

A TAXONOMIC STUDY OF THE PHYTOSEIINAE (FAMILY LAELAPTIDAE) PREDACEOUS UPON TETRANYCHIDAE OF ECONOMIC IMPORTANCE

by

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The increased importance which the European red mite (*Paratetranychus pilosus* (Can. et Fanz.)) (= *Metatetranychus ulmi* (Koch)) has assumed in recent years has led to an intensive study of its biology and natural history. In the course of these investigations many workers, and in particular those in Nova Scotia (vide Lord, 1949), have become convinced that this pest can be controlled, on apple trees at least, by natural means and that some of the most active agents in its eradication are the representatives of that group of predaceous mites which Vitzthum (1941) placed in the subfamily Phytoseiinae Berlese, 1916¹). As the late Dr. A. C. Oudemans of Arnhem included many if not most of these species in the genus *Typhlodromus* as he conceived it, this paper is in essence a revision of that genus.

Presumably because of their small size and limited distribution, which is largely contingent upon readily available populations of their hosts, little attention has been paid to these predators from either the ecological or taxonomic point of view. A cursory survey of the literature pertaining to the predaceous relationship which exists between the Phytoseiinae herein to be discussed and the tetranychid mites may serve as an appraisal of this economically significant group of mites. Koch (1839) in describing what now appears to be a typhlodromid, viz., *Gamasus vepallidus*, made no reference to its possible predaceous habits. Scheuten (1857) thought that the eriophyids which he found associated in numbers with his *Typhlodromus pyri* were its offspring. Berlese (1882-1898), however, had a better understanding of these relationships and was able to state in his redescription of *G. vepallidus* as *Seius (Seiulus) vepallidus* (K.) that it was a predator of small acari as well as being a mycophage. His countryman, Ribaga (1902), writing of the gamasids associated with plants, failed to note any such relationship. In 1906 the American entomologist Parrott, as a result of his studies on the eriophyids of apple and pear trees, was able to state, "The apple and pear blister mite is much subject to the ravages of a gamasid mite *Seius pomi* (Parrott). This was very abundant this season upon infested trees and undoubtedly material-

1) For a list of the genera included in this group see p. 4, footnote.

ly assisted in reducing the numbers of blister mites". Six years later Quayle (1912) reported a gamasid preying upon a tetranychid which he called *Tetranychus mytilaspidis* Riley (? = *Metatetranychus ulmi* (Koch)). In 1914 Ewing described in a rather general manner the different instars of *Seius pomi* and reported that in Oregon he found it to be one of the most efficient natural enemies of *Tetranychus telarius* (L.) and of a species which we now believe was probably the European red mite. These findings relative to the predaceous habits of typhlodromids were in the main substantiated by Newcomer and Yothers (1929) working in the apple growing areas of the Pacific north-west (the state of Washington and surrounding areas) and by Gilliatt (1935) in a similar ecological area in Nova Scotia. The latter author was somewhat more outspoken in his claims for *Seiulus pomi* (Parrott): "This mite is probably the most important of all the predators attacking the European red mite in Nova Scotian orchards, not that it consumed more mites during the many periods under observation in comparison with other predators, but on account of its being active for the entire season from early spring before the red mite eggs hatch until well after all winter eggs have been deposited". Somewhat similar but less emphatic results have been reported by Kuenen (1945) working with *Typhlodromus similis* (Koch)¹ in the Netherlands and by Masee (private correspondence) in England. As a result of four seasons of experimental and observational work in the main fruit growing areas of Canada, I am convinced that the complex of species loosely referred to as "*Seius (Seiulus) pomi*" is one of the most useful agents in the control of all tetranychid mites.

For many years the systematics of the species of the Phytoseiinae has been in a state of confusion. Many factors have conspired to bring this about. None of the older type specimens were available for study and most original descriptions were so vague that they could be variously interpreted. Finally, there was almost a complete lack of liaison between the zoologists in Europe who were engaged in taxonomic pursuits and those in America who were interested in the biology and ecology of the species involved. Some of this trouble has now been remedied. Large collections, numbering hundreds of specimens of some species, of Canadian, American and European material have been compared with the Oudemans specimens in the Rijksmuseum van Natuurlijke Historie, Leiden, and a diligent search has been made of the older literature in an effort to understand what the writers had in mind, or rather hand, when they made their descriptions. While the type specimens are still not available and repeated search leads one to believe that they are gone

1) Berlese regarded this species as being synonymous with *Amblyseius obtusus* K. There is no question about its inclusion in the genus *Amblyseius*, but there is some doubt about the specific synonymy.

forever, collections from the type localities have proved an aid in interpreting the original descriptions. Some word of thanks should be extended to Dr. H. Boschma, the Director of the above mentioned museum, who kindly placed the Oudemans collection at my disposal in the summer of 1948 when I was in Leiden and who has given me permission to include many of Oudemans' original drawings in this paper.

As first reviewer of the group I have had to exercise a certain amount of choice in the fixing of genotypes and hence the genera, but at all times great care has been taken because I realized that in so doing I was adopting a somewhat arbitrary taxonomic position. It is my belief, however, that the exigencies of the situation warranted such an action and that it is preferable to maintain taxonomic names, which in the past have expressed a true biological relationship rather than to discard them because the type specimens on which they are based are no longer available.

In 1929 Oudemans began his studies of the typhlodromid mites by separating the known species into two groups on the nature of the dorsal setae. For those with smooth setae he resurrected Scheuten's 1857 genus *Typhlodromus* stating that as Scheuten's type *pyri* (1857) was synonymous with *Gamasus vepallidus* Koch, 1839, the latter would have to be designated the type of the genus. Antithetically the species with the rough, feather-like dorsal setae were relegated to the genus *Sciulus* Berlese, 1887, type *Sciulus hirsutigenus* Berl., 1887 (vide infra). The genus *Typhlodromus* as thus conceived and understood by Oudemans was a composite group including several widely divergent forms¹⁾. The Dutch author recognized this and in 1930 expressed doubts in his own mind about the advisability of maintaining such a heterogeneous group but stated²⁾ that as he had never seen *pyri* he did not dare to break up the genus *Typhlodromus* into the different subgroups which were apparent. He did, however, indicate possible relationships and cited the different species which he would group together (vide 1930 paper).

The genus stood as such until June of 1948 when Dr. Philip Garman decided to split it into its component parts by means of such characters as the number and disposition of the dorsal setae and the size and shape of the anal

1) Oudemans never, to my knowledge, apart from designating the type and setting forth the description of several species, gave a formal description of this genus. My knowledge of his conception of the genus is based on (1) his species descriptions; and (2) his type specimens and figures deposited in the Rijksmuseum van Natuurlijke Historie, Leiden, Nederland.

2) Oudemans' words read, "Zoolang ik de op *Pirus communis* (en wellicht op andere vruchtboomen) voorkomende *T. pyri* Scheuten 1857 [he apparently overlooked the fact that in 1929 he stated that *pyri* was a synonym of *vepallidus*], type van het genus *Typhlodromus* Scheuten 1857, niet met eigen oogen aanschouwd heb, waag ik het niet, de door mij beschrevene soorten in subgenera, of genera, te splitsen".

plate of the female. On the basis of these criteria the genus *Typhlodromus* was retained for the group of species where there are upwards of twenty-five pairs of dorsal setae and where the anal plate is small and seldom bears more than three setae. Ribaga's 1902 genus *Iphidulus* (type *I. communis* Rib., 1902), on the other hand, was revived from obscurity for the species with only seventeen pairs of dorsal setae and with the larger anal plate which bears more than three setae.

Two questions must now be proposed: was Garman justified in his separation of the genus *Typhlodromus* (as understood by Oudemans) into its component parts, and what are the correct generic names to be applied. The first question, I believe, may be answered in the affirmative if investigators in this field are willing to set aside a purely legalistic interpretation of the relationships of species in favour of biological realities. Garman was correct in his assertion that Oudemans' group of species falls quite naturally into two (later discussion will reveal at least four) subgroups but, as I subsequently hope to shew, I do not think the generic names which he used were the correct ones.

Before any definite decision can be made concerning Garman's choice of generic names the genera ¹⁾ of the Phytoseiinae which are involved and those proposed in 1902 by Ribaga will have to be examined.

The genus *Typhlodromus* was established in 1857 by Scheuten for his new species *T. pyri*. The description and figures which he presented in support of his contention that he had an undescribed mite are not sufficiently detailed to be of much value. In describing his species, however, he stated

1) Vitzthum (1941) page 767.

"5. Subfamilia: Phytoseiinae Berlese 1916.

Genera und Subgenera:

1. *Typhlodromus* Scheuten 1857 (= *Seiulus* Berlese 1920),
Typus: *Gamasus vepallidus* C. L. Koch 1839 (= *Typhlodromus pyri* Scheuten 1857).
2. *Seiulus* Berlese 1887 (= *Echinoseius* Ribaga 1902),
Typus: *Seiulus hirsutigenuis* Berlese 1887.
3. *Phytoseius* Ribaga 1902,
Typus: *Gamasus plumifer* G. Canestrini et Fanzago 1876.
4. *Iphidulus* Ribaga 1902,
Typus: *Iphidulus communis* Ribaga 1902.
5. *Amblyseius* Berlese 1914,
 - a) *Amblyseius* s. str.,
Typus: *Seius obtusus* Berlese 1889 ex Koch.
 - b) *Seiopsis* Berlese 1923,
Typus: *Amblyseius (Seiopsis) brevipilus* Berlese 1923.
6. *Kleemannia* Oudemans 1930,
Typus: *Zercon pavidus* C. L. Koch 1839."

that he found it on pear leaves associated with eriophyids and in his drawing, which might otherwise be taken for a generalized Laelaptid, he shewed the outline of the gut. This latter point is worthy of notice because in the usual Laelaptids which are found on apple and pear leaves only those forms¹⁾ which feed on red mites and have a weakly sclerotized dorsum shew this character. From this very pertinent observation and from his description I am convinced beyond reasonable doubt that Scheuten had one of the common predators of the European red mite and that he was justified in establishing a monotypic genus for it. The question, however, of the type and, dependent upon that, the limits of the genus *sensu stricto*, is a controversial point which must be settled.

There are two possible solutions to this problem. One is to declare that as there is no holotype or lectotype material available we are justified in treating *Typhlodromus* as a *nomen dubium* and erecting a new genus for many of the species which Oudemans placed in his genus *Typhlodromus*. The other is to attempt to identify Scheuten's species within certain justifiable limits and so fix the genus if not on one species, at least on a group of very closely related forms. The first procedure is a sound taxonomic expedient which avoids entirely the purpose and spirit of modern systematic thought, the second is a somewhat arbitrary practice which, however, preserves the spirit if not the letter of the law and maintains a well-established generic name. Furthermore, in essence the second method of dealing with this problem has been condoned by the Paris meetings of the International Commission on Zoological Nomenclature²⁾.

1) Included in this group are the species known and described by Oudemans as *Typhlodromus tiliae*, *rhenanus*, *tiliarum*, and *finlandicus*, and *Seiulus spoofti*. I doubt if Scheuten would have confused the last mentioned species with any of the former because its large serrate setae make it quite distinct even under the lower powers of magnification.

2) A pertinent excerpt from the Proceedings of the International Commission on Zoological Nomenclature at its Session held in Paris in July, 1948; 4 (46): 76, 25th May 1950; reads as follows: —

“(g) that, where an author, when publishing the name of a nominal species, either (i) omits to specify the material on which that nominal species is based and it is later found impossible to trace that material, or (ii) specifies his type material, but that material either (a) is so imperfect or in such bad condition as to render it impossible to recognise the taxonomic species of which it consists, or (b) was lost or destroyed before the identity of the taxonomic species in question was established, the following rules are to be applied: —

(1) where, in spite of the lack of a holotype or lectotype or, as the case may be, of a recognizable holotype or lectotype, specialists are able to recognise the taxonomic species represented by the nominal species in question the name of that nominal species shall apply to the taxonomic species so recognised.”

Certain portions of the above excerpt are applicable to the case in hand of *Typhlo-*

If we adopt the second alternative what then is *Typhlodromus pyri* Scheuten? From collections which I have made in the Netherlands, Belgium, and France and which have been made for me in and about the neighbourhood of Bonn, Germany, where Scheuten states he found his specimens I am convinced that the species under discussion was either *Typhlodromus tiliae* Oudms., the almost identical *T. tiliarum* Oudms., or *T. finlandicus* (Oudms.). These three species are similar morphologically and ecologically and can only be separated with difficulty. Of the three species just noted I am inclined to favour the first mentioned, viz., *Typhlodromus tiliae* Oudms., because it is by far the most widespread and common of the predators of the European red mite and eriophyids, because it shews the outline of the gut very clearly after feeding on red or clover mite¹⁾ eggs, and because anatomically it corresponds with the figures and descriptions published by Scheuten.

Oudemans on the basis of rather limited collections²⁾ but a wide knowledge of the literature took a somewhat different view. In 1929 he was convinced, for reasons which I have not been able to discover, that Scheuten's type from pear was synonymous with Koch's *Gamasus vepallidus* 1839 from elm, whilst in the next year he cast doubt on this by stating (1930) that he had not yet seen the type of *T. pyri*. Subsequently in 1941, Vitzthum either was ready to accept Oudemans' former statement or had reasons of his own for arriving at the same conclusions for in his last great work which appeared in that year he accepted *G. vepallidus* Koch as the type of the genus *Typhlodromus*.

Before this synonymy can be accepted, however, an exact knowledge of the nature of *Gamasus vepallidus* should be available. Koch's drawings are too vague to be of value and those published by Berlese in 1897 complicate

dromus pyri. Clause (i) is relevant in that Scheuten made no reference in his description to his disposition of his type material, whether it was placed in a museum or in a private collection. All we know is that to all intents and purposes it is lost. In all probability, living when he did, he did not realize that type specimens had any great significance. His writings also, wherein he referred to glycerine preparations, would indicate that he did not make permanent preparations. Clause (ii) b is also helpful because as far as we know no person ever saw the types. Oudemans (1930) stated that he had not seen any and Berlese made no reference to any knowledge of Scheuten's work.

1) From the description and figures given it would appear that one of the other mites, viz., *Sannio rubrioculus* Scheuten which Scheuten found in his collections from pear and linden was the clover mite *Bryobia practiosa* Koch, a frequent prey of *Typhlodromus* spp.

2) I doubt if Oudemans had in all more than 75 or 80 specimens of *Typhlodromus* mites. The great bulk of these were submissions by others rather than his own collections. In fact in later life he regretted that he had not been able to spend more time in the field observing some of these forms under natural conditions.

the issue because it appears that he either misidentified the species, published a composite drawing or incorrectly drew what he saw¹). Thus we are in the position of being unable on anatomical grounds to identify *G. vepallidus* any more exactly than to a group of species within the genus *Typhlodromus* (Oudemans' conception). There are, furthermore, no ecological or natural history notes in this description as there were in the case of *T. pyri* to aid us in arriving at a satisfactory conclusion. Oudemans (1905) has stated that his *Seiulus rhenanus* is very similar to *G. vepallidus* but that it differs in a few minor details, viz., in lacking two coarse setae behind the vertical setae; in that it has only one pair (not two) of coarse setae at the posterior margin of the body; and in that the copulatory organs of the two species are somewhat differently shaped. It is difficult to understand how the Dutch author could make these statements because Koch's drawing of *vepallidus* looks like a simplified version of almost any one of half a dozen different species and from extant records (both written and microscopic slides) he could have had little knowledge of *vepallidus* apart from the original description.

On the basis of the above argument and in view of the fact that *G. vepallidus* was found on elm²) whereas *T. pyri* has been taken from pear, apple and linden, the evidence seems to be in favour of the opinion that *pyri* and *vepallidus* can not be synonymous and that *pyri* should stand as

1) Berlese's figures of the dorsal surface though far from exact (vide A.M.S. fasc. 54, N8. fig. 1) and of the chelicerae (ibidem, figs. 5 and 6) indicate that his *vepallidus* belongs to that group of species which is typified by *T. tiliae* Oudms., i.e., those in which there are not more than 17 pairs of setae on the dorsal shield. The ventral view (ibidem, fig. 2), on the other hand, shows a small anal plate which would place the species under discussion in the other group with such forms as *T. domesticus* Oudms. and *T. pomorum* Oudms. In interpreting these figures and the accompanying descriptions we can assume: i) that Berlese correctly drew what he saw which would indicate that he had a species which has subsequently never been seen by either Oudemans or later workers; ii) that he confused two species, drawing the dorsal surface of one and the ventral surface of another, which would be almost impossible because the species comprising the two subgroups are seldom if ever found together in the same habitat; iii) that he incorrectly drew either the dorsal or ventral surface. I am inclined to the third explanation and to adopt the attitude that the ventral surface of the female (ibidem, fig. 2) was incorrectly drawn because, as has already been stated, the figures of the dorsal surface and the chelicerae are applicable within justifiable limits to the *tiliae* group of species, whereas the anal plate, whilst typical of the other group might have appeared as a small oval platelet rather than the full hexagon under certain methods of clearing and observation. Garman (1948) has taken the opposite view and he based his conception of the genus *Typhlodromus* on the ventral view alone, apparently ignoring the figures of the dorsum and the chelicerae.

2) In Southern Canada and in the adjacent northern states, by far the most common species on elm is a form which closely resembles *Typhlodromus rhenanus* Oudms. and which in all probability is *Typhlodromus vepallidus* (Koch).

the type of the genus *Typhlodromus*. The exact identity of *pyri* and hence of the genus *sensu stricto* can never be established beyond all shadow of a doubt. As first reviewer of the group, however, I believe that the evidence is sufficient to state that *Typhlodromus pyri* Sch., 1857, and *T. tiliae* Oudms., 1929 are very closely related if not identical, and that the specimens of *T. tiliae* in the Oudemans collection in the Rijksmuseum van Natuurlijke Historie, Leiden, bearing the labels "op *Tilia platyphyllos* Arnhem 1900" could be regarded as *Typhlodromus pyri* and considered illustrative of the genus *Typhlodromus*. In the event of these ever being lost there are specimens in my collection which were taken from pear trees from the Bonn area, Germany, which have been critically compared with Oudemans' type material.

The genus *Iphidulus* (type: *I. communis* Rib., 1902¹) which was established in 1902 by Ribaga is worthy of consideration. Vitzthum admitted it to his list of genera in the subfamily Phytoseiinae and Garman (1948) used the name for that group of species, which Oudemans placed in the genus *Typhlodromus*, wherein there are not more than seventeen pairs of dorsal setae and a large anal plate in the female (in other words the group which has just been discussed under the genus *Typhlodromus sensu stricto*). The question follows as to whether these two workers were justified in believing that this group had any validity. Three reasons are patent which seriously question their position: i) Ribaga's (1902) writings lead us to believe that he had no clear cut idea as to the limits or main characteristics of either the genus *Seiulus* or *Iphidulus* because while he stated in his "Gamasidi Plan-ticoli" that the setae in the genus *Seiulus* are of the slightly denticulate plumiform type ("setis mediocribus, lenitre denticulato-plumatis armatum") and all those in the genus *Iphidulus* are simple not heavily pectinate or plumose ("omnibus autem simplicibus (nec plumosis)") he placed *Gamasus vepallidus* Koch in the genus *Seiulus* despite his assertion that it possesses simple setae ("setulis omnibus subtilibus"). Had he been consistent he would have placed *G. vepallidus* in his genus *Iphidulus*. Instead he chose a new

¹) Ribaga's (1902) description of this genus and of *Seiulus* reads as follows in translation:

"Genus *Iphidulus* Rib. n. gen.

Body ovoid. Six posterior setae (caudal, precaudal, and caudoventral) longer than the scapular and genual setae, all others very small or non existant; all are simple not pectinated; posteriorly the female genital scutum is almost as wide as the anal scutum."

"Genus *Seiulus* Berl.

Body oval, with moderate setae armed with slightly denticulate feathers. Cephalo-lateral, humeral, scapular, infrascapular and median setae of unequal length, among themselves and [i.e., the setae named vary in length among themselves and are shorter than the caudal] scarcely shorter than the caudal."

species, viz., *I. communis* as the type of the genus. ii) His (1902) descriptions both of his species and his genera are too vague to be of any value; they were not accompanied by any figures or ecological notes which might serve to elucidate the descriptions, and as far as can be ascertained, there are no type specimens for a final comparison. iii) The earlier use of the name *Iphidulus* by Berlese (1882-1898) in setting forth his description of *Laelaps (Iphidulus) vepallidus* Koch (sive *Laelaptis stabularis* protonympha) could be considered sufficient to invalidate its use by another author and in a different context. As a result I am of the opinion that the resurrection of the genus *Iphidulus* from semiobscurity was unwarranted and that it would be better taxonomic practice if this name were placed on the list of dubious or unknown genera.

On the basis of the above argument the question concerning Garman's use of the generic names *Iphidulus* and *Typhlodromus* can now be answered. It would appear that the only logical solution would be to transfer those mites which Garman described in the genus *Iphidulus* to the genus *Typhlodromus*, and to place the genus *Iphidulus* in the list of *nomina dubia*. The species remaining of those which Oudemans described in the genus *Typhlodromus*, viz., those with better than twenty-five pairs of dorsal setae and a small female anal plate, will have to be assigned to a new genus herein to be described.

The genus *Seiulus*.

Certain difficulties have also arisen in connection with the use of the name *Seiulus* which was introduced in 1887 by Berlese (vide 1882-1898, fasc. 41, N3) in his description of *Seius (Seiulus) hirsutigenus* and used again in the description of *Seius (Seiulus) vepallidus* (K.) Berl. 1). Since the term is commonly used in the literature pertinent to this group of Laelaptids, some attention should be given to its validity. In 1902 Oudemans stated that there is "reason enough to adopt the name *Seiulus*" to replace Berlese's genus *Seius* 2), because of the incorrect use of the last mentioned

1) The subtitle of this description (vide A.M.S. fasc. 54 N8) reads "Seii obtusi nympha generans".

2) Koch originally erected a genus *Seius* in 1836 with *Seius togatus* as type. In 1842 he apparently forgot about this work and chose *S. viduus* as the type for another genus *Seius*. What *S. viduus* is no one knows but Berlese believed it to be *Epicrius glaber*. Thus Koch had two genera by the name of *Seius* — one in 1836 and another in 1842. Only the former of these can stand. In 1881 Berlese erected a third genus *Seius* (the one in question above) and designated *Seius echinatus* Koch as the type. Since this name is preoccupied, an alternative one must be chosen and Oudemans (1902) has selected *Seiulus* Berl., 1887. Berlese (1921) overcame the difficulty himself by transferring the species described in his genus *Seius* to other genera.

name by the Italian author, and in 1929 (vide supra) he still thought that the genus (*Seiulus*) should be retained for the more limited group of mites possessed of the large feather-like lateral setae. Berlese apparently took cognisance of Oudemans' 1902 criticism because in 1921 he abandoned his use of the genus *Seius* by transferring all the species previously attributed by him to that genus to other genera. In this synonymic work (1921) he recognized Ribaga's genus *Echinoseius*, type *Seius* (*Seiulus*) *hirsutigenus* Berl., and left but a single species, *Seius* (*Seiulus*) *vepallidus* K. (Berl.)¹), in the genus *Seiulus*.

As Berlese never gave a formal description of this genus, our knowledge of his conception must be based on his comments about the species which he first assigned to it, and as the two species placed in the genus are totally different (vide A.M.S. fasc. XLI, N3 and fasc. LIV, N8), the question of which is the type is important. Vitzthum (1941) has taken the attitude that since *hirsutigenus* (ibid., fasc. XLI, N3) was the first described it should be considered the type and on this basis he has placed Ribaga's genus *Echinoseius* in synonymy with *Seiulus*. Berlese (1921) on the other hand, in his Index Sinonimico designated *Seius* (*Seiulus*) *vepallidus* (Koch) as the type of his genus *Seiulus*²) and transferred *S. hirsutigenus* to the genus *Ameroseius* Berl., 1904. If this be accepted the genus *Seiulus* Berlese, 1921 will be based not on Koch's *vepallidus* but on what has been argued elsewhere in this paper, is an incorrect interpretation of this species and furthermore a form which has been so figured and described that it cannot be specifically identified or separated from the members of the established genus *Typhlodromus*.

If, on the contrary, we accept Vitzthum's contention the genus *Seiulus* can stand on the type *hirsutigenus*. What *hirsutigenus* is again poses difficulties and two alternative explanations of its identity have been advanced — one, that it is the immature stage of an already described species, and the other, that it is a valid species. In his original description Berlese (ibid., fasc. XLI, N3) hinted at the former, stating that it might be the protonymph of *Seius hirsutus* Koch (his quotation reads 'sive *Seii hirsuti* protonympha') and later, in the introduction to the "Mesostigmata", he stated

1) Some attention should be drawn to the apparent confusion which exists concerning the authority for this species. Oudemans (1929 and 1939) attributed the species *vepallidus* correctly to C. L. Koch, 1839. In 1887 Berlese (1882-1898) cited Koch as the reference whereas in 1921 Kramer was given by Berlese.

2) Ribaga in 1902 had already done this but as has been pointed out elsewhere in this paper, his conception of the genus *Seiulus* and his statement of the characteristics of *vepallidus* are so at variance that I fail to see how he could assign the latter to the former.

that *S. hirsutigenus* was the *nympha generans* of *S. hirsutus*. Subsequent work has in part confirmed his suspicions in that many now believe *hirsutigenus* to be the protonymph of either *Seius echinatus* Koch or *Seius hirsutus* Koch. If such be true, and I see no way of proving it in the absence of all type specimens, two results are evident: (i) on the basis of Berlese's statement in his revision of the genus *Ameroseius*, that *S. echinatus*¹⁾ and *S. hirsutus*¹⁾ are identical, and taking into consideration Vitzthum's (1941) contention that these two species are synonymous with *S. muricatus* Koch, 1839 and *Acarus corbicula* Sowerby, 1806, it follows that *A. corbicula* on the basis of priority becomes the type of the genus *Seiulus* and (ii) that the genus *Ameroseius* Berlese, 1904 falls into synonymy with *Seiulus* because of the fact that both were erected on the same type (*S. hirsutus*).

If on the contrary, we accept Vitzthum's (1941) position and regard *hirsutigenus* as being a valid species, it follows that it is the type of the genus *Seiulus*. Ribaga's *Echinoseius* (type *hirsutigenus*) falls into synonymy, and the genus *Ameroseius* stands on type *A. corbicula*. Since the evidence to my mind, for maintaining that *hirsutigenus* is the protonymph of *S. hirsutus* (= *S. echinatus*) is weak, I believe that we would be in a sounder position if we accepted the second of those two possible alternatives, which automatically rules out the possibility of Berlese's *vepallidus* being the type of *Seiulus*, and regarded *hirsutigenus* Berlese as a valid species and type of the genus *Seiulus*. This does not help our immediate problem much, but it does remove the genus *Seiulus* from the genera which have to be considered in this context. The only genus with which it might be confused is *Phytoseius*, but as the latter has only fourteen pairs of serrate setae and as the former has many more, this ought not to be possible. On the basis of *hirsutigenus* the genus *Seiulus* has in all probability a greater affinity with the genus *Kleemannia*, but until the types of both can be examined this must remain an open question.

MORPHOLOGICAL NOTES

The mites of the subfamily Phytoseiinae are, on the whole, small (300 to 600 μ long), generalized gamasids with few diagnostic features to distinguish them. The gnathosoma is typical of most Laelaptids. It may be divided into two portions, the distal which is composed dorsally of the epistome or tectum as Snodgrass (1948) calls it, and ventrally of the two halves of the hypostome or lower lip; and the proximal part which bears the palps and

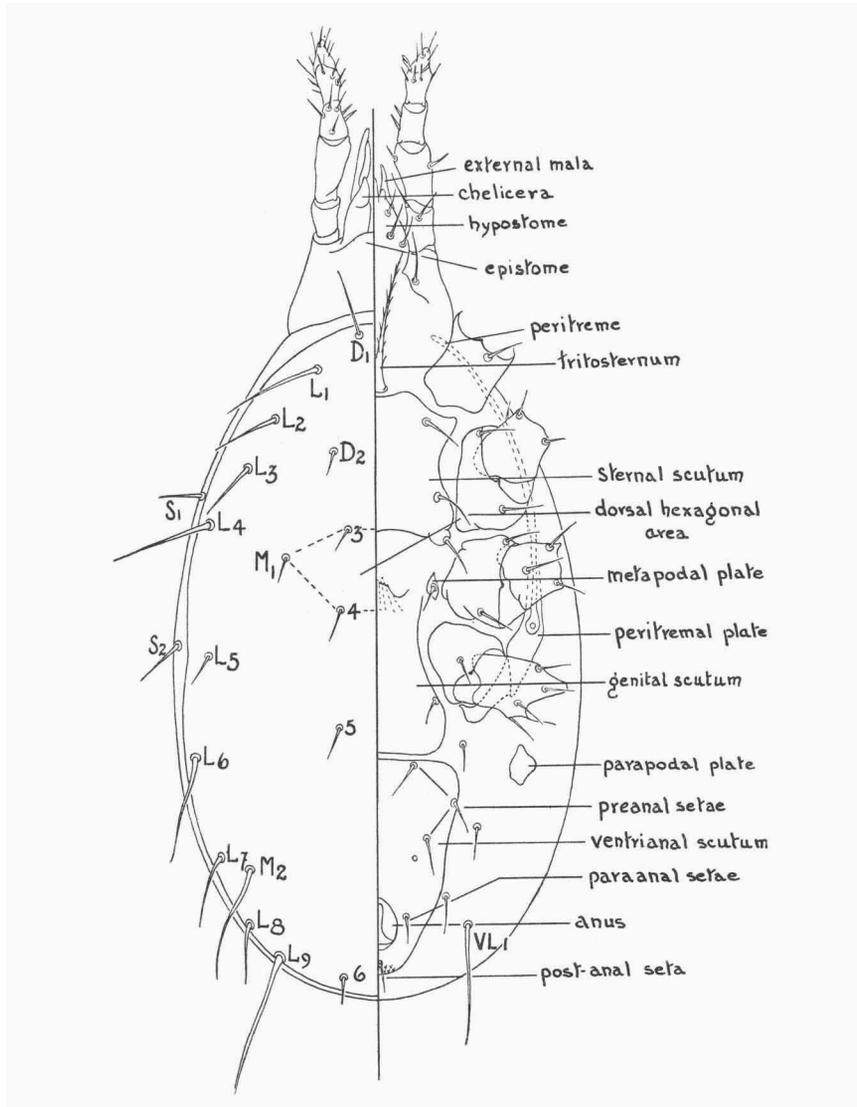
1) Both species were described by Koch (1839) in Deut. Crust. Myr. Arachn. — *hirsutus* in fasc. 24, t. 12, *echinatus* in fasc. 24, t. 13.

is confluent with the body proper. The margin of the epistome which is roughly triangular or semi-hexagonal in shape may be entire or slightly serrate. In such species as *Garmania bulbicola* it is drawn out into little teeth at its lateral angles (giving it the appearance of a cat's jaw). Distally, the hypostome is divided into two halves or flap-like processes, each bearing four setae, by a groove through which the labrum may be seen. In this groove are the transverse rows of minute teeth which Oudemans referred to as the *rima*. (The number of rows varies in different species and the number of teeth per row). Proximally the hypostome is continuous with the basal ring of the gnathosoma. Beneath the hypostome, in ventral view, may be seen the triangular-shaped outer, and needle-like inner, coxal processes¹⁾, the so-called maxillary malae or corniculae. Dorsad of these lie the chelate chelicerae. In the female these are simple unmodified shears with curved tips; in the male the moveable digit bears a copulatory apparatus or process which has been compared to a roe's horn. In some species both digits of the chelicerae are toothed, in others only the fixed. As in all Laelaptids the fixed digit also bears a small seta, the *pilus dentilis*, about one-third of the way from the tip; in some there is in addition to this a small peg-like structure near the joint of the moveable member and in still others laterally a flap-like process which is mildly denticulate along its free margin.

The idiosoma of the adult is covered dorsally by a single dorsal shield (in the larvae there may be one large and three smaller shields), which varies in the degree or rugosity which it exhibits and in the number, nature and disposition of the setae which it bears. In this group of mites all types of dorsal shield may be found from the smooth, highly polished back of *Amblyseius* to the heavily sclerotized and deeply pitted dorsum of the mites of the genus *Klccmannia*. In the genus *Typhlodromus* the dorsum exhibits scale-like markings or imbrications in low relief. Somewhat the same condition is frequently visible in *Garmania*; in *Kampimodromus* the markings are still more distinct and in *Phytoseius* the ridges are in high enough relief to give the surface a mat appearance under the lower powers of magnification. The chaetotactic pattern likewise varies in different groups though in all the most constant feature is a distinct hexagonal area, on the anterior half of the shield, which is delimited on each side by setae D_3 , M_1 and D_4 ²⁾. For comparison, the genus *Typhlodromus* (vide text-fig. 1) with its short setae of comparable length may be taken as the basic pattern. In *Amblyseius* the

1) Winkler (1886) states that the maxillary malae are processes of the hypostome. In the Laelaptidae there is reason for believing that the inner needle-like structures are processes of the labrum.

2) The terminology applicable to the setae has been adopted from Garman (1948).



Text-figure 1. *Typhlodromus masseei* n. sp., female. Left, dorsal surface, shewing L, lateral setae, D, dorsal setae, M, median setae and S, sacral setae. Right, ventral surface, shewing scuta and VL₁, ventrolateral seta. Original.

disposition of the setae is relatively the same but the setae themselves shew great differences in length; several of the marginal setae, viz., D₁, L₄, L₆ and L₈ are very long (L₈ equals almost one-half of the width of the body) and the median setae are minute. In the genera *Kampimodromus* and *Phytoseius* the chaetotactic pattern is recognizably similar to that of *Typhlodro-*

mus but again the marginal setae are greatly modified in that they are slightly pectinated in the first-mentioned genus and heavily serrate in the second. In *Garmania* the basic pattern is altered by the addition of at least eight more pairs of setae but the nature of the setae is similar to that of *Typhlodromus*. Finally in *Kleemannia* both the disposition and nature of the setae is greatly modified.

The ventral surface of the idiosoma is protected by a series of scuta or plates and bears the legs, the peritremata and the tritosternum. The latter, a forked structure of unknown but most probably sensory function, is composed of a short basal piece and two heavily pectinated flagella. It arises anterad of the sternal scutum and lies ventrad of the gnathosoma. The venter of the female is covered by several plates; the sternal is the most anterior of these and is roughly square in shape. In most of the species which will be discussed it bears three pairs of small bristles; in such forms as *T. reticulatus*, *T. fallacis*, and *T. vitis*, however, the rearmost pair of bristles stand on two small processes that extend posteriorly from the main body of the plate. In *G. amboinensis*, *T. (N.) rhenanus*, *T. tiliae*, *T. tiliarum*, and *T. conspicuus*, the third pair of bristles has moved posteriorly to arise from a pair of small platelets which may be either a logical outcome of the processes of isolation begun in such forms as *T. reticulatus* or a subdivision of the metapodal scuta which follow. These latter platelets each bear a bristle. Between the two metapodal platelets is an area which is mildly sclerotized. Most authors¹⁾ who have written about this group, regard this as an anterior extension of the genital plate, the vulvar area through which the eggs pass; Garman (1948), however, calls it the ventral plate. It continues posteriorly as a well sclerotized genital plate which bears one pair of setae and is usually truncate posteriorly. Behind it lies the last of the ventral plates — that called by Oudemans the ventrianal, by Garman the anal. In the majority of the species studied this is obviously a composite plate of hexagonal or rectangular shape made up of a small anal plate²⁾ carrying three paraanal setae and a larger anterior extension which bears an additional three or four pairs of preanal setae. In the remainder of the species, viz., those of the genus *Garmania*, only the small oval-shaped anal plate is present. In a few species such as *T. tiliae* the ventrianal scutum is separated from the genital plate by a narrow band of chitin in which lies a long narrow bar or a series of small bars of more heavily sclerotized chitin. The remainder of the ventral surface of the female is covered by weakly sclerotized chitin which extends dorsally

1) See Ewing (1929) for a somewhat different terminology.

2) The composite nature of this scutum is particularly evident in such forms as *N. bakeri* (Garm.) where the anal plate appears to be on top of the ventral plate.

to fuse with the dorsal shield. In the systematic part of this paper it has been referred to as the interscutal membrane. Laterad of the ventrianal plate it may include one or two parapodial plates which have no great significance and laterad and posterad of coxa IV the peritremal plate which bears the stigma and continues forward as the peritrema. The interscutal membrane supports a few setae: two just off the dorsal shield, one in the humeral position S_1 and one in the sacral region S_2 , three laterad of the ventrianal plate on each side, and a pair of ventro-lateral setae (VL_1) near the posterior margin of the body.

The ventral surface of the male differs quite radically from that of the female in that it is on the whole more heavily sclerotized and is covered by only two large scuta. The anterior region between the coxae is paved with the sternal scutum which bears five setae which are homologous with those on the sternal, metapodal and genital scuta of the female. On its anterior margin may be seen the opening of the vas deferens and through the plate the vague outlines of the duct. The opisthosomal region behind coxae IV is covered by one large plate which usually bears five pairs of setae in addition to the three anal setae. As in the female there are three additional pairs of setae on the interscutal membrane, S_1 and S_2 beside the dorsal shield and a pair behind the ventrianal plate.

The legs of these mites bear few setae which have taxonomic significance. On the genu and tarsus of leg IV of many species are to be found modified setae which probably have a sensory function.

KEY TO THE GENERA OF THE PHYTOSEIINAE

- A1. All dorsal setae smooth, some (L_4 , 6, 8) long and whip-like, others minute . . . B
 B1. Ventrianal scutum of the female much wider than the genital; peritremal plate truncate Gen. *Amblyseius* Berlese¹⁾
 B2. Ventrianal scutum of the female not conspicuously wider than the genital; peritremal plate blunt or approaching acute Subgen. *Amblyseiopsis* Garman¹⁾
- A2. Most dorsal setae smooth, some (such as those at the posterior margin) very faintly pectinate B
 B1. With not more than 18 pairs of dorsal setae; ventrianal plate of female with at least three pairs of setae in addition to the paraanals²⁾
 Gen. *Typhlodromus* Scheuten
 B2. With upwards of 25 pairs of dorsal setae; ventrianal plate of female may or may not have setae in addition to the paraanals C
 C1. The moveable and fixed digits of the chelicerae of comparable length. D
 D1. Anal plate of female small and provided with only 3 setae
 Gen. *Garmania* n. gen.

1) The characters used for the separation of these two groups have been taken from Garman (1948).

2) In the keys "paraanal" is used as a collective term to include both the para- and postanal setae.

- D₂. Ventrianal plate of female larger and provided with 4 pairs of setae in addition to paraanals Subgen. *Paragarmania* n. subgen.
- C₂. Fixed digit of chelicerae only one-third as long as the moveable and surmounted by a seta-like process Gen. *Blattisocius* Keegan
- A₃. Many dorsal setae distinctly pectinate or serrate B
- B₁. Dorsum smooth or mildly imbricate, marginal setae noticeably pectinate, others may be Gen. *Kampimodromus* n. gen.
- B₂. Dorsum distinctly rugose C
- C₁. Marginal setae long, serrate or thorny Gen. *Phytoseius* Rib.
- C₂. All dorsal setae leaf-like and serrate Gen. *Kleemannia* Oudms.

Genus **Typhlodromus** Scheuten

Typhlodromus Scheuten, 1857. Archiv für Naturges. 23: 104-112.

The genus *Typhlodromus* as understood in this paper is a closely-knit and coherent group of rapidly running predaceous mites. Its members may be recognized by the possession of the following characters: a weakly sclerotized body covered by a single dorsal shield which may be mildly imbricate and which bears approximately 17 pairs of simple rarely pectinate setae. The chaetotactic pattern of the dorsum (vide text-fig. 1) is basically made up of 6 dorsal, 2 median and 8 or 9 pairs of lateral setae; and in addition there are the scapular and lumbar setae which arise from the interscutal membrane laterad of the dorsal shield. The epistome may be smoothly rounded, sinuate or nearly pointed. It is never drawn out into a long spine. The chelicerae are denticulate with the arrangement of the teeth varying in different species. The male spermatophore is either T- or hammer-shaped. The sternal plate in the female usually bears three pairs of setae. Occasionally when there are only two pairs, the third and most posterior pair stands on a small pair of platelets located between the sternal plate in the metapodals. The ventrianal plate in the two sexes, whilst different in shape, bears three or four pairs of preanal setae in addition to the paraanals. The setae of the legs are of approximately the same length as those of the dorsum. The only exception to this being the tactile setae of leg IV which may on occasion be represented by one long whip-like or truncate seta on the tarsus or less frequently by a series of three setae on the last three members of the leg.

Type of the genus: *Typhlodromus pyri* Scheuten (= ? *T. tiliae* Oudms.).

It should be noted that Oudemans always included the two setae on either side of the anus (never, however, the postanal) in computing his figure of the number of setae on the ventrianal plate. In this paper the three paraanal setae (i.e., the two beside and one behind the anus) have been excluded from this figure as they are constant in all the Phytoseiinae.

SYNOPSIS OF THE SPECIES

- A₁. With 8 lateral setae B
- B₁. With setae L₇, L₈, and M₂ of equal length; ventrianal plate in both sexes provided with 4 pairs of preanal setae and a pair of pores
T. conspicuus (Garman)
- B₂. With seta L₇ noticeably shorter than either M₂ or L₈; ventrianal plate with 3 pairs of preanal setae but lacking a pair of pores C
- C₁. With L₁ equal in length to the distance between its base and that of D₂ and with the tip of M₂ extending well beyond the margin of the dorsal shield
T. aberrans Oudms.
- C₂. With L₁ equal to approximately one-half of the distance between its base and that of D₂; tip of M₂ does not extend beyond the margin of the dorsal shield
T. vitis Oudms.
- A₂. With 9 lateral setae B
- B₁. Seta M₂ paired¹⁾ with one of either L₇ or L₈ C
- C₁. Seta M₂ paired with L₇ D
- D₁. The 6 setae of the dorsal hexagonal area shorter in length than the distance between their bases E
- E₁. Anterior lateral setae L₁ to L₄ greater in length than the distance between their bases
T. masseei n. sp.
- E₂. Anterior lateral setae shorter by approximately one-half than the distance between their bases F
- F₁. Dorsum noticeably reticulate; ventrianal plate of female roughly triangular in shape and as broad as long
T. reticulatus Oudms.
- F₂. Dorsum only mildly imbricate; ventrianal plate hexagonal in shape and almost one and one-third times as long as broad
T. cucumeris Oudms.
- D₂. The setae of the dorsal hexagonal area are equal in length to the distance between their bases
T. fallacis (Garman)
- C₂. Seta M₂ paired with L₈ D
- D₁. All dorsal setae exceedingly long; extend as far as or well beyond the bases of succeeding ones E
- E₁. Dorsal setae extend well beyond the bases of the succeeding; 4 pairs of preanal setae on ventrianal plate.
T. longipilus n. sp.
- E₂. Dorsal setae extend as far as but not beyond the bases of the succeeding; only 3 pairs of preanal setae on the ventrianal plate
T. occidentalis n. sp.
- D₂. Dorsal setae shorter; tips do not extend beyond the bases of the succeeding
T. tiliae Oudms. (= ?*T. pyri* Scheuten)
- B₂. Seta M₂ either forming a triangle with two of the lateral setae or well removed from all other setae C
- C₁. Setae M₂, L₆ and L₇ equidistant from each other and describing a triangle; ventrianal plate of the female provided with 3 pairs of preanal setae situated on the anterior third of the plate
T. finlandicus Oudms.

1) When the expression *paired* is used in this paper it means that the bases of the two different setae referred to (M₂ and one of the lateral group) are as close together as are the bases of the two setae D₃. It might be noted that a line drawn through L_x M₂ L_x should be straight. The only point in the key where this definition is at all strained is the coupling D₁ of C₂ of B₁ of A₂ where in the two species mentioned M₂ and L₈ are separated by a distance which is greater by one-quarter than the distance D₃-D₃.

- C₂. Seta M₂ unpaired with any of the lateral setae but equidistant from D₅ and L₇
T. pomi (Parrott)
- A₃. With 10 lateral setae B
- B₁. Setae M₂, L₅ and L₆ form a triangular grouping
T. (Neoseiulus) tiliacolus (Oudms.)
- B₂. Setae M₂, L₈ and L₉ form a triangular grouping C
- C₁. With 2 or 3 pairs of preanal setae on the ventrianal plate in both sexes. D
- D₁. With only 2 pairs of preanal setae; ventrianal plate devoid of pores, in
the female sole-shaped *T. (Neoseiulus) soleiger* (Ribaga)
- D₂. With 3 pairs of preanal setae; ventrianal plate provided with a pair
of pores, in the female hexagonal in shape
T. (Neoseiulus) barkeri (Hughes)
- C₂. With 4 pairs of preanal setae on the ventrianal plate D
- D₁. Ventrianal plate simple but bearing a pair of crescent-shaped pores in
addition to the setae *T. (Neoseiulus) rhenanus* Oudms.
- D₂. Ventrianal plate modified to give the impression of an anal plate super-
imposed on the larger plate *T. (Neoseiulus) bakeri* (Garman)
- A₄. With 11 lateral setae; M₂ paired with L₉ *T. tiliarum* Oudms.

Typhlodromus tiliae Oudemans (? = *T. pyri* Scheuten)

Plate IV; Plate V; Plate VIII figs. 1 and 3; Plate XI figs. 15 and 25.

Typhlodromus tiliae Oudemans, 1929. Entom. Bericht. 8(169): 14-15.

Typhlodromus tiliae Oudemans, *ibid.*, 8(170): 33 (additional notes).

Typhlodromus tiliae Oudemans, *ibid.*, 8(171): 51 (redescription).

In the first description alluded to above, Oudemans described Nympha I as follows (in translation):

"Nympha I: 191 μ long; width at the shoulders (flattened specimen) 120 μ ; oval in shape with the narrow end directed to the front. The dorsal shield bears 14 pairs of setae of which the two vertical, the two humeral, and the two at the rear margin are stronger than the others. Moreover, 8 setae are placed on the rear margin. The edge of the epistome is semicircular in shape. Tarsus IV is provided with a sensory seta which is one-half as long as the tarsus."

In the third description Nympha I is characterized as follows:

"As I now have a better example than formerly, I can now give a better description than previously. Length 235 μ ; breadth below the shoulders 149 μ ; oval with the point towards the rear; in front of the shoulders slightly concave. Propodosomal shield with 9 pairs of setae; pygidial shield semicircular in shape with a rounded semi-circular extension of the anterior median border. It bears 4 pairs of setae of which two are longer and extend beyond the hind margin. In addition to these there are two intermediate shields in the interscutal membrane and 5 pairs of setae (2 at the shoulders). Anterad of the anal plate there are 3 pairs of bristles [and beside the plate] ¹⁾ an additional pair that are a little thicker."

Female: From the first description:

"340 μ long, width at the shoulders 190 μ (flattened specimen), oval in shape with the

1) In this paper square [] brackets have been used to indicate an interpolation in the translation.

apex directed to the front. The dorsal shield bears 18 pairs of setae, the most striking of which are: the two short vertical setae [D₁] [in the third description Oudemans states 'The vertical setae are placed close to each other at the base and diverge distally like a tulip cup']; the humeral setae [S₁] placed just off the shield; posteriorly, on each side 2 sacral setae [S₂], and 4 rear marginal setae of which two are placed submarginally on the shield and two on the interscutal membrane. Between the 2 submarginal setae [L₉] arise two extremely short bristles [D₆]. The sternal scutum is nearly square with only two pairs of bristles [a character which Oudemans stated, in the second paper listed above, it shares with *T. amboinensis*] the third pair is placed on two small rounded platelets (peculiar situation!). The metasternalia are small, round, and each provided with one bristle. The genital scutum is truncate posteriorly and does not reach past legs IV. Between this latter [plate] and the ventrianal scutum — there is a line-like intermediate plate. The ventrianal scutum bears 5 pairs of bristles in addition to the seta post-analis. The stigmata are on a line between legs III and IV, and [are on] a narrow peritremal scutum which is pointed posteriorly. The margin of the epistome is triangular in shape enclosing an angle of 120°. [Oudemans states in the third paper that the epistome is sometimes convex.] The chelicerae are very simple with no internal membrane; the digitus fixus has 3 teeth whilst the digitus mobilis has only one. The legs shew no peculiarities; tarsus IV is without a sensory seta."

In the third paper listed above Oudemans published some additional notes on the female of this species, viz., "The length of the back bristles varies in different individuals. The ventrianal scutum is sometimes broader and round, sometimes more pointed."

Male: The description given of the male of *T. tiliae* in the first paper listed above was withdrawn in the second with the note by Oudemans that he had erred in his diagnosis and that the description given was of the male of *T. tiliaculus*. In the third paper he gave a corrected description which, in translation, is as follows:

"Length 240 μ , breadth in the middle 132 μ ; regularly oval with the apex directed forwards. Very closely related to *Typhlodromus rhenanus* (Oud. 1905), but differing in the following details: the dorsal setae are differently placed. The sterni-metasterni-genital scutum is broadened between coxae I and II, and the ends of these 'wings' are scalloped. The ventrianal scutum is not as square as in *rhenanus* but has a beautiful half-elliptical form; it bears 6 (not 5) pairs of bristles which are well separated from the front margin. The peritremal plates are bowed about the fovea of legs IV. The species also occurs on *Pinus silvestris* in Baden."

Type Habitat: On *Tilia platyphyllos*, Arnhem, The Netherlands. The male described above was taken on *Pinus sylvestris*, that drawn in plate no. 405 was, like the female, taken on *Tilia platyphyllos*.

Type: This species is represented by three slides and plates nos. 403 to 405 inclusive in the Oudemans collection of the Leiden Museum.

Notes: A clear understanding of the nature of this species is necessary because as has already been shewn above, it is either identical with or very closely related to *T. pyri* Scheuten, the type of the genus. Oudemans may have been conscious of this relationship as the descriptions which he gave

of this mite are as detailed as any which he made apart from those published in 1915 in the *Archiv für Naturgeschichte*.

The description of the female, with my interpretative remarks in the square brackets, is a good description of the type with the exception that the dorsal shield bears 17, not 18 pairs of setae. As may be noted from my comparative drawings (Plate VIII figs. 1 and 2) the dorsal setae are of medium length, the longest being L_9 and VL_1 . A very distinctive feature of this species and one which Oudemans noted in his drawings but did not comment upon is the possession of a small pore just anterad of L_9 . There are three other similar but less distinct pores or markings on the dorsum, one mesiad of L_4 , one postero-mesiad of L_6 , and one anterad of the paired M_2 L_8 . The dorsum is mildly imbricate. The fixed digit of the chelicera bears 3 teeth, the moveable one and laterally a thin hyaline membrane.

The chaetotactic pattern of the male is almost identical with that of the female. Again setae L_9 and VL_1 are the longest and, as in the opposite sex, frequently pectinate. Oudemans' drawing of the dorsal shield of the male is somewhat at fault in that he has shewn S_1 and S_2 as arising from the plate rather than from the interscutal membrane laterad of it. The male ventrianal plate bears 5 pairs of preanal setae. As in many of the species of this genus the external and internal malae and the labrum are larger, more distinct and more heavily sclerotized than in the female. The spermatophore bearer has somewhat the shape of an inverted boot.

The species is undoubtedly the most widespread and common of the predators of the European red mite. In Canada it is the dominant species in the maritime fruit growing areas and it has been found in all the provinces. Specimens have, likewise, been seen from the orchards of the U.S.A. (the states of Connecticut, Massachusetts, Maine, New York, Ohio, Virginia, California, Washington), from Great Britain, France, Belgium, Sweden, Germany, the Netherlands and Denmark. It has been taken on the following trees: apple, pear, prune, plum, cherry, the horse chestnut (*Aesculus hippocastanum* L.), spruce (*Picea* sp.), pine (*Pinus sylvestris*), the different species of *Tilia*, *Salix*, *Acer*, and *Citrus* and on such plants as clover, beans, hollyhock, dogbane (*Apocynum androsaemifolium* L.), raspberry, strawberry, pumpkin and melons.

Typhlodromus aberrans Oudemans

Plate I.

Typhlodromus aberrans Oudemans, 1930. Entom. Bericht. 8 (171): 48-49.

The original description of this species reads in translation as follows:
 "Typhlodromus aberrans nov. spec.

"Nympha I (male or female?): length 232 μ , width 142 μ . Elliptical; slightly concave before the shoulders. The propodosomal shield is more or less oval, truncated posteriorly, 138 μ long, and with 8 pairs of setae of which the 3 marginal ones are longer than the submedian ones. The pygidial shield is small, of greater width than length; it has 4 pairs of setae of which 2 pairs are longer than the others. [There are also] two large intermediary shields with 2 bristles each. The shoulder setae are short and located (off the plates) on the interscutal membrane. The epistome is convex with smooth borders. Tarsus IV has a sensory seta. The malae interiores of the maxillae are as long as the corniculae and paper-knife shaped. The hypostomal groove has six double teeth. [Oudemans uses the phrase 6×2 teeth].

"The 2 large, oval, intermediary shields whose top is mesially directed resemble those of the protonymphae of *Uropodina*. The border between *Gamasides* and *Uropodina* is indeed getting harder to define all the time!

"Curiously enough I find two different Nymphae II in this species. As one of them was in the act of metamorphosing into a male I know for certain which of the two was the Nympha II masculina. The question arises: have all *Typhlodromus* species two different Nymphae II? For the time being I cannot answer that question. If it be true, have all the *Laelaptidae* (sensu lato, with protonymphae with intermediary shields) two different types of Nymphae II?

"Nympha II female: Length 290 μ ; width at the middle 160 μ .

Elliptical, very slightly concave before the shoulders. The dorsal shield has 15 pairs of setae of which the marginal setae are longer than the submedian ones. However, one pair of the latter (on the back posterior half of the shield) are long. In the interscutal membrane there are 2 pairs of setae, 1 pair of which is at the shoulders. The peritremata [which become] dorsad before the shoulders reach almost as far as coxae I. — The sternimetasternal shield is rounded posteriorly; the anal shield is round. In the interscutal membrane are 8 pairs of bristles of which 1 pair at the posterior margin is a bit thicker. The epistome is faintly convex with a smooth margin. The malae of the maxillae are similar to those of Nympha I. The hypostome has 7 double teeth. The tarsus IV has a sensory seta which is more than half as long as the tarsus.

"Nympha II male: The measurements and shape are similar to those of the female Nympha II. The dorsal shield has 16 pairs of setae of similar shape and position as those of the female of Nympha II. Those above the coxae I are, however, short. — The sternimetasternal shield is shorter and wider than that of the female of Nympha II. There are only 4 pairs of bristles in the interscutal membrane and no bristles at the posterior margin.

"Male: Through the skin of the Nympha II, I could establish that the male has not a seta more than the Nymph and that the arrangement is also the same. The free living male is positively larger than the Nymphs and will have relatively longer legs. The sterni-metasterni-genital plate has 5 pairs of bristles and is rectangular. The ventrianal scutum occupies the whole space behind coxae IV and [has] its front corners rounded off. It bears only 4 pairs of bristles in addition to the seta postanalisis."

Type Habitat: On *Tilia platyphyllos*, Arnhem, The Netherlands.

Type: This species is represented by four slides and plates nos. 361 to 364 in the Oudemans collection of the Leiden Museum.

Notes: So far this species has never been seen in North American collections nor has it been rediscovered in specimens taken in Europe. It and *T. vitis* are so remarkably alike that I am almost persuaded that *vitis* is the adult of *aberrans*. Until, however, either the adult of *aberrans* or the nymphal forms of *vitis* are available for study this point cannot be settled. In the

Oudemans collection one nymph of *aberrans* has an immature male inside it but as *vitis* is only known from Oudemans' drawings (the type specimen is not on the slide) a comparison would be difficult and of little validity.

Typhlodromus conspicuus (Garman)

Plate X fig. 9; Plate XI fig. 22.

Iphidulus conspicuus Garman, 1948. Connecticut Agricultural Expt. Sta. Bull. 520: 14.

The original description of this species reads as follows:

"*Iphidulus conspicuus* n. sp. Female: 6 dorsal, 8 lateral and 2 median setae on dorsum, longest M₂ and L₈. Integument of dorsum smooth, faintly reticulate in some. Chelicerae with mandibular teeth if present very indistinct not more than 2 or 3 at most, all at tips. Epistome with lateral arms or cornicula slender, very sharp; distal margin between cornicles with indistinct teeth. Legs with setae uniform in length. Anal plate much longer than wide, lateral margins indented, 5 paired setae including the 2 short para anals on each side of the anal opening. Two metapodal plates with short seta on each, 1 parapodal plate each side, the plate long, slender, appearing more like a slit in the integument. Peritremal plates long, acute at mesal ends.

"Dimensions: length .38, width .22 mm., Leg IV .44 mm., seta L₈ .06 mm.

"Male not seen.

"Type Habitat: Apple bark. Hamden, January 24, March 16, October 25, 1937; New Haven, February 10, April 27, 1937 (pear bark).

"Types in Connecticut Agricultural Experiment Station collection".

Notes: The description given by Garman agrees closely with his type specimens. His statement that the epistome has corniculae is, however, open to criticism as the corniculae are morphologically part of either the hypostome or the labium. The free margin of the epistome is mildly convex and very slightly denticulate. The moveable digit of the chelicerae has one minute tooth proximad of the terminal incisor, the fixed has a slightly larger tooth in a similar position between the top and the *pilus dentilis*.

T. conspicuus has been taken on a few occasions from apple leaves, in budmoth webbing, and on apple twigs in Nova Scotia and New Brunswick. It has never been found on sprayed trees which are grown for commercial purposes.

Typhlodromus conspicuus (Garman) var. **herbertae** n. var.

As this mite differs from *T. conspicuus* in only minor details it is herewith described as a variety of the latter. The points of difference pertain to the general shape of the body which is somewhat narrower in the new variety and more specifically to the lengths of certain of the dorsal setae. In *conspicuus* L₅ and L₆ are relatively twice and L₇ three times as long as their counterparts in the variety under discussion. In the new variety, however, M₂ and L₉ are quite noticeably (with the higher power of the microscope) pectinate, whereas in the described species such pectinations are rare.

Type Habitat: Apple leaves, Aldershot, Nova Scotia.

Holotype: Female, Aldershot, N. S., Sept. 13, 1950 (Coll. by Miss J. Herbert in whose honour this variety has been named). No. 5965 in the Canadian National Collection, Ottawa.

Paratypes: 13 females, same data; 10 females on apple leaves, Habitant, N.S.; 1 female, apple leaf, Blomidon, N.S.

Typhlodromus cucumeris Oudemans

Plate II; Plate IX fig. 6; Plate XI fig. 18.

Typhlodromus cucumeris Oudemans, 1930. Entom. Bericht. 8(172): 69-70.

The original description of this species reads in translation as follows:

"Female: Length 385 μ , width 175 μ . It is thus more than twice as long as wide, is rounded posteriorly, and has nearly parallel sides except for the noticeable indentations between coxae I and II. The dorsal shield surrounded on all sides by a narrow band of soft skin [interscutal membrane], is only noticeably imbricate posteriorly (where the scales are nearly hexagonal), and bears 17 pairs of setae, of which that [L₉] at the posterior margin is as long as femur IV. In front of the (last mentioned) is a pair [M₂] which is as long as tibia IV. Between these two pairs, a little externally, is a similar pair [L₈]. The sternal scutum has 3 pairs of bristles; the metasternal setae arise from the interscutal membrane; the genital scutum is small, trapezoidal [in shape], 1½ times as long as wide and broader in front than posteriorly. The ventrianal [scutum] is more or less trapezoidal in shape and 1½ times as long as wide; it is broader anteriorly than posteriorly and posteriorly rounded. In the interscutal membrane are 4 more pairs of bristles of which the most posterior pair are as long as genu IV. The peritremata assume a dorsal position between coxae I and II and extend anteriorly just beyond the centre of coxae I. Tarsus IV has a sensory bristle as long as tibia IV. The two internal bell-shaped bladders of this form are filled with a liquid that refracts the light more strongly than lactic acid, but this does not prove that the liquid is a kind of oil."

Type Habitat: "Among numerous *Tetranychus* on *Cucumis melo*, Buré (Meurthe et Moselle), France."

Type: This species is represented by one slide and plate no. 371 in the Oudemans collection of the Leiden Museum.

Notes: The drawings made by Oudemans correspond as closely as possible with the specimens which are in a very poor state of preservation. In Plate 371 the moveable digit of the chelicera is shown as noticeably shorter than the fixed. In many of the specimens that I have taken it appears so but as in the remainder the two are of equal length it is possible that the former observation is an artifact caused by the clearing agent used.

This species has been found on a few occasions on such cover crops as beans and dogbane where it was feeding on Tetranychids. To date it has only been taken thrice on apples and here only when the host was one of the yellow tetranychids such as *Tetranychus telarius* (L.) or *Septanychus canadensis* McG. From circumstantial evidence it would appear that this species has no liking for the European red mite. Our collections include specimens from Nova Scotia, Quebec, Ontario and Virginia.

Typhlodromus fallacis (Garman)

Plate VIII figs. 2 and 4; Plate X fig. 11; Plate XI fig. 17.

Iphidulus fallacis Garman, 1948. Connecticut Agric. Expt. Sta. Bull. 520: 13.

Garman's original description reads as follows:

"*Iphidulus fallacis* n. sp. Female: 6 dorsal, 2 median and 9 lateral setae. L₇ opposite M₃ [should be M₂] L₉ sparsely plumose. Integument smooth, not rough or pitted. Chelicerae without teeth. Epistome of usual shape with long sharp cornicles or lateral arms and small teeth on distal margin between. Legs with one long seta on proximal segment of Tarsus IV. Sternal plate with 3 pairs of setae; anal plate reticulate, usually with 3 pairs of setae on the anterior portion (besides the para anals) and 1 pair of pores in addition; sometimes 4 pairs seen. One pair metapodals and 2 pairs of parapodals each side. Peritremal plates blunt and hooked at mesal ends though not always quite as blunt as illustrated.

"Dimensions: Length .34, width .22 mm., Leg IV .32, L₉ seta .03 mm. Anal plate .06 by .09 mm.

"Male: Hooks on male cheliceral appendages short, inconspicuous. Anal plate broad, with 3 pairs setae besides para anals and 1 pair pores.

"Dimensions: Length .25, width .16 mm.

"Type Habitat: Apple leaves. Branford, August 11, 1947; Deep River, August 31; Hamden, August 9, 12, 19, 1947; Wallingford, August 10, 1947.

"Types in the Connecticut Agricultural Experiment Station collection."

Notes: As an examination of the specimens labelled *T. fallacis* in the Connecticut Agricultural Experiment Station Collection has revealed that more than one species was included, an attempt must be made to fix the type more exactly than was done. The specimens from Wallingford may be eliminated because they are *T. tiliae*. Of the remaining those from Hamden are most worthy of consideration because they are the most consistent within the group and agree most closely with the descriptions and drawings given. Accordingly, I would suggest that the syntype of this species be chosen from the Hamden collection.

With the above reservations in mind it is possible to state that Garman's description and figures agree very closely with his specimens with the possible exception that, if anything, he has shewn the setae somewhat shorter than they really are (vide Plate VIII fig. 2 for comparison). As in the case of *T. conspicuus* the same criticism may again be made of Garman's interpretation of the nature of the gnathosoma and of the epistome in particular. The epistome of *T. fallacis* is very weakly sclerotized and has a convex, entire margin. The fixed digit of the chelicerae is provided with two small teeth, the larger of which is just proximad of the incisor. The moveable digit is virtually toothless though on a few specimens a small suggestion of a tooth may be seen near the hinge.

This species has been taken from apple, raspberry, strawberry, beans, corn and similar garden crops, dogbane, clover, and other orchard cover

crops and such wild trees as the willows, where in all cases it was preying upon such tetranychids as *Tetranychus telarius* (L.), *Septanychus canadensis* McG., and *S. schoenei* (McG.). On only a few occasions has it been seen feeding upon *Metatetranychus ulmi* (K.). In the summer of 1950 a heavy infestation of *S. canadensis* was attacked by *T. fallacis*. In the course of three weeks the population of the host was reduced from approximately 110 mites (all stages) per leaf to less than 10. This reduction can be attributed to typhlodromid predators because throughout the orchard few other predators were seen and, where possible on isolated branches of the experimental trees, insect predators were excluded by screening.

T. fallacis has been found in the provinces of Nova Scotia, New Brunswick, Quebec, Ontario, Manitoba, and British Columbia in Canada; and in the states of Connecticut, New York, Virginia and Washington in the U.S.A. As yet there are no records from Europe.

Typhlodromus finlandicus (Oudemans)

Plate III; Plate IX fig. 5; Plate X fig. 12; Plate XI fig. 19.

Seiulus finlandicus Oudemans, 1915. Entom. Bericht. 4(83):183.

Seiulus finlandicus Oudemans, 1915. Archiv für Naturges. 81A(1):159-161, figs. 117-119 incl. (A further description and additional notes).

Typhlodromus pruni Oudemans, 1929. Entom. Bericht. 8(170): 32-33. (A fairly lengthy description of the male and female of *pruni* = *finlandicus*).

Typhlodromus finlandicus Oudemans, 1929. Entom. Bericht. 8(171): 50. (In this short note Oudemans states that as *pruni* is the same as *finlandicus* it will have to be placed in synonymy with the latter.)

The first description given by Oudemans of this mite reads in translation as follows:

"*Seiulus finlandicus* nov. sp.

"Female: length 345 μ , width 215 μ . The epistome is slightly convex on top. On the dorsal shield there are 19 pairs of setae of which the vertical [D₁] and postvertical [L₁] are directed anteriorly. The humeral setae [L₃ or S₁] are smaller but the setae behind them [L₄] are as long if not longer [Oudemans uses expression 'stronger'] than the vertical setae. The setae posterad of these [L₅, 6, 7, and 8] are again as small as the humeral setae proper. At the posterior margin are the two largest setae [L₉] and between them the two smallest [D₆]. The tritosternum is Y-shaped and each arm is split [distally] into three. The sternal scutum is nearly quadrangular. The genital scutum is posteriorly abruptly widened. The ventrianal scutum is shield-shaped."

Type Habitat: On *Salix caprea*, Åbo, Finland.

Type: This species is represented by three slides and plates nos. 377 (figures 117-119 published in Archiv für Naturges.), 378 and 379 in the Oudemans collection of the Leiden Museum.

Notes: Since the original description given above, with the added designation of the setae, and the much fuller subsequent description not herein

quoted, are sufficient for a clear understanding of this species there is no need to furnish additional notes. The female is one of the most easily recognized of all typhlodromids because of the peculiar pattern of the setae on the ventrianal plate.

This mite is very widespread in distribution, cosmopolitan in its choice of food plants, and exhibits a lack of specificity in its feeding habits. From this one gets the general impression that unlike many other typhlodromids it is not dependent upon fruit growing areas but is a species which is indigenous to the north temperate regions. Specimens have been taken in all the Canadian provinces, the northern states of the U.S.A., Great Britain, France, Belgium, the Netherlands and Scandinavia. It has been found on neglected and cultivated apple trees, though it is more prevalent upon unsprayed trees, on other fruit trees and such wild trees as willows, maples, lindens, oaks and beeches where it has been seen feeding on almost all tetranychids common to these food plants, eriophyids and other small mites.

***Typhlodromus longipilus* n. sp.**

Plate IX fig. 8; Plate XI figs. 21 and 24.

This species and the closely related *occidentalis* n. sp. differ so markedly from the other members of this genus in the length of the dorsal setae that they might be considered as belonging to a different group. When, however, more fundamental characters such as the dorsal chaetotactic pattern and the arrangement of the ventral scuta are taken into consideration it is obvious that these species can be included in the genus *Typhlodromus*.

Female: Exclusive of the gnathosoma the females of this species measure .31 to .33 mm long and .2 to .22 mm wide. The dorsum (vide Plate IX fig. 8) appears to be free of any markings and bears 17 pairs of long setae the tips of which extend well beyond the bases of the succeeding (i.e., with the exception of D_1 and D_6). Seta M_2 stands closest to L_8 . Seta S_1 is present on the interscutal membrane laterad of the dorsal scutum. S_2 is missing. The epistome is moderately sclerotized and in the form of a blunt triangle. The fixed member of the chelicerae (vide Plate XI fig. 24) bears 3 minute teeth distally; the moveable has one small tooth at the base of the incisor. The sternal scutum has only 2 pairs of setae; the third pair arise from a pair of small platelets posterad of the sternal scutum. The ventrianal scutum (vide Plate XI fig. 21) is of a characteristic shape and bears 4 pairs of preanal setae. The peritremal plate ends behind coxa IV in a blunt hook. The pedipalps and legs carry the usual complement of setae but none of these exhibit any outstanding characteristics.

The male of the species has not as yet been found.

Type Habitat: Apple leaves, Central Experimental Farm, Ottawa, Canada.

Holotype: Female, Ottawa, Oct. 6, 1947. No. 5967 in the Canadian National Collection, Ottawa.

Paratypes: 10 females on apple leaves, Experimental Station, Geneva, N.Y., Oct. 7, 1947; 2 females on apple leaves, Clinton, P.E.I., August 20, 1949; 4 females on apple leaves, White's Cove, N.B. (Coll. J. Herbert), June 21, 1949; 1 female on apple leaves, Rougemont, Que. (Coll. A. Beaulieu), August 1949; 1 female on apple, Harwood, Wash., U.S.A., June 20, 1950 (Coll. R. W. Burrill), deposited in U.S. National Museum, Washington, D.C.

Typhlodromus massei n. sp.

Plate X figs. 10 and 14; Plate XI figs. 23 and 26; text-fig. 1.

Female: Exclusive of the gnathosoma the females of this species measure .44 to .46 mm in length and .26 to .29 mm in width. The dorsum (vide text-figure 1) appears to be free of imbrications and bears 17 pairs of setae of variable lengths. When the distance between the opposing members of D_3 (i.e., the same seta on the opposite side of body) is taken as the unit of measurement, setae D_2 , 3 , 4 , 5 and 6 are equal to one-half, L_1 , 4 , 6 , and M_2 twice, and L_9 four times this distance. Seta M_2 stands closest to L_7 . Setae S_1 and S_2 are present on the lateral interscutal membrane. The epistome is moderately sclerotized, ox-bow in shape with the centre directed forwards and provided with an entire margin. The fixed member of the chelicerae is equipped proximally with 5 distinct teeth (this number does not include the terminal incisor or the *pilus dentilis* which are present on the chelicerae of all of the Phytoseiinae); the moveable has only 3 barely perceptible indications of teeth. The sternal scutum bears 3 pairs of setae, the third pair of which arise from posterolateral processes of the plate proper. The anterior margin of the genital scutum is distinctly sclerotized. The ventrianal scutum carries 3 pairs of preanal setae and an indistinct pair of pores. On some of the specimens seen there is only one large parapodal plate, on others two smaller ones. The peritremal plate ends bluntly behind coxa IV. The pedipalps carry the usual compliment of setae; leg IV bears three distinct sensory setae, equal in length to the genu, on the last three joints.

Male (Plate X fig. 10): The male of this species differs so from the female in general appearance that it might have been taken for a different species had the two not been captured *in copulo*. The dorsal shield is somewhat shorter but comparatively broader than that of the female; is ovoid in shape and measures .41 to .44 mm in length and .28 to .31 mm in width. The chaetotactic pattern (which includes the lengths of the setae) is fun-

damentally the same in the two sexes, but the differently shaped opisthosoma of the male so alters its general appearance that the pattern appears to be quite different. This apparent difference is furthermore enhanced by the heavily sclerotized nature of the male and by the fact that its posterior setae have somewhat coarser bases. Including the terminal tooth or incisor the fixed member of the chelicerae (vide Plate XI fig. 26) bears 8 teeth. The moveable carries the spermatophore bearer and one distinct tooth. The external malae are larger than in the female and, as in the last mentioned sex, the labrum is drawn out into a denticulate spine. The ventrianal scutum has four pairs of preanal setae but lacks the minute pores present in the female. Leg IV bears three distinct sensory setae on the last three joints.

Notes: On the basis of the females alone this species is a good representative of the genus *Typhlodromus* but the males exhibit characteristics which would place them in close affinity with the genus *Amblyseius*, viz., the heavily sclerotized and smooth dorsum, the small median and long lateral setae and the three long sensory setae on tarsus IV. The exact zoological position of this species is thus open to considerable doubt, but it would appear that it stands as a link between the two genera mentioned. As, however, the majority of the evidence seems to be in favour of including it in the genus *Typhlodromus* such has been done in this paper. The species has been named in honour of Dr. A. M. Massee of East Malling, Kent, England, who collected the English specimens.

Type Habitat: On apple leaves and twigs, Berwick, Nova Scotia.

Holotype: Female, Berwick, N.S., August 12, 1946. No. 5966 in the Canadian National Collection, Ottawa.

Allotype: Male, same data.

Paratypes: 9 females, 1 male, 1 immature female, same locality, August 1945; 2 females, same locality, June 26, 1944 (Coll. H. T. Stultz); 2 females on beans, Berwick, N.S., August 24, 1944 (Coll. H. T. Lord); 1 female on *Tilia* sp., Brackley Beach, P.E.I., August 28, 1950; 2 females on apple tree, Aylesford, N.S., March 22, 1949; and 2 females and one male, on apple tree, abandoned orchard, Court Lodge, E. Malling, Kent, England, August 20, 1948 (Coll. Dr. Massee).

***Typhlodromus pomi* (Parrott)**

Plate IX fig. 7; Plate XI fig. 16.

Seius pomi Parrott, P. J., 1906. New York Agric. Expt. Sta. Bull. 283:302-303.

Iphidulus pomi (Parrott), Garman, P., 1948. Connecticut Agric. Expt. Sta. Bull. 520:13 (a redescription).

Garman's redescription of what he believed to be Parrott's *Seius pomi* reads as follows:

"*Iphidulus pomi* (Parrott) N. Y. (Geneva) Agr. Exp. St. Bul. 283, p. 302, Pl. IV. Fig. 3, 1906. (*Seius*, *Seiulus*).

"Female: Dorsum smooth, 6 dorsal, 9 lateral, 2 median and 1 scapular setae. M₂ between L₇ and L₈ in position. Chelicerae with 2 teeth at tips of mandibles. Epistome with typical cornicles and teeth along the distal margin. Longest seta L₉. Anal plate longer than wide, with 4 setae on each side besides the para anals. Sternal plate with 3 setae each side. No metapodal plates visible and only 1 parapodal near lateral margin of abdomen, sometimes a faint indication of second but nothing definite. Peritremal plate slender, hooked, not blunt or truncate, with large vacuoles.

"Dimensions: Length .29 mm. to .31 mm., width .16 to .19 mm.; Leg IV .22 to .25 mm., seta L₈ .03 mm.

"Male: Mandibles of chelicerae with strongly hooked appendage. Anal plate with 4 pairs setae each besides the para anals.

"Dimensions: Length .23 mm., width .13 mm. Leg IV .22 mm., L₈ seta .03 mm.

"Redescribed from material collected in and around New Haven.

"Original types destroyed or lost according to information from Dr. Glasgow of the New York Agricultural Experimental Station."

Notes: As the type material of this species is no longer available (independently of Garman, I too made an exhaustive but futile effort to find these specimens) and as Garman has made every effort to correctly identify Parrott's species I see no valid reason for not accepting his interpretation and for not regarding the *Iphidulus pomi* of Garman as the true species.

This species is one of the less frequent predators of tetranychids in general and of the European red mite in particular. It has been found, however, in Nova Scotia, Prince Edward Island, New Brunswick, Ontario, New York and Connecticut on apple and other fruit trees.

***Typhlodromus occidentalis* n. sp.**

Female: Exclusive of the gnathosoma the females of this species measure .32 to .34 mm long and .22 to .24 mm wide. The dorsum is noticeably imbricate, but in very low relief and bears 17 pairs of long setae, the tips of which reach approximately as far as the bases of the succeeding (i.e., with the exception of D₁ and D₆). The scale-like markings of the dorsum are in the form of longitudinally elongate hexagons. Seta M₂ stands closest to L₈. Between the last mentioned seta and L₉ is a mark which is reminiscent of a seta-pore. Seta S₁ of the lateral interscutal membrane is present, but S₂ is missing. The epistome is more noticeably sclerotized than in most forms and is in the form of a blunt triangle. The fixed member of the chelicerae ends distally in 3 minute teeth, the moveable has one small tooth at the base of the incisor. The sternal scutum bears only 2 pairs of setae; the third pair

arise from a separate pair of platelets. The ventrianal scutum is of a characteristic shape and bears 3 pairs of long setae which are equal in length to the distance between the 2 most anterior setae. The peritremal plate ends behind coxa IV in a noticeable hook.

Male: The male of this species is noticeably smaller than the female. It measures .28 to .30 mm in length and .19 to .20 mm in width. Dorsally it presents the same chaetotactic pattern as the female and ventrally the ventrianal scutum bears 3 pairs of preanal setae. The external malae are somewhat larger and more lanceolate than in the female. The spermatophore bearer of the chelicerae is in the form of a twisted and inverted L.

Notes: As has been noted elsewhere in this paper, this species and the closely related *T. longipilus* differ from the other members of the group in the length of the dorsal setae. Apart from the kindred form just mentioned the only other mite which at all approximates this species, and with whom it might be confused, is *T. fallacis*. Because these two forms differ in such characteristics as: the length of the dorsal setae which are noticeably shorter in *T. fallacis* (vide Plate VIII fig. 2 or 4); the alignment of the dorsal and medial setae (vide the key to the species of the genus *Typhlodromus*); the shape of the ventrianal scutum of the female; and in the absence of pores on this last mentioned plate in both sexes of the species under consideration, they need not be confused. On the other hand, *T. occidentalis* differs from *T. longipilus* in having somewhat shorter dorsal setae; a more heavily sclerotized and noticeably imbricate dorsum, and only 3 pairs of preanal setae on the ventrianal scutum of both sexes. In *longipilus* the dorsal setae noticeably exceed in length the distance between their bases and those of the succeeding setae; in *occidentalis* most of the setae just equal this length.

Type Habitat: On rose, Brandon, Manitoba.

Holotype: Brandon, Man., Summer 1950. No. 5968 in the Canadian National Collection, Ottawa (Coll. A. G. Robinson, who found it preying on *Tetranychus* sp.).

Allotype: Male same data.

Paratypes: 6 females same data; 2 females, on raspberry, Brandon, Man., June 24, 1950 (Coll. A. G. Robinson); 5 females, 2 males, on raspberry, Lulu Island, B. C., July 13, 1950 (Coll. H. Andison) arranged on 2 slides; 2 females, 1 male, on apple, Summerland, B.C., July 29, 1950 (Coll. C.V.G. Morgan); 10 females, on plum, Creston, B.C., October 11, 1947 (Coll. W. B. Waddell); 1 female, on prune, Summerland, B.C., July 27, 1949 (Coll. R. S. Downing).

Typhlodromus tiliarum Oudemans

Plate VI

Typhlodromus tiliarum Oudemans, 1930. Entom. Bericht. 8(171): 51-52.

Oudemans' original description in translation reads as follows:

"Female: Has somewhat the same size and form as *T. tiliae* Oudms. 1929 but differs in having two instead of four setae on the posterior margin; different types of scales (imbrications) on the dorsal shield (these can only be properly illustrated by a sketch and detailed description); eight [dorsal] pores which are twice as large; a broader sternal scutum; a genital scutum which does not suddenly widen out behind the middle, and no line-like intermediate shield. The ventrianal scutum is furthermore (in *tiliarum*) more rectangular and has its lateral margin indented. It bears only four pairs of bristles in addition to the seta post analis. The jaws of the chelicerae are slighter and the malae interiores which are barely visible are in the form of a willow leaf.

"In the Ent. Bericht. v. 7, n. 159, Jan. 1928, p. 285, I have already made mention of the two pear-shaped bladders, the openings of which lie between coxae III and the external parapodal scuta. In *tiliarum* the openings are between coxae III and IV and the bladders (which I could not see) hang from well-sclerotized bell-like structures."

Type Habitat: On *Tilia* sp., Dahlem, Germany.

Type: This species is represented by one slide containing two specimens and plate no. 400 in the Oudemans collection in the Leiden Museum.

Notes: *T. tiliarum* is unique among the typhlodromids in having 11 lateral setae. M_2 is paired with L_9 and L_{10} arises just anterad of a pore, similar to that referred to in a like position in *T. tiliae*. As in the last mentioned species the dorsum is provided with three pairs of distinct pores, the most posterior of which form the two foci about which the posterior whorls of imbrications centre. The sternal scutum bears only two pairs of setae, the third pair stand on a separate pair of platelets; the ventrianal plate carries four pairs of preanal setae, not three as mentioned by Oudemans. The Dutch author also made reference to the fact that the bases of the bladder-like organs (probably coxal glands or seminal receptacles) are readily visible in this species as they are well sclerotized. This is a feature which happened to shew up well in his specimen but which is not too constant in all the ones which I have seen. Depending upon the method of clearing used and unknown physiological states of the animals these bell-like structures can be seen in almost any typhlodromid.

This is not a common species. It has been taken on a few occasions but never in any great numbers on apple, linden (*Tilia* sp.) and pear trees in Nova Scotia and New Brunswick. As yet it has not been found in any other part of Canada. A few specimens have been recorded from Great Britain and the Netherlands.

Typhlodromus vitis Oudemans

Plate VII.

Typhlodromus vitis Oudemans, 1930. Entom. Bericht. 8(173):99.

Oudemans' original description in translation reads as follows:

"*Typhlodromus vitis* nov. spec. — Female: Length 310 μ , width 150 μ . Oval in shape with the apex directed anteriorly, scarcely indented before the shoulders. The dorsal scutum is surrounded at the front and both sides by a narrow band of weakly sclerotized integument. It bears 16 pairs of setae and is rather coarsely and irregularly imbricate. The longest setae are the two at the rear margin which are a bit longer than genu IV; the submedian ones are the shortest. In the interscutal membrane are two more pairs of bristles, one at each shoulder and one just beyond the middle of the body. On the ventral side the sternal scutum is similar to that of *T. reticulatus* (see Ent. Ber. 8(171): 70, March 1930). The metasternalia are either absent or very small. The genital [scutum] is trapezoidal in shape, a little longer than wide, somewhat wider posteriorly than anteriorly, and [possessed] of a straight rear margin. The ventrianal [scutum] is similar to that of *T. cucumeris*, *elongatus*, *finlandicus* or *tiliarum*; it lacks the two [crescent-shaped] pores but has four pairs of bristles besides the postanal seta. The external parapodial platelets and the peritremal plate are fused to form one long narrow scutum. In the interscutal membrane are four more pairs of bristles, one pair placed at the rear margin are short, coarse and curved. The internal malae are needle-shaped. Tarsus IV has not a sensory seta worth mentioning."

Type Habitat: On *Vitis vinifera*, Buré (Meurthe et Moselle), France.

Type: This species is represented by one vacant slide from which the specimens are gone and plate no. 408 in the Oudemans collection of the Leiden Museum.

Notes: As the type specimens of this species are gone¹⁾ Oudemans' drawings are the only evidence available concerning its nature. So far as is known this species has never been described again from the type or any other locality. From the drawing it is obvious that the dorsum is imbricate, that it bears 16 pairs of dorsal setae, and that seta M_2 is unpaired with any of the lateral setae. Some of the dorsal setae such as the D_1 , M_2 and L_8 are mildly pectinate. The sternal plate has three pairs of setae and the ventrianal three pairs of preanal setae. The legs are normal and do not bear any conspicuous sensory setae.

SPECIES DUBIAE

Since the descriptions given by Ribaga of his species are too vague to be of any help without illustrations, and as we shall never, in all probability, know any more about these mites as the types cannot be found, there seems

1) The slide is present in the Oudemans collection, but the cover glass and preparations have been lost.

to be no suitable method of dealing with them apart from placing them in a list of dubious species. It is questionable whether they even belong to this genus ¹⁾. *Typhlodromus musci* Oudemans is also included in this list, not because it has not been adequately described and figured, but because it is only known from Nympha I. Unfortunately, our present knowledge of the nature of the immature forms of the different species is so far from complete that comparisons are unreliable.

Typhlodromus communis (Ribaga)

Iphidulus communis Ribaga, C., 1902. Riv. di Patologia Vegetale, 1902: 176.

Ribaga's original description in translation reads as follows:

"*Iphidulus communis*, Rib. n. sp. White-hyaline, ovoid. Female anal scutum rectangular with the sides gently excavated, caudal setae in each sex equal to about one-third of the length of the body.

Male length 290 μ , width 150 μ .

Female length 370 μ , width 230 μ .

"Habitat: Frequently on the lower surface of the leaves of *Viburnum Tinus*, *Ilex Cassine*, etc. Portici, Febr. coll."

Typhlodromus communis var. **hederae** (Ribaga)

Iphidulus communis var. *Hederae* Ribaga, C., 1902. Riv. di Patologia Vegetale, 1902: 176.

Ribaga's original description in translation reads as follows:

"*Iphidulus communis* var. *Hederae* Rib. n. var. The short setae which in the type stand along the back between the vertical and scapular setae are here missing. The caudal setae are longer than in the type species, the caudoventral scarcely smaller.

"Habitat: On the leaves of *Hedera Helix*, Portici."

Typhlodromus curtipilus (Ribaga)

Seiulus curtipilus Ribaga, C., 1902. Riv. di Patologia Vegetale, 1902: 175-176.

Ribaga's original description in translation reads as follows:

"*Seiulus curtipilus* Rib. n. sp. Body oval, adorned with very small setae which are not quite equal in length to one another. The caudal, precaudal and the other caudoventral setae are somewhat longer than the others. The anal scutum of the female is not quite pentangular, the anterior margin is gently curved [like a bow], and the sides behind the anterior angle are scarcely sinuate.

Body length 350 μ , width 240 μ .

"Habitat: On the lower surface of the leaves of *Citrus*, Portici."

Typhlodromus musci Oudemans

Typhlodromus musci Oudemans, 1929. Entom. Bericht. 8(170): 31.

Oudemans' original description in translation reads as follows:

1) It is quite possible that *T. communis* and *T. communis* var. *hederae* should be assigned to the genus *Amblyseius*.

"*Typhlodromus musci* nov. spec. Nympha I: 275 μ long. Propodosomal shield egg-shaped with the apex directed anteriorly; with 6 pairs of marginal setae and 3 pairs of much smaller ones. Opisthosomatic shield trapezoidal in shape with a median tongue-like process directed anteriorly; with 4 pairs of longer and 1 pair of very short (submedian) bristles. Edge of epistome a bit convex and undulating. There is a long sensory seta on tarsus IV."

Type Habitat: In moss, Baarn, The Netherlands.

Type: This species is represented by one slide and plate no. 385 in the Oudemans collection of the Leiden Museum.

Subgenus **Neoseiulus** Hughes

Neoseiulus Hughes, 1948. The mites associated with stored food products. Min. of Agric. and Fisheries, London. H. M. Stationery Office, p. 141.

When the species which have been described above in the genus *Typhlodromus* sensu stricto are compared with what might be called the peripheral or kindred forms, two main observations are patent. One, on the basis of the presence of imbrications and rugosities alone, which some authors have been tempted to use as a diagnostic character, no clear cut separation can be made. The degree of imbrication is variable from species to species and there seems to be no distinct pattern or evolution in its complexity. Two, when, however, the numbers of lateral setae are used as a basis for comparison, two main groups of species are readily distinguishable. The one which includes those mites with 8, 9, or 11 lateral setae and with variable but mild dorsal imbrications is the group herein understood as the genus *Typhlodromus*. The other which is made up of a small group of species with 10 lateral setae and with frequently a noticeable degree of imbrication should be placed in a separate subgroup of the genus *Typhlodromus*.

The decision to consider this last group as being worthy of only subgeneric rather than generic rank is based on the fact that the species of the two groups are all fundamentally similar and that they can only be separated readily on such a minor character as the number of lateral setae. The name which is applicable to this group may easily be chosen. In 1948 Mrs. Hughes established the genus *Neoseiulus* on the type *N. barkeri* Hughes. As an examination of the type specimens has revealed that it is a typical *Typhlodromid* of the 10 lateral setae group the name *Neoseiulus*, but reduced to the rank of subgenus, is applicable to this group of species.

Because the original description of *Neoseiulus*, herein considered, was broad enough to include the whole of the genus *Typhlodromus*, it will be necessary to restrict it to a smaller but more compact group of mites. Redescribed the subgenus may be characterized as follows: the species

have a moderately sclerotized body covered by a single dorsal shield which is imbricate and occasionally possessed of rugose patches. It bears 18 pairs of setae arranged in a chaetotactic pattern similar to that exhibited by the members of the genus *Typhlodromus* sensu stricto except that there are always 10 pairs of lateral setae and M_2 may not be as closely paired with one of the members of the lateral group. The ventrianal scutum bears either three or four pairs of preanal bristles and sometimes a pair of pores.

If subsequent work should reveal that I have erred in my understanding of the nature of *T. pyri*, i.e., that it is not fundamentally similar to *T. tiliae*, and hence that the genus *Typhlodromus* is not as I have here considered it to be, *Neoseiulus* would then stand as the genus for the species herein placed in the former group.

Type of the subgenus: *Neoseiulus barkeri* Hughes. For a key to the subgenus *Neoseiulus* see Key to species of genus *Typhlodromus* couplet A₃.

***Typhlodromus (Neoseiulus) barkeri* (Hughes)**

Plate XII figs. 31 and 33.

Neoseiulus barkeri Hughes, 1948. Mites associated with stored food products. London, H. M. Stationery Office, pages 141-143, figs. 200-206 incl.

Lasioseius polonicus Willman, 1949. Veröff. Mus. Bremen, 1949 (A₁):117-118.

As the description and the drawings which Mrs. Hughes has presented in describing this species are complete and compare as faithfully as possible with her type specimens the reader is referred to these. In the event of her work not being available a brief synopsis is herewith given. The dorsum is mildly imbricate and has a few barely perceptible rugose patches. There are 10 lateral setae and seta M_2 is paired with L_8 . The epistome is feebly chitinized with a smoothly curved convex edge. The sternal scutum of the female bears three pairs of setae; the ventrianal three pairs of preanal setae. The peritremal plate ends in a sharp hook behind coxa IV. The corniculae of the hypostome are long, slender and converge distally towards the midline. The moveable digit of the chelicera of the female has a single tooth; the fixed has three small teeth distad of the *pilus dentilis*. The chelicera of the male has been described by Mrs. Hughes as: "the chelicera is smaller than that of the female. The fixed arm is cleft at the base and bears a single large tooth; the moveable has no teeth, but a single large hammer-shaped appendage [spermatophore bearer] which projects above the extremity of the chelicera". The idiosoma of the male of this species measures .330 mm in length. That of the female is just slightly larger.

Type Habitat: On germinating barley, London Docks, London, England.

Types: Not stated in the original description but presumably in the collection of Mrs. Hughes.

Notes: From the available records it appears that this species has only been reported on two or possibly three occasions: once in the original collections where the author (Hughes) states that it was feeding on a species of *Acotyledon*; and secondly in two samples of debris from the holds of wheat-transporting vessels where it was associated with the tyroglyphids *Acarus siro* L. (= *Tyroglyphus farinac* Latr.) and *Tyrophagus dimidiatus* (Herm.). Thirdly, there is the possibility that the records published by Willman for *Lasioseius polonicus*¹⁾ are applicable to this species. On the basis of his description and drawings (unfortunately, I have not been able to examine the type specimens) it is probable that *L. polonicus* Willmann is either a synonym of *T. (Neoseiulus) bakeri* (Hughes), or a very closely related variety. The former of these two alternatives has been adopted in this paper despite the somewhat different habitats of the species involved.

Typhlodromus (Neoseiulus) bakeri (Garman)

Plate XII figs. 28 and 29.

Seiulus bakeri Garman, 1948. Connecticut Agric. Expt. Sta. Bull. 520: 15.

The original description of this species reads as follows:

"*Seiulus bakeri* n. sp. Female: Dorsum pitted and roughened, with 5 dorsal, 10 lateral, 2 median and only 1 scapular seta. Pattern as for other Phytoseiinae. Shears or mandibles of chelicerae with 3 teeth on fixed arm. Epistome of usual form, the cornicles or arms long and slender. Legs are not longer than the body length, setae uniform. Sternal plate with 2 pairs of setae, ventral plate 1 pair, and genital plate 1. No metapodal plates visible, but 2 parapodals each side [fig. nos. removed]. Anal plate shorter and more rounded at sides than *Iphidulus* with 4 pairs setae besides the para anals, and the anal opening apparently within a small plate included in the larger anal plate. Peritreme plate bluntly rounded at mesal ends, otherwise of usual form.

"Dimensions: Length .378 to .39 mm., width .210 to .270 mm., Leg I .270 to .300 mm., Leg IV .270 to .300 mm.

"Male not seen.

"Habitat: All collections from apple bark. Hamden (Westwoods), February 4, 16, May 3, 1937. Hamden (Mount Carmel), March 19, 1938.

"Types in Connecticut Agricultural Experiment Station Collection."

Notes: The dorsum of this species is not as distinctly imbricate as *T. (N.) rhenanus* but it bears a few rugose patches near the anterior end which might indicate an affinity with the genus *Phytoseius*.

The chaetotactic pattern is similar to that exhibited by any member of the genus *Typhlodromus*; there are 10 pairs of short lateral setae; M_2 is paired with L_7 ; and L_{10} is flattened and distinctly pectinate; in fact in some preparations it is almost serrate. The external malae are thin and blade-like,

1) *L. polonicus* was found on earth in dried salt marshes and on the earth in nearby meadows.

the epistome is mildly convex. The fixed digit of the chelicerae bears five, the moveable three minute teeth in addition to its terminal incisor. The ventrianal scutum of the female is unusual in that it appears to be a composite plate made up of a large ventral plate carrying four pairs of preanal setae and delimited from or superimposed upon this a smaller anal plate bearing the three paraanal setae.

Apart from the type records this species has only been found on the bark of neglected or unsprayed apple trees in Nova Scotia.

Typhlodromus (Neoseiulus) reticulatus Oudemans

Plate XIII

Typhlodromus reticulatus Oudemans, 1930. Entom. Bericht. 8(172): 70-71.

Oudemans' original description in translation reads as follows:

"Female: Length 412 μ , width 232 μ . Broad oval in shape with the apex towards the front. It is only at the sides of the dorsal shield that a narrow band of soft skin is visible. As the [surface of the] dorsal shield is raised in sharply bordered scales [i.e., distinctly imbricate], it presents a beautifully reticulate appearance. It bears 17 pairs of setae of which one pair [L₉] at the rear edge is as long as genu IV. In front of that is a pair [each of which is] as long as the trochanters of the palps. The sternal scutum has three pairs of bristles but the third pair arise from small processes which extend posteriorly from the plate proper. Such a sternal scutum is therefore intermediate between one with 2 and one with 3 pairs of bristles. There are two oblong metasternalia. The genital scutum is wide and behind coxae IV still wider. Its sclerotized portion has a strikingly dark median internal point. The ventrianal scutum is [roughly] triangular in shape with the corners rounded, is wider than the genital plate and bears 3 pairs of bristles in addition to the postanal seta. On the interscutal membrane are 4 more pairs of bristles, the rearmost pair of which is the coarsest and is as long as the trochanter of the palps. The space outside the coxae is occupied by one large peritremal plate in which is to be found the peritrema which becomes dorsal behind coxa I and extends anteriorly to end before the setae verticales [D₁]. Tarsus IV possesses a sensory seta which is as long as genu IV. The two internal bladders with the bell shaped intermediate piece are readily visible."

Type Habitat: On *Calluna vulgaris*, Wageningen, The Netherlands.

Type: This species is represented by one slide and plate no. 389 in the Oudemans collection of the Leiden Museum.

Notes: As Oudemans' description and drawings suffice for an understanding of the nature of this species no additional comments are necessary apart from the remark that there are three, not two preanal setae on the ventrianal plate of the female. He might also have noted that the mesial seta of the pedipalpal femur is distally flattened in the form of a small blade.

This is not a common species in North America. It has been found on a few occasions in Nova Scotia, British Columbia and California where it was preying upon tetranychids attacking strawberries and clover. So far,

apart from the type specimen, there are no European records except for a single specimen which was taken on gorse (*Ulex* sp.) in Kent, England. The type specimens of this species and *T. cucumeris* are too poor for a highly critical examination, but there is good evidence for believing that they may be closely related.

Typhlodromus (Neoseiulus) rhenanus (Oudemans)

Plate X fig. 13; Plate XI fig. 20; Plate XII fig. 27; Plate XIV; Plate XV.

Seiulus rhenanus Oudemans, 1905. Tijdschr. voor Entomol. 48: Verslagen, p. lxxviii.

Seiulus rhenanus Oudemans, 1915. Archiv für Naturges. 81 A (1): 154-156.

Typhlodromus foenilis Oudemans, 1930. Entom. Bericht. 8(172): 70 (description of female).

The original description from the first reference reads, in translation, as follows:

"*Seiulus rhenanus* nov. sp. male. I found this [specimen], 23-vii-1901, between rotting leaves at Benel near Bonn. It is closely related to *S. vepallidus* (C. L. Koch). The differences are, among others, that it lacks the two coarse setae behind the vertical setae, and that it has only 1 pair (and not two pairs) of coarse setae at the posterior margin [of the body]. Also the copulatory organ is different and reminds one of a deformed roe-horn. The length is 240 μ ."

The description of the female which Oudemans published under the name of *T. foenilis* reads, in translation, as follows:

"Female: Length 384 μ , width 206 μ . It is elliptical and only very slightly indented before the shoulders. The dorsal shield is surrounded by a narrow band of soft skin; shews distinct large round imbrications, and bears 18 pairs of setae, the longest pair of which [L10] extends beyond the rear margin of the body, yet is not longer than tibia III. The peritremata assume a dorsal position behind coxae I and extend anteriorly nearly as far as the setae verticales [D₁]. The sternal scutum has (very probably) 2 pairs of bristles with the result that there are 4 very small metasternalia. [This arrangement of platelets is not shewn in the large habitus figure of Oudemans' plates but is on one of the smaller explanatory figures]. The genital scutum is widened posteriorly and terminated by a straight line. The ventrianal scutum is nearly heptagonal, slightly longer than wide, rounded posteriorly and bears 5 pairs of bristles in addition to the postanals. The peritremata are very narrow, terminate posteriorly in a sharp point and extend only as far as the centre of the coxal cavities of the 4th pair of legs. In the interscutal membrane there are 3 pairs of bristles. Tarsi I are covered with extremely fine hairs. Tarsi IV possess indistinct sensory setae."

Type Habitat: Male, between rotting leaves, Benel near Bonn, Germany. Female, "In hayloft, Franeker [the Netherlands], where it was probably blown by the wind."

Type: This species is represented by one microscopic preparation and plate no. 380 of the female (labelled *T. foenilis*) and by one preparation and plate no. 390 of the male in the Oudemans collection of the Leiden Museum.

Notes: As a critical examination of the type specimens has revealed that *T. rhenanus* and *T. foenilis* are identical the latter must be placed in synonymy with the former. This comparison was extended to specimens of *rhenanus* taken in the field *in copulo* and the agreement was found to be complete. The differences in the type habitats is slightly puzzling, but as *rhenanus* has been found (in North America) on rotting leaves and in the basements of old buildings where it was in search of food, such incongruities can be explained away. Because Oudemans' drawings and figures are good there is no need for elaboration. He made reference to the fact that in all probability there are only two pairs of setae on the sternal scutum. In the majority of the specimens which have been seen this is true. The terminal portion (i.e., biting part) of the chelicera is shorter than in most typhlodromids and the two members are more roundly hooked; the fixed bears two minute teeth between the *pilus dentilis* and the incisor in the male and a small comb-like structure of 4 or 5 minute teeth in the female. The moveable digit carries the spermatophore bearer and has one tooth proximad of the incisor in the male; and a minute tooth in this position in the female. The sensory seta of Tarsus II is readily noticeable.

This species is very widespread in distribution and plentiful in numbers. It has been found in the fruit growing areas of all the Canadian provinces, many of the northern states of the U.S.A. (including California), in England, the Netherlands, France, and Belgium. It has been taken on all the major types of fruit trees, orchard cover crops, small fruits and garden crops, on the trees of surrounding woods and on rotting debris. This species, in all probability, is indigenous to North Temperate zones and has secondarily become a factor in the control of the tetranychids of economic significance. It has been seen feeding on many of the species of the last mentioned pests, on *Bryobia praetiosa*, on eriophyids and on other small arthropods (including aphids).

Typhlodromus (Neoseiulus) soleiger (Ribaga)

Plate XII figs. 30 and 32.

Seiulus soleiger Ribaga, C., 1902. Riv. di Patologia Vegetale 1902: 176.

Ribaga's original description in translation reads as follows:

"*Seiulus soleiger* Rib. n. sp. Body oval. Like *S. curtipilus* in the size of the dorsal setae. Female anal scutum sole [slipper]-shaped, in other words about one-third part forwards the scutum is drawn together [constricted], the anterior part is rounded.

Body length 400 μ

Body width 200 μ .

Habitat: On the lower surface of the leaves of *Citrus* Portici."

Type: Repeated search has failed to locate the type of this species.

Notes: Ribaga's comment about the shape of the female ventrianal scutum coupled with his note concerning the nature of the dorsal setae is sufficient to identify this species fairly accurately. On the basis of this identification a description can be presented of the male and female of the species.

Female: The dorsum is noticeably imbricate and provided with 10 pairs of lateral setae. M_2 is paired with L_8 and L_{10} is very slightly pectinate. The epistome is moderately sclerotized and triangular in shape with sinuous sides. The fixed arm of the chelicera is provided with two or three small teeth, the moveable with one. The external malae are blade-like in shape. As is *Phytoseius spoofi* (Oudms.) it has only two pairs of preanal setae placed on the anterior one-third of the plate. The anus and its surrounding setae are well removed from the posterior point of the plate.

Male: The dorsum is as in the female. The external malae are somewhat larger and so directed mesially that they enclose a triangular area. The jaws of the chelicerae seem to be devoid of teeth; the moveable digit, however, carries a roe-horn-shaped spermatophore bearer. The ventrianal plate is oval in shape and provided with only two pairs of setae. As in the female the anus is well removed from the posterior margin.

This species has only been found once in North America on apple leaves, Rougemont, Quebec.

Typhlodromus (Neoseiulus) tiliacolus Oudemans

Plates XVI and XVII.

Typhlodromus tiliacolus Oudemans, 1929. Entom. Bericht. 8(170): 33-34.

Oudemans' original description of this species reads, in translation, as follows:

"*Typhlodromus tiliacolus* nov. spec. The male described by me in Entomologische Berichten v. 8 n. 169 p. 15, does not belong to *tiliae*.

"It resembles so much the male of *T. pruni* [Oudemans subsequently placed this species in synonymy with *T. finlandicus*] that it is undoubtedly related to it. It is distinguishable, however, by the following characteristics: The dorsal scutum bears 20 pairs of setae. The ventrianal scutum has two broad rounded processes which extend laterally of coxae IV; it, however, lacks the two queer 'pores'. The epistome has a triangular projection in its centre. The chelicerae have as broad digits as [in the above mentioned species]; the spermatophore bearer is at the base of the moveable digit, it is directed anteriorly and bears a hook at the end. The bristle at the inner back corner of the trochanter of the palp is as long as the more internal one. The setae of leg I are no longer than on the other legs. Genu, tibia and tarsus of leg IV are each provided with a sensory seta which is of relatively the same length on the three joints though strikingly coarser on tibia IV."

The male which was originally assigned to *T. tiliae* (vide above reference) and which Oudemans now maintains is that of *T. tiliacolus*, was described as follows (in translation):

“Male: A good 250 μ long and provided with 20 pairs of setae. The sternal, metasternal and genital plates [are combined into one plate] which bears five pairs of bristles, is rectangular in shape and has a straight posterior margin. Close behind it an enormous ventrianal plate occupies nearly the whole surface of the venter. It bears four pairs of bristles in addition to the postanal seta. The epistome is triangular with faintly undulating sides. The chelicerae are without teeth; the spermatophore bearer is one and one-half times as long as the jaws; it has two semicircularly shaped hyaline apophyses and an end hook. Tibia IV is distally provided with a short, thick bristle and tarsus IV has a sensory seta which is one-third as long as the tarsus.”

Type Habitat: On *Tilia* sp., Berchtesgaden, Germany.

Type: This species is represented by two slides and two drawings, nos. 401 and 402 in the Oudemans collection of the Leiden Museum.

Notes: This species is as puzzling as any which Oudemans described in this group. In the first account quoted above he stated that it was closely related to *T. pruni* (= *finlandicus*), yet that it had 20 pairs of dorsal setae. As I have already shown this latter remark is sufficient to place it in a totally different group. From what can be seen of the type specimen (the preservation is poor) it would appear that the number of dorsal setae should be 18. Apparently setae S_1 and S_2 of the interscutal membrane were accidentally included on the dorsal plate. This interpretation would place the number of lateral setae at 10. Setae M_2 , L_5 and L_6 form a triangle. The epistome is triangular in shape with sinuous sides and the chelicerae of the male appear to be toothless. The male ventrianal plate is roughly of the same shape, and has much the same chaetotactic pattern as that of *T. finlandicus* though it lacks the pores present on the latter. As Oudemans did not give a description of the female the drawing will have to suffice. There is, however, considerable doubt about the validity of this drawing. In the notes which accompanied it Oudemans questioned whether it was the female of *tiliacolus*. I am inclined to agree with him because it has only 9 lateral setae and to regard it as the female of some other form (i.e., a species of the genus *Typhlodromus* sensu stricto).

The species has never been subsequently recorded.

SPECIES DUBIAE

There still remain a few unidentifiable species whose taxonomic position should be discussed.

Typhlodromus (Neoseiulus) vepallidus Koch

Gamasus vepallidus Koch, C. L., 1839. Deutsch. Crust. Myr. Arachn., fasc. 25. t. 22.

Koch's original description reads as follows:

"G. elongatus, albidotestaceus, macula antica alba, seta utrinque humerali, quatuor posticis remotis." This was followed by a somewhat longer German description.

Habitat: On the leaves of elm (*Ulmus* sp.).

From Koch's two descriptions (which are more generic than specific) it is impossible to correctly identify this mite. On purely circumstantial evidence, however, it is possible to state that *T. (N.) rhenanus* may be very closely related to it. This observation is based on the fact that there is on elms in Nova Scotia a heavily imbricate variety of *rhenanus* which fits Koch's description as closely as possible. Because, however, of the widely separated habitats, I have hesitated to take the next logical step of placing *rhenanus* in synonymy with *vepallidus* (or of considering it a variety of the latter).

Typhlodromus? vepallidus Berl. (non Koch)

Seius (Seiulus) vepallidus Berlese (non Koch), 1887. Acari, Myriapoda etc. fasc. 54, N. 8.

From the above comments about Koch's description and with the knowledge that we now have of the habitats of these mites I fail to see how Berlese could have identified the form described under the above title with Koch's species. Not only had the two creatures in question different habitats, elm on the one hand and "all plants" on the other, but as has been noted elsewhere in this paper, Berlese either drew the dorsal surface of one species and the ventral surface of another, or so incorrectly drew one or both surfaces that we cannot identify the species which he had.

Lasioseius minutus (Halbert)

Seiulus minutus Halbert, 1915. Proc. Roy. Irish Acad. 31(2): 76.

Lasioseius (Leioseius) minutus Halbert, 1923. J. Linn. Soc. (Zool.) 35: 374-375.

This species is included here not because I have any doubt about Halbert's wisdom in transferring it to the genus *Lasioseius*, but because Mrs. Hughes (1948) included it in the list of species of the genus *Neoseiulus*.

Seiulus levis Oudms. et Voigts

Seiulus levis Oudemans et Voigts, 1904. Zool. Anz. 27 (20/21): 651-656.

Seiulus levis Oudemans et Voigts, 1904. Abh. Nat. Ver. Bremen 18: 199-252.

This species like the former is placed in this list because Mrs. Hughes (1948) included it in her list of the genus *Neoseiulus*. From the descrip-

tion and drawings given by Oudemans and Voigts, in the second paper referred to, it is definitely not a *Typhlodromus*. In all probability it could be placed in the genus *Lasioseius*.

Genus **Garmania** ¹⁾ n. gen.

When the species herein attributed to the genus *Typhlodromus* have been separated from those which Oudemans placed in a genus of similar name, there still remain many different forms. One lot of these includes two groups of species which are closely related yet sufficiently different to be considered discrete entities. Because of the fact that the mites of both groups have dorsa which support large numbers of setae (upwards of 24 pairs) and because they have many other characters in common they have been placed in the same genus. As, however, they differ radically in the type of anal plate present in the female (the male of only one species is known) they have been tentatively placed in different subgenera until more can be discovered about them.

The members of the genus *Garmania* may be recognized by the possession of the following characters: a poorly sclerotized body covered by a single dorsal shield which may shew mild imbrications and which bears at least 24 pairs of simple setae. The interscutal membrane surrounding the shield is likewise richly supplied with setae. The epistome may be convex, semi-hexagonal or triangular in shape. In only one species, viz., *G. novae-guineae*, is it drawn out into spinous processes. The sternal plate usually bears three pairs of setae; when only two are present the third is placed on a pair of platelets located between the sternal plate and the metapodals. The anal plate is small, oval in shape and surrounded by at least 8 pairs of setae in addition to VL₁; it bears the anus and three setae. In the only known male of the group, viz., that of *G. domestica* (Oudms.), the ventrianal plate is large (similar to any *Typhlodromus* sp.) and provided with 6 pairs of preanal setae. The peritremal plates are small and do not curve posteriorly behind coxae IV as they do in the members of the genus *Typhlodromus*. None of the legs bear any noticeable sensory setae.

Type of the genus: *Typhlodromus domesticus* Oudemans.

SYNOPSIS OF THE SPECIES

As our knowledge of these species is far from complete — in only *G. domestica* has the male been found — this does not pretend to be other than a tentative key based on the females of the genus.

¹⁾ This genus has been named in honour of Dr. Philip Garman of New Haven, Connecticut, who was of invaluable assistance in the initial phases of these studies. This genus should not be confused with *Garmannia* (double nn), a genus of Pisces.

- A1. With a small anal plate bearing only 3 setae B
 B1. With the sternal plate provided with lateral wing-like expansions before coxae II ¹⁾ *G. domestica* (Oudemans.)
 B2. Sternal plate without such processes and roughly hexagonal or rectangular in shape C
 C1. Epistome drawn out into 3 distinct spines; posterior margin of the sternal plate deeply eroded (as far forward as the second pair of setae) *G. novae-guineae* (Oudemans.)
 C2. Margin of epistome denticulate; posterior margin of sternal plate mildly concave D
 D1. Anterior setae of the hypostome coarse and readily noticeable; chelicerae provided with a mesial, hyaline denticulate process *G. bulbicola* (Oudemans.)
 D2. Anterior setae of the hypostome no larger than the others, chelicerae without such a process *G. pomorum* (Oudemans.)
 A2. With a larger ventrianal plate bearing 4 pairs of preanal setae B
 B1. With only 2 pairs of setae on the sternal plate *G. (Paragarmania) amboinensis* (Oudemans.)
 B2. With 3 pairs of setae and a pair of pores on the sternal plate *G. (Paragarmania) mali* (Oudemans.)

Garmania domestica (Oudemans)

Plates XXI and XXII.

Typhlodromus domesticus Oudemans, 1929. Entom. Bericht. 8(170): 29-30.

Typhlodromus domesticus Oudemans, 1930. Ibid. 8(171): 49-50 (Corrections and additional notes).

Oudemans' original description in translation reads:

"*Typhlodromus domesticus* nov. spec.

"Female: 500 μ long; 300 μ broad (behind legs IV). Oval in shape with the apex directed anteriorly." In the second description mentioned above Oudemans changed this to read: "New material shews that the shape is not 'oval, etc.' but as follows: The idiosoma can be called long. That of the female is 488 μ long and 240 μ wide at the shoulders. The idiosoma of the male is 366 μ long and 190 μ wide at the shoulders. Both have nearly parallel sides which are, however, slightly concave in the middle region of the animal. This statement is made on the assumption that the female is not gravid."

"The dorsal scutum bears 26 pairs of setae of which the two at the rear margin are coarser and three times as long [as the others]. In the interscutal membrane surrounding the shield are 17 pairs of setae of which the two at the posterior margin are coarser and thrice as long as the others. The humeral setae [on the other hand are only] twice this length and horizontal in position. The peritremata become visible dorsally in front of the shoulders and extend anteriorly above coxae I beyond which the peritremal sheaths continue for a short distance to terminate [each] in a bristle. Sternal scutum longer than broad, convex behind." In the second paper devoted to this species Oudemans gave the additional notes: "The sternal shield extends laterally before coxae II." "There are no metasternalia. The genital scutum is twice as long as broad, and rounded in front and behind. There is no ventral scutum. The anal plate is nearly round. Behind coxa IV there is a triangular metapodal plate that continues as two triangular

1) These lateral processes before coxae II are also present in the sternal plate of the male of this species.

external parapodals¹⁾. On the interscutal membrane about the anal plate are 8 pairs of bristles. Behind the stigmata the peritremata continue for a short distance. The epistome is triangular. The chelicerae have externally as well as internally an oblong membranous bladder. There is no tibial organ. The digitus fixus has a row of 5 or 6 extremely small molars; the digitus mobilis has a [single] triangular tooth [Oudemans uses term caninus] and ventrally a fine needle-like spur which is directed forwards: (rudimentary spermatophore bearer?). The legs are strikingly short without peculiarities. Legs IV extend just beyond the posterior margin [of the body]."

The second paper listed above described the male as follows:

"Male: Peculiarities of the male are as follows: The dorsal shield has 24 pairs of setae of which the 2 at the posterior margin are coarser and 3 times as long as the others. In the interscutal membrane which surrounds the shield there are 16 pairs of setae. The humeral setae stand out horizontally but are not any longer. The sterni-metasterni-genital plate extends beyond the foveolae of legs IV. [Anteriorly] it extends laterally before coxae II, [posteriorly] it is abruptly truncate. The ventrianal scutum lies immediately behind this plate. It is of similar width [anteriorly] but almost immediately flares out laterally (with rounded corners) to taper off in a blunt triangle. It is surrounded by a broad band of interscutal membrane on all sides. It bears 7 pairs of setae in addition to the postanal seta. Behind the foveola of leg IV is also to be found a metapodal shield which is smaller than that of the female. In the interscutal membrane are 5 pairs of setae of which the two at the posterior margin are stronger and thrice as long as the others. The corniculae are farther apart than in the female. As far as I can see the digits of the chelicerae have no teeth; the spermatophore-bearer, attached to the front of digitus mobilis, is cylindrical, mobile and directed towards the front."

Type Habitat: Oudemans' notes pertaining to the type habitat read as follows: "In dust in house, but also in greasy matter; smoked beef, hog's bladders, etc., probably hunting for 'small game'. However, it is not impossible that it lives on these greasy matters." Hamburg, Germany.

Type: This species is represented by at least three slides and plates nos. 372 to 375 inclusive in the Oudemans collection of the Leiden Museum.

Notes: Oudemans' drawings here reproduced in plates XXI and XXII are quite accurate except that when the specimens of slide no. 3846 were remounted (which was necessitated by the fact that they had migrated so close to the periphery of the cover slip as to be unobservable) the chelicerae were noticeably larger than those shewn in the drawings. The specimens on the other two slides were not distinct enough for critical examination.

Like many of the other species of this genus this form seems to be rather rare. Apart from two doubtful groups of specimens, one from under elm bark from Berthierville, Quebec, and the other from rotting onions from Australia, it is doubtful whether this species has ever been subsequently captured. The two groups of specimens just alluded to are enough like the

1) From the specimens and drawings I presume Oudemans is here referring to a triangular plate which lies behind coxa IV and mesad of the peritremal plate. It continues anteriorly as two small triangular plates which fill in the cavity between coxae II and III, III and IV.

type to be considered a variety of the latter were it not for the totally different habitats, but not sufficiently different to be regarded as a separate species.

Garmania bulbicola (Oudemans)

Plate XX.

Typhlodromus bulbicolus Oudemans, 1929. Entom. Bericht. 8(169): 15-16.

Typhlodromus bulbicolus Oudemans, 1929. Ibid. 8(170): 29 (additional notes).

Oudemans' original description in translation reads:

"*Typhlodromus bulbicolus* nov. spec. In rotten lily bulbs imported from United States, and sent to me by the Plant Disease Station in Wageningen (January 1925). Also from a house in Berlin-North.

"Larva: 240 μ long. Propodosomal scutum with 9 pairs of setae. Behind it there are 6 pairs of setae. The sternal scutum is large and bears 4 pairs of bristles. The margin of the epistome is rounded off and has a sub-convex centre portion directed anteriorly. Tarsus IV is without a sensory seta.

"Nympha I: [This description is from the second of the two references given above.] 285 μ long; width at the shoulders 142 μ . Long oval in shape. Propodosomal [scutum] with 11 setae; opisthosomal scutum with 8 pairs of setae. Between the two scuta there are 4 pairs of setae and two (?) round intermediary shields. [Laterally] and submarginally to the left and right there are 9 bristles. Ventrally on the interscutal membrane there are 4 pairs of bristles.

"Nympha II: 380 μ . The entire dorsum is covered by one shield on which I can count 43 pairs of setae. The humeral seta is directed laterally. At the rear [margin] there are two somewhat longer setae between which are two minute bristles. The sterni-metasterni-genital scutum has 5 pairs of bristles. The anal scutum [which is] poorly defined is nearly round. The anus is strikingly large. The [interscutal membrane of the] venter bears 9 pairs of bristles. The stigmata lie behind the line that passes through the centre of the fovea of legs IV. The peritremata are hard to follow even with the use of an immersion [lens]. They end opposite the centre of the fovea of legs II. The epistome is trapezoidal in shape with serrate front and lateral margins; the teeth at the corners of the anterior margin are noticeably larger. The genu of the chelicerae has internally a semi-circular hyaline process with an extremely finely toothed edge. The digitus fixus has 2 terminal teeth [Oudemans uses term incisors] and 6 conical blunt molars; the digitus mobilis has a long blunt molar and ventrally a conical sharp pointed apophysis. There is no 'pulvillum'. Of the 4 pairs of bristles ventrad of the maxillicoxae the foremost pair (near the cornicula) are twice as thick as the others. The trochanter of the palp bears ventrally an internal [mound-shaped] proximal apophysis. Tarsus IV is without a sensory seta.

"Female: 445 μ . Dorsal scutum as in Nympha II. The sternal scutum bears 3 pairs of bristles and has a mildly concave posterior margin. The genital plate is posteriorly rounded. The anal scutum is [similar to] that of Nympha II. The interscutal membrane of the venter bears 12 pairs of bristles. The stigmata are in front of a line that goes through the centre of fovea of legs IV. The peritremata reach dorsally as far as the external vertical setae. The remainder of the body is similar to that of Nympha II.

"The male is unknown to me."

Type Habitat: On rotten lily bulbs from the United States of America.

Type: This species is represented by four slides and plates nos. 367 to 370 inclusive in the Oudemans collection of the Leiden Museum.

Notes: Oudemans' drawings (vide pl. XX) are a faithful representation of this species except that in a few instances on the centre of the dorsal shield the setae are **not shewn** as long as they should be. The tips of many of these setae frequently overlap the basis of the succeeding. Attention should also be drawn to the fact that this species is unique among the typhlodromids in having a very large and conspicuous pair of setae on the anterior part of the hypostomal lips. The epistome is semi-hexagonal in shape and provided with a serrate anterior margin which bears two distinct teeth at the antero-lateral corners. The mesial sensory seta of the pedipalpal femur is distally flattened and oval in shape.

From the scanty evidence that is now available this species does not appear to be a predator of tetranychids in particular. It has been caught feeding on several different kinds of mites and other small arthropods in such habitats as: on sod and apple bark, Yakima, Wash., on rotting debris in the Okanagan Valley, B.C., on humus, Ottawa, Ontario, and on rotting bulbs (kind not known) St. Catharines, Ontario.

Garmania novae-guineae (Oudemans)

Plate XXIV.

Seiulus novae-guineae Oudemans, 1901. Entom. Bericht. 1(23): 222.

Oudemans' original description in translation reads:

"*Seiulus novae-guineae* nov. sp. — Female: 512 μ — 524 μ . Resembles *S. muricatus* (Berl.). The sternal scutum is very large. The metasternal scuta are very small. The genital scutum is long, tongue-shaped and has a nearly straight posterior margin. The peritremata extend anteriorly as far as the vertical setae. The epistome has three points. The centre lobes of the hypostome are united into a medianly forked lobe. The horns have an internal basal flap. The fixed member of the chelicera is multidentated, the moveable member is tridentated. The femur of the palp bears internally a bristle which is distally abruptly widened. The tarsus of the palp has internally a three-pronged bristle, the front prong [Oudemans uses expression tooth] of which is oval and flat."

Type Habitat: On the head of *Goura* sp. (Crowned pigeon), Jamou, Netherlands East Indies.

Type: This species is represented by one slide and plate no. 356 in the Oudemans collection of the Leiden Museum.

Notes: Apart from the drawing and description little is known of this species. Such characters as the three-pronged epistome, the deeply croted posterior margin of the sternal plate and the elaborate sensory setae on the mesial face of the pedipalp give the impression that this species might well be placed in another genus. Since Oudemans, however, grouped it with such mites as *G. pomorum*, *G. domestica* and *G. bulbicola* it has been left in this somewhat anomalous taxonomic position but with many mental reservations by the writer who is undecided as to where it should be put.

Garmania pomorum (Oudemans)

Plate XXV.

Typhlodromus pomorum Oudemans, 1929. Entom. Bericht. 8(170): 31-32.

Oudemans' original description in translation reads:

" *Typhlodromus pomorum* nov. spec.

"Nympha I: 285 μ long; 165 μ broad (in the centre). Elliptical in shape, a little depressed in front of the shoulders. The propodosomal shield has 11 pairs of setae; the opisthosomal shield is broadly semicircular in shape and [bears] 6 pairs of setae. There are six round intermediary shields. In the interscutal membrane there are 12 pairs of setae. All the setae are of about the same length, the most striking of which are the four vertical setae and the two humeral setae which are obliquely directed anteriorly and slightly curved. The sternal scutum bears three pairs of bristles; the anal is a bit longer than broad. Between these two [last mentioned] scuta are 3 pairs of bristles. The anal [scutum] is flanked by a pair of bristles. The epistome is trapezoidal with a finely serrate margin, the legs are strikingly short without any peculiarities.

"Female: 475 μ long; 265 μ broad. Elliptical in shape, a little depressed before the shoulders. The dorsal scutum covers nearly the whole of the back and carries 42 pairs of setae of which the two humeral and two posterior marginal are slightly longer than the others. Noticeable [also on the dorsum] are a thin but nevertheless distinct scalloped (∪-shaped) line in the centre and a number of little furrows ('Erosionsgruben' Klti.) in the anterior half. The peritremata assume a dorsal [position] before the shoulders and extend as far forward as the four vertical setae. The sternal scutum is nearly square; the metasternalia are triangular. The genital [scutum] is broad and rounded off behind. There is no ventral [scutum]. The anal plate is elliptical. On the interscutal membrane about the anal plate are 9 pairs of bristles of which the two at the rear margin are a bit longer than the postanal seta. The epistome is similar to that of Nympha I or to that of *T. bulbicolus* Oudemans 1926. The digitus fixus of the chelicerae has only two blunt teeth behind the incisor; the digitus mobilis is without teeth but has a needle-like thorn ventrally directed to the front (rudimentary spermatophore bearer?) as in *T. domesticus*. The corniculae are broadened externally; the interior malae are short, narrowly triangular. In the 'rima' there are six transverse rows of fine teeth. The legs are strikingly short without any peculiarities."

Type Habitat: In the stem furrow of an apple, Arnhem, The Netherlands.

Type: This species is represented by two microscopic slides, one of Nympha I and the other of a female and by plates nos. 387 and 388 in the Oudemans collection of the Leiden Museum.

Notes: This species is larger than most typhlodromids and, like *T. masseei* n. sp., has a rather heavily sclerotized dorsum. As Oudemans has justly pointed out the dorsal shield (of the female type specimen) is divided by a scalloped line which is dorsad of a line between coxae II and III. Anterad of this line are a few very faintly etched rugose patches; posterad of it can be seen the (faint) hexagonal imbrications which are typical of this group of mites. The peritremal plate is small and does not extend behind coxa IV.

Again this is not a common species. It has been found on few occasions; once by Oudemans in the stem end of an apple, and later on the bark of an apple tree, Wilhelminadorp, Z., The Netherlands. As yet it has not been found in North America.

Subgenus **Paragarmania** n. subgen.

The members of this subgenus may be separated from those of the genus *Garmania* sensu stricto on the basis of the nature of the ventrianal plate. In the latter (vide supra) there is only a small anal plate bearing three setae. In the species that are here placed in the subgenus *Paragarmania*, on the other hand, the ventrianal plate is almost as large as in *Typhlodromus* and equipped with four pairs of preanal setae.

Type of the subgenus: *Typhlodromus mali* Oudemans.

Garmania (Paragarmania) mali (Oudemans)

Plate XXIII.

Typhlodromus mali Oudemans, 1929. Entom. Bericht. 8(170): 30-31.

Oudemans' original description in translation reads:

"*Typhlodromus mali* nov. spec.

"Nympha II: 245 μ long, 160 μ broad. Oval, with the apex directed anteriorly. The dorsal scutum is suddenly narrowed just past the centre. On the narrowed [posterior] portion 4 of the bristles are just as long as, and 4 longer than, the two setae verticales. These [latter] diverge widely whilst arising from bases which are close together. The dorsal scutum is surrounded by a soft membrane [interscutal membrane] except at the extreme rear. In this membrane lie the foremost halves of the peritremata which reach as far as coxae I. The epistome is short with a triangular front margin including an angle of 140°. The corniculae are narrow, and close together; the malae interiores are one-half as long, narrow and round in front. The hypopharynx is one and one-half times as long as the corniculae and pointed. Tarsus IV has a sensory seta which is as long as tibia IV.

"Female: 518 μ long, 310 μ broad. More or less rectangular in shape, round in front and behind and with distinct shoulders. The dorsal scutum has the same shape and is surrounded by a narrow interscutal membrane laterally and posteriorly. The peritremata are distinct from the shoulders forward to the vertical setae. These latter are as in Nympha II. The dorsal scutum has 34 pairs of setae of which 2 at the posterior margin are as long as the width of the gnathosoma. The sternal [scutum] is round in front, straight behind and concave at the sides. There are no metasternalia. The genital [scutum] is round in front and straight behind. The ventrianal is more or less of a rounded triangle with the apex directed posteriorly and with a lateral concavity [on each side] near the anus. It bears 5 pairs of setae in addition to the seta postanal. The epistome is similar to that of Nympha II but more rounded as in *T. amboinensis* (Oudemans, 1925), *musci* (Oudemans, 1929) and [*S.*] *truncatus* (Oudemans, 1905). The digitus fixus of the chelicera has its large tooth [Oudemans uses expression 'caninus'] displaced proximally and is provided with a long needle-like tibial organ [pilus dentilis]. The corniculae are more robust than in Nympha II. The hypopharynx is not longer than the corniculae. The rima has seven transverse rows of from 3 to 11 fine teeth. The femora, genua, and tibiae of the palpi and legs have dorsally slightly tinged ovals (Erosionsgruben Klti.). There is no feeler bristle on tarsus IV."

Type Habitat: On the bark of *Pirus malus* and in the bore channels of an apple, Arnhem.

Type: This species is represented by 2 microscopic preparations and plates nos. 383 and 384 in the Oudemans collection of the Leiden Museum.

Notes: As the female of this species has been well described and beautifully illustrated by Oudemans there is little need to recapitulate. Mention might have been made of the facts that this species is large for a typhlodromid, that it has large and cumbersome chelicerae and that like *G. (P.) amboinensis* it has a large ventrianal plate bearing four pairs of preanal setae. The dorsum is only slightly imbricate though there is a somewhat noticeable patch of long hexagonal scales in the dorsal hexagonal area. The sternal plate has a pair of crescent-shaped pores (with the horns of the crescent directed forwards) just anterad of the third pair of setae.

Despite the thousands of specimens that have been examined from apple trees this species has never been found in North America. The only specimen that has been seen, apart from the type, is one which was taken in the summer of 1948 at East Malling, Kent.

***Garmania (Paragarmania) amboinensis* (Oudemans)**

Plates XVIII and XIX.

Seiulus amboinensis Oudemans, 1925. Entom. Bericht. 7(146): 30-31.

Oudemans' original description in translation reads:

"*Seiulus amboinensis* nov. spec. 1 female long oval in shape. The dorsal shield bears short setae though the two at the posterior margin are strikingly longer. The epistome is the same as that of *Seiulus truncatus* Oudms.

"The chelicerae are short. Tarsus IV has a basitarsus which bears a strikingly long sensory seta. On the ventral surface the hypostomal process is unrecognizably transparent. The rima has one transverse row of 4 teeth. The end of the innermost maxillary lobe is shaped like a fishes' snout. The corniculae are very long. The femur of the palp bears a bristle with a unilateral triangular distal knife [-like edge]. The tritosternum has a square basal piece and two flagella which are fused for almost one-half of their lengths. The sternal scutum is convex anteriorly, has concavities on the sides, is straight posteriorly and bears only 4 bristles. The two other bristles each arise from a separate square platelet. The genital scutum is long, narrow between coxae IV and posteriorly trapezoidal. The ventrianal scutum is a reversed triangle with rounded corners. It bears 8 ventral and 3 anal bristles. There are no metasternalia. The peritremal shields are extremely narrow with a long pointed process [or tail-piece] behind the stigmata. There are no inguinal shields. This specimen was in a tube with parasites from a Microchiropteron but it is undoubtedly not a parasite."

Type Habitat: Found with parasites from a Microchiropteron.

Type: This species is represented by one slide and plates nos. 365 and 366 in the Oudemans collection of the Leiden Museum.

Notes: As Oudemans' drawings and description suit the type specimen there is no need for a redescription. Apart from the type specimen there is no record of this species having been subsequently found.

Genus **Blattisocius** Keegan

Keegan, H. L., 1944. On a new genus and species of parasitid mite. *J. Parasit.* 30(3): 181.

Keegan described the genus *Blattisocius* in the following manner:

"Genus *Blattisocius* gen. nov. Colour white. Moveable chela bearing three teeth. Fixed chela about a third as long as moveable chela, with a seta-like process near its tip. Anal plate bearing four paired and one unpaired seta [seta postanal], anteriorly truncate, larger than sternal plate. Peritremal and parapodal plates present. A pair of spindle-shaped plates present, one of which lies on either side of the dorsal plate between the latter and coxae I and II. A pair of large setae at posterior margin of dorsal shield."

Type of the genus: *Blattisocius triodons* Keegan (= *Typhlodromus tineivorus* Oudemans.).

Blattisocius tineivorus (Oudemans)

Plates XXVI and XXVII.

Typhlodromus tineivorus Oudemans, 1929. *Entom. Bericht.* 8(170): 34-35.

Blattisocius triodons Keegan, H. L., 1944. *Journ. of Parasit.* 30(3): 181-183.

Typhlodromus tineivorans Hughes, 1948. The mites associated with stored food, etc., p. 144-146.

Oudemans' original description in translation reads:

"*Typhlodromus tineivorus* nov. spec. I received from Dr. A. E. Miller of Urbana (Illinois) [a sample of] Acari which had appeared in masses in a culture of the "Angoumois grain moth" (*Sitotroga cerealella* Oliv.). All the specimens sent to me were extraordinarily swollen and burst because I left them too long in lactic acid to make the legs stretch. Miller will send me other material; for the time being the following [must suffice].

"Female: Dorsal shield 510 μ long; 240 μ broad; with 32 pairs of rather long setae. The sternal scutum is trapezoidal in shape. There are no metasternalia. The genital [scutum] is narrow and abruptly truncate posteriorly. The ventrianal [scutum] is as narrow, and has 4 pairs of bristles in addition to the post-anal seta. The peritrema is thick and extends beyond coxae III. The epistome is low, at the most a little convex, and with an irregular edge. Digitus fixus [of the chelicerae] is one-half as long as mobilis; it is without teeth but distally bears a needle-like tibial organ which is directed anteriorly. The moveable member is of the normal build and bears 2 low teeth. The chelicerae give the impression that they are used as piercing weapons rather than as grasping organs.

"Male: 440 μ long; 285 μ broad; broad-oval in shape with the top directed anteriorly. The shield is nearly as long but narrower and [equipped] with 33 pairs of bristles. The sternal-metasternal-genital scutum is narrow and nearly straight posteriorly. The ventrianal which is nearly round and bears 7 pairs of bristles in addition to the postanal seta, covers most of the opisthosoma. At the rear margin 4 firm setae are noticeable. A free epistome is hardly present; it is a very low convex with a smooth edge. The peritremata are thick, and extend only as far as coxae II. Laterad [Oudemans says 'external to it'] of it is an organ that looks like a piece of peritrema. I have never seen anything like it. Tarsus IV is without a sensory seta."

Type Habitat: On cultures of *Sitotroga cerealella* Oliv. Urbana, Illinois, U.S.A.

Type: This species is represented by five slides and plates nos. 406 and 407 in the Oudemans collection of the Leiden Museum.

Notes: In the summer of 1948 specimens of *Blattisocius triodons* from Keegan's type collection were critically compared with Oudemans' specimens of *Typhlodromus tineivorus* and the similarity was found to be complete. Accordingly, *triodons* is placed in synonymy with *tineivorus*. The genus *Blattisocius*, however, may be retained as a valid genus because *tineivorus* Oudemans (and its synonym *triodons* Keegan, the genotype) differs sufficiently from the other members of the genus to have warranted its inclusion in a separate genus from the time of its original description. On the basis of this and the other arguments presented in this paper it appears that Mrs. Hughes' restriction of the use of *Typhlodromus* to this species alone was unwarranted.

B. tineivorus (Oudms.) is a fairly common pest of many of the different species of stored product insects which are grown under experimental conditions, viz., *Tribolium confusum* J. du V., *T. castaneum* Hbst., *Attage-nus piceus* Oliv., *Tineola biselliella* Humm., and *Ephestia sericarium* (Scott). It has also been found in fair numbers in unsanitary flour mills which were badly infested with some of the pests just mentioned.

As yet there are no records of its having been found in the wild state out of buildings.

Genus **Kampimodromus** ¹⁾ n. gen.

There still remain three of Oudemans' species which differ from the other forms that he placed in the genus *Typhlodromus* in the nature of certain setae of the dorsum. In these the lateral setae are pectinate without being flattened and serrate as they are in the genus *Phytoseius* (*Seiulus* of some authors). To emphasize this fact and thus to maintain their taxonomic identity they have been isolated along with a new species in a separate group whose characters are as follows: the dorsum is very slightly if at all imbricate and bears 7 to 9 pairs of distinctly pectinate lateral setae and 5 or 6 pairs of median setae which may or may not shew slight pectinations; D_1 and VL_1 are pectinate. The epistome is decidedly rounded. The chelicerae are denticulate with 3 to 5 teeth on the moveable digit and an equal number on the fixed. The peritremal plate is small yet extends posterad of coxa IV. The sternal scutum bears three pairs of setae and the ventrianal, which is

1) From the Greek for crooked runner, based on the observation that most of these mites run about in an erratic manner looking for prey. The word *Kampimodromus* was used by Euripides in "Iphigenia in Tauris", l. 82.

equal in width to the genital, three pairs of preanal. The fourth pair of legs may not bear conspicuous sensory setae.

Type of the genus: *Typhlodromus elongatus* Oudms., 1930.

SYNOPSIS OF THE SPECIES

- A1. With simple (non pectinate) median setae¹⁾ which are never more than one-half as long as the lateral setae B
 B1. Median setae longer than the distance between the opposite members of D₃ .
K. elongatus (Oudms., 1930)
 B2. Median setae much shorter than the distance between the opposite members of D₃ C
 C1. With 7 pectinate lateral setae *K. heveae* (Oudms., 1930)
 C2. With 4 pectinate lateral setae *K. hevearum* (Oudms., 1930)
 A2. With slightly pectinate median setae which are almost equal in length to the lateral setae *K. transvaalensis* n.sp.

Kampimodromus elongatus (Oudemans)

Plate XXVIII.

Typhlodromus elongatus Oudemans, 1930. Entom. Bericht. 8(171): 50.

Oudemans' original description in translation reads:

"Female: Length 330 μ ; width before the middle 160 μ . Elliptical in shape with slight concavities before the shoulders. The dorsal shield covers the whole of the back and is provided with 17 pairs of thick setae, the longest of which are as long as genu I and are serrate as are probably also the shorter ones. The sternal plate is slightly longer than broad, and indented posteriorly. The metasternalia are small and round. The anterior two-thirds of the genital plate is rectangular as is the posterior third which is, however, much broader, and with a straight (posterior) margin. Beside the last [mentioned] plate are two small platelets. The ventrianal plate is twice as long as broad, and [provided] with four pairs of setae in addition to the postanal seta. Inguinalia line-shaped. The peritremal plate is very narrow and extends anteriorly in a point past the fovea of leg IV. On the interscutal membrane [laterad of the ventrianal plate] are located five pairs of bristles, the posterior pairs (2) of which are thick and thorny. The peritremata become thinner on the dorsal surface of the shoulders and reach anteriorly a little beyond coxae I. The epistome is very short, broad and anteriorly convex. The digitus fixus (of the chelicerae) is broad; the digitus mobilis is three times narrower. The corniculae are small and close together. The interior malae are long, thin and barely visible. Hypostome has 6 pairs of teeth. I did not see the hypopharynx.

"This species differs from *finlandicus* by its thorny dorsal setae, by the longer peritremata, by the concave hind margin of the sternum and by the lack of two pores on the ventrianal plate."

Type Habitat: On *Tilia platyphyllos*, Arnhem, The Netherlands.

Type: This species is represented by one microscopic preparation and plate no. 376 in the Oudemans collection of the Leiden Museum.

Notes: As the type of this species is shrivelled beyond recognition the drawing must suffice. As far as is known it has never been taken on a subsequent occasion.

1) This term is used to include setae D₂, 3, 4, 5, and M₂.

Kampimodromus heveae (Oudemans)

Plate XXIX.

Typhlodromus heveae Oudemans, 1930. Entom. Bericht. 8(173): 97.

Oudemans' original description in translation reads as follows:

"Female: Length 390 μ , width at the shoulders 195 μ . [The dorsum is] wide behind the gnathosoma, slightly indented before the shoulders, and continues posteriorly with parallel sides to end with a rounded posterior margin. The dorsal scutum is surrounded on all sides by a weakly sclerotized integument and bears 14 pairs of setae, 8 of which are marginal, coarse and pectinate (with fine hairs), while 6 are submedian, small and smooth. There are also 2 pairs of thick setae in the interscutal membrane, one at the shoulders and one in the middle [S₁ and 2]. On the ventral side the tritosternum is long and the flagella are fused for over more than half their length. The sternal scutum bears 3 pairs of bristles; the metasternalia are small, round, and each provided with one bristle. The genital scutum has a straight posterior margin and bears one pair of bristles. The ventrianal scutum has 4 pairs of bristles in addition to the postanal seta. On the interscutal membrane are two pairs of bristles. All these bristles [I presume Oudemans means by this all the ventral bristles] are long and limp. Near the posterior margin there are also 2 pairs of submarginal bristles of different lengths. The epistome is nearly round. The fixed digit [of the chelicerae] has 3, the moveable member 5 or 6, teeth. No genual or tibial organs could be seen. The hypostome has seven rows of double teeth. The corniculae are long, narrow, and close together. There are 2 long internal malae. The legs are rather long; genu I and II bear a heavy short bristle. On the genu, tibia and basitarsus of legs IV is a truncate seta which may even be somewhat knob-shaped terminally."

Type Habitat: On *Hevea* sp. leaves, Medan, Deli, Sumatra (Summer 1927).

Type: This species is represented by one microscopical preparation and plate no. 381 in the Oudemans collection of the Leiden Museum.

Notes: From my experience with some of the species of the Phytoseiinae where the males and females differ somewhat I am inclined to favour Oudemans' first suggestion appended to his description of *hevearum* and to regard that species and *heveae* as the male and female of the same form. Until, however, more specimens can be found, or until a pair are taken *in copulo* such a suggestion can not be implemented and *hevearum* placed in synonymy with *heveae*. Oudemans' drawings in the case of both "species" are excellent reproductions which do not require any comment.

Kampimodromus hevearum (Oudemans)

Plate XXX.

Typhlodromus hevearum Oudemans, 1930. Entom. Bericht. 8(173): 97-98.

Oudemans' original description in translation reads as follows:

"*Typhlodromus hevearum* nov. spec.

Male. Length 245 μ , width at the shoulders 149 μ . [The dorsum is] more or less egg-shaped with the top directed posteriorly. [It is] somewhat narrower behind the gnathosoma, slightly indented before the shoulders and decreases in width from this point to

the blunt, nearly straight, posterior margin. The dorsal scutum is not surrounded by a weakly sclerotized band of integument. It bears 15 pairs of setae, 5 of which are marginal, coarse and pectinate (with very fine setae), the other ten (4 marginal and 6 submedian) are very small and smooth. On the ventral surface the tritosternum is short and the flagella are fused for over one-quarter of their length. The sterni-metasterni-genital scutum bears 5 pairs of very short bristles. The other scuta are fused. On the ventrianal plate are 4 pairs of very short bristles, besides the postanal seta, and one pair of longer, coarser marginal setae. There are, moreover, in front of the anus 2 crescent-shaped pores such as are found in either *finlandicus* or [*Amblyseius*] *similis*. The epistome is convex. The fixed digit [of the chelicerae] has a row of 10 teeth, the moveable member is devoid of teeth, but bears ventrally near the middle the flexible spermatophore bearer, which is of the usual shape. The hypostome has 5 rows of double teeth, the corniculae are not long but bent. There are 2 knob-shaped and 2 long internal malae. The legs are rather long. On genu I, genu and tibia II, and genu, tibia and bitarsus IV there is a thicker bristle that ends as a fine hair.

"At first I thought that [the specimen, herewith described] was the male belonging to the female of *heveae* because both were in the same tube with some young *Hevea* leaves preserved in alcohol. As the tritosternum of *Parasitus* males and females are likewise different [the differences noted between these two species] would thus not be a sufficient cause for separating them. The ventral setae, the ventral scutum and the sensory setae on legs IV should, however, be the same in both sexes of one species."

Type Habitat: On *Hevea* sp. leaves, Medan, Deli, Sumatra. Taken with *K. heveae* (Oudms.).

Type: This species is represented by one microscopical preparation and one plate, no. 382, in the Oudemans collection of the Leiden Museum.

Notes: See *K. heveae*.

***Kampimodromus transvaalensis* n. sp.**

Female: The idiosoma of this species measures .39 mm in length and .23 mm in width. The dorsum is roughly oval in shape with a lateral indentation between L_6 and L_7 (S_2 is opposite this spot). It appears to be free of any imbrications (it may be that my specimens have been cleared too much) and bears 16 pairs of fairly long pectinate setae which are arranged in a chaetotactic pattern similar to that of *T. (N.) bakeri* (vide Pl. XII fig. 28). When the distance between the bases of the opposite members of D_3 is taken as the unit of measurement, setae D_1 , 2 , and 3 , and S_1 and 2 , are equal to this length, D_4 , 5 , and M_2 exceed it by one quarter and L_1 to 7 and M_2 exceed it by varying lengths up to one and three-quarters. L_8 , L_{10} and VL_1 are equal to about one-third of the width of the dorsal shield. L_9 and D_6 are extremely minute and unpectinate. Setae L_8 , M_2 , M_2 and L_8 are in a fairly straight transverse line. M_2 and L_8 might be said to be paired though their bases are as far apart as the length of L_8 or M_2 . The epistome is a blunt triangle or tongue-shaped; its edge is entire. On the ventral surface the external malae are blade-shaped with the mesial faces straight. The hypostome bears three pairs of similar setae. The moveable digit of the

chelicera has one minute tooth, the fixed a larger tooth just proximad of the terminal incisor forming a U-shaped notch. The femur of the pedipalp bears mesially a sensory bristle which is distally flattened. The sternal scutum is roughly rectangular in shape and bears three setae: the ventrianal is hexagonal in shape and is as wide as the genital and bears three pairs of preanal setae; the anus is large. Laterad of the ventrianal plate the setae of the interscutal membrane, with the exception of VL₁, are extremely minute. Also in this membrane just behind coxae IV are to be found the long and slender parapodal plates. The peritremal plates extend slightly posterad of coxae IV. Tarsi of all legs are richly supplied with setae; those of coxae IV are coarse but none are noticeably longer than the others.

Type Habitat: Predaceous on small acari on ground peanuts, Nylstroom, Transvaal, Union of South Africa.

Holotype: Female, Nylstroom, Transvaal, February 1947 (Coll. R. F. Lawrence), No. 5970 in the Canadian National Collection.

Paratype: Female, on *Rattus* sp., Pinellas Park, Fla., December 17, 1947. Despite the difference in habitat this specimen is considered a paratype of the species in question because morphologically the two are identical. It is possible that the paratype was either accidentally on the rat, or was there looking for small Acari.

Genus **Phytoseius** Ribaga

Phytoseius Ribaga, 1902. Riv. di Patologia Vegetale, 1902: 177.

Ribaga's description of this genus, in translation, reads as follows:

"Body oval, armed with fourteen very long denticulate dorsal setae. Two infrascapular and two median setae erect, rather long. The precaudal setae [are] arched or curved forwards. The genual setae are well developed but simple. The female genital scutum [has] a broader base than the anal scutum."

Type of the genus: *Gamasus plumifer* Can. et Fanz., 1876.

Notes: Apart from *P. plumifer* which cannot be identified too exactly from the original description, it would appear that the only well authenticated species in this genus is Oudemans' *Typhlodromus spoofi*. It is quite possible that *plumifer* and *spoofi* are the same, as the latter is widely distributed. There is also the probability that both are identical with a species which Banks (1909) described as *Sejus macropilis*. As, however, the types of the latter do not seem to be available and as the description is vague, the identity can never be proven and *P. spoofi* will have to stand as the name of the one reliable species in the genus, albeit it may be synonymous with *plumifer*.

On this basis of *spoofi* the generic description can be enlarged to read: The dorsum is distinctly imbricate (in a rhombic pattern) and provided with

rugose patches. The chaetotactic pattern is made up of five dorsal setae of which only one, viz., D_1 , shews any pectinations; 1 median and 9 lateral distinctly serrate setae. Characteristic of the group is the position which seta L_8 takes, bent or arched forward over the body. The epistome is roughly triangular in shape. The chelicerae are denticulate. The sternal scutum bears three pairs of setae, the ventrianal only two (preanal). The legs are long and richly supplied with setae, some of which may be modified for sensory functions.

Phytoseius spoofi (Oudemans)

Plates XXXI and XXXII.

Seiulus spoofi Oudemans, 1915. Entom. Bericht. 4(83): 184.

Seiulus spoofi Oudemans, 1915. Archiv für Naturges. 81A(1): 161-165, figs. 120-127 incl. (A fuller description and additional notes).

The first description given by Oudemans of this mite reads, in translation, as follows:

"*Seiulus spoofi* nov. sp.

"Female: Length 335 μ , width 170 μ . It can thus be seen that this mite is slim. The legs are also slim. The male whose length is 256 μ and whose width is 140 μ is likewise slim. On the dorsal shield are 13 pairs of setae of which the vertical [D_1], post-vertical [L_1], ante-humeral [L_5], humeral [L_6], scapular (1), lateral [L_7], pygidial [L_9], and parapygidial [L_8], are extremely heavy and serrate [pectinate, Oudemans uses expression, 'provided with thorns']. There are also two similar setae [VL_1] which flank the posterior part of the ventrianal shield. The parapygidial setae are directed anteriorly."

Type Habitat: On *Salix caprea*, Åbo, Finland.

Type: This species is represented by two microscopical preparations and plates nos. 396 (figs. 120-123 as noted above), 397, 398 (figs. 124-127 as noted above), and 399 in the Oudemans collection of the Leiden Museum.

Notes: In the two references cited above Oudemans has given adequate descriptions of this mite. There only remains to note that the only simple setae on the dorsum are D_2 , 3, 4, (5 is missing), 6 and M_1 (2 is likewise missing).

This species is very widely distributed in the North temperate zones. It has been found in every Canadian province, the northern States of the U.S.A., England, The Netherlands, Sweden, Finland, Denmark, and France. It has been taken mainly from uncultivated trees and unsprayed apple trees, raspberries, currants, dogwood, etc., where it was feeding on red and other tetranychid mites and other small arthropods. When it feeds on red or clover mite eggs the gut becomes visible through the dorsum.

SPECIES DUBIAE

Ribaga described two species in this genus, but as the descriptions which he gave are too vague for reliable identification, they are placed in the category of dubious species.

Phytoseius finitimus Ribaga

Phytoseius finitimus Ribaga, C., 1902. Riv. di Patologia Vegetale 1902: 178.

Ribaga's original description in translation reads as follows:

"*Phytoseius finitimus* Rib. n. sp. All the setae are slender. The median setae almost equal two-thirds of the body in width and are longer than the infrascapular. The female genital scutum is long, oval in shape, the anterior margin is truncate, the side edges are indented. It is furrowed crosswise near the indentation. The anterior part is equipped with three pairs of setae.

Body length 300 μ

Body width 175 μ

Habitat: The specimens were seen on the lower surface of the leaves of *Buddleia madagascariensis*, collected at Portici."

Phytoseius horridus Ribaga

Phytoseius horridus Ribaga, C. 1902. Riv. di Patologia Vegetale 1902: 178.

Ribaga's original description in translation reads as follows:

"*Phytoseius horridus* Rib. n. sp. All the setae are thickened and strongly denticulate. The infrascapular are larger than the median and equal two-thirds of the width of the body. The humeral setae are small. The anal scutum of the female is not quite pentangular [in shape], the anterior margin is straight, the sides are hollowed out and it is wider in front than at the rear. [It bears] three pairs of setae.

Body length 315 μ

Body width 190 μ

Habitat: Frequently on the lower surface close to the stem of the leaves of *Quercus Ilex*, Portici."

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EXPLANATION OF THE PLATES

Plate I

Typhlodromus aberrans Oudms., 1930. Nympha II male. Ventral habitus view; dorsal habitus view; ventral view of the hypostome; ventral view of the chelicera. After Oudemans' plate no. 362.

Plate II

Typhlodromus cucumeris Oudms., 1930. Left top, two views of the chelicera; dorsal habitus view of the female; left bottom, lateral and ventral view of the chelicera, ventral view of the hypostome; right top, ventral habitus view of the female; right bottom, enlarged view of the malae and tritosternum; centre, ventral view of coxa I. After Oudemans' plate no. 371.

Plate III

Typhlodromus finlandicus (Oudms., 1915). Extreme left, dorsal view of tarsus I; left, epistome above, dorsal habitus view of the female below; centre, dorsal view of the pedipalp; right, ventral view of the female and enlarged view of the tritosternum; extreme right, top, ventral view of the chelicerae, bottom, ventral view of the hypostome, shewing hypostomal setae a, b, c, d. After Oudemans' plate no. 378.

Plate IV

Typhlodromus tiliae Oudms., 1929, female. Left top, two views of the chelicera and one of the terminal portion of tarsus I; left centre, ventral view of the female; left bottom, ventral view of the hypostome; right top, two outlines of the epistome; right centre, dorsal habitus view of the female and an enlarged dorsal view of the chelicera; right bottom, dorsal pore (very enlarged) and alternate views of the genital and ventrianal plates of the female; centre bottom, enlarged view of the tritosternum. After Oudemans' plate no. 404.

Plate V

Typhlodromus tiliae Oudms., 1929, male. Left top, outline of the epistome, dorsal view of the chelicera and peritremal plate; left centre, dorsal habitus view of the male, enlarged view of one of the posterior setae, and an alternate view of the peritremal plate; left bottom, ventral view of the hypostome and an enlarged ventral view of the chelicera; right top, ventral view of the male. After Oudemans' plate no. 405.

Plate VI

Typhlodromus tiliarum Oudms., 1930. Left top, greatly enlarged view of the posterior marginal pores; left centre, dorsal habitus view of the female; left bottom, enlarged view of the anterior portion of the hypostome; centre top, dorsal view of the chelicera; centre bottom, enlarged view of the tritosternum; right top, ventral view of the female; right centre, view of coxae III and IV shewing bell-shaped organs; right bottom, ventral view of the hypostome and greatly enlarged view of the dorsal pores. After Oudemans' plate no. 400.

Plate VII

Typhlodromus vitis Oudms., 1930. Right top, ventral habitus view of the female; right bottom, ventral view of the hypostome and of the left chelicera; left top, tritosternum and coxa I; left centre, dorsal habitus view of the female; left bottom, outline of the epistome, enlarged view of setae D₁, and M₂ or L₈, ventral view of the hypostome, and dorsal view of the right chelicera. After Oudemans' plate no. 408.

Plate VIII

Comparative studies of the dorsal shield. Fig. 1, *Typhlodromus tiliae* Oudms., female; fig. 2, *Typhlodromus fallacis* (Garman), female; fig. 3, *Typhlodromus tiliae* Oudms., male; fig. 4, *Typhlodromus fallacis* (Garman), male. Original, figs. 2 and 4 drawn from Garman's Hamden collection.

Plate IX

Comparative studies of the dorsal shield. Fig. 5, *Typhlodromus finlandicus* (Oudms.), female; fig. 6, *Typhlodromus cucumeris* Oudms., female; fig. 7, *Typhlodromus pomi* (Parrott), female; fig. 8, *Typhlodromus longipilus* n.sp., female. Original, fig. 7 drawn from Garman's specimens.

Plate X

Comparative studies of the dorsal shield and ventrianal plate. Fig. 9, *Typhlodromus conspicuus* (Garman), dorsal shield, female; fig. 10, *Typhlodromus masseei* n.sp., dorsal shield, male; fig. 11, *Typhlodromus fallacis* (Garman), ventrianal plate, male; fig. 12, *Typhlodromus finlandicus* (Oudms.), ventrianal plate, male; fig. 13, *Typhlodromus* (*Neoseiulus*) *rhenanus* (Oudms.), ventrianal plate, male; fig. 14, *Typhlodromus masseei* n.sp., ventrianal plate, male. Original, figs. 9 and 11 drawn from Garman's specimens.

Plate XI

Comparative studies of the ventrianal plate. Fig. 15, *Typhlodromus tiliae* Oudms., female; fig. 16, *Typhlodromus pomi* (Parrott), female; fig. 17, *Typhlodromus fallacis* (Garman), female; fig. 18, *Typhlodromus cucumeris* Oudms., female; fig. 19, *Typhlodromus finlandicus* (Oudms.), female; fig. 20, *T. (Neoseiulus) rhenanus* (Oudms.), female; fig. 21, *Typhlodromus longipilus* n.sp., female; fig. 22, *Typhlodromus conspicuus* (Garman), female; fig. 23, *Typhlodromus masseei* n.sp., female; fig. 24, *Typhlodromus longipilus* n.sp., lateral view of female chelicera; fig. 25, *Typhlodromus tiliae* Oudms., ventrianal plate, male; fig. 26, *Typhlodromus masseei* n.sp., lateral view of male chelicera. Original, figs. 16, 17 and 22 drawn from Garman's specimens.

Plate XII

Comparative studies. Fig. 27, *Typhlodromus (Neoseiulus) rhenanus* (Oudms., 1915), dorsal shield; fig. 28, *T. (N.) bakeri* (Garman, 1948), dorsal shield; fig. 29, *T. (N.) bakeri* (Garman, 1948), ventrianal plate of female; fig. 30, *T. (N.) soleiger* (Ribaga, 1902), ventrianal plate of female; fig. 31, *T. (N.) barkeri* (Hughes, 1948), ventrianal plate of female; fig. 32, *T. (N.) soleiger* (Ribaga, 1902), ventrianal plate of male; fig. 33, *T. (N.) barkeri* (Hughes, 1948), ventrianal plate of male. Original, figs. 27, 28, 29, 31, and 33 drawn from type material.

Plate XIII

Typhlodromus (Neoseiulus) reticulatus (Oudms., 1930), female. Left top, dorsal habitus view; left centre, pear-shaped bladder opening between coxae III and IV; left bottom, lateral view of chelicera; right top, ventral view of the idiosoma; right centre, ventral view of hypostome; right bottom, basi-femur of leg I. After Oudemans' plate no. 389.

Plate XIV

Typhlodromus (Neoseiulus) rhenanus (Oudms., 1905), female. Left top, dorsal habitus view, and enlarged ventral view of the pedipalpal tarsus; left bottom, tritosternum, ventral view of right chelicera and ventral view of hypostome; top centre, ventral view of coxa I; right top, ventral habitus view and enlarged ventral view of pedipalpal trochanter; right bottom, dorsal view of chelicera and alternate view of sternal and genital scuta. After Oudemans' plate no. 380 (*T. foenilis*).

Plate XV

Typhlodromus (Neoseiulus) rhenanus (Oudms., 1905), male. Left top (fig. 104), tritosternum; (fig. 101), dorsal habitus view; top centre (fig. 102), ventral view of hypostome; right top (fig. 103), ventral habitus view; centre below (fig. 105), lateral view of the chelicera. After Oudemans' plate no. 390. See Archiv für Naturges. 81A(1): 154-156.

Plate XVI

Typhlodromus (Neoseiulus) tiliacolus (Oudms., 1929), male. Left top, tritosternum; left centre, ventral view of male; left bottom, ventral view of hypostome; centre top, ventral view of chelicera and enlarged view of epistome; centre, dorsal habitus view of male; right top, dorsal view of the chelicera; right centre, terminal portion of tarsus I enlarged; right bottom, sensory seta from mesial face of pedipalpal tarsus. After Oudemans' plate no. 401.

Plate XVII

Typhlodromus (Neoseiulus) tiliacolus (Oudms., 1929), female. After Oudemans' plate no. 402.

Plate XVIII

Garmania (Paragarmania) amboinensis (Oudms., 1925). Dorsal habitus view of female. After Oudemans' plate no. 365. From Zool. Meded. 10:195.

Plate XIX

Garmania (Paragarmania) amboinensis (Oudms., 1925). Fig. 17, ventral habitus view of the female; fig. 18, enlarged ventral view of the hypostome with the pedipalp and tritosternum. After Oudemans' plate no. 366. From Zool. Meded. 10:197.

Plate XX

Garmania bulbicola (Oudms., 1929). Left top, outline of the epistome; left centre, dorsal habitus view of the female with displaced and enlarged chelicerae; left bottom, lateral and dorsal views of the chelicera; right top, ventral view of the idiosoma of the female; right centre, ventral view of the chelicera, ventral view of the hypostome and tritosternum; centre, lateral view of the chelicera. After Oudemans' plate no. 370.

Plate XXI

Garmania domestica (Oudms., 1929), female. Left top, dorsal habitus view; left bottom, two dorsal views of the chelicera; centre top, tritosternum; centre bottom, ventral view of the hypostome; right top, ventral habitus view; right bottom, two ventral views of the chelicera. After Oudemans' plate no. 372.

Plate XXII

Garmania domestica (Oudms., 1929), male. Left top, dorsal habitus view; left bottom, dorsal view of the chelicera and two enlarged views of the anterior part of the hypostome; centre top, peritremal plate; centre, tritosternum; right top, ventral habitus view; right bottom, ventral view of the hypostome and chelicera. After Oudemans' plate no. 375.

Plate XXIII

Garmania (Paragarmania) mali (Oudms., 1929), female. Left top, dorsal habitus view; left bottom, lateral and dorsal views of the chelicera; centre top, ventral view of the hypostome showing the rima; centre bottom, tritosternum, right top, ventral habitus view; right bottom, ventral view of the pedipalp and chelicera. After Oudemans' plate no. 384.

Plate XXIV

Garmania novae-guineae (Oudms., 1905), female. Left top, two outlines of the epistome; left centre, dorsal habitus view and an enlarged view of one of the posterior setae; left bottom, lateral view of the chelicera; centre top, terminal portions of tarsi I

and IV; right top, ventral view of the hypostome and tritosternum; right centre, ventral view of the idiosoma and enlarged ventral view of the pedipalp; right bottom, lateral view of the chelicera. After Oudemans' plate no. 386. See Nova Guinea 5 (1), pl. I (recte II) figs. 1-11.

Plate XXV

Garmania pomorum (Oudms., 1929), female. Left top, dorsal shield; left bottom, tarsus IV, an outline of the epistome, and a dorsal and ventral view of the chelicera; right top, ventral view of the hypostome; right bottom, ventral view of the idiosoma. After Oudemans' plate no. 388.

Plate XXVI

Blattisocius tineivorus (Oudms., 1929). Right top, three views of the female chelicera; right centre, three outlines of the epistome; right bottom, ventral view of the female idiosoma; left top, lateroventral view of the male hypostome, and ventral and lateral views of the male chelicera; left bottom, dorsal view of the female dorsum; centre bottom, peritremal plate. After Oudemans' plate no. 406.

Plate XXVII

Blattisocius tineivorus (Oudms., 1929), male. Left top, dorsal habitus view; left bottom, dorsal view of the epistome and chelicerae; centre, forked seta from pedipalpal tarsus and peritremal plate; right top, ventral habitus view; right bottom, ventral view of the hypostome. After Oudemans' plate no. 407.

Plate XXVIII

Kampimodromus elongatus (Oudms., 1930), female. Left top, dorsal habitus view; left bottom, dorsal view of chelicera; right top, ventral view of the idiosoma and of the chelicera; right bottom, ventral view of the hypostome; centre bottom, the tritosternum. After Oudemans' plate no. 376.

Plate XXIX

Kampimodromus heveae (Oudms., 1930), female. Left top, lateral view of ambulacrum III; left centre, dorsal habitus view; left bottom, dorsal view of left chelicera, and ventral view of ambulacrum I; right top, armature of femur and genu palpi; right centre, ventral habitus view; right bottom, ventral view of ambulacrum II-IV, and ventral view of right chelicera; centre top, hypostome; centre bottom, tritosternum. After Oudemans' plate no. 381.

Plate XXX

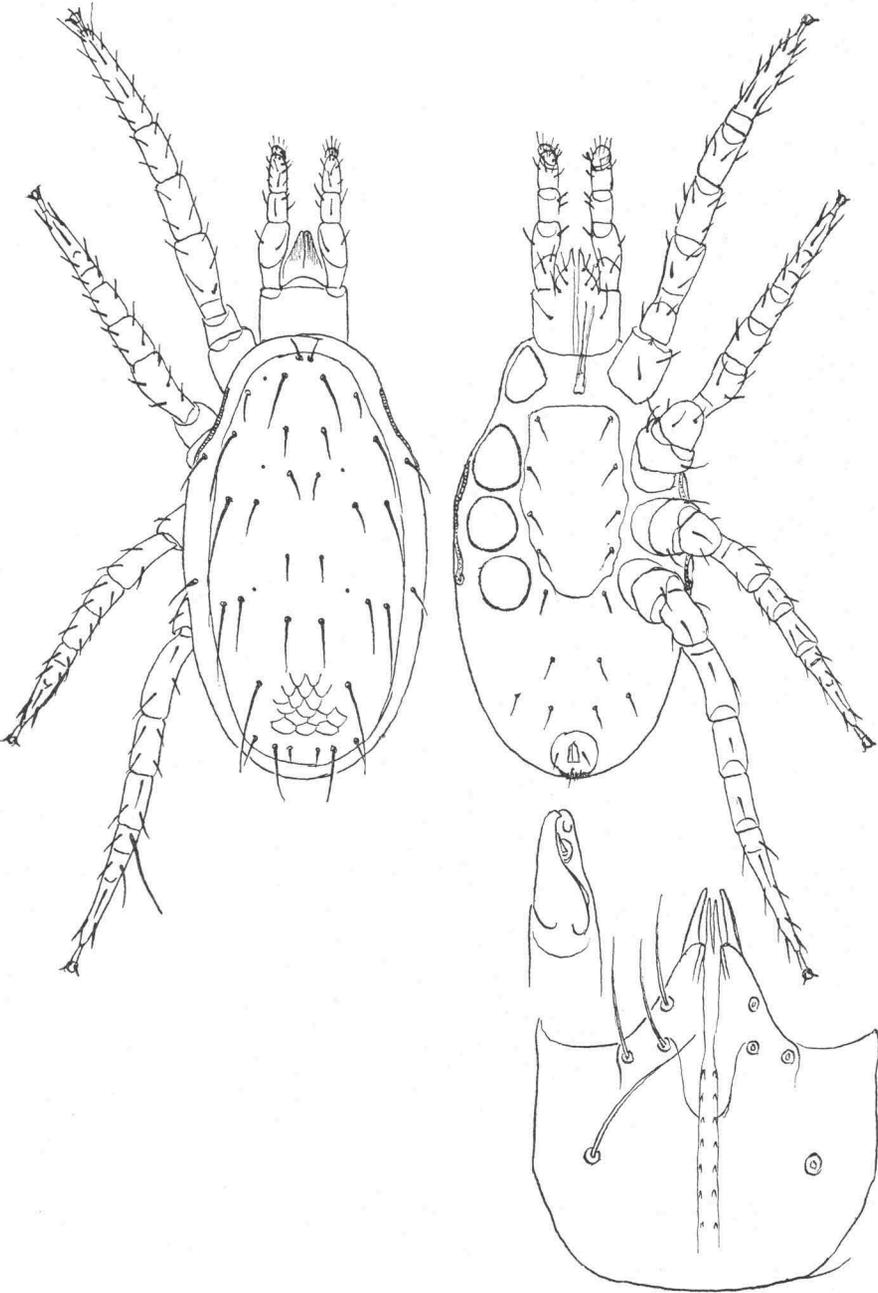
Kampimodromus hevearum (Oudms., 1930), male. Left top, vertex; left centre, dorsal habitus view; left bottom, longest hair of the posterior border, and dorsal view of right chelicera; right top, ventral view of right chelicera; right centre, ventral habitus view, and tritosternum; right bottom, hypostome, and ventral view of left chelicera; centre top, dorsal view of left tarsus I. After Oudemans' plate no. 382.

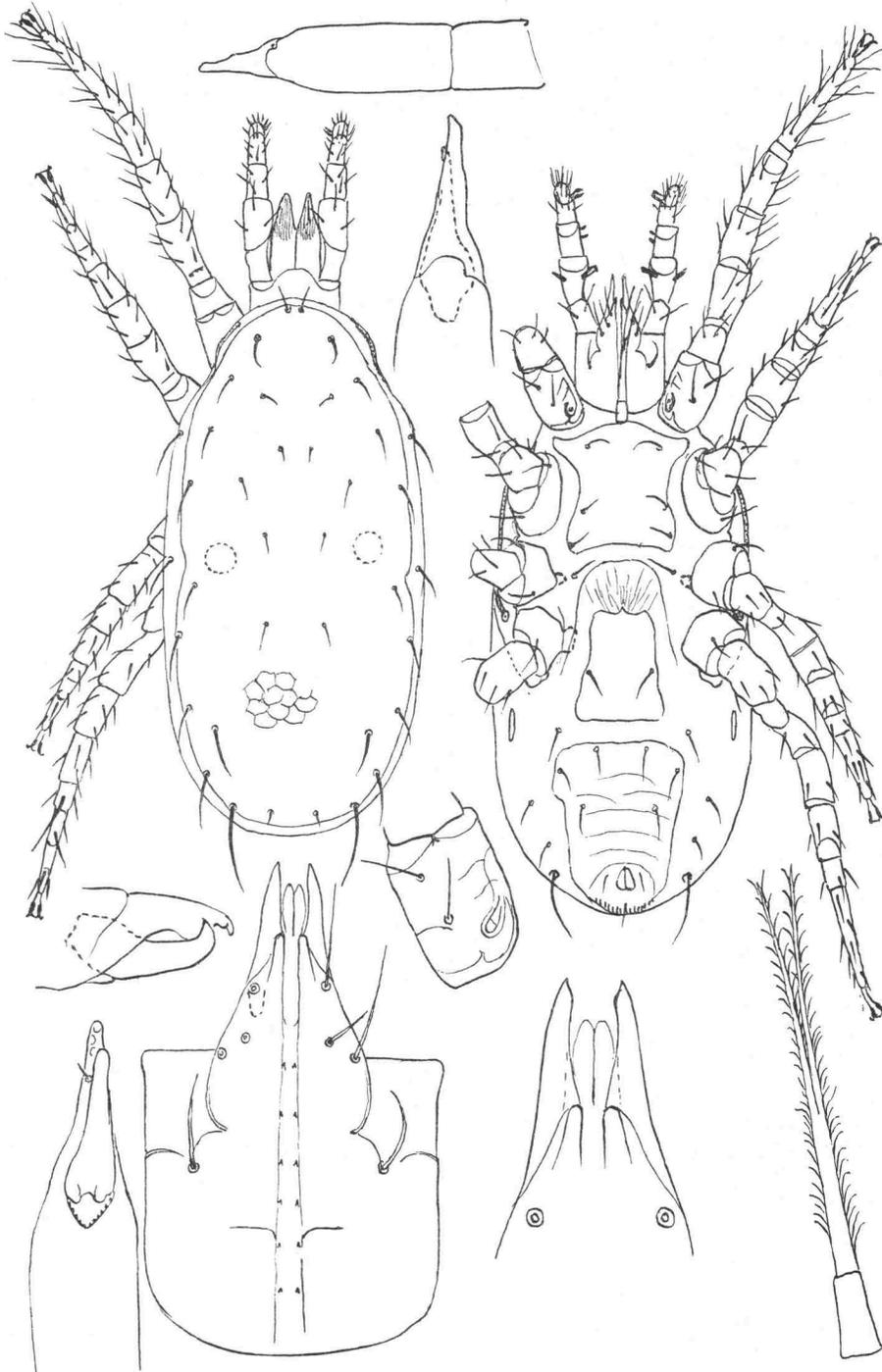
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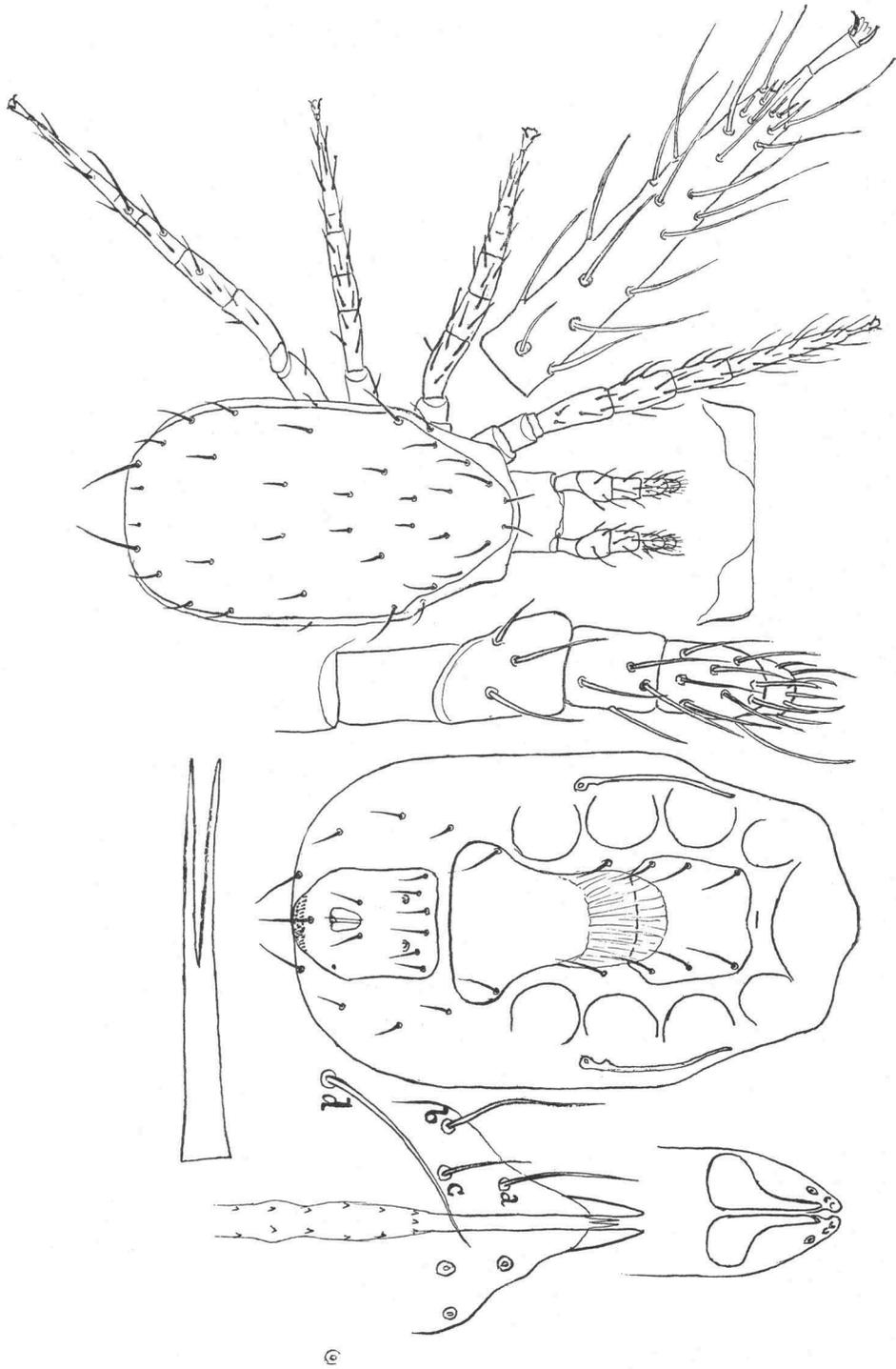
Phytoseius spoofti (Oudms., 1915), female. Left top, setae D₁ and L₄; left centre, dorsal view of the chelicerae and dorsal habitus view; left bottom, L₅; centre top, tritosternum; centre bottom, ventral view of hypostome; right top, lateral view of chelicera; right centre, ventral habitus view; right bottom, enlarged view of external malae. After Oudemans' plate no. 397.

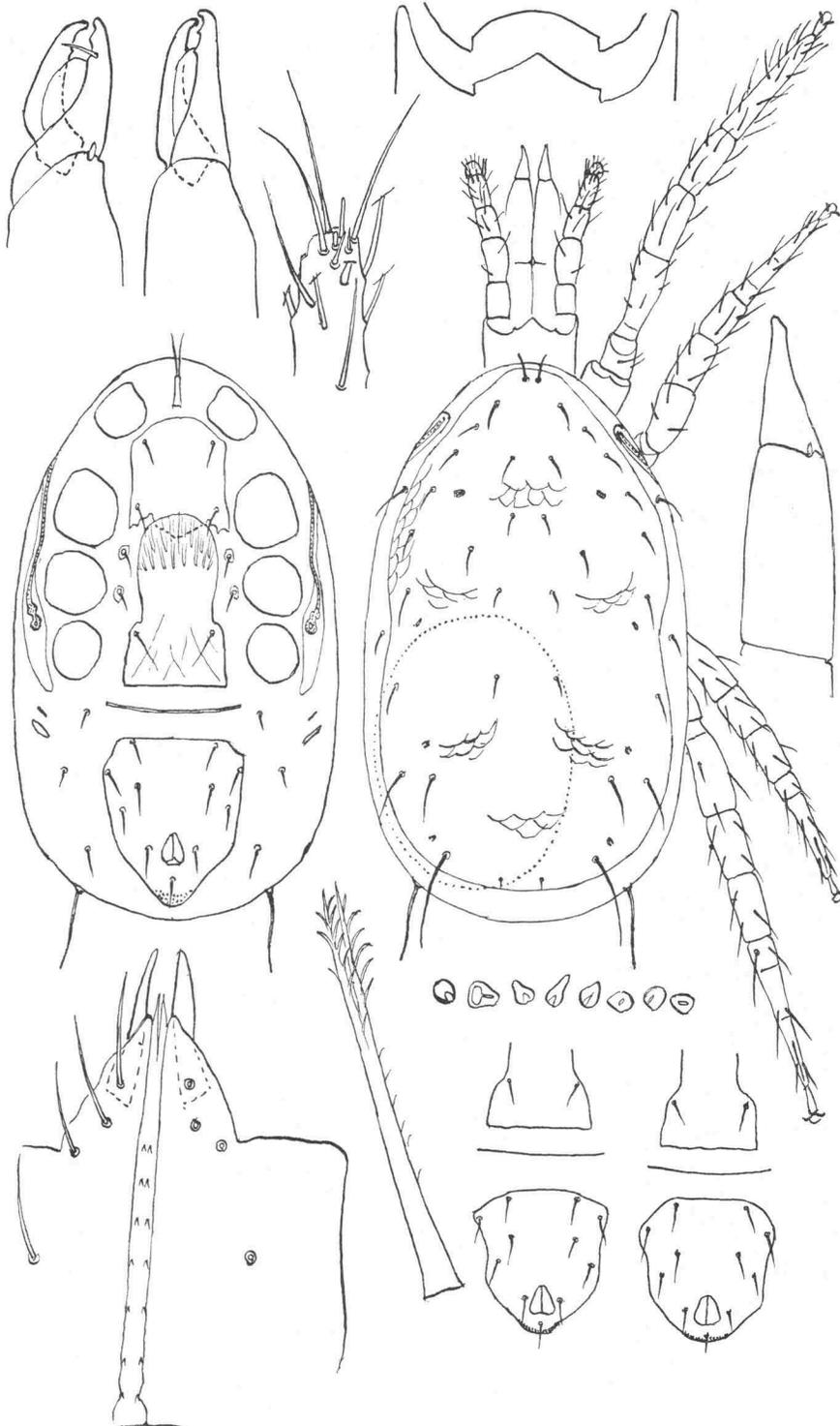
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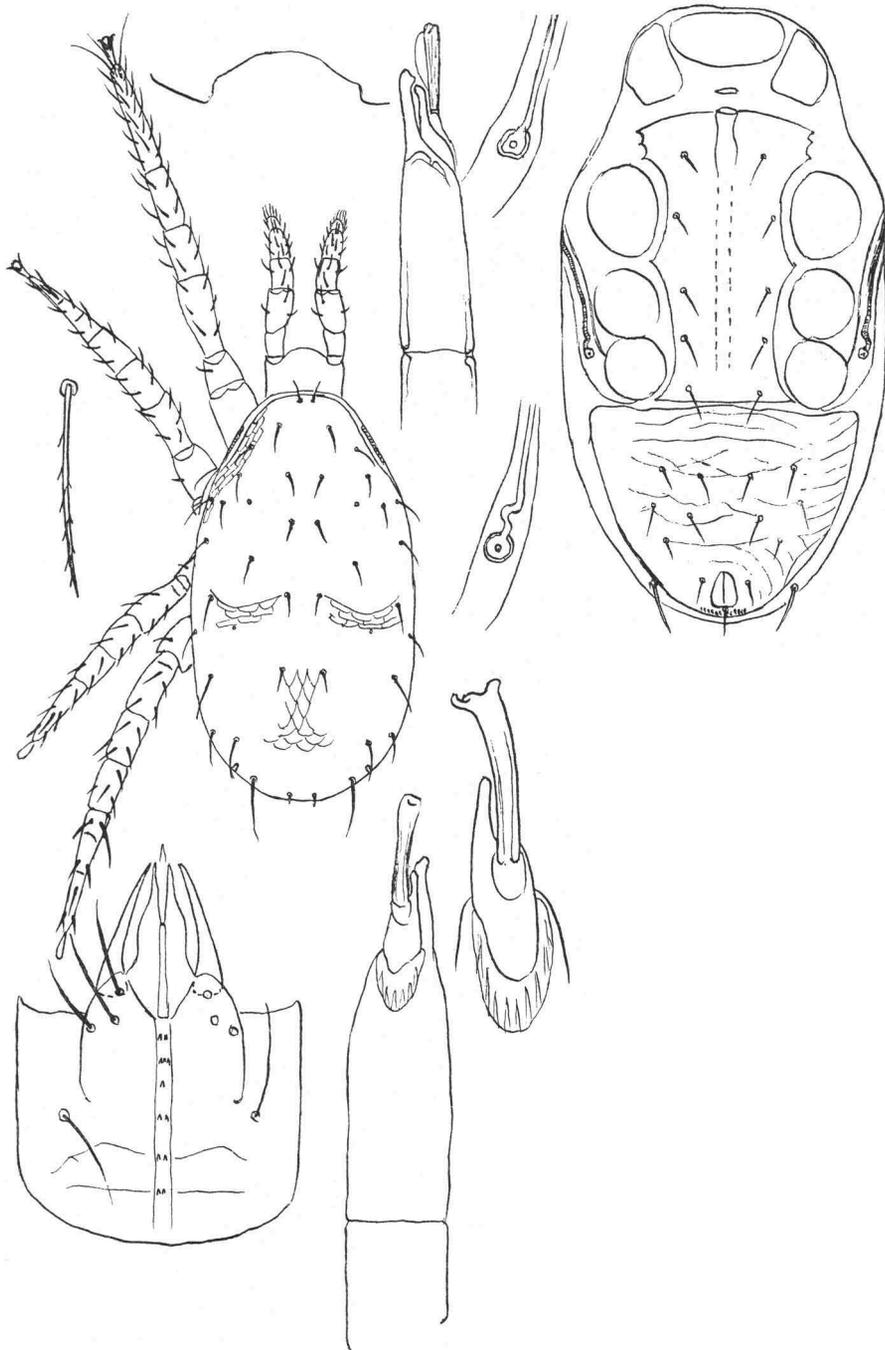
Phytoseius spoofi (Oudemans, 1915), male. Left top, seta D₁, seta from tibia IV and dorsal habitus view; left bottom, seta L₆, and two views (different magnification) of the two chelicerae; centre top, ventral view of chelicera, shewing di. fi., digitus fixus, di. mo., digitus mobilis, and a, apophysis; centre, enlarged views of external malae; right top, ventral habitus view; right bottom, ventral view of hypostome and view of tri-tosternum. After Oudemans' plate no. 399.

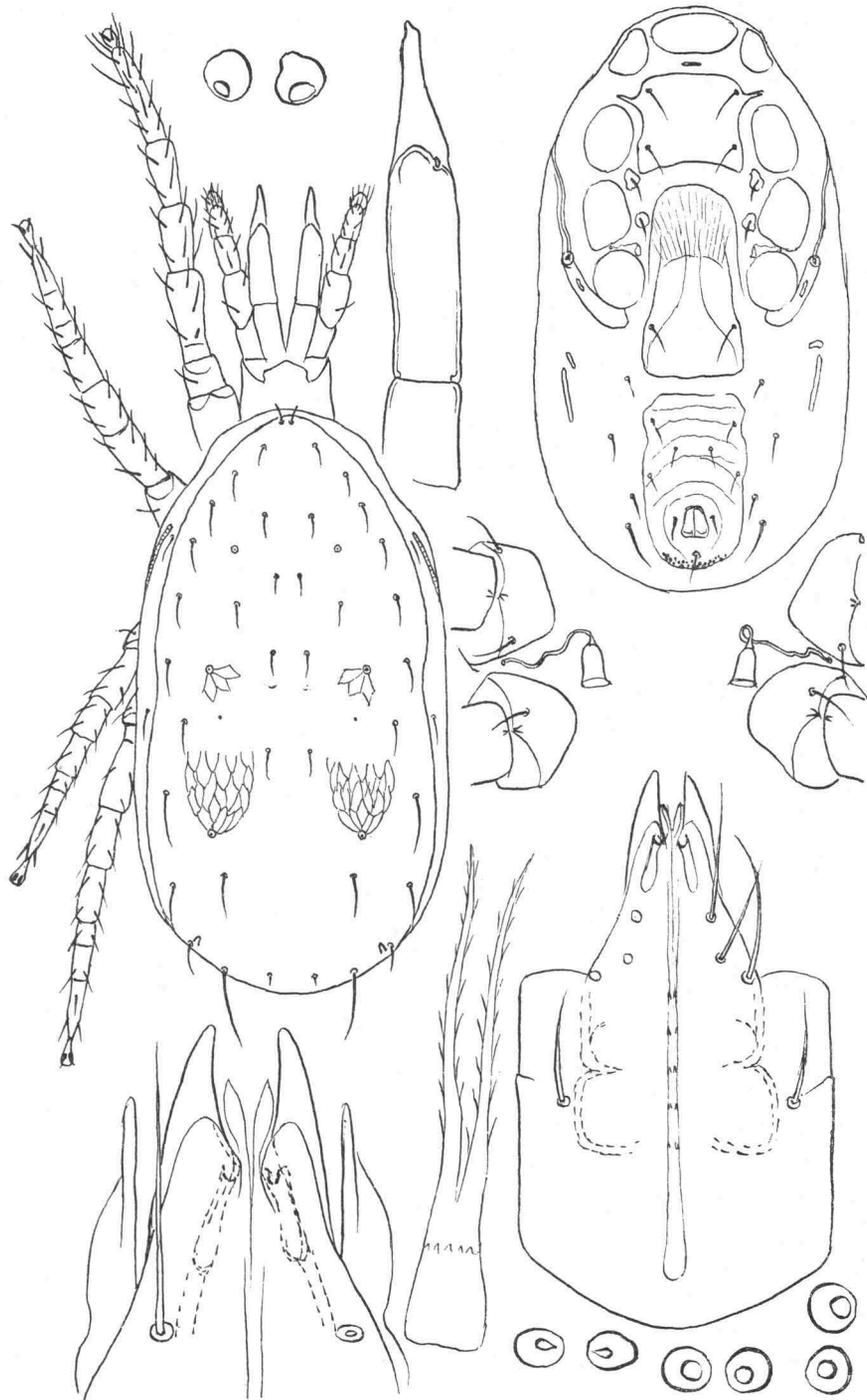


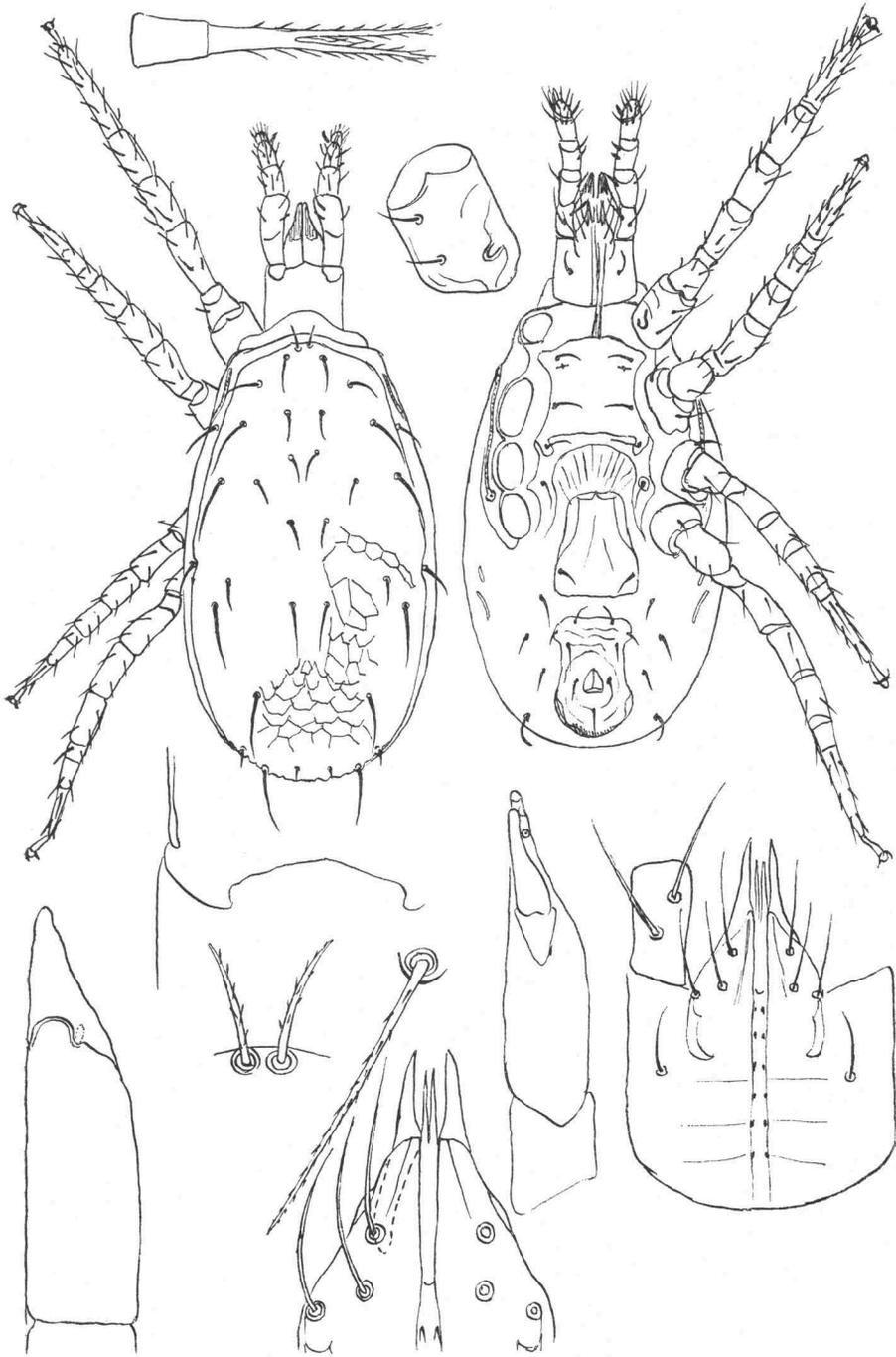


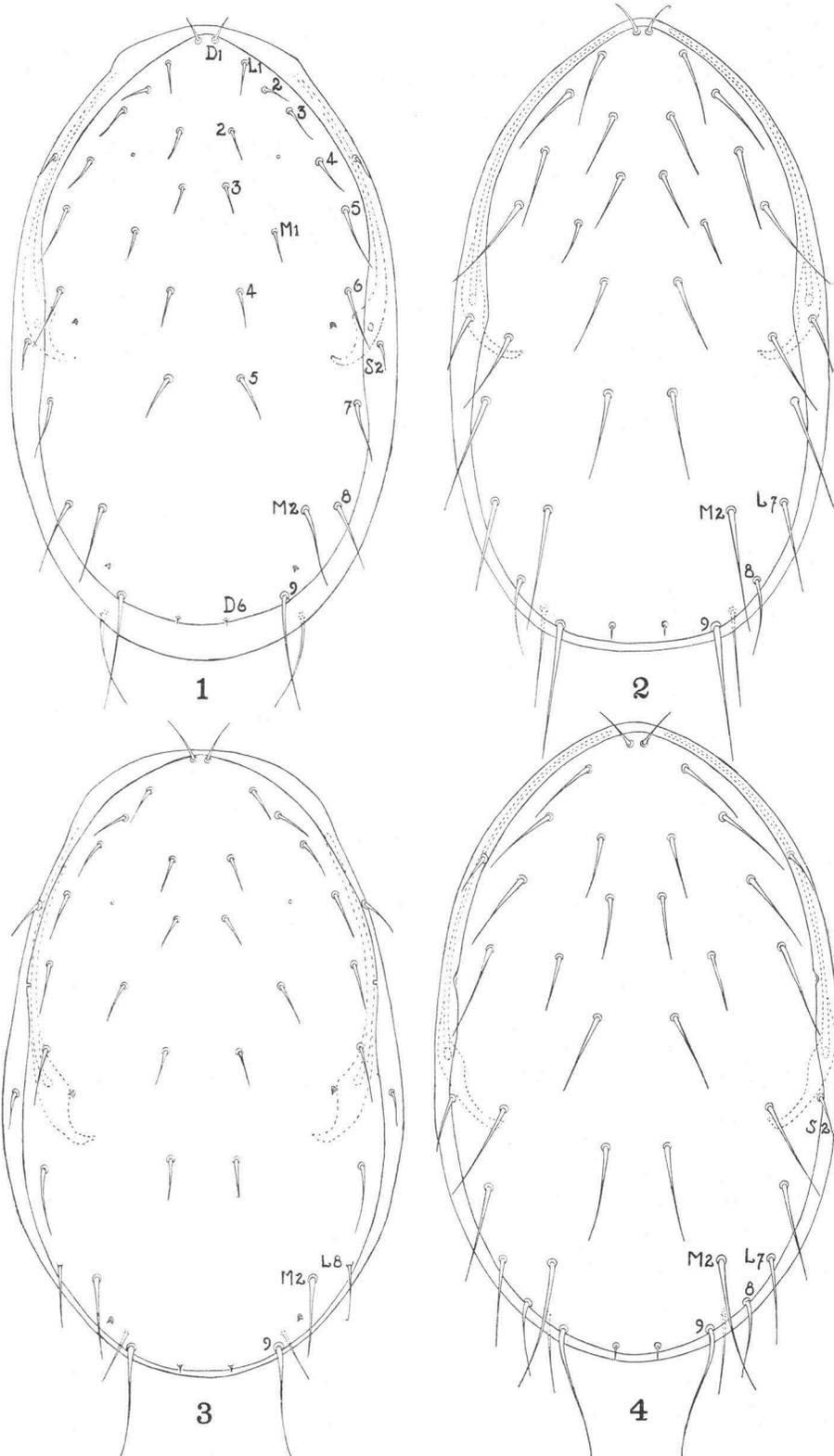


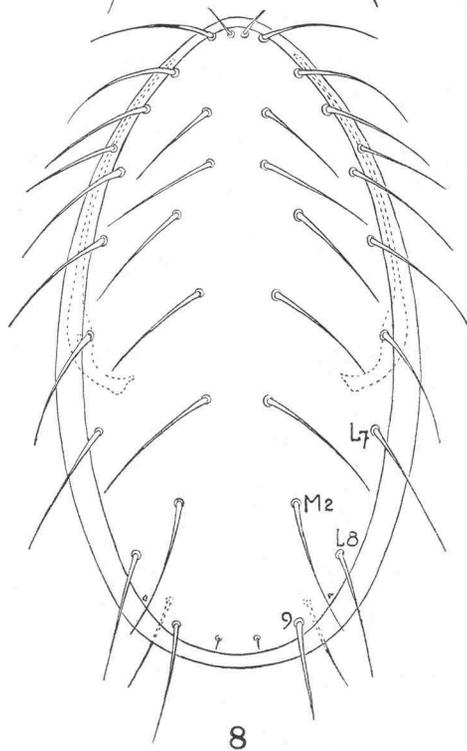
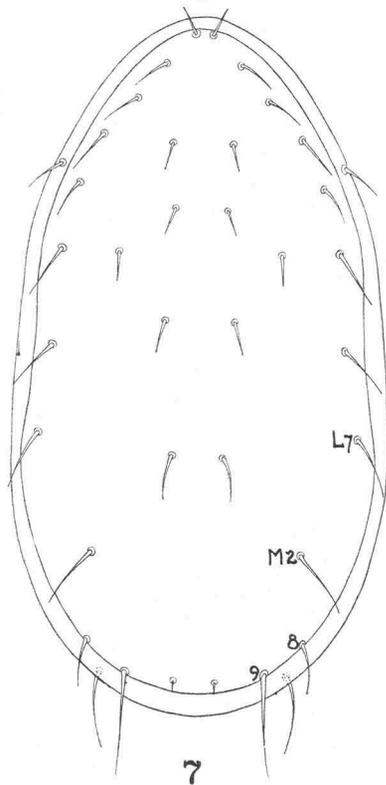
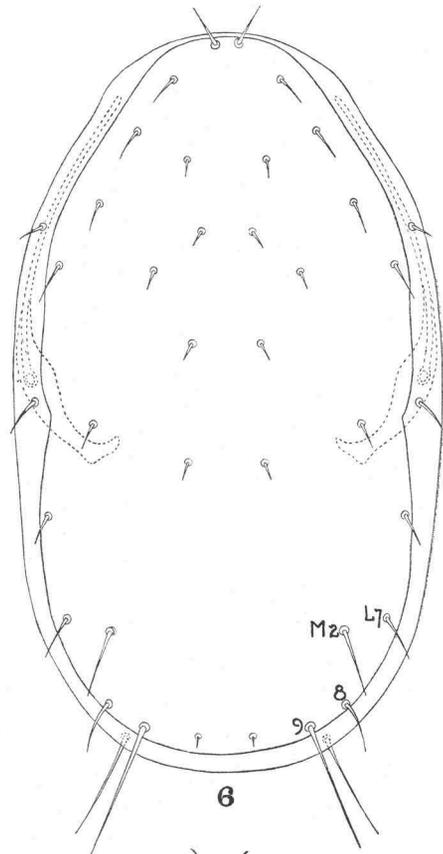
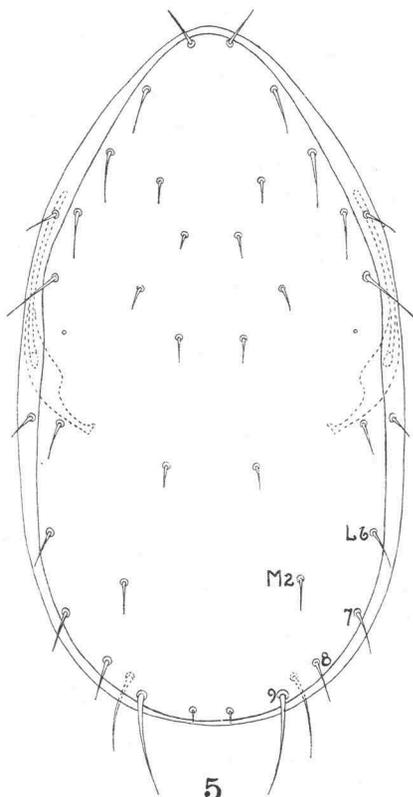


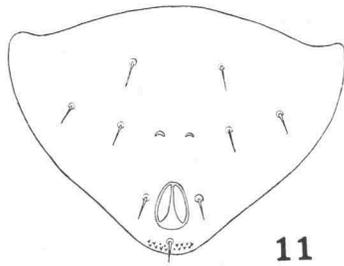




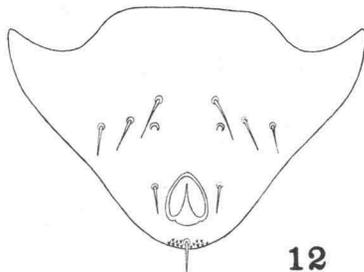




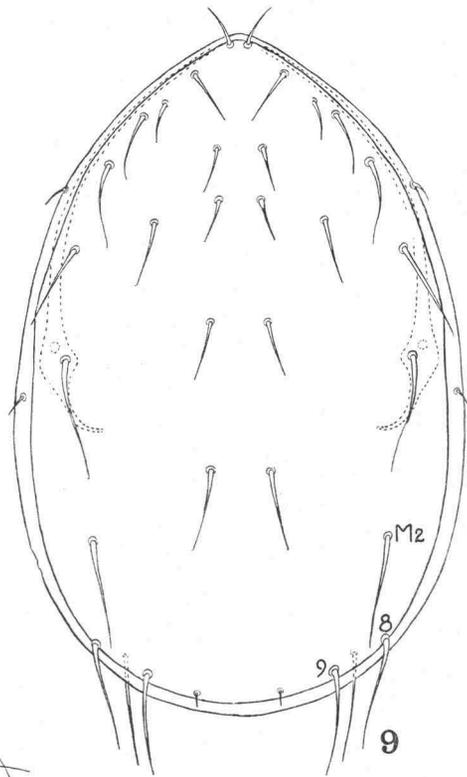




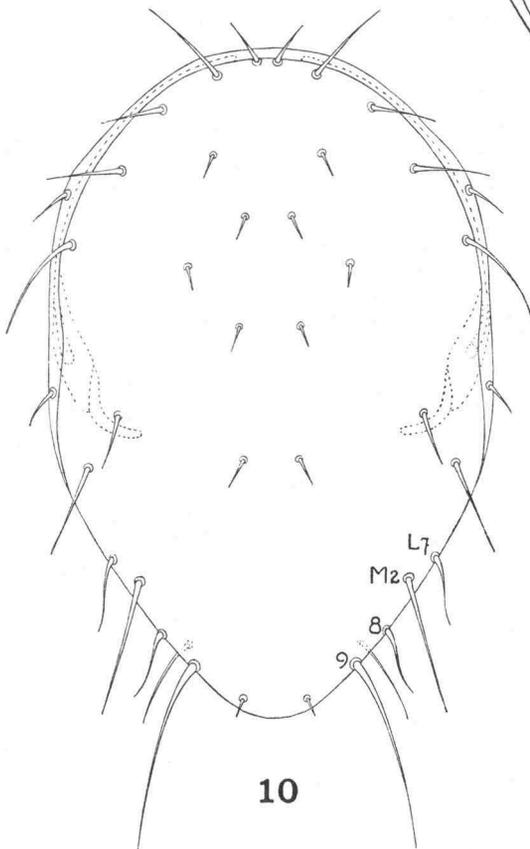
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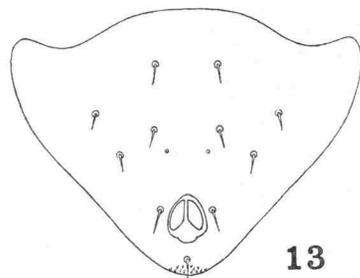
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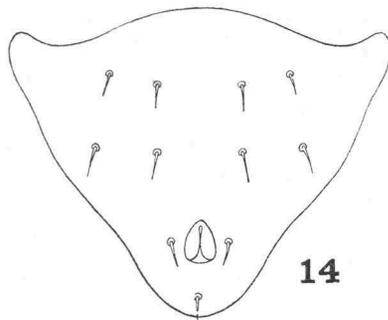
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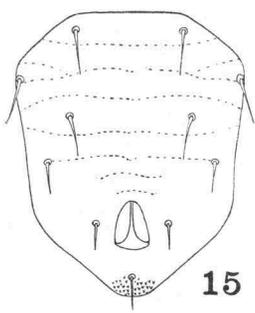
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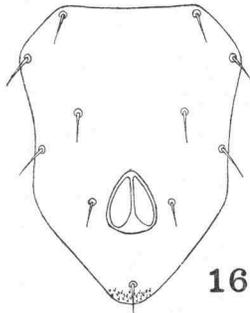
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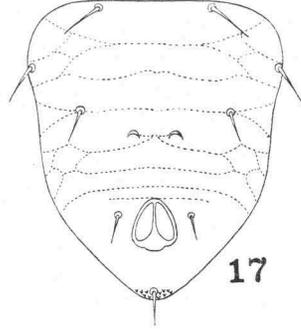
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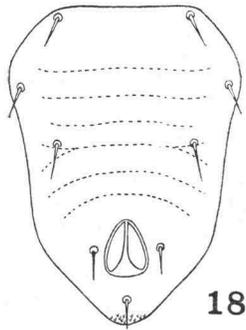
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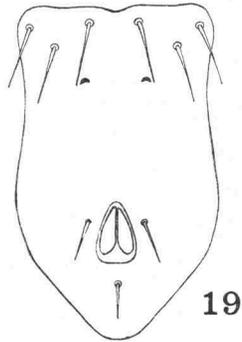
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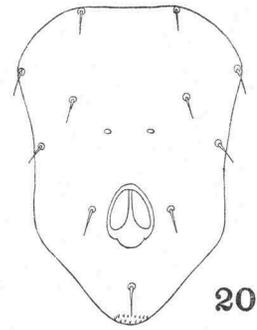
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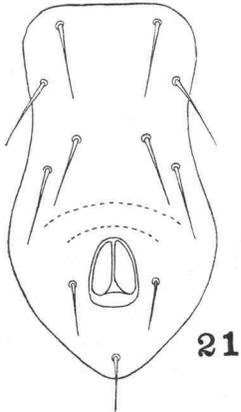
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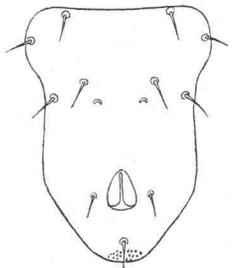
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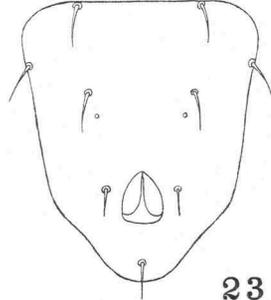
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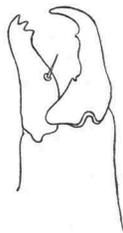
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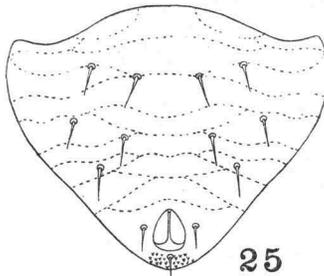
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