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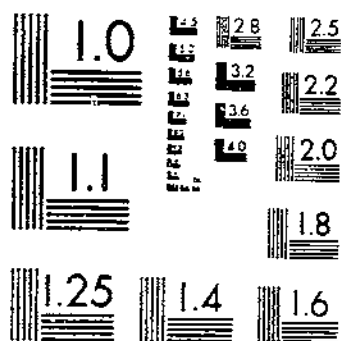
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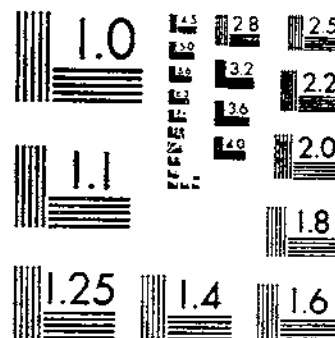
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A REVISION OF THE MITES OF THE SUBFAMILY TARSONEMINAE OF NORTH AMERICA  
BY WING, H. E. 1-40 P. 1955

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UNITED STATES DEPARTMENT OF AGRICULTURE  
WASHINGTON, D. C.

# A REVISION OF THE MITES OF THE SUBFAMILY TARSONEMINAE OF NORTH AMERICA, THE WEST INDIES, AND THE HAWAIIAN ISLANDS

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Quarantine

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## INTRODUCTION

The tarsonemid mites of the subfamily Tarsoneminae have long been recognized as of much economic importance because of the injury many of them cause to cultivated plants. The group is widely distributed, being found throughout the warmer parts of the world. All groups of plants are probably affected to some extent by the attacks of these mites, but they are most injurious to succulent herbaceous species.

<sup>1</sup> Submitted for publication March 29, 1938.

A need for a revision of the whole group has long been obvious, but such a task has been made all but impossible because of the wide distribution of the types and other material. After many years of patient endeavor, however, the collections of the Bureau of Entomology and Plant Quarantine of the United States Department of Agriculture and those of the United States National Museum have been increased to such an extent as to make a revision of the North American species possible.<sup>2</sup>

This revision includes, not only species of Tarsoneminae known to be established in the territory under consideration, but also species that have been intercepted by Federal plant quarantine inspectors. In the case of one species, *Tarsonemus bancrofti* Michael, two infestations in the United States were brought to light. In both instances prompt measures were taken for their eradication.

#### METHODS OF COLLECTING AND MOUNTING TARSONEMID MITES

Tarsonemid mites may be collected individually on the point of a camel's-hair brush and transferred to vials of alcohol (70 to 95 percent). A brush used for this purpose should be pruned down to two hairs at the tip. When it is desired to mount the specimens directly in a combination clearing-mounting medium, such as Berlese's mixture or some modification of this mixture, the mite may be placed on the microscope slide, the mixture added, and the coverslip put in place. Floyd F. Smith uses, instead of a camel's-hair brush, a pin mounted on a brush handle and having its point bent at a right angle. The bent end of this pin is moistened with some of the mounting medium and then applied to the tarsonemid mite to be collected. The mite adheres to the pin point and can easily be transferred to a microscope slide and mounted directly in the mounting medium. W. W. Baker soaks dormant plant buds in a hot solution of potassium hydroxide and thus kills the mites infesting them. The mites settle to the bottom of the caustic solution, where they are obtained and washed in water before being mounted in a clearing-mounting medium.

Small mites frequently can be mounted directly in a combination clearing-mounting medium, thus eliminating the usual process of running them through a separate clearing solution. In selecting such a medium for tarsonemid mites it should be kept in mind that they are very minute acarids, somewhat flattened, and possessing a tough integument, which, however, is poorly sclerotized and poorly pigmented. The important taxonomic characters to be studied are found largely on the hind legs of the male and the front legs of the female. For these reasons a combination clearing-mounting medium should be selected that will give a favorable refractive index, while it may have but little clearing, or soft-tissue-destroying, power.

Berlese's mixture, while well adapted for the mounting of many mites, has a larger chloral hydrate content than is desirable for tarsonemid mites. This content is so high that mounts are liable soon to show crystallization and be seriously injured or ruined. If a small

<sup>2</sup> A very large percentage of the specimens studied in connection with this revision were collected by the writer's coworker, Floyd F. Smith, although many lots were contributed by William W. Baker, likewise of this Bureau. The drawings were prepared by Mary F. Benson.

quantity of water is substituted for part of the chloral hydrate in Berlese's formula, not only are the mounts more durable but the medium has a better refractive index, permitting most of the taxonomic characters of the tarsonemid mites to be studied to better advantage. Furthermore, the refractive index is improved by the reduction of the amount of glycerin, and the physical properties are improved by the addition of glucose sirup. The formula given here has been used in the writer's work on tarsonemid mites, and may be employed to good advantage for feather mites (Analgesidae) and gall mites (Eriophyidae), but it is not so well suited for the mounting of itch mites, cheese mites, or chiggers.

*Formula for a combination clearing-mounting medium*

|                 |       |    |
|-----------------|-------|----|
| Water           | cc    | 35 |
| Chloral hydrate | grams | 30 |
| Gum arabic      | do    | 20 |
| Glycerin        | cc    | 12 |
| Glucose sirup   | do    | 3  |

Microscope-slide mounts made with this mixture should not be given oven treatment at temperatures above 33° C. if they are to be permanent.

### THE FAMILY TARSONEMIDAE

The family Tarsonemidae is one of the three families that compose the superfamily Tarsonemoidea. This superfamily is recognized as the suborder Heterostigmata by some authorities. It includes many small mites of diverse food habits; yet the group undoubtedly is a natural one. The members have a segmented body; tracheae are usually present in the females, and also, usually, a pair of clavate sense organs between the bases of the first and second legs. Largely because of the presence of these sensory organs, some authors hold that the group is most nearly related to the beetle mites, or Cryptostigmata.

The family Tarsonemidae is divided into three subfamilies, the Tarsopolipinae, the Podapolipinae, and the Tarsoneminae. Members of the Tarsopolipinae are well known as parasites of insects. One species, *Acarapis woodi* (Rennie), the tracheal mite of the honeybee, causes a very serious disease of adult honeybees known as Isle of Wight disease. Another, *Locustacarus trachealis* Ewing, the tracheal mite of grasshoppers, has been reported as causing injury to these Orthoptera in Kansas.

The members of the subfamily Podapolipinae are parasitic exclusively on insects, and it is in this subfamily that the limit of degeneration for any acarid is reached. The female of one species, *Podapolipus reconditus* Rovelli and Grassi, which occurs under the elytra of certain Old World beetles, is legless, while the mouth parts are reduced to a pair of minute, hooklike appendages.

In the subfamily Tarsoneminae some species are parasitic on insects, others are necrophagous, and several attack living plants. Attention is particularly directed in this bulletin to those species in the last category.

## TAXONOMY OF THE SUBFAMILY TARSONEMINAE

The subfamily Tarsoneminae should be restricted to include only those species that would go into the genus *Tarsonemus* as originally defined.

The writer (13, p. 34),<sup>3</sup> in his key to the genera of the Tarsonemidae published in 1929, included but two genera in the subfamily Tarsoneminae, *Tarsonemus* Canestrini and Fanzago and *Acarophenax* Newstead and Duvall. The genus *Acarophenax*, however, should be transferred to the subfamily Tarsopolipinae, and the genus *Pseudotarsonemoides* Vitzthum should be included in the Tarsoneminae. To the two described genera here included in the subfamily there is added in this bulletin a new genus, making three in all for the group.

## A GENERALIZED LEG OF A TARSONEMID MITE

The leg of a tarsonemid mite, as found in those genera least affected by degeneration, is five-segmented (exclusive of the tarsal claw) and of a primitive type that is found in several acarine families, particularly in the related mites of the suborder Cryptostigmata (beetle mites). In such a leg the bend occurs between the second and third and between the third and fourth segments. The first leg segment, the coxa, is short, broad, and may be somewhat flattened. The second, or femur, is the largest of all and is directed upward and away from the body. The patella, or knee segment, is third. The fourth segment, the tibia, is subcylindrical, usually longer than the third, and extends downward. The fifth and last segment, or tarsus, tapers to its apex, where it bears the tarsal claw or claws. The latter, of course, really represent a segment and might be termed the "pretarsus." In taxonomic work, however, the terms "tarsal claw" and "claws" are used.

In the subfamily Tarsoneminae some of the legs may be reduced to four, or even three, segments. In such cases it is important to know how this reduction has taken place. Unfortunately, the process has not been studied sufficiently to permit identification of the segments in legs of a reduced number. However, in the last pair of legs of the male (the most important ones taxonomically) the segments can be identified.

## SEGMENTATION AND CHAETOTAXY OF THE FOURTH PAIR OF LEGS IN THE TARSONEMINAE

The fourth pair of legs in the Tarsoneminae (figs. 1 and 2) are so important in the taxonomy of the group that they are here considered in some detail. Leg IV in both sexes is typically four-segmented. In the males of certain species it is three-segmented, the method of reduction being clearly indicated, not only by intermediate types, but particularly by the presence of certain setae easily identified in leg IV of any male.

In those males that have leg IV four-segmented (fig. 1) the segments are identified as coxa, femur, tibia, and tarsus. The tibia in such a leg bears an enormous tactile seta on its ventral side and a short clavate seta (the only one on the whole leg) on its dorsal

<sup>3</sup> Italic numbers in parentheses refer to literature cited, p. 62.

side; the tarsus bears two small simple setae on or near its inner margin. Thus there are four setae on the tibia and tarsus together, and two of these are of unusual shape or size.

In legs having but a single segment beyond the femur, there are always found on that segment a large, ventral tactile seta, a small, dorsal clavate seta, and usually two small, simple setae near the

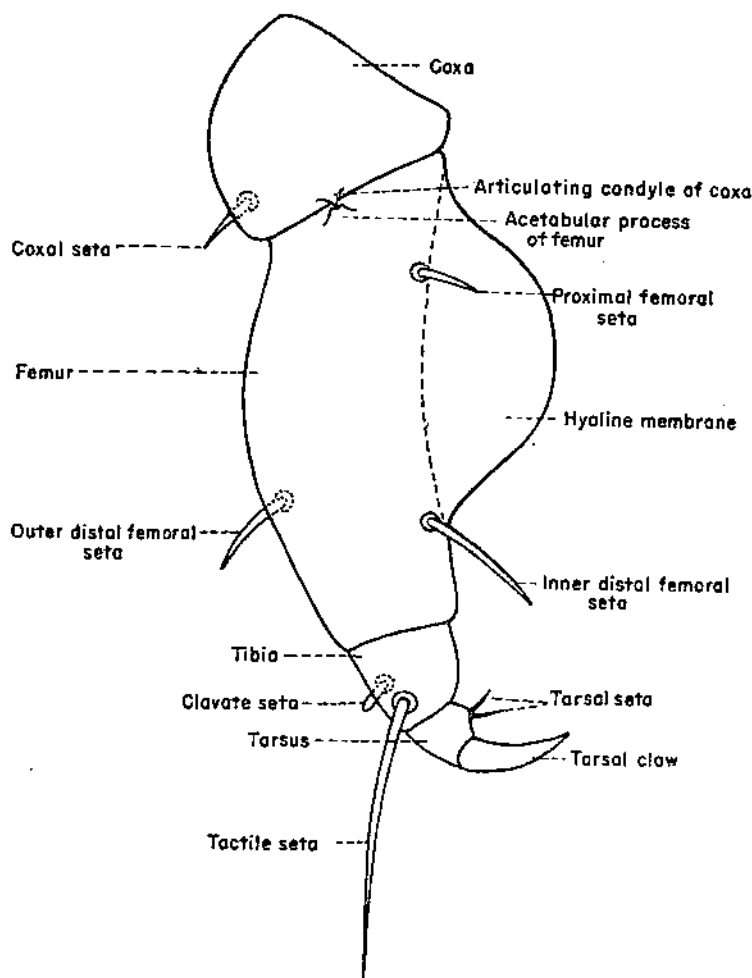


FIGURE 1.—Ventral side of leg IV of a male tarsonemid mite, with parts labeled.

inner margin. The segment has, in other words, the setae of the tibia plus those of the tarsus. The only conclusion to be drawn from this is that the tibia and tarsus have united. Thus the chaetotaxy of the segments indicates clearly what has happened when leg IV of the male becomes three-segmented. That the tibia and tarsus have fused is further indicated by the presence of an incomplete suture between them in certain species. Because of the minute size of the tarsonemid mites and the methods used in mounting them, very

little has been learned of their leg muscles, and these cannot at present be used to advantage in homologizing the leg segments.

The hind legs of the male are used as claspers, much of the motion between the segments taking place between the coxa and the femur. These two segments are articulated both dorsally and ventrally, the latter articulation being the more conspicuous. This ventral hinge (fig. 1) is composed of a backwardly directed articulating condyle on the posterior margin of the coxa, which sets into a socket of the submarginal acetabular process of the femur. In some species in which this ventral coxofemoral hinge is small, the acetabular process

suggests a seta pit, while the articulating condyle, which rests in the acetabulum, appears like a short, curved, spinelike seta. Hence the entire hinge may easily be mistaken for a short, submarginal femoral seta.

The chaetotaxy of leg IV of the male is as follows (fig. 1): The coxa bears a single seta, which is relatively small, simple, and curved. It may be situated dorsally or ventrally, or on the lateral margin of the segment. The femur bears three simple setae. One of these is situated on the basal half of the segment, usually on or near the inner margin, and is known as the proximal femoral seta. Two setae are usually situated on the distal half of the femur, one on or near the inner margin and the other on or near the outer margin. The inner one may be greatly enlarged in certain species. It is known as the inner distal femoral seta. The outer one, or outer

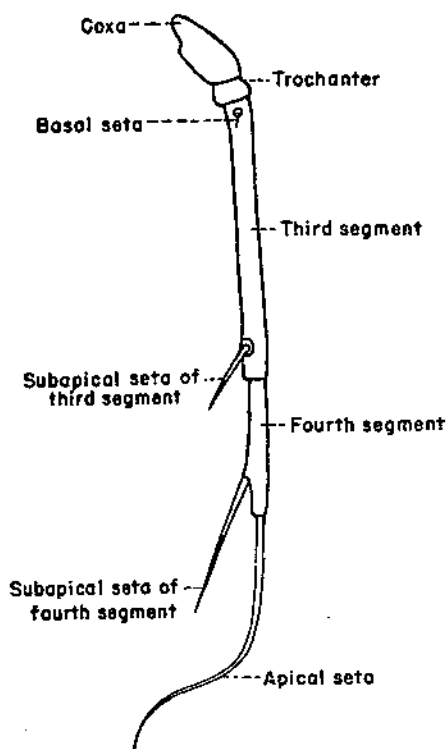


FIGURE 2.—Ventral side of leg IV of a female tarsonemid mite, with parts labeled.

distal femoral seta, is variable in both size and position. The tibia bears only two setae, a very long, ventral tactile seta and a short, clavate dorsal seta. The tarsus typically has two small, simple, divergent setae situated on or near its inner margin.

Thus the total number of setae on leg IV in the male is eight, and in nearly every species of the subfamily Tarsoneminae these eight setae can be detected. In some species, however, the coxal seta appears to be absent. The same appears to be true of one or the other of the two tarsal setae.

Leg IV of the female (fig. 2) is much less important in the taxonomy of the Tarsoneminae than the same leg of the opposite sex.

The four segments are always present, the two basal ones varying but little, whereas the third and fourth vary chiefly in length. Segments I and II are without setae; segment III may bear near its base a minute seta, and nearly always bears a much longer seta which is dorsal and subapical; segment IV bears a very long apical seta and a somewhat shorter subapical one.

The segments in leg IV of the female have not been homologized. Doubtless the basal segment represents the coxa, and apparently the second segment represents the trochanter. Thus far there is no convincing evidence of the identity of segment III or segment IV.

### DESCRIPTION OF THE SUBFAMILY TARSONEMINAE

With the characters of the family Tarsonemidae and in addition: Female with a clavate pseudostigmatic organ on each side of the cephalothorax between legs I and II; posterior legs very slender, four-segmented, and ending in two long, simple setae, one apical and one subapical; first segment of leg IV flattened, platelike, immovable; second segment ringlike, broader than long; third segment filiform, very long and slender, the longest segment; fourth segment filiform, slender, but shorter than the third and bearing the apical and subapical setae. Male with last pair of legs thickened, clasperlike, three- or four-segmented, and usually ending in a single claw; coxa of leg IV flattened, usually subtriangular; femur the longest and stoutest segment, frequently bearing a cusplike process or a hyaline expansion; tibia sometimes ankylosed with tarsus; when distinct, short and bearing a clavate seta and a long tactile, setiform seta; tarsus, when distinct, usually broader than long and bearing one or two short, simple setae in addition to tarsal claw; tarsal claw clawlike, tuberclelike, or absent. Genital papilla cone-shaped, sometimes provided with genital flap; penis small and usually short, flanked on each side by a sclerotized process, the two together probably acting as a dilator during copulation.

*Type genus.*—*Tarsonemus* Canestrini and Fanzago.

The subfamily Tarsoneminae is most closely related to the subfamily Tarsopolipinae; in fact, the type species of two of the genera, *Acarapis* Hirst and *Tarsonemella* Hirst, of the last-named group were originally described as species of *Tarsonemus*. The genus *Tarsonemella* connects the two subfamilies. It is placed in the Tarsopolipinae because in it the females have no pseudostigmatic organs.

### KEY TO THE GENERA OF TARSONEMINAE

1. Palpi three-segmented, free, filiform; capitulum entirely concealed from above by a large, hoodlike projection from the cephalothorax; tarsus I much shortened and with a stout claw

*Pseudotarsonemoides* Vitzthum, 1921

(Type: *P. eccoptogasteris* Vitzthum, 1921)

Palpi one-segmented to three-segmented and sometimes partly ankylosed with capitulum, the latter never entirely concealed from above by a hoodlike projection

2

2. Tarsus I either two-clawed or one-clawed; tarsus III with claws unreduced in size; tibia and tarsus of leg IV of male frequently separated by a suture and their combined length never so much as two-thirds that of the femur

*Tarsonemus* Canestrini and Fanzago, 1876

(Type: *Chironemus minusculus* Canestrini and Fanzago, 1876)

Tarsus I always one-clawed; tarsus III with claws reduced, the pulvillus far surpassing them; tibia and tarsus of leg IV of male not separated by a suture but ankylosed, forming a slender, curved tibiotarsus which is more than two-thirds as long as the femur

*Hemitarsonemus*, new genus

(Type: *Tarsonemus lepidariorum* Warburton, 1904)

The Genus *PSEUDOTARSONEMOIDES* Vitzthum

*Pseudotarsonemoides* was established by Vitzthum (31, p. 72) as a monotypical genus in 1921. It was based entirely upon females, males being unknown. The genus is here redescribed:

Having the characters of the subfamily Tarsoneminae and in addition: Palpi free, filiform, distinctly three-segmented, and extending beyond the tips of chelicerae. Chelicerae rather stout, extending backward only a little posterior to bases of palpi. Capitulum oblong, concealed from above by large hoodlike plate of cephalothorax. Hood of cephalothorax about as broad as or broader than long and bearing two pairs of simple, long, dorsal setae. Leg I thickened; tarsus I as broad as or broader than long, with a single sense seta and a single, stout claw, the pulvillus being absent.

*Type species.*—*Pseudotarsonemoides eccoptogasteris* Vitzthum.

The genus *Pseudotarsonemoides* differs from *Tarsonemus* rather sharply in the nature of the palpi and tarsus I. The former are distinctly three-segmented, while in *Tarsonemus* they are not distinctly segmented. The cephalothoracic hood, so conspicuous in *Pseudotarsonemoides*, is present in some of the species of *Tarsonemus*, but is never so large and bears but a single pair of dorsal setae.

*PSEUDOTARSONEMOIDES INNUMERABILIS* Vitzthum

Described by Vitzthum (32, p. 176) in 1923. Hirst (19, p. 997) described, as new, *P. spiritarsus*, which is here regarded as a synonym of *innumerabilis*.

MALE (Unknown)

## FEMALE

*General appearance.*—Capitulum and all of first pair of legs except tips of tarsi covered by cephalothoracic shield, which is almost as broad as long, broadly rounded in front, and bears an anterior pair of long, straight setae, situated almost on the front margin and a posterior pair of similar, but slightly longer, discal setae. Abdomen showing four segments dorsally, the posterior segment being small and largely concealed by the third.

*Capitulum.*—Very long, being about three times as long as broad, and decidedly constricted at the base. Palpi free, three-segmented, convergent; distal segment small, cone-shaped. Chelicerae with stout bases and short needlike tips.

*Tarsus I.*—Stout, well sclerotized, about one and one-half times as long as wide, and over twice as long as tibia. Distal sense hair slightly clavate, situated dorsally about one and one-half times its length from distal end of segment. Proximal sense seta about the same size as distal sense seta, situated dorsolaterally about its length from base of segment. Tarsus ending in a stout, strongly deflexed claw and a strongly sclerotized bilobed tubercle.

*Leg IV.*—Short, extending slightly beyond margin of body. Coxa subquadrate, slightly longer than broad. Trochanter broader than long. Third segment about as long as other segments taken together; basal seta absent; subapical seta slender, extending to tip of fourth segment. Fourth segment short, scarcely one-half as long as third; subapical seta long, somewhat flagelliform, equal to leg itself in length; apical seta much stouter than subapical and twice as long.

Total length, 0.195 mm; total width, 0.092 mm.

## FEMALE LARVA

(Fig. 3)

Not seen by the writer. As described and figured by Vitzthum it is longer in proportion to its width than the adult female, has the front tarsi two-clawed, no pseudostigmatic organs, and four dorsal shields. The cephalothoracic shield

bears three pairs of setae instead of two, as in the adult female, and the first and second abdominal tergites are separated from each other by an area of striated cuticle.

MALE LARVA AND EGG (UNKNOWN)

*Type host.*—(*Eccoptogaster*) *Scolytus laevis* (Chapuis).

*Type locality.*—Austria.

*Type.*—In collection of Graf Hermann Vitzthum.

Description of the female is based on a single specimen taken at New York City on an elm log from France, August 16, 1933, Shamin and Dodd collectors (N. Y. No. 21227). Hirst (19, p. 997) described in December 1923 his *Pseudotarsonemoides spinitarsus*, which was taken from the elm bark beetle, *Scolytus scolytus* F. (= *destructor* Oliv.) at Kew, England. Of this species Hirst states: "This species seems to differ from Vitzthum's *P. eccoptogasteris* in having a stout spinule on the dorsal surface of the second tarsus." Since this statement applies equally well to Vitzthum's *innumabilis*, which was taken from a very closely related bark beetle, one is led to suspect Hirst's species of being a synonym of *innumabilis*. A comparison of the two species further indicates their synonymy.

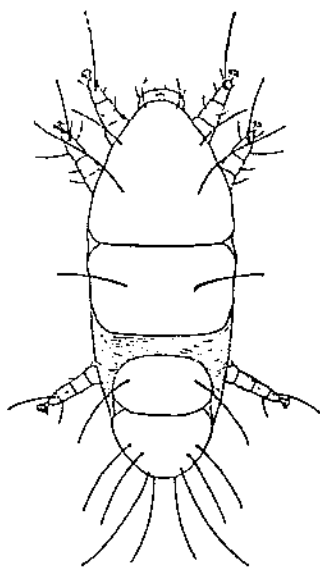


FIGURE 3.—Dorsal view of female larva of *Pseudotarsonemoides innumabilis* Vitzthum; greatly enlarged. (Vitzthum.)

PSEUDOTARSONEMOIDES CRYPTOCEPHALUS, new species

(Fig. 4)

MALE

*General appearance.*—Cephalothoracic shield covering about two-thirds of capitulum. Legs of moderate length; last pair equal in length to third pair. Color of freshly mounted specimens a light yellowish brown.

*Capitulum.*—Slightly longer than broad, pointed in front and strongly constricted at base. Chelicerae with stout bases. Palpi free, very short, as broad at tips as at bases, indistinctly segmented.

*Genital papilla.*—Much longer than broad, cone-shaped, dorsal in position. Genital flap absent. Penis rodlike, in repose extending to tip of papilla. Accessory sclerites long, slender, reaching to apex of papilla.

*Leg IV.*—Only slightly stouter than other legs. Coxa triangular, as broad as long; coxal seta apparently absent. Femur about two and one-half times as long as broad, outer margin outcurved, inner margin about straight; no hyaline expansion present; proximal femoral seta minute, marginal, situated midway between base of femur and inner distal femoral seta; inner distal femoral seta large, straight, submarginal, extending to tip of tibia; outer distal femoral seta dorsal, submarginal, curved, situated at about one-half the distance from base to apex of femur. Tibia



FIGURE 4.—Ventral view of right posterior leg of male of *Pseudotarsonemoides cryptocephalus*, new species. X 800.

long, about twice as long as broad, outer margin almost straight, inner margin inwardly rounded; tactile seta flagelliform, equal to leg itself in length and situated in posterolateral angle of tibia; the so-called clavate seta only slightly clavate, dorsal, situated slightly anterior to tactile seta. Tarsus very short, twice as broad as long; tarsal setae very slender, divergent; tarsal claw long, curved, acuminate at apex, in length almost equal to tibia.

Total length, 0.135 mm; total width, 0.07 mm.

#### FEMALE

*General appearance.*—Body short. Capitulum concealed from above by the large cephalothoracic shield. Pseudostigmatic organs with short pedicels and subspherical heads.

*Tarsus I.*—About one and one-half times as long as the rather long tibia. Distal sense seta large, fusiform, situated dorsally about its length from apex of tarsus. Proximal sense seta less than one-half as long as distal, situated dorsolaterally about its length from base of tarsus and at about the same distance from that point as the nearest simple seta. Tarsus ending in a small pulvillus and a single strongly curved claw.

*Leg IV.*—Extending slightly beyond margin of body. Coxa subtriangular, as broad as long. Trochanter about twice as broad as long. Third segment considerably longer than the other segments taken together; basal seta apparently absent; subapical seta conspicuous, lateral, almost straight, and situated about as far from tip of segment as length of fourth segment. Fourth segment short, being about one-third as long as segment III; subapical seta rigid, slightly curved, twice as long as segment that bears it; apical seta flagelliform, as long as leg itself.

Total length, 0.12 mm; total width, 0.07 mm.

#### LARVA AND EGG (UNKNOWN)

*Type host.*—*Persea americana*.

*Type locality.*—Chile (?).

*Type slide.*—United States National Museum No. 1117.

This species represents a connecting link between *Pseudotarsonemoides* and *Tarsonemus*. The front tarsi are those of *Tarsonemus*; the cephalothoracic shield is like that of *Pseudotarsonemoides* but is smaller than in described species of this genus.

Material at hand as follows: Males and females taken from type host, the avocado, at New York City, on a shipment from Chile, July 3, 1934, by Inman and Whitlock, of the Division of Foreign Plant Quarantines, Bureau of Entomology and Plant Quarantine (N. Y. No. 23998). It is not known whether this species feeds on the avocado. It may be parasitic on some insect.

#### The Genus TARSONEMUS Canestrini and Fanzago<sup>4</sup>

The genus *Tarsonemus* was first described under the name *Chironemus* by Canestrini and Fanzago (9) in 1876. This name, however, was found to be preoccupied by *Chironemus* Cuvier (1829), a genus of fishes; so the name *Tarsonemus* was substituted by the same authors (10) later in the same year. Canestrini and Fanzago established *Chironemus* as a monotypical genus based on a new species, *C. minusculus*. To them the male was unknown, and their generic characters apply only to females. In this original description the authors state that the legs of the first three pairs are terminated by two claws. In those species studied by the present writer it is ob-

<sup>4</sup> Since this manuscript was written, one species, *Tarsonemus oryzae* Canestrini, not described in this paper, has been reported from Santo Domingo, where it is said to have caused the withering of rice plants.

served that the legs of the first pair have nearly always a single claw, while those of the second and third pairs have two claws.

When Canestrini and Fanzago proposed the name *Tarsonemus* to take the place of the preoccupied *Chironemus*, and added to this genus a new species, *floricolus*, they stated that the diagnostic generic character relating to the two clubs of the cephalothorax would not hold. Apparently they did not see these structures in *T. floricolus*, or possibly they observed their absence in immature forms and were led to make such a statement. It is interesting to note that Canestrini (8, v. 3, p. 313) later (1888) omitted all reference to the pseudostigmatic organs in his diagnosis of the genus *Tarsonemus*, while showing them in his figure of the female of *T. floricolus*, the only species to be illustrated.

In the same year (1876) that Canestrini and Fanzago proposed the name *Tarsonemus*, Kramer established his *Dendroptus*. The next year he (20, p. 219) acknowledged his genus to be only a synonym of *Tarsonemus*. In 1884 Trouessart (29) established the genus *Cheylurus* for a new species, *C. socialis*, said to live in large numbers on the skins of birds. Although he placed this in the family Cheyletidae, Canestrini (8, v. 3, p. 311) (1888) and Berlese (6, no. 1) (1894) both regarded it as a synonym of *Tarsonemus*. Notwithstanding the unusual habits of Trouessart's species, his generic description certainly fits *Tarsonemus*.

Hirst (19, p. 995) in 1923 described *Tarsonemella* as a subgenus of *Tarsonemus*, basing it on a new species, *T. africanus*, from Koforidua, Gold Coast. This subgenus is quite different from *Tarsonemus*, and not only should be recognized as a distinct genus but should go in the subfamily Tarsopolipinae. It differs from *Tarsonemus* in that the females possess greatly enlarged front legs which lack the pulvillus and have the single claw greatly thickened. In addition, the females are without pseudostigmatic organs. The two species of *Tarsonemella* are parasitic on African hymenopterous insects.

*Tarsonemella* is also closely related to *Acarapis*, the species of which parasitize Old World honeybees. It should be regarded as a connecting link between *Tarsonemus* and *Acarapis*, and also between the Tarsopolipinae and the Tarsoneminae.

Oudemans (26) in 1928 established the genus *Avrosia* based on *Acarus translucens* Nietner (1861), although the only description of this species given by Nietner was the bare statement that it was a very small, translucent, whitish mite. Oudemans considered Nietner's species to be the same as Green's *A. translucens*. Green himself, however, did not regard his *translucens* as the same as the *translucens* of Nietner. In this opinion Green must have been correct, since the habits of *A. translucens* Nietner as related by Nietner himself are such as to convince one that it is a species different from Green's *A. translucens*. Nietner (24) states that his species was associated with scale insects, occurring particularly among the eggs of *Lecanium coffeae* (= *Saissetia hemisphaerica* Targ.). He believed it attacked the eggs, with the result that the injury caused the accumulation of a whitish flocculent substance. These habits fit very well those of *Hemisarcoptes malus* Shimer, a species with which the writer is very familiar, and it is his opinion that *A. translucens* Nietner probably is no other than this species of Shimer, which is not a tarsonemid mite

but a mite of the family Canestrinidae. If *A. translucens* Nietner is not Shiner's species, it probably is a member of the family Canestrinidae, but it may be an insectivorous tarsonemid. However, all such known species are very different from *A. translucens* Green, which is a tarsonemid and, as shown above, is a synonym of *Hemitarsonemus latus* (Banks).

A new description of the genus *Tarsonemus* Canestrini and Fanzago is given here:

With the characters of the subfamily Tarsoneminae and in addition: Capitulum subspherical, oblong, or cone-shaped, not produced into a beak; chelicerae swollen at the base and each ending in a needlelike tip; palpi much reduced, distinctly or indistinctly segmented. Hood of cephalothorax small or absent. Tarsus I much longer than tibia I, bearing two sense setae and ending in one or two claws and a pulvillus. Leg IV of male three- or four-segmented; femur enlarged, frequently with a hyaline expansion; tibia short, sometimes ankylosed with tarsus; tarsus, when distinct, broader than long and usually bearing a claw.

*Type species.*—*Chironemus minusculus* Canestrini and Fanzago.

It is unfortunate that the genus *Tarsonemus* is established upon a rare species that has never been adequately described. In it the front tarsi are said to be two-clawed. Such a condition is very unusual in the genus, and it would appear logical to restrict *Tarsonemus* to those species in which the front tarsi are two-clawed and to make a new genus for those species that have the front tarsi single-clawed. If this were done, it would change the generic name of every economic species of the genus. This would be most unfortunate. Furthermore, it should be noted that there is confusion in regard to the number of claws on tarsus I in some of the species. This probably is due to the fact that some of the curved setae near the tip of the tarsus have been mistaken for claws; also, in some species in which the pulvillus of tarsus I is well developed, the lateral margins are thickened and look like claws unless seen to good advantage. For the present it appears best to define the genus *Tarsonemus* in such a way as to leave in it most of the known species.

#### KEY TO THE KNOWN MALES OF NORTH AMERICAN SPECIES OF TARSONEMUS

- |                                                                                                                                                                                                                          |    |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----|
| 1. Femur IV without a hyaline expansion or cusplike process on inner side..                                                                                                                                              | 2  |
| Femur IV with either a hyaline expansion or a cusplike process on inner side.....                                                                                                                                        | 3  |
| 2. Tibia IV usually distinct from tarsus, and the two segments taken together much longer than the tibia is broad.....                                                                                                   | 4  |
| Tibia IV ankylosed with, or indistinctly separated from, tarsus IV, thus forming a tibiotarsus, which is but slightly, if any, longer than broad; inner margin of femur IV frequently angulate near base of segment..... | 11 |
| 3. Femur IV with a cusplike process on inner side.....                                                                                                                                                                   | 17 |
| Femur IV with a large, hyaline expansion on inner side.....                                                                                                                                                              | 18 |
| 4. Tactile seta of leg IV very short, not extending beyond tip of tarsal claw; genital papilla as broad as long.....                                                                                                     |    |
| Tactile seta of leg IV long, extending beyond tip of tarsal claw for at least one-third its length.....                                                                                                                  | 5  |
| 5. Femur IV swollen on the inside between the proximal femoral seta and the inner distal femoral seta; tactile seta rather short, extending beyond tip of tarsal claw for less than half its length.....                 |    |
| .....                                                                                                                                                                                                                    | 6  |
| Femur IV not swollen on inner side.....                                                                                                                                                                                  | 7  |
| 6. Leg IV very long, tibia IV being about twice as long as wide.....                                                                                                                                                     |    |
| Leg IV not longer than usual, tibia IV but slightly longer than broad..                                                                                                                                                  | 9  |

7. Coxa IV without a ventral seta; inner distal femoral seta extending to tip of tibia; outer distal femoral seta situated at about middle of segment----- *setifer*, new species
- Coxa IV with a conspicuous ventral seta; inner distal femoral seta usually not reaching middle of tibia; outer distal femoral seta situated beyond middle of segment----- 8
8. Inner margin of femur usually not angulate near base of segment; inner distal femoral seta marginal and situated far from apex of segment----- *pseudosetifer*, new species
- Inner margin of femur produced into an angle near base of segment; inner distal femoral seta submarginal and subapical----- *bakeri*, new species
9. Femur IV angulate on inner side near base; claw of tarsus IV shorter than tibia IV----- *occidentalis*, new species
- Femur IV not angulate on inner side near base; claw of tarsus IV longer than tibia IV----- 10
10. Femur IV not wider at base than coxa IV; inner distal femoral seta extending but slightly beyond tip of femur----- *waiteri* Banks
- Femur IV wider at base than coxa IV; inner distal femoral seta extending much beyond tip of tibia----- *chionaspicorus* Ewing
11. Femur IV produced into an angle on inner side near base----- 12
- Femur IV not produced into an angle on inner side near base----- 15
12. Femur IV swollen laterally; tibiotarsus not over two-thirds as long as wide----- *simplex*, new species
- Femur IV not swollen laterally; tibiotarsus as long as or longer than broad----- 13
13. Femur very long, about three times as long as broad at base; claw of tarsus IV as long as tibiotarsus----- *randsi*, new species
- Femur only about twice as long as broad at base; claw of tarsus IV much shorter than tibiotarsus----- 14
14. Axis of femur IV curved, outer margin of same segment outwardly curved; tibiotarsus truncate distally; claw of tarsus IV usually about two-thirds as broad at base as it is long----- *confusus*, new species
- Axis of femur IV almost straight, outer margin of same segment almost straight; tibiotarsus rounded distally; claw of tarsus IV not over one-half as broad at base as it is long----- *scuturus*, new species
15. Femur IV swollen on inside between base and proximal femoral seta----- *unguis*, new species
- Femur IV not swollen on inside between base and proximal femoral seta----- 16
16. Femur IV not swollen on inside at level of proximal femoral seta; tibia IV separated from tarsus by an indistinct suture, the two segments together being considerably longer than broad----- *floriculus* Canestrini and Fanzago
- Femur IV swollen on inside at level of proximal femoral seta; tibia IV ankylosed with tarsus, forming tibiotarsus, which is about as long as broad. (On leaves of date palm.)----- *texanus*, new species
17. Tibiotarsus of leg IV less than half as long as femur, of the usual shape and bearing at its tip a well-developed tarsal claw. (On pineapple plants.)----- *ananas* Tryon
- Tibiotarsus of leg IV about two-thirds as long as femur, clavate, bearing a long, curved external process but with no claw at its tip----- *viridis*, new species
18. Hyaline expansion of femur IV a narrow lamella; claw of tarsus IV slender, acuminate at apex----- 19
- Hyaline expansion of femur IV a broad lobe with rounded margin; claw of tarsus IV stout, usually with a rounded apex----- 20
19. Hyaline expansion of femur IV extending to apex of segment but not to base; coxa IV triangular----- *laminifer*, new species
- Hyaline expansion of femur IV not reaching apex of segment but extending to base; coxa IV quadrangular----- *femoratis*, new species
20. Axis of femur IV approximately straight; claw of tarsus IV claw-like----- 21
- Axis of femur IV bent near its middle so as to form almost a right angle; claw of tarsus IV knoblike----- *phyllophorus* Ewing

21. Coxa IV subquadrangular, distinctly longer than broad; tibia IV and tarsus IV either distinctly or indistinctly separated from each other..... 22  
     Coxa IV triangular, about as broad as, or broader than, long; tibia IV and tarsus IV anchylosed..... 23
22. Hyaline expansion of femur IV arising from inner margin of segment, not from a tubercle; claw of tarsus IV rounded at apex.....  
     ..... *bancrofti* Michael
23. Femur IV about twice as long as broad at base; tibiotarsus of leg IV without a hyaline expansion; tactile seta of leg IV as long as the leg itself.....  
     ..... *spirifer* Marchal
- Femur IV about as long as broad at base; tibiotarsus of leg IV with a small lateral hyaline expansion; tactile seta of leg IV at one-half as long as the leg itself.....  
     ..... *pallidus* Banks
- Femur IV about as long as broad at base; tibiotarsus of leg IV with a small lateral hyaline expansion; tactile seta of leg IV at one-half as long as the leg itself.....  
     ..... *latipes*, new species

## KEY TO SOME OF THE FEMALES OF NORTH AMERICAN SPECIES OF TARSONEMUS

1. Tarsus I with two claws..... 2  
     Tarsus I with only one claw..... 3
2. Body over three times as long as wide; capitulum broader than long and broadly rounded in front.....  
     ..... *phyllophorus* Ewing
- Body about twice as long as wide; capitulum longer than broad and pointed in front.....  
     ..... *biungulatus*, new species
3. Most of capitulum visible from above, there being no large cephalothoracic hood present..... 4  
     Only tip of capitulum visible from above, the remainder being hidden by a cephalothoracic hood; last segment of leg IV less than one-half as long as next to last segment.....  
     ..... *truncatus*, new species
4. Tarsus I with distal sense seta clavate, usually shorter than width of tarsus; claw of tarsus I moderate to small and not bent downward at right angle near base..... 5  
     Tarsus I with distal sense seta spinelike, large, usually about as long as width of tarsus itself; proximal sense seta usually situated less than its length from base of segment; claw of tarsus I bent downward at right angle near base.....  
     ..... *viridis*, new species
5. Tarsus I about three times as long as broad; tibia I seldom so much as half as long as tarsus I..... 6  
     Tarsus I about twice as long as broad; tibia I over two-thirds as long as tarsus I.....  
     ..... *laticeps* Halbert
6. The two sense setae of tarsus I situated less than width of tarsus from each other and near middle of segment.....  
     ..... *setifer*, new species
- The two sense setae of tarsus I situated much more than width of tarsus from each other..... 7
7. Proximal sense seta of tarsus I situated not more than its length from base of segment and nearer base than any of simple setae..... 8  
     Proximal sense seta of tarsus I situated more than its length from base of segment and farther away from the same than one or more of simple setae..... 9
8. Tibia I distinctly broader than long; distal sense seta of tarsus I situated at about one-third the distance from base to apex of segment.....  
     ..... *ioensis*, new species
- Tibia I distinctly longer than broad; distal sense seta of tarsus I situated at about middle of segment.....  
     ..... *simplex*, new species
9. Third segment of leg IV over two and a half times as long as fourth segment.....  
     ..... *ananas* Tryon
- Third segment of leg IV less than twice as long as fourth segment.....  
     ..... *pallidus* Banks

The species of *Tarsonemus* may be identified by means of the characters of the fourth leg in the male where this sex is known, and the characters of the fourth leg in the female are of value in distinguishing certain species. The size, shape, and position of the setae on the fourth leg in both sexes are of great importance; yet

it should be remembered that there is considerable individual variation in their position and length. In some species certain of these setae are either absent or so small as to escape detection. This is particularly true of the coxal seta on the fourth leg in the male and the basal seta on the third segment of the fourth leg in the female.

The taxonomic characters of the larvae have not been worked out to the complete satisfaction of the writer. In all the North American species the front tarsi appear to be two-clawed and the pseudostigmatic organs absent. The general shape of the larvae varies much according to the species, but the setae have a similar position in most of them.

The chief characters for identifying the eggs are their size and the ratio of their length to their breadth.

**TARSONEMUS LATICEPS Halbert.**

(Fig. 5; fig. 22, A)

Described by Halbert (16, p. 381) in 1923, and again by the present writer (14) in 1929, as *Tarsonemus approximatus* Banks var. *narcissi*, and by Vitzthum (33) in 1929 as *Tarsonemus hydrocephalus*.

**MALE**

**General appearance.**—A species of unusual appearance owing to the large size of the capitulum and the parallel sides of the abdomen. It is also characterized by the shortness of all setae. In living specimens the body is of a light, transparent, brownish color, becoming darker with age; the mouth parts and legs are darker than the body.

**Capitulum.**—Inflated, broader than long. Chelicerae not typical of the genus, each with a broad expanded base occupying about one-half width of capitulum and ending in a fine needle at apex. Palpi reduced to short cones, each being about as broad as long and half as long as the chelicerae.

**Genital papilla.**—Broad, dome-shaped, as broad as long. Penis and accessory sclerites very stout.

**Leg IV.**—Rather short, stout, without hyaline expansions or cusplike processes. Coxa triangular, as broad as long; coxal seta dorsal, not extending beyond middle of segment. Femur with inner margin almost straight, outer margin strongly outcurved; proximal femoral seta minute, discal; inner distal femoral seta submarginal, situated slightly beyond middle of segment and extending to about middle of tibia; outer distal femoral seta situated almost opposite inner distal one, extending slightly beyond end of femur. Tibia slightly longer than broad, inner margin strongly incurved; tactile seta short, spinelike, not reaching tip of tarsal claw; clavate seta situated on outer margin approximate to tactile seta. Tarsus much broader than long, with a single seta and a long, stout, curved, and acutely pointed tarsal claw.

Total length, 0.172 mm; total width, 0.090 mm.

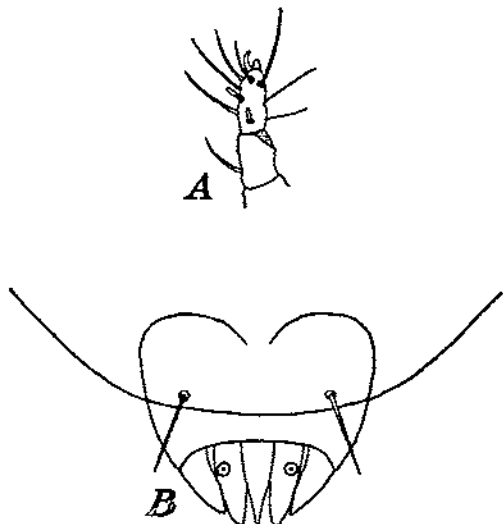


FIGURE 5.—*Tarsonemus laticeps* Halbert: A, Lateral view of tibia and tarsus of leg I of female; B, dorsal view of genital papilla of male.  $\times 800$ .

## FEMALE

*General appearance.*—Short-legged, with oblong body and large capitulum. Pseudostigmatic organs unusual in that each is acuminate apically, the broad head being drawn out at its tip into a setalike apex. Color the same as in the male.

*Tarsus I.*—Very short, with simple setae conspicuous. Distal sense seta medium, clavate, situated dorsally at middle of tarsus. Proximal sense seta smaller than distal, clavate, lateral, situated at about its length from base of tarsus and nearer to this base than any simple seta. Tarsal claw slender; pulvillus moderately developed.

*Leg IV.*—Not reaching margin of body in well-fed individuals. Last segment about one-half as long as segment III; subterminal seta of segment III extending almost to tip of leg; terminal seta of leg IV almost as long as leg itself; subterminal seta less than half as long as terminal.

Total length, 0.240 mm; total width, 0.122 mm.

## LARVA

Anterior part of cephalothorax not covered by dorsal shield, but with integument transversely striated. Shield of cephalothorax bearing four pairs of setae, the two posterior pairs being arranged in a transverse row of four setae. Inner setae of this transverse row fully twice as long as outer setae.

Abdomen saclike, without transverse sutures but with a small apical cone which bears four marginal setae, the two nearest the apex being longer than the other two. First and second dorsal plates of abdomen separated by an area of transversely striated integument. In living larvae both body and appendages translucent whitish, in fact almost colorless.

Total length, 0.256 mm; total width, 0.102 mm.

## EGG

Eggs observed inside of narcissus bulbs are oblong-oval, translucent whitish, slightly shiny, and without tubercles or markings of any kind. They are attached to plant tissues either at one end or on the side. So nearly are the eggs like the tissue of a bulb in color that they might easily be overlooked. A female with an egg partly protruding from the end of the abdomen is sometimes observed.

Length, 0.145 mm; width, 0.074 mm.

*Type host.*—*Narcissus* sp.

*Type locality.*—County Dublin, Ireland.

*Types.*—In Irish National Museum.

*Common name.*—Bulb scale mite.

This is evidently the bulb scale mite that was described by the present writer (14) as *Tarsonemus approximatus* var. *narcissi*. The original description of *Tarsonemus laticeps* by Halbert in 1923 was overlooked, not only by the writer, but apparently also by Vitzthum, whose *Tarsonemus hydrocephalus* must be the same as Halbert's species.

In comparing *narcissi* with Halbert's description and figures of *laticeps*, many differences are noted; nevertheless, the writer is convinced the two forms are the same. The differences pertaining to the posterior leg of the male are as follows: The number of leg segments in *laticeps* is given as three, whereas four are present in *narcissi*; the coxal seta is not shown as occurring in *laticeps*, whereas it is present in *narcissi*; the femur is said to have two "hairs" in *laticeps*, but in *narcissi* there are three; and the clavate seta is shown as simple in *laticeps* but clavate in *narcissi*. However, the coxa, the femur, and the claw, in fact the entire fourth leg, as figured by Halbert, is shaped as in *narcissi*.

Vitzthum described *Tarsonemus hydrocephalus* from Stockholm, on *Pancreatium* sp. When the hind leg of a male of variety *narcissi* is compared with his figures of *T. hydrocephalus*, it is observed to differ in the following points:

(1) The femur is stouter, particularly in its outer margin being more outcurved.

(2) The inner distal seta is about twice as long as in Vitzthum's figure.

(3) The tibia and tarsus are distinctly separated by a suture.

(4) The clavate seta is clavate instead of setiform.

(5) The tactile seta does not extend beyond the tip of the tarsal claw.

When other comparisons are made between specimens of *narcissi* and Vitzthum's drawings, other differences are noted. Yet it is of equal importance to note the agreement in several characters which not only should identify the species but are unusual in the genus *Tarsonemus*. They are as follows:

(1) The large size of the capitulum, particularly its width.

(2) The acuminate tips of the pseudostigmatic organs.

(3) The very long tibia I in the female.

(4) The short tarsus I in the female, with three long dorsal setae.

(5) The conspicuous seta on the third segment of leg IV of the female.

(6) The shortness of all setae on leg IV of the male.

Because of the agreement in these characters, which are of an unusual nature, the present writer considers *T. hydrocephalus* Vitzthum to be a synonym of *narcissi* and of *laticeps*.

North American material examined as follows:

California:

On *Narcissus* bulbs imported from the Netherlands, Santa Cruz, November 21, 1925, C. F. Doucette.

On *Narcissus* bulbs, Fortuna, January 13, 1926; Santa Cruz, February 13, 1929, C. E. Scott.

On *Narcissus* stems, Anaheim, February 15, 1926, C. F. Doucette.

On *Narcissus* stems and leaves, Natividad, January 28 and February 6, 1926, C. F. Doucette.

On *Narcissus* stems, leaves, and flower buds, San Leandro, February 3, 1926, C. F. Doucette.

New York:

On "bulbs" (imported), New York, 1920, brought in by a Miss Broadbent. In the National Museum mite collection there is a slide containing only females and larvae with the data given above. With the knowledge now attained these specimens may be definitely identified as *Tarsonemus laticeps*. This record is the earliest known from North America.

North Carolina:

On *Narcissus*, Castle Hayne, January 30, 1932, J. T. Sondey.

Oregon:

On *Narcissus*, Brookings, February 1 and 2, 1934, C. F. Doucette; Elkton, April 6, 1932, "F. P. M."

Virginia:

On *Narcissus*, Arlington, January 28 and February 26, 1931, F. Weiss.

Washington:

On *Hippeastrum* (amaryllis), Sumner, April 15, 1933, C. F. Doucette.

On *Narcissus*, Bellingham, September 18, 1926, D. Griffiths; Sumner, March 22, 1934, R. Latti.

In addition to the material from North America, three lots from England, taken on *Narcissus*, February 15, 16, and 17, 1932, by W. E.

Hodson have been studied. No differences were noted between the specimens from England and those from North America.

**TARSONEMUS SMITHI, new species**

(Fig. 22, B)

**MALE**

*General appearance.*—Body rather long, broadest immediately in front of coxae III. First pair of legs longer and stouter than either second or third pair.

*Capitulum.*—Slightly longer than broad. Chelicerae short. Palpi short, stout, scarcely twice as long as broad, and indistinctly three-segmented.

*Genital papilla.*—General shape that of a truncated cone. Genital flap small, circular, extending beyond margins of papilla only at apex of latter. Penis slender, reaching tips of accessory sclerites; the latter with bulbous bases.

*Leg IV.*—Slender. Coxa not triangular; coxal seta dorsal, extending beyond margin of segment. Femur slender, with inner margin outcurving very strongly between proximal and inner distal femoral setae; inner distal femoral seta submarginal, situated opposite outer distal femoral seta, and extending slightly beyond tip of segment; outer distal femoral seta slightly smaller than inner. Tibia longer than broad, inner margin strongly incurved; tactile seta somewhat spinelike, extending beyond tip of tarsal claw by about half its length; clavate seta dorsal, peglike, situated slightly anterior to tactile seta. Tarsus with two inner tarsal setae; tarsal claw long, strongly curved, acuminate at apex, three times as long as tarsus itself.

Total length, 0.180 mm; total width, 0.092 mm.

**FEMALE**

*General appearance.*—Body oval, with capitulum set apart by its strong basal constriction; abdomen broadly and evenly rounded behind. Mounted specimens of various shades of yellowish brown.

*Tarsus I.*—About twice as long as tibia and of about the same width for most of its length. Distal sense seta fusiform, about as long as width of tarsus, and situated dorsally at about middle of tarsus. Proximal sense seta minute, clavate, less than half as long as distal one, and situated dorsolaterally at about the same distance from base of tarsus as the most proximal simple seta. Tarsus I provided distally with a single strongly curved claw and a small oval pulvillus.

*Leg IV.*—Coxa short, subtriangular. Trochanter very short, ringlike, about half as long as coxa. Third segment longer than other segments taken together; subapical seta straight, somewhat spinelike, and extending to tip of leg. Last segment about one-half as long as third segment; subapical seta stout, slightly curved; apical seta also curved and almost twice as long as subapical seta.

Total length, 0.200 mm; total width, 0.101 mm.

**LARVA AND EGG (Unknown)**

*Type host.*—*Rubus occidentalis* (common blackcap).

*Type locality.*—Rosslyn, Va.

*Type slide.*—United States National Museum No. 1118.

Material at hand as follows: On type host, at type locality, by F. F. Smith, a male (holotype) accompanied by *T. simplex*, new species, October 31, 1933; and a male, accompanied by *T. confusus*, new species, and *T. femoralis*, new species, November 22, 1933. From Puyallup, Wash., by W. W. Baker, male and female, on *Ribes sanguineum*, October 11, 1934; males and females, on *Althaea rosea* (hollyhock), October 13, 1934; and many specimens, on *Chrysanthemum*, October 15, 1934.

## TARSONEMUS SETIFER, new species

(Fig. 6; fig. 22, C)

## MALE

**General appearance.**—Body rather long, broadest opposite third pair of coxae. Legs long. Color light, translucent, yellowish brown.

**Capitulum.**—Oval. Chelicerae very short, appressed, presenting the appearance of a minute cone. Palpi free, incurved, indistinctly segmented.

**Genital papilla.**—Cone-shaped, longer than broad. Genital flap absent. Penis with stout, rodlike base and needlelike tip. Accessory sclerites about one-half as long as papilla.

**Leg IV.**—Coxa not triangular, broader than long; coxal seta ventral, near lateral margin of segment. Femur long, slender, curved, varying considerably in width among different individuals (usually stouter than shown in figure); proximal femoral seta marginal, situated before middle of segment; inner distal femoral seta submarginal and subapical, extending slightly beyond tip of tibia; outer distal femoral seta situated near middle of segment and not extending to apex of same. Tibia long, inner margin strongly incurved, distinctly separated from tarsus; tactile seta very long, flagelliform, equal to leg IV in length; clavate seta situated almost opposite tactile seta on dorsal side of tibia. Tarsus bulbous; tarsal setae subequal, divergent; tarsal claw very long, strongly bent near its base, but only slightly curved for much of its length, apex acuminate.

Total length, 0.157 mm; total width, 0.075 mm.

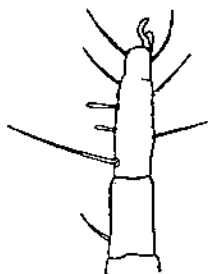


FIGURE 6.—*Tarsonemus setifer*, new species. Outside view of tibia and tarsus of leg I of female.  $\times 800$ .

## FEMALE

On the type slide with males are several females which have the capitulum very similar to that of the males. Such females are presumed to be those of *setifer*; however, on the same slide is a female of a very different kind.

**General appearance.**—Typical for females of the genus. Capitulum more prominent and somewhat less egg-shaped than in male.

**Tarsus I.**—Slightly over one and a half times as long as tibia. Distal sense seta clavate, as long as width of tarsus, and situated at about the middle of dorsal aspect of same. Proximal sense seta about half as long as distal, situated dorsolaterally and much farther from base of tarsus than is the first simple seta. Pulvillus small. Tarsal claw well developed, strongly curved.

**Leg IV.**—Not reaching margin of abdomen in moderately engorged specimens. Third segment somewhat longer than the other leg segments taken together, its subterminal seta extending to tip of segment IV. Fourth segment about two-fifths as long as third; terminal seta of segment IV very long, flagelliform, about one and a half times as long as leg IV; subterminal seta stiff, slightly curved, about one and a half times as long as segment IV.

Total length, 0.232 mm; total width, 0.126 mm.

## LARVA

Single mounted specimen practically colorless except for chelicerae, which are yellowish brown. Pseudostigmatic organs absent. Leg I subequal to leg II; tibia I almost as long as tarsus, of about same width throughout, bearing dorsally near its middle a long, curved, tactile seta; tarsus I with basal third about as broad as tibia, but remainder of segment narrower, the single sense seta clavate, situated dorsally about its length from base of segment; claws of tarsus I subequal, pedicellate; pulvillus absent. Abdomen with but slight indication of segmental sutures, cone-shaped posteriorly with terminal pair of rather conspicuous setae. Anus not observed.

Total length, 0.210 mm; total width, 0.101 mm.

Ega (Unknown)

*Type host.*—*Chrysanthemum* sp.*Type locality.*—Pittsburgh, Pa.*Type slide.*—United States National Museum No. 1119.

Description based on material as follows:

## California:

On *Rubus* sp. (raspberry buds), San Jose, December 20, 1934, Leslie Smith.  
District of Columbia:On *Chrysanthemum*, October 5, 1933, F. F. Smith.

## Louisiana:

On *Chrysanthemum* (in flower with thrips), November 7, 1934, Mrs. J. W. Papis.

## New York:

On *Gerbera jamesoni* (flame-ray gerbera), Babylon, January 18, 1934, F. F. Smith.On *Penstemon*, Pelham, August 20, 1934, F. F. Smith.

## Pennsylvania:

On *Acalypha* (copperleaf), Pittsburgh, November 7, 1933, F. F. Smith.On *Chrysanthemum*, Camp Hill, December 6, 1933, and Pittsburgh, November 3, 1933, F. F. Smith.

## Virginia:

On *Rosa canina* (dogbrier), Arlington, June 27, 1934, F. F. Smith.

## Washington:

On *Chrysanthemum* (in greenhouse), Everett, October 10, 1930, W. W. Baker.  
On *Fragaria* sp. (strawberry), Orting, by "Crocker."On *Rosa* sp. (rose hips), Osceola, March 17, 1933.On *Rubus parviflorus* (whitewflowering raspberry, dried berries), Puyallup, February 8, 1933.On *Rubus leucodermis* (whitebark raspberry), Oak Point, October 18, 1934, W. W. Baker.On *Rubus* sp. (evergreen blackberry), Puyallup, September 8, 1933, and October 4, 1933, W. W. Baker.On *Rubus* sp. (Himalaya blackberry), Tacoma, September 22, 1931, W. W. Baker.On *Rubus* sp. (blackberry), Sumner, September 16, 1931, S. E. Crumb.

## TARSONTOMUS BAKERI, new species

(Fig. 22, D)

## MALE

*General appearance.*—Rather slender, long-legged, the fourth pair of legs distinctly longer than any of the others. Freshly mounted specimen a light yellowish brown.*Capitulum.*—Oblong-oval, about one and a fourth times as long as broad. Palpi small, free, cone-shaped, convergent, and indistinctly segmented. Chelicerae needlelike.*Genital papilla.*—Cone-shaped, about one and a half times as long as broad. Genital flap a circular, hyaline, cusplike expansion near apex of papilla. Penis long, slender, in repose extending to apex of papilla. Accessory sclerites slender, slightly bulbous at bases and acuminate apically.*Leg IV.*—Very long, only slightly enlarged. Coxa subquadrangular, broader than long; coxal seta ventral, extending beyond margin of segment by half its length. Femur very long, much longer than other segments combined, angulate along inner margin near base; hyaline expansion absent; proximal femoral seta slightly curved, about as long as width of femur and situated on inner margin of segment about halfway from base of femur to inner distal femoral seta; inner distal femoral seta almost straight, as long as tibia and tarsus combined, and situated near inner margin of segment at about one-half the seta's length from apex; outer distal femoral seta discal, almost as long as inner distal femoral seta, and situated more proximad than the latter. Tibia much longer than broad, outside margin almost straight, inside margin broadly and deeply incurved; tactile seta very long, about as long as leg itself; clavate seta subapical, extending slightly beyond lateral margin of tibia. Tarsus much broader than

long; tarsal setae subequal, divergent; tarsal claw large, sharp, sickle-shaped, about as long as tibia.

Total length, 0.202 mm; total width, 0.101 mm.

#### FEMALE

*General appearance.*—Oblong-oval; legs rather slender. Color of freshly mounted specimen a very light yellowish brown.

*Tarsus I.*—Slender, about one and one-half times as long as slender tibia. Distal sense seta spindle-shaped, medium-sized, situated a little more than its length from apex of tarsus. Proximal sense seta clavate, about one-half as long as distal sense seta, situated dorsally about twice its length from base of tarsus. Tarsus ending in a small pulvillus and a single, slender, strongly curved, sharp claw.

*Leg IV.*—Slender, extending slightly beyond margin of body. Coxa about as broad as long. Trochanter ringlike, almost twice as broad as long. Third segment slender, longer than other segments combined; basal seta apparently absent; subapical seta situated far from apex of segment and extending to about tip of leg. Fourth segment about one-third as long as third segment; subapical seta almost straight, fully twice as long as segment IV itself; apical seta flagelliform, longer than leg.

Total length, 0.206 mm; total width, 0.109 mm.

#### LARVA AND EGG (Unknown)

*Type host.*—*Tilia* sp.

*Type locality.*—Puyallup, Wash.

*Type slide.*—United States National Museum No. 1120.

*Common name.*—Basswood tarsonemid mite.

Description based on a single male (holotype) and single female taken at type locality from type host (basswood), October 5, 1933, by W. W. Baker.

This species is related to *T. setifer*, new species, but differs from *setifer* in that leg IV of the male is more slender, has the inner margin of the femur formed into an angle near the base, and the femoral setae differently placed.

#### TARSONEMUS OCCIDENTALIS, new species

(Fig. 22, E)

#### MALE

*General appearance.*—Body short, sides subparallel for much of their length. Legs medium in length and thickness. Freshly mounted specimens very pale greenish yellow.

*Capitulum.*—Longer than broad, strongly constricted at base. Palpi small, cone-shaped, convergent, indistinctly segmented.

*Genital papilla.*—Broader than long. Genital flap conspicuous, as broad as papilla itself, forming a circle about papilla. Penis ending in a slightly curved hooklike process. Accessory sclerites short, strongly bulbous at base, and acuminate at apex.

*Leg IV.*—About as long as leg III. Coxa triangular, broader than long. Femur as long as other segments taken together, slightly curved, inner margin produced to form angle near base of segment; no hyaline expansion; proximal femoral seta very slender, not conspicuous, situated on inner margin at about one-third the distance from base of femur to its apex; inner distal femoral seta very large, extending to tip of tarsal claw, situated almost on inner margin of segment near the distal end; outer distal femoral seta large, discal, fully as long as inner, extending beyond apex of femur by one-half its length. Tibia short, almost as broad as long, outer margin slightly outcurved, inner margin incurved; tactile seta heavy, about as long as femur; clavate seta long, situated almost opposite tactile seta, and extending beyond margin of segment. Tarsus

about twice as broad as long; tarsal setae subequal, divergent; tarsal claw stout, moderately curved, acuminate at apex, equal to tibia in length.

Total length, 0.156 mm; total width, 0.075 mm.

#### FEMALE

*General appearance.*—Body oblong-oval, with anus located on low anal papilla. Legs rather slender, of medium length. Freshly mounted specimens light yellowish brown.

*Tarsus I.*—Twice as long as tibia, tapering to apex. Distal sense seta spindle-shaped, about one-half as long as width of tarsus, and situated dorsally at middle of segment. Proximal sense seta clavate, about one-half as long as distal sense seta, situated dorsolaterally at about its length from base of tarsus. Tarsus ending in a small pulvillus and a single, strongly curved, sharp claw.

*Leg IV.*—Reaching margin of body. Coxa triangular, broader than long. Trochanter ringlike, twice as broad as long. Third segment about equal to the other segments taken together; basal seta longer than width of segment and situated at about one-half its length from base of same; subapical seta nearly straight and extending to tip of fourth segment. Fourth segment about one-half as long as third; subapical seta almost straight, one and one-half times as long as fourth segment; apical seta flagelliform, fully as long as leg itself.

Total length, 0.198 mm; total width, 0.111 mm.

#### LARVA

Body strongly constricted between cephalothorax and abdomen and just posterior to attachment of third pair of legs. Legs similar, subequal. Pseudostigmatic organs absent. Tarsus I short, only slightly longer than tibia, ending in a small pulvillus and two strongly curved, equal, divergent claws. Posterior pair of cephalothoracic setae very long, equal to second leg in length. Apical abdominal setae curved, divergent, about two-thirds as long as third leg.

Total length, 0.166 mm; total width, 0.110 mm.

#### Egg (Unknown)

*Type host.*—*Fragaria* sp.

*Type locality.*—Sumner, Wash.

*Type slide.*—United States National Museum No. 1121.

Material at hand with following data:

#### Virginia:

On *Rubus occidentalis* (common blackcap), Arlington, September 10, 1934, F. F. Smith.

#### Washington:

On *Corylus californica* (hazelnut), Puyallup, October 9, 1934, W. W. Baker.

On *Fragaria* sp. (strawberry), Puyallup, September 30, 1933, W. W. Baker; Sumner, March 22, 1934, F. F. Smith.

On *Malus sylvestris* (apple), Quinault, October 20, 1933, W. W. Baker.

On *Rubus* sp. (evergreen blackberry), Montesano, October 16, 1934; Osceola, September 13, 1933, October 4, 5, 1933; Puyallup, August 8, 18, 1934, September 29, 1933, October 5, 1933; Skamokawa, October 18, 1934; South Bend, October 17, 1934, and South Prairie, October 26, 1934; all collected by W. W. Baker.

On *Rubus* sp. (native dewberry), Puyallup, July 25, 1933, W. W. Baker.

On *Salix* sp. (willow), in gall of *Eriophyes*, Eatonville, November 12, 1934, W. W. Baker.

On *Spiraea douglasii*, Puyallup, November 23, 26, 1934, W. W. Baker.

#### TARSONEMUS WAITEI Banks

(Fig. 7; fig. 22, F)

This species, described by Banks (4) in 1912, has no known synonyms.

#### MALE

*General appearance.*—Typical for the genus. Body considerably longer than broad and broadest opposite the third pair of coxae.

**Capitulum**.—Cone-shaped, longer than broad. Chelicerae extending beyond palpi, each ending in a needlelike process. Palpi filiform, distinctly three-segmented.

**Genital papilla**.—Large, cone-shaped, longer than broad. Genital flap cannot be seen in balsam mount of male type specimen. Accessory sclerites, consisting of appressed vertical plates, as long as broad and curved upward. Penis slender, needlelike apically.

**Leg IV**.—Coxa triangular, as broad as long; coxal seta dorsal, near posterior margin. Femur stout, twice as long as broad; proximal femoral seta cannot be located in balsam mount; inner distal femoral seta situated on inner margin of segment not far from apex, length probably greater than shown in drawing, the tip being invisible in balsam; outer distal femoral seta submarginal, situated beyond middle of segment. Tibia about as long as broad; tactile seta situated at apex of tibia, extending beyond tip of tarsal claw by half its length; clavate seta situated dorsally almost opposite tactile seta, slightly clavate and extending beyond margin of segment. Tarsus not distinctly separated from tibia; tarsal setae invisible in the balsam mount; tarsal claw large, long, slender, and sharp at apex, in length equal to tibiotarsus.

Total length, 0.129 mm; total width, 0.064 mm.

#### FEMALE

**General appearance**.—Body oval, in well-fed specimens about two-thirds as broad as long. Freshly mounted specimens light yellowish brown, the capitulum more strongly pigmented than the body.

**Tarsus I**.—About one and a half times as long as the long tibia; distal sense seta clavate, in length equal to a little more than one-half the width of tarsus; proximal sense seta not properly observable in type material, in fresh specimens seen to be situated laterally, less than its length from base of tarsus and nearer the base of this segment than the nearest simple seta. Pulvillus greatly reduced.

**Leg IV**.—Coxa small, longer than broad. Trochanter broader than long. Segment III slightly longer than the other segments taken together and with rather inconspicuous subapical seta. Segment IV less than one-half as long as segment III; apical seta flagelliform, about as long as the leg itself; subapical seta somewhat spinelike, longer than segment IV.

Total length, 0.204 mm; total width, 0.112 mm.

#### LARVA

Capitulum similar to that of female. Tarsus I provided with two equal claws. Pseudostigmatic organs absent. Region of abdomen behind insertion of third pair of legs cone-shaped, and bearing at apex a pair of setae equal in length to this section of abdomen.

Total length, 0.139 mm; total width, 0.072 mm.

#### Egg (Unknown)

**Type host**.—Peach tree.

**Type locality**.—West Chester, Pa.

**Type slide**.—United States National Museum No. 1122.

**Common name**.—Peach bud mite.

The description here given is based entirely upon type specimens insofar as the male and the larva are concerned. This is unfortunate, since the type specimens were mounted many years ago in balsam and now do not show some of the more important structures. In the case of the females, however, fresh material is at hand.

Banks, in describing *T. waiti*, commented as follows: "They destroy the terminal peach buds and are thus a serious menace to peach culture."



FIGURE 7.—*Tarsonemus waiti* Banks. Ventral view of right leg of the last pair in female.  $\times 800$ .

Material studied: The types mounted on five slides, taken at West Chester, Pa., on peach buds, August 24, 1911, by J. F. Zimmer; four females, Bell Station (near Bowie), Md., on peach trees, by W. B. Wood; questionably identified as *waitei*, two males and a female found "infesting cultures" at botany department, Michigan Agricultural College, East Lansing, Mich.

# TARSONEMUS CHIONASPIVORUS Ewing

(Fig. 23, A)

Described by the present writer (11) in 1911, and subsequently as *Tarsonemus approximatus* by Banks (5) in 1914.

## MALE

*General appearance.*—Color whitish transparent. Legs rather short and body broadest at base of abdomen.

*Capitulum.*—Cone-shaped, slightly longer than broad. Chelicerae short, not inflated at their bases. Palpi incurved, indistinctly segmented.

*Genital papilla.*—Dome-shaped, longer than broad, reaching tip of femur IV. Penis with distal half needlelike, in repose not extending beyond apex of papilla. Accessory sclerites with inflated, rounded bases.

*Leg IV.*—Coxa subtriangular, broader than long, outer margin outcurved; coxal seta short, dorsal in position, and not extending beyond lateral margin of coxal segment. Femur about as long as the other segments combined; proximal femoral seta marginal, situated on basal half of segment; inner distal femoral seta submarginal, situated about one-third its length from apex of segment and extending almost to tip of tarsal claw; outer distal femoral seta dorsal, submarginal, situated more proximad than the inner distal seta and extending almost to apex of femur. Tibia as long as broad, inner margin somewhat incurved; tactile seta submarginal, subapical, almost as long as leg IV itself; clavate seta almost peglike, situated slightly proximad and slightly laterad of tactile seta. Tarsus broader than long. Only a single tarsal seta visible in holotype. Tarsal claw long, curved, sharp, and conspicuous.

Total length, 0.211 mm; total width, 0.106 mm.

## FEMALE

A female specimen of *chionaspivorus* is not available for a redescription; hence the original description (11, p. 40) is here quoted:

Legs almost hyaline; body and beak, which have the integument more chitinated, brownish yellow.

Cephalic papilla two-thirds as broad as long; broadest at the base. Eplimera of the first pair of legs united at the median line so as to form a Y; eplimera of the second pair of legs not united. Cephalothorax broadest at its base where it joins the abdomen.

Sides of abdomen straight and approaching each other as you pass from the anterior to the posterior end. A pair of shoulder bristles present, about as long as the femur of leg III. Posterior margin of abdomen with but two minute bristles.

Legs of the anterior group subequal; those of the second pair extending forward for two-thirds of the length of the first legs. Tibia of third pair of legs about twice as long as tarsus. Last segment of leg IV about one-third as long as penultimate segment, and bearing at its free end two large bristles, the shortest of which is about twice as long as the segment itself; the longer bristle is fully twice as long as the shorter.

Length, 0.16 mm; breadth, 0.08 mm.

## LARVA AND EGG (Unknown)

*Type host.*—*Chionaspis* sp.

*Type locality.*—Ames, Iowa.

*Type slide* (holotype).—In writer's collection.

*Common name*.—Scale tarsonemid mite.

This species was originally described from specimens taken on a scale insect on poplar at Ames, Iowa, July 25, 1910, by the writer. *Tarsonemus approximatus* Banks was described from material occurring also on a scale insect, *Coccus (longulus* Doug.) = *elongatus* (Sign.), at Pomona, Calif., "July 8 (Quayle)." The writer has compared a male specimen from the type host and type locality of *T. approximatus* and finds it to be the same as *chionaspivorus*.

Material examined as follows: The holotype and, in addition, a single male from Pomona, Calif., "Feeding on eggs of (*Coccus longulus*?)," July 2, 1912, "Neüls." In view of the fact that this second male specimen was taken at Pomona, Calif., on July 2, the writer wonders if it could not have been a part of the type material of *T. approximatus*. Banks gives the collection date as July 8, but it has been observed that the figure 8 is written in pencil on the slide bearing this male specimen; furthermore, the figure 2 might have been mistaken for an 8.

#### TARSONEMUS RANDSI, new species

(Fig. 23, B)

##### MALE

*General appearance*.—Sides of body between second and third pairs of legs almost parallel; posterior part of abdomen cone-shaped. Color of freshly mounted specimens very pale yellowish brown.

*Capitulum*.—About one and one-half times as long as broad, slightly constricted at base. Palpi not truncate but tapering to a point at apex, convergent, indistinctly segmented.

*Genital papilla*.—Longer than broad. Genital flap conspicuous, about as broad as papilla. Penis long, slender, when protruded reaching almost to tip of femur IV. Accessory sclerites protruding, constricted near their bases, swollen near apices, and each bearing a short, spinelike process at tip.

*Leg IV*.—Equal in length to third leg. Coxa triangular, broader than long; coxal seta absent. Femur longer than other segments combined; proximal femoral seta very slender, situated on inner margin at about one-third the distance from base to apex of segment; inner distal femoral seta submarginal, extending to tip of tibiotarsus and situated at about one-third its length from end of segment; outer distal femoral seta dorsal, submarginal, equal to inner, situated at about the middle of the segment. Tibiotarsus one and one-third times as long as broad; tactile seta rather short and somewhat spinelike, a little longer than tibiotarsus plus claw; clavate seta small, dorsal, submarginal; tarsal setae subequal, subparallel; tarsal claw stout, curved, acuminate at apex, as long as tibiotarsus.

Total length, 0.176 mm; total width, 0.096 mm.

##### FEMALE

*General appearance*.—Constriction at junction of cephalothorax and abdomen slight. Freshly mounted specimens rather opaque, yellowish brown.

*Tarsus I*.—Short, broad distally, about one and one-fourth times as long as tibia. Distal sense seta stout, spindlelike, in length equal to a little more than one-half the width of tarsus, situated dorsally at middle of segment. Proximal sense seta minute, situated nearer base of segment than any simple seta. Tarsus ending in a small pulvillus and a single, strongly curved, sharp claw.

*Leg IV*.—Short, barely reaching margin of body. Coxa subtriangular, longer than broad. Trochanter ringlike, twice as broad as long. Third segment longer than other segments combined; basal seta minute, curved, situated at about one-half its length from base of segment; subapical seta ventral, extending half

its length beyond end of segment. Fourth segment short, scarcely one-third as long as third; subapical seta slightly curved, about three times as long as segment and situated near middle; apical seta very long, flagelliform, as long as leg itself.

Total length, 0.215 mm; total width, 0.109 mm.

#### LARVA

Newly emerged larva hyaline, practically colorless. Sides of abdomen in front of third leg parallel. Posterior pair of cephalothoracic setae about three times as long as middle pair and extending almost to posterior margin of first abdominal segment. Pseudostigmatic organs absent. Tarsus I about twice as long as tibia and much narrowed from base to apex. One sensory seta, small and clavate, situated dorsally on tarsus I at about one-third the distance from apex to base. Tarsus I ending in a small pulvillus and two conspicuous, strongly curved, sharp claws. Setae on two posterior segments of abdomen arranged as usual.

Total length, 0.155 mm; total width, 0.068 mm.

#### Egg

Long, elongate-oval, the two ends broadly and equally rounded. Surface smooth. Freshly laid eggs colorless.

Length, 0.105 mm; width, 0.061 mm.

*Type host.*—*Saccharum officinarum*.

*Type locality.*—Arlington, Va.

*Type slide.*—United States National Museum No. 1123.

Description based on several males, females, larvae, and eggs found in association with *Tarsonemus bancrofti* Michael on sugarcane growing in a quarantine greenhouse on the Government farm at Arlington, Va., February 5, 1935. The specimens were taken by F. F. Smith from cane samples that were collected by R. D. Rands, for whom the species is named.

There are questionably included under this species some specimens taken on rose hips in a greenhouse at Arlington Experiment Farm, Arlington, Va., June 26, 1934, by F. F. Smith. In the male the inner distal femoral seta and tactile seta of leg IV are much longer than in *randsi*, the outer distal femoral seta is situated farther out on the segment, the penis is shorter, and the accessory sclerites are differently shaped. Notwithstanding these differences, in other respects the form from rose hips is so similar to that on sugarcane that it is quite possible they are conspecific.

*Tarsonemus randsi* may be the smaller of the two species of *Tarsonemus* on diseased sugarcanes sent to Michael (23) in 1890 by Bovell from Barbados. Michael, unfortunately, gave no description of the smaller species; so we are left entirely in doubt in regard to this matter.

#### TARSONEMUS CONFUSUS, new species

(Fig. 8; fig. 23, C, D)

#### MALE

*General appearance.*—There is nothing distinctive in the general appearance of this species. It is easily confused with others because of variations in the posterior legs, which are only slightly enlarged in the male. Freshly mounted males are very light brown.

*Capitulum.*—Rather small, slightly longer than broad, not constricted at base. Chelicerae forming what appears to be a short, sharply pointed cone. Palpi small, strongly incurved, distal segment hyaline.

**Genital papilla.**—Broad, short, as broad as long. Genital flap a hyaline, sucker-like disk almost equal in diameter to the genital papilla. Penis not extending to tips of accessory sclerites.

**Leg IV.**—Coxa varying somewhat in shape but usually subtriangular; coxal seta apparently absent. Femur not swollen, curved, with inner margin angulate near base; proximal femoral seta small, marginal, situated at about one-third the distance from base to tip of femur; inner distal femoral seta long, submarginal, situated about halfway from proximal femoral seta to end of femur; outer distal femoral seta submarginal, curved, situated almost opposite inner distal seta and extending about to tip of femur. Tibiotarsus variable in length and width, but always longer than broad; tactile seta stout, straight, about as long as femur; clavate seta but very slightly clavate, situated dorsally about its length from base and lateral margin of tibiotarsus; one tarsal seta marginal in the usual position, and one dorsal, which is not easily seen; tarsal claw stout, short, about one-half as long as tibiotarsus.

Total length, 0.151 mm; total width, 0.071 mm.

#### FEMALE

**General appearance.**—Typical for the genus. Body oval, about twice as long as broad. Color of freshly mounted specimens various shades of light yellowish brown.

**Tarsus I.**—About twice as long as tibia. Distal sense seta stout, spindle-shaped, dorsal, situated at about two-fifths the distance from base to apex of tarsus. Proximal sense seta clavate, about one-half as long as distal sense seta, situated dorsolaterally somewhat nearer base of tarsus than any of the simple setae. Tarsus ending in a single strongly curved claw and a much reduced pulvillus.

**Leg IV.**—Short, not reaching margin of body. Coxa subtriangular, as broad as long. Trochanter ringlike, twice as wide as long. Third segment longer than the other segments taken together and bearing two setae, a subbasal, lateral curved seta and a subterminal lateral seta that is slightly curved. Fourth segment short, one-fourth to one-third as long as third segment; subapical seta over twice as long as segment IV; apical seta very long, flagelliform, longer than leg IV itself.

Total length, 0.194 mm; total width, 0.133 mm.

#### LARVA

Unengorged individuals with abdomen strongly constricted just posterior to third legs; the posterior lobe thus formed, as in some other species of the genus, angulate behind, bearing a pair of straight lateral setae, a pair of similar but longer terminal setae, and a transverse row of four dorsal setae. Tarsus I ending in two equal claws and a much reduced pulvillus. Pseudostigmatic organs absent. Posterior pair of cephalothoracic setae very long.

Total length, 0.194 mm; total width, 0.079 mm.

#### Egg

Oblong-oval, equally rounded at the ends. Chorion smooth, without granules or tubercles. Interior of egg appearing light yellowish brown by transmitted light. Length, 0.099 mm; width, 0.049 mm.

**Type host.**—*Delphinium belladonna*.

**Type locality.**—Suitland, Md.

**Type slide.**—United States National Museum No. 1124.

**Common name.**—Confused tarsonemid mite.

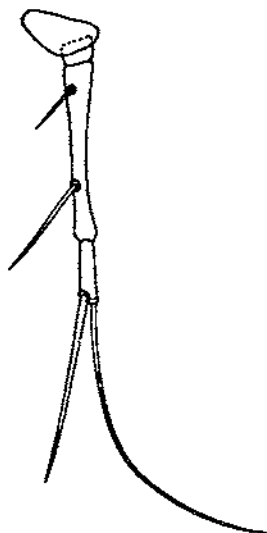


FIGURE 8.—*Tarsonemus confusus*, new species. Ventral view of right leg of last pair in female.  $\times 800$ .

This species is a difficult one to deal with taxonomically, and only the male is distinct. The males, however, vary greatly in those characters that usually are of most taxonomic importance, so that on superficial study they appear to represent two or three species. Furthermore, *confusus* closely approximates *scaurus*, although the characters given in the key to the species of *Tarsonemus* separate the two.

Description based on material as follows:

District of Columbia:

- On *Cyclamen indicum*, October 21, 1933, F. F. Smith.
- On *Delphinium belladonna*, August 4, 1933, F. F. Smith.
- On fungus from bananas, May 23, 1908, Spear.
- On *Nicotiana* sp. (tobacco, in greenhouse), November 11, 1933, F. F. Smith.
- On *Saintpaulia ionantha* (African-violet), December 5, 1933, F. F. Smith.

Maryland:

- On *Chrysanthemum* sp., Baltimore, October 3, 1933; Fullerton, October 25, 1933; Oxon Hill, December 2, 1933; Suitland, November 20, 22, 30, 1933; all taken by F. F. Smith.
- On *Delphinium belladonna*, Suitland, September 20, 1933, F. F. Smith.
- On *Fragaria* sp. (strawberry), Salisbury, September 5, 1934, G. M. Darrow.
- On *Myosotis* sp., Oxon Hill, December 2, 1933, F. F. Smith.

Maine:

- On *Delphinium belladonna*, Kingsfield, June 19, 1933, G. P. Coilesolla.

New York:

- On *Gerbera jamesoni* (flame-ray gerbera), Babylon, January 11, 1934.
- On *Iris kaempferi*, Brooklyn (Brooklyn Botanic Garden), August 2, 1934, G. M. Read.

Oregon:

- On *Rubus* sp. (youngberry), Roseburg, March 31, 1934, S. C. Jones.

Pennsylvania:

- On *Acalypha* sp. (copperleaf), Pittsburgh, November 7, 1933, F. F. Smith.
- On *Chrysanthemum* sp., Camp Hill, December 6, 1933, F. F. Smith; Pittsburgh, November 3, 7, 1933, F. F. Smith.
- On *Crassula rubicunda*, Lancaster, December 8, 1933, B. F. Barr; Pittsburgh, November 9, 1933, F. F. Smith.
- On *Cyclamen indicum*, Carlisle, December 6, 1933, F. F. Smith.
- On *Dahlia* sp., Media, September 21, 1933, F. F. Smith.
- On *Gerbera* sp. (in greenhouse), Media, September 21, 1933, F. F. Smith.
- On *Impatiens sultani* (sultan snapweed), Chambersburg, December 7, 1933, F. F. Smith.

South Carolina:

- On *Camellia japonica*, Charleston, April 3, 1935, F. F. Smith.

Virginia:

- On *Chrysanthemum* sp. (in greenhouse), Alexandria, September 29, 1933, F. F. Smith.
- On *Rubus* sp. (black raspberry), Arlington, November 22 and December 8, 1933, F. F. Smith.

TARSONEMUS SCAURUS, new species

(Fig. 23, F)

MALE

*General appearance.*—Body rather short and stout. First pair of legs largest; second pair larger than third; third pair longer than fourth.

*Capitulum.*—Cone-shaped, slightly longer than broad, bearing dorsally a pair of small setae. Chelicerae short, the two together appearing as a sharply pointed cone. Palpi incurved, reaching tips of chelicerae; distal palpal segment truncate, somewhat flattened, broader than long.

*Genital papilla.*—Very broad and short, almost twice as broad as long. Genital flap absent. Penis with basal two-thirds stout and distal third narrow, needlelike. Accessory sclerites stout, slightly incurved, and each ending in an inwardly directed spinelike process.

*Leg IV.*—Considerably smaller than is usual for the genus, and somewhat club-shaped (hence the name *scaurus*). Coxa triangular as seen from below,

fully as broad as long; coxal seta dorsal, extending laterally beyond margin of coxa for about half its length. Femur but very slightly swollen, produced to form an inner marginal angle near its base; proximal femoral seta straight, marginal, situated at about one-half the distance from base of femur to inner distal femoral seta; inner distal femoral seta submarginal, situated at about two-thirds distance from base to apex of femur and extending beyond this segment for about a third of its length; outer distal femoral seta long, curved, longer than inner distal seta, and situated almost opposite the latter. Tibia and tarsus ankylosed, forming the tibiotarsus, which is slightly longer than broad and rounded at its free end; tactile seta subterminal, in length about equal to that of leg IV; clavate seta but slightly clavate, situated less than its length from base of tibiotarsus and extending laterally beyond margin of same; tarsal setae not divergent; tarsal claw about as long as width of tibiotarsus, curved, and decidedly acuminate at tip.

Total length, 0.123 mm; total width, 0.072 mm.

#### FEMALE

*General appearance.*—Stout, legs rather short. Abdomen extending forward in front of posterior group of legs about twice as far as it extends backward from these legs.

*Tarsus I.*—Almost twice as long as the rather short and stout tibia, bearing at its tip a single, strongly curved, sharp claw and a small pulvillus; distal sense seta almost fusiform, three-fifths as long as width of tarsus; proximal sense seta less than half the size of distal, situated dorsolaterally less than its length from base of tarsus, and nearer base than first simple seta.

*Leg IV.*—Extending slightly beyond margin of abdomen. Segment III not attaining margin of abdomen, its subapical seta almost reaching tip of segment IV. Segment IV about one-third as long as segment III; apical seta flagelliform, about as long as leg IV; subapical seta stiff, slightly curved, reaching to tip of leg III.

Total length, 0.202 mm; total width, 0.102 mm.

#### LARVA

Cephalothorax as in female except that pseudostigmatic organs are absent. Leg I as in female except for its terminal armature, which is as follows: Tarsus I bearing distally two subequal claws and a minute pulvillus. Abdomen with distinct transverse sutures. Last abdominal segment cone-shaped and bearing four pairs of conspicuous setae, two pairs being dorsal, one lateral, and one terminal, the terminal pair being the longest. Anal plate poorly sclerotized. Anus small, subterminal.

Total length, 0.160 mm; total width, 0.089 mm.

#### Egg (Unknown)

*Type host.*—*Fragaria* sp.

*Type locality.*—Bell, Md.

*Type slide.*—United States National Museum No. 1125.

*Common name.*—Club-footed tarsonemid mite.

Description based upon material as follows:

#### District of Columbia:

On *Delphinium belladonna* (belladonna larkspur), September 7, 1933, F. F. Smith.

#### Maryland:

On *Chrysanthemum hortorum*, Suitland, November 22 and 28, 1933, F. F. Smith.

On *Cyclamen indicum*, Raspeburg, October 25, 1933, and Oxon Hill, December 4, 1933, F. F. Smith.

On *Delphinium belladonna* (belladonna larkspur), Suitland, June 28, 1934, F. F. Smith.

On *Fragaria* sp. (strawberry), Bell, June 15 and October 16, 1933, F. F. Smith.

#### New York:

On *Iris kaempferi*, Brooklyn (Brooklyn Botanic Garden), August 2, 1934, G. M. Read.

## Pennsylvania:

On *Cyclamen indicum*, Lancaster, December 9, 1933, F. F. Smith.

## Virginia:

On *Rubus* sp. (black raspberry), Rosslyn, October 31, 1933, and Clarendon, November 4, 1934, F. F. Smith.

## TARSONEMUS UNGUIS, new species

(Fig. 23, F)

## MALE

*General appearance*.—Legs of moderate length; sides of body subparallel for much of their length. Color a light yellowish brown.

*Capitulum*.—Small, extending forward to about middle of first pair of legs, slightly constricted at base and about three-fourths as broad as long.

*Genital papilla*.—Slightly longer than broad. Genital flap apparently absent. Penis long, slender, yet not protruding from genital papilla. Accessory sclerites large, well sclerotized, and protruding for about one-third of their length.

*Leg IV*.—Coxa rather small, triangular; coxal seta dorsal, extending beyond lateral margin of coxa for about one-third of its length. Femur swollen on inside between base and proximal femoral seta, and with outer margin only slightly outcurved; proximal femoral seta large, straight, ventral, submarginal, situated at about two-fifths the distance from base of femur to its apex; inner distal femoral seta long, almost straight, submarginal, extending slightly beyond tip of tarsal claw; outer distal femoral seta much enlarged, being the largest of all the femoral setae, curved, dorsal, submarginal, situated somewhat nearer base of femur than inner distal femoral seta. Tibiotarsus as broad as long; tactile seta rather stout and short, not equaling femur in length; clavate seta only very slightly clavate, situated less than its length from lateral margin; tarsal setae both directed inward, slightly divergent; tarsal claw large, curved, acuminate at tip, slightly longer than tibiotarsus.

Total length, 0.114 mm; total width, 0.069 mm.

## FEMALE, LARVA, AND EGG (Unknown)

*Type host*.—*Fragaria* sp.

*Type locality*.—Bell, Md.

*Type slide*.—United States National Museum No. 1126.

Known only from a single male found with several individuals of *T. viridis*, new species, on strawberry plant at type locality, October 16, 1933, by F. F. Smith. The great length of the outer distal femoral seta of leg IV, particularly in comparison with the tactile seta, is perhaps the most distinctive character of the species.

## TARSONEMUS FLORICOLUS Canestrini and Fanzago

(Fig. 24, A)

Described by Canestrini and Fanzago (10) in 1876. Certain other species have been declared synonyms of *Tarsonemus floricolus* (see discussion following descriptions), but there is some doubt as to the correctness of that synonymy.

## MALE

*General appearance*.—Body rather short. Sides of abdomen parallel in front of third pair of legs. Freshly mounted males translucent whitish in color.

*Capitulum*.—Cone-shaped, longer than broad, broadest at base. Palpi free, slightly convergent, truncate, three-segmented; first segment very short, second segment about twice as long as broad, third segment broader than long.

*Genital papilla*.—Slightly longer than broad. Genital flap poorly developed, not so broad as papilla, situated dorsally. Penis long, in repose the needlelike tip projecting free from papilla. Accessory sclerites bulbous at their bases and acuminate at apices.

*Leg. IV.*—Stout, rather short. Coxa fully twice as broad as long; coxal seta small, dorsal, submarginal. Femur about as long as other segments taken together; no hyaline expansion present; proximal femoral seta almost straight, situated about its length from base of segment; inner distal femoral seta long, submarginal, extending about one-half its length beyond end of femur; outer distal femoral seta dorsal, submarginal, situated at about same distance from apex of femur as inner distal femoral seta, to which it is about equal. Tibia slightly longer than broad, outer margin slightly outcurved, inner margin slightly incurved; tactile seta subapical, longer than leg itself; clavate seta situated dorsally almost opposite tactile seta and extending beyond lateral margin of tibia by half its length. Tarsus much broader than long; tarsal setae subequal, almost parallel; tarsal claw large, strongly curved, acuminate at apex, equal to tibia in length.

Total length, 0.144 mm; total width, 0.073 mm.

#### FEMALE

*General appearance.*—Body short, oblong-oval. Legs small. Color of freshly mounted specimens translucent, with very slightly yellowish tint.

*Tarsus I.*—Almost twice as long as tibia. Distal sense seta clavate, situated dorsally at about middle of segment. Proximal sense seta about half as long as distal, situated dorsolaterally at about its length from base of segment. Tarsus ending in a large pulvillus and a single, strongly curved, sharp claw.

*Leg IV.*—Small, short, not reaching margin of abdomen. Coxa longer than broad. Trochanter about one and one-half times as broad as long. Third segment slightly curved, almost as long as other segments taken together; basal seta minute, barely visible, in usual position; subapical seta apparently absent. Fourth segment about one-half as long as third; subapical seta nearly straight, twice as long as segment IV; apical seta flagelliform, about as long as leg itself.

Total length, 0.192 mm; total width, 0.117 mm.

#### LARVA AND EGG (Unknown to the writer)

*Type host.*—Flowers.

*Type locality.*—Italy.

Description based on several males and females taken from decaying buds of *Iris kaempferi* in greenhouse, Brooklyn Botanic Garden, Brooklyn, N. Y., August 8, 1934, by F. F. Smith.

According to Berlese (*6*, no. 2) the following species are synonyms of *floricolus robinii* (Kramer), *socialis* (Trouessart) (29), *macronychus* Sicher and Leonardi (28), and *supinoi* Sicher and Leonardi. Oudemans (25) in 1926 observed under the microscope a live female tarsonomid mite which he identified as *Tarsonemus minusculus* (Canestrini and Fanzago). After studying the descriptions given of *T. minusculus* and of *T. floricolus*, and weighing certain relative statements given by Canestrini, he decided that *T. floricolus* was only a synonym of *T. minusculus*. His arguments are more interesting than convincing. In view of the fact that both species were described by the same authors, and also that Canestrini himself, when he later revised the genus *Tarsonemus*, considered them distinct, the present writer is inclined to regard them in a similar manner.

#### TARSONEMUS TEXANUS, new species

(Fig. 9; fig. 24, B)

#### MALE

*General appearance.*—Rather typical of the genus. First pair of legs considerably longer than second. Mounted specimens almost colorless but showing a slight tinge of yellowish brown.

*Capitulum.*—Cone-shaped, not constricted at base. Chelicerae minute, needle-like, arising from near middle of capitulum. Palpi tapering, showing two segments distinctly.

**Genital papilla.**—Much broader than long. Genital flap apparently absent. Penis with distal part long, curved, needlelike, and extending for most of its length beyond tip of papilla. Accessory sclerites somewhat clavate and projecting slightly from papilla.

**Leg IV.**—Short, stout. Coxa subtriangular, about as broad as long. Femur expanded on inner margin about base of proximal femoral seta, outer margin almost straight; proximal femoral seta submarginal, situated at about its length from base of segment; inner distal femoral seta very similar to proximal, situated at about one-half its length from apex of segment; outer distal femoral seta very long, curved, submarginal, in length equal to the femur itself. Tibia and tarsus ankylosed, forming the tibiotarsus, which is slightly longer than broad; tactile seta submarginal, in length equaling the femur; clavate seta

situated dorsally opposite the tactile seta; only one tarsal seta observed; tarsal claw stout, curved, acuminate at apex, and about three-fourths as long as tibiotarsus.

Total length, 0.112 mm; total width, 0.064 mm.

#### FEMALE

**General appearance.**—Very short and stout, with short legs and the posterior margin of the body broadly and evenly rounded.

**Tarsus I.**—Broad distally, almost truncate. Distal sense seta spindle-like, in length equal to two-thirds width of tarsus and situated dorsally at about middle of segment. Proximal sense seta about one-half as long as distal sense seta, and situated

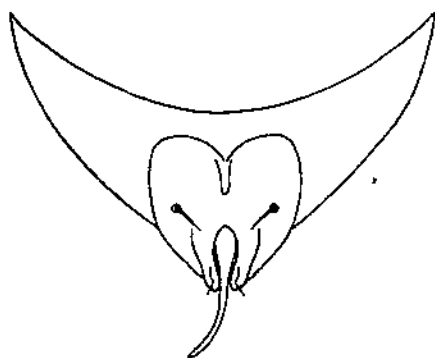


FIGURE 9.—*Tarsonemus texanus*, new species. Dorsal view of genital papilla of male.  $\times 800$ .

ated laterally about its length from base of segment. Tarsus terminated by a single, strongly curved claw and a reduced pulvillus.

**Leg IV.**—Rather short, not extending beyond margin of body. Coxa subtriangular, as broad as long. Trochanter two-thirds as broad as coxa and much broader than long. Third segment longer than the other three segments taken together and apparently without setae. Fourth segment slightly over one-half as long as third; subapical seta rigid, slightly curved, in length equal to segment III; upical seta considerably longer than subapical seta and flagelliform.

Total length, 0.141 mm; total width, 0.090 mm.

#### LARVA AND EGG (Unknown)

**Type host.**—Date palm.

**Type locality.**—Brownsville, Tex.

**Type slide.**—United States National Museum No. 1127.

**Common name.**—Date palm tarsonemid mite.

Males and females taken from diseased leaves of type host, at type locality, November 9, 1928, by F. H. Benjamin (F. H. B. 15).

#### TARSONEMUS SIMPLEX, new species

(Fig. 10; fig. 24, C)

#### MALE

**General appearance.**—Body stout. Legs of medium length. Mounted specimens of a very pale yellowish-brown color.

**Capitulum.**—Rather small, longer than broad. Chelicerae stout, with short, sharp, needlelike apices. Palpi two-segmented, of uniform width throughout.

**Genital papilla.**—Very broad and short. Genital flap small, inconspicuous. Penis stout, conical, extending to tip of papilla. Accessory sclerites well sclerotized, acuminate at tips.

*Leg IV.*—Short, stout, slightly swollen. Coxa subtriangular, broader than long; coxal seta apparently absent. Femur about twice as long as the other segments taken together, swollen laterally, and with inner margin produced to form an angle near base of segment; proximal femoral seta marginal, situated at about one-third the distance from base to apex of segment; inner distal femoral seta submarginal, situated at about one-half its length from apex of segment and extending to tip of tarsal claw; outer distal femoral seta submarginal, situated almost directly opposite the inner distal seta and of about the same size. Tibiotarsus broader than long and with incomplete transverse suture; tactile seta rigid, almost straight, somewhat shorter than femur; clavate seta small, situated near base of segment; only one tarsal seta observed; tarsal claw short, stout, strongly curved, and acuminate at apex.

Total length, 0.128 mm; total width, 0.077 mm.

#### FEMALE

*General appearance.*—Well-fed females stout and oval, the capitulum appearing as a small cone. Freshly mounted specimens of a uniform light yellowish-brown color.

*Tarsus I.*—Long, rather slender, tapering to apex. Distal sense seta clavate, rather short, situated dorsally at middle of segment. Proximal sense seta about one-half as long as distal, situated dorsolaterally, less than its length from base of segment, and nearer to base than any simple seta. Tarsus terminated by a single strongly curved claw and a very small pulvillus.

*Leg IV.*—Short, in well-fed specimens not reaching margin of body. Coxa as broad as long. Trochanter ringlike, about twice as broad as long. Third segment much longer than the other three segments combined; basal seta situated on lateral margin at about one-half its length from base, slightly curved and longer than usual; subapical seta short, inconspicuous, situated laterally. Fourth segment very short, about one-fourth as long as third segment; subapical seta scarcely stouter than apical, about as long as third segment; apical seta flagelliform, fully as long as the leg itself.

Total length, 0.209 mm; total width, 0.121 mm.

#### LARVA (Unknown)

#### Egg

Short, oblong-oval, each end equally and broadly rounded. Surface smooth, without granules. Freshly mounted eggs with a pale yellowish tinge when viewed by transmitted light.

Length, 0.106 mm; width, 0.077 mm.

*Type host.*—*Fragaria* sp.

*Type locality.*—Massachusetts.

*Type slide.*—United States National Museum No. 1128.

For some time the present writer confused this species with *approximatus* Banks. It is, however, very different from *approximatus*, and Banks' species should be regarded as a synonym of *chionospirivorus* Ewing, as is shown elsewhere in this paper.

Material examined as follows:

#### District of Columbia:

On *Chrysanthemum* sp., November 1 and December 19, 1933, F. F. Smith.

On *Fuchsia speciosa* (common fuchsia), September 14, 1934, F. F. Smith.

On *Verbena* sp., February 5, 1934, F. F. Smith.

#### Maryland:

On *Fragaria* sp. (strawberry), Bell, January 12, 1934, and Beltsville, October 16, 1933, F. F. Smith.

#### Massachusetts:

On *Fragaria* sp. (strawberry), 1929, Dr. Piakidas.

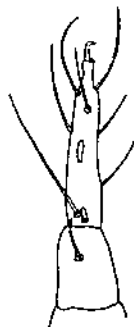


FIGURE 10.—*Tarsonemus simplex*, new species. Underside view of tibia and tarsus of leg I of female.  $\times 800$ .

## New York:

On *Cuscuta* sp. (dodder), Pelham, August 20, 1934, F. F. Smith.

On *Gerbera jamesoni* (flame-ray gerbera), Babylon, January 17, 1934, F. F. Smith.

On *Iris kaempferi*, Brooklyn, August 2, 1934, F. F. Smith.

## Oregon:

On *Malus sylvestris* (apple tree, underside of leaf), Corvallis, September 17, 1912, H. E. Ewing.

## Virginia:

On *Chrysanthemum* sp., Alexandria, August 11, 1934, "M. H. R."

On *Delphinium* sp. (larkspur), Arlington, January 19, 1934, F. F. Smith.

On *Geum juliana*, Arlington, January 25, 1934, F. F. Smith.

On *Pyrethrum* sp., Arlington, July 16, 1934, F. F. Smith.

## Wisconsin:

Infesting cultures at plant pathology laboratory, University of Wisconsin.

## TARSONEMUS ANANAS Tryon

(Figs. 11 and 12)

This species was described by Tryon (30) in 1908. No synonyms are known.

## MALE

Since males are not at hand for description, the original description of this sex by Tryon is quoted:

*Male*.—Oval in shape, with the hinder margin rounded. A narrow linear groove crossing the body immediately behind the second pair of legs divides it into two unequal parts. In front of this line it narrows to the foreborder of the head, and somewhat widens behind it. It measures from  $173\mu$  to  $188\mu$  in length, and from  $75\mu$  to  $76\mu$  in extreme breadth, being somewhat smaller than is the female. The head and sexual (?) organs, that terminate the body in front and behind respectively, are almost identical in form and size, being ovate and slightly excavated at the base and terminally rounded. The latter, however, is somewhat the larger of the two. Two short setae occur on each side between the second and third pairs of legs, and one on each side of the sexual organ. The first pair of legs extend beyond the rostrum, and the second pair almost equal them. Both they and the third pair are composed of five joints, and are nearly identical in form. The first pair each terminates in a single claw, and has three small fusiform sensory bodies on the outer borders of their last joint or tarsus. The second and third pairs are two-clawed, and the former have apparently one sensory club only on their tarsi; each has a few—one or two of which are rather long—outwardly directed setae on the four distal joints. The third and fourth pairs of legs extend far beyond the posterior border of

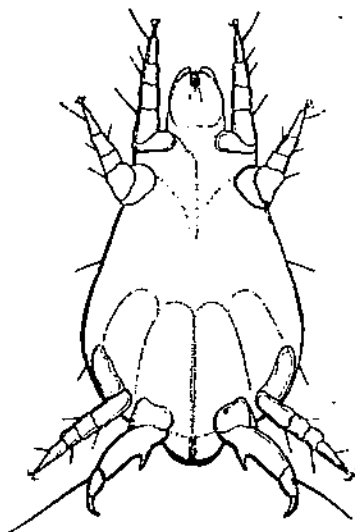


FIGURE 11.—*Tarsonemus ananas* Tryon. Ventral view of male, greatly enlarged. (Tryon.)

the body. The legs constituting the fourth pair are very robust. Their first joint is broader than long; the second is rather more than twice as long as broad, and is furnished on the inner face with a stout, sharply pointed toothlike expansion, and with a short, terminally widened tactile bristle at the extremity of the joint beyond it; the third joint has a longer, stout, backwardly directed seta on its dorsum; the fourth joint is very short, and terminates in a single, stout, slightly curved, gradually pointed claw. The epimera of the first pair meet at an angle at the middle line, and then form a nar-

row longitudinal keel that extends beyond the origin of the second pair of legs. The epimera of the third pair conjoin those of the fourth pair internally, and the four together are considerably and equally advanced in front.

## FEMALE

*General appearance.*—Elongate, with sides of body parallel for much of their length and posterior end somewhat pointed. Capitulum subcircular.

*Tarsus I.*—Short, about one and two-thirds times as long as tibia. Distal sense seta clavate, dorsal, situated slightly in front of middle of segment. Proximal sense seta clavate, about one-half as long as distal, situated dorsally just in front of large posterior dorsal simple seta. Tarsus I terminated by a single claw and very small pulvillus.

*Leg IV.*—Rather long, extending beyond margin of body for about one-third of its length. Coxa longer than broad. Trochanter as broad as coxa. Third segment about as long as other segments taken together; basal seta apparently absent; subterminal seta small, ventral, extending beyond tip of segment for about one-half its length. Fourth segment scarcely one-half as long as third; subterminal seta rigid, slightly curved, slightly longer than segment that bears it; terminal seta very long, flagelliform, fully as long as leg IV itself and over twice as long as subterminal seta.

Total length, 0.218 mm; total width, 0.104 mm.

## LARVA

Capitulum large subcircular, similar to that of female. Pseudostigmatic organs absent. Tarsus I ending in two sharp, strongly curved, subequal claws and a pulvillus. Abdomen constricted behind posterior legs to form a large terminal lobe, which is subtriangular and bears a subterminal anal slit, a pair of lateral, curved, simple setae, and a similar pair of somewhat longer subterminal setae.

Total length, 0.192 mm; total width, 0.095 mm.

## EGG (Unknown)

*Type host.*—*Ananas comosus* (pineapple).

*Type locality.*—Southern Queensland, Australia.

*Type slide.*—Location unknown.

*Common name.*—Pineapple tarsonemid mite.

Two females and one nymph examined. They are part of a lot that was taken at Honolulu, Hawaii, by J. F. Illingworth and sent to the writer in 1929. He states: "This mite is giving us trouble on planting material and fruit."

## TARSONEMUS VIRIDIS, new species

(Fig. 13; fig. 24, D)

## MALE

*General appearance.*—Stout-bodied, with rather weak, slender legs. The whole body and its appendages apple green in color, this green being somewhat paler in the latter, particularly toward tips of legs.

*Capitulum.*—Somewhat cone-shaped, distinctly longer than broad, and slightly constricted at base. Chelicerae subfalcate, sclerotized part not so long as palpi. Palpi broad at apex, indistinctly two-segmented.

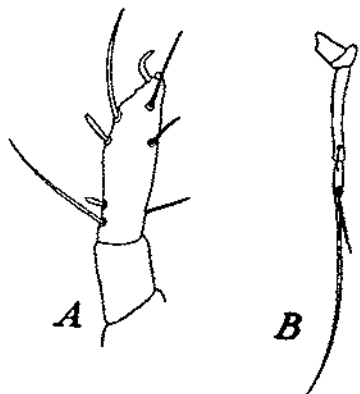


FIGURE 12.—*Tarsonemus ananas* Tryon: A, Outside view of tibia and tarsus of leg I of female; B, ventral view of right leg of last pair in female.  $\times 800$ .

*Genital papilla*.—Small, largely or completely concealed from above. Genital flap absent. Penis very small, needlelike. Accessory sclerites broad; inner terminal angle somewhat acuminate.

*Leg IV*.—Remarkably different in appearance and structure from that in any other known species. Coxa subtriangular, as broad as long; coxal seta marginal, as long as coxa itself; femur scarcely as long as other segments taken together, outer margin convex, inner margin gashed with a deep notch slightly behind its middle, in front of which is a cusp bearing the inner distal femoral seta; proximal femoral seta marginal, situated about its length from base of segment; distal femoral seta situated ventrally on cusp, and extending to tip of leg; outer distal femoral seta marginal, situated about its length from apex of segment. Tibiotarsus of unusual shape, being clavate and without tarsal claw; tactile seta stout, curved, about as long as leg, and situated at end of segment; clavate seta very long, curved, equal in length to tibiotarsus itself, and situated laterally near base of segment; proximal tarsal seta marginal, curved, distinctly longer than distal; distal tarsal seta straight, spinelike, ventral.

Total length, 0.129 mm; total width, 0.080 mm.

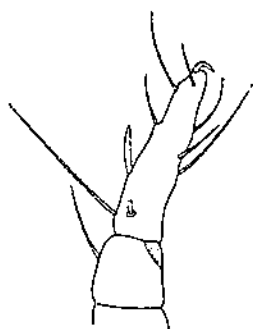


FIGURE 13.—*Tarsonemus viridis*, new species. Outside view of tibia and tarsus of leg I of female.  $\times 800$ .

#### FEMALE

*General appearance*.—Body almost oblong-oval; abdomen somewhat pointed behind. Color apple green throughout, the tips of the legs being of a lighter tinge.

*Tarsus I*.—Rather long and tapering somewhat toward tip. Distal sense seta large, spinelike, situated dorsally a little more than its length from base of tarsus. Proximal sense seta minute, clavate, situated dorsolaterally about its length from base of tarsus and about as far from base as first simple seta. Tarsus ending in a single, sharp, strongly bent claw and vestigial pulvillus.

*Leg IV*.—Short, not reaching margin of body. Coxa subquadrangular, longer than broad. Trochanter ringlike, about three times as broad as long. Segment III fully as long as other segments taken together and indistinctly separated from segment IV; basal seta absent; subterminal seta ventral, extending beyond tip of segment by one-half its length. Segment IV about one-third as long as segment III; subterminal and terminal setae subequal, both terminal in position and in length equal to third and fourth segments combined.

Total length, 0.201 mm; total width, 0.104 mm.

#### LARVA

Stout, almost as broad as long, apple green, with rather slender legs. Capitulum as in adults. Pseudostigmatic organs absent. Tarsus I attenuate, with two equal, slender, curved claws, but apparently without pulvillus. Narrowed part of abdomen composed of three segments, the most anterior of which is the broadest and bears dorsally a transverse row of four subequal, curved setae. The next to last segment bears a pair of conspicuous lateral setae and the last segment a pair of conspicuous subterminal setae.

Total length, 0.156 mm; total width, 0.083 mm.

#### Egg

Short, oblong-ovate. Surface smooth. Color apple green, the same as in adults. Only two eggs, in poor condition, observed; both had been crushed.

*Type host*.—*Fragaria* sp.

*Type locality*.—Bell, Md.

*Type slide*.—United States National Museum No. 1129.

*Common name*.—Green tarsonemid mite.

Only two lots taken: Specimens in all stages from type host (strawberry), at type locality, October 16, 1933, by F. F. Smith; and a single

female taken with several specimens of *T. pallidus* Banks on *Cyclamen indicum*, San Jose, Calif., November 19, 1934, by Leslie Smith.

This species is an isolated one and probably some day will be placed in a new genus. The male departs widely in its characters from the other males of *Tarsonemus*, but the female is much more like the females of the other species.

#### TARSONEMUS LAMINIFER, new species

(Fig. 24, E)

##### MALE

*General appearance.*—Body small, stout, with rather large, conspicuous legs. Freshly mounted specimens of a uniform yellowish color.

*Capitulum.*—Almost as broad as long, dome-shaped. Palpi of about uniform width throughout, indistinctly two-segmented.

*Genital papilla.*—Almost as broad as long. Genital flap on dorsal side of papilla and in the form of a crescent, its length equal to width of papilla, the front margin of which is distinct and definite while the posterior margin is indefinite. Penis a sharp-pointed cone, the tip of which reaches to the apex of the papilla. Accessory sclerites very broad, truncate distally.

*Leg IV.*—Slightly longer than leg III. Coxa subtriangular, as broad as long; coxal seta short, dorsal, situated near posterior margin of segment. Femur about as long as other segments taken together, with an inner blade-like expansion which extends from near base to apex of segment. Proximal femoral seta short, submarginal, situated a little more than its length from base of segment; inner distal femoral seta large, conspicuous, slightly curved, situated about two-thirds its length from apex of segment; outer distal femoral seta small, submarginal, less than one-half as long as inner distal seta and situated almost opposite the latter. Tibia distinctly longer than broad, outer margin nearly straight, inner margin with crescentic emargination; tactile seta very long and curved, equal to femur in length and situated apically; clavate seta marginal and apical. Tarsus small, as broad as long, bearing two subequal tarsal setae and the long, slender, curved, sharp tarsal claw.

Total length, 0.128 mm; total width, 0.088 mm.

##### FEMALE

*General appearance.*—Outline of body oblong-oval. Legs short and weak. Most of freshly mounted specimens a light yellowish brown, but one a uniform apple green, which is probably the color of live specimens.

*Tarsus I.*—Long, slightly arched near its base, and tapering toward apex. Distal sense seta long, spinelike, situated dorsally about its length from base of segment. Proximal sense seta minute, almost invisible, situated dorsolaterally slightly nearer base of the segment than the first simple seta. Tarsus terminating in a single, slender, strongly curved, sharp claw and a small pulvillus.

*Leg IV.*—Very short, not reaching margin of body. Coxa subtriangular, slightly broader than long. Trochanter about two-thirds as broad as coxa and somewhat broader than long. Third segment short, not equal to combined lengths of other segments; basal seta small, in length scarcely equal to one-half width of segment III, situated on inner margin at base of segment; subapical seta apparently absent. Segment IV about two-thirds as long as segment III; subapical seta slightly curved, about as long as segment IV; apical seta more slender than subapical seta and about twice as long.

Total length, 0.165 mm; total width, 0.117 mm.

##### LARVA AND EGG (Unknown)

*Type host.*—*Fragaria* sp.

*Type locality.*—Bell, Md.

*Type slide.*—United States National Museum No. 1130.

Described from several males and females taken from type host (strawberry) at type locality, October 16, 1933, by F. F. Smith.

## TARSONEMUS FEMORALIS, new species

(Fig. 24, F)

## MALE

*General appearance.*—Body much longer than broad, with legs conspicuous. Freshly mounted specimen almost colorless, but showing a tinge of pale yellow.

*Capitulum.*—Longer than broad, dome-shaped, reaching middle of tibia I. Chelicerae subfulcate. Palpi rather slender, two-segmented; distal segment narrower than basal.

*Genital papilla.*—Slightly longer than broad, extending beyond posterior margin of abdomen by about one-half its length. Genital flap consisting of a hyaline flange extending in a circle around papilla near its apex. Penis with distal part needlelike, and in repose not reaching apex of papilla. Accessory sclerites each with bulbous base and acuminate apex.

*Leg IV.*—Slightly longer than leg III. Coxa quadrangular, broader than long, with coxal seta situated ventrally in posterolateral corner. Femur slightly longer than other three segments taken together and with hyaline expansion on inside extending from base to inner distal femoral seta; proximal femoral seta small, short, curved, situated on inner margin of hyaline expansion of femur; inner distal femoral seta large, conspicuous, almost straight, situated on inner margin of femur at distal end of hyaline expansion; outer distal femoral seta equal to inner, and situated dorsally about one-half its length in front of the latter. Tibia about twice as long as wide, outer margin nearly straight, inner margin concave; tactile seta subapical, extending beyond tip of tarsal claw by one-half its length; clavate seta situated dorsally opposite tactile seta. Tarsus much broader than long; tarsal setae divergent, subequal; tarsal claw large, with acuminate tip, more than twice as long as tarsus.

Total length, 0.196 mm; total width, 0.099 mm.

## FEMALE, LARVA, AND EGG (UNKNOWN)

*Type host.*—*Rubus* sp.

*Type locality.*—Rosslyn, Va.

*Type slide* (holotype).—United States National Museum No. 1131.

Described from a single male taken in association with *T. smithi*, new species, and *T. confusus*, new species, on black raspberry, November 23, 1933, by F. F. Smith. Because only a single specimen of this species was found, the writer hesitated to regard it as new, and there is a possibility that the holotype represents a very abnormal specimen of *smithi*.

## TARSONEMUS BANCROFTI Michael

(Fig. 25, A)

This species was described by Bancroft (1) in 1877 but was not named until 1890, when Michael (23) proposed for it the name "*Tarsonemus bancrofti*." It has as a synonym *Tarsonemus spinipes* Hirst (17), described in 1912.

## MALE

*General appearance.*—Body characteristically shaped, there being a constriction at the junction of the cephalothorax and abdomen and that part of the abdomen posterior to the third pair of legs being cone-shaped. Legs large and conspicuous. In life the body surface of the male, as well as of the female, has a soft, satiny appearance.

*Capitulum.*—Subcircular in outline, as broad as long. Each chelicera ending in a minute, fine, needlelike tip. Palpi small, tapering apically, convergent, two-segmented.

*Genital papilla.*—Longer than broad, constricted at base, distinctly dorsal in position, and bearing dorsally a conspicuous submarginal pair of simple setae. Genital flap absent. Penis in repose falling far short of apex of papilla, and ending in an upwardly turned hook. Accessory sclerites very short, with swollen bases, and not reaching apex of papilla.

*Leg IV.*—Shorter than leg III and situated laterally. Coxa quadrangular, greatly enlarged, longer than broad; coxal seta marginal, conspicuous. Femur about as long as the other segments taken together, with a large, broadly rounded, inner hyaline lobe which extends to neither base nor apex of segment; proximal femoral seta apparently absent; inner distal femoral seta situated dorsally slightly distad to middle of segment; outer distal femoral seta short, curved, marginal, situated opposite inner distal femoral seta. Tibia as broad as long and indistinctly separated from tarsus; tactile seta stout, rigid, fully twice as long as tibia and tarsus combined; clavate seta situated dorsally in posterolateral corner of segment. Tarsus broader than long; one tarsal seta setiform and in usual position; other tarsal seta apparently absent; tarsal claw stout, curved, with slightly rounded apex.

Total length, 0.209 mm; total width, 0.108 mm. Males of this species vary greatly in size. One very dark male has a total length of 0.288 mm and a total width of 0.142 mm.

#### FEMALE

*General appearance.*—Unusually long, with rather small, circular capitulum and medium-sized legs.

*Tarsus I.*—Short, broad distally, about one-third longer than tibia. Distal sense seta clavate, about as long as one-half width of tarsus and situated at about one-third the distance from apex to base of segment. Proximal sense seta not observed. Tarsus ending in a well-developed pulvillus and a sharp, slender, curved claw.

*Leg IV.*—Very slender, extending beyond margin of body for about one-third its length. Coxa triangular. Trochanter very short, being fully three times as wide as long. Third segment very much longer than other segments taken together; basal seta apparently absent; subapical seta dorsal, extending beyond end of segment for about one-half its length. Fourth segment very short, scarcely one-third as long as segment III; subapical seta stout, curved, twice as long as segment IV itself; apical seta very long, flagelliform, fully twice as long as subapical seta.

Total length, 0.209 mm; total width, 0.115 mm.

#### LARVA

Very long and slender. Capitulum small, fully as broad as long. Pseudo-stigmatic organs absent. Tarsus I stout, ending in a large pulvillus and two sharp, slender, strongly curved, subequal claws. Three pairs of legs similar, subequal. Pair of lateral setae on posterior part of abdomen short, nearly straight, and subequal with pair of subapical setae.

Total length, 0.316 mm; total width, 0.110 mm.

#### APODOUS NYMPH

Inside the skin of a quiescent larva was found an apodous skin, and inside this apodous skin a completely formed adult female.

Apodous nymph with cephalothorax distinctly broader than abdomen and capitulum represented by undifferentiated cone.

Third pair of legs of adult female formed immediately under third pair of larval legs (inside of apodous skin) and probably homologous with the latter. Added pair of legs in adult appear to be the fourth pair.

#### EGG

Long, oblong-oval; ends broadly and equally rounded. Surface of eggshell smooth, without marks of any kind.

Length, 0.126 mm; width, 0.064 mm.

*Type host.*—*Saccharum officinarum*.

*Type locality.*—Australia.

*Common name.*—Sugarcane tarsonemid mite.

Material examined as follows:

From North America.—One lot of specimens (Acc. No. 720) in all stages on sugarcane, Rio Piedras, P. R., July 28, 1913, T. H. Jones; live material on

samples of sugarcane from greenhouse, Arlington, Va., February 5, 1935, R. D. Rands; and many females from sorghum hybrids and New Guinea canes on Government experimental plots, Canal Point, eastern edge of Everglades, Fla., January 23, 1936, W. J. Ingram.

From South America.—Six males (No. 610) on sugarcane, Vicosia, Brazil, November 8, 1932, E. J. Hambleton.

From Philippine Islands.—Male, female, and two larvae (M. A. 118) on sugarcane, San Pagio, Negros Island, July 24, 1929, W. D. Pierce.

According to F. F. Smith, the adults of this species are the only ones in the genus *Tarsonemus* observed by him to have in life a soft, satiny appearance, all others being smooth and polished.

*Tarsonemus bancrofti* was redescribed by Hirst (17) in 1912 under the name of *T. spinipes*. Hirst claimed that the figures given by Bancroft were not accurate enough properly to identify a species of the genus. With this the present writer is inclined to take issue. In fact, the description of the habits and the nature of injury caused by the mites as given by Bancroft would alone virtually identify his species.

When studies on these tarsonemid mites were begun by the present writer, no record of *T. bancrofti* for the United States was known. The species has now been eradicated at Arlington, Va., and measures have been taken toward its eradication at Canal Point, Fla.

#### TARSONEMUS SPIRIFEX Marchal

(Fig. 25, B)

This species was described by Marchal (21) in 1902, and has no known synonyms.

#### MALE

*General appearance.*—Body stout, slightly constricted at junction of cephalothorax with abdomen, broadest near middle, cone-shaped posteriorly. Freshly mounted males very slightly yellowish.

*Capitulum.*—Subcircular in outline, slightly broader than long, and with basal one-third concealed from above by a necklike extension of cephalothorax. Chelicerae subfalcate. Palpi strongly convergent, tapering to acuminate apices, without indication of segmentation.

*Genital papilla.*—Much longer than broad, situated dorsally so that basal half is concealed from below by abdomen. Genital flap absent. Penis long, slender, needlelike for most of its length. Accessory sclerites long, broader at apex than in middle, and reaching tip of papilla.

*Leg IV.*—Short, stout. Coxa very large, subquadrangular, longer than broad; coxal seta situated ventrally at middle of segment, extending backward almost to posterior margin of same. Femur about as long as other segments taken together, about twice as broad at base as at apex; hyaline expansion a large, rounded lobe arising from a large tubercle on inner margin and divided into an inner and an outer zone by a crescentic line; proximal femoral seta short, curved, situated at base of hyaline expansion; inner distal femoral seta somewhat larger than proximal and situated ventrally near apex of tubercle, bearing hyaline expansion; outer distal femoral seta situated on margin a little more than its length from apex. Tibia cylindrical, slightly longer than broad; tactile seta long, curved, two-thirds as long as femur; clavate seta peglike, submarginal, situated ventrally. Tarsus broader than long, with one seta; tarsal claw very short, stout, acuminate at apex, about as long as tarsus itself.

Total length, 0.214 mm; total width, 0.102 mm.

#### FEMALE

*General appearance.*—Body very long and distinctly segmented. Pseudostigmatic organs with long, apically pointed heads. Legs rather small.

*Tarsus I.*—Short, broad at apex, one and one-half times as long as tibia. Distal sense seta short, peglike, situated dorsally about its length from apex of

tarsus. Proximal sense seta not observed. Tarsus ending in a pulvillus and a single, strongly curved, sharp claw.

*Leg IV.*—Of medium length, reaching slightly beyond margin of body. Coxa large, quadrangular, slightly longer than broad. Trochanter very short, ringlike, about three times as broad as long. Third segment fully as long as the other segments taken together; basal seta as long as subapical seta, situated ventrolaterally at base of segment; subapical seta ventral, extending almost to tip of fourth segment. Fourth segment about one-third as long as third segment; subapical seta about two-thirds as long as third segment; apical seta flagelliform, twice as long as subapical seta.

Total length, 0.300 mm; total width, 0.122 mm.

#### APODOUS NYMPH

A quiescent larva reveals the form of an apodous nymph inside, which is similar to the larva in shape except posteriorly, where the abdomen ends in a bilobed expansion. Setae and mouth parts absent.

#### LARVA

Very long, with capitulum much broader than long. Pseudostigmatic organs absent. Tarsus I stout, about one and one-half times as long as tibia and ending in a pulvillus and two sharp, strongly curved, subequal claws. Last abdominal segment with a pair of subapical setae and a pair of slightly shorter lateral setae. Next to last abdominal segment with a transverse dorsal row of four subequal setae near its posterior margin.

Total length, 0.311 mm; total width, 0.165 mm.

#### EGG

Short, almost as broad as long. Equally rounded at both ends. Surface of shell smooth, without granules, tubercles, or marks of any kind.

Length, 0.115 mm; width, 0.068 mm.

*Type host.*—*Avena sativa* (oats).

*Type locality.*—Vienna, Austria.

*Common name.*—Oat mite.

Described from specimens in all stages taken on *Panicum obtusum* (panic grass) at Douglas, Ariz., August 25, 1932, by W. W. Jones. This species is known as a pest on oats in Europe.

#### TARSONEMUS PALLIDUS Banks

(Fig. 14; fig. 23, C)

Described by Banks (2) in 1898. *Tarsonemus fragariae* Zimmermann (35), described in 1905, and *T. destructor* Reuter (27), described in 1906, are synonyms.

#### MALE

*General appearance.*—Body well proportioned. Legs medium in size and length. Live specimens of a pale yellowish brown, and not differing in this respect from several other species.

*Capitulum.*—Rather slender, much longer than broad; sides convergent and almost straight. Chelicerae needlelike. Pulpi of uniform width throughout, slightly convergent, two-segmented.

*Genital papilla.*—Very broad, broader than long, ventral in position; basal two-thirds concealed from above by abdomen. Genital flap conspicuous, dorsal, as broad as papilla itself. Penis slender, needlelike, in repose reaching apex of papilla.

*Leg IV.*—Very stout, slightly longer than leg III. Coxa triangular, as broad as long; coxal seta short, curved, ventral, and submarginal. Femur about equal in length to other segments taken together, outer margin strongly outcurved; hyaline expansion a large rounded lobe attached to inner margin of femur for posterior two-thirds of length of latter; proximal femoral seta minute, fre-

quently overlooked, situated ventrally at beginning of hyaline expansion; inner distal femoral seta much enlarged, extending to tip of tarsal claw and situated very near posterior margin of femur; outer distal femoral seta short, spinelike, dorsal, submarginal, situated at about twice its length from distal end of femur. Tibiotarsus longer than broad; tactile seta very long, curved, fully as long as leg IV itself; clavate seta clavate, dorsal, submarginal, extending beyond lateral margin of segment by about half its length; tarsal setae divergent, situated on low tubercle, varying somewhat in thickness, the front seta in some specimens being twice as stout as the rear seta; tarsal claw stout, moderately curved, rounded at apex.

Total length, 0.207 mm; total width, 0.106 mm.

#### FEMALE

*General appearance.*—Body with rather small, slender capitulum, medium-sized legs, and pointed abdomen.

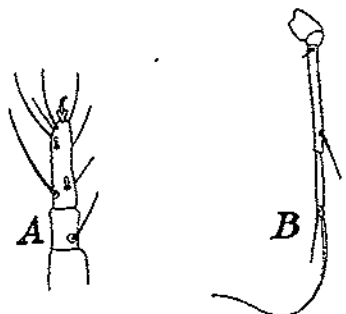


FIGURE 14. — *Tarsonemus pallidus* Banks: A, Outside view of tibia and tarsus of leg I of female; B, ventral view of right leg of last pair in female.  $\times 800$ .

Live specimens of various shades of light yellowish brown, except for newly emerged individuals, which are whitish.

*Tarsus I.*—One and a half to almost two times as long as tibia and narrowed apically only slightly. Distal sense seta small, clavate, situated dorsally at about twice its length from apex of tarsus. Proximal sense seta clavate, subequal to distal sense seta, situated dorsolaterally at about twice its length from base of tarsus and farther from base of latter than one of simple setae. Tarsus ending in a pulvillus and a single, sharp, strongly curved claw.

*Leg IV.*—Extending beyond margin of body by about one-half the length of fourth segment. Coxa slightly longer than broad. Trochanter about twice as broad as long, ringlike. Third segment not quite so long as the other three segments taken together; basal seta minute, situated at base of segment, in length scarcely equal to width of

segment; subapical seta situated ventrolaterally, extending to middle of segment IV. Fourth segment long, three-fifths as long as third segment; subapical seta almost straight, scarcely as long as segment IV; apical seta flagelliform, about as long as leg IV itself.

Total length, 0.229 mm; total width, 0.096 mm.

#### APODOUS NYMPH

The presence of an apodous nymph is indicated by a study of the quiescent stages. As in some other species, the nymphal cuticle is without setae. The legs of the adult are not formed inside the larval legs, but from the material that has undergone histolysis inside the skin of the apodous nymph.

#### LARVA

Long, slender; abdomen divided into four segments. Capitulum as in adults. Pseudostigmatic organs absent. Tarsus I short, slightly longer than tibia, with a single clavate sense seta situated dorsally slightly behind middle of segment, and ending in a pulvillus and two strongly curved, sharp, subequal claws. First abdominal segment much the largest and bearing third pair of legs; second abdominal segment about three times as broad as long and bearing dorsally a single pair of simple setae; third abdominal segment much smaller than second, bearing dorsally a transverse row of four setae, the inner pair slightly longer than the outer pair; fourth and last abdominal segment triangular, with a pair of lateral and a pair of subapical setae.

Total length, 0.213 mm; total width, 0.094 mm.

Male and female larvae are essentially similar when young. F. F. Smith states that as they become older the male larvae are observed to be more slender than the female larvae. After becoming quiescent the formation of the different sexes changes rather markedly the shape of the old larval skin. The developing female is more elongate than the male, and the last two pairs of legs of this sex protrude into the last abdominal segment of the old larval skin, whereas a developing male stretches the old larval skin at the middle of the abdomen and leaves the last abdominal segment of the old larval skin vacant and whitish.

#### Egg

Elongate, oblong-oval, the two ends equally rounded, but not so broadly rounded as in most species. Surface of chorion smooth, without granules or marks of any kind.

Length, 0.096 mm.; width, 0.054 mm.

*Type host*.—*Chrysanthemum* sp.

*Type locality*.—Jamaica, N. Y.

*Type*.—United States National Museum No. 1132.

*Common name*.—Cyclamen mite.

Floyd F. Smith and the present writer (15) hold that the arsonemid mite of Europe, *Tarsonemus fragariae* Zimmermann, is only a synonym of *T. pallidus* Banks, notwithstanding opinions to the contrary that have been held by some other workers. It has been claimed by Massee (22) that the setae of the third segment of the last pair of legs of the male in *fragariae* are different from those of *pallidus*. In particular he has insisted that the tarsal setae of *pallidus* are "very much weaker" than those of *fragariae*. Also, it has been claimed that the setae on the second segment (femur) of the hind leg of the male differ in the two species.

The writer has had the opportunity of comparing European specimens undoubtedly representing *fragariae* with *pallidus*. Specimens of the former were sent to Washington by Massee from East Malling, Kent, England, where they had been taken from strawberry plants. When these English forms were compared with the American forms of *pallidus*, no differences could be observed.

Certain specimens of both *fragariae* and *pallidus* were found in which the tarsal setae of leg IV of the male were enlarged, particularly the anterior tarsal seta, but there was much variation in this respect, and this variation was observed in both the European and the American material. Likewise, a comparison between the setae of femur IV of the male in the English and American representatives showed no real differences, those that were said to occur being due either to individual variations or to differences in mounting technique.

Leslie Smith has been investigating the strawberry tarsonemid mite of California, which he originally considered as *Tarsonemus fragariae*. Like Massee, he held that there was a difference between the true *fragariae* and *pallidus*. The writer, however, has carefully compared specimens on strawberry from California with eastern specimens of *pallidus* and has found that they agree in structural characters. The supposed difference in the clavate seta of leg IV of the male is due to apparent variations in this structure in different positions. Since this comparison was made, Floyd F. Smith has successfully transferred the

California forms from strawberry to cyclamen plants, thus indicating their racial identity with *pallidus*.

*Tarsonemus destructor* Reuter is a synonym of *T. fragariae* Zimmermann. Reuter's figure shows the anterior tarsal seta of leg IV of the male to be very much heavier than the posterior tarsal seta, even exaggerating the extreme variation in size of this seta. Doubtless this one fact has had much to do with later beliefs that *T. fragariae* and *T. pallidus* are distinct species.

The North American material of *Tarsonemus pallidus* examined is as follows:

Alabama:

On *Cyclamen indicum*, Auburn, F. F. Smith.

California:

On *Fragaria* sp. (strawberry), Long Beach (on plants from Arkansas), October 7, 1934, L. M. Smith; Los Angeles (on plants from Eastern States), October 3, 1934, L. M. Smith; Salinas (no date); San Jose, May 1, 1935; Sawyers Bar (Siskiyou County), September 14, 1934, Bruce Butler; Stanton, October 3, 1934, L. M. Smith; Watsonville, October 30, 1934, L. M. Smith; no locality, October 6, 1934, L. M. Smith.

Canada:

On *Cyclamen indicum*, Jordan, Ontario, November 13, 1916, W. A. Ross.  
On *Fragaria* sp. (strawberry), Vineland, Ontario, July 23, 1928, W. A. Ross.  
On *Fragaria* sp. (wild strawberry), Ottawa District, 1929.  
On *Heliotropium* sp., Ottawa, December 15, 1898, J. Fletcher.

Connecticut:

On *Antirrhinum* sp. (snapdragon), New Haven, January 5, 1914, S. T. Bradley.  
On *Cyclamen indicum*, Hartford, December 12, 1913, Q. S. Lowry.

District of Columbia:

On *Amaranthus retrofractus* (pigweed), May 10, 1933, F. F. Smith.  
On *Begonia* sp. (wax begonia), March 13, 1933, and November 13, 1931, F. F. Smith.  
On *Chrysanthemum* sp., December 1, 1934, F. F. Smith.  
On *Chrysanthemum* sp. (marguerite), July 10, 1931, F. F. Smith.  
On *Crassula rubicunda*, May 10, 1933, F. F. Smith.  
On *Cyclamen indicum*, January 25, 1934, H. H. Richardson; October 21, 1933, F. F. Smith; February 11, 1911 (collector?).  
On *Delphinium ajacis* (rocket larkspur), July 23, 1931, F. F. Smith.  
On *Delphinium belladonna*, June 21, 1933, F. F. Smith.  
On *Fragaria* sp. (strawberry), December 9, 1926, W. B. Wood; October 26, 1928, G. M. Darrow.  
On *Gerbera jamesoni* (flame-ray gerbera), June 18, 1934, F. F. Smith.  
On *Iresine* sp., August 2, 1933, F. F. Smith.  
On *Oxalis* sp., May 10, 1933, F. F. Smith.  
On *Plantago major* (common plantain), September 12, 1933, F. F. Smith.  
On *Portulaca oleracea* (common purslane), September 12, 1933, F. F. Smith.  
On *Rubus laciniatus* (cutleaf blackberry), January 28, 1935, F. F. Smith.  
On *Vaccinium* sp., December 17 (year?).  
On *Verbena* sp., February 5, 1934, F. F. Smith.  
On *Veronica peregrina* (purslane speedwell), May 10, 1933, F. F. Smith.

Illinois:

On *Felicia* sp., Urbana, October 14, 1921, F. O. Otanes.  
On *Petunia* sp., Urbana, April 1919.

Indiana:

On *Chrysanthemum* sp., Richmond, October 29, 1926.  
On *Delphinium* sp. (larkspur), Indianapolis, July 18, 1927, H. F. Dietz.

Maine:

On *Delphinium belladonna* (belladonna larkspur), Kingfield, June 19, 1933, F. F. Smith.

Massachusetts:

On *Cyclamen indicum*, Nahant, November 12 (year?), T. Roland.  
On *Delphinium* sp. (larkspur), Brookline.

Maryland:

- On *Dianthus* sp. (carnation), Suitland, November 5, 1931, F. F. Smith.
- On *Geranium* sp., White Marsh, June 1, 1916, E. R. Sasscer.
- On *Gerbera jamesoni* (flame-ray gerbera), Oukland, April 25, 1934, F. F. Smith.
- On *Lantana* sp., White Marsh, September 28, 1931, F. F. Smith.
- On *Parthenocissus tricuspidata* (Boston ivy), White Marsh, September 28, 1931, F. F. Smith.

Michigan:

- On *Cyclamen indicum*, East Lansing, January 25, 1921.

Minnesota:

- On *Antirrhinum* sp. (snapdragon), Mankato, December 1, 1927.
- On *Chrysanthemum* sp., Mankato, December 1, 1927.
- On *Cyclamen indicum*, Mankato, December 1, 1927.
- On "saxifrage flowers," Mankato, December 1, 1927.

Mississippi:

- On *Cyclamen indicum*, Agricultural and Mechanical Arts College, 1929, L. E. Miles.

New Hampshire:

- On *Cyclamen indicum*, Bennington, February 13, 1933, F. F. Smith.

New York:

- On *Chironia linoides*, New York City, January 19, 1934, F. F. Smith.
- On *Chrysanthemum* sp. (in greenhouse), Jamaica, F. A. Sirrine (type material); Larchmont, October 23, 1928; Staten Island, 1923; New York City, October 11 and 18, 1934, F. F. Smith.
- On *Cyclamen indicum*, Ithaca, March 19, 1914, C. H. Crosby; New York City, no date, H. S. Adams; no locality, November 2, 1933, F. L. Gambrell.
- On *Dahlia* sp., Rochester, October 28, 1931, F. F. Smith.
- On *Delphinium* sp. (larkspur), Amsterdam, June 10, 1933, F. F. Smith; Rochester, April 15, 1929, W. E. Blauvelt; Watkill, 1930.
- On *Fragaria* sp. (strawberry), Geneva, June 29, 1928, no collector, and July 3, 1928, R. Cecil.
- On *Galinisoga parviflora*, New York City, October 18, 1934, F. F. Smith.
- On *Gerbera jamesoni* (flame-ray gerbera), Babylon, January 17 and 18, 1934, F. F. Smith.
- On *Gerbera* sp., Babylon, February 14, 1931, F. J. Spruijt, and September 9, 1931, H. H. Richardson.
- On *Geum* sp., Sterlington, January 20, 1934, F. F. Smith.
- On *Geum* sp., Sterlington, March 3 and 4, 1934, F. F. Smith.
- No host given, Babylon, February 26, 1929, W. E. Blauvelt.

Ohio:

- On *Cyclamen indicum*, Barberton, October 1927; Columbus, 1929, W. J. Engel.
- On *Delphinium* sp. (larkspur), Springfield, June 1927, J. M. R. Adams; Wooster, June 2, 1922.
- On *Esacum affine*, Barberton, July 10, 1934, F. F. Smith.
- On *Fragaria* sp. (strawberry), Wooster, June 2, 1922, and November 24, 1930.
- On *Pelargonium* sp. (rose geranium), January 9, 1922, J. S. Houser.
- On *Saintpaulia ionantha* (African-violet), Barberton, January 31, 1934, and Urbana, January 29, 1934, F. F. Smith.

Oregon:

- On *Cyclamen indicum*, Corvallis, November 26, 1916, December 10, 1916, and January 19, 1917, G. F. Moznette.

Pennsylvania:

- On *Antirrhinum* sp. (snapdragon), Bala, February 25 (year?); Willow Grove, February 16, 1925, C. F. Doucette.
- On *Chrysanthemum* sp., Camp Hill, December 6, 1933, F. F. Smith; Lancaster, 1928, W. R. Markley, and December 8, 1933, F. F. Smith.
- On *Cyclamen indicum*, Carlisle, December 6, 1933; Chambersburg, December 7, 1933; Lancaster, December 8 and 9, 1933; Hanover, December 7, 1933; all by F. F. Smith.
- On *Delphinium belladonna* (belladonna larkspur), Harrisburg, August 21, 1933, P. Brierley; Millvale, November 3 and 4, 1933, and Stroudsburg, May 29, 1934, F. F. Smith; Willow Grove, February 23, 1924, February 24, 1925, and March 3, 1926, C. F. Doucette.

## Pennsylvania—Continued.

On *Fragaria* sp. (strawberry), Pittsburgh, November 10, 1933, F. F. Smith.  
 On *Impatiens sultani* (snapweed), Chambersburg, December 7, 1933, F. F. Smith.

On *Verbena* sp., Bloomsburg (date?), by Dillon; Lancaster, December 8, 1933, F. F. Smith.

No host given, Willow Grove, August 10, 1924, C. F. Doucette.

## Virginia:

On *Ambrosia artemisiifolia* (ragweed), Arlington, June 19, 1934, F. F. Smith.  
 On *Chrysanthemum parthenium* (feverfew), Arlington, January 21, 1935, F. F. Smith.

On *Delphinium* sp. (larkspur), Arlington, June 19, 1934, F. F. Smith.

On *Fragaria* sp. (strawberry), Arlington, June 19 and August 21, 1934, F. F. Smith.

On *Geum* sp., Arlington, June 29, 1934, F. F. Smith.

On *Oxalis* sp., Arlington, June 19, 1934, F. F. Smith.

On *Rumex acetosella*, Arlington, June 19, 1934, F. F. Smith.

On *Verbena* sp., Arlington, February 13, 1934, F. F. Smith.

## Washington:

On *Cyclamen indicum*, Bainbridge Island, November 1 and 3, 1930, W. W. Baker; Sunnydale, October 26, 1933, C. F. Doucette, October 3, 1933, W. W. Baker and C. F. Doucette, and December 21, 1933, C. F. Doucette.

On *Fragaria* sp. (strawberry), Puyallup, August 28, 1934, and October 8, 1933, W. W. Baker; Sumner, September 15.

On *Kalanchoe coccinea*, Sunnydale, December 17, 1934, C. F. Doucette.

On *Urtica dioica* (nettle), Puyallup, September 13 and 22, 1933, W. W. Baker; Sumner, October 26, 1933, C. F. Doucette and W. W. Baker.

On *Verbena* sp., Renton, February 1, 1934.

No host, Crocker, August 5, 1934, W. W. Baker.

## TARSONEMUS LATIPES, new species

(Fig. 25, D)

## MALE

**General appearance.**—Body stout, compact, with rather short, stout legs. Freshly mounted specimens hyaline, almost colorless.

**Capitulum.**—Small, slender, slightly constricted at base. Chelicerae minute, with needlelike tips. Palpi broadest at distal ends, slightly convergent, indistinctly segmented.

**Genital papilla.**—Long, slender, about twice as long as broad, situated dorsally and scarcely reaching posterior margin of abdomen. Genital flap absent. Penis with slender, needlelike distal part. Accessory sclerites curved, clasperlike, each more or less crescentic.

**Leg IV.**—Short and very broad. Coxa triangular, much broader than long; coxal seta situated on lateral margin and extending to posterior margin of segment. Femur about two-thirds as broad at base as long and fully twice as broad at base as at apex; hyaline expansion a large rounded lobe, about as broad as long, and attached to about middle half of inner margin of femur; proximal femoral seta about three-fifths as long as width of hyaline expansion, situated ventrally at junction of hyaline expansion with femur; inner distal femoral seta long, spine-like, arising from a small tubercle near inner distal angle of femur; outer distal femoral seta almost as long as inner ventral, submarginal, situated about its length from apex of segment. Tibiotarsus considerably longer than broad, with small, flangelike, hyaline expansion on outer margin; tactile seta submarginal, slightly curved, about as long as femur; clavate seta only slightly clavate, situated dorsally near middle of tibiotarsus; only one tarsal seta observed, in usual position; tarsal claw very stout, about twice as long as broad, slightly curved, rounded at apex.

Total length, 0.119 mm; total width, 0.062 mm.

## FEMALE

**General appearance.**—Body long and slender, with sides parallel for most of their length, posterior end rounded. Color of freshly mounted specimens pale yellowish brown.

*Tarsus I*.—About one and one-half times as long as tibia and somewhat tapering toward apex. Distal sense seta rather strongly clavate, situated dorsally about one-half its length from free end of tarsus. Proximal sense seta minute, not clavate, situated dorsolaterally a little over its length from base of segment. Tarsus ending in a well-developed pulvillus and a single, minute, strongly bent, very sharp claw.

*Leg IV*.—Slender, extending slightly beyond margin of body. Coxa trapezoidal, slightly longer than broad. Trochanter ringlike, about three times as broad as long. Third segment very slender, longer than the other segments combined; basal seta not observed; subterminal seta small, marginal, extending beyond tip of segment by one-half its length. Fourth segment short, about one-third as long as third segment; subapical seta not in its usual position but situated ventrally and extending downward and somewhat backward, in length about equal to fourth segment; apical seta very long, in length equalling leg IV itself.

Total length, 0.134 mm; total width, 0.049 mm.

#### LARVA AND EGG (Unknown)

*Type host*.—Unknown.

*Type locality*.—Colombia (?).

*Type slide*.—United States National Museum No. 1133.

Many males and females on unidentified leaf with a species of *Eriophyes* in banana debris, from Colombia, at New York City (N. Y. No. 28237), September 20, 1934, F. O. Dodd collector. This species differs from all North American species in two respects—in the presence of an external hyaline expansion on the outside of tibiotarsus of leg IV of the male, and in the unusual ventral position of the subapical seta of the fourth segment of leg IV of the female.

#### TARSONEMUS PHYLLOPHORUS Ewing

(Fig. 15; fig. 25, E)

Described by the writer (12) in 1924.

#### MALE

*General appearance*.—Peculiar in that the posterior part of the abdomen is decidedly broadened to accommodate the greatly enlarged third and fourth pairs of coxae. Second pair of legs larger than first; third pair much larger than second and apparently adapted for clasping.

*Capitulum*.—Circular in outline, extending forward to tip of tarsus I. Palpi small, convergent, each somewhat cone-shaped and indistinctly segmented.

*Genital papilla*.—Very broad, a third broader than long. Genital flap a dorsal crescentic expansion almost as broad as papilla itself. Penis in repose not reaching apex of papilla. Accessory sclerites very short, slightly convergent, with inner distal corners acuminate.

*Leg IV*.—Greatly shortened and expanded. Coxa subquadrangular; coxal seta marginal, curved, reaching beyond end of coxa. Coxa and femur articulating with each other by means of a conspicuous condyle of the coxa, which rests in a cavity of the acetabular process of the femur. Femur remarkable in that its main axis is bent almost at a right angle near the middle; hyaline expansion a broad rounded lobe, considerably longer than broad, which is attached to about the central half of the femur; proximal femoral seta situated on outside margin of segment at angle of bend; inner distal femoral seta long, conspicuous, submarginal, extending beyond inner margin of hyaline expansion by about one-third of its length; outer distal femoral seta minute, situated on lateral margin at apex of segment. Tibiotarsus as broad as long; tactile seta slightly longer than tibiotarsus itself and



FIGURE 15.—*Tarsonemus phyllophorus* Ewing. Ventral view of right leg of last pair in female.  $\times 800$ .

situated near middle of latter; clavate seta situated on lateral margin; tarsal setae apparently absent; tarsal claw modified into a short knoblike projection. Total length, 0.211 mm; total width, 0.122 mm.

## FEMALE

*General appearance.*—Body long, sides parallel for much of their length; abdomen rounded posteriorly; legs rather short.

*Tarsus I.*—About one and one-third times as long as wide and about twice as long as the very short tibia. Distal sense seta short, clavate, equal in length to about one-half width of tarsus and situated dorsally at about its length from free end of tarsus. Proximal sense seta subequal to distal, situated dorsolaterally at about its length from base to tarsus. Tarsus I ending in a pulvillus and two small, curved, sharp, subequal claws.

*Leg IV.*—Slender, but rather short. Coxa considerably longer than broad. Trochanter much broader than long, anterior margin angularly emarginate. Third segment almost as long as other segments combined; basal seta absent; subapical seta situated on inner margin of segment and extending slightly beyond apex. Fourth segment about one-half as long as third; subapical seta almost straight, slightly longer than segment IV; apical seta flagelliform, about equal to leg IV itself in length.

Total length, 0.228 mm; total width, 0.079 mm.

## LARVA AND EGG (Unknown)

*Type host.*—*Phyllostachys bambusoides*.

*Type locality.*—Brooksville, Fla.

*Type slide.*—United States National Museum No. 23777 (insect book).

*Common name.*—Bamboo mite.

Material examined from localities as follows: Type locality, on type host (bamboo). March 24, 1917, David Fairchild, February 3, 1921, W. B. Wood (F. H. B. 38914), February 12, 15, 1922, H. L. Sanford (S. P. I. 24760 and 23261), and February 18, 19, 1924, W. T. Owrey (Nos. 256, 266, and 270); Yokohama, Japan, on bamboo, November 27, 1922.

This species differs widely from the other members of the genus known to the writer in two respects—the great enlargement of the third pair of legs in the male and the bent nature of femur IV in the same sex.

## TARSONEMUS IOWENSIS, new species

(Fig. 16)

MALE (Unknown)

FEMALE

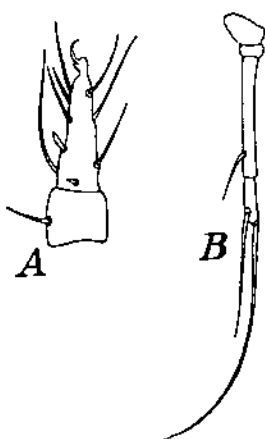


FIGURE 16.—*Tarsonemus iowensis*, new species: A, Outside view of tibia and tarsus of leg I of female; B, ventral view of right leg of last pair in female.  $\times 800$ .

*Tarsus I.*—Tapering from base to apex, about two and one-half times as long as the short tibia. Distal sense seta somewhat spindle-shaped, one-half as long as width of tarsus, situated at about one-third the distance from base of tarsus to its apex. Proximal sense seta about half as long as distal, situated laterally, about its length from base of tarsus and nearer base than any of the simple setae. Tarsus ending in a small pulvillus and a single, strongly curved, sharp claw.

*General appearance.*—Body rather short; posterior margin of abdomen rounded; legs small, third and fourth pairs slender.

*Leg IV.*—Not reaching margin of body. Coxa longer than broad. Trochanter ringlike, twice as broad as long. Third segment equal in length to the other segments taken together; basal seta apparently absent; subapical seta situated laterally and extending beyond tip of segment III by one-half its length; segment IV scarcely one-half as long as segment III; subapical seta about twice as long as segment IV; apical seta about as long as leg itself.

Total length, 0.220 mm; total width, 0.104 mm.

LARVA AND EGG (Unknown)

*Type host.*—*Acer saccharum*.

*Type locality.*—Ames, Iowa.

*Type slide.*—United States National Museum No. 1134.

Description based on three females taken by the writer from inside of nail galls on type host, at type locality, August 30, 1910. This species is most nearly related to *simplex*, new species, from which it differs in having tibia I very much shorter and in a few other characters.

TARSONEMUS TRUNCATUS, new species

(Fig. 17)

MALE (Unknown)

FEMALE

*General appearance.*—Body short, truncate posteriorly. Dorsal integument striated longitudinally. Cephalothoracic plate extending forward to cover much of the capitulum from above. Pseudostigmatic organs strongly clavate.

*Capitulum.*—About twice as long as wide, very broadly rounded in front and constricted at base. Palpi very small, convergent, indistinctly segmented, and tapering to a point at apex.

*Tarsus I.*—One and one-half times as long as tibia. Distal sense seta small, slightly clavate, situated dorsolaterally at about twice its length from anterior end of segment. Proximal sense seta longer than distal, with long pedicel and small head, situated dorsolaterally about its length from posterior margin of tarsus. Just above, and almost contiguous with the proximal sense seta, is a peglike seta which is considerably shorter than the former. Tarsus ending in a rounded pulvillus and a single strongly curved, sharp, tarsal claw.

*Leg IV.*—Rather short. Coxa subtriangular. Trochanter twice as broad as long. Third segment about as long as other segments combined; basal seta minute, about as long as width of segment, and situated approximate to base of same; subapical seta ventral, situated about one and one-half times the width of third segment from apex of latter. Fourth segment short, about one-third as long as third; subapical seta long, slightly curved, equal to leg itself in length; apical seta flagelliform, one and one-half times as long as subapical seta.

Total length, 0.132 mm; total width, 0.078 mm.

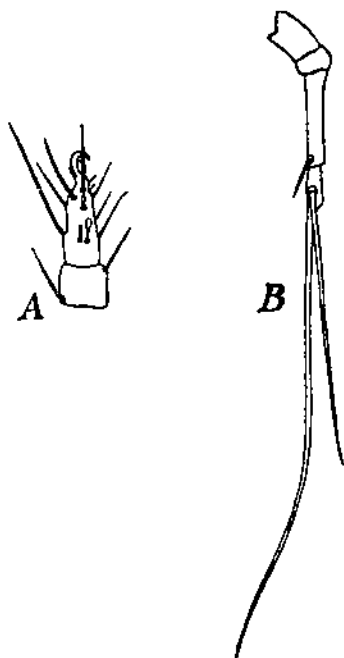


FIGURE 17.—*Tarsonemus truncatus*, new species: A, Outside view of tibia and tarsus of leg I of female; B, ventral view of right leg of last pair in female. X 800.

## LARVA AND EGG (Unknown)

*Type host.*—*Ips oregoni* (Eich.).

*Type locality.*—Coeur d'Alene, Idaho.

*Type slide.*—United States National Museum No. 1135.

Three females from type host, a bark beetle, at type locality, August 15, 1931, H. J. Rust (Hopk. U. S. No. 20258).

This species connects in a way *Tarsonemus* with *Pseudotarsonemoides*. The sense setae differ from those of other species of *Tarsonemus* in their marked lateral position and in that the proximal seta is larger than the distal one.

## TARSONEMUS BIUNGULATUS, new species

(Fig. 18)

## MALE (Unknown)

## FEMALE

*General appearance.*—Body short; abdomen pointed posteriorly. Capitulum longer than broad, with free, indistinctly segmented palpi. Pseudostigmatic organs subcapitate, with short pedicels. Freshly mounted specimen a very light yellowish brown.

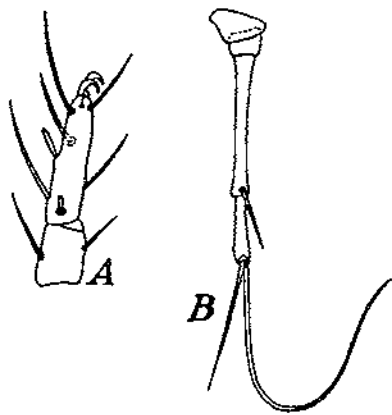


FIGURE 18.—*Tarsonemus biungulatus*, new species: A, Outside view of tibia and tarsus of leg I of female; B, ventral view of right leg of last pair in female.  $\times 800$ .

*Tarsus I.*—About twice as long as tibia. Distal sense seta clavate, about as long as width of tarsus and situated dorsally at middle of segment. Proximal sense seta about one-half as long as distal, situated dorsolaterally about its length from base of tarsus and nearer base than any one of simple setae. Tarsus ending in a very small pulvillus and two strongly curved, sharp, subequal claws.

*Leg IV.*—About reaching margin of body. Coxa triangular, as broad as long. Trochanter ringlike, almost twice as broad as long. Third segment about as long as other segments taken together; basal seta apparently absent; subapical seta ventral, straight, extending almost to tip of fourth segment. Fourth segment about one-half as long as third; subapical seta slightly curved, much longer than third segment; apical seta about as long as leg itself.

Total length, 0.214 mm; total width, 0.117 mm.

## LARVA AND EGG (Unknown)

*Type host.*—*Malus* sp.

*Type locality.*—Unknown.

*Type slide.*—United States National Museum No. 1136.

*Common name.*—Two-clawed tarsonemid mite.

One female specimen, "on apples", from Germany, at Boston, January 9, 1934, C. A. Davis (Boston No. 9164).

This single specimen was found in association with a species of *Glyciphagus*. Probably it, as well as the species of *Glyciphagus*, was feeding on decaying tissues.

## TARSONEMUS ASSIMILIS Banks

(Fig. 19)

This species was described by Banks (5) in 1914.

MALE (Unknown)

FEMALE

Known only from type material, which has not been seen by the writer. The original description is here quoted in full:

In general similar to *T. approximatus*, but on tarsus I the bristles and clavate hairs are placed differently, as seen in figure. The body of female shows below apparently but one transverse line, which at middle has a median tooth with notch each side; the beak is pointed in front; the legs are rather stout, especially the anterior pairs; tarsus I is shorter than in *T. approximatus* and shows a subbasal clavate hair and long hair nearby. There is a large, fusiform hair at middle of the joint, and two near tip with one or two others nearer to tip. Coxae III are more slender than in *approximatus*, the coxae IV are close together as in that species, and the terminal hairs are very long.

From Whittier, California, September 7 (Quayle), from red scale. This and the preceding species, by their approximate hind coxae, are related to *T. culmicolus* Reuter. Our other species have the tips of the hind coxae more widely separated.

LARVA AND EGG (Unknown)

*Type host*.—*Chrysomphalus* (*Aonidiella*) *aurantii* (Mask.).

*Type locality*.—Whittier, Calif.

*Type*.—Probably at Pomona College.

The *T. approximatus* mentioned by Banks in his description of this species is a synonym of *T. chionaspivorus* Ewing (p. 24).

The Genus **HEMITARSONEMUS**, new genus

When Oudemans (26) established the genus *Avrosia* (1928) with *Acarus translucens* Nietner (1861) as type, he thought that he was dealing with a species the same as *A. translucens* Green, and his generic characters fit the latter species. As already shown (p. 11), *A. translucens* Nietner is a quite different form.

In Opinion 65 of the International Commission on Zoological Nomenclature, Case of a Genus Based upon Erroneously Determined Species, it is held that the genus has as its type the species named as

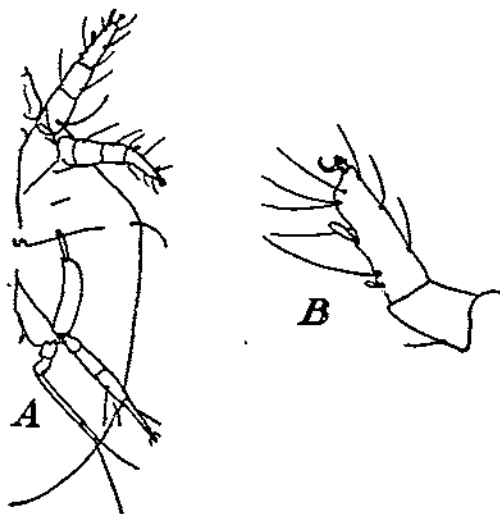


FIGURE 19.—*Tarsonemus assimilis* Banks. Ventral view (A) of female and side view (B) of tibia and tarsus of leg I of female, both greatly enlarged. (Banks.)

type, regardless of misidentification. This being the case, a new genus should be proposed for *translucens* Green (not Nietner) and congeneric species. Because of the confusion that has resulted in regard to the status of the *Acarus translucens* Green, it is considered best not to make this species type of the new genus.

With the characters of the subfamily Tarsoneminae and in addition: Capitulum considerably longer than broad. Palpi free, filiform, two-segmented, and poorly sclerotized. Tarsus I of female with a single, well-developed claw, and with or without a pulvillus; distal sense seta large, long, spinelike, and studded with fine scobinations. Tarsus III of both sexes with claws reduced, and the pulvillus surpassing them. Leg IV of the male very long, three-segmented, and only moderately thickened; its segments as follows: Coxa never triangular, about as long as broad; femur with a prominent cusplike process on inside at level of inner distal femoral seta; tibiotarsus very long, more than half as long as femur, strongly curved inward and ending in either a normal claw or a tuberclelike claw.

*Type species.*—*Tarsonemus tepidariorum* Warburton.

Two species of *Tarsonemus*, *T. viridis*, new species, and *T. ananas* Tryon, have males in which femur IV possesses an inner cusplike process similar to that found in *Hemitarsonemus*, but in these males the tibiotarsus is very different from that of *Hemitarsonemus*. The characters of the females of *T. viridis* and *T. ananas* are those of the genus *Tarsonemus*. These two species may perhaps be regarded as a link connecting *Hemitarsonemus* with *Tarsonemus*.

#### KEY TO THE NORTH AMERICAN SPECIES OF HEMITARSONEMUS

1. Tarsus I of female provided with a pulvillus and distal sense seta situated at about middle of segment; posterior legs of male each ending in a claw..... *H. tepidariorum* (Warburton)
- Tarsus I of female without pulvillus and with distal sense seta situated at about one-fourth the length of the segment from its base; posterior legs of male each ending in a sclerotized tubercle (the claw).... *H. latus* (Banks)

The two North American species of *Hemitarsonemus* are plant feeders and are of economic importance.

#### HEMITARSONEMUS TEPIDARIORUM (Warburton)

(FIG. 20)

This species was described by Warburton in 1904 (34).

#### MALE

*General appearance.*—Body broadest near the middle and somewhat diamond-shaped; legs long and slender.

*Capitulum.*—Longer than broad, extending for about one-half its length beyond front margin of cephalothorax. Palpi indistinctly segmented, slightly surpassing the rather short chelicerae.

*Genital papilla.*—Large, broader than long, truncate at tip. Penis very slender, needlelike; in repose not projecting from genital papilla.

*Leg IV.*—Very long, only slightly enlarged. Coxa as long as broad, not subtriangular; coxal seta ventral, extending beyond lateral margin of coxa by about one-third its length. Femur broadened in basal two-thirds, distal third scarcely one-half as broad as basal two-thirds; proximal femoral seta situated on inner margin, its length equal to about one-half width of femur; outer distal femoral seta small, dorsal, extending beyond lateral margin of segment for about one-half its length; inner distal femoral seta very large, situated at base of cusplike process and extending to tip of leg. Tibiotarsus incurved, about three-fourths as long as femur, of almost equal width throughout; clavate seta situated on outer margin of tibiotarsus, about its length from end of segment;

tactile seta subterminal, in length more than equal to tibiotarsus plus tarsal claw; tarsal claw large, curved, and acuminate at tip.

Total length, 0.174 mm; total width, 0.110 mm.

## FEMALE

*General appearance.*—Body oval, and in well-fed specimens almost egg-shaped; legs medium, first and second pairs subequal.

*Tarsus I.*—About three times as long as tibia I, ending in a strong claw, and deflexed at base; pulvillus present; distal sense seta as long as width of tarsus, situated at middle of same; proximal sense seta minute, lateral, situated its length from base of tarsus.

*Leg IV.*—Rather short, with stout setae. Coxa about one and a half times as long as broad. Trochanter twice as broad as long. Third segment somewhat thickened at base and about twice as long as coxa and trochanter combined, bearing a large seta on outer margin near its tip, which extends to tip of fourth segment of leg. Fourth segment slightly over one-half as long as third; terminal seta curved, somewhat spinellike, slightly longer than segment bearing it; subterminal seta similar to terminal, but slightly smaller.

Total length, 0.266 mm; total width, 0.152 mm.

## LARVA

Cephalothorax similar to that of female. Abdomen more slender than in female, divided into three segments by two deep, transverse grooves. Second segment of abdomen about three times as broad as long and separated from first by a curved transverse suture. Last segment of abdomen cone-shaped, bearing ventrally the triangular anal plate and at its tip a pair of small setae.

Total length, 0.188 mm; total width, 0.093 mm.

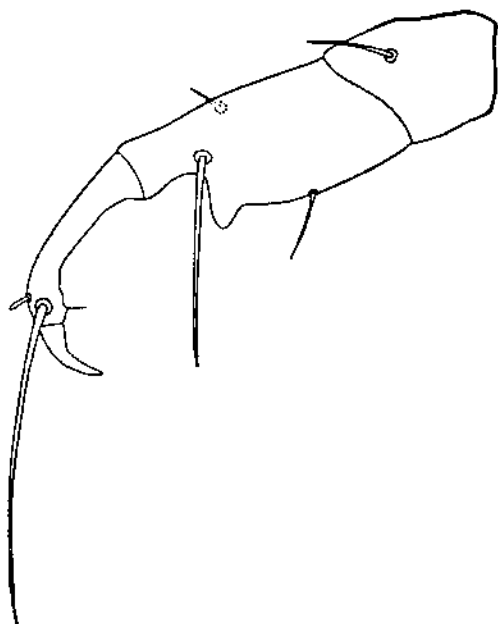


FIGURE 20.—*Hemitarsonemus lepidariorum* (Warburton). Ventral view of right leg of last pair in male.  $\times 800$ .

Egg (Not observed by present writer)

*Type host.*—Fern plants.

*Type locality.*—England.

*Location of types.*—Probably at Zoological Laboratory, Cambridge, England.

*Common name.*—Fern mite.

Although Warburton's figures lack some of the desired detail, the species is so characteristic, and its food plant so unusual, that there seems to be no doubt regarding the identification of American specimens as this species.

Material examined consists of a single lot composed of one male, several females, and several larvae, from Minnesota, April 17, 1929, on *Polystichum* (hollyfern).

## HEMITARSONEMUS LATUS (Banks)

(Fig. 21)

This mite was described by Green under the name *Acarus translucens*, but this name is preoccupied by *A. translucens* Nietner.<sup>5</sup> Banks' description of *Tarsonemus latus*, a synonym, appeared in 1904 (3), and this name becomes available for Green's species. Bondar (7) in 1928 described *T. phaseoli*, which is here considered a synonym of *latus*. A good description of the species, under the name *T. translucens* Green, and accompanied by excellent figures by Terzi, has been published by Hirst (18, p. 797).

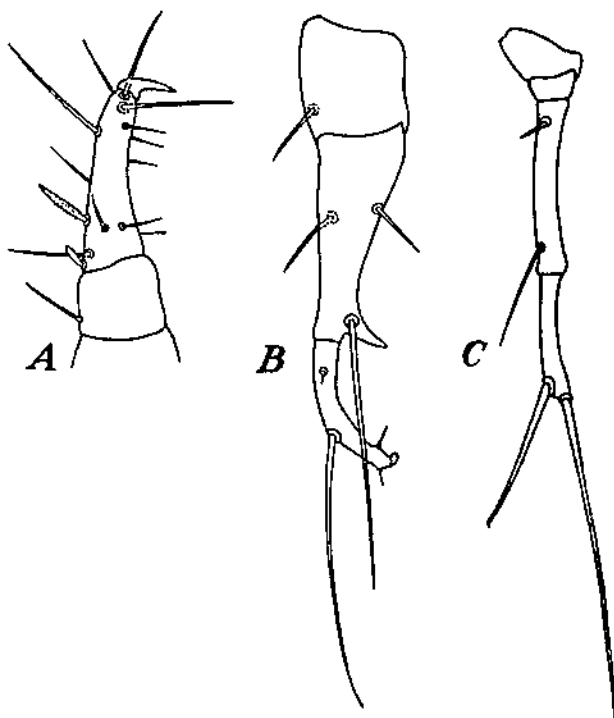


FIGURE 21.—*Hemitarsonemus latus* (Banks): A, Outside view of tibia and tarsus of leg I of female; B, ventral view of right leg of last pair in male; C, ventral view of right leg of last pair in female.  $\times 800$ .

## MALE

**General appearance.**—Body short and broad. Legs long, conspicuous, and with prominent setae; tarsi I to III very slender, tapering, with well-developed pulvilli but minute to vestigial claws. Color of dead specimens light yellowish brown.

**Capitulum.**—Papillalike, about as broad as long, and completely exposed above; palpi somewhat sclerotized, incurved. Chelicerae extending inward somewhat beyond bases of palpi, each ending distally in a needlelike tip.

<sup>5</sup> The writer has been unable to see the original description by Green. The earliest reference noted is to an article by Green, *Insect Pests of the Tea Plant*, Colombo, 1890. This paper could not be obtained.

*Genital papilla*.—Usually appearing truncate at apex; when dilators are expanded, papilla may be funnel-like. Penis short, stout, about one-third as long as papilla.

*Leg IV*.—Very long, slightly enlarged. Coxa slightly longer than broad; sides subparallel; coxal seta dorsal, submarginal, extending beyond lateral margin of segment by most of its length. Femur very long, broadest at its base, and produced on its inner side near tip into a conspicuous cusplike process; proximal femoral seta spinelike, submarginal, situated almost opposite outer distal femoral seta, the latter being slightly larger; inner distal femoral seta situated at base of cusplike process, extending beyond tip of leg by about one-half its length. Tibiotarsus curved, of about equal width throughout; clavate seta spinelike, dorsal, situated near base of segment; tactile seta situated on outer margin of tibiotarsus at about middle of segment, very long, subequal to inner distal femoral seta; tarsal claw an incurved tubercle.

Total length, 0.146 mm; total width, 0.088 mm.

## FEMALE

*General appearance*.—Body oval, somewhat broader than usual. Legs slender, first pair shorter than second. Color of living females a light, translucent yellowish green, the legs having a whitish hue. Down the middle of the dorsum is a faint whitish longitudinal stripe, not observable in mounted specimens.

*Tarsus I*.—Very characteristic; broadest at its base, tapering to its tip, but stout; ending in a large, deflexed tarsal claw. Pulvillus absent. Distal sense seta spinelike, studded with minute scobinations, situated its length from base of tarsus. Proximal sense seta clavate, dorsal, situated approximate to base of tarsus.

*Leg IV*.—About reaching margin of body. Coxa broader than trochanter. Trochanter a short, truncate cone, broader than long. Third segment medium in length, but peculiar in that it bears, in addition to a large subterminal seta, a smaller seta ventrally near its base. Fourth segment long, four-fifths as long as third segment; terminal seta long, flagelliform, about equal in length to leg IV itself; subterminal seta spinelike, about equal in length to segment that bears it.

Total length, 0.224 mm; total width, 0.150 mm.

## LARVA

Cephalothorax similar to that of female except for absence of pseudostigmatic organs. Tarsus I with two equal claws but no pulvillus. Abdomen three-segmented; second segment ringlike, three-fourths as broad as first segment and about one-fourth as long as broad; last segment cone-shaped, with a pair of conspicuous apical setae and two pairs of somewhat shorter ventral setae. Anal shield broader than long and occupying entire ventral surface of last abdominal segment. Color of living larvae a light, transparent, watery green, with whitish reflections about margins of body.

Total length, 0.163 mm; total width, 0.085 mm.

## EGG

The egg as seen from above when attached to a leaf is oblong-oval in outline. If it is turned halfway over, it is observed to be flattened below, as if the lower third had been cut off with a knife. Lower surface smooth and transparent; upper surface studded with round, whitish tubercles, arranged in five or six longitudinal rows, about eight tubercles in the longest row.

Length, 0.111 mm; width, 0.076 mm.

*Type host*.—Mango (in greenhouses).

*Type locality*.—Washington, D. C.

*Common name*.—Broad mite.

The original description of *latus* by Banks is very brief; yet the characteristics of the species are so striking that this description

easily identifies it. The writer has seen only a single lot of material determined by Banks. The specimens of this lot were taken from the type host, at the type locality, but they cannot be the types of *latus*, since they were collected in 1908 whereas Banks described the species in 1904. However, since these specimens are from the type host and type locality and were determined by Banks, they may be confidently regarded as representing his species. On this slide there are two specimens, one a female that shows clearly the characters given by Banks. The other specimen is so badly crushed that only the tarsal characters of two legs can be clearly detected. It may be a larva. Bondar's *phaseoli* was found attacking beans in Brazil. That investigator has kindly sent the present writer specimens of his species, which are found to be identical with *Hemitarsos-nemus latus* (Banks). A female specimen received from England through G. Fox Wilson, which was collected on fuchsia, Royal Horticultural Society Gardens, Wisley, Surrey, July 26, 1934, is found to be the same as our American forms of *T. latus*.

The North American material examined is as follows:

Connecticut:

On tomatoes, New Haven, September 25, 1928.

District of Columbia:

On *arbutus*, April 9, 1913, through Mr. Sasscer; May 1, 1913, "Mr. Coville"; May 17, 1913, through Mr. Sanford.

On *Beta vulgaris* (common beet), June 13, 1934, F. F. Smith.

On *Boussingaultia baselloides* (Maderia-vine), March 13, 1933, F. F. Smith.

On *Castanea dentata* (in greenhouse), August 2, 1933, F. F. Smith.

On *Castanea* sp., August 8, 1934, F. F. Smith.

On *Citrus* sp., W. B. Wood.

On *Cyclamen indicum*, October 21, 1933, F. F. Smith.

On *Delphinium* (larkspur), July 30, 1931, F. F. Smith.

On *Fragaria vesca* (Alpine strawberry), June 13, 1934, F. F. Smith.

On *Gerbera*, March 29, 1933, and February 19, 1934, F. F. Smith.

On *Geum atrosanguinea*, March 21, 1932, F. F. Smith.

On *Hevea spruceana*, August 21, 1920, W. B. Wood.

On *Impatiens sultan* (sultan snapweed), December 29, 1933, F. F. Smith.

On *Iresine lindeni*, June 19, 1934, F. F. Smith.

On *Lycium chinense* (Chinese matrimony-vine), October 16, 1931, F. F. Smith.

On *Mangifera indica* (mango, in greenhouse), May 8, 1908, by "J. G. S."

On *Pelargonium*, July 14 and 17, 1931, F. F. Smith.

On pepper, September 28, 1931, October 6, 1932, and August 2, 1934, F. F. Smith.

On *Persea americana* (avocado, in quarantine greenhouse), August 21, 1920, W. B. Wood.

On *Rubus laciniatus*, August 2, 1934, F. F. Smith.

On *Solanum carolinense* (horse-nettle), August 2, 1933, F. F. Smith.

On *Solanum tuberosum* (potato), July 10, 1931, F. F. Smith.

On *Thunbergia alata*, December 15, 1933, F. F. Smith.

On *Torenia fournieri* (blue torenia), December 10, 1931, F. F. Smith.

On *Vaccinium corymbosum*, F. V. Coville.

On *Vitis*, June 25 and August 28, 1934, F. F. Smith.

Florida:

On *Mangifera indica* (mango), Miami, February 13, 1923, W. B. Wood (No. 55); June 1, 1923, G. F. Moznette; and February 7, 1924, W. J. Owrey (F. H. B. 22).

On *Spathodea campanulata*, Miami, February 14, 1923, W. B. Wood (S. P. I. 47218).

Illinois:

On gardenia, Maywood, April 16, 1933, C. C. Compton.

- Louisiana:  
On *Ficus* (fig. leaves), New Orleans.
- Maryland:  
On *Gerbera jamesoni* (flame-ray gerbera), Cumberland, November 11, 1933, "A. H. Bopp."  
On *Pelargonium peltatum* (ivy-leaf geranium), Bell, October 2, 1931, F. F. Smith.
- New York:  
On *Begonia saundersi*, Brooklyn (Brooklyn Botanic Garden), January 19, 1934, F. F. Smith.
- Pennsylvania:  
On *Dahlia*, Media, September 21, 1933, F. F. Smith.  
On *Gerbera* (in greenhouse), Media, September 21, 1933, F. F. Smith.  
On *Hedera helix* (in greenhouse), Pittsburgh, November 3, 1933, F. F. Smith; Verona, April 25, 1934, F. F. Smith.  
On *Impatiens sultani*, Chambersburg, December 7, 1933, F. F. Smith.
- Virginia:  
On *Begonia* (English), Hot Springs, October 4, 1932, G. B. Milne.  
On *Castanea* (in greenhouse), Arlington, August 8, 1934, F. F. Smith.  
On *Cuphea ignea* (in greenhouse), Arlington, September 10, 1934, F. F. Smith.  
On *Dahlia*, Clarendon, September 22, 1932, F. F. Smith.  
On parsley, Arlington, September 10, 1934, F. F. Smith.
- Virgin Islands:  
No host given, St. Croix, December 31, 1921, C. E. Wilson.
- Washington:  
On *Bouvardia*, Sumner, September 29 and November 16 and 17, 1931, C. F. Doucette; Tacoma, October 20, 1933, C. F. Doucette.
- No locality:  
On *Mangifera indica* (mango), no date, no collector's name.

LIST OF SYNONYMS OF NORTH AMERICAN SPECIES OF  
TARSONEMINAE

(The synonyms are in italics, the valid names in roman.)

- Acarus translucens* Greene (1890) (not Nietner) = *Hemitarsonemus latus* (Banks) (1904).
- Cheylurus socialis* Trouessart (1885) = *Tarsonemus floricolus* Canestrini and Fanzago (1876).
- Dendroptus robinii* Kramer (1876) = *Tarsonemus floricolus* Canestrini and Fanzago (1876).
- Pseudotarsonemoides spinitarsus* Hirst (1923) = *Pseudotarsonemoides innumera-bilis* Vitzthum (1923). New synonymy.
- Tarsonemus approximatus* Banks (1914) = *Tarsonemus chionaspivorus* Ewing (1911). New synonymy.
- Tarsonemus approximatus* var. *narcissi* Ewing (1929) = *Tarsonemus laticeps* (1923). New synonymy.
- Tarsonemus destructor* Reuter (1905) = *Tarsonemus pallidus* Banks (1890). New synonymy.
- Tarsonemus fragariae* Zimmermann (1905) = *Tarsonemus pallidus* Banks (1890).
- Tarsonemus hydrocephalus* Vitzthum (1929) = *Tarsonemus laticeps* Halbert (1923). New synonymy.
- Tarsonemus macronychus* Sicher and Leonardi (1895) = *Tarsonemus floricolus* Canestrini and Fanzago (1876).
- Tarsonemus phaseoli* Bondar (1928) = *Hemitarsonemus latus* (Banks) (1904). New synonymy.
- Tarsonemus spinipes* Hirst (1912) = *Tarsonemus baneroffi* Michael (1890). New synonymy.
- Tarsonemus supinoi* Sicher and Leonardi (1895) = *Tarsonemus floricolus* Canestrini and Fanzago (1876).

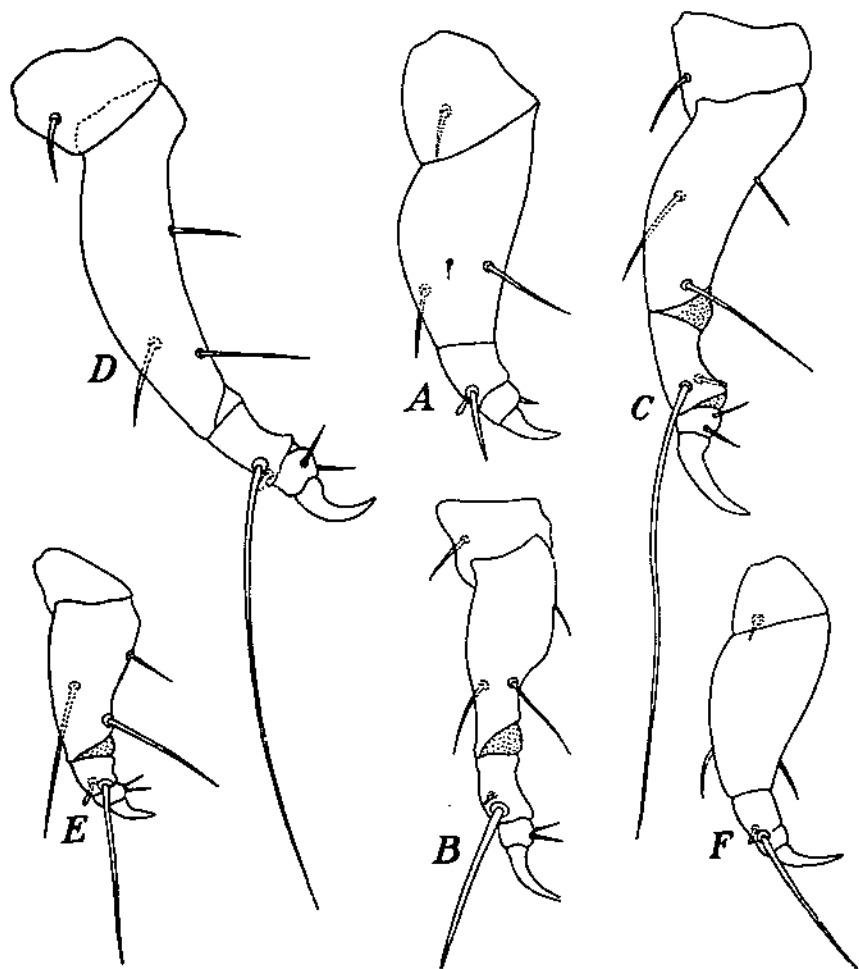


FIGURE 22.—Ventral views of right posterior leg of males: A, *Tarronemus laticeps* Halbert; B, *T. smithi*, new species; C, *T. settifer*, new species; D, *T. bakeri*, new species; E, *T. occidentalis*, new species; F, *T. waltti* Banks.  $\times 800$ .

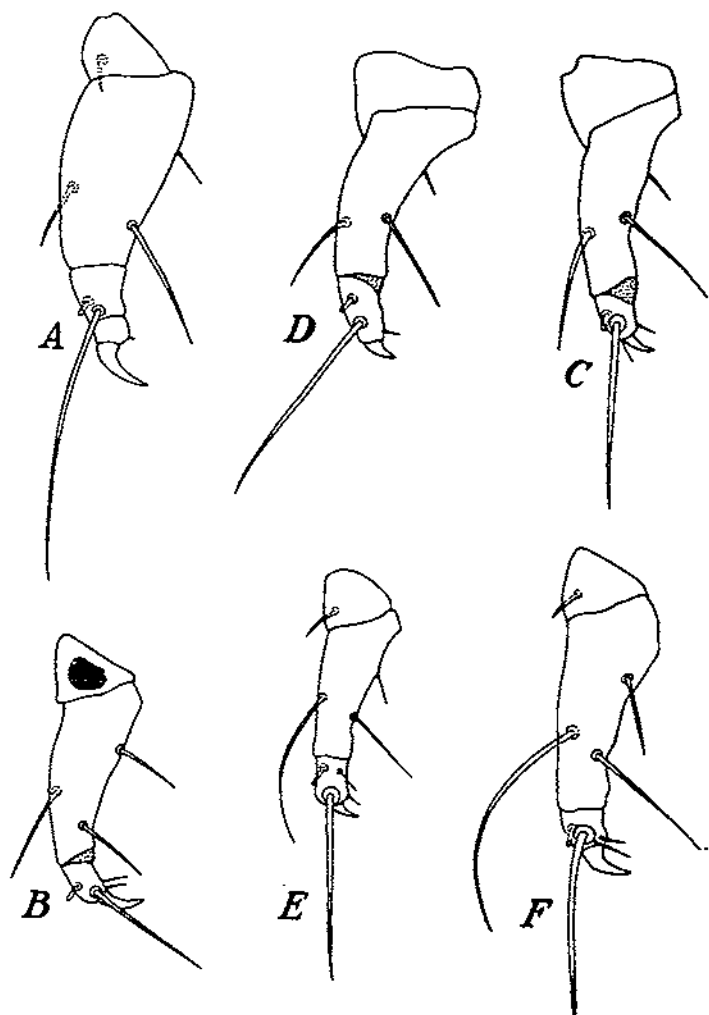


FIGURE 23.—Ventral views of right posterior leg of males: A, *Tarsonemus chthonaspivorus* Ewing; B, *T. randei*, new species; C, *T. confusus*, new species; D, variation in *T. confusus*; E, *T. scaurus*, new species; F, *T. unguis*, new species.  $\times 800$ .

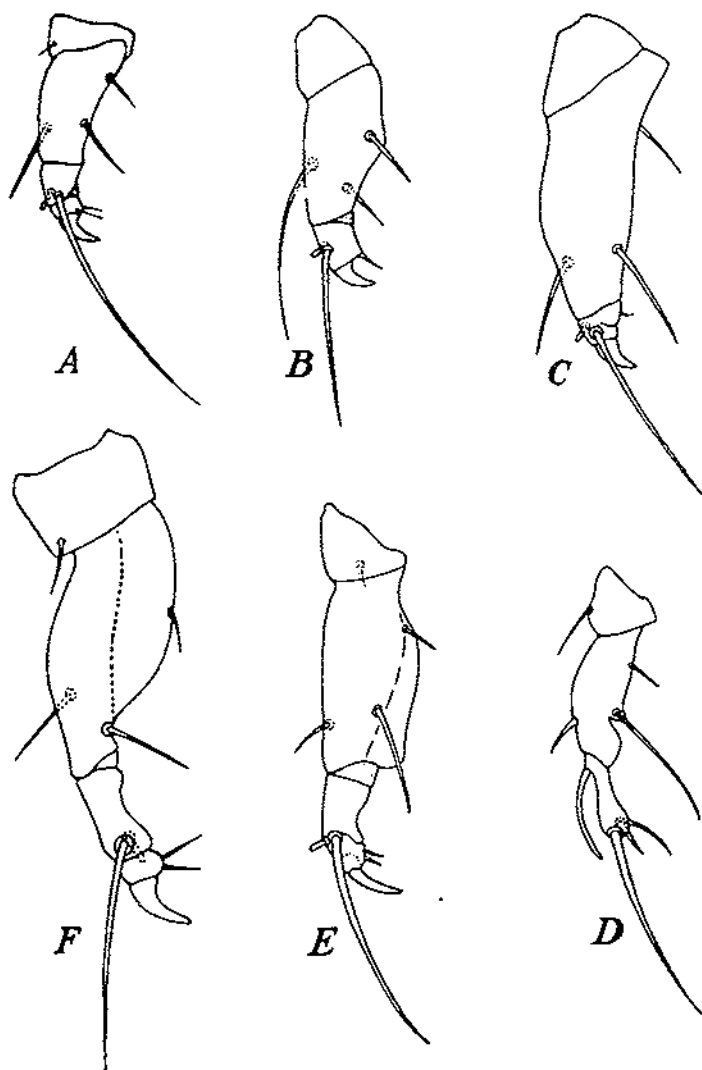


FIGURE 24.—Ventral views of right posterior leg of males: *A*, *Tarsonemus floricolus* Canestrini and Fanzago; *B*, *T. texanus*, new species; *C*, *T. simplex*, new species; *D*, *T. viridis*, new species; *E*, *T. laminifer*, new species; *F*, *T. femoralis*, new species.  $\times 800$ .

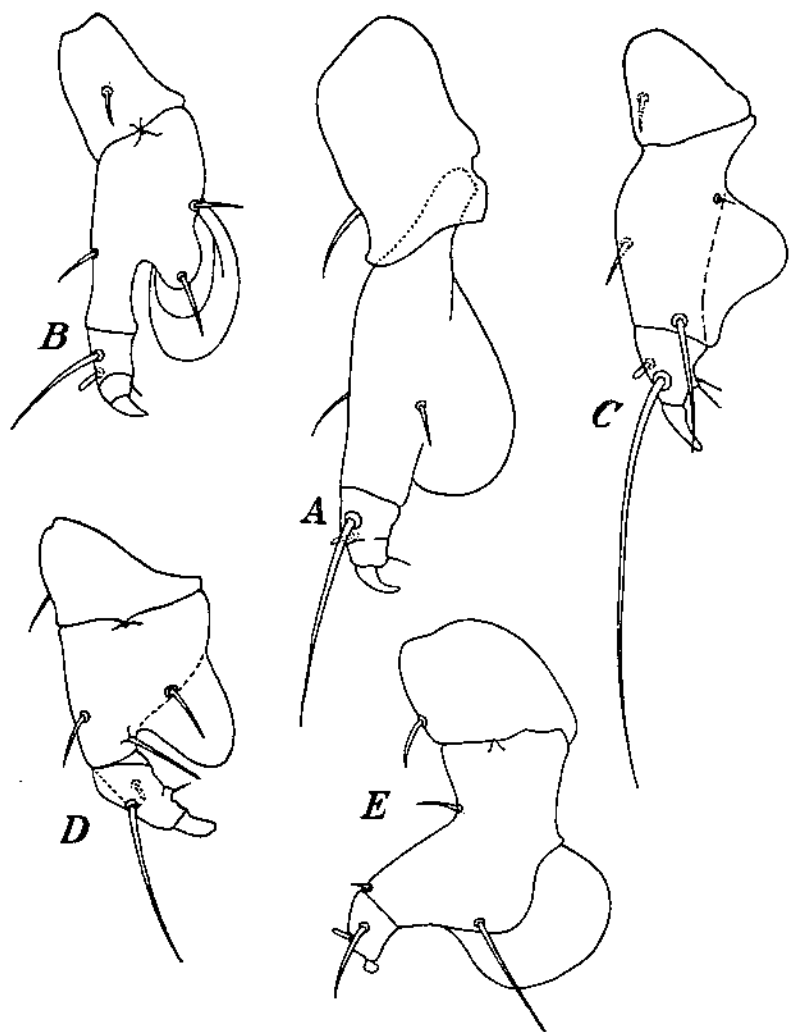


FIGURE 25.—Ventral views of right posterior leg of males: A, *Tarsonemus bancrofti* Michael; B, *T. spirifer* Marchal; C, *T. pallidus* Banks; D, *T. latipes*, new species; E, *T. phyllophorus* Ewing.  $\times 800$ .

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