

THE TAXONOMY AND BIONOMICS OF SOME PANAMANIAN TROMBIDIID MITES

(Acarina)¹

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The principal purpose of this paper is to present information concerning the life histories of some species of mites from Panama. Incidentally, several species are described as new.³ The need for knowledge of life histories, particularly for correlations of larvae and adults, is great in the Trombidiidae, because the great majority of the species and even of the genera are known from larvae only or adults only. Thus there are two nearly separate classifications, one for adults, the other for larvae.

CLASSIFICATION

The family Trombidiidae was divided by Thor (1935) into ten subfamilies, and this classification has been followed by Womersley (1937) and others. The species discussed in this paper all fall in the subfamilies Allothrombidiinae and Microtrombidiinae. The Trombiculinae are considered only in a comparative way in the section on life history, the detailed information concerning them having been presented in previous papers. Incidentally, it does not seem justifiable to recognize the latter group as a separate family as has recently been done (Ewing, 1944), especially when the other nine subfamilies are not also raised to family rank. It is far more logical to expand and enrich the classification by the use of subfamily and tribal names than by elevating each slightly distinct group to the family status.

Numerous genera have been described in the Microtrombidiinae, many of them based primarily on differences in the structure of the body hairs. Such differences are exceedingly striking, and in some instances doubtless offer good generic characters. However, some of the "genera" are merely unnatural assemblages of species. Obviously related species sometimes have very different body hairs and fall into different "genera." Thus, the species *pistiae* and *maculatum* described in this paper are clearly related, as shown by such characters as the

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³Holotypes and allotypes of all new species will be placed in the collection of the American Museum of Natural History. Paratypes of each species will be deposited in the U. S. National Museum and the Museum of Comparative Zoology.

bidentate chelicerae of the larvae, the loss of one of the claws of the posterior legs of the larvae, the structure of the pedipalps and their claws in the larvae, the shape of the crista and associated structures in the adults, the presence of two accessory claws on the pedipalps of the adults, etc. Yet because the body hairs differ, these two species would fall in different genera in recent classifications. For the present, I have followed the example of Boshell and Kerr (1942) and described such species in *Microtrombidium*. At some later date, when more larvae and adults have been correlated, it will doubtless be possible to define natural genera.

There is a wide range of variation in some of the characters which have commonly been considered of value in distinguishing species. This is particularly true in species which grow and molt as adults. Thus in *Manriquia bequaerti* the number of setae in the basal comb of the pedipalpal tibia ranges from eight to thirty, and in *M. panamensis*, from four to twenty-one.

LIFE HISTORY

In order to clarify the use of the terms here employed to designate the various stages in the life cycle of these mites, a summary of the life history is here presented. The opportunity is taken to point out certain differences between the subfamilies which apply to all the species investigated in this study. When the stages of the life cycle are known for a greater number of genera and species, some of these differences may be shown to be subfamily characters.

The eggs are spherical, smooth or feebly roughened, laid in groups or masses in the Microtrombidiinae and Allothrombidiinae, and occasionally in the Trombiculinae, although they are more often laid singly in the latter subfamily. In one species (*Microtrombidium maculatum*) the eggs are laid in a mass in a matrix of a translucent gelatinous substance. Apparently there is a correlation between the size of the mite and the manner in which the eggs are laid. Thus it is the small species which lay eggs singly, middle sized species in small clusters, and large species in large masses. There may be several hundred eggs in the masses of *Allothrombium metae*, a large mite, reaching a length of 3.5 mm. The duration of the egg stage ranges from as little as four days (in *Microtrombidium pistiae*) to over two weeks (in *Manriquia bequaerti*).

Upon hatching, the chorion of the egg breaks more or less equally into two portions, and the next stage, the deutovum, becomes visible. The deutovum or prelarval stage is quiescent, without setae but often finely papillate, with six unsegmented immobile legs directed more or less forward and with one or occasionally two dorsal spines. In the subgenus *Megatrombicula* of the genus *Trombicula* there are several other spines on the deutovum. The posterior portion of the chorion or egg shell usually covers the posterior part of the deutovum, while the anterior portion remains over the anterior part of the deutovum, so that only the middle of the deutovum is exposed (Trombiculinae) or falls away leaving the entire anterior part of the deutovum exposed (Microtrombidiinae). The deutovum is considerably larger in size than the egg. It is possible that absorbed water accounts for this phenomenon.

Before the emergence of the larva the red pigment spots surrounding the larval eyes become visible through the integument of the deutovum. The larval appendages form within the unsegmented deutoval appendages. The coxae and trochanters of the larval legs are directed outward into three blunt lateral protuberances on each side of the deutovum; the remaining segments of the legs are directed from these protuberances downward and forward into the leg sheaths of the deutovum. For as much as three or four days, in some instances, before larval emergence, the legs of the larva may be seen moving back and forth within the leg sheaths of the deutovum.

The larva is an active, six-legged form, more or less sparsely setose. The larvae are parasitic, those of the Trombiculinae on vertebrates, those of the Microtrombidiinae and Allothrombidiinae on insects and spiders. After attaching themselves to their hosts by means of the chelicerae, they engorge, reaching a size varying from one and one-half (small *Eutrombicula*) to six (*Allothrombium*) times the length of the unengorged larvae. Engorgement apparently requires two or more days, larvae sometimes remaining attached to their hosts for over three weeks. The time until larvae leave the host is highly variable even among individuals of a single species. After engorgement the larvae drop from the host, walk about for a short time, and then become quiescent in a suitable hiding place. Among genera known from Panama, larvae of the Trombiculinae have a single dorsal plate while those of the other two subfamilies have two. This distinction applies in general to species from other areas of the world, but a few exceptions have been found.

After becoming quiescent, the integument of the protonymph or nymphochrysalis develops within that of the engorged larva. The protonymph is pupa-like and entirely quiescent, never emerging from within the larval integument, and as with other such stages, setae are absent. The protonymphal integument, however, is often exposed by breaks in the larval integument. In some species such breaks occur normally, exposing many parts of the protonymph. With the development of the protonymph, the larval appendages become dead and brittle, histolysis probably taking place within them. The appendages of the protonymph (in those groups which possess them) thus develop within the body of the larva. There are eight legs instead of six as in the larvae. The protonymphs of the three subfamilies here studied are conspicuously different from one another by the characters shown in Table I. The nymphal appendages develop within those of the protonymph in the Trombiculinae and Allothrombidiinae, and curl within the protonymphal sac (fig. 27) in the Microtrombidiinae.

The nymph is the first active eight legged stage. Like the adults, the nymphs are covered with numerous setae, usually branched and often thickened or curiously ornate. Nymphs of the Microtrombidiinae and Trombiculinae may be distinguished from adults by the presence of but four genital suckers, but in *Allothrombium* there are six in both nymphs and adults. The penal cone and sacculi (as they are called by Ewing, 1944a), characteristic of the genitalia of the adult males and females respectively, are absent in nymphs, the sexes being apparently indistinguishable. The setae on the body and appendages are sparser

than in adults and the number of coarse setae or spines on the pedipalps of nymphs is generally fewer. The more important taxonomic features of nymphs, however, such as the structure of the body hairs, the crista, the pseudostigmatic organs, the eyes, and the arrangement of combs, accessory claws, and the like on the pedipalps are not greatly different from those of the adults.

The nymphal stage is followed by another quiescent stage, the *preadult*. The preadult differs from the protonymph only in its larger size. After the formation of the preadult integument, the nymphal appendages become dry and brittle, and the preadult integument is frequently exposed by breaks in the old nymphal integument. The preadult, however, never emerges from the nymphal integument. The preadult (and hence adult) appendages do not form within those of the nymph, but are folded inside the body of the nymph. The relation of developing adult appendages to those of the preadult is the same as that of nymphal appendages to the protonymph.

TABLE I
CHARACTERISTICS OF THE PROTONYMPHS AND PREADULTS OF THREE
SUBFAMILIES OF TROMBIDIIDÆ

ALLOTHROMBIDIINÆ	TROMBICULINÆ	MICROTROMBIDIINÆ
Appendages present; body fitting around appendages at rear, so that the appendages occupy a shallow concave space in venter of body; no dorsal spine, but a large longitudinal anterior dorsal groove; body surface not tuberculate but coarsely wrinkled.	Appendages present; body not fitting around them, the appendages projecting freely; anterior dorsal spine present, dorsal groove absent; body surface finely tuberculate.	Body saclike, without appendages, dorsal spine or groove; body surface often finely tuberculate.

The *adult* in the Microtrombidiinæ and Trombiculiniæ may be recognized by the presence of six genital suckers. Other features which distinguish adults from nymphs are indicated above.

In certain species of Microtrombidiinæ the adults continue to grow and molt. Each succeeding adult stadium is preceded by a quiescent stage not distinguishable from the preadult. For convenience the term preadult is applied to these stages, although actually they are between (not merely before) adult stages. Even among individuals of a single species the number of adult stadia is highly variable. Thus in *Microtrombidium maculatum*, the best known species exhibiting adult growth, the number of adult stadia may probably vary from three to seven. Information on growth in this species is shown in Table VIII. Because the body integument stretches, body growth can take place between molts. For this reason, to get information on molts, measurements were made of the last segment of the anterior leg. Although no individuals were reared through, numerous lines on the graph indicate the amount of growth accomplished at one ecdysis. This information was obtained by comparing the measurements of exuviae with the mites which emerged from them. An examination of the graph shows that the amount of growth at one molt is highly variable, ranging from as little as 0.02 mm. to as much as 0.19 mm. in the length of the last

segment of the front leg. The largest adult measured was three times the size of the smallest.

The smaller adults, here termed *subadults* for convenience although no clear-cut distinction can be drawn between subadults and adults, differ from larger ones in having somewhat fewer setae, although they are approximately as dense as in larger individuals. For this reason the combs of the pedipalpal tibiae have fewer setae in small than in large specimens. Thus in *Manriquia bequaerti*, which, like *Microtrombidium maculatum*, grows considerably as an adult, the longer comb of the pedipalpal tibia has as few as eight setae in a small subadult, as many as thirty in a larger adult.

In some species in which there is adult growth, egg laying is observed only among females of middle size and above. The genital structures appear the same, however, in large and small individuals. For example, the smallest males have a penial cone structurally indistinguishable from the largest. Growth and molting continue after the egg laying size has been reached, and it is probable that females lay several masses of eggs during their lives. In other species (eg. *Manriquia panamensis*) even small females produce eggs.

TABLE II
SUMMARY OF LIFE HISTORY OF TROMBID MITES

Major stages.....	egg		larva		nymph		adult
Intervening stages.....		deutovum		protonymph		preadult	

Even among rather closely related species, some may show adult growth and others not. Thus in *Microtrombidium pistiae*, obviously related to *M. maculatum*, there are normally no adult molts.

Females average somewhat larger than males in each species studied. The distinctions between the sexes of the *Trombiculinae* were pointed out (for *Eutrombicula göldii*) by Boshell and Kerr (1942) and again, with illustrations, by Ewing (1944). In other subfamilies features distinguishing the sexes are about the same, except that the necks of the sacculi of the female are inconspicuous and the penial cone of the male is often turned on its side in mounting. Its several apodemes projecting into the body (figs. 29 and 30) are conspicuous.

Table II will serve as a summary of the life history. The nature of the intervening stages remains a matter of doubt. Probably they should not be considered as separate stadia. The integument of these stages consists in part of a cuticle, not affected by caustic, which is apparently laid down by a layer of epithelial cells (Henking, 1882). In these respects this integument resembles other arthropod integuments. However, the occurrence of such a stage between each major stage, regardless of the number of the latter in species molting as adults, suggests that the pupa-like quiescent stages are merely a part of the mechanism of ecdysis in this group.

ABNORMALITIES

Most of the variations observed, as for example in the number of coarse spines on the pedipalps, are considered to be within the limits of ordinary specific variation and are discussed separately under each species. A few very curious specimens have come to notice. In each case the specimens appear to be normal except for the peculiarities described.

One subadult of *Microtrombidium maculatum* was reared from a normal and apparently uninjured nymph. The subadult had the normal three genital suckers on the left side of the body, but two elongated ones on the right. The fourth leg was completely absent on the right side, the area where its coxa should have been being covered by bare and slightly tuberculate integument. The third leg on the same side was represented only by a small hairy projection about the size and shape of the distal half of the last tarsal segment, arising directly from the body without a coxa and bearing a pair of normal claws.

A nymph of the same species had a very small sucker behind the normal posterior genital sucker of one side. An adult had a very small sucker behind the median genital sucker of one side.

An adult of *Manriquia bequaerti* had four genital suckers of equal size on one side, making a total of seven. Another adult of the same species had a total of but four genital suckers, thus resembling a nymph, although the suckers were elongated.

An adult of *Manriquia panamensis* had two elongate suckers on one side, instead of the usual three. Another specimen had the posterior sucker of one side reduced to about one-fifth of the normal diameter.

TAXONOMY AND BIONOMICS

Allothrombium metae Boshell and Kerr

Allothrombium metae Boshell and Kerr, 1942, Rev. Acad. Colombiana Cien. Exact., Fisic. Nat. Vol. 5, p. 126.

Adults of this species, agreeing well with the original description and ranging from 2.6 to 3.5 mm. in length, were found at Old Panama, Panama, in January, February, March, October, November, and December. One was also taken near Pacora, Panama Province, Panama, and others at Santa Rosa, Colon Province, Panama, and Juan Mina, Canal Zone, Panama.

Egg: Yellow, smooth, spherical, laid in masses of several hundred.

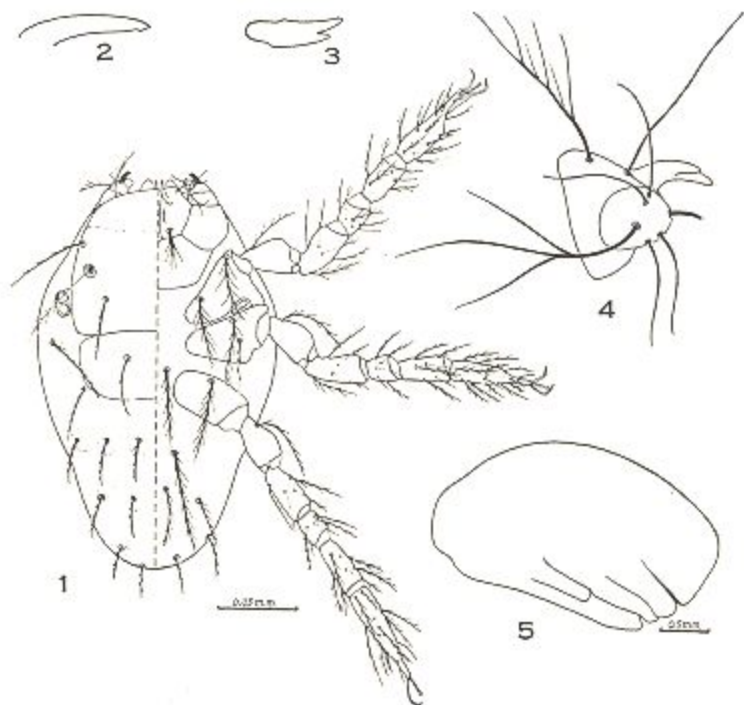
Deutovum: Dull yellow. Unfortunately none were preserved for study.

Larva: Length about 0.23 mm. when unengorged, color orange yellow; when fully engorged length 1.4 mm., color orange red. The characters are shown in the accompanying illustration. Anterior eyes commonly smaller than posterior.

Protonymph: Dull red; body surface coarsely and irregularly wrinkled, not tuberculate; leg sheaths closely appressed together and to

body; antero-dorsal portion of body with broad, deep longitudinal groove, corresponding to the groove in which the crista of the next stage lies.

Nymph: Length 1.5 mm. when freshly emerged to 2.5 mm. when ready to molt. Agreeing in general with adult, even having six genital suckers as in adult; last anterior tarsal segment little longer than tibia, instead of much longer as in adult.



Allothrombium metae Boshell and Kerr. 1, larva; 2, apex of chelicera of larva; 3, pedipalpal claw of larva; 4, apex of pedipalp of larva; 5, preadult.

Preadult: Distinguishable from protonymph only by size.

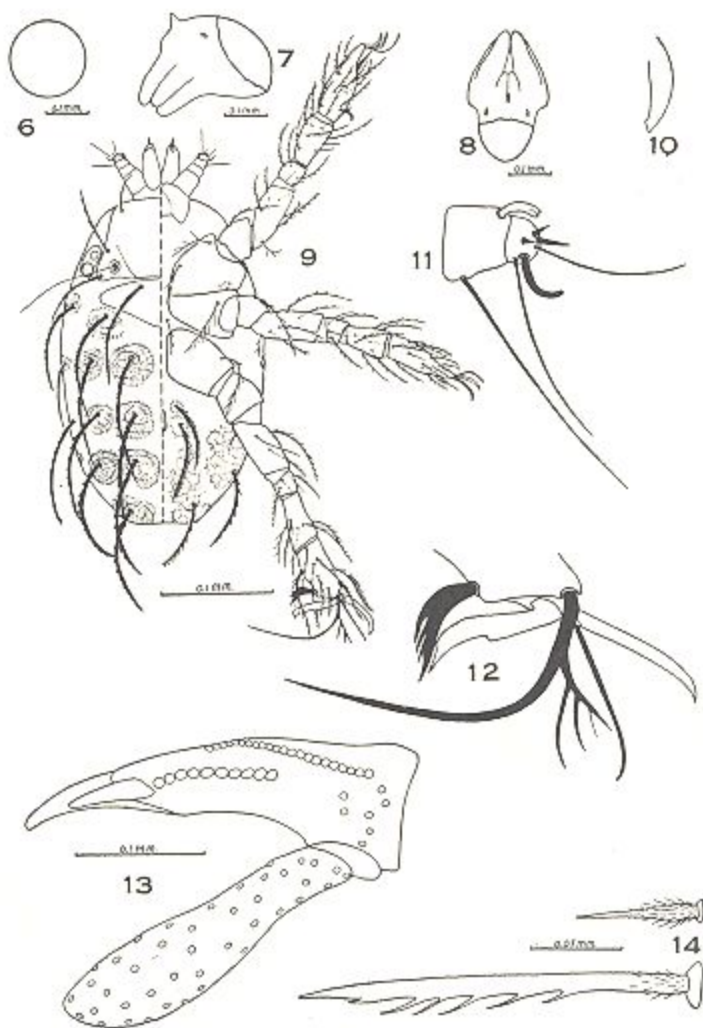
Bionomics: Nymphs and adults were usually found beneath stones, occasionally beneath logs. They are rather uncommon, and seem to disappear during the latter part of the dry season and early part of the wet season. Their movements are slow.

On January 15 at Juan Mina three very large engorged larvae were found attached to lycosid spiders of the genus *Pirata* (determined by Dr. Willis J. Gertsch). Each spider carried a single larva attached between the cephalothorax and the abdomen.

Egg masses were found beneath stones, and one was laid in the laboratory. The egg and deutoval stages are long, as larvae emerged

on May 8 from a mass laid before April 1. Two tremendously engorged larvae were found beneath a stone at Santa Rosa on November 14. Each soon became a protonymph, and three weeks later one was mounted and found to contain a nearly completely formed nymph. On December 12 after thirty days of quiescence, a nymph emerged from the other. These nymphs were similar to nymphs obtained in the field. A preadult was found beneath a stone on November 8.

From the relatively uniform size of the appendages of adults of this species it seems probable that there are no adult molts. Although this



Manriqua bequaerti Boshell and Kerr. 6, egg; 7, lateral view of deutovum; 8, dorsal view of deutovum; 9, larva; 10, apex of chelicera of larva; 11, apex of pedipalp of larva; 12, apex of posterior leg of larva; 13, inner view of tibia and tarsus of pedipalp of adult; 14, body hairs of adult.

is the largest of the mites studied, it attains its size, not by repeated molts as in the large Microtrombidiinae, but by great increase in size and stretching of the body integument during each active stage.

Manriquia bequaerti Boshell and Kerr

Manriquia bequaerti Boshell and Kerr, 1942, Rev. Acad. Colombiana Exact., Físic. Nat. Vol. 5, p. 119.

Adults of this species from Panama differ from the original description of the species in being more often dull red than reddish brown, although a few specimens were of the latter color; and in having the fingers of the pedipalps slightly exceeding the claws, at least in large specimens. The combs of the tibia of the pedipalp do not both arise close to the base of the claw, as described for *bequaerti*. One arises at the base of the accessory claw; another, more dorsal in position, arises some distance from the claw. Panamanian specimens were sent to Dr. H. E. Ewing for comparison with the types of *bequaerti*. He found them to be the same, noting particularly that only one palpal comb arises close to the base of the claw, in contrast to the original description of *bequaerti*. It may be noted that the setae of the basal (dorsal) comb are a little more slender, or at least have smaller bases, than those of the distal comb. The distal segment of the anterior tarsus varies in shape, but is usually more than twice as long as broad, contrary to the description of by Boshell and Kerr. Indeed the photograph given by these authors shows it more than twice as long as broad.

Adults were collected at Old Panama, Panama; near the landing at Barro Colorado Island, Canal Zone, Panama; and at Santa Rosa and Pina, Colon Province, Panama.

As with other species which grow and molt as adults there is great variation in size and in the number of bristles in the pedipalpal combs in *M. bequaerti*. Subadults have been collected which were only 0.77 mm. in length, while the largest adults were 2.4 mm. long. The variation in the number of bristles in the pedipalpal combs is in general correlated with size, but there is much variation in this matter, as shown in Table III. Here the numbers of bristles in the combs and the length of the last segment of the foreleg are shown for certain specimens selected to demonstrate the extent of the variation. There is frequently a difference of one or two in the number of bristles in the combs of the two pedipalps of a single individual. When the setae of both pedipalps could be accurately counted and a difference was noted, it is indicated by a double entry in the columns of this table.

Usually but not always there are two large simple bristles basad of the large spine on the outer side of the tibia of the pedipalp. Sometimes there is but one such bristle, and in one specimen a bristle was present on one side, absent on the other.

There is noticeable variation also, not correlated with size or number of setae in the combs, in the body hairs. The larger hairs are often longer and more slender than in the figure. Large hairs which are not at all swollen at the base lack the small setulae shown in the figure, but those which are slightly swollen have such setulae. Occasionally a

specimen is found having a few small setulae throughout the length of the large hairs. The number of large teeth on the large hairs varies from two or three to over ten. Small hairs are sometimes setulose to the apices.

All these variations have been observed in specimens collected at Old Panama at the same time under the same group of rocks.

Egg: Orange, smooth, spherical, averaging about 0.18 mm. in diameter, laid in masses of 50 to 100. On breaking, anterior portion of shell falls completely away, the posterior remains around the posterior portion of the deutovum.

Deutovum: Orange red with single dorsal spine; body surface with scattered fine sharp papillae.

Larva: Length about 0.29 mm. when unengorged. Color red. The characters are shown in the accompanying illustration.

TABLE III

NUMBERS OF SETAE IN PEDIPALPAL COMBS AND LENGTH OF LAST ANTERIOR TARSAL SEGMENT IN SELECTED ADULT SPECIMENS OF *Mantiquita bequaerti*

Setae in Basal Comb	Setae in Distal Comb	Length (mm.) of Last Anterior Tarsal Segment	
24	14-13	.77	Largest specimen
10	5	.27	Smallest specimen
30-29	16	.56	Longest and shortest basal combs
8	5	.29	
26	17-16	.74	Longest and shortest distal combs
22	17	.63	
9	5	.29	
12-11	9	.33	Combs not greatly different in length
21	14	.55	
15	10	.45	
13	7	.40	Combs of widely different lengths
20	10	.59	
25	13-15	.66	

There are several differences between the larva and the description of Boshell and Kerr. They state, for example, that the second dorsal plate has four setae, while it has but two in Panamanian specimens. These differences are evidently more apparent than real, however, since their material was evidently poor. The extra pair of setae which they describe as arising from the second dorsal plate is present, but does not arise from the plate.

The inner hair of the anterior coxa is often trifid instead of bifid as shown. In one "freak" larva studied there are three instead of two midventral abdominal hairs on one side, and on the same side of the body there is an extra antero-lateral seta on the anterior dorsal plate.

Protonymph: Unknown.

Nymph: Length 0.52-0.77 mm. Agreeing with the adult except for the usual nymphal features. Basal comb of pedipalps with four to five bristles, distal with four; body hairs noticeably sparser than in adults.

Preadult: Sac-like, surface practically smooth. Color red.

Bionomics: All stages of this mite have been collected beneath stones, and an occasional individual has been found beneath a log or in leaf mold. It is the most common trombidid beneath stones among the ruins of Old Panama, although not much more abundant than *M. panamensis*. Adults of all sizes have been found at all seasons of the year, although at Old Panama specimens were very difficult to find during the last of the dry season and first part of the rainy season (May to July). The few nymphs obtained were found in August and October, eggs in May and August. Although long-legged, these mites are usually very sluggish in their movements.

Egg masses have been found under stones in the field, and have been laid in the soil in a rearing jar in the laboratory. The meagre information available on the duration of the egg and deutoval stages is as follows: eggs found in field on May 12, 1945, were in deutoval stage by May 20, larvae emerged May 30 to June 3; eggs laid in the laboratory on May 30 reached the deutoval stage about June 14 and larvae emerged June 26 to 28.

There is no information on the duration of the other stages, except that field collected preadults have remained in that stage for as much as fourteen days before transforming.

In this species there are several adult molts. Table IV, in which the length of the last anterior tarsal segment is used as an index of size and lines indicate the growth of certain individuals at one molt, shows all available data on growth. Unlike *M. panamensis*, egg laying probably does not begin until the females reach middle size. At each molt, there is an increase in size as well as in number of bristles of the pedipalpal combs. The amount of increase in size is well correlated with the number of additional bristles acquired. Thus in two cases in which the amount of growth of the last anterior tarsal segment was 0.04 mm. at a molt there was only one seta added to each pedipalpal comb. On the other hand, in one specimen in which the amount of growth was 0.16 mm. there were four bristles added to the distal comb and five to the basal comb.

Manriquia panamensis n. sp.

Adult: A moderate sized red species with body hairs of two types, both pointed at tips, the larger type with branches of one side thickened and dense distally giving each hair a club-like appearance at low magnifications.

Length 1.5 mm. (varying from 0.8 to 1.8 mm. among paratypes).

Pedipalps reaching to middle (or apex) of patella of foreleg; claw less than half as long as distal process of chelicera (more than half as long in some paratypes); outer side of tibia with a slender spine⁴ varying from two-thirds as long to as long as claw and arising about midway between base of claw and base of finger; inner side of tibia with an accessory claw half as long as principal claw, and two combs of bristles,

⁴The thickness of this spine varies. It is rather unusually long and slender in figure 16. Sometimes it is entirely lacking; in other specimens it is preceded by two small spines or by two large ones so that there is a row of three spines, the basal one above the base of the finger.

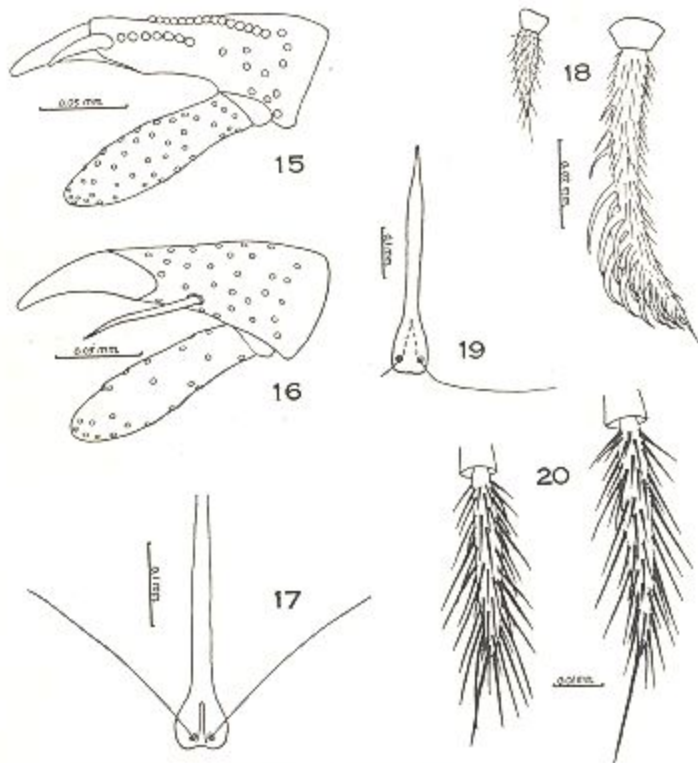
TABLE IV

Maniquia bequaerti
 FREQUENCY DISTRIBUTION OF MEASUREMENTS (IN MILLIMETERS) OF LAST
 SEGMENT OF FORELEG

N=nymphs, M=adult males, F=adult females. Figures under "eggs" show the number of individuals in each size class which laid or contained eggs. Lines under "growth of individuals" show the amount of growth at one molt of certain individual mites.

	N	M	F	Eggs	GROWTH OF INDIVIDUALS	
					Males	Females
.19-.20	1					
.21-.22	2					
.23-.24						
.25-.26						
.27-.28		1	2			
.29-.30		2	2			
.31-.32						
.33-.34		2	2			
.35-.36		3				
.37-.38		2	2			
.39-.40		2	1			
.41-.42		1	3			
.43-.44		8	1			
.45-.46		2	1			
.47-.48		1	4			
.49-.50		6	4			
.51-.52		2	1			
.53-.54		3	1	1		
.55-.56		5	4	2		
.57-.58		3	1			
.59-.60		2	3			
.61-.62		3				
.63-.64		3	1			
.65-.66		1	5	1		
.67-.68			1			
.69-.70			3			
.71-.72						
.73-.74			1			
.75-.76						
.77-.78			1			

the distal one of about seven (three to thirteen in adult paratypes of various sizes) bristles extending from the middle of the segment to the accessory claw, the basal (or upper) one of about sixteen (four to twenty-one in adult paratypes of various sizes) bristles extending from the end of the first fourth of the segment to the end of the third fourth; bristles of distal comb scarcely larger than those of basal comb; finger reaching apex of claw, its setae and most of those of outer side of tibia plumose. *Chelicerae* with distal process sickle-shaped, sharply pointed apically, the



Manriqueia panamensis Michener. 15, inner view of tibia and tarsus of pedipalp of adult; 16, outer view of same; 17, crista of adult; 18, body hairs of adult.

Manriqueia boshelli Michener. 19, crista of adult; 20, body hairs of adult.

concave margin minutely dentate. *Crista* rod-like, expanded posteriorly into a rounded pseudostigmatic area somewhat wider than long; pseudostigmatic organs simple, arising from cup-like depressions with sharp elevated margins in posterior lateral positions of pseudostigmatic area. *Eyes* sessile, posterior ones much smaller than anterior. *Body hairs* dorsally of two types; larger type more abundant posteriorly than anteriorly, arising from short thick papillae which are much broader basally than apically, main axis of hair curved, thickest near base, tapering near apex to slender sharp point (which in some specimens does not project beyond setulae as in figure 18); main axis covered on

concave side and base of convex side with numerous small hairlike setulae, remainder of convex side with numerous thickened curved setulae which often give entire hair a club-like aspect; smaller type of dorsal hair arising from papillae similar in shape to those of larger hairs, main axis much thickened but tapering to a sharp point and covered with numerous small setulae; venter anteriorly and around genital opening with rather elongate hairs of the small type, posteriorly with large type in addition; area anterior and lateral to eyes with slender hairs of the small type only. *Legs* (also basal halves of pedipalps) with hairs, particularly of upper surfaces, similar to larger type of body hairs, those of inner surfaces of appendages and distal segments being more slender and less curved than body hairs; first and fourth pairs of legs subequal in length and slightly longer than body, other pairs shorter than body; forelegs with femur longer than patella, scarcely longer than tibia, slightly shorter than basitarsus and much shorter than the dilated distitarsus, claws about two-thirds the size of those of other legs; second and third legs each with femur slightly longer than patella, slightly shorter than or subequal to tibia, and scarcely two-thirds length of each of the tarsal segments; fourth legs with femur, patella, and tibia subequal, tarsal segments longer, equal to each other (or the first a little longer than the second).

Holotype male: Old Panama, Panama, January 10, 1945, under stone (C. D. Michener). *Allotype* female and eighty-three *paratypes* from the same locality dated January 10, March 1 and 5, May 29, August 16 and 30, October 5, and November 10, 1945. This is a very common species at Old Panama. Additional specimens are from Chiva Chiva, Juan Mina, and Barro Colorado Island, Canal Zone, Panama; Santa Rosa and Pina, Colon Province, Panama; and three miles southwest of Arraijan, Panama Province, Panama.

Since adult growth occurs in this species, there is great variation in size of adults, the smallest subadults being only 0.7 mm. in length. Associated with the variation in size is variation in the numbers of setae in the combs of the pedipalps. In general, the smaller the specimen the fewer the setae in these combs, but there is great variation in this correlation, as shown in Table V, in which data on specimens showing extreme conditions of various sorts is presented, to give an idea of the extremes of the variation. The number of setae on combs of the two sides of the body frequently varies by one or two, very rarely more. When such variation was noted it is shown in this table.

Among specimens from localities other than Old Panama, there is some variation in the structure of the larger body hairs. These hairs are more slender apically in some, with the larger setulae more slender than in figure 18.

This species appears to be most closely related to *M. manriquei* Boshell and Kerr but differs, apparently, by the relatively longer fingers of the pedipalps, the usually fewer bristles in the combs of the pedipalpal tibiae, the presence of fine setulae on the concave sides of the large body hairs, and the more slender legs. In the figure of *M. manriquei* the last tarsal segment of the second, third, and fourth pairs of legs is clearly more slender than the next to the last segment, while they are of equal width in *panamensis*. The species is also evidently

TABLE V

NUMBERS OF SETAE IN PEDIPALPAL COMBS AND LENGTH OF LAST ANTERIOR TARSAL SEGMENT IN SELECTED ADULT SPECIMENS OF *Manriquia panamensis*

Setae in Basal Comb	Setae in Distal Comb	Length (mm.) of Last Anterior Tarsal Segment	
16	6-7	.44	Largest specimen
4	3	.18	Smallest specimen
17-21	13	.33	Longest and shortest basal combs
20	7	.41	
4	3	.18	
17-21	13	.33	Longest and shortest distal combs
4	3	.18	
9	9	.35	Combs equal or nearly so
11	9	.33	
9	7	.24	
5-6	5	.22	Specimens of small size
9	4	.22	
13	8	.25	

TABLE VI

Manriquia panamensis

FREQUENCY DISTRIBUTION OF MEASUREMENTS (IN MILLIMETERS) OF LAST SEGMENT OF FORELEG

N=nymphs, M=adult males, F=adult females. Figures under "eggs" show the number of individuals of each size class which contained eggs. Line under "growth of individual" shows the amount of growth of one female at one molt.

	N	M	F	Eggs	Growth of Individual
.15-.16	1				
.17-.18	1	1			
.19-.20					
.21-.22		1	2		
.23-.24		1			
.25-.26		3	3	1	
.27-.28		2			
.29-.30		3	3		
.31-.32		5	1		
.33-.34		11	4	1	
.35-.36		6	2		
.37-.38		3	5		
.39-.40		5	9		
.41-.42			2		
.43-.44			2	1	

related to the European *Microtrombidium sardoum* Berlese, and to the American *Microtrombidium modestum* Berlese, both of which should apparently be placed in *Manriquia*.

Egg: Similar to that of *M. bequaerti*, about 0.18 mm. in diameter.

The eggs are probably laid in clusters as a number of eggs have been found within the body of a single mite.

Deutovum: Unknown.

Larva: Apparently indistinguishable from that of *M. bequaerti*.

On June 24, 1945, larvae were found in a culture jar which had contained adults of this species for slightly over a month.

Protonymph: Unknown.

Nymph: Length 0.7 mm. Agreeing with description and figures of adult except as follows: Basal comb of tibia of pedipalp with four to six setae, distal comb of three to five; crista with an internal projection extending behind pseudostigmatic area, just as in both adults and nymphs of *Microtrombidium maculatum* and *pistiae*, body hairs rather sparse, larger type somewhat less thickened and thickened hairs of appendages more slender than those of adults.

Preadult: Saclike. Color red.

Bionomics: This species has been found under stones, under logs, in rotten logs, inside of a hollow tree several feet above the ground, in leaf mold and among the roots of grasses. Small as well as large individuals have been found at all seasons of the year, but at Old Panama, where it occurs chiefly under stones, this species became scarce during the latter part of the dry season of 1945.

Table VI shows that the adult growth is similar to that of *Microtrombidium maculatum* and *Manriquia bequaerti*. The most striking feature is that eggs are evidently laid by relatively small females.

Manriquia boshelli n. sp.

Adult: A moderate sized red species with body hairs essentially of a single type, pointed apically and densely plumose.

Length 1.5 mm. (varying from 1.0 to 2.1 mm. among the paratypes).

Pedipalps reaching to apex (or middle) of patella of front leg; principal claw more than half as long as process of chelicera; tibia with slender spine about as long as claw arising on outer side near base of finger; inner side of tibia with accessory claw half as long as principal claw and with two combs of bristles, the distal one of eleven (varying from six to twelve among paratypes) bristles extending from near middle of segment to accessory claw, the basal (upper) one of eighteen (ten to twenty-four among paratypes) bristles with its basal and distinctly nearer to base of segment than distal end is to apex of segment; bristles of distal comb coarser, having larger bases, than those of basal comb; setae of inner side of tibiae which are not in combs are unusually long and coarse, unbranched; finger slightly exceeding claw, parallel-sided, its setae and those of outer side of tibia plumose. (Apex of pedipalp about as figured for *M. bequaerti* except for the larger claw and parallel-sided finger.) *Chelicerae* with process sickle-shaped, sharply pointed, the concave margin minutely denticulate. *Crista* thick, rod-like, expanded posteriorly into a pseudostigmatic area which is longer than wide,

rounded posteriorly; pseudostigmatic organs simple. *Eyes* sessile, posterior ones slightly smaller than anterior. *Body hairs* arising from short subcylindrical papillae which are slightly wider distally than basally (or in small specimens slightly wider basally than distally); body hairs densely plumose, the main axes slightly thickened, apices sharply pointed; posterior portion of body with an intermixture of similar but slightly shorter hairs, lacking the slender free apex (figure 20). *Genitalia* with longer apodemes of penial cone fully as long as cone. *Legs* and most of pedipalps covered with a mixture of slender plumose and slender simple hairs none of them thickened like the body hairs although some of the plumose hairs are slightly thickened near bases; fourth pair of legs longest, first slightly shorter and about as long as body, second and third considerably shorter; forelegs with femur longer than patella, equal to tibia, slightly shorter than basitarsus, much shorter than the dilated distitarsus, claws about two-thirds the size of those of

TABLE VII

NUMBERS OF SETAE IN PEDIPALPAL COMBS AND LENGTH OF LAST ANTERIOR TARSALE SEGMENT IN SELECTED ADULT SPECIMENS OF *Manriquia boshelli*

Setae in Basal Comb	Setae in Distal Comb	Length (mm.) of Last Anterior Tarsal Segment	
22	12	.51	Largest specimen
11	7	.29	Smallest specimen
24	12	.44	Longest and shortest basal combs
10	7	.33	
21	12	.48	Longest and shortest distal combs
15	6-7	.33	
14	10	.39	Combs not greatly different in length
15-16	12-7	.47	
20	9	.44	Combs of widely different lengths

other legs; second and third legs with femora and following segments progressively increasing in length; fourth legs thick except for the rather slender distitarsi, patella the thickest segment, trochanter swollen, femur, patella, tibia, and basitarsus progressively longer, distitarsus as long as tibia; pits from which hairs arise on fourth legs unusually large, so that seen in profile the margins of the segments appear dentate.

Holotype male, *allotype* female and four *paratypes*: Old Panama, Panama, August 16, 1945, under stone. Two *paratypes*, same locality, October 5 and November 8, 1945. Seven *paratypes*, Santa Rosa, Colon Province, Panama, September 10, 1945. Additional specimens are from Juan Mina, Canal Zone, Panama (R. Melvin).

The great variation in adult size of this species indicates that, as in other species of *Manriquia* studied, there is adult growth. Table VII shows, for certain selected individuals, the length of the last segment of the foreleg and the number of bristles in the pedipalpal combs.

This species seems to be related to *M. bolivarensis* Boshell and Kerr and *M. rocae* Boshell and Kerr. It differs from both in the thickened

body hairs with numerous branches and in the elongate pseudostigmatic area. It differs further from *M. rocae* in the larger posterior legs, and from *M. bolivarensis* in the longer pedipalpal claws.

Egg: Red, smooth, spherical, 0.16 to 0.19 mm. in diameter, probably laid in masses since one female collected August 16, 1945, contained 71 eggs.

Deutovum: Unknown.

Larva: Unknown.

Protonymph: Unknown.

Nymph: Length 0.9 mm. Agreeing with description of adult except for the usual nymphal characteristics. Distal comb of pedipalpal tibia with five to six bristles, basal with seven; body hairs sparser than in adult, their papillae slightly wider basally than distally.

Preadult: Unknown.

Bionomics: This species has been found under stones, under logs, and in rotting logs. It is much less common than either *M. bequaerti* or *panamensis*. Because of the variability of adults, it is quite certain that adult molts occur in this species, although none have been observed.

One adult remained alive in a rearing jar containing a small amount of earth for six months.

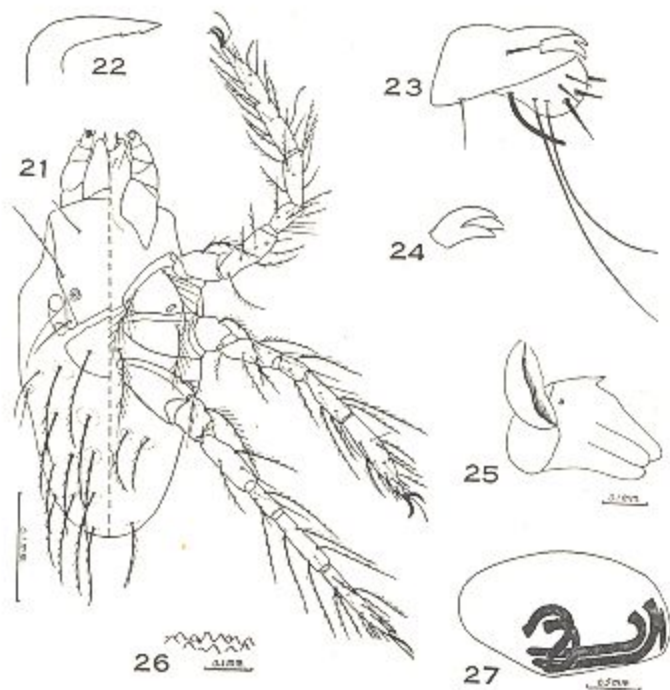
Microtrombidium maculatum n. sp.

Adult: This is a large red species, with small, somewhat diffuse, whitish spots produced by white hairs on the dorsal surface, these consisting of four transverse rows of three spots each, the foremost just behind the pseudostigmatic area, and behind these rows two pairs of spots. There are also white hairs at the posterior end of the body, on the venter, and on the legs. In cleared and stained specimens these spots are not visible. On each side of the principal claw of the pedipalp is a heavy spine or accessory claw, so that the pedipalp appears to be three-clawed.

Length 2.2 mm. (varying from 1.5 to 2.75 mm. among the paratypes).

Pedipalps reaching to apex of femur or middle of the patella of the anterior leg, depending on how much they are straightened in mounting; principal claw less than half as long as distal process of chelicera, on either side of principal claw is an accessory claw more than half as long as principal claw, that on outer side farther from principal claw than that on inner side; setae of inner side of tibia simple, numerous, those of distal half arranged in a comb reaching nearly to base of inner accessory claw, the comb becoming irregular basally so that it is difficult to determine where it stops; distal setae of comb progressively shortened and thickened, the terminal one about as long as (or shorter than) accessory claw; above this comb is a second and much shorter comb (sometimes so irregular as to be unrecognizable); finger approximately parallel sided (or slightly tapering), not quite reaching apex of claw, its hairs and those of outer side of claw-bearing segment finely plumose. *Chelicerae* with distal process broad, sickle-shaped, acutely pointed, with fine teeth on concave margin. *Crista* rod-like, with an internal projection extending a short distance behind pseudostigmatic area, the latter triangular, truncate behind; pseudostigmatic organs simple,

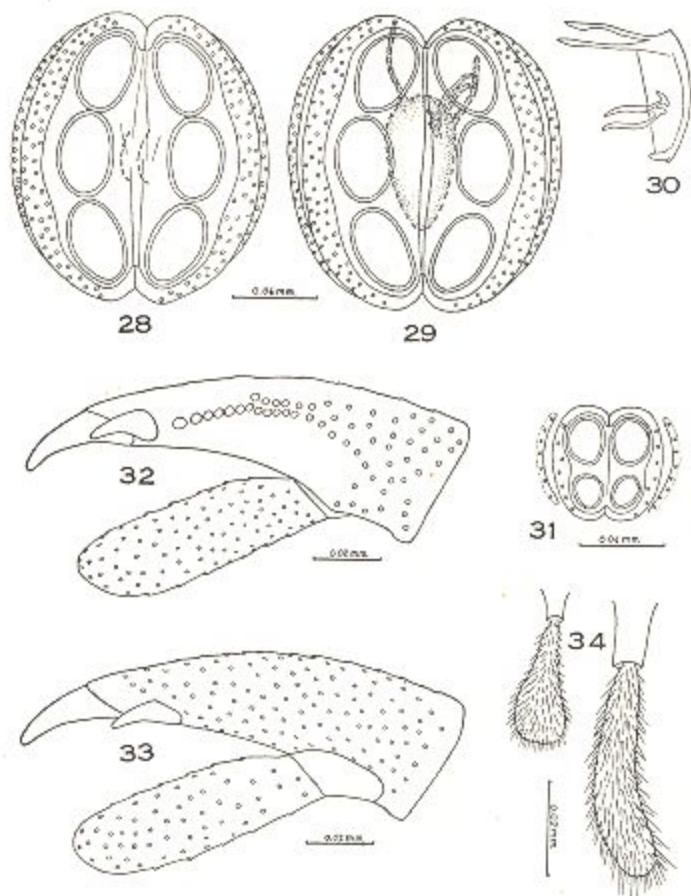
arising from posterior lateral corners of pseudostigmatic area; crista not consistently different from that of *pistiae*, but rod-like portion anterior to pseudostigmatic area often narrower than figured for that species, and sometimes expanding gradually into the pseudostigmatic area. *Eyes* elevated, sessile, in the usual position above anterior coxae, the anterior ones much larger than the posterior (which are sometimes inconspicuous or virtually absent). *Body hairs* dense, those of dorsum and sides of two sizes, arising from large elongate papillae which are widest basally, the hairs thickened, rounded apically, widest subapically,



Microtrombidium maculatum Michener. 21, larva; 22, apex of chelicera of larva; 23, apex of pedipalp of larva; 24, claw of pedipalp of larva; 25, deutovum and broken egg shell; 26, surface sculpture of preadult; 27, preadult, showing diagrammatically the manner in which the adult legs are developed within.

curved, and covered with many fine setulae; hairs of venter, except marginally, of a single size, arising from smaller papillae, the hairs thickest subbasally (or medially) and tapering to a pointed apex, covered with numerous setulae. *Genitalia* with apodemes of penial cone of male shorter than cone. *Legs* with hairs but slightly thickened, pointed, plumose; fore and hind legs slightly longer than body, other pairs shorter; fore legs with femur, patella, tibia, and second tarsal segment subequal, first tarsal segment slightly longer, second tarsal segment somewhat swollen, about three times as long as broad, its claws about three-fourths the size of those of other legs; proportions of segments of other legs approximately as in *M. pistiae*.

Holotype female, *allotype* male, and sixteen *paratypes*: Juan Mina, Canal Zone, Panama, June 10, 1945. One hundred and eighty-one additional paratypes from the same locality, March 15, August 23, September 12, and October 17, 1945. All were collected by the author in company with *M. pistiae* on the undersides of leaves of floating plants of *Pistia stratiotes*. Additional specimens were collected from a roadside ditch near Juan Diaz, Panama Province, Panama (R. Melvin).



Microtrombidium maculatum Michener. 28, genital area of adult female; 29, genital area of adult male; 30, lateral view of penial cone of adult male; 31, genital area of nymph; 32, inner view of tibia and tarsus of pedipalp of adult; 33, outer view of same; 34, body hairs of adult.

Since adult growth occurs in this species there is great variation in the size of adults and subadults. Subadults have been collected as small as .85 mm. in length. Structurally they are similar to large adults. Since there are fewer setae on small individuals the pedipalpal combs contain fewer setae, the longer comb having as few as eight in

some individuals. The principal claw of the pedipalp in small subadults is more than half as long as the distal process of the chelicera.

This species resembles *M. arborealis* Boshell and Kerr in some respects. That species, however, has two long combs on the tibia of the pedipalp, greater differentiation of the two sizes of body hairs and greatly modified posterior legs. In both larval and adult characters *maculatum* is related to *pistiae*, from which it differs most obviously in the nature of the body hairs. *M. maculatum* may be related to *M. 13-maculatum* Berlese, but the latter apparently lacks the inner accessory claw of the pedipalp.

Egg: Bright red, smooth, spherical, about 0.17 mm. in diameter, laid in masses of 120 to 200, enveloped in a translucent gelatinous material, unlike anything observed with other Trombididae. The chorion, on breaking, does not usually separate into two completely separate portions (see figure 4).

Deutonymph: Similar to that of *M. pistiae*, having two dorsal spines, but the leg sheaths shorter than in that species; surface finely papillate in some areas.

Larva: Length 0.32 mm. when unengorged; when engorged up to 0.66 mm. Color red. The characters of the larvae are shown in the accompanying illustration. The pedipalpal claw often appears bilobed instead of trifid because of the curvature of the claw.

Protonymph: Saclike, finely tuberculate. Color red.

Nymph: Length 0.65 to 1.1 mm. Agreeing with the description and figures of adult except as follows: principal claw of pedipalp considerably more than half as long as process of chelicera; finger of pedipalp tapering toward blunt apex, considerably exceeded by claw; combs of pedipalpal tibia shorter, becoming irregular basally like those of adult so that it is difficult to state the number of setae; upper comb usually unrecognizable, consisting of one or two setae, longer lower comb consisting of four to seven setae; genital area with but two pairs of suckers; body hairs as in the adult but much sparser; legs with proportions of segments different from the adult, the two tarsal segments of the posterior leg being subequal.

Preadult: Differs from protonymph only in larger size.

Bionomics: Except for an occasional stray individual on other species of aquatic plants, nymphs and adults of this mite have been found only on floating plants of water lettuce, *Pistia stratiotes*. In sloughs along the Chagres River near Juan Mina, Panama Canal Zone, this plant sometimes forms dense patches in which *M. maculatum* is abundant and even conspicuous. Although this and other *Pistia*-inhabiting mites were found in numerous localities near Juan Mina, the most favorable of these places was in the Rio Hondo, a tributary of the Chagres just outside the Canal Zone boundary. The under surface of the thick, spongy *Pistia* leaves are coarsely ribbed or grooved and provided with numerous large hairs, and at the bases of several of the grooves are deep pits in the leaves of large plants. Except for the parasitic larval stage, this mite apparently normally spends its entire life in the protection of the grooves and pits of the *Pistia* leaves.

Although rather sluggish in its movements, these mites are able to walk easily on the water surface when disturbed. They quickly retreat

to *Pistia* leaves, however, if necessary pushing their way under water to get beneath the margins of the leaves. The mites do not get wet, their bodies being strongly hydrophobic.

All stages of the development of this mite have been found in practically every month of the year. The only obvious effect of the season on the abundance of the species results from the influence of varying water levels on the abundance of *Pistia*.

The large egg masses, enveloped in a translucent gelatinous material, are placed in grooves on the under sides of *Pistia* leaves. Eggs laid in the laboratory required at least eight days for the deutovum to appear. When the deutovum appears the egg shell breaks into anterior and posterior portions, but instead of becoming entirely separate, the anterior portion usually remains narrowly attached to the posterior at one side (see fig. 25). The deutoval stage, six to nine days in duration, is passed in the gelatinous matrix in which the eggs are imbedded.

The larvae, after working their way out of the gelatinous mass surrounding the eggs, crawl around actively on the *Pistia* leaves and on the water surface. Some individuals remained alive without feeding for thirty days, walking about on the surface of water in a jar. Most, however, died in a shorter period of time.

Engorged larvae have been found attached to mosquitoes (*Mansonia titillans* (Walker) and *M. nigricans* (Coquillett)) collected at Gatuncillo, Colon Province, Panama, by H. Trapido, as well as at Juan Mina. Most of the mites found on mosquitoes at these localities, however, were not trombidids. The larvae of *M. titillans* at least are frequent on the roots of *Pistia*. On the mosquitoes, the mite larvae attach themselves to the intersclerotic membranes, for example, the cervical membrane, the membranes at the bases of the coxae, and less frequently the abdominal membranes.

Larval mites did not attach to *Anopheles albimanus* Wiedemann when adults of this mosquito were put in jars with the mites nor when adults emerged from pupae placed in a jar of water on the surface of which were many mites.

After engorgement the larva leaves its host, and engorged larvae are occasionally found on *Pistia* plants. The quiescent protonymph stage is apparently usually passed in a protected place on the under surface of a *Pistia* leaf. The duration of this stage is unknown but nymphs did not emerge from field collected protonymphs for as much as five days after the time of collection.

The duration of the nymphal stage is unknown. The quiescent preadult stages apparently have a duration of about ten days.

This species is characterized by a varying but relatively large number (probably two to six) of adult molts. Table VIII, using the length of the last segment of the foreleg as an index of size, and indicating by lines the differences in size between particular exuviae and the mites emerged from them, shows all the available information concerning growth. It is evident that the amount of growth occurring at the time of ecdysis is highly variable, and also that molting may take place after the egg laying size is reached. This last is emphasized by a gravid female, collected while quiescent, and with a preadult integument clearly developing around her internal organs and eggs.

Adults which have freshly emerged from the preceding preadult stage appear dark red and wet. The white spots are not visible until the body hairs dry.

TABLE VIII

Microtrombidium maculatum

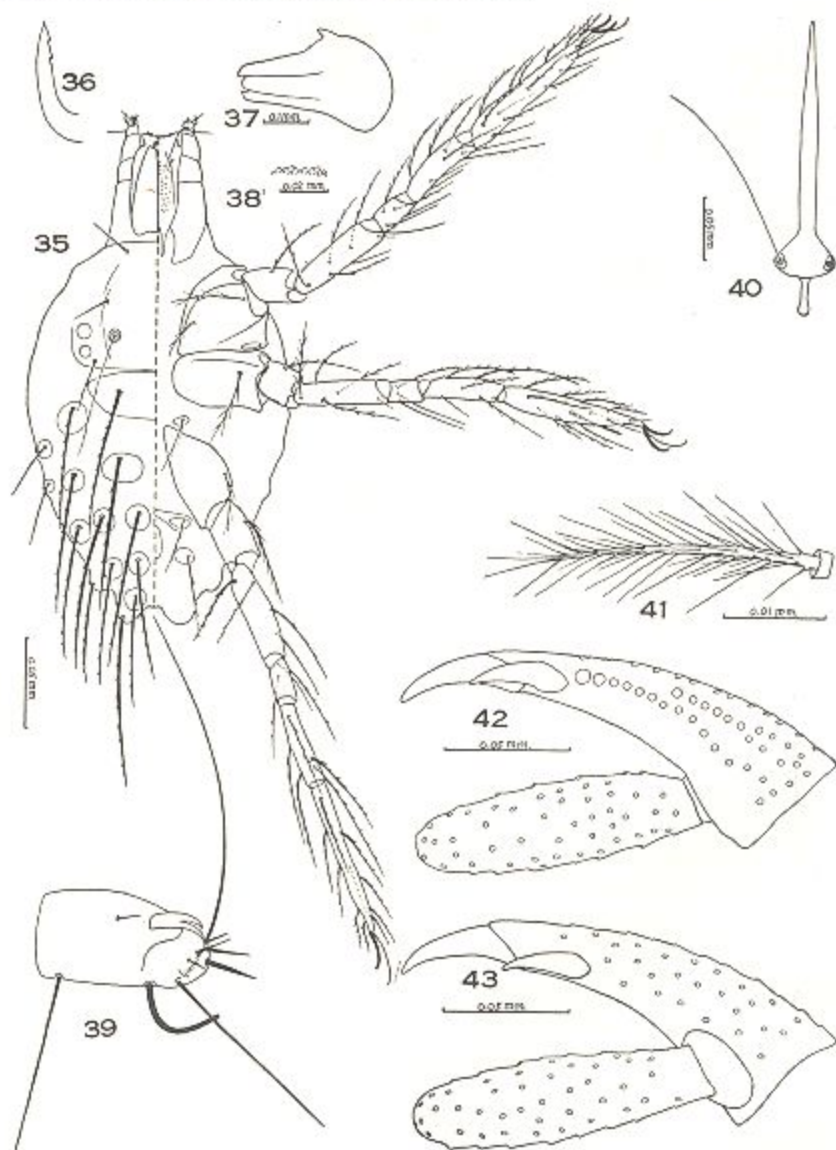
FREQUENCY DISTRIBUTION OF MEASUREMENTS (IN MILLIMETERS) OF LAST SEGMENT OF FORKLEG

N=nymphs, M=adult males, F=adult females. Figures under "eggs" show the number of individuals in each size class which laid or contained eggs. Lines under "growth of individuals" show the amount of growth at one molt of certain individual mites.

	N	M	F	Eggs	GROWTH OF INDIVIDUALS	
					Males	Females
.13-.14	1					
.15-.16	11					
.17-.18	11					
.19-.20	2					
.21-.22		8	1			
.23-.24		6	1			
.25-.26		2	5			
.27-.28		6	4			
.29-.30		5	5			
.31-.32		1	2			
.33-.34		9	7			
.35-.36		3	2			
.37-.38		6	6			
.39-.40		16	11			
.41-.42		8	8			
.43-.44		16	10			
.45-.46		4	1			
.47-.48		5	7	2		
.49-.50		2	9	5		
.51-.52			10	3		
.53-.54		4	5	1		
.55-.56			13	6		
.57-.58			4	2		
.59-.60			5	1		
.61-.62			3	1		
.63-.64						
.65-.66			1	1		

Microtrombidium pistiae n. sp.

Adult: A rather small red or brownish-red, or occasionally brown, species with body hairs of a single type, unthickened and plumose. On each side of the principal claw of the pedipalp is a heavy spine, so that the pedipalp appears to be three-clawed.



Microtrombidium pistiae Michener. 35, larva; 36, apex of chelicera of larva; 37, deutovum; 38, surface sculpture of deutovum; 39, apex of pedipalp of larva; 40, crista of adult; 41, body hairs of adult; 42, inner view of tibia and tarsus of adult; 43, outer view of same.

Length 1.0 mm. (varying from 0.8 mm. to 1.5 mm. among the paratypes and to 2 mm. among other individuals).

Pedipalps reaching beyond the middle of the patella of the anterior legs (or in some reaching only base of patella); principal claw about half as long as distal process of chelicera; on either side of principal claw is an accessory claw about two-thirds as long as principal claw, that on outer side farther from principal claw than that on inner side; setae of inner side of claw bearing segment simple, most of them arranged into two combs, each of which becomes somewhat irregular basally so that it is difficult to state the number of setae in the combs, in some paratypes combs are longer and more regular than in figure; combs close together so that under low power they may appear as one; distal setae of distal (lower) comb progressively shortened and thickened, the distal one about as long as accessory claw; finger more or less parallel sided, reaching apex of claw, its hairs and those of outer side of claw-bearing segment finely plumose. *Chelicerae* with distal process broad, sickle-shaped, acutely pointed, with fine teeth on concave margin. *Crista* rod-like, with an internal projection extending a short distance behind the pseudostigmatic area which is transverse, truncate behind; pseudostigmatic organs simple, arising from lateral angles of pseudostigmatic area. *Eyes* elevated, sessile, in the usual position above anterior coxae, the anterior ones considerably (or but slightly) larger than the posterior. *Body hairs* dense, of a single type, arising from small papillae which are broadest distally; hairs not thickened, main axis broadest at base, strongly plumose; hairs of posterior part of body not longer than those of shoulders. *Genitalia*: Apodemes of penial cone of male considerably longer than cone. *Legs* with many plumose hairs with shorter branches than the body hairs; first and fourth pairs longer than the body (except in individuals whose bodies are swollen, as gravid females), others scarcely shorter than body; forelegs with femora about equal in length to the last tarsal segment and only slightly longer than the intervening three subequal segments (in some all five segments subequal), last tarsal segment somewhat enlarged, two and one-half to nearly three times as long as broad, its claws about three-fourths as large as those of other segments; second and third pairs of legs with femora longer than patella, the following segments progressively longer than patella, the first tarsal segment about equal to femur; fourth legs with trochanters somewhat swollen, the following segments subequal except for the first tarsal segment which is longer than the others.

Holotype female, *allotype* male: Juna Mina, Canal Zone, Panama, March 15, 1945. One hundred and seventy-one *paratypes* from the same locality, March 7, 15, and June 10, July 2, August 8, 15, and 29, September 12, October 17, 1945. An additional specimen was collected in a roadside ditch near Juan Diaz, Panama Province, Panama (R. Melvin).

Growth during the adult stage apparently is unusual in this species, but a very few specimens which are apparently subadults have been collected. These differ from ordinary adults principally in their smaller size (length 0.7 to 0.9 mm.).

The apparently three-clawed apex of the pedipalp is somewhat similar to that of *Microtrombidium arborealis* Boshell and Kerr, a species which, however, has thickened and wholly different body hairs.

Egg: Smooth, red, spherical, about 0.15 mm. in diameter, laid in masses of 85 to 120 or more.

Deutovum: Dull red, more elongate than in other species studied, as shown in figure; two adjacent dorsal spines present, one on each side of midline of body; body surface minutely papillate.

Larva: Length about 0.24 mm. when unengorged. Color red. Larval characters are shown in the accompanying figure. Pedipalpal claw trifold as shown in *M. maculatum*, but often appearing bilobed because of the apical curvature of claw. Anterior dorsal plate defined only at its rear margin; branches of body hairs short, fine, and inconspicuous; inner hair of the anterior coxa commonly merely forked instead of three branched as shown.

Protonymph: Saclike, finely and sparsely tuberculate. Color red.

Nymph: Length 0.66 to 0.93 mm. Agreeing with the description and figures of the adult except as follows: setae of inner surface of tibia of pedipalp only about nine in number, four to six of them arranged to form a single comb of widely spaced coarse setae; finger not attaining apex of claw, finger provided with a few coarse simple setae at apex; genital area with but two pairs of suckers; body hairs sparser than in adult; anterior legs with last tarsal segment slightly longer than other segments.

Preadult: Differs from protonymph only in larger size.

Bionomics: This species occurs with *M. maculatum* on floating plants of *Pistia stratiotes*. It is about as abundant as that species or in some areas more so, although because of its smaller size and usually duller coloration it is less conspicuous. All the comments under *M. maculatum* concerning the behavior of nymphs and adults and the seasonal occurrence of the species apply also to *M. pistiae*.

Adults have been observed apparently feeding on dead bodies of chironomid midges floating on the water surface. Eggs almost completely fill the bodies of gravid females, which appear shriveled after egg laying.

In this species there are normally no molts after reaching the adult stage. This fact is indicated in Table IX in which it is shown that nymphs, in a single step, become adults of maximum size, and that even the smallest adult females are able to lay eggs. Out of approximately 190 specimens measured, however, there were three males which probably represent a subadult stage. Possibly under conditions of minimum food supply and slow growth such a stage occurs. There is no proof that such small adults (i. e., subadults) molt again in this species, but since adult molts are normal but variable in number in the related *M. maculatum*, it is possible that they occur rarely and under certain conditions in *M. pistiae*.

An examination of a series of specimens of this species always reveals some in which the body hairs are densely packed and others in which the hairs appear relatively widely separated. The former are freshly molted individuals. The latter are those which have grown, with resultant stretching of the body integument, after the molt. As this species attains full size with relatively few molts, this stretching is considerable and its effect on the density of the body hairs is noticeable.

Microtrombidium fluminis n. sp.

Adult: A small bright red species with body hairs of a single type, thickened, blunt apically, with numerous fine branches. The finger of pedipalp is small, conical, and much exceeded by the claw.

Length 0.85 mm. (varying from 0.8 to 1.4 mm. among the paratypes).

Pedipalps reaching about middle of patella of first pair of legs; principal claw small, less than one-third as long as distal process of chelicera; inner side of tibia with accessory claw two-thirds to three-fourths as long as principal claw, arising close to the base of the latter, and with one comb of about four widely separated spines which are shorter and coarser than the scattered hairs of the segment, and

TABLE IX

Microtrombidium pistiae

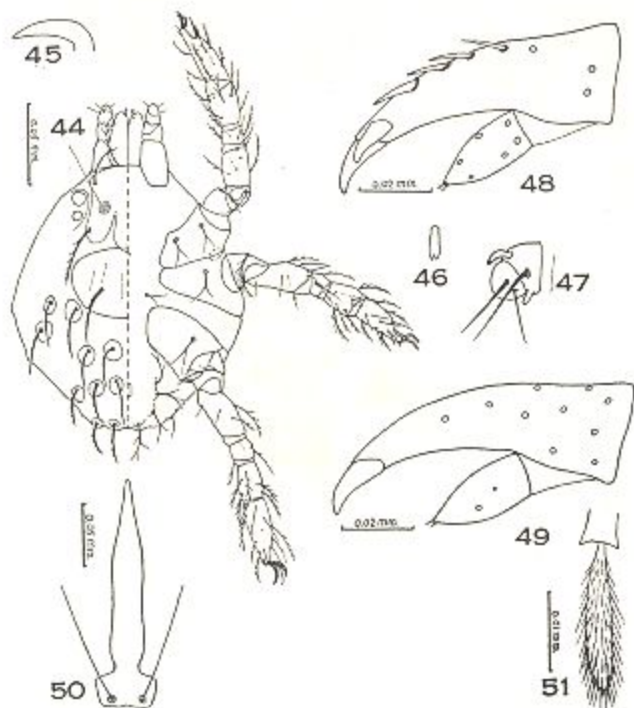
FREQUENCY DISTRIBUTION OF MEASUREMENTS (IN MILLIMETERS) OF LAST SEGMENT OF FORELEG

N=nymph, M=adult males, F=adult females. Figures under "eggs" show the number of individuals of each size class which laid or contained eggs. Lines under "growth of individuals" show the amount of growth at one molt of certain female mites.

	N	M	F	Eggs	Growth of Individuals
.13-.14	6				
.15-.16	8	3			
.17-.18		1			
.19-.20		14			
.21-.22		36	3	1	
.23-.24		23	10	1	
.25-.26		16	25	5	
.27-.28		1	24	4	
.29-.30		2	7	2	
.31-.32			1	1	

progressively coarser distally; outer side of tibia with scattered hairs only; finger small, tapering to a point, reaching to base of claw, its hairs conspicuously barbed. *Chelicerae* with distal process sickle-shaped, sharply pointed apically, the concave margin minutely dentate. *Crista* thick, tapering to a point anteriorly, slightly narrowed immediately anterior to abruptly expanded pseudostigmatic area which is wider than long and about twice as wide as crista at its widest point; pseudostigmatic organs rather short, simple. *Eyes* sessile, two on each side, anterior ones smaller than posterior; eyes not above anterior coxae but located antero-laterally from pseudostigmatic area, from which they are separated by only half width of this area. *Body hairs* of a single type, each arising from a large papilla which is broadest apically, hair arising from a cup-shaped apical concavity in papilla; hairs slender basally but otherwise much thickened, terminating bluntly, and provided with numerous fine setulae; axes of ventral hairs slightly more

slender than of dorsal ones. *Genitalia* with inner plates unusually broad, only about four times as long as broad (penal cone not clearly visible). *Legs* and pedipalps with hairs slender and for the most part plumose, not resembling the body hairs; first and fourth pairs of legs about as long as body, others shorter; forelegs with femur longer than patella, the latter equal to first tarsal segment but longer than tibia, second tarsal segment longer than femur, dilated, about two and one-half times as long as broad, claws about two-thirds as large as those of other legs; second and third pairs of legs each with femur slightly longer



Microtrombidium fluminis Michener. 44, larva; 45, apex of chelicera of larva; 46, pedipalpal claw of larva; 47, apex of pedipalp of larva; 48, inner view of tibia and tarsus of pedipalp of adult; 49, outer view of same; 50, crista of adult; 51, body hair of adult.

than the subequal patella and tibia, equal in length to first tarsal segment, but much shorter than second; fourth legs with trochanters dilated, femur slightly longer than the subequal patella and tibia, much shorter than either tarsal segment, first tarsal segment scarcely shorter than second.

Holotype (male?): Summit, Canal Zone, Panama, April 4, 1945. Three *paratypes* from the same locality. Thirteen additional *paratypes* from Tocumen, Panama Province, Panama, March 25 and April 1, 1945. Specimens were also taken at Camarón, Panama Province, Panama, March 19, 1945.

The small finger of the pedipalp of this species suggests *M. pusillum* (Hermann), *columbianum* Berlese, *balzani* Berlese, *confusum* Berlese, and *soperi* Boshell and Kerr. Of these species only *confusum* has body hairs similar to those of *fluminis*, but that species apparently differs by the more numerous and closely spaced bristles of the pedipalpal comb.

Egg: Bright red, smooth, spherical, laid in masses of about twenty

Deutovum: Observed but unfortunately not preserved for study.

Larva: Length 0.17 mm. Color red. The characters are shown in the accompanying figure. The minute pedipalpal claws appear bilobed as shown, but may actually be trifid, as with certain other species whose claws appear bilobed in certain views. Noteworthy features are the trilobate anterior dorsal plate, the simple claws of the posterior legs, and the absence of median claws on the front and middle legs.

Protonymph: Unknown.

Nymph: Length 0.6 mm. Bristles of comb of pedipalpal tibia slender, three in number; crista almost or completely broken just in front of pseudostigmatic area; pubescence sparse, the body hairs much more slender than in adults but nevertheless distinctly thickened and ending bluntly.

Preadult: Sac-like, to judge by examination of a live specimen through nymphal integument.

Bionomics: Nymphs and adults of this species have been found running actively among moist dead and decaying leaves along the edges of pools and puddles in small drying stream beds at the end of the dry season. Some have also been taken running over damp rocks a few inches from the edges of similar pools.

The egg masses have been found in the field among the moist dead leaves where the adults occur. One was also laid in a rearing jar, among similar leaves. Larvae appeared on April 2 from a mass laid on March 26. Deutova were observed but unfortunately not preserved or described.

Apparently there are no adult molts in this species although evidence is meagre. All adults collected were more or less the same size. One individual was collected as a preadult. The outside integument was that of a nymph and the mite which emerged was an adult as large in measurements of the appendages as those which laid eggs.

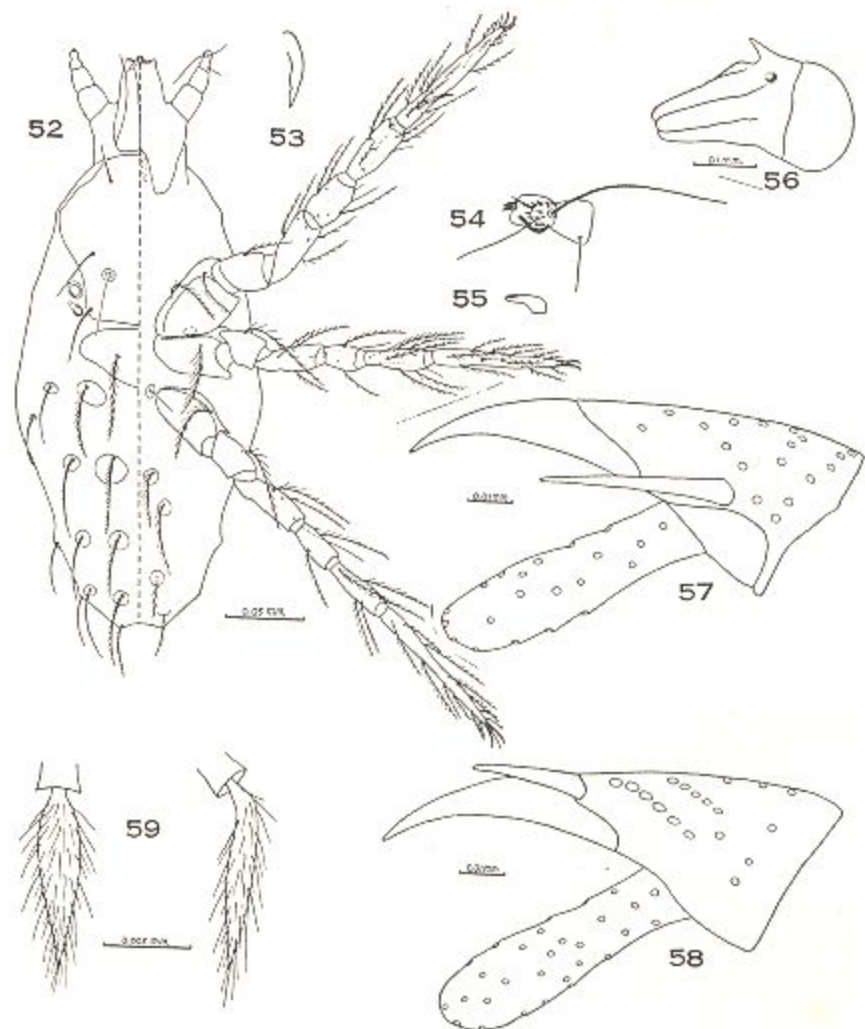
Microtrombidium littorale n. sp.

Adult: This is a small, very bright red, rather elongate species. The hairs are of a single type in any one area of the body. They are thickened but pointed at the tips. The tibia of the pedipalp is provided with two oblique combs or bristles.

Length 1.02 mm. (varying from 0.83 to 1.10 mm. among paratypes).

Pedipalps reaching middle or apex of patella of anterior leg; principal claw about as long as distal process of chelicera and approximately the length of pedipalpal tibia; inner surface of tibia with slender accessory claw about half length of principal claw and two oblique combs, each consisting of five or six coarse bristles; bristles of distal comb coarser

and with larger bases than those of basal comb (basal of combs are sometimes one to five simple setae); outer surface of tibia with large spine, nearly as long as claw, arising above base of finger; finger reaching to apex of claw, slightly more slender basally than apically, covered, like outer surface of tibia, with plumose setae. *Chelicerae* with distal process short, broad, acutely pointed, minutely dentate on concave margin. *Crista* slender, rod-like, with short internal projection, scarcely longer than broad, extending behind pseudostigmatic area; pseudostigmatic area roughly round, tapering anteriorly, with pseudostigmatic



Microtrombidium littorale Michener. 52, larva; 53, apex of chelicera of larva; 54, apex of pedipalp of larva; 55, pedipalpal claw of larva; 56, deutovum; 57, outer view of tibia and tarsus of pedipalp of adult; 58, inner view of same; 59, body hair in dorsal and lateral view.

organs arising posteriolaterally; pseudostigmatic organs simple, only about half as long as crista. *Eyes* sessile, in usual position above anterior coxae, the anterior ones slightly larger than posterior. *Body hairs* of a single type (except for certain areas), arising from large papillae which are broader distally than basally; hairs bent posteriorly near bases, somewhat flattened, narrow at bases, rather abruptly broadened near bases so that they are broadest subbasally or medially, tapering thence to pointed apices; hairs covered with numerous fine setulae; ventral hairs more slender than dorsal; areas laterad of eyes and connected by a narrow band behind pseudostigmatic area with even more slender and longer hairs, some of them scarcely thickened. *Legs* with hairs plumose, not thickened; legs rather slender, all shorter than body, anterior and posterior pairs much longer than others; fore legs with femur, tibia, and first tarsal segment subequal, patella somewhat shorter (or tibia and patella equal, both shorter than femur and first tarsal segment), second tarsal segment longer than other segments, much swollen, 2.2 (2.0 to 2.3) times as long as broad, its claws about two-thirds as large as those of other segments; second and third pairs of legs with segments following femur progressively longer, second tarsal segment much longer than any of the others, about as long as patella and tibia together; fourth pair of legs also with segments following femur progressively longer, but second tarsal segment but little (sometimes not at all) longer than first.

Holotype male, *allotype* female, and thirty-three *paratypes* from Old Panama, Panama, November 27, 1945 (C. D. and Mary H. Michener).

This species does not closely resemble any described American form. The shape of the papillae of the body hairs suggests *Microtrombidium wilsoni* Boshell and Kerr, among others, but the hairs themselves are scarcely thickened in that species. Evidently *M. littorale* is related to the European *M. stimulans* Berlese.

Egg: Bright red, smooth, spherical, 0.11 to 0.13 mm. in diameter, laid in masses of ten to thirty-five.

Deutonymph: Legs elongate; dorsum with two large spines strongly diverging from one another.

Larva: Length about 0.29 mm. Color red. Characteristic features shown in fig. 52. Pedipalpal tibia with median constriction, the distal portion being flattened and projecting over the tarsus and bearing the small claw at its apex; median claws absent on first two pairs of legs; dorsal plates conspicuously longitudinally striate.

Protonymph: Unknown.

Nymph: Length 0.65 mm. Agreeing in general with description of adult; tibia of pedipalp with only one comb of three to five bristles, apparently corresponding to distal comb of adult; body hairs sparser than in adult but otherwise similar.

Preadult: Unknown.

Bionomics: This species was very abundant in an area near Old Panama. It has not been found outside of the intertidal zone, and barnacles and marine snails are found as much as four and one-half feet above the level where the mites occur. Nymphs and adults are exceedingly active and run rapidly over the surface of mud, even in bright sunlight, in a mangrove swamp as well as where mud formed a

thin covering over rocks some distance from the mangroves. The surface of the mud where these mites were collected was partly covered by an inconspicuous filamentous green alga. The broad bare mud flats evidently are not a suitable habitat for this species. When disturbed by attempts to catch them, and doubtless also by the rising tide, they go into small holes in the mud, of which there are many, mostly made by small polychaete worms.

The egg masses are laid in holes in the mud. In the laboratory it has been found necessary to remove the eggs from rearing jars as soon as possible after laying, as otherwise they are eaten by the mites. Frequent submersion in sea water does not seem to be necessary for life in this species, as the mites live well in rearing jars containing some mud kept moist by keeping the jar sealed. In such jars adults lived for over a month.

The duration of the egg stage in this species is about ten days, of the deutoval stage ten to twelve days.

There is no great variation in the size of adults in this species, and it is reasonably certain that adult molts do not occur.

Microtrombidium arborealis Boshell and Kerr

Microtrombidium arborealis Boshell and Kerr, 1942, Rev. Acad. Colombiana Cien. Exact., Fisic. Nat., vol. 5, p. 123.

Specimens of this species were collected beneath a log at Santa Rosa, Colon Province, Panama, August 29, 1945. Another was found at Juan Mina, Canal Zone, Panama.

It is worth pointing out that this curious species is related to *M. distinctum* (Canestrini) from the Old World tropics.

Several other species of trombidids were collected in small numbers during the author's stay in Panama. These included two species related to *Microtrombidium duartei* Boshell and Kerr, one additional species of *Manriquia*, etc.

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