

THE RED SPIDERS OF AMERICA AND A FEW EUROPEAN SPECIES LIKELY TO BE INTRODUCED.

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The so-called red spiders or spinning mites (which were all included in the genus *Tetranychus* until within the last few years) are without doubt the most important economically of the mites, and cause great damage annually to many of the most valuable cultivated plants. The writer has previously estimated that at normal prices the cotton crop of the United States may suffer through the ravages of the common red spider (*Tetranychus bimaculatus* Harvey) to the extent of \$2,000,000. Leading crops in various parts of the world are known to suffer similarly.

As Trägårdh and others have pointed out, the systematic knowledge of the red spiders is by no means on a plane with the comprehension of their economic status. Moreover, not until the completion, recently, of the investigation of the red spider on cotton (23)² by the Bureau of Entomology, was much known as to accurate details of their biology. Banks in the United States and Berlese in Europe were the pioneers who undertook the taxonomic separation of the species of this group. As Zacher (13) and the present writer (20) have already pointed out, the ordinary microscopic equipment with which these mites previously have been studied was far too crude, and only on such grounds could the finer taxonomic details have escaped such excellent observers as the two above mentioned pioneer acaridologists.

In Banks's Red Spiders of the United States (9) he separates the species chiefly through the palpal and tarsal characters. These are still very useful in the taxonomy of the group, but to them have been added the so-called collar tracheae and the penis. In order properly to examine these structures it is absolutely necessary to employ an

¹ Since this paper was written the author has resigned from the Bureau of Entomology.

² The numbers in parentheses refer to "References" at the end of this paper.

oil-immersion lens. H. E. Ewing (17) and the present writer have already pointed out that a careful examination of red spider species with up-to-date equipment has revealed the fact that the tarsal and palpal structures are not nearly as simple as Banks (9) and other earlier workers have indicated. Also for years it was believed that each of the numerous host plants supported a distinct species, and that each of the many color forms represented a species. In this manner a very annoying confusion regarding synonymy arose, which has not been entirely straightened out at the present writing.

A sort of controversy has arisen between certain of the recent workers concerning the correct nomenclature of the microscopic structural parts of the tip of the tarsus. Trägårdh (18) claims that Zacher and Ewing each had the wrong conception of what constitutes the empodium. The former asserts that the bases of the tenent hairs are homologous with the claws of other mites. He claims that what Banks, Ewing, and others have been calling the true claw is but the empodium which in the several species is variously modified so as to exhibit from one to six claw divisions.

It was Zacher (13) who first recognized the importance of the penis as possessing specific variations, and Ewing (15) followed soon after with an amplification of the penis characters. Trägårdh (18) also recognizes the taxonomic value of the variation shown by the penis of the various species. The present writer's studies have similarly tended to corroborate the opinions of the above workers as to the value of the penis in possessing specific characters. Dr. W. Dwight Pierce has pointed out to the writer the resemblance of this chitinous organ to the oedeagus of insects, especially the Strepsiptera. He believes that the penis will be found to be a delicate extrusible tube within this chitinous oedeagus. Perhaps detailed study will bear him out. The writer has not had this opportunity as the suggestion was made while Doctor Pierce was reading over the completed manuscript.

The "thumb" or terminal joint of the palpus has long been accorded a place of importance among the taxonomic structures. The characters of this member, however, appear through recent studies to be rather too constant to furnish specific features of a very satisfactory nature. There are almost without exception seven appendages, including, two "fingers," two digituli, and three short hairs. About the only characteristics of these appendages that appear useful are the outlines of the terminal and the dorsal "fingers" and their proportionate sizes one to the other.

The dorsal body bristles or appendages also offer some assistance in the taxonomy, although, aside from the two members of the genus *Anychus*, the number and arrangement of these hairs seem to be nearly constant.

Trägårdh (18) very fortunately discovered the utility of the collar trachea as a help in the differentiation of the species. In certain species this organ is V-shaped with both arms of equal caliber; in some it is also V-shaped but with one arm much thicker than the other; while in other species the collar trachea is straight with a bladder-like enlargement at its end.

As to any taxonomic importance being attributed to the respective colors of the various species, there is much doubt. Ewing (17) conducted some interesting tests, the results of which indicated that the various shades of green, yellow, orange, brown, and black were attributable to the presence in the blood, tissues, or fecal matter of chlorophyll, or other pigments derived from it through the process of metabolism. The investigations of the present writer (23) of *T. bimaculatus* in South Carolina indicated that the species was subject to much variation in color and that individuals about to enter the wintering existence often became a salmon-yellow color. At various seasons and under varying conditions individuals of the two-spotted mite could be found of nearly all shades exhibited by any species of red spider. It would seem that the color pattern rather than the general color of the species is the important factor.

Once more it is important to emphasize that the minuteness of the taxonomic structures together with the aggravating light refraction when employing great magnifications makes the definite conception of the microscopic image extraordinarily difficult. This has also been mentioned by a few other workers.

The red spider body is oval or elliptical, furnished with a score or more of dorsal cuticular appendages arranged in four rows. These appendages are usually long and hairlike and either simple or finely plumose, or are in the form of short, rather stout rods. The cephalothorax is separated from the abdomen by a slight constriction, and bears on each side one or two simple eye corneas. The pedipalps are short, the third joint ends dorsally in a strong claw; the last joint is thumblike and bears one or more appendages called "fingers," as well as digituli and sense hairs. In all species examined the palpus of the male bears dorsally on the distal margin of the second joint a strong spur. The basal portion of the mandibles are fused to form a broad retractile plate, the apical portion of which is produced into the slender piercing stylet. The legs, the first pair of which are longest, are never much longer than the body, with scattered hairs, the tarsus terminating in claw appendages which vary greatly in arrangement: the name *Tetranychus* is based upon those species the tarsal claw of which is split into four parts. The anal and genital openings occur ventrally near the tip of the abdomen; the former is terminal, the latter basal.

KEY TO GENERA.

- a*¹. Empodial claw vestigial, connate at base to tarsus of which it is merely a protuberance.....*Anychus*, new genus.
- a*². Empodial claw distinctly separated at base from distal portion of tarsus.
- b*¹. Claw simple.....*Neotetranychus* Trägårdh.
- b*². Claw complex.
- c*¹. Claw cleft with from 2 to 6 equal divisions.
- d*¹. Claw divisions 2.....*Schizotetranychus* Trägårdh.
- d*². Claw divisions 4¹ to 6.....*Tetranychus* Dufour.
- c*². Claw appendiculate either at base or at a point between it and middle point with from 4 to 6 spurs.
- d*³. Dorsal spur of tarsus decidedly shorter than the ventral group of spurs.....*Septanychus*, new genus.
- d*⁴. Dorsal spur more prominent and much longer or about equaling the appendiculate spurs: collar trachea straight, enlarged at end.
Paratetranychus Zacher.

ANYCHUS, new genus.

This genus is thus far represented by a species from Florida and one from Peru, South America.

Spinning mites, having only a vestigial claw which is connate at base with the tarsus of which it forms merely a protuberance. The usual series of dorsal bristles is replaced by a series of rodlike or spatulate appendages.

Type.—*Tetranychus* (*Anychus*) *banksi* McGregor.

KEY TO SPECIES OF GENUS ANYCHUS.

- a*¹. "Finger" on tip of palpal "thumb" terminal and much stouter than the two digituli, at base nearly as thick as tip of "thumb"; dorsal appendages 18, spatulate-serrate.....*A. banksi* McGregor.
- a*². "Finger" on tip of palpal "thumb" ventro-terminal, less conspicuous than the two digituli, at base about one-fourth as thick as tip of "thumb"; dorsal appendages 26, noutapering, serrate, rodlike.....*A. rusti* McGregor.

ANYCHUS BANKSI (McGregor).

Tetranychus banksi MCGREGOR, 1914, Ann. Ent. Soc. Amer., vol. 7, no. 4, p. 357.

Color rusty red, from underlying paired organs which occupy all of the dorsal region excepting a median abdominal area and a clear area containing the mandibular plate. Eyes (in mounted material) translucent, directly over suture between coxae I and II. The usual series of dorsal bristles is lacking, but a series of 18 spatulate-serrate hairlike appendages are distributed on the dorsal aspect of the body as follows: One at either side of the mandibular plate anteriorly, one just mediad of each eye, one just overlying each coxa II, six forming a fringe at hind margin of body, and three along

¹ All recent European authorities show four divisions of the tarsal claw for *T. telarius* and *T. althaeae* and others, but this type has not yet been seen in this country.

each side of abdomen. Body of female rhombic-ovate, widest across cephalothorax, exceedingly obese for the size of the legs; cephalothorax rounded generally anteriorly with a slight concave border overlying the palpi; male almost sagitate in outline, conspicuously reduced in proportion to the legs. Mandibular plate about half again as long as wide, tapering somewhat anteriorly, with a distinct emargination and with a superimposed chitinized ridge anteriorly. "Thumb" of palpus subconical, upper surface twice transversely depressed with an intervening dilation, bearing at its tip a long slender "finger," which is over four times as long as thick; on its upper side arising between middle and tip are two stout hairs, and near the base of upper side arise a reduced "finger" and two stout hairs; the claw of the penultimate joint reaches only to the basal "finger"; a hair arises ventrally from the "thumb" and another laterally from the penultimate joint. Legs of female are of average length, barely equaling length of body; those of male are about twice as long as body; femur between four and five times as long as thick, three-quarters again as long as tarsus; tibia somewhat longer than patella, which is over twice as long as trochanter; relative length of joints as follows: Coxa, 9; trochanter, 3.75; femur, 14; patella, 8.75; tibia, 10.9; tarsus, 8; tip of tarsus not provided with a claw, it being reduced to a vestigial protuberance; the customary series of four tenent hairs arise from the onychium.

Type.—Cat. No. 19089, U.S.N.M.

The type material was from Orlando, Florida, August 16, 1913, from the under surface of castor beans (*Ricinus communis*) and velvet bean leaves. Mr. W. W. Yothers writes that the species is an important pest of the castor bean plant in Florida, but that at times it is controlled by a predaceous mite (*Sciulus*, species) and by the coccinellid *Stethorus*, species. Larvae and pupae of *Arthrocnodax carolina* have been observed on infested castor bean leaves from Orlando, Florida.

ANYCHUS RUSTI (McGregor).

Tetranychus rusti McGREGOR, 1917, Proc. U. S. Nat. Mus., vol. 51, p. 582.

Color ranging from yellowish or greenish to red. Eyes (in mounted material) translucent, directly over coxae II and between subfrontal and posterior cephalothoracic bristles. The dorsal epidermal appendages are not distributed to conform with the usual arrangement for this genus, but a series of 26 moderately short, nontapering, sparsely serrate, rod-like appendages are distributed on the dorsal aspect of the body as follows: One at either side of mandibular plate anteriorly, one just anterior to each eye, one just posterior to each eye, six forming a fringe at hind margin of body, three along each side of abdomen, one on either side of median axis in line with coxae III,

and one on either side of median line near hind margin of abdomen. Body of female ovate, widest across front region of abdomen, slightly obese for the size of the legs; cephalothorax rather evenly rounded anteriorly with a slight truncate border overlying the palpi; male elongate-sagitate in outline, legs conspicuously long for size of body. Mandibular plate slightly over half as wide as long, tapering gradually forward, with almost no emargination anteriorly. "Thumb" of palpus subcylindrical, bell-shaped considerably at base, upper surface indented near central point; tip of "thumb" bearing three "fingers," one at inferior angle conical and three times as long as thick, one at superior angle slender and eight times as long as thick; a slender "finger" between these at inner angle which in size is intermediate between them. A reduced "finger" and a slender spine arise side by side from the indentation of the upper side of "thumb." The claw of the penultimate joint reaches to the subbasal "finger." Legs of female are of average length, barely less than that of body; those of male are slightly more than half again as long as body. Femur nearly five times as long as thick, from three-quarters again to twice as long as tarsus. Tibia about a quarter again as long as patella, which is two and one-half times as long as trochanter. Relative lengths of joints are as follows: Coxa, 6; trochanter, 4; femur, 15; patella, 10.3; tibia, 12.7; tarsus, 8.5. Tip of tarsus not provided with a claw. The usual series of four tenent hairs arise from the end of the onychium.

Type.—Cat. No. 20170, U.S.N.M.

The type material was from Mira Flores Station, Departamento de Piura, Hacienda "San Jacinto," Peru, South America, October 15, 1912, on papaya (*Carica papaya*). Mr. E. W. Rust, the collector, states that the species in life behaves much like *T. bimaculatus*, and injures the tender leaves of the papaya by feeding on the upper surface.

Genus NEOTETRANYCHUS Trägårdh.

Neotetranychus TRÄGÅRDH, 1915, Med. Nr. 109 fr. Centr. f. förs. på jordbr. Entom. avdel. Nr. 20, p. 20.

This genus is thus far represented by a species from Europe and a species from Illinois.

Spinning mites with empodial claw undivided and without subbasal appendages, sickle-shaped, slightly dentate at end; collar tracheae of the *Tetranychus* type, but with posterior limb much wider; penis strongly hooked and attenuate, unbarbed.

Type.—*Neotetranychus rubi* Trägårdh, originally designated.

KEY TO SPECIES OF GENUS NEOTETRANYCHUS.

- a¹. Empodial claw sickle-shaped, strongly curved, dentate at tip; tenent hairs four—
Neotetranychus rubi Trägårdh.
a². Empodial claw slightly curved, very sharp at tip; tenent hairs two—
Tetranychus (*Neotetranychus*) *uniunguis* Ewing.

NEOTETRANYCHUS RUBI Trägårdh.

Trägårdh (18) erected this genus in 1915 for a Swedish red spider which was only observed on wild raspberries in the autumn. He states that "to this genus belong *bicolor* Banks and *modestus* Banks, which both have a simple, claw-shaped empodium." A careful study of Banks's types, as elsewhere indicated, shows that in both the above species the empodial claw is furnished with the group of subbasal appendages, thus placing them in the genus *Paratetranychus*.

NEOTETRANYCHUS UNIUNGUIS (Ewing).

Tetranychus uniunguis EWING, 1917, Journ. Econ. Ent., vol. 10, no. 5, p. 497.

A greenish-yellow species. Palpi rather stout, reaching the tip of tibia of leg I. Palpal claw rather short, strongly curved, and not very sharp at its tip. "Thumb" of palpus stout, as broad as long, reaching but not surpassing the palpal claw; "finger" of "thumb" situated in middle of the apex, about twice as long as broad, and rounded at its tip. Hairs of "thumb" distributed as follows: Two small ones on the inside of "thumb" near its apex, one long hair, about as long as the "thumb" itself, on the inside near the base; and another of about equal length on top not far from the base. Chelicerae each arising near the base of plate, and making an evenly rounded loop posteriorly, and then passing forward for about two-thirds their length, then in a downward direction to their tips. The only place that the chelicerae are swollen is near their bases. Tarsus of leg I considerably longer than the tibia. Tarsi each ending in a single claw, which is not strongly curved, but is very sharp; two tenent hairs. Length, 0.59 mm.; width, 0.42 mm.



FIG. 1.—NEOTET. RANYCHUS UNIUNGUIS EWING. PALPAL APPENDAGES (AFTER EWING).

From Urbana, Illinois; on arbor vitae (*Thuja occidentalis*).

Genus SCHIZOTETRANYCHUS Trägårdh.

Schizotetranychus TRÄGÅRDH, 1915, Med. Nr. 109, fr. Centr. f. förs. på jordbr. Entom. avdel Nr. 20, p. 19.

This genus is represented at present by a species in Germany and one in the United States.

Red spiders with empodial claw possessing two subequal simple divisions; penis with a large basal lobe and with a coarse tip.

Type.—*Schizotetranychus schizopus* Zacher, originally designated.

KEY TO SPECIES OF GENUS SCHIZOTETRANYCHUS.

- a*¹ Palpal "thumb" without digit; tarsus I very broad and truncate at tip, two claws subequal.....*Schizotetranychus latitarsus* Ewing.
*a*² Palpal "thumb" with slender terminal "finger" and adjacent digitulus; two strong-curved tarsal claws; penis broader than that of *tolorius*, with an obtuse basilar lobe.....*Schizotetranychus schizopus* Zacher.

Trägårdh (18) writes: "To this genus (*Schizotetranychus*) probably belongs *T. mytilaspidis* Riley,¹ and to judge from Ewing's description of it, and Zacher's figure of *S. schizopus* the penes of the two species seem to be of the same shape." However, a comparison of Zacher's figure 4 and the writer's figure 4,² of the penis of *S. schizopus* and *T. citri* (*mytilaspidis*, authors not Riley) respectively, shows rather conclusively the marked difference in the penis type; furthermore, as elsewhere stated herein, it develops that the tarsal claw of *Tetranychus citri* McGregor is not simply two cleft, but possesses in addition four empodial spurs, and is accordingly referable to a different genus—Paratetranychus.

SCHIZOTETRANYCHUS SCHIZOPUS Zacher.

Tetranychus schizopus ZACHER, Jan., 1910, Mitt. Kais. Biol. Anst. f. Land- und Forst., Heft 9, p. 40.

Zacher (13) described this species in 1910 from material on various species of willows collected at Dahlem, Germany.

SCHIZOTETRANYCHUS LATITARSUS Ewing.

Schizotetranychus latitarsus EWING, 1917, Journ. Econ. Ent., vol. 10, no. 5, p. 498.

Preserved specimens yellowish and reddish, with dark spots showing through the body wall. Cephalothorax fully as broad as long. Mandibular plate or rostrum over twice as long as broad. Apparently two eyes on each side of cephalothorax, but only one with a perfect cornea. Palpi prominent; palpal claw very short, stout, and but slightly hooked; "thumb" swollen, short, not reaching tip of claw and apparently without digit. Abdomen rather strongly arched and evenly rounded behind except for the anal papilla. Above the abdomen is sparsely clothed with long, prominent, slightly curved, minutely pectinate setae. Legs moderate; tarsus of leg I but slightly longer than tibia, very broad and truncate at its tip; at its tip above it bears a large tactile seta much longer than the tarsus itself. The tarsi of the legs are each provided distally with two subequal, simple claws, and four tenent hairs; of the latter the two inner are longer than the two outer, and all are at least twice as long as the claws. Length, 0.36 mm.; width, 0.23 mm.



FIG. 2.—SCHIZOTETRANYCHUS LATITARSUS EWING. TARSUS AND ITS APPENDAGES (AFTER EWING).

From Pasadena, California; on bamboo; by C. P. Clausen. Described from several specimens. This species is probably an introduced one, according to Ewing.

¹ The true *mytilaspidis* Riley belongs to the genus *Penthalodes* and is not a red spider.

² Ann. Ent. Soc. Amer., vol. 9, no. 3, pl. 14.

Genus **TETRANYCHUS** Dufour.

Tetranychus DUFOUR, 1832, Ann. Sci. Nat., vol. 25, p. 276.

Until quite recently there were included under this generic name practically all the red spiders or spinning mites. As designated by the most recent workers, however, there are included in this genus only those species in which the empodial claw is divided into from four to six subequal divisions. Based on this new conception of the genus there are in Europe three or four species and in America about ten species. With respect to the tarsal, palpal, and collar trachea characters, there is rather good coordination among the several species of *Tetranychus*; on the other hand, the penis exhibits rather radical variation within the genus. With a very few exceptions the more important red spiders economically are contained within this genus.

Red spiders the empodial appendage of which is cleft to the middle or more with from four to six subequal divisions, the whole strongly bent near middle; collar trachea V-shaped, of about the same caliber throughout.

Type—*Tetranychus telarius* Linnaeus, designated by Trägårdh, 1915.

KEY TO SPECIES OF THE GENUS TETRANYCHUS.

1. Empodial appendage four-cleft..... 2
Empodial appendage more than four-cleft..... 3
2. Penis slender; basilar lobe obtusely sharp-angled; shaft slender, strongly hooked, acuminate without barb..... *T. telarius* Linnaeus.
Penis shaft rather broad, with a small protuberance on the concave side, weakly hooked and blunt pointed; male tarsus with three-cleft empodial claw; collar trachea U-shaped, anterior arm twice as long but of same caliber as posterior arm..... *T. olthaeae* Von Hanstein.
Penis much broader; basilar lobe in the form of a broad rectangular projection; shaft rather stout, weakly hooked, with a truncate pseudo-barbed tip.
T. ludeni Zacher.
3. Empodial appendage five-cleft; penis somewhat undulate, sting-like, unbarbed.
T. flavus Ewing.
- Empodial appendage six-cleft..... 4
4. Empodial appendage six-cleft, tip of tarsi broad, truncate, each bearing very long tactile seta; palpal "thumb" with at least 5 digituli near tip.
T. multidigituli Ewing.
- Empodial appendage six-cleft, tarsus narrowed toward tip, palpal "thumb" with only two digituli near tip..... 5
5. Penis shaft tapering without well-defined hook..... 7
Penis shaft stouter with well-defined hook..... 6
6. Collar trachea U-shaped; penis with small, hooklike dorsal basilar lobe, and stout upturned hook bearing recurved barb..... *T. bimaculatus* Harvey.
Collar trachea V-shaped; penis with prominent dorsal basilar lobe, and strong upturned hook bearing a barb, the posterior tip of which is produced into a long, sharp spur..... *T. pacificus*, new species.
7. Tip of penis with knoblike barb, basilar lobe about equal to inner lobe in length.
T. borealis Ewing.

Tip of penis obliquely truncate and produced ventrally into a very inconspicuous spur; basilar lobe merely an obtuse prominence; collar trachea pipe-shaped, with slender almost straight ventral arm and very short swollen dorsal arm.

T. sexmaculatus Riley.

Tip of penis narrowly rounded without barb, basilar lobe absent.

T. veldoni Ewing.

Tip of penis sharply acuminate..... 8

8. Penis shaft somewhat undulate; collar trachea sickle-shaped; empodial claw not cleft as deeply as usual, divisions closely appressed... *T. willamettei* McGregor.

Penis shaft straight, sting-like; empodial claw divisions deeply cleft, two ventral divisions much heavier..... 9

9. Collar trachea pipe-shaped with anterior arm about four times as long as posterior arm, which forms a thickened elliptical chamber.... *T. oregonensis* McGregor.

Collar trachea L-shaped, with anterior arm about twice as long as posterior arm, which is of somewhat thinner caliber than the anterior arm.....
..... *T. monticolus* McGregor.

TETRANYCHUS TELARIUS (Linnaeus).

Plate 79, fig. 7.

1761. *Acarus telarius* LINNAEUS, Faun. Succ., p. 431.—1804, *Trombidium t.* HERMANN.—1834, *Tetranychus t.* DUGÈS.

1804. *Trombidium tiliarium* HERMANN.—1834, *Tetranychus t.* DUGÈS.—1867, *Acarus t.* TURPIN.—1875, *Tetranychus t.* KOCH.

1804. *Trombidium maius* HERMANN.—1834, *Tetranychus m.* DUGÈS.

1804. *Trombidium tenuipes* HERMANN.—1834, *Tetranychus t.* DUGÈS.

1804. *Trombidium socium* HERMANN.—1867, *Acarus s.* MÜLLER.—1875, *Tetranychus socius* KOCH.

1832. *Tetranychus lintearius* DUFOUR.—1867, *Acarus l.* BOISDUVAL.—1877, *Tetranychus l.* MURRAY.

1867. *Acarus russulus* BOISDUVAL.—1875, *Tetranychus r.* KOCH.

1867. *Acarus tini* BOISDUVAL.—1877, *Tetranychus t.* MURRAY.

1867. *Acarus cucumeris* BOISDUVAL.—1877, *Tetranychus c.* MURRAY.

1867. *Acarus rosarum* BOISDUVAL.—1877, *Tetranychus r.* MURRAY.

1867. *Acarus cinnabarinus* BOISDUVAL.—1877, *Tetranychus telarius* var. *c.* MURRAY.

1867. *Acarus haematodes* BOISDUVAL.—1877, *Tetranychus telarius* var. *h.* MURRAY.

1867. *Acarus vitis* BOISDUVAL.—1877, *Tetranychus v.* MURRAY.

1867. *Tetranychus ferrugineus* BOISDUVAL.

1875. *Tetranychus urticae* KOCH.

1875. *Tetranychus fervidus* KOCH.

1875. *Tetranychus populi* KOCH.

1875. *Tetranychus piger* DONNADIEU.

1875. *Tetranychus minor* DONNADIEU.

1875. *Tetranychus longitarsis* DONNADIEU.

1875. *Tetranychus pluvistoma* DONNADIEU.

1875. *Tetranychus rubescens* DONNADIEU.

1875. *Phytocoptes epidermi* DONNADIEU.

1875. *Phytocoptes gallarum* DONNADIEU.

1875. *Phytocoptes nervorum* DONNADIEU.

This acarid is the pioneer of all red spiders, having first been described in 1761 by Linnaeus (1), from material on linden trees, calling it *Acarus telarius*. Throughout Europe it is best known as the linden mite from which host the specific name is derived. This red spider

has long been recognized as an economically important species, and has been treated taxonomically and economically by many workers since Linnaeus, including Boisduval, Lucas, Whitehead, Murray, Ormerod, Oudemans, Berlese, Canestrini, Fanzago, Von Hanstein, Tullgren, Noel, Bruyant, Keiffer, Trägårdh, Banks, and Ewing.

Among American workers Ewing (17) alone has claimed that the common red spider described in 1892 by Harvey as *T. bimaculatus* is identical with the linden mite. He claims also that *T. sexmaculatus* Riley and *T. gloveri* Banks are synonyms of *T. telarius*. The present writer believes he has established in the present work the valid specific distinction of each of these excepting *T. gloveri*, which he finds to be identical with *T. bimaculatus*.

The linden mite of Europe is the smallest of the true *Tetranychus* species. It feeds commonly on linden, elm, horse-chestnut, maple, aspen, and bird-cherry. In Europe *T. telarius* is known to occur in England, France, Germany, Norway, Sweden, Denmark, and Italy. American material has been determined at times by Banks as *T. telarius*, but the latter authority admits that he has not given the matter the critical analysis that present-day workers in the Tetranychidae have found to be necessary for the proper separation of species. The present author has never collected the linden mite in this country.

The description of the European *T. telarius* as compiled from accounts by European workers is as follows:

Length of female, 0.42 mm.; length of male, 0.33 mm. Color yellowish-greenish-yellow, sometimes green and with the hibernating females orange-yellow. A single eye cornea on each side. The body has the typical 13 pairs of bristles, of which those located in the hind half of the hysterosoma are the shortest; bristles not at all pilose; the two front vertex hairs are shorter than the hind ones; the hairs are fine, the longest of them being about one-third the length of the body. The collar trachea is V or U shaped and of about even thickness throughout. A transverse suture sharply separates the proterosoma from the hysterosoma, and immediately behind this line the body attains its greatest width. Leg I of male has empodium of same structure as the other pairs of legs. Empodial claw sometimes 6-cleft, but usually 4-cleft. Penis slender, the inner lobe rod-like; the basilar lobe obtusely sharp angled; the shaft somewhat thicker than inner lobe and is bent upward about 60° from the shaft axis to form the hook, which is acuminate pointed. Palpal "thumb" with stout terminal "finger," which at base is nearly as wide as tip of "thumb;" a pair of digituli at upper distal angle; a small dorsal "finger" midway to base than which the terminal "finger" is two and one-half times as thick, a pair of short hairs between dorsal "finger" and base; and a hair arising latero-ventrally from the middle of the "thumb." Hook of the penultimate joint just reaching to the dorsal "finger."

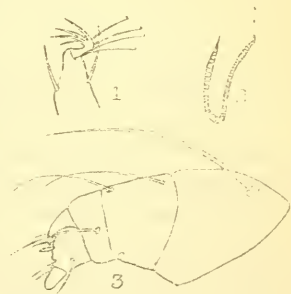


FIG. 3.—TETRANYCHUS TELARIUS LINNAEUS. 1, TARSAL APPENDAGES; 2, COLLAR TRACHEA; 3, PALPUS AND ITS APPENDAGES (AFTER TRÄGÅRDH).

TETRANYCHUS ALTHAEAE Von Hanstein.

Plate 79, fig. 8.

Tetranychus althaeae VON HANSTEIN, 1901, Zeitschr. wiss. Zool., vol. 70, pp. 53-108, pl. 6.

Von Hanstein (10) described this mite from material on hollyhock in Germany. His original description of *T. althaeae* was altogether too vague to be of much value taxonomically. We are therefore including Trägårdh's (18) revised diagnosis, which in substance is as follows:

Length of female, 0.570 mm.; of male, 0.430 mm. Body of female broadly oval, more reduced backwards than forward, and with a slight constriction between proterosoma and hysterosoma, the greatest width, 0.225 mm., is not at the shoulders, but nearer the middle. The legs are relatively longer in the male than with the female. The body hairs are finely pilose, quite pointed and short (about 0.09 mm.), not arising from elevations of the cuticle, and consisting of 13 pairs in the typical arrangement; frontal hairs only half as long as subfrontal ones. Pedipalps in both sexes with claw shorter than "thumb." Male palpus with claw small, slightly bent, and reaching very little onto the "thumb," which is sloping conical so that the dorsal line is longer than ventral line, and in the middle of the dorsal line with a small concavity. The seven typical appendages are present, including three hairs, two "fingers" and two digituli. The dorsal "finger" is only half as long and broad as terminal "finger," which is half as long as the fourth joint, cylindrical, three times as long as thick, and rounded at tip. The two digituli are somewhat longer than the terminal "finger" and are placed close together. Penis with a relatively stout and short shaft with a blunt point and with a slight prominence on the middle of the dorsal outline of shaft. (See plate 79, fig. 8.) Female pedipalp broader at base than in male, second joint about twice as long as third one; the terminal "finger" of the "thumb" is large, just equaling the ventral side of the fourth joint, cylindrical and rounded at tip; the digituli and hairs are similar to those of male. The tip of tarsus of female, with a strongly curved empodial claw, which is four-cleft beyond the angle, and four tenent hairs are borne on two enlarged pedicels at the sides of the claw base. The male tarsus bears an empodial claw that is very short, stout, and slightly bent, and is tripartite beyond the angle. The collar trachea extends straight down and is then bent in a round bow backward and upward without widening to a noticeable extent at any point.

TETRANYCHUS LUDENI Zacher.

Plate 79, fig. 10.

Tetranychus ludeni ZACHER, 1910, Mitth. Kaiserl. Biol. Anst. f. Land- und Forst., Heft 9, January.

A translation of Zacher's (13) text wherein he describes this species is as follows:

On *Salvia splendens*, *Solanum melongena*, and *Curcubita*, St. Cloud, near Paris, April, 1912; Dahlem, 1911 and 1912. This species, concerning which I was able to report on a former occasion, occurred well into the winter in greenhouses. In January, however, the colonies perished, and I was therefore glad when I opportunely, during a visit to Paris, again found them in April in the greenhouse of Herr Ian I. Luden van Heumen. They occurred there in great numbers on *Salvia splendens* in the greenhouse and also in the forcing beds. Since we jointly studied the species there, and were able to establish its status as a new species, I therefore name the species in honor of my friend. In June I received from Herr Luden van Heumen colonies on *Salvia splendens* and *Curcubita* which I reared through the entire summer and autumn in the greenhouse, for the observation of which, however, I did not have time. The species appeared spontaneously in great abundance on *Solanum melongena* in the greenhouse in scattered situations separated by several partitions. The structure of the claws agrees entirely with *T. telarius* L. The terminal "finger" of the palpus is clearly broader, the lateral "finger" somewhat farther distant from the base of the terminal "finger" than with *T. telarius* L. The penis [see pl. 79, fig. 10] deviates strongly. It is broader, only slightly curved, not hook-shaped. At the location of the angular projection in other species, there occurs a broad, rectangular projection. In color the species deviates strongly from *T. telarius* L. and other species, but the young larvae are red colored. It is a large species since the mature female measures 0.870 mm.

TETRANYCHUS FLAVUS Ewing.

Plate 79, fig. 4.

Tetranychus flavus EWING, 1913, Ann. Ent. Soc. Amer., vol. 6, p. 458.

The description according to Ewing is as follows:

General appearance similar to *T. borealis* Ewing; also similar to *T. telarius* Linn., but the individuals are smaller. Color of immature forms green or yellow; of adults green or yellow, with black markings not pronounced. Adults are never orange or red. In the winter when deprived of food supply all instars yellow. General structures similar to those of *T. telarius* Linn., but the tarsal claw in most instances is only five-cleft, the two inner prongs being united. In the case of the female of *T. flavus* the anal spines are situated farther forward than in *T. telarius* Linn., and also nearer the margins of the genital slit or opening. This species differs from *T. borealis* Ewing in the tarsal characters which are nearer those of *T. telarius* Linn., and in having no barb to the penis.

The penis of this species [see pl. 13, fig. 4] is entirely different from the penis of *T. telarius* Linn. It is long and spine-like. In length it is equal to a third or fourth of the entire length of the body. Inner lobe of penis not prominent, slightly swollen at its anterior end; in size, smaller than the basilar lobe of shaft. Shaft long, curved, and resembling the sting of a wasp; varying greatly in curvature, generally bending downward, then upward, or it may have but a single curve, or it might be straight. Basilar lobe large, subcylindrical, equal to one-fourth of the total length of the entire shaft. Hook and barb absent.

Ewing (15) writes that this species is a serious pest to apples in the Hood River Valley and the Willamette Valley, Oregon, and that it probably occurs throughout the Pacific Northwest above altitudes of 1,000 feet. He adds that "when fall comes and the trees drop their leaves, these mites all become a pale yellow in color, and collect in masses about the trunks of trees and the cracks of the ground for a region of several feet from the tree bases. Here they pass the winter, and become active again in the spring, when the trees put out their foliage."

TETRANYCHUS MULTIDIGITULI Ewing.

Tetranychus multidigituli EWING, 1917, Journ. Econ. Ent., vol. 10, October, p. 497.

Ewing's (22) original description of this species is as follows:



FIG. 4.—TETRANYCHUS MULTIDIGITULI EWING. PALPAL APPENDAGES (AFTER EWING).

Preserved specimens yellowish. Body somewhat depressed, skin more or less wrinkled, and abdomen somewhat pointed behind. Palpi prominent; claw strong and much curved; "thumb" stout, almost as broad as long, and not surpassing the claw; digit of "finger" about half as long as "thumb" and less than half as long as broad; digituli or spines, at least five near tip of "thumb," setae also present on "thumb." Mandibles or chelicerae, slender, with a simple loop toward base, and of uniform diameter except at base where they are slightly swollen. A single pair of eyes present, placed laterally; cornea strongly curved. Abdomen clothed above with rather stout, simple, slightly curved setae. Legs moderate; tarsus of leg I about one and one-third times as long as tibia, and truncate at its tip, from which springs a very long tactile seta. Tarsal claws rather weak, strongly curved near their bases, beyond which they are divided into six prongs. Onychium with four tenent hairs. Length, 0.30 mm.; width, 0.21 mm.

According to Ewing this species is described from several specimens on the bark of honey locust (*Gleditsia triacanthos*), collected by J. S. Houser. The author states that the "species differs from most of the other species in the genus in having several digituli, or setae, near the tip of 'thumb;' in having the setae of the body relatively short and of about the same length, and in having the tip of the tarsus broad and truncate."

TETRANYCHUS BIMACULATUS Harvey.

Plates 76, 79, fig. 11, and plates 80 and 81.

Tetranychus bimaculatus HARVEY, 1892 (1893), Ann. Rept. Maine Agric. Exp., Sta., p. 133.

?*Tetranychus vitis* BOISDUVAL, 1867, Entom. Horticole, p. 92.

Tetranychus desertorum BANKS, 1900, Tech. Bull. No. 8, Div. of Ent., U. S. Dept. of Agric., p. 76.

Tetranychus verbesinae COCKERELL, 1902, Nature, vol. 16, Oct., p. 608.

Tetranychus gloveri BANKS, 1900, Tech. Bull. No. 8, Div. Ent., U. S. Dept. Agric., p. 76.

Tetranychus opuntiae BANKS, 1908, Proc. Wash. Ent. Soc., vol. 10, p. 36.

The writer (23) published a list of 29 synonyms of the original European red spider (*T. telarius*) as claimed by various workers since Linnaeus. The studies that resulted in the elaboration of this extensive synonymy were, for the most part, probably not conducted with equipments of a nature satisfactory for the determination of the taxonomic characters. A further critical review of these species may bring to light additional synonyms of *T. bimaculatus*. Ewing (15) states that *T. telarius*, *T. bimaculatus*, *T. gloveri*, and *T. sexmaculatus* should be considered as synonymous.

The writer has had an opportunity to study very critically all of Banks's types, and has examined *bimaculatus* material collected by Harvey at Orono, Maine (type locality of same), as well as copious material of *sexmaculatus* from Florida. We are agreed with Ewing that *gloveri* and *bimaculatus* are the same, but our studies have demonstrated conclusively that *sexmaculatus* is distinct. Since Trägårdh (18), Zacher (13), and Berlese (5) of Europe state that *telarius* possesses but four empodial claws, and since Zacher's and Berlese's figures of the penis differ radically from that of *bimaculatus*, the writer prefers to consider the latter a distinct species, at least for the present.

T. vitis was described in 1867 by Boisduval (2) from mites on grape in France. The accompanying text figures of the palpus and mandibular plate, drawn from material collected and determined in France, are obviously identical with the corresponding characters of *bimaculatus*. The tarsal appendages also agree perfectly with those of *bimaculatus*. A study of Boisduval's type may corroborate this and cause *bimaculatus* to fall as a synonym of *vitis*.

A critical study of Banks's type slide (No. 7508) of *T. desertorum* reveals the fact that the tarsal claw is 6-cleft (not 4-cleft as claimed by Banks), and it otherwise agrees with that of *bimaculatus*. The palpal appendages of the former are also just like those of the latter, and this is true also with the mandibular plate.

A study of Cockerell's (11) type slide of *T. verbesinae* on *Verbesina exauriculata*, from Las Vegas, New Mexico, proves that the tarsal structure, as well as that of the mandibular plate, shape of body, arrangement of bristles and other characters, is quite like that of *bimaculatus*. Cockerell's description is so general that it might apply equally to any of the red spiders, and is of almost no taxonomic value.

Banks's type slide (No. 2330) of *T. gloveri* contains material that conforms perfectly with *bimaculatus*. The palpal appendages and the collar trachea are of the *bimaculatus* type, the tarsal claw is 6-cleft, and the mandibular plate is just as in the latter species.

An examination of Banks's type slide of *T. opuntiae* on cactus from Arizona reveals the fact that the palpal and tarsal characters are precisely as in *bimaculatus*. The empodial claw is 6-cleft, there is

a single eye cornea on each side, and the ratio of the frontal to subfrontal bristles is 3:5. The collar trachea appears about like that of *bimaculatus*.

In Banks's type collection there was a species that he had indicated as new and had given it the manuscript name *T. peruviansis*. It is well to record at this point that this species likewise agrees thoroughly with *bimaculatus* when subjected to a very close study.

At the time of publication of previous papers on *T. bimaculatus* by the writer a really ultramicroscopic examination with the aid of the oil immersion equipment (such as we have more recently adopted as the necessary standard) had not been made. Such intensive studies have since been conducted (see pl. 76, fig. 1), and I can corroborate Ewing's (17) description of the tarsal appendages wherein he says:

Tarsal claw strongly curved at its base, * * * then divided into six pronglike elements * * * arranged in three pairs.

Description of female of *T. bimaculatus* Harvey:

Color variable; at times rusty green, sometimes greenish amber, or yellowish, at times almost black, but more often brick red or ferruginous red. Pigmented blotches occur almost invariably on the sides of the body, which are usually coalesced to form two large dark spots, one on each side extending from the back of the cephalothorax to the posterior region of the abdomen. These are often interrupted posteriorly to form a large anterior and a small posterior spot. These spots arise from underlying paired organs. Almost directly over coxae II are the carmine eyespots located on each side near the margin of the cephalothorax. Legs pale amber, much paler than ground color of body. Palpi pale salmon. Dorsal bristles pale, not arising from tubercles. Body pyriform oval, widest across posterior region of cephalothorax; bristles in four rows, each succeeding pair becoming shorter; the frontal pair a little over half as long as the subfrontal pair which, like the median pair next behind, are two-fifths the greatest width of body. Mandibular plate about twice as long as broad, tapering slightly forward, broadly rounded at tip, with a slight median notch. "Thumb" of palpus in shape somewhat like a truncated cone, the dorsal face about one-third longer than the greatest width at base, the upper surface twice slightly depressed transversely, with an intervening dilation, bearing on its tip a subcylindrical "finger" which is about two-fifths as wide at its base as the distal end of the "thumb." On its upper side, just above the "finger," are two stout, straight hairs arising close together, one medially and the other laterally, which do not greatly exceed in length the "finger." Near the middle of the upper side is a small "finger" three-fourths the length and one-half the width of the terminal "finger" and very similar to the latter. Between this dorsal "finger" and

the base of the "thumb" and at middle of latero-ventral aspect of "thumb" arises a hair about equalling the latter. The penultimate palpal joint bears the usual claw, which reaches about to the basal "finger," and also bears two bristles, one arising dorsally at base of claw which hardly equals the length of claw, and one arising near center of outer side which about equals the length of claw, and one arising near center of outer side which about equals the dorsal bristle. Legs I hardly equal the length of body from the anterior margin of cephalothorax to tip of abdomen; relative lengths of segments of leg I—coxa, 25; trochanter, 15; femur, 53; patella, 23; tibia, 30; tarsus, 49; femur almost four times as long as thick; tip of tarsus (the onychium) bearing a claw which is strongly arcuate and 6-cleft to its middle. Arising also from the onychium, lateral of base of claw on either side is an enlarged process which immediately splits into two nearly straight hairs, each of which bears a capitate tip. These four tenent hairs spread spokelike in the same plane and their respective lengths are similar to those of the fingers of the human hand viewed dorsally. A series of measured females gave the following dimensions: Length (front of cephalothorax to tip of abdomen), 0.424 mm.; width (across posterior margin of cephalothorax), 0.278 mm.; length of forelegs, 0.325 mm. (see pl. 76 and pl. 79, fig 11).

From Orono, Maine, on 37 species of cultivated plants by F. L. Harvey (7), who also reported it from Ithaca and New York and from West Grove, Pennsylvania.

TETRANYCHUS PACIFICUS, new species.

Plates 77 and 79, fig. 12.

Color, lemon-amber; spotted laterally from fecal contents of viscera. A single pale eye cornea on either side postero-ventrad of subfrontal bristles. Legs and palpi pale. Dorsal bristles about 24, in four rows, appearing simple, pale, longest bristle (subfrontal) equaling breadth of body. Body elliptical, 0.39 mm. long by 0.215 mm. wide; vertical thickness of body about normal. "Thumb" of palpus of about usual length, a trifle longer than wide, bearing at its tip a subcylindrical "finger," the length of which is two and one-fourth times that of its thickness, and whose base is hardly one-half the width of "thumb" at tip; on its dorso-distal angle are two digituli; on dorsal face hardly midway to base is a "finger" or sensilla, in length just one-half that of terminal "finger," and between this and base are two short hairs barely exceeding the digituli; a hair arises latero-ventrally from the center of the "thumb;" the claw on the penultimate joint nearly reaches to the dorsal "finger." The spur on the second joint of the male palpus is conical and arises from a

flattened tubercle. The forelegs are about three-quarters the length of body. Femur three and one-half times as long as wide, about one-fifth longer than tarsus; tibia one-fifth longer than patella, which is two-thirds again as long as trochanter. Relative lengths of joints as follows: Trochanter, 9; femur, 33; patella, 15; tibia, 18; tarsus, 27. Tip of tarsus with empodial claw, which is strongly bent below its middle, and with distal two-thirds cleft into six equal spurs arranged in pairs. The usual series of four tenent hairs arise from the onychium at the sides of the empodial claw base. Collar trachea scythe-shaped, extends backward and downward, then bends sharply upward, of rather even caliber throughout. Penis (see pl. 79, fig. 12) nearest that of *T. bimaculatus* but very distinct in the nature of the barb; inner lobe slender, horn-like; basilar lobe projecting dorsally as a cone-shaped process; shaft not very stout, but somewhat thicker than inner lobe, bent upward to form an angle of about 90°; hook bearing a barb that is produced posteriorly into a spur nearly as long as the hook (see pl. 4).

Type.—Cat. No. 22292, U.S.N.M.

The type material is from Portland, Oregon, September 2, 1915, from mock orange (*Philadelphus gordonianus*), from *Vicia*, species, and from wild current (*Ribes*, species), and on chinaberry from Tracey, California, September 12, 1915, collected by the author. The species is nearest *T. bimaculatus*, from which it differs chiefly in the structure of the penis and of the collar trachea.

TETRANYCHUS BOREALIS Ewing.

Plate 79, fig. 9.

Tetranychus borealis EWING, 1913, Ann. Ent. Soc. Amer., vol. 6, p. 457.

In the original publication Ewing (15) states that the female is "similar to the female of *T. telarius* Linn., but smaller, and never orange or red. The inner prongs of the tarsal claw are stouter than the inner prongs of the tarsal claw of *T. telarius* Linn." Regarding the male he states it is "similar to the male of *T. telarius* Linn., except for penis. Penis long, straight. Inner lobe about equal to basilar lobe in length. Shaft shaped like a slender rod. Basilar lobe very pronounced, cone-shaped, equal to about one-fourth the length of the shaft. Hook absent. Barb knob-like." (See pl. 79, fig. 9.)

Ewing's type material was from *Spirea* species, from the Coast Range Mountains, Benton County, Oregon. Ewing states that this species is very closely related to *T. flavus* Ewing, but on account of the marked difference in the character of the empodial claws, and of the penis, the writer is of the opinion that the two species are rather widely separated.

TETRANYCHUS SEXMACULATUS Riley.

Plates 78 and 79, fig. 5.

*Tetranychus sexmaculatus*¹ RILEY, 1890, Insect Life, vol. 2, p. 225.The original description of *T. sexmaculatus* by Riley is as follows:

Length of the full-grown specimens, 0.3 mm. General color, pale greenish-yellow, marked on the abdomen with six or less small dusky spots. General shape oval, somewhat broadest in front of the eyes; laterally slightly constricted just opposite the eyes and at about the middle of the body, at which latter constriction the body is divided by a more or less distinct suture into two parts. There is often also a distinct though small tail-like projection at the end of the body. Anterior projection of cephalothorax rather short, somewhat conical, its apex rounded. Terminal joint of legs longest. Eyes, two each side, the anterior one of each pair being blood-red, this pigment extending some distance into the body giving the appearance of two red eyes on each side; the posterior eyes are colorless and transparent. The spots of the abdomen are arranged in two subdorsal rows, of three spots to each row; they are rounded and quite constant, especially in the smaller and more numerous specimens, though somewhat variable in the larger or full-grown mites.

In the mature specimens the anterior spots, which are arranged close to the dividing suture, are often composed of a collection of 8 to 12 larger or smaller, more or less circular, quite deep black spots, while in others all the spots are single, and with one or the other of the median pair wanting. In the smallest specimens these spots are either wanting or only the anterior or posterior pairs are present, the last pair in this case being generally largest and very distinct. The distribution of the hairs of the body is as follows: Two short slender hairs medially at anterior margin, directed forward, crossing each other near their tips; each side of these, also, close to margin, at about equal distances from each other and the lateral margin is a pair of transparent, circular pores, resembling those which usually give rise to a bristle. In front of the eyes and removed slightly toward the middle is, on each side, a row of rather long and stout bristles, the anterior pair being directed outward and slightly toward the head, and projecting beyond the lateral margin; the median pair are directed forward and cross each other near their tips. The third pair are longest, situated a little in front of the eyes and directed backward. Besides these stout bristles there is another smaller and slender hair not far from the lateral margin behind the eyes, and another at the margin in front of the eyes. The abdomen is provided on each side with a subdorsal row of three very long bristles, a more slender lateral row, four long dorsal bristles surrounding the end, and four ventral terminal bristles, of which the median pair is smallest.

The eggs are 0.11 mm. in diameter, globular, either colorless and transparent or very pale greenish-yellow, and are loosely attached to the web.

Riley's description is too general to be of much value taxonomically. Following is a condensed description from material on citrus leaves from Florida:

Body rhombic-elliptic; color lemon-yellow with blackish spots usually grouped in three blotches along each lateral region. A well-formed anterior and an abortive posterior eye cornea on each side. Subfrontal bristles about one and one-half times the length of the frontal bristles. Length of palpal "thumb" about equaling the width of the "thumb" at tip; dorsal "finger," digituli, and three hairs very similar to *T. bimaculatus*. Tarsal appendages consist of a strongly curved, 6-cleft empodial claw, and four tenent hairs—all resembling *T. bimaculatus*. Collar trachea pipe-

¹In the original description Riley (4) designated the species name as "*6-maculatus*," but later writers have adopted the "*sexmaculatus*" form of the word.

shaped, anterior arm slender, expanding and bending upward and backward into the short, conical posterior arm. Penis [see pl. 79, fig. 5] with slender inner arm, basilar lobe merely an obtuse prominence, shaft very similar in size and outline to inner lobe, tip obliquely truncate and produced ventrally into a very inconspicuous spur. Relative lengths of joints of foreleg as follows: Coxa 20, trochanter 9, femur 23, patella 12, tibia 13, tarsus 16 (see pl. 78).

This mite has done much to injure the citrus trees in Florida since 1886, according to Riley. Mr. W. W. Yothers tells me that the 6-spotted mite is most abundant in Florida during February and March. The species works in restricted colonies, causing severe yellow blistering of the leaf. When abundant, as is frequently the case, an alarming amount of defoliation of the citrus trees occurs.

TETRANYCHUS WELDONI Ewing.

Plate 79, fig. 6.

Tetranychus weldoni EWING, 1913, Ann. Entom. Soc. Amer., vol. 6, p. 457.

Ewing (15), in his original description of this species, says that for a long time he had confused this mite with *T. bimaculatus*, but that he had demonstrated that the males of the two species are quite distinct. Ewing's description of the species follows:

Female: Similar in all respects to the female of *T. telarius* Linn.

Male: Different from male of *T. telarius* Linn. in characters of penis and spur on palpus. Spur on palpus not so pointed as in *T. telarius* Linn. Penis very long, rod-like, equal to one-third the length of the body. Inner lobe short, rod-like, slightly swollen at its anterior end. Shaft rod-like, not setiform; gradually tapering as you pass backward; posterior one-half turned upward; tip narrowly rounded, not pointed. Basilar lobe absent. Hook absent. Barb absent. (See pl. 79, fig. 6.)

From Grand Junction, Colorado; on apple, prune, cottonwood.

TETRANYCHUS WILLAMETTEI McGregor.

Plate 79, fig. 1.

Tetranychus willamettei MCGREGOR, 1917, Proc. U. S. Nat. Mus., vol. 51, no. 2167, p. 586.

Color, pale lemon-yellow. Eyes single on each side. Legs and palpi, pale color. Dorsal bristles not arising from tubercles. Body of female elliptical, four-fifths again as long as broad, widest between legs III; length, 0.25 mm.; breadth, 0.14 mm. Bristles, about 22, in four dorsal rows, the longest about half the width of body. Mandibular plate with parallel sides, two and three-quarter times as long as broad, rounded at tip with no emargination visible. "Thumb" of palpus of very unusual form—semispherical or subconical, bearing at its tip a very slender, long "finger"; on its upper side near apex are two pin-shaped pseudo-fingers, and on same side about midway to base is a "finger" shorter and even thinner than terminal "finger"; between this and base are two slender hairs a trifle longer than subbasal "finger"; a slender hair arises latero-ventrally one-third the distance from tip to base of "thumb." The claw on the penultimate joint does not reach to subbasal "finger." The legs are rather short;

forelegs about four-fifths the length of body. Femur about two and one-half times as long as thick, barely longer than the tarsus; tibia and patella equal. Tip of tarsus bears a claw which is rather strongly bent near base and only slightly arched for the rest of its length; it appears to be unclenched for over half its length, and then divided into six closely appressed spines. The usual series of four tenent hairs arise in pairs by the side of the claw base. The collar trachea, opening medially in a pore, runs first downward and backward, then upward and backward, and then upward and slightly forward. It is of nearly even caliber throughout, but gradually enlarges a trifle toward the hind end. Viewed as a whole it is very nearly sickle-shaped. The penis (see pl. 79, fig. 1) is simple in structure, the shaft being very gradually attenuated to an extremely sharp point; it is very slightly bent just distad to the middle, but is generally straight.

Type.—Cat. No. 20169, U.S.N.M.

From Oregon City, Oregon, from the leaves of white oak (*Quercus lobata*), to which a noticeable rusty appearance is imparted through the work of the species.

TETRANYCHUS OREGONENSIS McGREGOR.

Plate 79, fig. 2.

Tetranychus oregonensis McGREGOR, 1917, Proc. U. S. Nat. Mus., vol. 51, no. 2167, p. 585.

Color, straw color or pale yellowish amber; lateral spots lacking or very inconspicuous. Eyes pale, a single one on either side near base of subfrontal bristles. Legs and palpi paler than body. Dorsal bristles 26, in four rows, plumose, pale, longest bristle (subfrontal) equal to half the breadth of body. Body elliptic-ovate, 0.304 mm. long by 0.142 mm. wide; vertical thickness of body greatly reduced. "Thumb" of palpus very short, nearly half again as wide as long, bearing at its tip a fairly ample "finger," whose base, however, is slightly more than one-third the width of "thumb" at tip. On its upper distal corner are two pseudo-fingers; on upper side hardly midway to base is a very small "finger" or sensilla, and between this and base are two short hairs; a pair arises latero-ventrally from the center of the "thumb." The claw on the penultimate joint reaches to the dorsal "finger." The spur on the second joint of the male palpus is rather long and tack-like. The legs are rather short, about three-fourths the length of body. Femur hardly twice as long as wide, equaling the tarsus; tibia one-fourth longer than patella, which barely surpasses the trochanter in length. Relative lengths of joints as follows: Trochanter, 10; femur, 21; patella, 11; tibia, 14; tarsus, 21. Tip of tarsus bears a claw which is strongly bent below its middle; the portion beyond this point is cleft into six nearly straight

claw divisions, the two inner of which are somewhat stronger than the others. The usual series of four tenent hairs arise by the sides of the claw base. Collar trachea of novel type; runs backward and downward as a straight, even-calibered tube, and then bends sharply upward into a short, wide chamber, the two arms making an angle with one another of less than 90° . The penis shaft (pl. 12, fig. 2) appears to taper gradually to a strong, unbarbed hook.

Type.—Cat. No. 20166, U.S.N.M.

From Portland, Oregon, on wild cherry (*Prunus*, species). Probably nearest *T. monticolus*, from which it is readily separated through the collar trachea and penis characters.

TETRANYCHUS MONTICOLUS McGregor.

Plate 79, fig. 3.

Tetranychus monticolus MCGREGOR, 1917, Proc. U. S. Nat. Mus., vol. 51, no. 2167, p. 584.

Body of a rather uniform pale amber color. Eyes pale; one cornea on each side close behind the subfrontal bristle, behind which are the carrot-colored eyespots. Legs and palpi rather paler than body. Dorsal bristles colorless, distinctly plumose, 26 in four rows, the longest about five-ninths the width of body. Body pyriform-elliptic, usually widest between legs II and III. Mandibular plate nearly three times as long as broad, narrowed considerably anteriorly to a well-rounded, unemarginated tip. "Thumb" of palpus two-thirds as long as broad, bearing on its truncate tip a subconical "finger," whose base is only two-fifths as wide as the tip of the "thumb." On its upper distal corner are two pin-shaped pseudo-fingers, in length somewhat exceeding the terminal "finger," on upper side, about a third the distance to base, is a small "finger;" and immediately proximad to this is a short hair. Another similar hair occurs on the upper side just at base; a hair arises on the ventral aspect of the "thumb." The claw of the penultimate joint does not reach quite to the dorsal "finger." The legs are short, not much over two-thirds the length of body (exclusive of palpi). Femur a little more than twice as long as wide, not quite as long as tarsus; tibia a little longer than patella, which is five-sevenths again as long as the trochanter. Relative lengths of joints are as follows: Coxa, 8; trochanter, 7; femur, 20; patella, 12; tibia, 14; tarsus, 22. Tip of tarsus bears a claw which is bent near its middle and cleft into six slightly curved spurs. The customary four tenent hairs arise, two on either side by base of claw, tarsal claw of male differing from that of female in that its six divisions are much shorter and more abruptly acuminate. The collar trachea is rather novel; it runs downward

and backward from the pore, then turns suddenly upward and backward to form an angle of about 130° , and then the superior arm bends abruptly forward and upward, paralleling the inferior arm. The superior arm is much shorter and of somewhat smaller caliber than the inferior arm. The penis (pl. 79, fig. 3) is of unusual type. The short inner lobe is rod-like for most of its length and then expands suddenly to form the prominent basilar lobe; the outer shaft arises as a rod-like structure not materially stouter than the inner lobe, and for one-third its length is directed about continuous with the inner lobe, but bends slightly downward, then extending backward as a straight, slender spur, terminating in a very sharp point.

Type.—Cat. No. 20165, U.S.N.M.

From the south slope of Mount Hood, Oregon, above Government Camp, at an altitude of 6,000 feet, from underside of leaves of large-berried huckleberry (*Vaccinium*, species). Considerable discoloration and dropping of leaves accompanies the mite's activities. The species is rather close to *T. oregonensis*, but is readily distinguished from the latter through the marked difference in the form of the penis and collar trachea.

SEPTANYCHUS, new genus.

This genus at present represented by two species from the United States.

Tarsus with empodial claw separated at base from distal portion of tarsus; claw complex, appendiculate at or near base with four to six spurs; the dorsal spur decidedly shorter than the ventral group of spurs.

KEY TO SPECIES OF GENUS SEPTANYCHUS.

- a¹. Terminal "finger" of palpal "thumb" in width at base exceeding its length; dorsal "finger" fully as long as terminal "finger;" mandibular plate converging to a well-rounded anterior margin.....*S. tumidus* Banks.
 a². Terminal "finger" of palpal "thumb" about half again as long as wide; dorsal "finger" only about two-thirds the length of the terminal "finger;" mandibular plate with subparallel sides, and subtruncate frontal margin.
S. quinquenychus McGregor.

SEPTANYCHUS TUMIDUS (Banks).

Tetranychus tumidus BANKS, 1900, Tech. Bull. No. 8, Div. of Ent., U. S. Dept. of Agric., p. 73.

The following description of *S. tumidus* is taken chiefly from Banks's (9) original paper, with such alterations as have been found necessary through a close study of the type material:

Dark red and somewhat pruinose, marked across the thorax with a dusky band, terminating each side in a rather large dusky spot, a similar spot on each side near end

of body; in some specimens there is an additional spot each side between the two; legs and mouth parts pale reddish. Young specimens are paler, with spots more

distinct and confluent. Eggs are pale red. Body moderately broad; bristles rather longer than usual, quite stout, all in the usual arrangement, subfrontal pair not twice as long as the frontal pair. Palpi of average length; "thumb" a trifle longer than greatest width, on its tip is a large, short, cylindro-conical "finger" whose base is over two-thirds the width of tip of "thumb," the usual dorsal "finger" arises at the middle of the dorso-median line and is about one-third longer than the terminal "finger," but in thickness is barely more than one-third that of the latter; the two customary digituli arise at the outer distal angle of the "thumb," and the usual two hairs occur dorsally between the dorsal "finger" and the base; a hair arises near the middle of the outer face of the "thumb." Mandibular plate twice as long as broad, narrowed toward tip, the sides before tip slightly concave, broadly rounded at tip, without a median emargination. Legs moderate; femur I twice as long as broad; tibia I longer than patella; tarsus of moderate length, terminating in a claw which is strongly bent near middle, at which point arise two main divisions—the termino-dorsal division consisting of a single stout spur, and the ventral division of a somewhat stouter claw that soon splits into six equal, slender, spine-like spurs, which exceed considerably the dorsal spur.

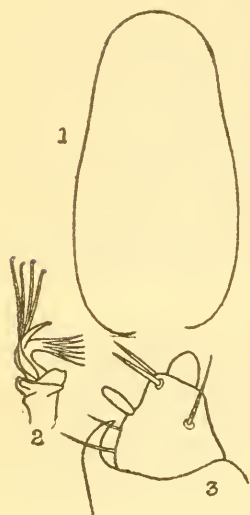


FIG. 5.—SEPTANYCHUS TUMIDUS BANKS. 1, MANDIBULAR PLATE; 2, TARSAL APPENDAGES; 3, PALPAL "THUMB" AND ITS APPENDAGES (ORIGINAL).

From Eustis, Florida, on the leaves of water hyacinth.

SEPTANYCHUS QUINQUENCHUS (McGregor).

Tetranychus quinquenchus MCGREGOR, 1914, Ann. Ent. Soc. Amer., vol. 7, no. 4, December.

There are a number of types of coloration, but the general ground-color is reddish-chestnut, with the cephalothorax decidedly paler; the prevailing design consists of two large lung-shaped blackish areas one on each side toward base of abdomen, which coalesce medially toward the front, a similar but smaller spot on each side near posterior end of abdomen; legs and mouthparts pale. Body broadest midway between legs II and III, tapering sharply forward to the narrow, slightly convex frontal margin, also tapering considerably behind, twice as long as broad; length, 0.45 mm., width, 0.23 mm.; bristles rather long and fine, seven each in the dorsal rows and six each in the sublateral rows, frontal pair half as long as subfrontal pair, which are placed just in front of the eyes. "Thumb" of palpus very short and stout—somewhat wider at base than the length, on its tip is a blunt "finger" the basal width of which is not greatly less than its length; midway on the upper side is a "finger" somewhat shorter than the terminal "finger" and of about one-third the width of the latter; at the upper distal angle are two digituli, and two short hairs occur on the "thumb" between the dorsal "finger"

and the antepenultimate claw. Mandibular plate with subparallel sides and subtruncate at front but unemarginated. Legs of moderate length; foreleg, 0.33 mm.; femur I, two and one-half times as long as broad; tibia I somewhat longer than patella I; tarsus in length equaling tibia and patella together; the tarsal appendages, consisting of the usual series of four tenent hairs and an empodial claw, which is very sharply bent at middle at which point arises dorsally a strong spur and ventrally a stronger division that immediately splits into six¹ equal, slender, distally-curving, spine-like claws which considerably exceed in length the dorsal claw. Relative lengths of the leg joints are as follows: Trochanter, 10; femur, 25; patella, 18; tibia, 19; tarsus, 37. There is but a single eye cornea on each side, which is set in a shallow submarginal socket directly over coxa II. Collar trachea scythe-shaped, the anterior arm running downward and backward with a slight upward convexity near its middle and then bending very sharply upward to form the nearly straight posterior arm, which is of similar caliber to the anterior arm. The spur on the male palpus consists of a spine-like appendage set in a thumb-like prominence of the second joint.

Type.—Cat. No. 19087, U.S.N.M.

From Orlando, Florida, on castor bean (*Ricinus communis*). This species is rather close to the preceding species, but is probably distinct through the following characters: Breadth of body; relative length of frontal to subfrontal bristles; mandibular plate; proportions of terminal "finger." A more careful study of *tumidus* material may eventually show that the species is identical with *quinquenchus*.

Genus PARATETRANYCHUS Zacher.

Paratetranychus ZACHER, 1910, Mitth. Kais. Biol. Anst. f. Land u. Forst., Heft 9, Januar, pp. 37-41.

This genus contains at the present date two European species, one South American species, and seven North American species.

Red spiders, with empodial claw complex, appendiculate at base or at point between it and middle point with from 4 to 8 spurs; dorsal spur more prominent and much longer or at least equaling the appendiculate spurs; collar trachea straight, enlarged at end into a bladder-shaped chamber.

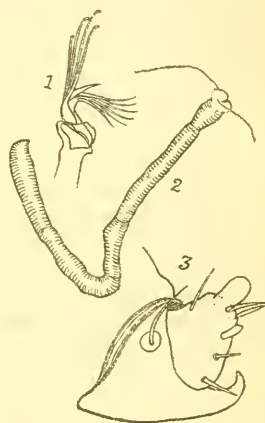


FIG. 6.—SEPTANYCHUS QUINQUENCHUS MCGREGOR, 1, TARSAL APPENDAGES; 2, COLLAR TRACHEA; 3, PALPAL "THUMB" AND ITS APPENDAGES (ORIGINAL).

¹ In the original description the author erroneously writes that the ventral claw division splits into our spurs. We take this opportunity of correcting this statement as above recorded in the text.

Type.—*Paratetranychus ununguis* Jacobi, designated by Trägårdh, 1915.

KEY TO THE SPECIES OF GENUS PARATETRANYCHUS.

1. Appendiculate spurs at base of tarsal claw about one-quarter the length of the main dorsal claw division; femur I about half again as long as tarsus I; palpal "thumb" over twice as wide as long; terminal "finger" about half again as long as thick; mandibular plate deeply emarginate.....*P. peruvianus* McGregor.
Appendiculate spurs at base of tarsal claw half or more the length of the main dorsal claw division..... 2
2. Main dorsal division of empodial claw decidedly exceeding the basal, appendiculate spurs; palpal "thumb" of male longer than wide..... 3
Main dorsal division of empodial claw not conspicuously exceeding the basal appendiculate spurs; palpal "thumb" wider than long..... 4
3. Terminal "finger" of palpal "thumb" well developed, at base fully half as wide as tip of "thumb"; tarsal appendiculate spurs rather closely appressed and fused toward the bases; penis shaft stout, bent sharply to form acuminate hook; mandibular plate elongate, truncate or broadly rounded in front without emargination.....*P. pratensis* Banks.
Terminal "finger" of palpal "thumb" of male inconspicuous, much less than half width of "thumb" at tip; tarsal appendiculate spurs widely radiate, free to their bases; penis shaft slender, together with acuminate hook forming sickle-shaped structure; mandibular plate wide, broadly rounded anteriorly without emargination.....*P. ununguis* Jacobi.
4. Terminal "finger" of palpus three times as long as thick, not over twice as thick as lateral "finger"; ventral tarsal claw division cleft barely more than half its length, and the six appendiculate spurs rather closely clustered; mandibular plate not plainly emarginate.....*P. modestus* Banks.
Terminal "finger" of palpus not much longer than thick, from three to five times as thick as lateral "finger"; ventral tarsal claw division cleft nearly or quite to base, and considerably divergent; mandibular plate more often emarginate.... 5
5. Mandibular plate not emarginate..... 6
Mandibular plate distinctly or indistinctly emarginate..... 7
6. Terminal "finger" of palpal "thumb" spatulate in outline; lateral "finger" short, tack-like; main dorsal claw of tarsus with greatest thickness at mid-point.
P. pilosus Canestrini and Fanzago.
Terminal "finger" of palpal "thumb" subconic in outline; lateral "finger" long, banana-shaped; main dorsal claw of tarsus thickest at base....*P. viridis*¹ Banks.
7. Dorsal bristles arising from prominent tubercles..... 8
Dorsal bristles not arising from prominent tubercles..... 9
8. Tarsus equaling femur; mandibular plate almost imperceptibly emarginate; hook of penis longer than shaft, bent 60° from main axis of penis; tarsal claw with six appendiculate spurs; subfrontal bristles about three times as long as frontals.
P. citri McGregor.
Femur from one-quarter to one-fifth longer than tarsus; mandibular plate distinctly emarginate; hook of penis about half length of shaft, bent over 90° from main axis of penis; tarsal claw with five appendiculate spurs; subfrontal bristles only one-quarter again as long as frontals.....*P. ilicis* McGregor.
9. Femur about two and one-half times as long as wide and one-quarter again as long as tarsus; tarsal claw with six appendiculate spurs.....*P. bicolor* Banks.
Femur about half again as long as wide and hardly equaling the tarsus; tarsal claw with five appendiculate spurs.....*P. yothersi* McGregor.

¹ *Viridis* and *simplex* are synonyms; the former was the earlier and holds.

PARATETRANYCHUS PERUVIANUS (McGregor).

Tetranychus (*Paratetranychus*) *peruvianus* MCGREGOR, (*peruvianus*) 1917, Proc. U. S. Nat. Mus., vol. 51, pp. 581, 582, 589, pls. 101-107. The name was misspelled on p. 581, but properly spelled on p. 589.

Color, translucent yellowish-green. Eyes (in mounted material) clear, directly over front margin of coxae II. Dorsal bristles, 24 in number, not arising from tubercles, for the most part very short and weak, distributed on dorsal aspect of body in about the usual arrangement. Body of female rhombic-ovate, widest across hind margin of cephalothorax, which is slightly emarginate in front; male cuneate-pentagonal, widest across hind margin of cephalothorax, which is truncate in front, abdomen tapering to acute point posteriorly. Mandibular plate considerably more than twice as long as broad, margins subparallel, with a very distinct anterior emargination. "Thumb" of palpus very short in proportion to its width, bearing at its tip a relatively large, subconical "finger," whose base is half as wide as tip of "thumb," length of "thumb" and terminal "finger" together equaling width of "thumb." On its rather truncate tip, on opposite sides of the "finger," are two stout spines or pseudo-fingers (not much thicker than hairs); on upper side about one-third to base, is a small "finger," and between this and base are two short hairs, the distal-most one of which appears to arise adjacent to the small "finger." The claw on the penultimate joint reaches far beyond the middle of the "thumb"; a hair arises laterally from the center of the "thumb," and another from a similar position on the penultimate joint. The legs are unusually short, in the female distinctly less than the width of the body, in the male barely exceeding the width of body. Femur I considerably less than twice as long as wide, about half again as long as tarsus I. Tibia I just equaling patella I, which barely equals trochanter I. Tip of tarsus bears a stout, sickle-shaped claw, which is unclenched to its tip; arising from the under face of this claw, near its base, are six weak spines, which are less than one-fourth of the length of the main claw. The usual series of four tenent hairs arise by the sides of the base of the claw from the tip of the short onychium. The egg is unknown to the writer.

Type.—Cat. No. 20164, U.S.N.M.

The type material was collected by Mr. E. W. Rust "along the line of the Ferrocarril Central del Peru near La Legua (between Lima and Callao), Peru, South America, January, 1913, from the underside of willow (*Salix*, species) leaves."

Notes.—An ample series of measurements of mounted material in fair condition yielded the following averages for adults of both sexes:

SEX.	Length (not including palpi).	Width.	Foreleg.
Female.....	<i>mm.</i> 0.299	<i>mm.</i> 0.205	<i>mm.</i> 0.173
Male.....	.237	.168	.177

The relative lengths of the leg joints are as follows: Coxa, 9; trochanter, 10; femur, 16; patella, 9.5; tibia, 9.5; tarsus, 10.

Mr. Rust states that the presence of this species causes the willow leaves to turn yellow and drop, but did not appear to greatly injure the trees. He says that the individuals live in restricted colonies under small, compact webs which almost completely conceal them. These webs, according to Mr. Rust, resemble very much the webs under which many true spiders deposit their eggs. No predaceous species were observed in the mite colonies.

PARATETRANYCHUS PRATENSIS (Banks).

Plate 79, fig. 16.

Tetranychus pratensis BANKS, 1912, Proc. Wash. Entom. Soc., vol. 14, p. 459.

Owing, undoubtedly, to inadequate microscopic equipment, Banks (14), in his original description of this species, entirely misstated the characters of the tarsus and palpus. Recent critical studies of the type material have revealed the fact that instead, as Banks states, of the tarsus ending "in two long, simple, and but little curved claws," it bears a single sickle-shaped claw, which gives rise near its base to six appendiculate spurs. Ewing writes that "the inner claw is bent downward very near its base, and beyond this bend it is three-cleft." Also the palpal "thumb," in addition to bearing "one stout finger and a hair at one corner," possesses the usual dorsal "finger," two digituli at the upper distal corner, and two short hairs dorsally between the dorsal "finger" and base. The original description as modified through the results of recent studies of the type material is as follows:

Pale greenish. Body nearly or quite twice as long as broad, rather more elongate than usual, broadly rounded behind, without humps above, with the usual four rows of rather long bristles, those above longer than the hind tarsi. Legs short, none as long as the body, with many long hairs, some extremely long, being as long as two joints together. Mandibular plate elongate, truncate, or broadly rounded in front, but not emarginate. Palpal "thumb" a

little longer than wide, bearing at its tip a well-developed "finger," whose base is about one-half the width of "thumb" at tip. On upper distal corner of "thumb" are two digituli about half again as long as terminal "finger." On upper side, barely midway to base, is a slender "finger" or sensilla only one-third as thick as the terminal "finger," and between this and base are two short hairs. A hair arises latero-ventrally from the center of the "thumb." The claw on the penultimate joint is about as usual. Tip of tarsus bears a very strong, sickle-shaped claw, which is uncleft to its tip. At a point one-fifth its length from the base there arises from the ventral surface six slender spurs in length about two-fifths that of the claw. The usual series of four tenent hairs arise by the sides of the base of the claw. Body length, 0.4 mm. According to Ewing the form of the penis (see pl. 79, fig. 16) is as follows: "Inner lobe slightly over one-half as long as the shaft of the penis. Shaft stout, somewhat similar to the shaft in *T. telarius* Linnaeus; enlarged slightly at its base, so as to form the basilar lobe. Hook pronounced; bent at an angle of about 90° to the axis of the shaft. Barb absent."

From Pullman, Washington, on timothy, in June. G. R. Hyslop, coll.

PARATETRANYCHUS UNUNGUIS (Jacobi).

Plate 79, fig. 13.

Tetranychus ununguis JACOBI, 1905. Naturw. Zeitschr. Land-u., Forst, p. 239.

Color greenish-yellow, abdomen black mottled through the visibility of the excrementary mass. One very long, slender tarsal claw with six widely appendiculate spurs, which are free to their bases, arising ventrally from a protuberance at the base of the claw. Body bristles pointed, not arising from tubercles. Mandibular plate wide, broadly rounded anteriorly without emargination. Penis shaft slender, (see pl. 79, fig. 13) together with acuminate hook, forming a sickle-shaped structure. Eggs round, dark-red, deposited on bark, bud scales, and needles.

In 1905 Jacobi (12) placed this European species under the then all-inclusive genus *Tetranychus*, but in 1910 Zacher (13) erected the genus *Paratetranychus* to include *P. ununguis* and *P. pilosus* Canestrini and Fanzago, based on the tarsal and collar trachea characters. *P. ununguis* was described by Jacobi from material on conifer needles collected at Dahlem, Germany. The preferred hosts were *Picea sitchensis* and *P. excelsa*, of which 30 per cent of the trees were attacked.

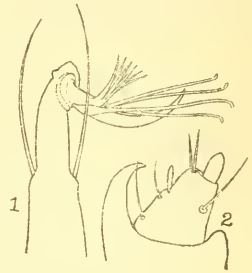


FIG. 7.—*PARATETRANYCHUS PRATENSIS* BANKS. 1, TARSAL APPENDAGES; 2, PALPAL "THUMB" AND ITS APPENDAGES (ORIGINAL).

PARATETRANYCHUS MODESTUS (Banks).

Tetranychus modestus BANKS, 1900, U. S. Dept. Agric., Div. Entom., Tech. Ser. No. 8, p. 73.

It is necessary to revise radically Banks's (9) original description of this species. He writes that the tarsus "ends in a long simple claw," and that the palpal "thumb" is not as long as claw, with three nearly equal fingers on the tip. A critical study of the type material reveals the fact that the tarsal claw is not simple but possesses a series of six appendiculate spurs, while the palpal "thumb" actually considerably exceeds the claw, and only the one usual terminal "finger" occurs on the "thumb," as well as the customary two digituli. A revision of the original description based on a careful study of the type material is as follows:

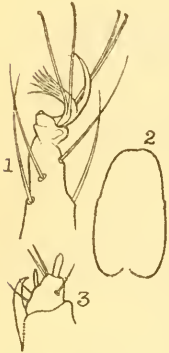


FIG. 8.—PARATETRANYCHUS MODESTUS BANKS. 1, TARSAL APPENDAGES; 2, MANDIBULAR PLATE; 3, PALPAL "THUMB" AND ITS APPENDAGES (ORIGINAL).

Head, palpi, and legs are brownish; the body yellowish, with quite large blackish irregular spots across middle of thorax; a large lateral spot in region of last pair of legs; and a broad irregular border around end of body. Body rather more elongate than usual; bristles in the usual arrangement. Legs short; femur I fully twice as long as broad; tibia I only a trifle longer than patella I; tarsus short, ends in a large, uniformly curved, acuminate claw, which is uncleft to its tip; arising ventrally from this claw, at a point one-quarter its length from the base, are six closely clustered appendiculate spurs which are two-thirds the length of the main claw and fused for about half their length. The usual series of four tenent hairs arise by the sides of the base of the claw from the tip of the onychium. Mandibular plate of moderate length, not much narrowed toward tip, which is broadly rounded. Palpi short, "thumb" a trifle wider than long, bearing at its tip a slender "finger" three times as long as thick whose base is less than half as wide as tip of "thumb." On its upper distal corner are two digituli one-half again as long as the terminal "finger," on upper side barely halfway to the base is a smaller "finger" a trifle over half the thickness of the terminal "finger," and between this and base are two short hairs. Another similar hair arises latero-ventrally near the center of "thumb." On each side of the anal opening there is a pair of fine hairs.

Found in August at Washington, District of Columbia, causing a rustlike appearance on the blades of corn.

PARATETRANYCHUS PILOSUS (Canestrini and Fanzago).

Plate 79, fig. 14.

Tetranychus pilosus CANESTRINI and FANZAGO, 1877-78, *Intorno agli Acari Italiani*, *Atti Ist. Venet.*, ser. 5, vol. 4, pp. 69-208.

Canestrini and Fanzago (3) in 1878 referred this species to the genus *Tetranychus*, but Zacher (13), in 1910, as before mentioned, erected the genus *Paratetranychus* to include *P. ununguis* Jacobi and *P. pilosus*. *P. pilosus* is called the rose mite in Italy and occurs there most commonly on roses, *Ribes*, species, pear, and cherry.

Length of female, 0.315 mm. Dorsal bristles, 26, in four rows, fine-pointed, pilose, and arising from tubercles. Palpal "thumb" bears on its tip a stout spatulate "finger," the thickness of which about equals its length. The usual dorso-terminal digituli, the dorsal "finger" which is tack-like, and the dorso-basal hairs occur on the "thumb," as well as the latero-ventral hair. The tarsus possesses a heavy, sickle-shaped claw which is thickest at mid-point; from this middle point ventrally four appendiculate spurs arise which considerably surpass the claw. The usual four tenent hairs are present. The inner lobe of the penis (see pl. 79, fig. 14) is club-shaped, thickening considerably posteriorly to form the obtuse basilar lobe; the shaft barely half as long as inner lobe but otherwise similar; hook bent only 45° from the main axis of the penis, sharply acuminate without barb. Collar trachea straight and of even caliber, with spherical, dilated chamber. Mandibular plate narrowed and rounded anteriorly, but not emarginate.

PARATETRANYCHUS VIRIDIS (Banks).

Tetranychus viridis BANKS, 1894, *Trans. Amer. Entom. Soc.*, vol. 21, p. 218.

Tetranychus simplex BANKS, 1914, *Pomona Journ. Ent. Zool.*, vol. 6, no. 2, p. 57.

Banks's (8) description of *P. viridis*, which follows, is in the most abstract terms and in no way differentiates the species from the red spiders:

Length, 0.40 mm. Greenish, with a large, blackish or sometimes reddish spot each side covering the shoulders of the abdomen and the posterior angles of the cephalothorax. The cephalothorax is quite distinctly separated from the abdomen by a constriction; the abdomen broadest at the shoulders; the cephalothorax short, broadly rounded. The body bears a few long bristles. Those on the legs are similar, but shorter. The anterior pairs of legs are somewhat larger than the posterior pairs.

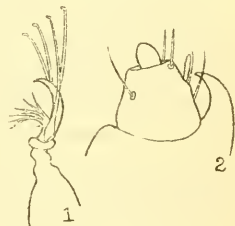


FIG. 9.—PARATETRANYCHUS VIRIDIS BANKS, 1, TARSAL APPENDAGES; 2, PALPAL "THUMB" AND ITS APPENDAGES (ORIGINAL).

A critical study of Banks's material reveals the following tarsal and palpal characters:

Tip of tarsus bears a short, sickle-shaped claw, which is unclawed to its tip; arising from the ventral surface of this claw, one-fifth its length from base, are six radiating spurs, which are about half the length of the main claw. The usual series of four tenent hairs arise by the sides of the base of the claw from the tip of the onychium. "Thumb" of palpus short, wider than long, bearing at its tip an unusually ample, oval-shaped "finger," which is almost as thick as long, and whose base is just half as wide as tip of "thumb." Near the upper distal angle are the two customary digituli which slightly exceed the terminal "finger;" on upper side not quite midway to base is a small, banana-shaped "finger" or sensilla one-fifth the thickness of the terminal "finger," and between this and base of "thumb" are two short hairs; a hair arises latero-ventrally from the center of the "thumb." The claw on the penultimate joint reaches to the dorsal "finger." Neither the penis nor the collar trachea could be discerned in the preserved material.

Type material from the upper side of pecan leaves, Texas.

It has developed from a study of the type material that Banks's species *T. simplex* is identical with *P. viridis*, and is herewith reduced through the operation of the priority rule.

PARATETRANYCHUS CITRI (McGregor).

Plate 79, fig. 15.

Tetranychus (Paratetranychus) citri MCGREGOR, 1916, Ann. Ent. Soc. Amer., vol. 9, no. 3, pp. 284-288, pl. 2.

Tetranychus mytilaspidis BANKS not Riley (*Penthalodes*), 1900, U. S. Dept. Agr., Div. Ent., Tech. Ser., Bull. 8, p. 71.

As pointed out in a paper by the present writer (20), the citrus mite had never been described prior to that time. Banks had interpreted Riley's type material of *Penthalodes mytilaspidis* to be the citrus mite which we have shown was clearly not the case.

Distinctly velvety-red in color. In size larger and more obese than the majority of red spider species. Female: Length, 0.305 mm.; width, 0.230 mm. A single eye cornea on each side, twice as far behind the subfrontal bristle as the latter's distance from the frontal bristle. Dorsal bristles long, stout, arising from prominent tubercles subfrontal bristles barely three times as long as frontals; bristles sparsely pilose. Legs paler than body color, bristles arranged chiefly in four longitudinal rows. Mandibular plate abruptly narrowed anteriorly, tip rounded, usually with an almost imperceptible emargination. Palpus is provided with a comparatively short "thumb," bearing a terminal, slightly clavate "finger" whose base is less than half the width of tip of "thumb;" with two pseudo-fingers arising on either side of the upper distal corner, which are not greatly thicker than hairs; on upper side hardly midway to base with a small "finger" between which and base are two short, stout hairs; near the lower center of the outer side of "thumb" with a hair

which reaches to the tip of the terminal "finger;" with the claw on the penultimate joint stout and reaching to the dorsal "finger;" a strong hair arising laterally from the center of the penultimate joint, another arising from the center of the dorsal face of this joint, which equals the claw, and a short weak hair with its origin on the inner base of claw; and with a very strongly tubercled spur arising distally from the top of the antepenultimate joint of the male. The legs are relatively short; femur somewhat more than twice as long as wide, barely equaling tarsus; tibia a little longer than patella which is one-third again as long as trochanter: Relative lengths of joints are as follows: Coxa 11, trochanter 11, femur 29, patella 15, tibia 17, tarsus 29. Tip of tarsus bears a claw which is rather straight for two-thirds its length and then bent sharply downward; at a point one-third the length of the claw from its base arise six slightly curved spurs whose tips surpass that of the main claw; the four usual tenent hairs arise two on either side of the base of the claw.

The male is considerably smaller than the female (length, 0.216 mm.; width, 0.146 mm.), abruptly narrowed posteriorly. The legs appear longer in proportion to the body than in the case of the female, and are salmon-pink. The distribution of dorsal bristles is similar to that of female. Penis (see pl. 79, fig. 15) comparatively short; inner lobe long, rod-like, about three times as long as the shaft; shaft very stout and short, becoming abruptly smaller distally, and bent upward at an angle of 120° to form the attenuate hook, which is considerably longer than the shaft; basilar lobe present on upper side of shaft as a strong, conical projection; hook possessing no barb, being spine-like terminally.

The egg when first laid is pale, almost colorless, like a drop of honey, but later turns bright red, is sphero-lenticular, with a vertical stalk arising from the center of the top side which in length is about twice the diameter of the egg. Several guy fibrils radiate downward from the apex of the stalk to the leaf surface, thus giving additional attachment to the egg.

Type.—Cat. No. 20362, U.S.N.M.

The type material is from Orlando, Florida, March 7, 1916, from the leaves of lemon, collected by W. W. Yothers.

PARATETRANYCHUS ILICIS (McGregor).

Plate 79, fig. 17.

Tetranychus ilicis McGREGOR, 1917, Proc. U. S. Nat. Mus., vol. 51, pp. 581-590, pls. 101-107.

Color, from ferruginous to reddish-brown, with a pale pink area embracing central portion of the cephalothorax; darker than most red spider species. Eyes conspicuous, carmine. Dorsal bristles

colorless, arising from rather prominent tubercles, densely clothed with distally pointing barbules; subfrontal bristle one-fourth again as long as frontal one. Body of female rotund-elliptical, length, 0.302 mm.; width, 0.259 mm. Male much less rotund, narrowed backward; length, 0.237 mm.; width, 0.184 mm. Bristles about 22 in four rows, in length averaging about five-sevenths the width of body. Mandibular plate three-fourths again as long as wide, narrowed somewhat anteriorly to a rotund tip, which is distinctly emarginate in the female. Palpi pale pink, like cephalothorax. "Thumb" of palpus not greatly shortened axially, the thickness at

middle being about one-fifth in excess of its length, bearing at its tip a slightly clavate "finger," whose base is less than half as wide as the tip of "thumb;" on its upper distal corner are two spine-like pseudo-fingers; on upper side almost midway to base is a greatly reduced "finger," about one-fourth as thick as the terminal "finger," and between this and base are two short stout hairs rather similar to the pseudo-fingers. A hair, similar to the upper basal one, arises laterally from the center of the "thumb." The claw of the penultimate joint reaches just beyond the dorsal "finger." The legs are pale amber-color, not quite as long as width of body. Femur three and one-half times as long as wide, somewhat exceeding tarsus. Tibia nearly a third longer than patella, which is nearly twice the

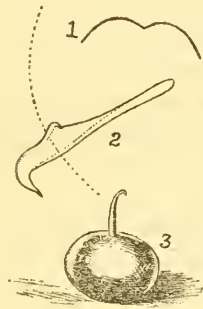


FIG. 10.—PARATETRANYCHUS ILICIS MCGREGOR. 1, TIP OF MANDIBULAR PLATE; 2, PENIS AND HIND BODY MARGIN; 3, EGG (ORIGINAL).

length of the trochanter. Tip or tarsus bears a stout claw, which is sickle-shaped; six slender spurs, which are free to their bases, arise perpendicularly from the claw a short distance from its base. The usual series of four tenent hairs are present, two on each side fusing to form a swollen pedicel, which are set on the onychium on either side of the main claw base. Relative lengths of leg joints as follows: Coxa, 15; trochanter, 7; femur, 26; patella, 12; tibia, 15; tarsus, 23. The collar trachea, opening medially in a pore, runs downward in an almost straight line, and just above the ventral end bends sharply backward and expands into an elliptical chamber, which is twice the caliber of the linear portion.

Penis (see pl. 79, fig. 17) appears to be intermediate between the *Tetranychus bimaculatus* type and that of *T. monticolus*. The inner lobe is rod-like, slender, and over twice as long as the shaft; a well-developed basilar lobe occurs dorsally; the shaft is comparatively short and thick and is bent abruptly downward at an angle of over 90° from the main axis of the penis to form the stout hook; the hook is about one-half the length of the shaft, and terminates in a rather straight, unbarbed, very sharp spur.

The egg is slightly depressed globose, and bears a recurved stalk which about equals the height of the egg.

Type.—Cat. No. 20167, U.S.N.M.

The type material is from Batesburg, South Carolina, January 6, 1916, from the upper and under sides of American holly leaves (*Ilex opaca*), collected by Mr. F. L. McDonough and the author. The present species bears some likeness to Trägårdh's genus *Schizotetranychus* in the presence of two main divisions of the tarsal claw.

PARATETRANYCHUS BICOLOR (Banks).

Tetranychus bicolor BANKS, 1894, Trans. Amer. Ent. Soc., p. 218.

The following original description of the species by Banks is so abstract as to be of almost no taxonomic value:

Length, 0.35 mm. Cephalothorax pale; abdomen dark red, the anterior edge of the red with a median and lateral projections; legs pale yellowish; eyes red; bristles white; Sometimes there is a light dorsal streak on the abdomen. Body elliptical, pointed in front. Cephalothorax with four long bristles; abdomen with a submedian row of five and an outer row of four bristles. All the bristles arise from small, circular depressions. Legs short, subequal, hairy. The male has the abdomen more pointed than in the female, otherwise similar.

The following diagnostic characters of real taxonomic importance were determined through a critical study of the type material:

Tarsus ending in a very strong, sickle-shaped claw, which is uncleft to its tip; arising from the ventral surface of the claw, one-fifth its length from its base, are six diverging spurs, the proximal one of which is the strongest, which in length are three-fifths that of the main claw. The customary four tenent hairs arise, two on each side at the base of the claw from the tip of the onychium. "Thumb" of palpus bears an ample "finger" terminally which is nearly as wide as long, and the base of which is three-fifths as wide as tip of "thumb"; two strong digituli arise at the dorso-terminal angle, and the dorsal "finger," which is only one-fourth the thickness of the terminal "finger," arises midway to the base; a pair of short hairs occur dorsally between the dorsal "finger" and the base, and a similar hair arises latero-ventrally near the middle of "thumb." Foreleg a trifle longer than width of body. Femur I about two and one-half times as long as wide, and one-fourth again as long as tarsus; tibia a little longer than patella, which barely

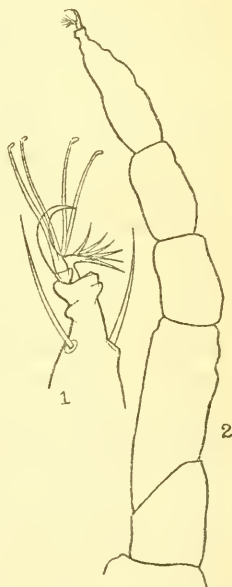


FIG. 11.—PARATETRANYCHUS BICOLOR BANKS. 1, TARSAL APPENDAGES; 2, FORELEG SHOWING RELATIVE LENGTHS OF JOINTS (ORIGINAL).

exceeds the trochanter, relative lengths of leg joints as follows: Trochanter 13, femur 29, patella 14, tibia 16, tarsus 23.

Type material on upper side of oak and chestnut leaves, woods near Sea Cliff, New York. Other specimens from oak at Washington, District of Columbia, and from Geneva, New York, on a Norway spruce hedge. This species is very close to *P. yothersi*.

PARATETRANYCHUS YOTHERSI (McGregor).

Tetranychus yothersi MCGREGOR, 1914, Ann. Ent. Soc. Amer., vol. 7, no. 4, December.

Predominating color a rusty-red, arising mainly from large intestinal structures occurring on each side and connected centrally by a narrow isthmus, a shield- or saddle-shaped pale pinkish-amber area includes most of the cephalothorax; a narrow clear or translucent area extends medially from behind almost to the thoracic suture. Eyes crimson, each set at inner border of a groove overlying coxae I and II. Coxae and femora of a greenish hue; tibia I and tarsi I salmon-color. Palpi salmon-color. Dorsal bristles colorless, not arising from tubercles. Body of female spherio-elliptical, widest equatorially; male subcuneate, widest across cephalothorax, which is somewhat truncate in front, abdomen tapering to acute point posteriorly; bristles in four rows, averaging in length two-fifths of the width of the body. Mandibular plate less than twice as long as broad, somewhat tapering anteriorly with a distinct emargination. "Thumb" of palpus much reduced longitudinally, bearing at its tip a relatively large, slightly clavate "finger" whose base is almost as wide as the tip of the "thumb"; on its upper distal corner are two pseudo-fingers, not greatly thicker than hairs; on upper side about midway to base is a small "finger," and between this and base are two short, stout hairs; the claw on the penultimate joint reaches to the middle of the "thumb"; a hair arises laterally from the center of the "thumb," and another from a similar position on the penultimate joint. The legs are relatively short, barely as long as width of body; femur only half again as long as wide, hardly equaling tarsus; tibia a trifle longer than patella, which equals the trochanter; tip of tarsus bears a claw which is nearly straight for two-thirds its length and then bent to nearly a right angle; a second claw, arising from the other at its point of origin from the onychium, is almost straight and forms with the first an obtuse angle; four strong spurs (corresponding to the usual 4-cleft claw) have their origin in common with the claws; the usual series of four tenent hairs arise by the sides of the claws from the tip of the onychium.

The egg is globose-lenticular and bears a stalk which varies in development from a length equaling the height of the egg to a mere

rudimentary papilla; gey fibrils are occasionally seen connecting the egg with the leaf; the color is smoky-amber.

Type.—Cat. No. 19088, U.S.N.M.

The type material is from Orlando, Florida, August 28, 1914, from the upper surface of camphor leaves, collected by W. W. Yothers.

An extensive series of measurements of material on Eucalyptus and camphor from Florida, and on oak, elm, and pecan from South Carolina have yielded the following averages:

Adults.

	Length (not including palpi).	Width.	Foreleg.
Female..	<i>mm.</i> 0.307	<i>mm.</i> 0.237	<i>mm.</i> 0.232
Male.....	.225	.152	.222

Egg.

Diameter.	Height.	Stalk (when well developed.
<i>mm.</i> 0.127	<i>mm.</i> 0.082	<i>mm.</i> 0.077

NOTES.

It is of interest to record that, whereas the common red spiders have long been known to feed almost exclusively on the under surface of the leaf, this species confines its activities entirely to the top of the leaves.

To date the species has been recorded upon camphor (*Camphora officinale*) and *Eucalyptus*, species at Orlando, Florida, avocado at Miami Beach, Florida, and upon two varieties of elm, the willow oak (*Quercus phellos*), the white oak (*Quercus alba*), and the pecan at Batesburg, South Carolina. Mr. Yothers says that at certain times it is everywhere present on the camphor tree, causing a reddening of the leaves and reduced vitality of the tree.

The species is exceedingly abundant certain seasons in North and South Carolina on the foliage of the small-leaved elm (*Ulmus americana*), to which it imparts a rusty appearance. In spite of the exposure of this species on the top of the foliage very little control seems to be exerted through rains. This may be accountable through the possession by the species of the strongly hooked tarsal claws which character also holds in the case of *P. ilicis*, another species that frequents the top side of leaves.

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EXPLANATION OF PLATES.

PLATE 76.

Tetranychus bimaculatus Harvey.

Fig. 1, tarsal appendages in profile; fig. 2, tarsal appendages viewed dorsally; fig. 3, collar trachea; fig. 4, penis; fig. 5, male palpus and its appendages; fig. 6, palpus of female. Figs. 1 and 2 are from material from Orono, Maine.

PLATE 77.

Tetranychus pacificus, new species.

Fig. 1, collar trachea; fig. 2, foreleg viewed laterally; fig. 3, penis; fig. 4, tarsal appendages; fig. 5, palpus and its appendages.

PLATE 78.

Tetranychus sexmaculatus Riley.

Fig. 1, left foreleg, viewed ventrally; fig. 2, tarsal appendages; fig. 3, eye corneae of right side, viewed from above; fig. 4, outline of body to show six typical spots from which the species derives its name; fig. 5, frontal and subfrontal bristles; fig. 6, palpal appendages; fig. 7, collar trachea; fig. 8, penis.

PLATE 79.

Showing variations of the penis of such species for which this structure is known.

Fig. 1, *Tetranychus willammettei* McGregor; fig. 2, *T. oregonensis* McGregor; fig. 3, *T. monticolus* McGregor; fig. 4, *T. flavus* Ewing; fig. 5, *T. sexmaculatus* Riley; fig. 6, *T. welloni* Ewing; fig. 7, *T. telarius* Linnaeus; fig. 8, *T. althaeae* von Hanstein; fig. 9, *T. borealis* Ewing; fig. 10, *T. ludeni* Zacher; fig. 11, *T. bimaculatus* Harvey; fig. 12, *T. pacificus*, new species; fig. 13, *Paratetranychus ununguis* Jacobi; fig. 14, *P. pilosus* Canestrini and Fanzago; fig. 15, *P. citri* McGregor; fig. 16, *P. pratensis* Banks; fig. 17, *P. ilicis* McGregor.

(Figs. 1, 2, 3, 5, 11, 12, 15, and 17 drawn from type or authentic material by the author; figs. 4, 6, 9, and 16 drawn from Ewing's descriptions; fig. 7 drawn from Berlese's figure; figs. 8, 13, and 14 after Trägårdh; fig. 10 after Zacher).

PLATE 80.

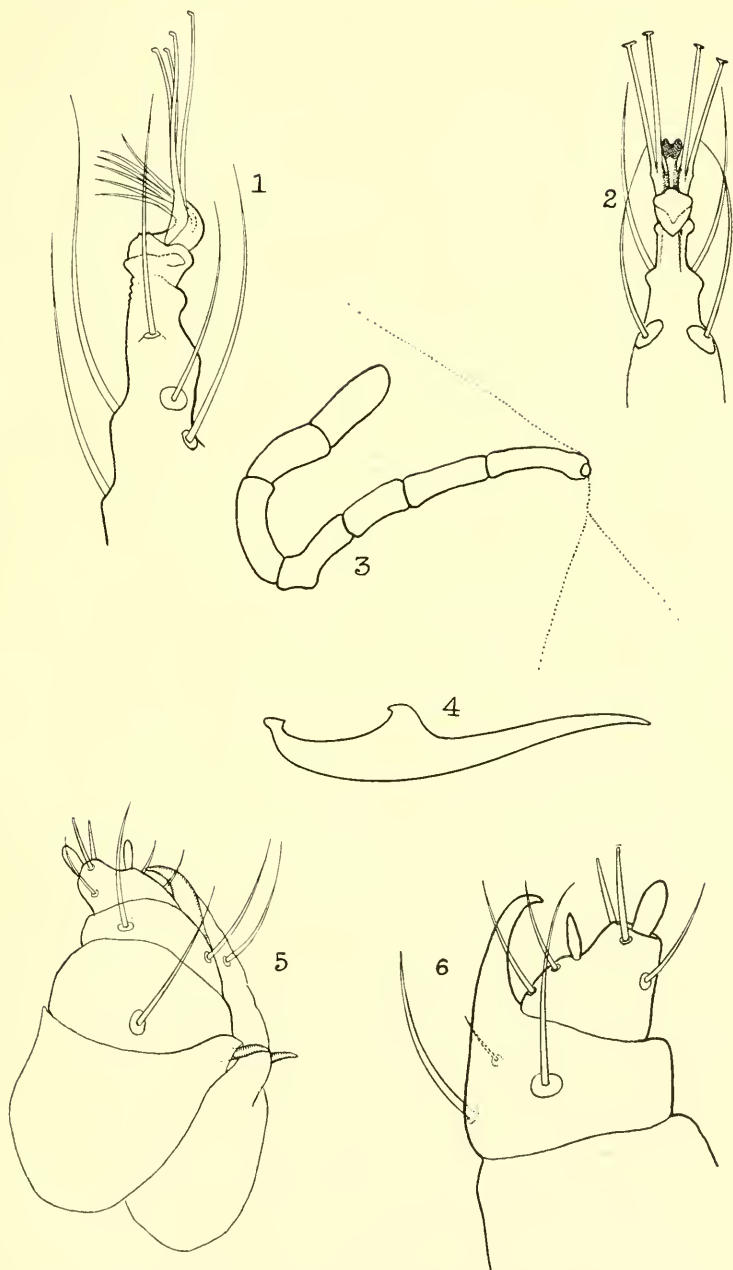
Work of *Tetranychus bimaculatus* Harvey on cotton leaves.

Fig. 1, incipient attack resulting in a single local discoloration spot; fig. 2, advanced work of red spiders resulting in the distortion and discoloration of entire leaf and ultimate defoliation of plant.

PLATE 81.

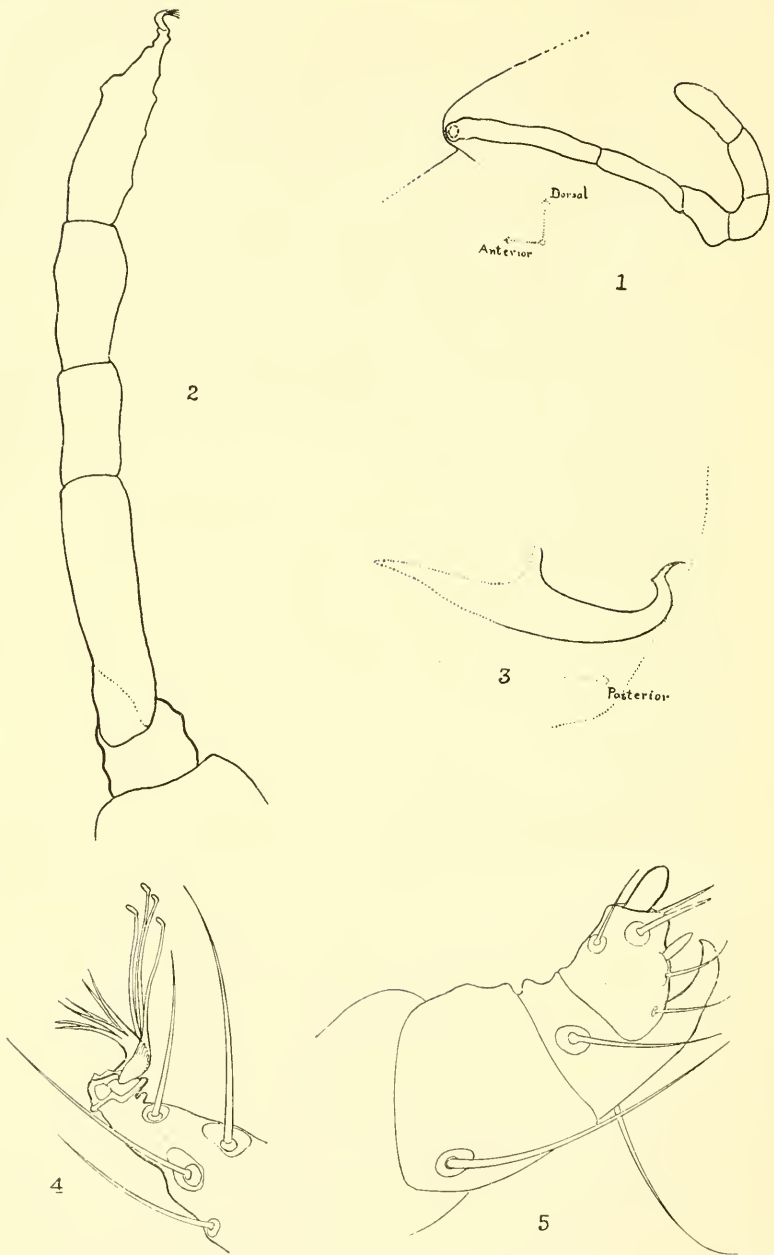
Tetranychus bimaculatus Harvey.

Fig. 1, adult female (X 116); fig. 2, adult male (X 150).



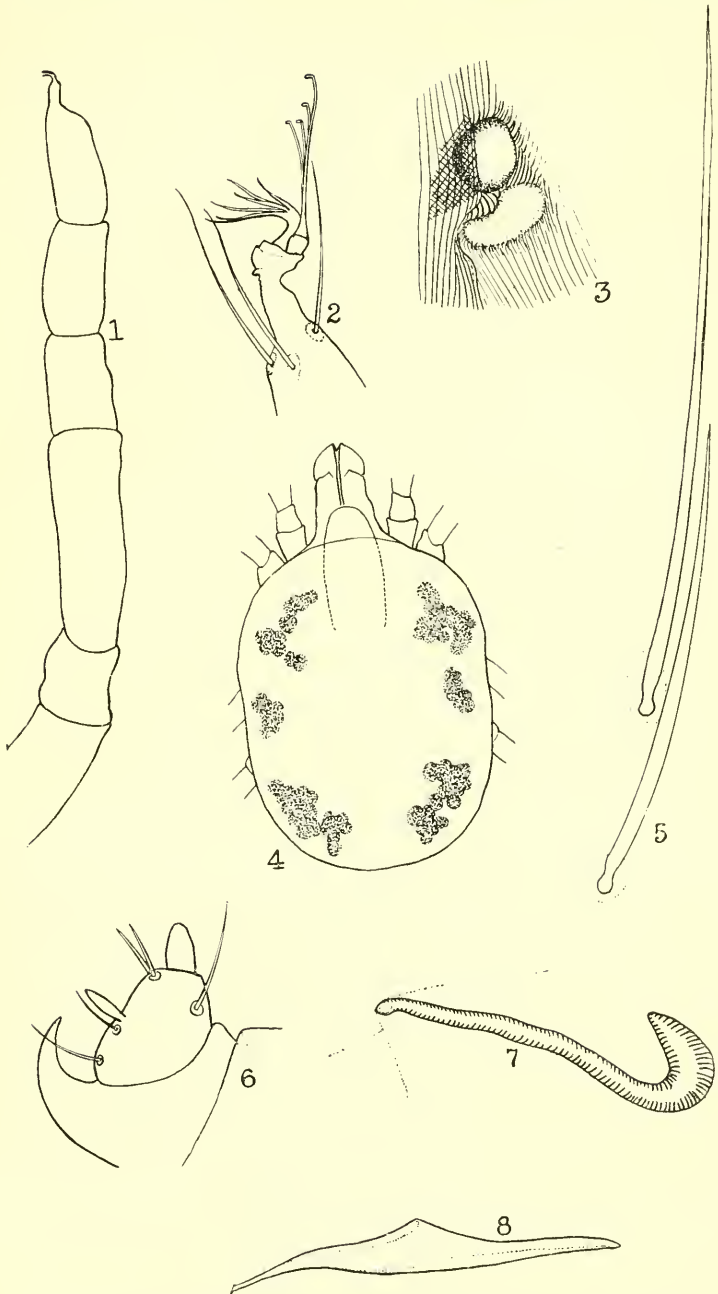
MICROSCOPIC CHARACTERS OF *TETRANYCHUS BIMACULATUS* HARVEY

FOR EXPLANATION OF PLATE SEE PAGE 678



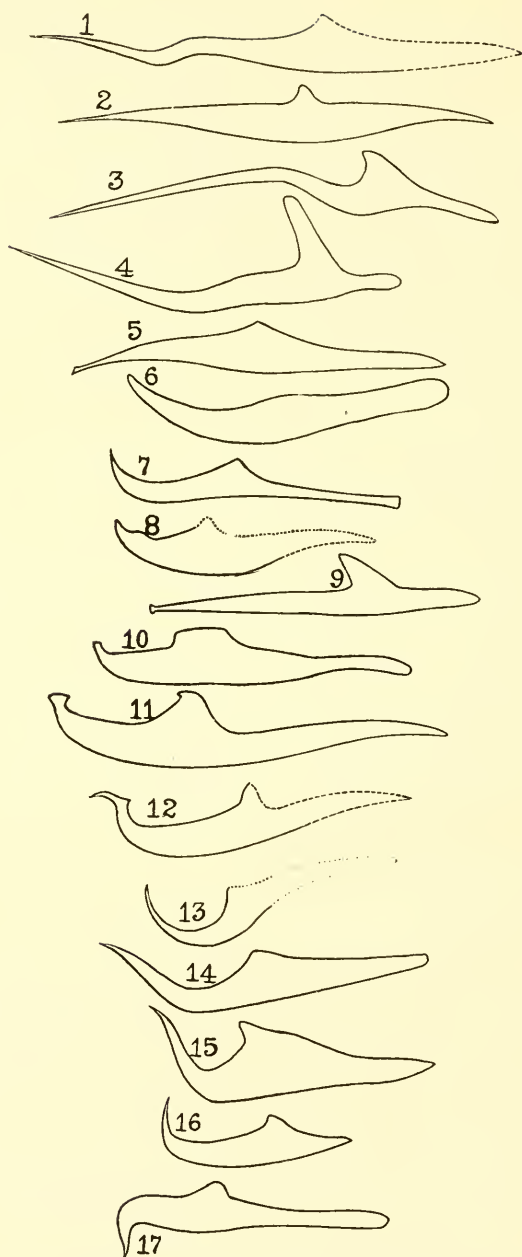
MICROSCOPIC CHARACTERS OF TETRANYCHUS PACIFICUS, NEW SPECIES

FOR EXPLANATION OF PLATE SEE PAGE 679



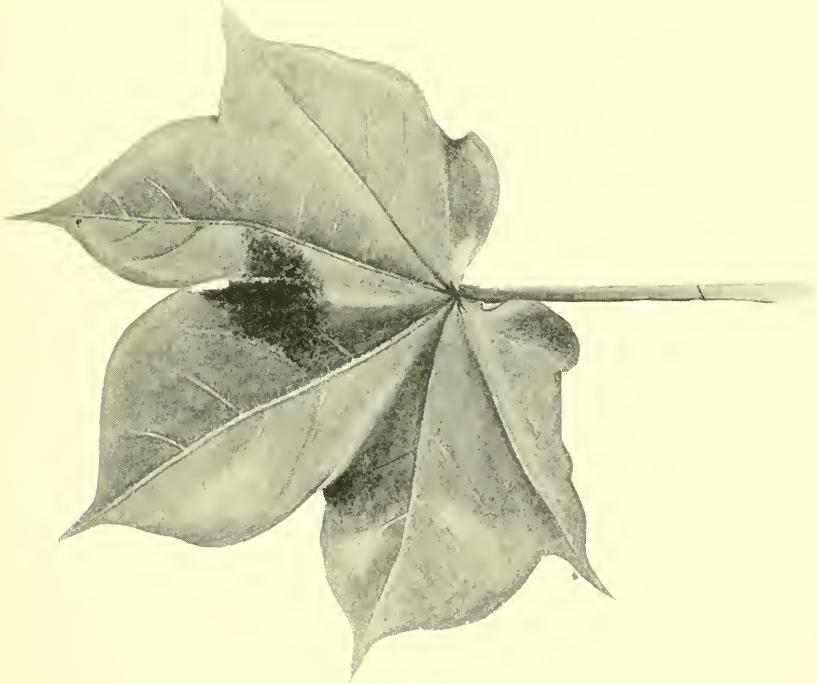
MICROSCOPIC CHARACTERS OF *TETRANYCHUS SEXMACULATUS* RILEY,
NEW SPECIES

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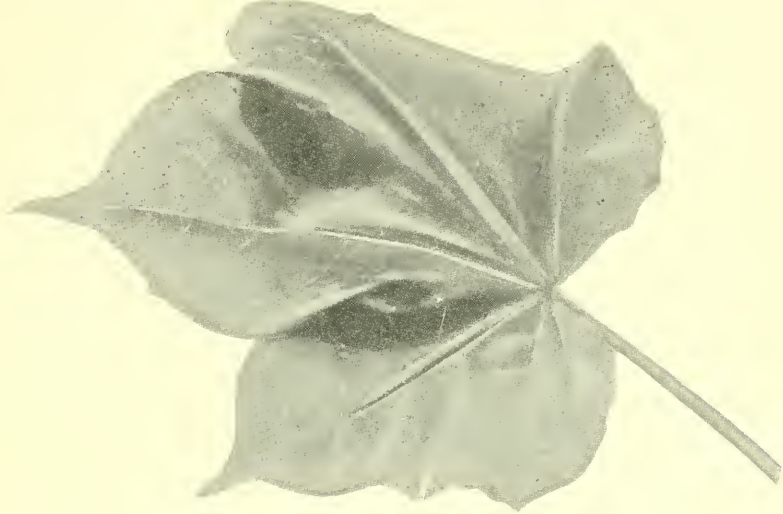


MALE CHARACTERS OF SEVENTEEN SPECIES OF RED SPIDERS

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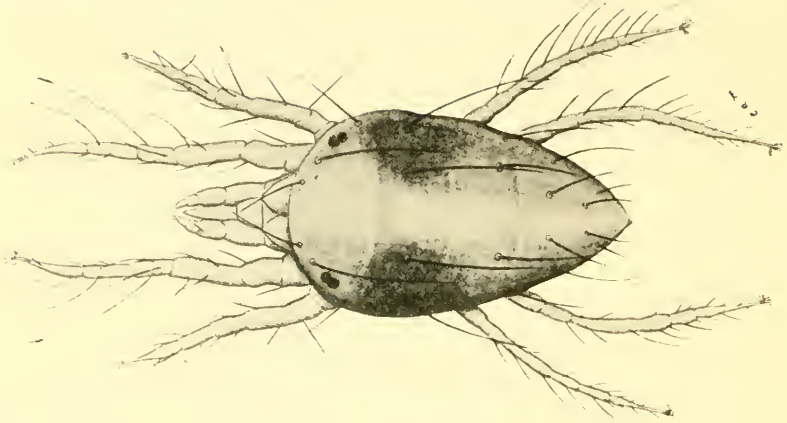
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2

WORK OF TETRANYCHUS BIMACULATUS HARVEY ON COTTON LEAVES

FOR EXPLANATION OF PLATE SEE PAGE 679



1 TETRANYCHUS BIMACULATUS HARVEY, ADULT (1) FEMALE AND (2) MALE

FOR EXPLANATION OF PLATE SEE PAGE 679