JV4* and *JV5* on integument surrounding ventrianal shield. Setae *JV4* and *JV5* serrated ; *JV5* 59. Metapodal plates not discernible. Caudoventral setal pattern, 9:JV-3:ZV.

Spermatheca with cervix elongate (Fig. 15), 18. Fixed digit of chelicera appearing to have eight teeth ; movable digit tridentate, 29. Chaetotactic formulae of leg segments as follows : femur I 2-5/3-2 ; genu I 2-2/1, 2/1-2 ; tibia I 2-2/1, 2/1-2 ; femur II 2-5/2-1 ; genu II 1-2/0, 2/0-1 ; tibia II 1-1/1, 2/1-1 ; femur III 1-3/1-1 ; genu III 1-2/1, 2/0-1 ; tibia III 1-1/1, 2/1-1 ; femur IV missing ; genu IV 1-2/1, 2/0-1 ; tibia IV 1-1/1, 2/0-1. Measurements of legs and palp as follows : leg I 358 ; leg II 334 ; leg III 338 ; leg IV 394 ; palp 188. Genu of leg III with macroseta, 30. Genu, tibia, basitarsus and tarsus of leg IV (Fig. 16) each with macroseta, tip slightly bulbous : broken, 53, 75 and 51 respectively. Peritreme extending anteriorly to level of *j1*.

Adult male — Unknown.

TYPE — The monobasic female holotype was collected on *Hevea* leaves, Medan, Deli, Sumatra, summer, 1927.

REMARKS — OUDEMANS' illustration of the dorsum (Fig. 13) is provided to show dorsal setae that are missing from the specimen we examined. Setae JV4 are serrated, though sparsely, on this species.

Specimens of *T. heveae* have been reported from Thailand (EHARA and BHANDHUFALCK, 1977) and southern China (LIANG and KE, 1982 ; KE, 1986). However, the descriptions of these specimens show that the shape of the spermatheca and the measurements of some dorsal setae differ from those of the holotype specimen. The obvious difference in the shape of the spermatheca indicates that these specimens are not conspecific with *T. heveae*.

Typhlodromus heveae appears to be close to *A. prunii* Liang and Ke and *A. omei* Wu and Li, recorded from China. Once again, the most obvious difference between *T. heveae* and these two species is the shape of the spermatheca. Because of the presence of setae *S4* and *S5* on the specimen of *T. hevearum* examined, we do not consider this species to be conspecific with *T. heveae* as OUDEMANS (1930c) and NESBITT (1951) suggested.

Typhlodromus hevearum Oudemans

Typhlodromus hevearum OUDEMANS, 1930c, pp. 97-98.
Kampimodromus hevearum (Oudemans), NESBITT, 1951, pp. 54-55, Pl. 30.

OUDEMANS (1930c) described *T. hevearum* based on an adult male specimen collected on leaves of *Hevea* sp. in Medan, Deli, Sumatra. He suggested that this specimen might be a male of *T. heveae*. NESBITT (1951) considered these two species as separate taxa.

Although the type specimen of *T. hevearum* is in poor condition for critical examination, it shows, contrary to previous reports, that setae S4 and S5 are present. This invalidates the possible conspecificity of this species with *T. heveae*. Nevertheless, because of the poor condition of the specimen, *T. hevearum* is regarded as a " *species inquirenda.* "

Typhlodromus dahliae Oudemans

Typhlodromus dahliae OUDEMANS, 1936, pp. 260-261, Fig. 99.

OUDEMANS proposed *T. dahliae* as a replacement name for *Acarus foliorum* Raspail, 1843, because the latter name was preoccupied by *Acarus foliorum* Schrank, 1781. He provided RASPAIL's illustrations as well as part of his description of this species. It is unclear as to why OUDEMANS concluded that the form described by RASPAIL fitted his own concept of the genus *Typhlodromus* : the illustrations and description provided are not sufficient for identification even at the generic level. Therefore, *T. dahliae* is best regarded as a *nomen nudum*.

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