

THE GENUS *ASCA* VON HEYDEN (ACARINA : MESOSTIGMATA)
IN NORTH AMERICA, HAWAII AND EUROPE¹

BY

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Mites of the genus *Asca* are an ecologically diverse group of Mesostigmata easily recognized by the presence of a pair of tubercles projecting from the posterolateral corners of the posterior dorsal shield. Each tubercle bears two setae although one of these setae is sometimes very reduced.

Prior to the present study the only species described from the continent of North America was *Asca elongata* (Berlese) 1910 which was collected from moss from Lake City, Florida. In 1941 WHARTON described *A. quinquesetosa* from booby nests from Clipperton Island. *A. duosetosa* was described by FOX (1946) from specimens taken off *Rattus* in Puerto Rico. Five species have been described from Europe including the type species *A. aphidioides* (L.) and *A. bicornis* (Can. & Fanz.) 1876. WILLMANN (1939) described *A. nova* from Germany but later (1949) made it a synonym of *A. bicornis*. *A. bicornis* was contrasted with *A. aphidioides* by SCHWEIZER (1948) and by HALASKOVA (1959). Recently ATHIAS-HENRIOT (1961) has described two species from the Mediterranean region, *A. nesoica* from northwestern Spain and *A. squamulata* from Corsica and Algeria. Three species of *Asca* have been reported from Australia (WOMERSLEY, 1956 and DOMROW, 1957), and one species has been recorded from Sumatra (VITZTHUM, 1925) and Guam (WHARTON, 1946). EVANS (1958 a) described *A. pallida* from spider nests in Uganda and included a key to the females of *Asca*. *A. aethiopica* and *A. spinosa* were described by RYKE (1961) from South Africa.

In the present paper eight species from North America and one species from Hawaii are described as new. The type specimens of *A. duosetosa*, *A. elongata* and *A. quinquesetosa* are redescribed. Three species believed to be conspecific with forms originally described from Europe are also treated.

1. Part of this investigation was carried out during the tenure of a Predoctoral Fellowship from the National Institutes of Health.

METHODS.

The dimensions of the dorsal shields were measured under a total magnification of 430X. They are accurate to about three microns. The length of the anterior dorsal shield was measured along the midline from a point halfway between the most anterior pair of setae to the posterior edge of the shield. The width is difficult to measure accurately because the degree of curvature of the lateral portions of the specimen varies depending upon whether or not the specimen was flattened by mounting. Most of the other measurements were made under a total magnification of 970X using oil immersion and phase contrast. Under these conditions one unit of the ocular micrometer was calculated to equal 1.22 microns. In measuring the lengths of setae both members of a pair of setae were measured. When setae on opposite sides of the body differed in length the longer measurement was recorded. The Pythagorean theorem was used to calculate the lengths of setae which were tilted in such a way that the entire length was not in focus at one time. Transverse distances such as J4-J4 or J4-Z3 are referred to as intersocketal distances (see fig. 21, i) and are usually about two microns less than the distances between the centers of the setae. Longitudinal distances such as J3-J4 or v1-v3 were determined by measuring from the base of one seta to the base of the seta behind it.

In the tables, L = the length of the anterior dorsal shield and N refers to the number of specimens measured. Da = the distance from the anterior edge of the anus to the anterior edge of the ventrianal shield.

The names applied to the setae are for the most part those used by HIRSCHMANN (1957). A few of the setae on the anterior dorsal shield have been renamed in order to account for a seta not shown by HIRSCHMANN in his figure of the deutonymph of *Asca*. Like HIRSCHMANN I have assumed that seta r1 is absent in *Asca*. The seta not shown by HIRSCHMANN is designated r4 in the present study. Seta s4 = Hirschmann's r4, s5 = s4, s6 = s5 and s7 = s6. Following this system the arrangement of the setae on the anterior portion of the idiosoma is nearly identical to that found in *Lasioseius*, *Leioseius* and *Digamasellus* except that seta r1 is missing in *Asca*. The anterior dorsal shield of a deutonymph is illustrated in figure 14.

Holotypes will be deposited in the collection at the U. S. National Museum, Washington, D. C.

Genus ASCA von Heyden.

Asca VON HEYDEN, 1826, *Isis* 18, 6:610.

Ceratozercon BERLESE, 1913, *Acarotheca Italica*, 204.

Female : Body flattened dorso-ventrally and with two approximately equal dorsal shields. Anterior dorsal shield with either seventeen or eighteen pairs of

setae depending upon location of r₄ which may be on the dorsal shield, on the peritrematal shield or on the membrane lateral to the dorsal shield. Setae r₅, r₆ and r₇ on membrane. Seta r₁₁ absent so that only a single pair of setae (il) is situated on the anterior margin of the idiosoma. Seta r₅ similar in length and form to adjacent setae. Posterior dorsal shield with fifteen pairs of setae. A cylindrical tubercle projects from each corner of the posterior shield. Each tubercle bears two setae, one of which is very minute in some species.

Sternal shield with two pairs of setae, the first pair of sternal setae being situated on faintly sclerotized jugularia. First pair of sternal pores on anterior boundary of sternal shield. Third pair of sternal pores (when visible) located on posterolateral corners of sternal shield. Metasternal setae arising from membrane. Two pairs of setae, three pairs of narrow platelets and one pair of pores on membrane between epigynial and ventrianal plates. Pores also present lateral to genital shield, behind coxa IV and near anterolateral corner of ventrianal plate. Outer and inner metapodal plates present. Ventrianal shield always broad, with six pairs of setae in addition to the perianals.

Tectum with anterior margin smooth, serrate, or with two or three equal tines. Moveable digit of chelicera with two teeth. All legs with claws.

Male : Dorsal shield similar to that of female, fused anteriorly to peritrematal shield. Sternigenital and ventrianal shields distinct. Setae V₁ and V₅ situated on ventrianal shield. Spermatophorentramer rod-shaped or slightly curved. Leg II without processes or spurs.

Biology and ecology : MOUSSA (1956) reported that an undescribed species of *Asca* was partly responsible for the mortality of the eggs of *Hypera punctata*, the clover leaf weevil, in Illinois. MOUTIA (1958) listed *Asca* sp. as a predator of *Tetranychus marianae* on *Solanum nigrum* and *S. indicum*. *A. bicornis* was reported to feed on young stages of Collembola by KARG (1961), and in the present study *A. garmani* was observed feeding on small collembolans on two occasions.

What appeared to be developing larvae were observed inside females of two species from Florida. In the case of most of the other species of *Asca* treated in this paper females with the outline of an egg visible have been observed. In northern United States gravid females have been found only in the spring and summer. Males are unknown in several species of *Asca* including the two common forms, *A. aphidioides* and *A. garmani*.

Asca have been collected from a wide variety of habitats such as moss, sod, litter, nests of spiders, birds and mammals, on rodents, bark of citrus trees and leaves of several plants. It apparently does not occur in the deeper layers of the soil.

KEY TO FEMALES OF THE GENUS *Asca*,
(North America, Hawaii and Europe).

Asca elongata (Berl.) is not included in the key. It is similar to *A. brachychaeta* but the nature of the sternal shield is uncertain.

1. Posterior tubercle appearing to bear a single pinnate seta ; second seta rudimentary (under $5\ \mu$ long)..... 2.
- Posterior tubercle clearly bearing two setae ; longer seta on tubercle not more than three times as long as shorter one..... 3.
2. Dorsal shields ornamented with a polygonal network of minute protuberances.....
A. aphidoides (L.).
- Dorsal shields without polygon-forming ornamentation..... *A. garmani* n. sp.
3. J₅ 14-20 μ long, at least half as long as S₅..... *A. duosetosa* Fox
- J₅ less than half as long as S₅, usually minute..... 4.
4. Tectum two-tined ; distance from J₄ to J₄ less than distance from J₄ to Z₃.... 14.
- Anterior margin of tectum smooth, serrate or with three tines of equal length ; distance from J₄ to J₄ greater than distance from J₄ to Z₃..... 5.
5. Tectum with three distinct tines ; intersocketal distance J₄-J₄ (see fig. 21 i) at least twice as great as J₄-Z₃..... 6.
- Tectum with anterior edge serrate or smooth ; J₄-J₄ less than three times as great as J₄-Z₃..... 8.
6. Seta il plumose. Algeria, Corsica..... *A. squamulata* Athias-Henriot
- Setae on anterior dorsal shield simple. Europe, North America..... 7.
7. Intersocketal distance J₄-J₄ less than 3 1/2 times distance from J₄ to Z₃ ; J₃ not usually extending past the base of J₄..... *A. nova* Willmann
- J₄-J₄ more than 3 1/2 times J₄-Z₃ ; J₃ extending past the base of J₄.....
A. nesoica Athias-Henriot
8. Setae on anterior dorsal shield simple. Mexico..... *A. pini* n. sp.
- Setae on anterior dorsal shield pilose..... 9.
9. Anterior dorsal shield with 18 pairs of setae, r₄ being located on the shield (figs. 23, 26) ; membranous margin adjacent to anterior dorsal shield with three pairs of setae ; posterior margin of sternal shield irregular, not distinctly concave..... 10.
- Anterior dorsal shield with 17 pairs of setae, r₄ being located on the membrane adjacent to the shield (see fig. 32) ; membranous margin adjacent to anterior dorsal shield with four pairs of setae ; posterior margin of sternal shield distinctly concave..
11.
10. Longer seta on posterior tubercle (S₅) strongly pilose ; J₄ not reaching to posterior margin of body ; dorsal shields with conspicuous ornamentation near midline.....
A. citri n. sp.
- S₅ slightly pilose ; distal tip of J₄ extending slightly past posterior margin of body ; posterior dorsal shield without ornamentation near midline.... *A. brachychaeta* n. sp.
11. Anterior margin of tectum without teeth (figs. 29, 39) ; seta J₃ over 1.8 times as long as intersocketal distance s₇-z₃ (fig. 40) ; length of J₃ equal to or greater than distance J₃-J₃..... 12.

- Anterior margin of tectum serrate (figs. 34, 35); J3 less than 1.6 times as long as s7-z3 (fig. 33); length of J3 less than .7 times intersocketal distances J3-J3.. 13.
- 12. Anterior margin of sternal shield with indentation; tectum triangular in outline....
A. incisa n. sp.
- Anterior margin of sternal shield without conspicuous indentation (fig. 31); anterior edge of tectum rounded *A. muma* n. sp.
- 13. J3 simple *A. neopallida* n. sp.
- J3 pilose *A. piloja* n. sp.
- 14. Setae J4, Z3, S4, S5, Z4 and Z5 stout and spinelike. Hawaii *A. spicata* n. sp.
- Setae not spinelike. Hawaii, Clipperton Island *A. quinquesetosa* Wharton

Asca aphidioides (L.).

- Acarus aphidioides* LINNAEUS, 1758, Syst. Nat. 10 : 235.
- Sejus bicornis* (in part) CANESTRINI, 1885, Prospetto dell' Acarofauna Italiana, pp. 91-92.
- Zercon bicornis* BERLESE, 1887, Acar. Myr. Scorp. 41 : 8.
- Asca aphidioides* VITZTHUM, 1926, Tierwelt Mitteleuropas 3 : 30.
- Asca aphidioides* WILLMANN, 1939, Zool. Anz. 125 : 247.
- Asca aphidioides* SCHWEIZER, 1948, Res. Rech. scient. Parc. Nat. Suisse N. F. 2 : 20.
- Asca aphidioides* SELLNICK, 1958, Swedish State Plant Protection Institute Contributions 11 : 22.
- Asca aphidioides* HALASKOVA, 1959. Acta Univ. Carolinae, Biol. 1 : 17.

Female : The following description is based on specimens taken from Patuxent Wildlife Research Refuge, Maryland. Information on variation in certain characters which were studied in more detail is given in table 1.

Anterior dorsal shield 143-166 μ long, 146-180 μ wide, with seventeen pairs of strongly pilose setae. Seta 11 13-17 μ long, s7 21-26 μ long, distance between s7 and z3 19-22 μ . Seta 14 arising from peritrematal shield just posterior to junction of latter with anterior dorsal shield (fig. 6). Both shields ornamented with a network of small protuberances (fig. 2). Posterior dorsal shield 125-140 μ long. Seta J2 equal to or slightly shorter than distance from base of J2 to base of J3. Latter distance 22-28 μ . J3 23-32 μ long, J3-J4 24-35 μ . J4 straight and strongly pilose, 38-45 μ long, not quite reaching to base of J5. J5 minute (3 μ). Z3 and Z5 with a swelling or bulge near the middle of the seta. Z5 39-49 μ long, not pilose. S4 28-34 μ long. The posterior tubercle appears to bear a single pinnate seta designated as S5. In lateral view, however, a small second seta, which is about 3 μ long, can be seen (fig. 6).

Sternal shield about 50 μ long near midline, v2-v2 45 μ , v2-v3 24 μ . Genital shield with conspicuous groove shaped like an inverted U. Ventrianal shield 165-185 μ wide, about 95 μ long. Seta Vx situated on lateral edge of shield. Da 50-61 μ .

Tectum usually with three simple tines, the middle tine sometimes slightly bifid.

Moveable chela 27 μ long, with two teeth. Distance from tip of moveable

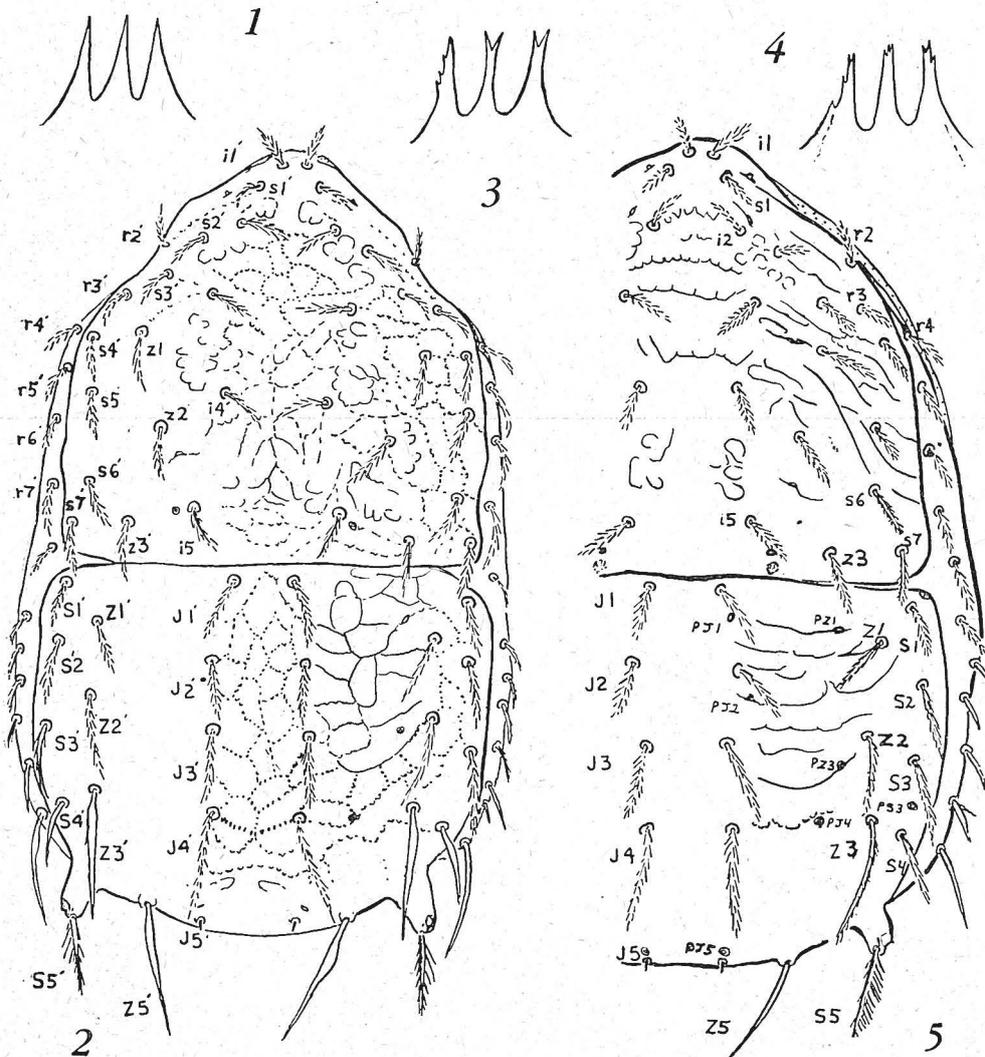


FIG. 1-2. — *Asca aphidioides*, ♀ from Bowie, Maryland. 1. tectum, 2. dorsal view.

FIG. 3. — *A. aphidioides*, ♀ from McConchie, Maryland, tectum.

FIG. 4-5. — *A. garmani*, holotype ♀. 4. tectum, 5. dorsal view.

digit to more distal tooth 4 to 5 μ , distance from latter tooth to proximal tooth of moveable digit 3 $\frac{1}{2}$ μ . Fixed digit (fig. 41) with only one tooth proximal to pilus dentilis. One large tooth and two small teeth situated between pilus dentilis and tip of fixed chela. Distance from tip of fixed chela to proximal tooth 10 μ . Distance from tip of fixed chela to proximal tooth 10 μ . Total length of penultimate segment of chelicerae along dorsal border 80 μ .

Leg IV, including coxa but not pretarsus, 195-210 μ long. Femur IV with six setae, genu IV and tibia IV each with nine setae. Tarsus IV about 60 μ long.

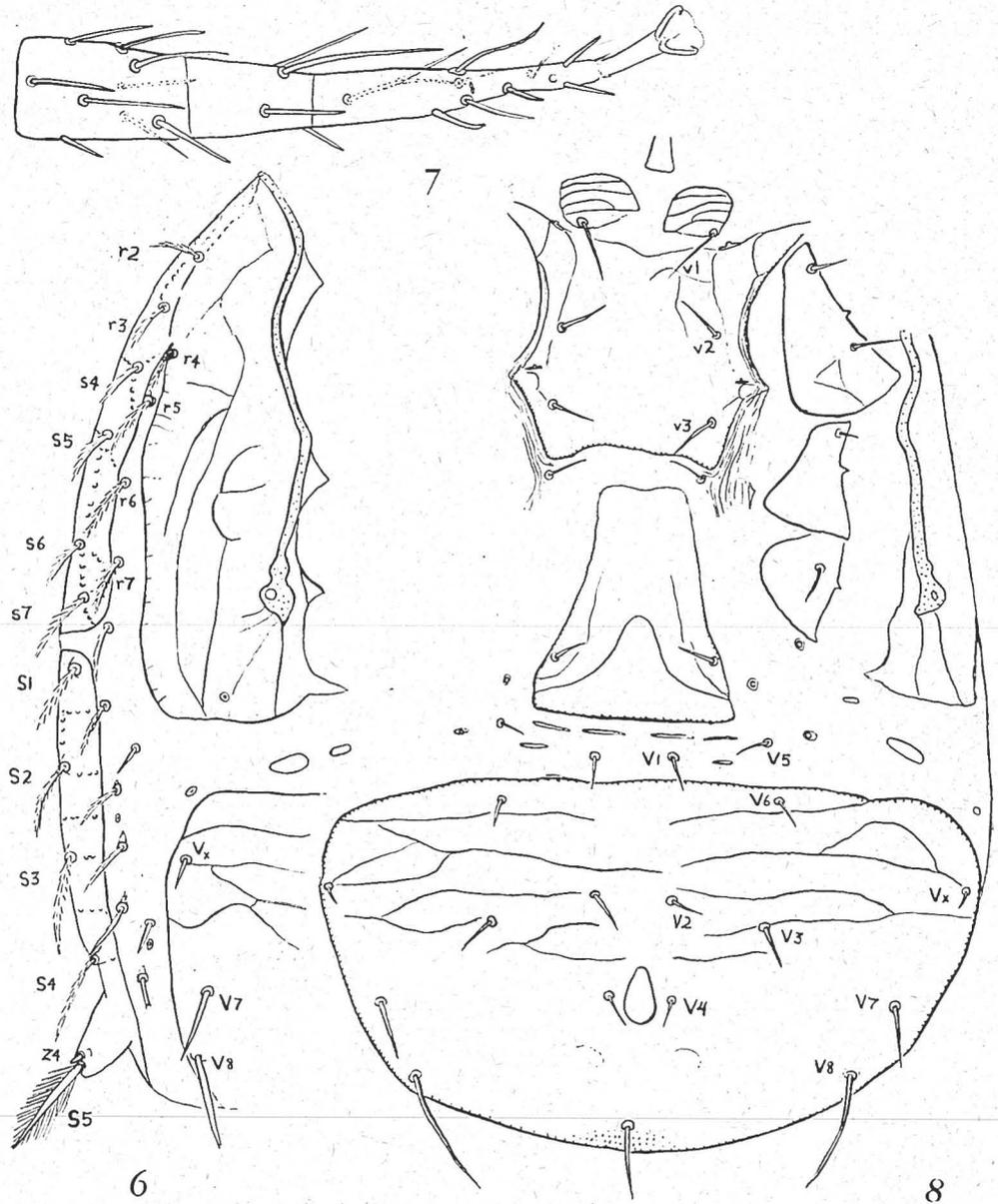


FIG. 6. — *A. aphidioides*, ♀ from Bowie, Maryland, lateral view.
FIG. 7-8. — *A. garmani*, holotype ♀. 7. tibia and tarsus IV, 8. ventral view.

Deutonymph: Anterior dorsal shield 135 μ long, posterior shield 90 μ long. Z5 37 μ , S5 25 μ long. The dorsal shields lack the networkforming ornamentation of the adult and cannot be distinguished with certainty from those of *A. garmani*. Fortunately, it was possible to observe two individuals in which the adult

cuticle could be seen developing under that of the deutonymph. The setae are less pilose than in the adult and Z₅ is not swollen. The tectal tines are simple but slightly frayed laterally.

Protonymph : On June 28, 1960 a single protonymph, which could have been either *A. aphidioides* or *A. garmani*, was collected. The arrangement of the dorsal setae in this specimen agrees with the figure of HIRSCHMANN (1957). Idiosoma 200 μ long. Anterior dorsal shield with eleven pairs of setae. Membrane with three pairs of setae lateral to anterior dorsal shield and two pairs of setae posterolateral to shield. Posterior dorsal shield bearing J₃, J₄, Z₃, Z₅, S₄ and S₅. Z₅ 29 μ long. S₅ arising from tubercle. J₁, J₂, Z₁, Z₂, S₂ and S₃ not on shield. Peritreme extending anteriorly to coxa II, 27 μ long. An anal shield bearing a total of five setae is present.

Larva : Idiosoma (fig. 12) 170 μ long. As in phytoseiid larvae the anterior dorsal shield bears nine pairs of setae. Posterior to the anterior shield nine pairs of setae arise from the dorsal surface. The posterior tubercles are concave distally and devoid of setae. The setation of the ventral surface is similar to that of phytoseiids (CHANT, 1958). Three pairs of setae occupy the intercoxal region while posteriorly there are seven paired setae plus an unpaired postanal seta. A pair of relatively long, curved setae, apparently not corresponding to any of the V-series of setae, arises just medioventrad to the posterior tubercles.

There are four pairs of setae on the basitarsus and in legs II and III there are ten pairs of setae on the telotarsus. The number of setae on the other segments of the legs is for leg I 2, 4, 10, 8 and 8; leg II 2, 4, 7, 6 and 7; leg III 2, 4, 5, 6 and 7. Leg III is 130 μ long including the coxa but not the pretarsus. There are no setae on the palp trochanter, four on the femur and five on the palp genu (fig. 13).

Distribution and biology : *Asca aphidioides* appears to be widespread in Europe. Part of the material described by CANESTRINI (1885) under the name *Sejus bicornis* may have been *A. aphidioides*. CANESTRINI noticed that some specimens had only one robust seta on each tubercle but considered these to be older individuals. The mite described by BERLESE in A. M. & S. (1887) as *Zercon bicornis* is evidently *A. aphidioides* as noted by SCHWEIZER (1948) and WILLMANN (1949). Dr. LOMBARDINI has kindly examined specimens of *Ceratozercon bicornis* from Berlese's acaroteca for me. He reports that the examples from Boboli (Firenze) and Sardegna (nel musco, 1915) have S₅ "veramente piumoso" and the dorsal shields with polygonal ornamentation made of points. In both specimens the distance from J₄ to J₄ is less than 3/4 the distance from J₄ to Z₃.

The late Dr. SCHWEIZER kindly loaned me a specimen collected by him in 1919 from moss near Basel, Switzerland (discussed in SCHWEIZER, 1948). The specimen, which was mounted in glycerine-gelatin, is in excellent condition and agrees closely with material from Connecticut. Recently Mr. D. JOHNSTON loaned me four specimens of *A. aphidioides* collected by M. ANDRÉ "ex Mousse, Orry-la-Villa Coye", France. *A. aphidioides* has also been reported from Sweden, Latvia,

Leningrad, Denmark, Germany, Austria, Czechoslovakia, Corsica and Spain. The identity of the species reported by FORD (1938) from *Bromus* tussocks in England is doubtful.

Material collected from North America is listed below. Except where otherwise noted mites were collected from deciduous litter by the author. Ex beech mor (H), Morgan Arboretum, Ste. Anne de Bellevue, Quebec, Oct. 22, 1960 by V. MARSHALL (1); Winsted, Conn. by E. MACLEOD (66); orchard sod, Storrs, Conn. (2); Gales Ferry, Conn. (4); Greene Co., N. Y. by R. HIGHTON (1); Yonkers, N. Y. (2); jct. Rt. 322 and Mifflin-Centre county line, Penn. (8); *Peromyscus* nests, Patuxent Refuge, Bowie, Md. by R. DRUMMOND (2); deciduous litter, numerous localities in Maryland and western Virginia; Duke Forest, Durham, N. C. by I. HUBER (1); under bark of dead pine, Atlanta, Ga. by P. HUNTER (1); on oak, Vero Beach, Florida by M. MUMA (1); ex leaf litter, 9 mi. E. McCook, Nebraska by T. ATYEO (2); ex leaf litter and ex moss, Pulaski and Jefferson counties, Missouri by T. ATYEO (15); *Eucalyptus* litter, Opaepala, Oahu, Hawaii by F. H. HARAMOTO (3).

In Maryland *A. aphidioides* is one of the commonest species of Mesostigmata inhabiting forest litter. In a study plot at Patuxent Wildlife Research Refuge *A. aphidioides* was found in 104 out of 119 samples. (Each sample was 16 cm. in diameter.) It was present in $101/119 = .849$ of the L&F subsamples and in $61/117 = .521$ of the H-layer subsamples. It was virtually absent below the H-layer. From April through October most individuals were collected from the L&F layer. During these months only 42 (10%) of the females collected were from the H-layer. In samples extracted from November through March, however, the number of individuals occurring in the H-layer usually exceeded the number found in the L&F layer.

The average number of females per sample was 7.95 with a variance of 66. The median number of females per sample was six. Each sample had an area of about 200 cm².

Gravid females were found from March until early September. They were most numerous in May and June. Immature stages of *Asca* were never recovered from samples collected between mid-October and April. Nymphs of *Asca* were collected in small numbers from May to early October, but unfortunately could not be identified to species. Specimens in which the adult exoskeleton was visible underneath that of the deutonymph were collected May 28, 1960 and May 27, 1961. Males are unknown in *A. aphidioides*.

Attempts to rear *A. aphidioides* in the laboratory were mostly unsuccessful. On May 30, 1962 a gravid female was transferred from an incubator set at 13°C to a room having a temperature of 25°C. The following morning a larva appeared. After a couple of days it became quiescent and on June 5 was mounted (figs. 12, 13).

Geographic and seasonal variation : Series of specimens from Connecticut, Pennsylvania and Maryland were measured in an attempt to learn something about geographic variation of body length and of setal lengths (see table 1). The

examples from Maryland were taken during 1959 and 1960 from a plot of deciduous forest located on Patuxent Wildlife Refuge near Bowie, Prince Georges Co. Three samples of litter were collected at random from the plot on each collecting date, and the mites were extracted from the litter with Tullgren funnels. All of the *Asca* recovered from the funnels were mounted in Hoyer's medium and numbered. Two specimens were selected randomly from each of two samples taken at twenty different times of the year (none from April or July). Thus a total of eighty mites was measured (see table 2). These were compared to sixty four *A. aphidioides* taken on May 17, 1961 by E. and M. MACLEOD from litter collected west of Highland Lake near Winsted, Connecticut. The anterior dorsal shield and setae J3, J4 and Z5 were significantly longer in the specimens from Connecticut than in those from Maryland. The probability due to chance that S5 in the Connecticut specimens would exceed in length the Maryland specimens by the amount observed was about .1. The distances J3-J4 and J3'-J3 were not significantly larger in the series from Connecticut while the ratio of J4-J4 divided by J4-Z3 was virtually identical in both localities. The small series from Pennsylvania was collected Aug. 31, 1959 from Mifflin Co. and in most respects appeared similar to the Maryland series. A few individuals from Pennsylvania and Maryland lacked the characteristic bulge in seta Z5.

TABLE I. — Variation in *Asca aphidioides*. Means and standard errors are given in microns.

Locality et date	A. D. S. L	Setal lengths				Distances			
		J3	J4	Z5	S5	J3-J4	J3-J3	ratio ¹	
Winsted, Conn. May 17, 1961	N	62	61	64	64	63	32	32	32
	\bar{X}	159	31.1	44.1	44.9	31.0	29.4	30.3	.69
	S. E.	0.5	0.2	0.2	0.2	0.1	0.3	0.4	.01
Mifflin Co. Penn. (N = 8) ²	\bar{X}	152	28.2	41.3	43.6	30.7	29.6	31.4	.68
	S. E.	1.4	0.4	0.3	0.6	0.4	0.4	0.3	.04
Bowie, Md. May 28 '60 (N = 25)		155	28.7	42.6	45.2	31.9	30.1	—	—
		0.9	0.3	0.4	0.4	0.4	0.3	—	—
Bowie, Md. Aug. 16 '60 (N = 25)		147	27.3	39.0	41.7	29.8	28.5	—	—
		0.7	0.4	0.3	0.2	0.2	0.2	—	—

1. Distance between J4 and J4 divided by distance between J4 and Z3.

2. Collected August 31, 1959.

In order to rule out effects of time of year and of differences between samples taken from different parts of the plot an analysis of variance was performed on the series from Patuxent Refuge, Maryland. The results of the analysis were unexpected. The effect of time of years was significant at the 5 % level for length of the anterior dorsal shield, for the distance J₃-J₄ and for the lengths of setae J₃, Z₅ and S₅. In the case of seta J₄ and the distance J₃'-J₃ p was between .05 and .10. In no case was there a significant effect due to samples.

It appeared from inspection of the data that specimens collected from August through early May were relatively uniform in regards to the characters studied. However, mites collected in late May and in June appeared to be larger and had longer setae than those collected at other times of the year. 25 females collected May 28, 1960 and 25 females collected Aug. 16, 1960 were then measured and compared (table 1). For each of the characters studied the difference between the means of the two samples was at least twice the sum of the standard errors of the means. The mean length of setae Z₅ and S₅ in the May 28 sample was even greater than the mean length of these setae in the sample from Winsted, Conn. (collected May 17, 1961). Evidently comparisons of *A. aphidioides* from different geographic areas will be difficult to evaluate until more is known about seasonal variation in the species.

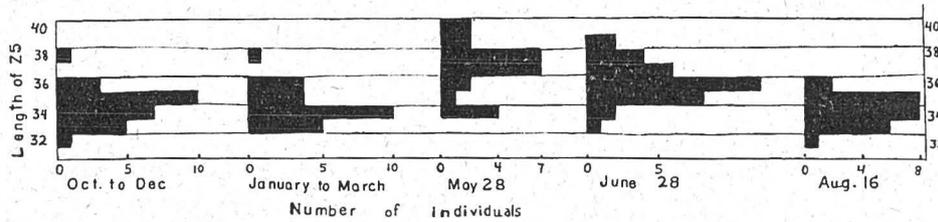


FIG. 9. — Seasonal variation in the length of seta Z₅ in females of *A. aphidioides* collected at Patuxent Refuge, Bowie, Maryland. Length of Z₅ given in ocular micrometer units. One micrometer unit = 1.22 microns.

The length of seta Z₅ in females collected at five different times of the year is shown in figure 9. Seta Z₅ was measured in 68 females collected between Sept. 4, 1959 and May 7, 1960, 25 females taken Aug. 16, 1960 and 16 females collected March 4, 1961. In only three of these mites was Z₅ over 44 μ (= 36 micrometer units) long. Out of 25 mites collected May 28, 1960, on the other hand, 18 had Z₅ over 44 μ long. Specimens with long setae were also collected June 14, 1959, June 13 and 28, 1960 and May 27, 1961.

Length of Z ₅	44 μ or less	over 44 μ
August through early May	114	4
late May and June	42	36

Several explanations of the observed seasonal differences are possible. It seems unlikely that the differences could be due to changes in the length of the

setae during the adult life of the individual mite. None of the setae which were measured appeared to be damaged. Both large and small types included gravid females. There is a slight possibility that two very similar species or clones are involved. However, if this is the case why should long seta forms be common in May and June but virtually absent during the rest of the year? Although extensive collecting of *Asca* at all times of the year has been done, immature stages have been found only from May to October. *A. aphidioides* probably overwinters as an adult. Therefore, it seems likely that forms having short setae can produce forms having long setae and vice versa. The production of the form with long setae might be due to environmental conditions during the growth of the individual mite or it might be related to conditions involving the mother. Unfortunately inability to rear *A. aphidioides* in the laboratory makes it difficult to test these hypotheses.

Distinguishing characteristic : *A. aphidioides* may be recognized by the network-like ornamentation on the dorsal shields.

***Asca garmani* n. sp.**

Holotype female : Anterior dorsal shield $175 \times 180 \mu$, with seventeen pairs of strongly pilose setae. Seta *il* curved, 17μ long. Seta *s7* 19μ , *z3* 21μ long, distance between *s7* and *z3* 21μ . Peritrematal shield joined to anterior dorsal shield just anterior to *r2*. Seta *r4* situated on membrane adjacent to dorsal shield. Ornamentation as in fig. 5. Posterior dorsal shield 150μ long. Anterolateral portion of shield with grooves, region between J series of setae without ornamentation. Several minute protuberances extend between *J4* and *Z3*. Seta *J2* 22μ long, distance from base of *J2* to base of *J3* 28μ . *J3* 28μ long, distance from base of *J3* to base of *J4* 31μ . *J4* 39μ long, not extending to *PJ5*. *J1*, *J2*, *J3*, *J4*, *Z1*, *Z2*, *S1* and *S2* are strongly pilose, *S3* and *Z3* slightly pilose. *S4* simple, 30μ long. *Z5* simple, not swollen, 44μ long. *J5* and *Z4* minute (under 2μ). The posterior tubercle appears to bear a single, strongly pilose seta. This seta is designated as *S5* and is 32μ long.

Jugularia (fig. 8) with four transverse grooves. Seta *vi* hairlike, 22μ long. Sternal shield 55μ long along midline. Distances between setae are as follows : *vi-vi* 37μ , *v2-v2* 45μ , *v3-v3* 45μ , *vi-v2* 30μ , *v2-v3* 27μ . Genital plate with conspicuous groove. Outer metapodal plate cigar shaped. Width of ventrianal shield at level of *Vx* 200μ . *V6-V6* 83μ , *da* 57μ .

Tectum (fig. 4) with three tines, middle tine trifid, lateral tines jagged.

The description of the chelicerae is based upon a specimen from Bowie, Md. (fig. 42). Moveable digit 30μ long, with two teeth. Distance from tip of moveable digit to more distal tooth 6μ , distance from latter tooth to proximal tooth 5μ . Fixed digit with two large teeth proximal to pilus dentilis. Each of these teeth is opposite a tooth on the moveable digit. One large tooth and three small teeth

situated between pilus dentilis and tip of fixed chela. Distance from tip of fixed digit to tooth immediately proximal to pilus dentilis $8\ \mu$, distance from latter tooth to proximal tooth $4\ \mu$. Total length of penultimate segment of chelicerae along dorsal border $78\ \mu$.

The number of setae on the coxa, trochanter, femur, genu and tibia is for leg II 2, 4, 11 (including a short spurlike seta on the basifemur), 11 (including a spurlike seta on the anterior surface) and 10; leg III 2, 4, 6, 8 and 8; leg IV 1, 4, 6, 9 and 9. Leg IV (fig. 7), including coxa but not pretarsus, $240\ \mu$ long in the holotype, 210 - $230\ \mu$ long in specimens from Maryland. Tarsus IV $70\ \mu$ long.

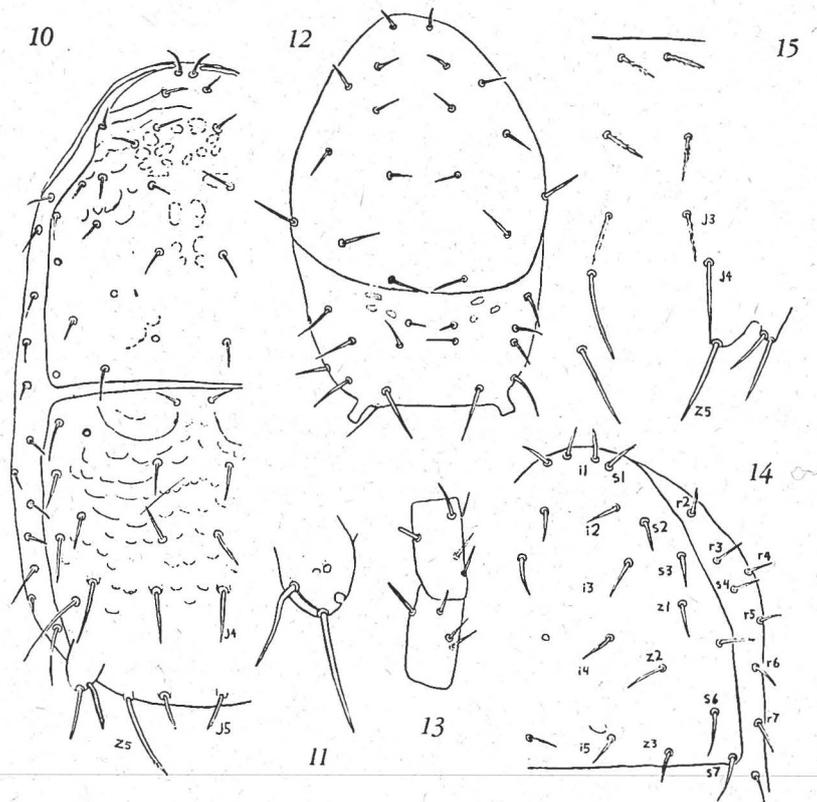


FIG. 10. — *A. duosetosa*, holotype ♀, dorsal view; FIG. 11. — *A. duosetosa*, posterior tubercle; FIG. 12-13. — *A. aphidioides*, reared larva. 12. dorsal view, 13. palp femur and genu; FIG. 14. — *Asca* ?*aphidioides* deutonymph, anterior dorsal shield; FIG. 15. — *A. elongata*, type ♀, posterior dorsal shield (drawn by Fausta-Pegazzano).

Distribution and biology : The holotype female was collected from sod from Houston's apple orchard, Route 44A, Storrs, Connecticut, June 24, 1956. Six females from same locality as holotype, summer of 1956 and April 1, 1961. *Asca garmani* was also collected from the following localities. The number of females examined is given in parentheses. Sod from abandoned orchard, Somers, Conn.

(6) ; orchard sod, Middletown, Conn. (2) ; deciduous litter, Gales Ferry, Conn. (4) ; beech mor (6), *Tsuga mor* (2), Morgan Arboretum, Ste. Anne de Bellevue, Quebec by V. MARSHALL ; deciduous litter, ten miles east of Elkins, Randolph Co., W. Va. by E. MACLEOD (3) ; nests of *Peromyscus maniculatus*, Patuxent Refuge, Md. by R. DRUMMOND (11) ; deciduous litter, numerous localities in Maryland and western Virginia ; Heintooga Overlook, Smoky Mt. Natl. Park, N. C. by T. SAVAGE (1) ; deciduous litter, Athens, Georgia by P. HUNTER (6) ; litter, Crescent City, Fla. (MCZ) (1) ; mixed hardwood, Moss Bluff, Fla. by M. MUMA and H. GREENE (1). Additional material was collected by Dr. M. MUMA and associates from citrus litter from the following localities in Florida : Weirsdale, Minneola, Lake Alfred, Winter Haven, Malabar and Fort Pierce.

Ex moss, Jefferson Co., Missouri by T. ATYEO (1) ; pine duff, Catalina Mts., Pima Co., Ariz. by C. O'BRIEN (2) ; in Narcissus bulb, Mexico D. F. by D. JOHNSTON (1) ; South Bimini, Bahama Is. by CAZIER and VAURIE (2) ; Vilckes Cave, Soledad, Cienfuegos, Cuba by BATES and FAIRCHILD (1) ; moss from tree trunks, Mt. Britton (2 300 feet), Puerto Rico by A. GURNEY (2) ; leaf mold, Coto, Costa Rica by E. DIXON (1) ; rotting wood, near Colon, Panama by F. GRANDJEAN (2) ; on Portuguese cypress, Hilo, Hawaii by W. BOYLE (4) ; banana litter, Waimea, Oahu by F. H. HARAMOTO (1) ; sugar cane litter, Punaluu, Oahu by HARAMOTO (1).

Thus far *A. garmani* has been collected from Quebec to Panama and from Puerto Rico to Hawaii. It has not yet been reported from Europe.

In a study plot at Patuxent Wildlife Refuge *A. garmani* was found in 93 out of 119 samples. It was present in $83/119 = .697$ of the L&F subsamples and in $32/117 = .274$ of the H-layer subsamples. From April through October 211 (95 %) of the females collected were from the L&F layer. During the winter months, however, the number of individuals occurring in the H-layer usually exceeded the number found in the L&F layer.

TABLE 2. — Comparison of *Asca aphidioides* and *A. garmani* from Patuxent Refuge, Maryland.

Species	A. D. S.	Setal lengths				Distances			
	L	J ₃	J ₄	Z ₅	S ₅	J ₃ -J ₄	J ₃ -J ₃	ratio ¹	
aphidioides (N = 80)	\bar{X}	152	28.3	41.1	42.7	30.5	29.1	29.8	.68
	S. E.	0.5	0.2	0.2	0.2	0.3	0.2	0.2	.01
garmani (N = 40)	\bar{X}	154	24.8	36.9	41.2	30.4	29.7	28.8	.80
	S. E.	0.7	0.3	0.4	0.3	0.2	0.3	0.3	.01

1. Distance between J₄ and J₄ divided by distance between J₄ and Z₃.

The average number of females per sample was 3.78 with a variance of 18. Half of the samples had three or more *A. garmani* per sample. Each sample had an area of about 200 cm².

Gravid females were found from late March until October in Maryland. They seemed to be most numerous in April and May. A mite in which the adult exoskeleton was visible underneath that of the deutonymph was collected September 2, 1960. Unfortunately the deutonymph of *A. garmani* cannot be differentiated from that of *A. aphidioides*. The ornamentation of the latter appears only in the adult stage. Males of *A. garmani* have never been found.

On two occasions females of *A. garmani* were observed feeding on small *Colembola* (probably isotomids).

Variation : In order to find out if individuals from northern localities were larger and had longer setae than those from southern United States series of *A. garmani* from Quebec, Connecticut, Maryland, Georgia and Florida were measured. The length of the anterior dorsal shield was greatest (157-175 μ) in specimens collected from Somers and Storrs in northeastern Connecticut. The smallest individuals were from Florida (140-152 μ) and Bimini, Bahamas. Mites from central and southern Maryland were intermediate in size (146-166 μ). However, eight mites from Morgan Arboretum, Ste. Anne de Bellevue, Quebec were most similar to the Maryland samples while the mean length of the anterior dorsal shield in five females from Athens, Ga. was greater than in either the Maryland or Quebec series. In most instances setal length was positively correlated with length of the anterior dorsal shield. It is hoped that it will be possible to present more information on geographic and seasonal variation in *A. garmani* in a future paper.

Distinguishing characteristics : *Asca garmani* is very similar to *A. aphidioides*. In both species the posterior tubercle appears to bear only a single seta. This seta (S5) is pinnate. The other seta arising from the tubercle is minute and difficult to see. In both *A. garmani* and *A. aphidioides* the setae on the anterior 3/4 of the idiosoma, including seta J4, are strongly pilose. The tectum is three-tined, the distance from J4 to J4 is less than the distance from Z3 to J4, the genital shield bears a conspicuous groove and the metapodal plates are cigar shaped.

Although one or more rows of minute protuberances are located adjacent to J4 in *A. garmani* the protuberances or "Punkte" do not form a polygonal network as in *A. aphidioides*. There is no ornamentation in the region between J2 and J2 in *A. garmani*. Usually the tectal tines of *A. garmani* are forked distally and frayed laterally whereas those of *A. aphidioides* are simple. However, this character is subject to some geographic variation. Quantitative differences also exist (see table 2), but these cannot be used to separate all individuals. There are differences in the chelicerae (figs. 41, 42) and these differences may be what enables the two forms to coexist over much of their geographic range.

Asca bicornis Canestrini & Fanzago.

Gamasus (Seius) bicornis CANESTRINI e FANZAGO, 1876, *Atti Soc. Ven.-Trent.* 5 : 103.

In the original description CANESTRINI and FANZAGO state, " Al margine posteriore dell'addome, verso di lati, trovansi due prominenze, o corna, cilindriche che portano all'apice due setole semplici ed acute, dirette in dietro ed in dentro. " An examination of *Asca* collected in soil from apple orchards in United States revealed the presence of two closely related forms fitting existing descriptions of *A. bicornis*. This species was not treated by VALLE (1955) in his revision of the Acaroteca of CANESTRINI, and I have not been able to determine whether type material is still in existence. Dr. LOMBARDINI has examined three of BERLESE's slides of " *bicornis* " but these have only one long seta on the posterior tubercle and are apparently *A. aphidioides* (L.). In the USNM collection at Washington, however, there is a slide of *Zercon bicornis* C. et F., collezione Berlese, nel musca Veneto. This specimen is in good condition and appears identical to one of the species which occurs in orchard sod in United States (see table 3). The other species from United States is very similar to specimens identified as *Asca bicornis* from England, Czechoslovakia and Switzerland and loaned to me by Dr. EVANS, Dr. HALASKOVA and Dr. SCHWEIZER respectively. The type locality of *A. bicornis* (C. & F.) is Trentino, Italy which is about midway between Switzerland and Veneto. Since it is not yet known if *A. bicornis* sensu SCHWEIZER and HALASKOVA occurs in Italy, the name *Asca nova* has been resurrected for this form, while the species from Veneto, Italy is treated as *A. nesoica*.

Asca nova Willmann.

Asca nova WILLMANN, 1939, *Zool. Anz.* 125 : 246-48.

Ceratozercon bicornis HALBERT, 1923, *J. Linn. Soc. London Zool.* 35 : 375-76.

Asca bicornis SCHWEIZER, 1948, *Ergebn. Wiss. Untersuch. Schweiz, Nationalparks* Heft. 20, Bd. 2 : 27-28.

Asca bicornis WILLMANN, 1949 (*A. nova* a synonym), *Veroffentl. aus dem Mus. fur Natur-, Volker- und Handelskunde in Bremen.* Reihe A, Heft 1 : 112.

Asca bicornis WILLMANN, 1952, *Veroffentl. Inst. Meersforschung Bremerhaven*, 1 : 145.

Asca bicornis HALASKOVA, 1959, *Acta Univ. Carolinae- Biologica* 1 : 17-21.

Asca nova was originally described from material collected by FRENZEL from soil in a meadow near Breslau in what is now Poland. Dr. SELLNICK has informed me that most of WILLMANN's prewar collection was ruined during World War II so that the type of *A. nova* is probably nonexistent. I have examined material collected by Dr. HALASKOVA from Czechoslovakia. This material agrees with WILLMANN's description and figure of *A. nova* and also agrees with specimens collected in England and United States. *A. bicornis* from Scans, Switzerland

(SCHWEIZER, 1948) is also similar except that J₃ is unusually long in the specimen from Switzerland. In 1949 WILLMANN made *A. nova* a synonym of *A. bicornis* (Can. & Fan.) 1876. However, since it has not yet been shown that the form from central Europe occurs in the type locality of *A. bicornis* it seems preferable to use the name *A. nova* for these specimens.

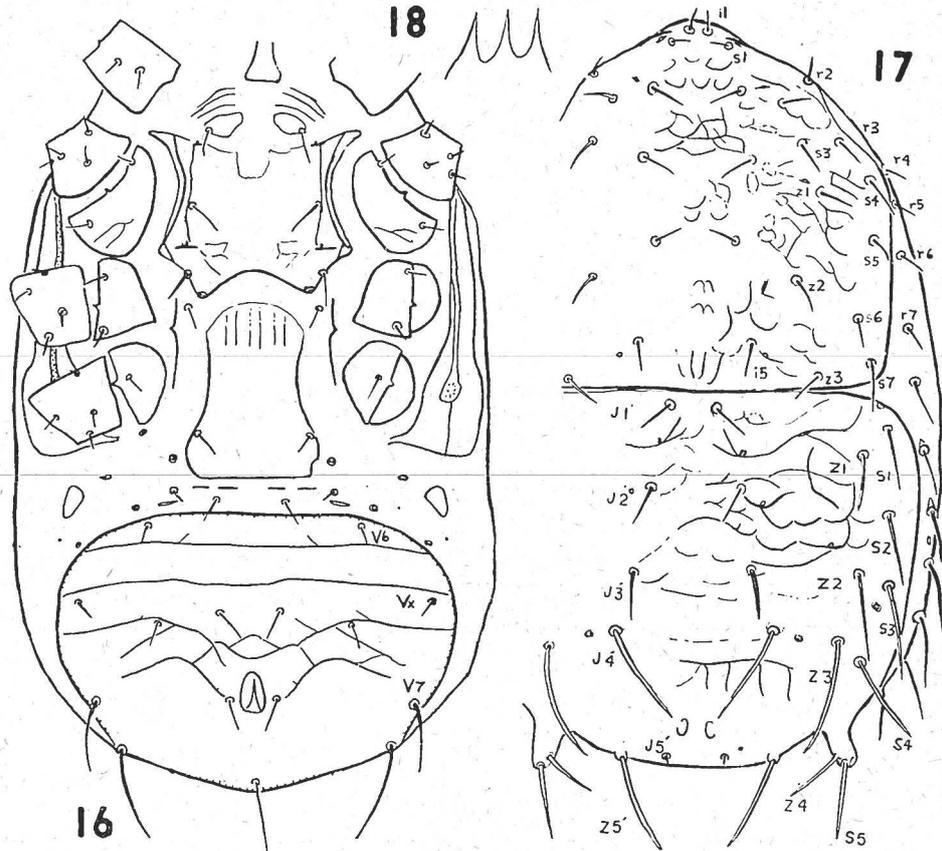


FIG. 16-18. — *Asca nova* (= *A. bicornis* sensu Halaskova), ♀ from Somers, Connecticut. 16. ventral; 17. dorsal; 18. tectum.

The length of the anterior dorsal shield plus the posterior dorsal shield varies from 345 to 380 μ in specimens from Connecticut. Ranges of other characters are given in table 3. Figs. 16-18 are of a specimen collected from orchard sod in Somers, Conn. The moveable chela (fig. 47) is 25 μ long and bears two teeth. Distance from tip of moveable digit to more distal tooth 4 μ , distance from latter tooth to proximal tooth of moveable digit 3 μ .

Material examined : In addition to the specimens from Europe I have examined several specimens collected during 1956 from sod from apple orchards located

near Somers, Conn., Storrs, Conn. (Houston's orchard) and South Windsor, Conn.

The male has not been collected in Connecticut but was described by HALASKOVA (1959).

Distinguishing characteristics : The intersocketal distance J₄-J₄ is 2-3 1/2 times as great as the distance J₄-Z₃. The dorsal setae are not pilose.

TABLE 3. — *Asca nova* and *A. nesoica* from North America and Europe.

Species	<i>Asca nova</i>				<i>Asca nesoica</i>			
	Conn- eticut	Eng- land	Czecho- slovakia	Switz- erland	Italy	Berlin	U.S.A.	Spain
ADS, length	165-180	180	177-183	186	180	170-177	150-180	174
ADS, width	177-200		189-200	200	186	177-180	165-190	
s7-z3	19-26	22	22-24	27	24		22-28	
s7	24-25	26	25-26	26	24		22-25	
J3	19-26	22	24-27	35	29	29-31	27-32	
J4	40-48	45	43-45	49	45	45-50	43-49	
Z5	45-55	51	49-51	54	49	49-52	45-51	56
S4	41-47	43	41-45	41	40	38-41	38-41	
S5	35-39		37-40	38	34	33-40	30-35	
J3-J3	37-49		42-57	46	42	39-46	38-51	
J4-Z3	22-31	24	24-28	24	20	16-20	14-21	
ratio ¹	2.2-3.4	3.3	2.4-3.1	3.3	3.8	3.8-5.0	3.6-5.3	
vi-v3	61-68	65	62-67	68		61-63	57-66	60
da ²	72-81		73-77	72		59-65	61-70	67
iva ³	190-210		200-208	200		172-186	168-197	191

Asca nesoica Athias-Henriot.

Asca nesoica ATHIAS-HENRIOT, 1961, *Acarologia* 3 : 463-466.

A. nesoica was originally described from a single female collected under *Ulex europaeus* on an island off the western coast of Spain. I have not seen the holotype but have examined specimens from United States and Europe which I consider to be conspecific with *A. nesoica* because of similarities in the shape of the sternal shield, in the arrangement of setae on the posterior dorsal shield and in the ornamentation of the dorsal shields. The type of *A. nesoica* reportedly has only five pairs of preanal setae instead of the six pairs found in other species of the

1. Intersocketal distance J₄-J₄ divided by distance between J₄ and Z₃.

2. Distance from anterior edge of anal opening to anterior edge of ventrianal shield.

3. Maximum width of ventrianal shield.

genus. Most of the *A. nesoica* which I have examined have six pairs of preanal setae on the ventrianal shield, seta Vx being situated near the lateral margin of the shield. However, in one specimen from Berlin and in one mite from Tolland, Conn. Vx is missing on one side but present on the other side. In another individual from Tolland seta Vx is entirely absent. Evidently the presence or absence of Vx is variable in *A. nesoica*. Seta Z5 appears to be longer in the type than in specimens which I have examined.

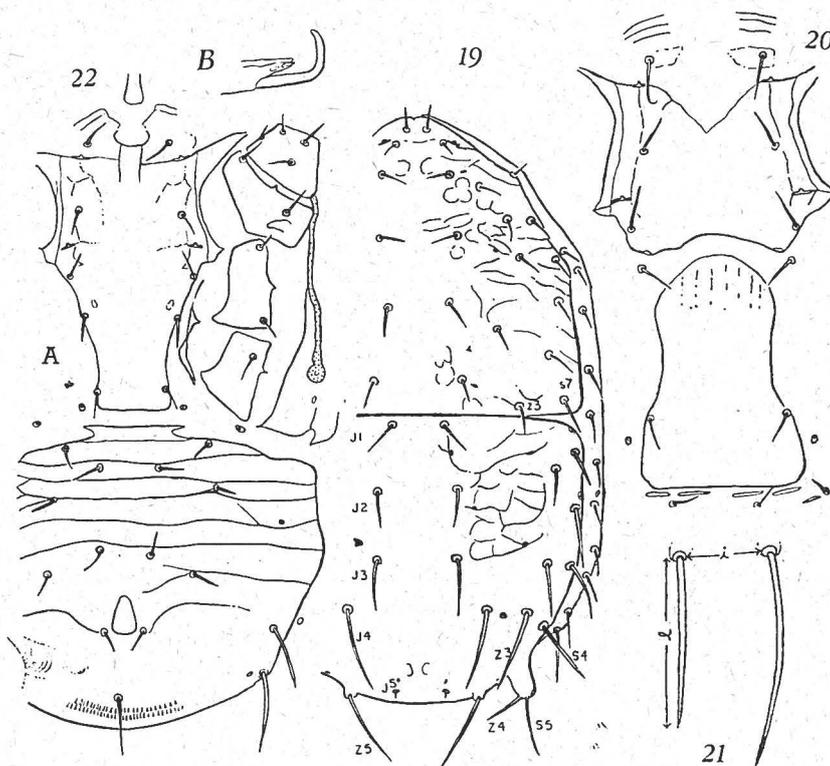


FIG. 19-21. — *A. nesoica*, ♀ from Storrs, Connecticut. 19. dorsal, 20. ventral, 21. inter-socketal distance, *i*, and length of seta, *r*. FIG. 22. — *A. nesoica*, ♂ from Frederick, Maryland. A. ventral, B. spermatophoretrager.

The length of the anterior dorsal shield plus the posterior dorsal shield varies from 325-350 μ in specimens from Storrs, Connecticut. Ranges of other characters are given in table 3. The female illustrated in figs. 19-20 was collected from sod from an apple orchard west of the University of Connecticut football stadium. Males were collected in Maryland but not in Connecticut.

The chelicerae (fig. 48) are very similar to those of *Asca nova*. There are only two teeth proximal to the pilus dentilis. The total length of the penultimate segment of the chelicerae is 80 μ .

Male : Anterior dorsal shield $145 \times 150 \mu$, joined to peritrematal shield just posterior to r5. Setae r5 and r4 arise from the shield whereas r6 and r7 are situated on the membrane. Distance from J4 to J4 59μ , 3.6 times J4-Z3. J4 37μ , Z5 39μ , S5 30μ long. Da 73μ . Spermatophorentrager strongly bent. A male from Maryland is shown in fig. 22.

Material examined : One female from moss, Veneto, Italy (USNM) ; ex moss on soil in forest, Berlin by W. KNÜLLE (4) ; orchard sod, Tolland, Conn. (5) ; sod, University apple orchard, Storrs, Conn. (6) ; orchard sod, Hamden, Conn. (2) ; same locality, swept from grass by P. GARMAN (3) ; apple orchard soil, Kearneysville, W. Va. by D. CLANCY (7) ; sod, apple orchard overgrown with poison ivy, Butterfly Lane, Frederick, Md. (40 females, 4 males) ; orchard soil, Mt. Hood, Hood River Co., Oregon (3).

Variation : Seta S5 was longer in specimens from Berlin than in those from United States. *A. nesoica* from Tolland and Storrs in northeastern Connecticut had longer anterior dorsal shields than *A. nesoica* from Hamden, Conn., West Virginia or Maryland. Specimens from Tolland, Conn. had longer setae than specimens from other localities. One of the specimens from Maryland had J4 missing on one side while another individual lacked s7 on both sides.

Distinguishing characteristics : Although *A. nesoica* is very similar to *A. nova* several differences between the species have been found. *A. nesoica* has a V-shaped notch in the anterior edge of the sternal shield, whereas *A. nova* has a U-shaped notch. The distance J4-J4 is over $3 \frac{1}{2}$ times as great as the distance J4-Z3 in *A. nesoica*. In all other North American species of *Asca* this ratio is under 3.4. Other differences are indicated in table 3.

Both *A. nesoica* and *A. nova* occurred in Connecticut but the two species were never collected from the same orchard.

Asca duosetosa Fox.

Asca duosetosa Fox, 1946, *Proc. Biol. Soc. Wash.* 59 : 174.

Holotype female : Anterior dorsal shield $190 \times 165 \mu$, with seventeen pairs of simple setae arranged as in fig. 10. Seta il 13μ , s7 18μ , z3 17μ long. Distance between s7 and z3 23μ . Posterior dorsal shield 195μ long, with numerous ripple like ornamentations. Distance J1-J1 15μ , J2-J2 36μ .

Jugularia faint. Posterior edge of sternum concave. Distances between sternal setae are as follows : v1-v1 37μ , v2-v2 43μ , v3-v3 54μ , v1-v2 36μ , v2-v3 30μ . Ventrianal shield with the usual six pairs of setae besides the perianals. Postanal seta 29μ long. Metapodals nearly circular in outline.

The tectum bears three simple tines.

The posterior tubercle of a female collected from Puerto Rico in 1954 is illustrated in fig. 11.

Male : Anterior dorsal shield $155 \times 140 \mu$, joined to peritrematal shield anterior to r2. Setae r4, r5, r6 and r7 arise from the membrane. Posterior dorsal shield 140μ long. J4 22μ , J5 9μ , Z5 30μ , S5 25μ long. Distance from J4 to J4 equal to distance J4-Z3. Da 67μ .

Material examined : Holotype female ex *Rattus norvegicus*, Santurce, Puerto Rico, September 17, 1946 by I. FOX (specimen in the San Juan School of Tropical Medicine collection). One female with same data as holotype but collected in 1954. One male in *Bufo marinus* alimentary tract, Rio Piedras, Puerto Rico by G. WOLCOTT. One female exposed by plane, Tampa, Florida, 1940 by O. DURHAM. Numerous adults of *A. duosetosa* were collected by Dr. MUMA and associates from citrus litter from the following localities in Florida : Weirsdale, Minneola, Kissimmee, Malabar, Winter Haven, Sebring, Turnbull Hammock, Arcadia and Cleveland.

Measurements :

Locality.....	L	J3	J4	J5	S5	Z5	J4-J4	J4-Z3
Holotype	190	17	26	17	—	35	34	34
Puerto Rico, 1954.	195	21	30	18	30	41	42	38
Tampa, Fla.....	190	18	28	16	26	37	40	35
Winter Haven (\bar{X})	185	19.8	28.3	17.3	29.7	38.6	37.7	36.1
(N = 9) S. E.	1	0.5	0.6	0.6	0.5	1.4	1.2	0.7

Distinguishing characteristic : *A. duosetosa* may be recognized by the relatively great length of J5 which is at least half as long as seta S5.

Asca elongata (Berlese).

Ceratozercon bicornis var. *elongatus* BERLESE, 1910, *Redia* 6 : 246.

According to BERLESE this mite, described from moss from Lake City, Florida, is 340μ long. Dr. FAUSTA-PEGAZZANO has supplied me with camera lucida drawings of the type specimen (no. 85/6 in the Berlese collection). A copy of one of these drawings is shown (fig. 15). According to Dr. FAUSTA-PEGAZZANO the seta designated in this paper as r4 is located on the dorsal shield. Setae z3 and s7 are pilose and approximately equal in length to each other. The distance z3-s7 is about equal to the length of z3. There appears to be no ornamentation between J2 and J2. The ventral surface of the type specimen is apparently difficult to observe. Dr. EVANS and Dr. FAUSTA-PEGAZZANO have sent me drawings indicating that the posterior margin of the sternal shield is strongly convex, but Mr. D. JOHNSTON believes that it is concave.

Asca brachychaeta n. sp.

Holotype female : Anterior dorsal shield $175 \times 155 \mu$, with eighteen pairs of pilose setae (fig. 23). Seta *il* curved, about 16μ long, *s7* 22μ long, *z3* 20μ long. Distance from *s7* to *z3* only 13μ . Seta *r4* on the shield, setae *r5*, *r6* and *r7* on the membranous margin adjacent to the shield. Posterior dorsal shield about 180μ long, setae on anterior portion distinctly pilose, more posterior setae only slightly pilose. Ornamentation present on anterolateral portion of shield, weak between J series of setae and absent between *J4* and *J4*. Seta *J2* 22μ long, distance from

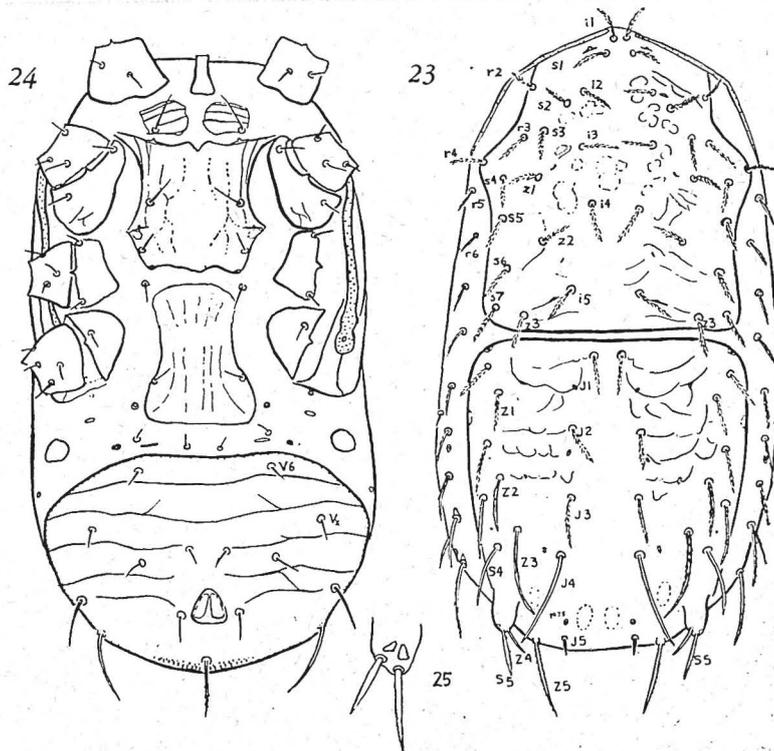


FIG. 23-25. — *A. brachychaeta*, holotype ♀. 23. dorsal, 24. ventral, 25. posterior tubercle.

base of *J2* to base of *J3* 37μ . Seta *J3* 28μ long, distance from base of *J3* to base of *J4* 35μ . *J4* 54μ long, extending past the base of *J5*. *J5* 7μ , *Z4* 18μ , *Z5* 38μ , *S5* 26μ long. *S5* and *Z5* slightly pilose. Intersocketal distances are as follows : *J1-J1* 13μ , *J2-J2* 36μ , *J3-J3* 34μ , *J4-J4* about 38μ , *Z3-J4* 26μ .

Jugularia ovoid, with three transverse grooves. Anterior edge of sternal shield with small notch, posterior edge irregular. Distance from notch to middle of pos-

terior edge of shield 67μ . Distances between setae are as follows : v_1-v_1 43μ , v_2-v_2 46μ , v_3-v_3 55μ , v_1-v_2 37μ , v_2-v_3 27μ . Genital shield with faint vertical grooves. Distance from anterior edge of anus to anterior edge of ventrianal shield 79μ .

The following description of the chelicerae is based on a specimen from Bowie, Maryland. Moveable chela 27μ long, with two teeth. Distance from tip of moveable digit to more distal tooth $4 \frac{1}{2} \mu$, distance from latter tooth to proximal tooth of moveable digit about 3μ . Fixed digit (fig. 44) with seven teeth, three of which are proximal to the pilus dentilis. Subapical tooth somewhat larger than adjacent teeth. The two proximal teeth are separated by a slight gap from the more distal teeth. Distance from tip of fixed digit to tooth immediately proximal to pilus dentilis 6μ . Total length of penultimate segment of chelicerae along dorsal border 78μ .

The anterior margin of the tectum is serrate.

Male : Anterior dorsal shield $145 \times 140 \mu$, joined to peritrematal shield just anterior to r_6 . Setae r_5 and r_4 arise from the shield whereas r_6 and r_7 are situated on the membrane. Posterior dorsal shield 130μ long, similar to female. J_4 39μ , Z_5 32μ , S_5 22μ long. Distance from anterior edge of anus to anterior edge of ventrianal shield 73μ . Spermatophoral process slightly curved, 14μ long.

The above description is based on a male from the type locality, Somers, Connecticut.

Deutonymph : A series of *A. brachychaeta* collected from pitcher plants from Polk City, Florida included deutonymphs and protonymphs. The anterior dorsal shield of the deutonymph is 135μ long and differs from that of the female in that setae r_2 , r_3 , r_4 , and s_4 are on the membrane adjacent to the shield. Posterior dorsal shield 110μ long, J_4 29μ , Z_5 27μ , S_5 21μ long. V_6 not on ventrianal shield.

Material examined : Holotype female taken by the author from sod from a neglected apple orchard located on the south side of Mountainview Road, one mile east of Route 83, Somers, Connecticut, June 23, 1956. Nine females, three males collected at various times between April and September, 1956 from the same locality as the holotype ; sod from Houston's apple orchard, Storrs, Conn. (5) ; field, Ithaca, N. Y. by E. MENHINICK (1) ; ex alfalfa stem, Champaign, Ill. ; ex grass, Lafayette, Ind. ; nests of *Peromyscus leucopus* (8), rabbit hutch (1), Patuxent Wildlife Refuge, Bowie, Md. by CROSS and DRUMMOND ; rat-run grass, Durham, N. C. ; on *Sarracenia*, 5 S. Groveland, Fla. by H. GREENE and M. MUMA (4) ; pitcher plants, Polk City, Fla. by J. MURRELL seven females, two deutonymphs and two protonymphs.

Distinguishing characteristics : *A. brachychaeta* is very similar to *A. elongata* (Berlese). In both species r_4 is situated on the dorsal shield, J_3 is slightly pilose and extends to the base of J_4 , and J_4 is simple and extends slightly past the base

of Z5. Setae z3 and s7 appear to be somewhat closer together than in *A. elongata*. The sinuate posterior margin of the sternal shield serves to differentiate *A. brachychaeta* from most other members of the genus. The nature of the sternal shield in *A. elongata* is uncertain.

TABLE 4. — Variation in *Asca brachychaeta*. Measurements given in microns.

Locality	A. D. S.	Length of setae					Distance between setae				
		L	s7	J3	J4	S5	Z5	J3-J4	J3-J3	J4-J4	J4-Z3
Somers, Conn. (N = 10)	\bar{X}	163	20.1	24.8	46.0	24.3	36.4	29.6	31.4	38.9	23.2
	S. E.	2	0.4	0.5	0.3	0.2	00.5	1.0	0.8	0.4	0.4
Storrs, Conn.		155	21	25	46	25	36	27	28	38	23
Ithaca, N. Y.		163	21	25	42	25	34	28	31	38	24
Champaign, Ill.		163	21	28	51	27	40	28	29	38	22
Bowie, Md.	N	8	9	7	8	8	8	8	7	9	9
	\bar{X}	162	19.9	23.7	47.0	25.5	36.8	27.0	34.0	36.9	22.9
	S. E.	2	0.5	0.6	0.4	0.4	0.4	0.8	0.7	0.8	0.6
Durham, N. C.		145	18	23	41	23	34	28	29	34	20
Groveland, Fla.		145	18	24	44	24	34	24	26	31	22
		149	20	24	44	23	34	27	27	35	22
		152	19	24	42	23	35	27	32	34	24
Polk City Fla. (N = 7)	\bar{X}	146	18.8	23.2	41.1	23.9	34.2	25.3	28.4	35.4	21.4
	S. E.	1	0.4	0.5	0.6	0.6	0.6	0.6	0.6	0.6	0.4

As in *A. garmani* individuals from Florida are smaller and have shorter setae than those from further north (table 4).

Asca citri n. sp.

Holotype female: Anterior dorsal shield $150 \times 150 \mu$, with eighteen pairs of distinctly pilose setae. Seta i1 15μ long, s7 18μ long, z3 16μ long. Distance from s7 to z3 only 13μ . Seta r4 situated on the shield. Surface of shield ornamented with numerous oval drumlin-like elevations arranged as fig. 26. Posterior dorsal shield 160μ long, setae on shield and setae on membranous margin adjacent to shield all pilose. Drumlin-like elevations present on anterior half of shield and also between J4 and J4. Distance from base of J2 to base of J3 33μ . Seta J3 curved, not reaching to base of J4. J4 not extending to the base of J5. J5 6μ , Z4 12μ long. S5 and Z5 relatively thick and short, pilose throughout their length. Pores on tubercles with long axes parallel to each other. The intersocketal distance J3-J3 is 20μ . Membranous margin adjacent to posterior dorsal shield with seven pairs of pilose setae.

Jugularia indistinct, ovoid, with three transverse grooves. Anterior edge of sternal shield with only a small notch, posterior edge sinuate, neither convex nor concave. Grooves on sternal and genital plates faint. Ventrianal plate with five transverse grooves and the usual six pairs of preanal setae. Da 64μ .

Moveable digit of chelicerae 27μ long. Proximal tooth on moveable digit 7μ from end of digit. Penultimate segment 73μ long along dorsal margin. Tectum serrate. A chelicera of a specimen from Fort Pierce, Florida is illustrated in fig. 43.

The outline of an egg is visible within the type specimen.

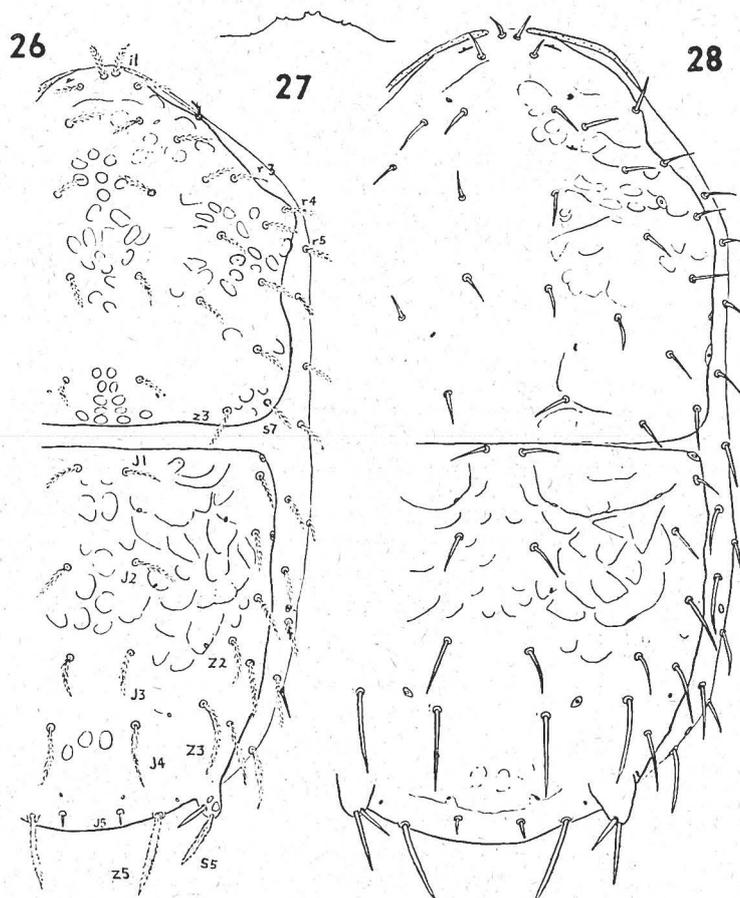


FIG. 26. — *A. citri*, holotype ♀, dorsal.
FIG. 27-28. — *A. pini*, holotype ♀, 27. tectum, 28. dorsal view.

Male: Anterior dorsal shield $125 \times 120 \mu$, joined to peritrematal shield anterior to r6. Setae r5 and r4 arise from the shield whereas r6 and r7 are situated on the membrane. Posterior dorsal shield 115μ long, both shields with numerous oval elevations. J4 25μ , Z5 24μ , S5 20μ long. Da 65μ . Spermatophoral process 14μ long.

Material examined : All of the specimens examined were collected in Florida by Dr. M. MUMA and associates. Holotype female on citrus leaf, 7 ½ N Oviedo, January 16, 1961. One gravid female on saw palmetto, Highlands Hammock State Park, Highlands Co., March, 1962. All other *A. citri* were collected from citrus leaves or fruit. Some of the mites were found under purple scale.

Measurements : The northernmost locality, Deland, is listed first. In one of the specimens from Deland S5 was 32 μ on one side and 24 μ on the opposite side.

Locality.....	L	s7	J3	J4	Z5	S5	J3-J4	J4-J4	J4-Z3
Deland.....	150	18	25	35	32	32	26	30	24
Deland.....	155	18	21	33	30	22	29	32	22
Oviedo (type).....	150	18	21	31	32	23	31	26	24
Oviedo	155	21	22	32	33	23	29	—	22
Parrish	145	17	20	29	28	21	26	25	23
Parrish	155	19	21	31	27	22	26	27	22
Highlands Park.....	155	20	25	35	33	24	29	30	25
Fort Pierce.....	155	18	22	34	28	22	27	—	23

Asea incisa n. sp.

Holotype female : Anterior dorsal shield 163 × 155 μ, with seventeen pairs of pilose setae (fig. 40). Seta ii 16 μ. Seta s7 24 μ, z3 22 μ long, s7-z3 15 μ. Seta r4 on the membranous margin adjacent to the anterior dorsal shield. Posterior dorsal shield 155 μ long, setae on anterior two thirds of shield distinctly pilose, Z5 and S5 also somewhat pilose. Seta J2 24 μ long, distance from base of J2 to base of J3 36 μ. J3 30 μ long, J3-J4 27 μ. J4 curved, extending to base of J5. J5 9 μ. Z4 21 μ long. Pores on tubercles with long axes perpendicular to each other.

Seta vi hairlike, 21 μ long. Anterior edge of sternal plate (fig. 38) with conspicuous indentation. Posterior end of indentation 12 μ from anterior edge of sternal shield, 57 μ from posterior edge of shield. Distances between setae are as follows : v1-v1 40 μ, v2-v2 47 μ, v3-v3 60 μ, v1-v2 35 μ, v2-v3 29 μ. Lateral margin of genital shield convex behind genital setae. Da 63 μ.

Details of the chelicerae could not be seen in the holotype but were examined in a specimen from Arcadia, Florida. In this specimen the moveable chela was 30 μ long and about 12 μ wide. Distance from tip of moveable digit to closest tooth 5 μ, distance from latter tooth to proximal tooth of moveable digit 3 ½ μ. Penultimate segment about 85 μ long. Fixed digit (fig. 37) with four teeth proximal to pilus dentilis. Distal to the pilus dentilis are four very small teeth and a larger subapical tooth. Distance from tip of fixed digit to tooth immediately

proximal to pilus dentilis $7\ \mu$, distance from latter tooth to proximal tooth of fixed digit $4\ \mu$.

Anterior edge of tectum smooth, triangular in outline.

Male : Anterior dorsal shield $140 \times 130\ \mu$. Setae r4, r5, r6 and r7 situated on membrane. Posterior dorsal shield about $115\ \mu$ long, ornamentation similar to that of female. J4 $32\ \mu$, Z5 $28\ \mu$, S5 $23\ \mu$ long. Da $64\ \mu$. Spermatophoral process about $15\ \mu$ long.

Material examined : Holotype female ex citrus fruit, Turnbull Hammock, 5 miles north of Mims, Brevard Co., Florida, May 6, 1960 by J. MURRELL. One male and one female ex bark, Arcadia, Florida, July 19, 1961. A larva is visible within the female from Arcadia.

Distinguishing characteristics : The deep indentation in the anterior margin of the sternal shield distinguishes *Asca incisa* from other species of *Asca* having pilose dorsal setae. The posterior margin of the sternal shield is concave. The tectum (fig. 39) is distinctive.

Asca muma n. sp.

Holotype female : Anterior dorsal shield $160 \times 150\ \mu$, with seventeen pairs of pilose setae (fig. 32). Seta il curved, about $16\ \mu$ long. Seta s7 $20\ \mu$ long, z3 $21\ \mu$ long, s7-z3 only $14\ \mu$. Seta r4 on the membranous margin adjacent to the anterior dorsal shield. Posterior dorsal shield $150\ \mu$ long, setae on anterior portion distinctly pilose, more posterior setae only slightly pilose. Ornamentation present on anterior two-thirds of posterior dorsal shield including region between J2 and J2 and lateral to J3. Long groove behind J1 continuous between po J1 of each side. Seta J2 $20\ \mu$ long, distance from base of J2 to base of J3 $35\ \mu$. Seta J3 $28\ \mu$ long, distance from base of J3 to base of J4 $27\ \mu$. J4 $40\ \mu$ long, extending past the base of J5. J5 $9\ \mu$, Z4 $17\ \mu$, Z5 $34\ \mu$, S5 $25\ \mu$ long. Pores on tubercles with long axes perpendicular to each other. Intersocketal distances are as follows : J1-J1 $14\ \mu$, J2-J2 $22\ \mu$, J3-J3 $28\ \mu$, J4-J4 $29\ \mu$, J4-Z3 $24\ \mu$.

Jugularia (fig. 31) broader medially than laterally. Seta v1 hairlike, $24\ \mu$ long. Anterior edge of sternal plate with five indentations, posterior edge concave. Distances between setae are as follows : v1-v1 $46\ \mu$, v2-v2 $52\ \mu$, v3-v3 $59\ \mu$, v1-v2 $36\ \mu$, v2-v3 $29\ \mu$. Genital shield slightly indented behind genital setae. Da $60\ \mu$.

Details of the chelicerae could not be seen in the holotype but were examined in a specimen from Isle of Pines, Cuba. In this specimen the moveable chela was $31\ \mu$ long, with a maximum width of $13\ \mu$. Distance from tip of moveable digit to closest tooth $5\ \mu$, distance from latter tooth to proximal tooth of moveable digit $4\ \mu$. Penultimate segment $85\ \mu$ long. Fixed digit with four teeth proximal to pilus dentilis. The two most proximal teeth are separated from the other teeth by a gap opposite the proximal tooth of the moveable digit. Distal to the

pilus dentilis are three small teeth and a larger subapical tooth. Distance from tip of fixed digit to tooth immediately proximal to pilus dentilis $7\ \mu$, distance from latter tooth to proximal tooth of fixed digit $6\ \mu$.

Anterior edge of tectum smooth.

The setae and legs of a larva are visible within the holotype female.

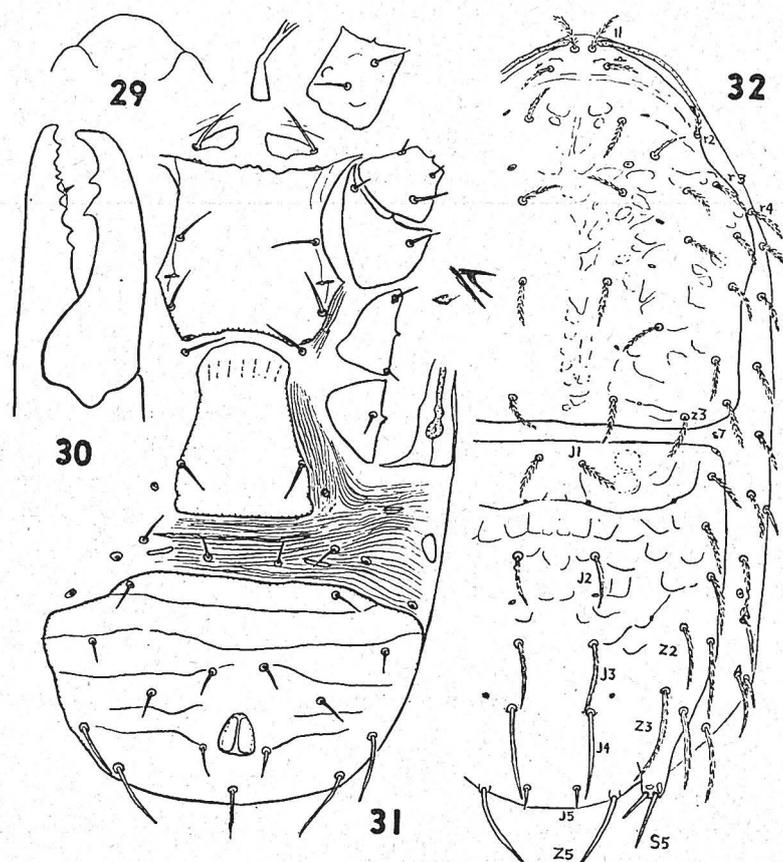


FIG. 29-32. — *A. muma*, holotype ♀. 29. tectum, 30. chelicera, 31. ventral, 32. dorsal view.

Material examined : Holotype female from bark sample (citrus), Avon Park, Florida, January 27, 1960 by H. GREENE. One female on citrus leaf, La Tumbita, Isle of Pines, Cuba by M. MUMA. Two females, two deutonymphs on *Sapodillas*, Cuba at Miami by C. STEGMAIER. Additional specimens were collected by Dr. M. MUMA and associates from citrus from the following localities in Florida : Oklawaha (leaves), Weirsdale (litter), Winter Haven (bark), Clearwater (litter, bark), Sebring (bark) and Fort Pierce.

TABLE 5. — *Asca incisa* and *A. muma* from Florida and Cuba.

Species	Locality	A. D. S.	Lengths of setae			Intersocketal distances		
		L	J3	Z5	S5	J3-J3	J4-J4	ratio ¹
<i>Asca incisa</i>	Turnbull, Fla.	163	30	35	29	24	40	1.57
	Arcadia, Fla.	163	30	35	30	28	40	1.57
<i>Asca muma</i>	Florida Range	150-163	27-31	31-34	23-27	24-29	27-32	1.1-1.4
	(N = 17)	\bar{X} 157	28.3	33.9	25.1	27.1	29.6	1.20
	S. E.	1	0.4	0.3	0.2	0.4	0.4	.02
	Cuba (at Miami)	154	28	34	25	28	30	1.05
	Isle of Pines	160	25	—	27	27	29	1.14

Distinguishing characteristics : The setae on the anterior dorsal shield are pilose, r4 is not on the dorsal shield and the posterior margin of the sternal shield is concave. *A. muma* differs from other species of *Asca* having the above combination of characters in that the distance from J4 to J4 divided by the distance from J4 to Z3 is under 1.4. The rounded and non-serrate tectum (fig. 29) is distinctive. There is usually an indentation in the genital plate. *A. muma* is most similar to *A. incisa* (see table 5).

***Asca neopallida* n. sp.**

Holotype female : Anterior dorsal shield 165 × 170 μ, with seventeen pairs of pilose setae (fig. 33). Seta il curved, about 18 μ long. Seta s7 23 μ long, z3 23 μ long, distance from s7 to z3 22 μ. Seta r4 on the membranous margin adjacent to the anterior dorsal shield. Posterior dorsal shield 165 μ long, ornamentation present on anterolateral portion of shield, weak between J series of setae. Posterior shield with J1, J2, Z1, and S1 pilose, other setae on shield simple. Seta J2 19 μ long, distance from base of J2 to base of J3 38 μ. Seta J3 29 μ long, distance from base of J3 to base of J4 27 μ. J4 about 60 μ long, extending past the base of Z5. J5 5 μ, Z4 24 μ, Z5 45 μ, S5 35 μ long. S5 slightly pilose distally. Posterior tubercle without apparent pores. Intersocketal distances are as follows : J1-J1 20 μ, J2-J2 42 μ, J3-J3 51 μ, J4-J4 62 μ, J4-Z3 24 μ.

Anterior edge of sternal shield with slight indentation, posterior edge concave. Distance from indentation to middle of posterior edge of shield 65 μ. Distances

1. Distance from J4' to J4 divided by distance from J4 to Z3.

between setae are as follows : VI-VI $45\ \mu$, V2-V2 $50\ \mu$, V3-V3 $62\ \mu$, VI-V2 $38\ \mu$, V2-V3 $29\ \mu$. Distance from anterior edge of anus to anterior edge of ventrianal shield $80\ \mu$.

Moveable chela $32\ \mu$ long, $15\ \mu$ wide. Distance from tip of moveable digit to closest tooth $5\ \mu$, distance from latter tooth to proximal tooth of moveable digit $4\ \mu$. Fixed digit (fig. 46) with a total of nine teeth, four of which are proximal to the pilus dentilis. Distance from tip of fixed digit to tooth immediately proximal to pilus dentilis $8\ \mu$, distance from latter tooth to proximal tooth of fixed digit $5\ \frac{1}{2}\ \mu$. Total length of penultimate segment $85\ \mu$.

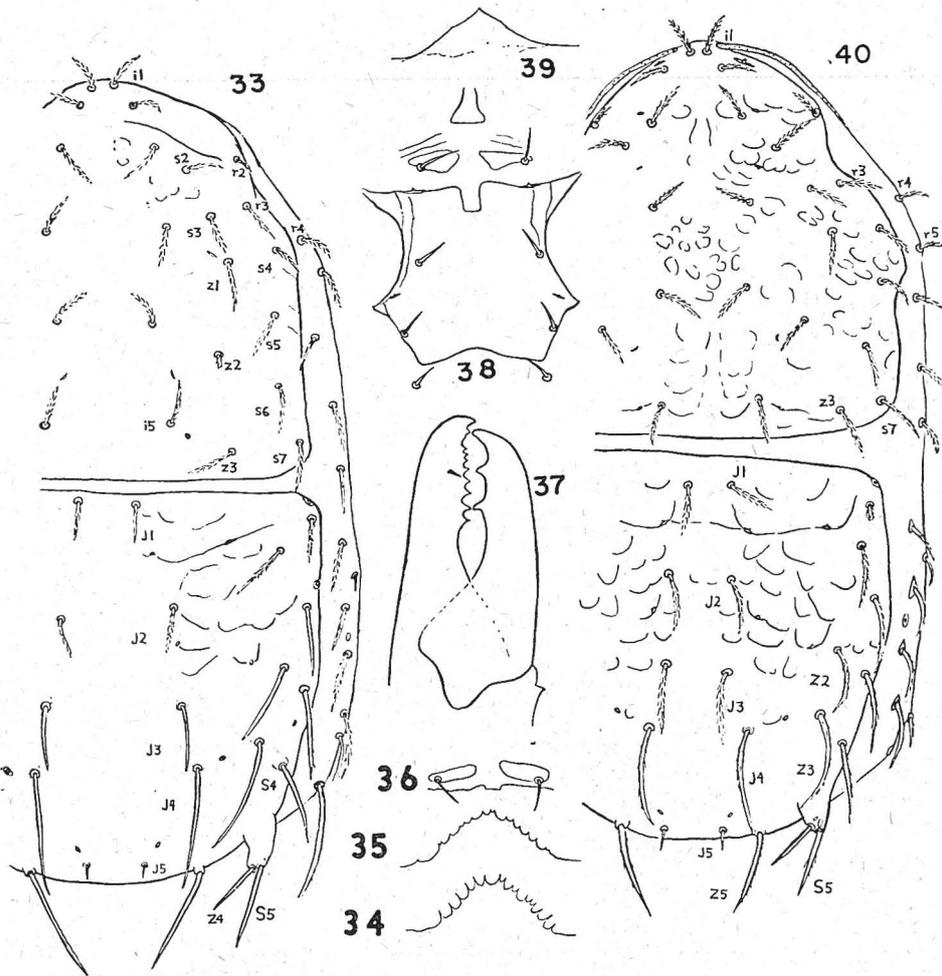


FIG. 33. — *A. neopallida*, holotype ♀, dorsal. FIG. 34. — *A. neopallida*, ♀, tectum. FIG. 35-36. — *A. piloja*; ♀, 35. tectum; 36. jugular shields. FIG. 37-40. — *A. incisa*, holotype ♀; 37. chelicera; 38. sternal shield; 39. tectum; 40. dorsal view.

TABLE 6. — *Asca neopallida* and *A. piloja* from Patuxent Refuge, Maryland.

Species		A.D.S.	Lengths of setae				Intersocketal distances		
		L	s7	J3	Z5	S5	J3-J3	J4-J4	ratio ¹
<i>Asca neopallida</i> (N = 20)	Range	157-170	22-27	28-33	43-49	32-35	46-59	59-71	2.0-2.9
	\bar{X}	164	24.0	30.2	46.4	33.7	53.0	63.6	2.50
	S. E.	1	0.3	0.3	0.3	0.3	0.6	0.6	0.04
<i>Asca piloja</i> (N = 8)	Range	150-162	20-22	23-26	44-46	33-37	35-41	44-51	1.6-2.1
	\bar{X}	156	20.9	25.0	45.3	34.8	38.7	48.4	1.87
	S. E.	1	0.4	0.3	0.4	0.3	1.8	2.5	0.60

Fifteen or sixteen small teeth arise from the anterior edge of the tectum (see fig. 34).

Male : Anterior dorsal shield $150 \times 135 \mu$, joined to peritrematal shield just anterior to r2. Setae r4, r5, r6 and r7 arise from the membrane. Posterior dorsal shield about 140μ long. J4 46μ , Z5 37μ , S5 32μ long. Distance from J4-J4 $2 \frac{1}{2}$ times distance from J4-Z3. Da 77μ . Spermatophoral process thick, curved, 17μ long.

Distribution : The holotype female was collected from deciduous litter at Patuxent Wildlife Research Refuge near Bowie, Maryland on June 13, 1960. In a study plot at Patuxent Refuge *A. neopallida* was found in $35/119 = .294$ samples. 70 out of the 74 specimens taken from these samples were from the L & F layer. In the spring and summer males and gravid females were occasionally collected. During the fall and winter only non-gravid females were found. *A. neopallida* has also been collected from deciduous litter in Frederick, Howard, Prince Georges and Talbot counties in Maryland and Culpepper Co., Va.

Distinguishing characteristics : The following combination of characters differentiates *A. neopallida* from other species of *Asca*. There are seventeen pairs of pilose setae on the anterior dorsal shield, J3 is simple and the distance from J4 to J4 is at least twice the intersocketal distance J4 to Z3.

***Asca piloja* n. sp.**

Holotype female : Anterior dorsal shield $150 \times 145 \mu$, with seventeen pairs of pilose setae. Seta il curved, about 17μ long. Setae s7 and z3 each 21μ long.

1. Distance from J4' to J4 divided by distance from J4 to Z3.

s7-23 18μ . Seta r4 on the membranous margin adjacent to the anterior dorsal shield. Posterior dorsal shield 145μ long, ornamentation similar to that of *A. neopallida*. J1, J2, J3, Z1, S1 strongly pilose, other setae on shield slightly pilose. Seta J2 15μ long, distance from base of J2 to base of J3 23μ . J3 24μ long, dis-

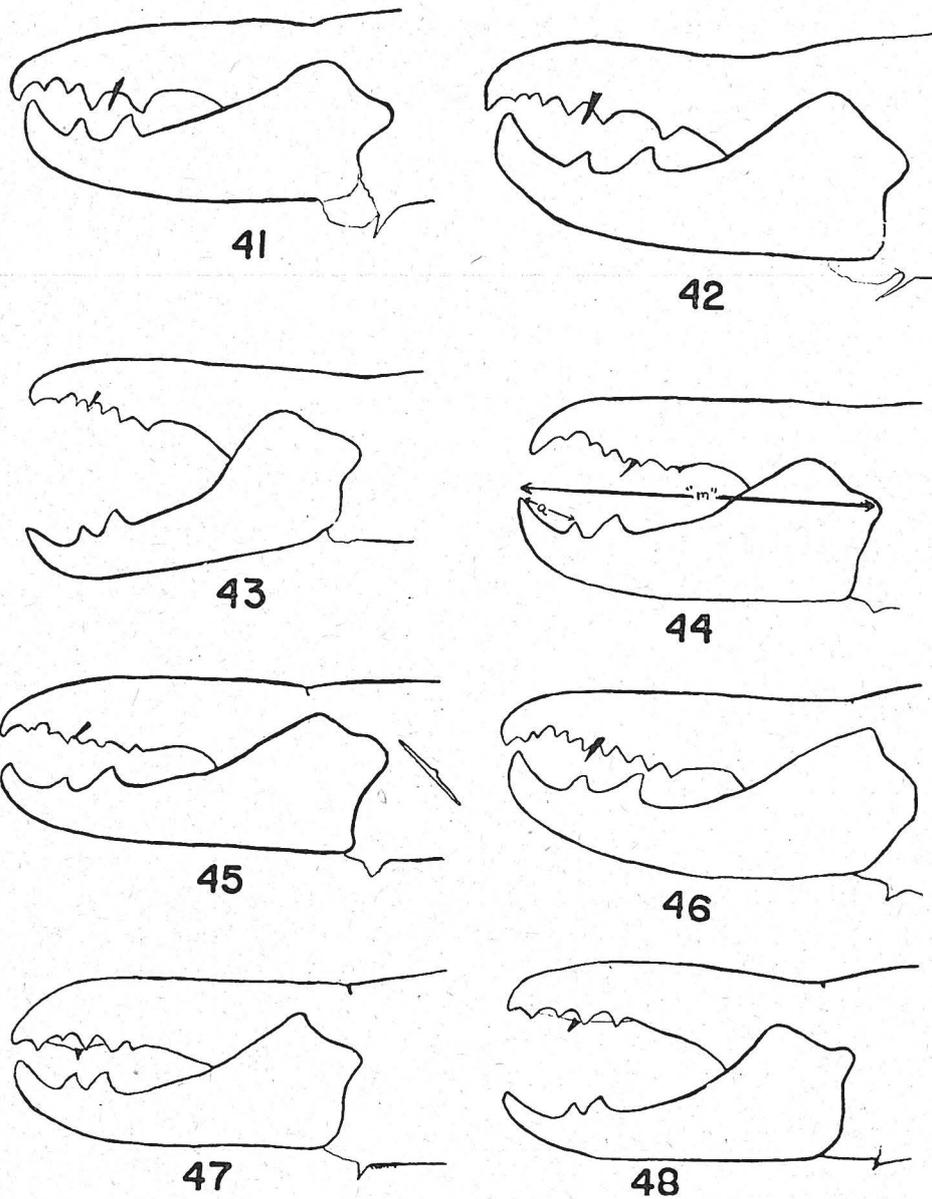


FIG. 41-48. — Female chelicerae. 41. *A. aphidioides* from Bowie, Maryland; 42. *A. garmani*; 43. *A. citri*; 44. *A. brachychaeta*; 45. *A. piloja*; 46. *A. neopallida*; 47. *A. nova* from Storrs, Conn.; 48. *A. nesoica* from Storrs, Conn.

tance from base of J₃ to base of J₄ 27 μ . J₄ about 48 μ long, extending past the base of Z₅. J₅ 6 μ , Z₄ 22 μ , Z₅ 44 μ , S₅ 33 μ long. The pores on the tubercle are difficult to make out in the type specimen. Two oval pores are clearly visible in a female collected from the same locality as the holotype. Intersocketal distances are as follows: J₁-J₁ 16 μ , J₂-J₂ 35 μ , J₃-J₃ 35 μ , J₄-J₄ 46 μ , J₄-Z₃ 24 μ .

Anterior edge of sternal shield with a slight indentation each side of the midline, posterior edge concave. Sternal shield 70 μ long along midline. Distances between setae are as follows: v₁-v₁ 44 μ , v₂-v₂ 46 μ , v₃-v₃ 56 μ , v₁-v₂ 32 μ , v₂-v₃ 27 μ . Da 67 μ . Genital shield notched laterally.

Moveable chela 29 μ long, about 12 μ wide. Distance from tip of moveable digit to closest tooth 4 μ , distance from latter tooth to proximal tooth of moveable digit 3 $\frac{1}{2}$ μ . Fixed digit (fig. 45) with eight small teeth. Distance from tip of fixed digit to tooth immediately proximal to pilus dentilis 7 μ , distance from latter tooth to proximal tooth of fixed digit 3 $\frac{1}{2}$ μ . Total length of penultimate segment 84 μ .

Several small teeth arise from the anterior edge of the tectum.

Material examined: Holotype and eight other females from sod and litter under brush (maple) near edge of corn field, Patuxent Wildlife Refuge, Bowie, Maryland, Nov. 26, 1959. Collections from litter from the nearby woods yielded *A. neopallida* and *A. garmani* but not *A. piloja*. The field and woods formed part of the study area mapped by DRUMMOND (1957).

Distinguishing characteristics: *A. piloja* is similar to *A. neopallida*, but seta J₃ is pilose in *A. piloja* whereas it is simple in *A. neopallida*. The two species are compared in table 6. *A. piloja* is also very similar to *A. pallida* which EVANS (1958) described from specimens collected from spider nests in Uganda.

Asca pini n. sp.

Holotype female: Anterior dorsal shield 220 \times 215 μ , with seventeen pairs of simple setae arranged as in fig. 28. Seta s₇ 20 μ long, s₇-z₃ 26 μ . Posterior dorsal shield 215 μ long. Seta J₂ 20 μ long, distance from base of J₂ to base of J₃ 55 μ . Lengths of other setae are as follows: J₃ 24 μ , J₄ 43 μ , J₅ 10 μ , Z₄ 29 μ , Z₅ 41 μ , slightly frayed, S₄ 32 μ , S₅ 33 μ . Intersocketal distances are as follows: J₁-J₁ 18 μ , J₃-J₃ 39 μ , J₄-J₄ 54 μ , Z₃-J₄ 35 μ .

Anterior edge of sternal shield indistinct, with a V-shaped indentation. Posterior margin of shield strongly concave, third pair of sternal pores on posterior corners of shield. Distance from v₂-v₂ 60 μ . Da 75 μ .

Tectum (fig. 27) with a few small teeth.

Material examined: Holotype female ex *Pinus* sp., Contreras, D. F., Mexico by M. GONZALEZ on Dec. 19, 1960. Female same data as holotype. Female ex *Pinus*, Vizarron, Queretaro, Mexico by M. GONZALEZ on Nov. 20, 1960.

Distinguishing characteristics : The tectum is serrate but the setae are not pilose. The large size of *A. pini* also aids in its recognition.

Asca quinquesetosa Wharton.

Asca quinquesetosa WHARTON, 1941, *Smiths. Misc. Coll.* 99, No. 12 : 2-4.

Lectotype female : Anterior dorsal shield $200 \times 200 \mu$, with seventeen pairs of slightly pilose setae. Seta 11 18μ long, s7 16μ long. Posterior dorsal shield 200μ long, with ornamentation as in fig. 52. Setae slightly pilose. J3 23μ long, distance from base of J3 to base of J4 33μ . Z4 27μ , J5 11μ long. S4 projecting laterally, 33μ long. Each tubercle with two setae and two circular openings.

As in other members of the genus the sternal plate bears two pairs of setae. First pair of sternal pores on anterior margin of sternal shield, third pair of sternal pores on posterior lateral margin of sternal plate. Metapodal plates present, metasternal plates not visible. Ventrianal shield with the usual six pairs of setae.

Tectum two-tined, the part between the tines slightly convex (fig. 51).

Material examined : Lectotype female from booby nest, Clipperton Island, July 21, 1938 by W. L. SCHMITT, U.S.N.M. no. 1374. Two females same data as lectotype. Gravid female November 1954 and non-gravid female April 1954 from litter, University of Hawaii campus, Oahu by F. H. HARAMOTO. One female from *Theretia peruviana* and two females from *Stephanotis floribundus* Oahu, Hawaii, February 1961 by H. WOOLFORD.

Measurements :

Specimen.....	L	J4	Z5	S5	s7-z3	J3-J3	J4-J4	J4-Z3
Clipperton (type).....	200	34	42	32	27	33	33	46
Clipperton Island.....	195	—	43	29	24	34	—	43
Oahu, gravid.....	190	34	41	30	27	33	34	46
Oahu, April.....	190	37	44	28	24	30	35	41
Oahu, <i>Theretia</i>	185	37	41	29	24	30	37	43
Oahu, <i>Stephanotis</i>	180	33	39	32	24	28	33	42
Oahu, <i>Stephanotis</i>	185	31	39	31	24	28	31	43

Distinguishing characteristics : The tectum, which is two-tined, is distinctive. J4 is over 30μ long and Z5 is not spinelike.

Although WHARTON (1941) figured five setae arising from each posterior tubercle, only two setae are present on each tubercle of the type specimens. The specimens of *A. quinquesetosa* from Hawaii, like all other known species of *Asca* with the possible exception of *A. magnituberculata* (Vitzthum), also have only

two setae arising from each tubercle. Two circular structures resembling setal sockets occur near the proximal part of each tubercle (fig. 52). Similarly located structures are visible on several species of *Asca* such as *A. brachychaeta*, *A. citri*, *A. duosetosa* and *A. muma*. In *A. duosetosa* these structures are circular but in *A. brachychaeta*, *A. citri* and *A. muma* they are oval or irregular. It seems likely that these structures are homologous to pores such as the "Anareaporen" associated with setae S5 and Z4 in *Digamasellus* (Hirschmann, 1960).

Asca spicata n. sp.

Holotype female : Anterior dorsal shield $185 \times 170 \mu$, with seventeen pairs of short, simple setae arranged as in fig. 50. Seta *ii* 10μ long, distance from *ii* to *ii* 3μ . Seta *s7* 13μ long, distance from *s7* to *z3* 22μ . Posterior dorsal shield 185μ long, deeply colored. J4, Z3, Z4, S3, S4, S5 and most posterior marginal setae stout and spinelike, other setae short and hairlike. Seta J2 only 12μ long,

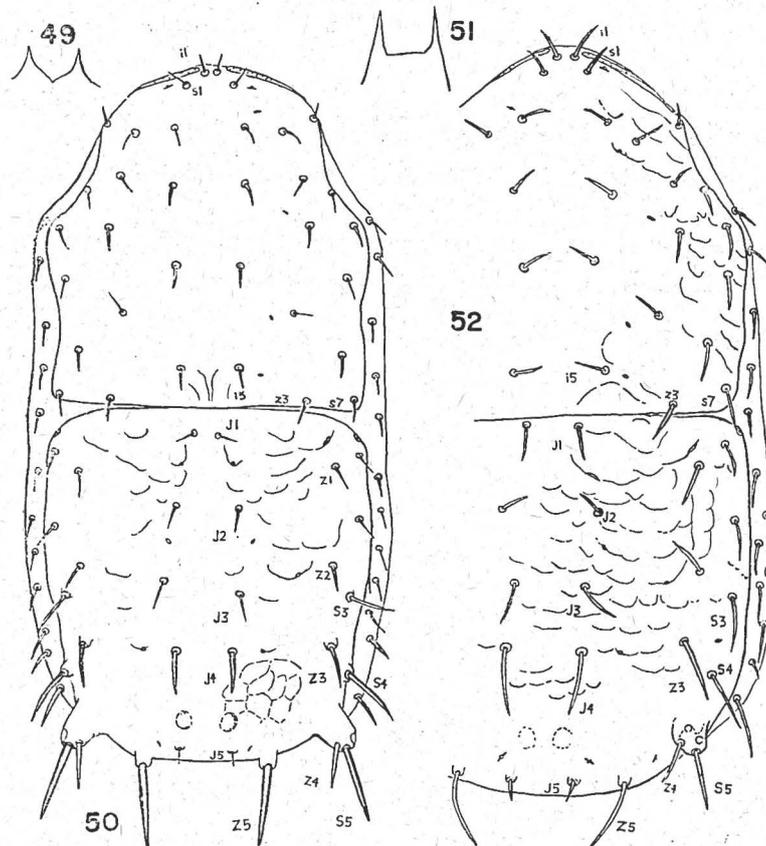


FIG. 49-50. — *A. spicata*, holotype ♀. 49. tectum; 50. dorsal view.
FIG. 51-52. — *A. quinquesetososa*, lectotype ♀. 51. tectum; 52. dorsal view.

distance from base of J₂ to base of J₃ 36 μ . Seta J₃ 12 μ long, extending less than half the distance to the base of J₄. Lengths of other setae as follows: J₄ 22 μ , J₅ 6 μ , Z₃ 26 μ , Z₄ 26 μ , Z₅ 43 μ , S₅ 37 μ , S₄ 38 μ . S₄ projects laterally. Intersocketal distances are as follows: J₁-J₁ 8 μ , J₃-J₃ 35 μ , J₄-J₄ 23 μ , Z₃-J₄ 45 μ .

Sternal shield 85 μ long along midline. Posterior margin slightly concave, third pair of pores on posterior corners of sternal shield. Distance from v₂-v₂ 40 μ . Posterior part of ventrianal shield deeply colored. Da 61 μ .

Tectum (fig. 49) two-tined.

Middle of tarsus IV with relatively long (30 μ) seta.

Material examined: Holotype female on *Metrosideros collina*, Hawaii volcanic area by H. WOOLFORD on April 11, 1960. Two females on *Cordyline terminalis*, Oahu, Hawaii by H. WOOLFORD on April 12, 1960.

Distinguishing characteristics: *A. spicata* is readily recognized by the spike-like setae and two-tined tectum.

SYSTEMATIC POSITION OF *ASCA*

There is little dispute among contemporary acarologists as to what kind of mites should be included in the genus *Asca*. The familial placement of *Asca*, however, is less certain. VITZTHUM (1926), for example, placed *Asca* in the same family as *Zercon* and *Liroaspis*. In subsequent works these three genera were placed in separate superfamilies. *Asca*, *Cyrtolaelaps*, *Dendrolaelaps*, *Gamasellus*, *Laelogamasus* and *Lobocephalus* were at one time grouped together on the basis of the presence of two divided dorsal shields, a truncate genital shield and a two-tined seta on the palp tarsus. This was the arrangement used by BAKER and WHARTON (1952). The family Digamasellidae was erected by EVANS (1957) to include *Asca* and *Digamasellus* (= *Dendrolaelaps*). Later (1958) EVANS transferred *Asca* to the Rhodacaridae. ATHIAS-HENRIOT (1961) and RYKE (1961) also placed *Asca* in the Rhodacaridae. KARG (1962) considered that the presence of a divided dorsal shield was insufficient reason for separating *Asca* and *Dendrolaelaps* from the Aceosejidae, and therefore transferred these two genera to the Aceosejidae. The similarity of the hypostome of *A. bicornis* to that of the aceosejids was noted by KARG.

EVANS (1963) analyzed the leg chaetotaxy of free-living Mesostigmata, and concluded that *Digamasellus*, *Asca* and *Halolaelaps* did not appear to be confamilial with the *Rhodacarus* group, but showed affinities with certain genera of the Aceosejidae. EVANS suggested that further study was needed to determine whether these three genera should be placed in the Aceosejidae or in a distinct family (Digamasellidae). In view of the numerous differences between *Asca* and *Digamasellus* the latter alternative seems undesirable. These differences are summarized in the following key.

Females : r1 absent ; r5, r6 and r7 on membrane ; anterior edge of posterior dorsal shield without incisions ; R series of setae on membrane ; S5 and Z4 on posterior cylindrical projections ; metasternal setae on membrane ; ventrianal shield broader than long, with seven pairs of setae ; V1 on membrane ; moveable chela bidentate. *Males* : ventrianal plate not fused with posterior dorsal shield ; setae v5 on sternigenital shield ; spermatophoreträger rod shaped or slightly bent ; legs without spurs or apophyses. . . .

Asca von Heyden.

Females : r1 present ; r5 on peritrematal shield, r6 usually on anterior dorsal shield ; anterior edge of posterior dorsal shield with incisions except in *D. angulosus* and *D. punctum* ; R2 to R5 sometimes on posterior dorsal shield ; posterior dorsal shield without cylindrical projections ; setae v4 on sternal shield ; ventrianal shield longer than wide, with two to seven pairs of setae ; if with seven pairs, V1 on shield ; moveable chela with three or more teeth ; *Males* : ventrianal shield fused with posterior dorsal shield ; v5 on separate triangular plates ; spermatophoreträger coiled ; leg II and sometimes leg IV with spurs or apophyses. *Digamasellus* Berlese

There are also differences in the shape of the peritrematal and metapodal plates. The tectum of *Asca* is variable, but never as in *Digamasellus*. The tectum of *Digamasellus* is three-tined with the middle tine arising ventrad to the lateral tines.

Asca seems to be more similar to *Leioseius* Berlese and *Gamasellodes* Athias-Henriot than to *Digamasellus*. Females of *Asca*, *Gamasellodes* and *Leioseius* possess the following features in common : 1) the R series of setae and setae r5 to r7 are always on the lateral membrane ; 2) anterior edge of posterior dorsal shield without incisions ; 3) setae v4, v1, and v5 on membrane ; 4) third pair of sternal pores situated on posterolateral corners of sternal shield ; 5) moveable chela bidentate. The ventrianal shield is variable in *Gamasellodes* and *Leioseius*, and may bear as few as three pairs of setae. However, as in *Asca* there are usually nine pairs of V setae, one of which is designated by ATHIAS-HENRIOT (1959) as Vx. *Leioseius ibericus* (Willmann) lacks v5, but is atypical of the genus in several other respects (EVANS, 1958 b). Unlike *Asca*, r1 is present in *Gamasellodes* and *Leioseius*, and seta r3 is on the membrane instead of on the anterior dorsal shield. The males of *Asca* are also more similar to *Gamasellodes* and *Leioseius* than they are to *Digamasellus*. The legs are unarmed, the ventrianal shield is separate from the dorsal shield, and v5 is on the sternigenital shield. Therefore, I believe that *Asca* (and also *Gamasellodes*) should be transferred to the Aceosejidae.

SUMMARY.

1. The following new species of *Asca* were described and figured : *A. garmani* (North America, West Indies, Hawaii) ; *A. brachychaeta* (U. S. A.) ; *A. citri* (Florida) ; *A. incisa* (Florida) ; *A. muma* (Florida, Cuba) ; *A. neopallida* (U. S. A.) ; *A. piloja* (Maryland) ; *A. pini* (Mexico) ; *A. spicata* (Hawaii). The type specimens of *A. duosetosus* Fox (Puerto Rico, Florida), *A. elongata* (Berlese) (Florida), and *A. quinquesetosus* Wharton (Hawaii, Clipperton Island) were redescribed. North American specimens of the following species

formerly known from Europe were described : *A. aphidioides* (L.), *A. nova* Willmann and *A. nesoica* Athias-Henriot. The identity of *A. bicornis* (Can. & Fanz.) is uncertain.

2. Seasonal and geographic variation were noted for some species. Females of *A. aphidioides* from Maryland collected in May and June were larger and had longer setae than females collected at other times of the year. Individuals of *A. garmani* and *A. brachychaeta* from Connecticut and Maryland were larger than those from Florida. *A. garmani* from Quebec were smaller than those from northern Connecticut, however.

3. Reasons for considering *Asca* to be more closely related to *Leioseius* and *Gamaselodes* than to *Digamasellus* were discussed.

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REFERENCES CITED

- ATHIAS-HENRIOT (C.), 1959. — Phytoseiidae et Aceosejidae (Acarina, Gamasina) d'Algérie. III. Contribution aux Aceosejinae. — *Bull. Soc. Hist. Nat. Afr. Nord* 50 : 158-195.
- ATHIAS-HENRIOT (C.), 1961. — Mesostigmates (Urop. Excl.) édaphiques Méditerranéens (Acaromorpha, Anactinotrichida). — *Acarologia* 3 : 381-509.
- BAKER (E. W.) and WHARTON (G. W.), 1952. — An Introduction to Acarology, New York, 465 p.
- BERLESE (A.), 1887. — Acari, Myriapoda et Scorpiones hucusque in Italia reperta. Partici et Padua.
- BERLESE (A.), 1910. — Lista di nuove species e nuovi generi di Acari. — *Redia* 6 : 242-271.
- CANESTRINI (G.), 1885. — Prospetto dell' Acarofauna Italiana. — *Atti Soc. Veneto-Trentina*, 154 pp.
- DOMROW (R.), 1957. — Some Acarina Mesostigmata from the Great Barrier Reef. — *Proc. Linn. Soc. New South Wales* 81 : 199-216.
- DRUMMOND (R.), 1957. — Observations on fluctuations of acarine populations from nests of *Peromyscus leucopus*. — *Ecol. Monog.* 27 : 137-152.
- EVANS (G.), 1957. — An Introduction to the British Mesostigmata (Acarina) with keys to the families and genera. — *J. Linn. Soc. London* 43 : 203-259.
- EVANS (G.), 1958 a. — Some mesostigmatid mites from a nest of social spider in Uganda. — *Ann. Mag. Nat. Hist.* (13) 1 : 580-590.
- EVANS (G.), 1958 b. — A revision of the British Aceosejinae (Acarina : Mesostigmata). — *Proc. Zool. Soc. London* 131 : 177-229.
- EVANS (G.), 1963. — Observations on the chaetotaxy of the legs in the free-living Gamasina (Acari : Mesostigmata). — *Bull. Brit. Mus. (Nat. Hist.)*, Zool. 10 : in press.

- FORD (J.), 1938. — Fluctuations in natural populations of Collemboles and Acarina. — *J. Anim. Ecol.* 7 : 350-369.
- FOX (I.), 1946. — Three new mites from rats in Puerto Rico. — *Proc. Biol. Soc. Washington* 59 : 173-176.
- HALASKOVA (V.), 1959. — Die Gattung *Asca* V. Heyden in der Tschechoslowakei (Acari : Gamasides). — *Acta Univ. Carolinae, Biologica* 1 : 17-21.
- HIRSCHMANN (W.), 1957. — Gangsystematik der Parasitiformes. Teil 1. Rumpfbehhaarung und Rückenflächen. — *Schriftenr. f. Milbenk. Fürth/Bay.* : 1-20, I-V, pl. 1-26.
- HIRSCHMANN (W.), 1960. — *Ibid.* Teil 3, Die Gattung *Dendrolaelaps* Halbert, 1915. — *Ibid.* : 1-27, pls. 1-28.
- KARG (W.), 1961. — Ökologische Untersuchungen über edaphische Gamasiden (Acarina, Parasitiformes). — *Pedobiologia* 1 : 53-98.
- KARG (W.), 1962. — Zur Systematik und Postembryonalen Entwicklung der Gamasiden (Acarina, Parasitiformes) Landwirtschaftlich Genutzter Böden. — *Mitt. Zool. Mus. Berlin* 38 : 23-119.
- MOUSSA (M.), 1956. — Bionomics of the clover leaf weevil, *Hypera punctata* (Fabricius). — *Diss. Abstr.* 16 (5) : 834-835.
- MOUTIA (L. A.), 1958. — Contribution to the study of some phytophagous Acarina and their predators in Mauritius. — *Bull. Ent. Res.* 49 : 59-75.
- RYKE (P. A. J.), 1961. — A review of the genus *Asca* von Heyden with descriptions of new species (Acarina : Mesostigmata : Rhodacaridae). — *Zool. Anz.* 167 : 127-135.
- SCHWEIZER (J.), 1948. — Landmilben aus der Umgebung des Schweizerischen Nationalparks. — *Res. Rech. scient. Parc Nation. Suisse N. F.* 2 : (20) : 1-28.
- VALLE (A.), 1955. — Revisione dell' Acaroteca Canestrini. — Padova, 37 pp.
- VITZTHUM (G.), 1925. — Fauna sumatrensis. (Beitrage no. 5) Acarinae. *Suppl. Ent. Berlin* 11 : 1-79.
- VITZTHUM (G.), 1926. — Tierwelt Mitteleuropas 3 : 1-112.
- WHARTON (G. W.), 1941. — Acarina collected on the presidential cruise of 1938. — *Smiths. Misc. Coll.* 99 (12) : 1-8.
- WHARTON (G. W.), 1946. — Observations on *Ascoschöngastia indica* (Hirst 1915) (Acarinida : Trombiculidae). — *Ecol. Monogr.* 16 : 151-184.
- WILLMANN (C.), 1939. — Drei neue terricolen Acari. — *Zool. Anz.* 125 : 244-248.
- WILLMANN (C.), 1949. — Beiträge zur Kenntnis des Salzgebietes Ciechocinek. I. Milben aus den Salzwiesen und Salzmooren von Ciechocinek and der Weisel. — *Veroff. Mus. Nat. Bremen* 1A : 106-135.
- WOMERSLEY (H.), 1956. — On some new Acarina-Mesostigmata from Australia, New Zealand and New Guinea. — *J. Linn. Soc. Zool.* 42 : 505-599.