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ASTIGMATIC MITES FROM NESTS OF BIRDS OF PREY IN THE U.S.A. IV. DESCRIPTION OF THE LIFE-CYCLE OF *ACOTYLEDON PARADOXA* OUDEMANS, 1903

by

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INTRODUCTION

In this paper we describe for the first time the life-cycle of *Acotyledon paradoxa* Oudemans, 1903. This species was known, so far, only from the hypopial stage and a protonymph. The discovery of the adults allows us to precise the systematic position of the genus *Acotyledon* and to throw light on this difficult group of Acaridae.

All our material was found by the junior author in a nest of a screech owl, *Otus asio*, in Syracuse, New York, U.S.A. It includes numerous hypopi, protonymphs, tritonymphs and adults of both sexes. One of our protonymphs contained a completely developed hypopus identical with the other free hypopi.

REVIEW OF THE LITERATURE

Oudemans (1903) erected the genus *Acotyledon* for a new species, *A. paradoxa*, represented only by a single hypopus collected on a bat from Russia. This hypopus is characterized by the vestigial aspect of the suctorial plate bearing only one pair of small suckers and no conoids.

Zachvatkin (1937) in his first study on Tyroglyphidae did not mention the genus *Acotyledon*, but in 1941, after having discovered new specimens of hypopi as wel as protonymphs of the species of Oudemans, he synonymized with *Acotyledon* the genera *Eberhardia* Oudemans (1924), *Cosmoglyphus*

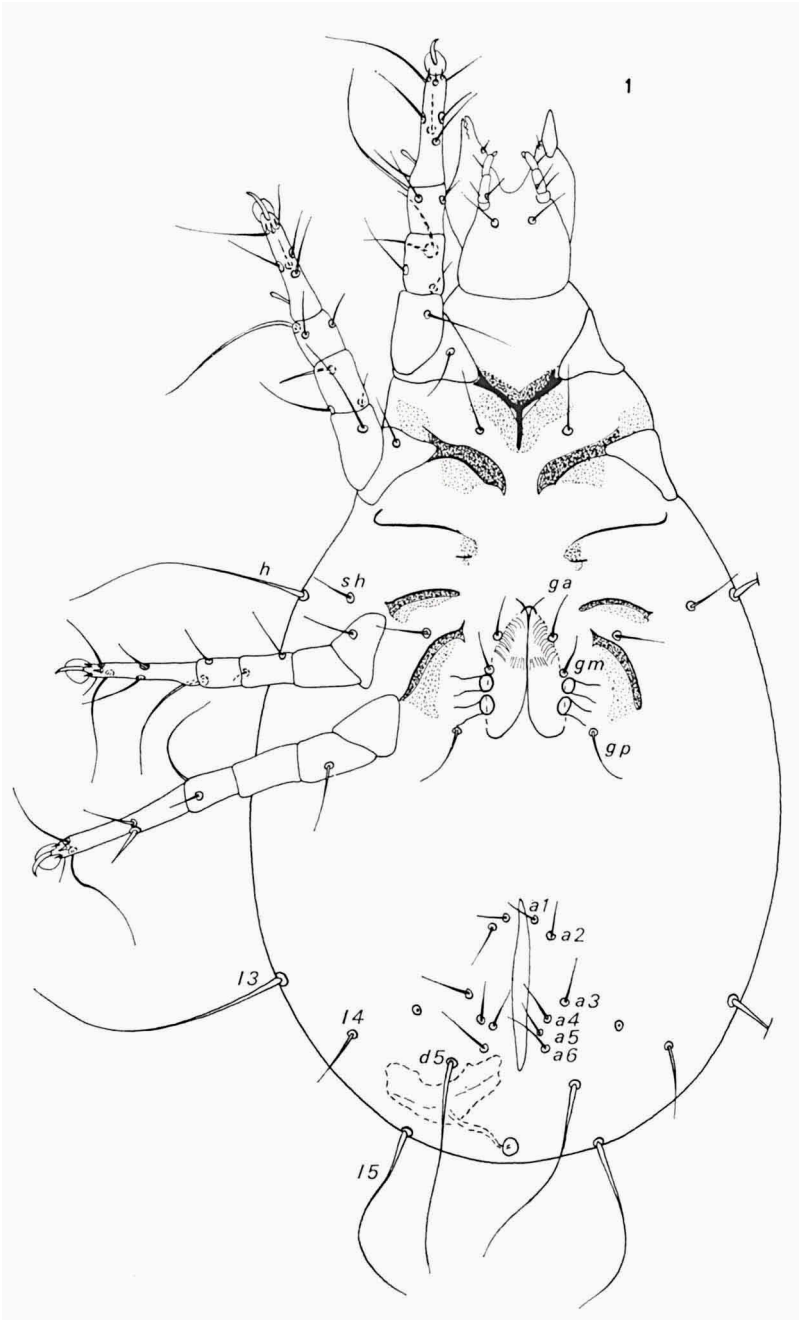


Fig. 1. *Acotyledon paradoxa* Oudemans. Female, ventrally (specimen from nest of *Otus asio*).

Oudemans (1932) and *Myrmoglyphus* Vitzthum (1935). He recognized, however, that this new complex comprised two sharply different morphological types of hypopi, one of the *Acotyledon* type with poorly developed suckers, the other of the *Cosmoglyphus* type with a normally developed suctorial plate. He included in the genus *Acotyledon* twelve palearctic and four tropical species.

Nesbitt (1945), in his revision of the family Acaridae based on adults, did not mention the genus *Acotyledon*, but he conserved the genus *Eberhardia* and placed the taxon *Cosmoglyphus* as a subgenus of the latter.

Baker and Wharton (1952) synonymized *Acotyledon* with *Eberhardia*.

Samsinak (1957) at first considered *Cosmoglyphus* a subgenus of *Acotyledon*. In 1960 he showed that the name *Eberhardia* Oudemans (1942) is homonymous with *Eberhardia* Angel (1920) (see Neave, S.A., Nomenclator Zoologicus, 1939). He did not mention the genus *Cosmoglyphus*, but in the same paper he described a new hypopus, *Acotyledon solenopsidis*, which is morphologically very close to the hypopus of *Cosmoglyphus krameri*, the type species of *Cosmoglyphus*. One may therefore suppose that this author considered *Cosmoglyphus* a synonym of *Acotyledon*. Moreover he accepted the opinion of Zachvatkin (1941) considering *Myrmoglyphus* Vitzthum a synonym of *Acotyledon* and he synonymized *Caloglyphus* with *Sancassania* Oudemans, 1916.

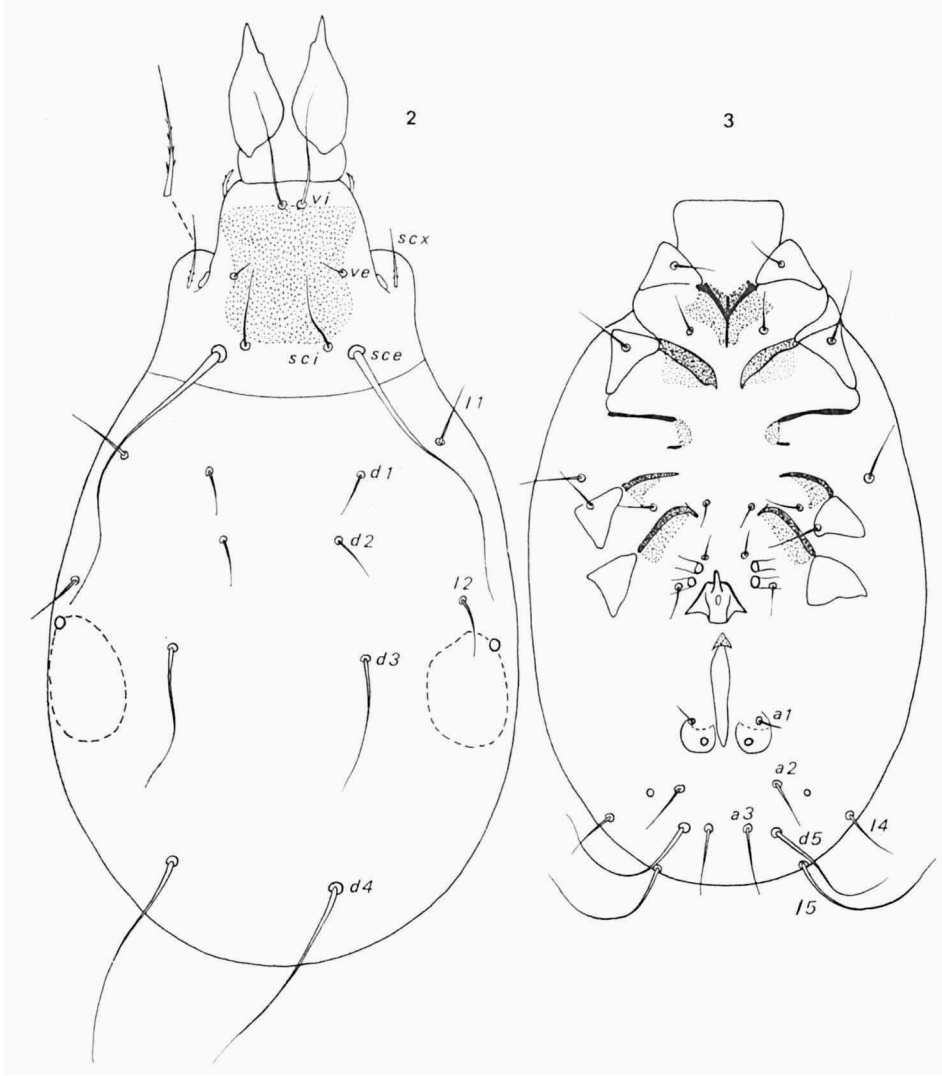
Hughes (1961) did not mention the genus *Cosmoglyphus* and incorporated *Acotyledon*, *Eberhardia* and *Myrmoglyphus* into the genus *Caloglyphus* Berlese (1923).

In 1966, Samsinak reestablished the genus *Cosmoglyphus* which he redefined as follows.

Adults: Cuticle whitish or dirty yellowish, shiny. Dorsum: A propodosomal shield is present. The *v e* are short, simple, situated along the lateral margins of propodosomal shield approximately at same distance from *v i* and *s cx*; the *sc i* are significantly shorter than *sc e*; the *s cx* are always thickened, long and distinctly barbulated. Grandjean's organ is rodlike. Orifice of oil-gland is situated between *l 2* and *l 3*. Venter: Vulva is between coxae IV. Copulatory suckers are present in male. Epimera I are fused in a Y, other epimera are free. Anal setae: 6 pairs in female, 3 pairs in male. Penis narrow, slightly curved. Chaetotaxy of legs: Tarsi I-II with never more than one foliate seta in male; without foliate setae in female. Claws simple; at base of claws there are 5 small spines; a slightly stronger additional spine is present dorsally near apex of tarsus I-III. The two ventral setae of tarsi are spinelike. Solenidiotaxy: *w 1* of tarsi I-II are club-shaped apically; *w 2* is basal and flanked with a simple seta, as long as *w 1*; *w 3* is long and apical; *phi* I-II are

as long as tarsi. The setae of tibiae I-II are small, spinelike; *sigma 2* of genu I is twice shorter than *sigma 1*. Male with two oval suckers on tarsi IV.

Hypopi: dorsum strongly convex, with anterior margin sinuous and curved backwards in its median part. Suctorial plate widely distant from posterior margin of the body (more than the width of the plate). Genu and tibia I with powerful spines. Setae of basal part of tarsus I relatively long. Genu IV



Figs. 2-3. *Acotyledon paradoxa* Oudemans. 2, female, dorsum; 3, male, venter (specimens from nest of *Otus asio*).

distinctly longer than femur IV. The hypopi of all the known species are very close to each other and very difficult to separate.

Samsinak includes in the genus *Cosmoglyphus* seven species represented by the adults.

Hughes (1976) incorporated *Acotyledon* and *Cosmoglyphus* into the genus *Caloglyphus*, considering the latter a valid genus, distinct from *Sancassania*.

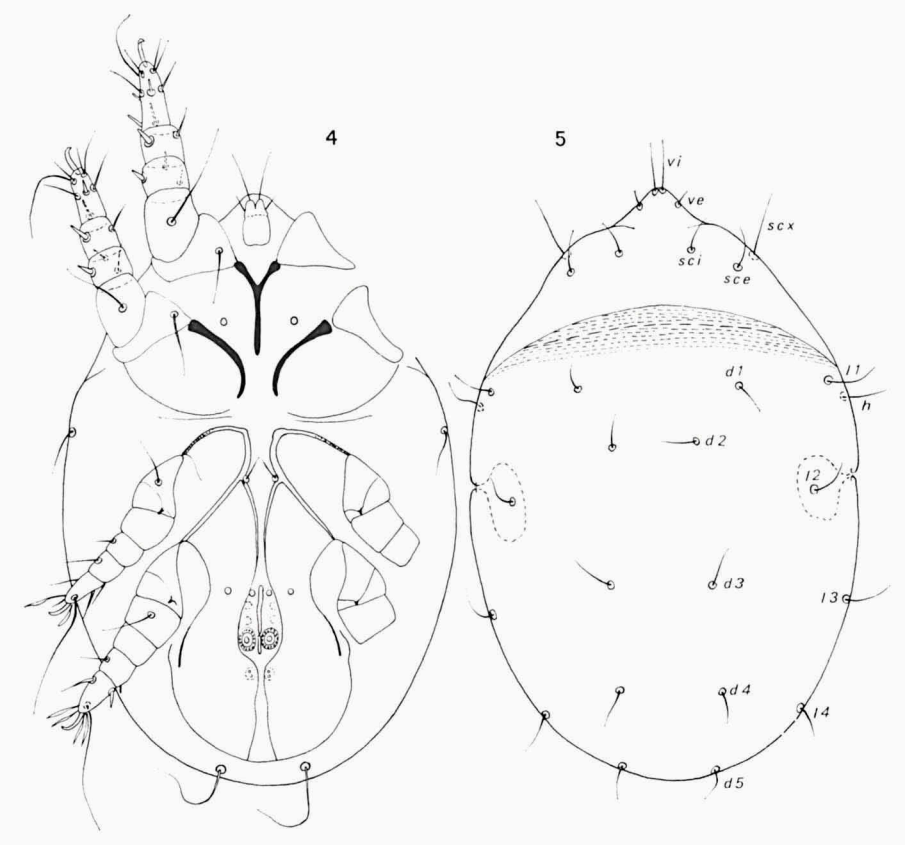
Acotyledon Oudemans, 1903

We give here a definition of this genus based on the adults and the hypopi of *Acotyledon paradoxa*.

Adults: Cuticle whitish and shiny, becoming yellowish in older specimens. Sejugal furrow well developed. Propodosoma with a large punctate shield. Oil gland orifice much closer to *l 2* than to *l 3* setae. The *v i* are shortly barbed in their apical half. The *v e*, short and thin, are situated on lateral borders of the shield and closer to *s-cx* than to *v i*. The *s-cx* are thin, long and with a few very short barbs. All the other dorsal setae are bare. The *sc i* are much thinner and shorter than *sc e*. Setae *d 1*, *d 2*, *l 1*, *l 2* and *l 4* thin and much shorter than the *d 3*, *d 4*, *d 5*, *l 3*, *l 5* and *h*. Epimera I fused in a Y, other epimera free. Vulva situated at level of coxae IV. A very small, poorly sclerotized epigynium is present. Genital suckers well developed. Anus ventral, relatively far in front of posterior margin of body. Female with 6 pairs of thin slightly unequal anal setae, male with only 3 pairs of setae. Tarsus IV of male with 2 suckers dividing the tarsus in 3 equal parts. Grandjean's organ rodlike with small denticles. Leg chaetotaxy: In female: Apex of tarsi I with 6 small spines and 2 unequal simple setae, the middle of this tarsus bears 4 simple setae, the base 1 simple seta. Tarsi III with apically 6 small spines and 2 long fine setae and medially 2 simple setae. Tarsus IV as tarsus III, but one of the median setae is a spine. Tibiae I-II with 2 thin non barbed setae, tibiae III-IV each with 1 thin seta. Genua I-IV with 2-2-1-0 thin setae. The legs do not bear any foliate seta. Male: as in the female except for tarsus IV, which bears apically 5 small apical spines and one apical simple seta, and medially one simple seta and one spinelike seta. Solenidiotaxy: *w 1* of tarsi I-II rather thick and bulbous apically; *w 2* thin and more basal than *w 1*; *w 3* apical, rather short. Tibiae I: *phi* of leg I-II longer than the tarsi. Genua I with 2 subequal rather long *sigma*.

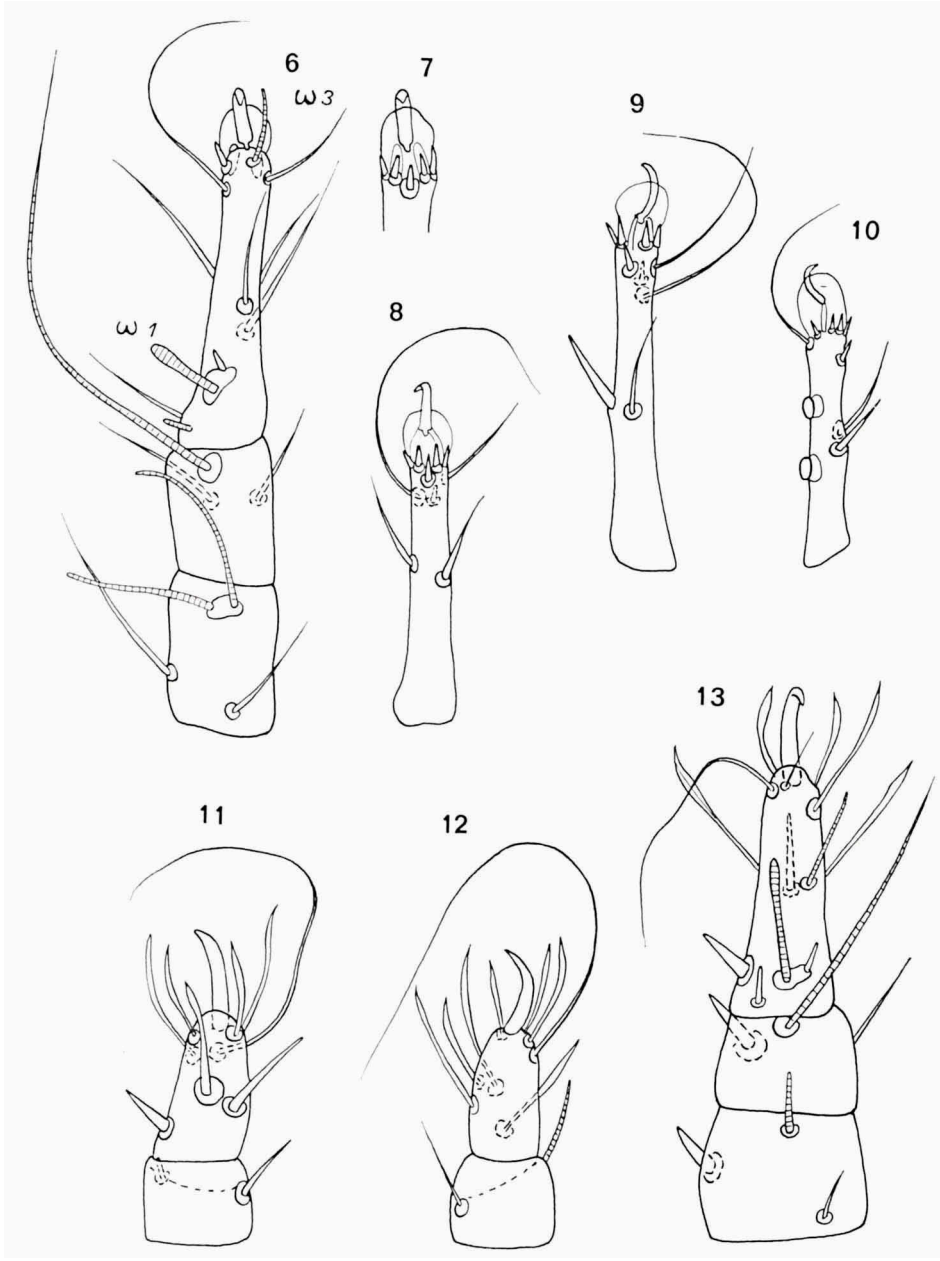
Hypopus: Cuticle poorly sclerotized. Dorsum slightly convex. The margins of the body are not membraneous. Anterior body tapering anteriorly into a small cone with rounded apex. Sejugal furrow well developed. Venter: epimera I fused in Y, epimera II free. Epimera III and IV poorly sclerotized,

fused at their apex, the two coxal fields III separated in the midline. Suctorial plate apparently large, bearing only the anterior pair of suckers. The posterior pair is represented by two very small pores situated beneath the cuticle. The conoids are completely lacking. Palposoma short. Legs short, rather thick ending into a rather strong and sessile claw. Chaetotaxy of body: the *v e* are present; the *s-cx* are long. Other dorsal setae rather short. Ventrally the *cx I*, *cx III* and *g m* are absent, some of them may be represented by very small pores. Leg chaetotaxy: Tarsus I with 5 foliate setae, 2 thin simple



Figs. 4-5. *Acotyledon paradoxa* Oudemans. Hypopus, venter and dorsum (specimen from nest of *Otus asio*).

setae and 2 spines. Tarsus II as tarsus I but the big basal spine is replaced by a submedian thin seta. Tarsi III with 7 foliate and 1 simple setae. Tarsi IV with 6 foliate setae, 1 spine and 1 simple seta. Tibiae I-IV with 2-2-1-1 setae. Tarsi I with a long *w 1* parabasal, a short *w 2* more basal than *w 1* and



Figs. 6-13. *Acotyledon paradoxa* Oudemans. 6-9, female, leg I (6-7), tarsi III (8) and IV (9); 10, male, tarsus IV; 11-13, hypopus, leg IV (11), leg III (12), leg I (13) (N.B.: All specimens from the nest of *Otus asio*).

situated close to a spine. The *w 3* is shorter than *w 1* and situated slightly closer to the apex than to the base of tarsus.

Type species: *Acotyledon paradoxa* Oudemans, 1903.

Other species of *Acotyledon*: We think that four other species should be incorporated in this genus: *Tyroglyphus agilis* Canestrini (1888), *Eberhardia (Cosmoglyphus) pedispinifer* Nesbitt (1944), *Eberhardia (Cosmoglyphus) rhizoglyphoides* Zachvatkin (1937) and *Acotyledon sokolovi* Zachvatkin (1941). The last two species differ from *A. paradoxa* mainly by the narrow shape and the different structure of the suctorial plate in the hypopi which bears 2 pairs of suckers (instead of one) and 4 small conoids placed on a transverse straight line (absent in *A. paradoxa*).

The hypopi of *A. agilis* and *A. pedispinifer* are unknown. The adults of *A. agilis* resemble closely those of *A. sokolovi*. The adults of *A. pedispinifer* differ from *A. paradoxa* only by slight characters such as the slightly larger size of the body, the more unequal length of the anal setae in the female and the different length and shape of some setae of legs.

The exact position of *Eberhardia michaeli* (Oudemans, 1924) (= *Rhizoglyphus agilis* Michael, 1903), the type of the genus *Eberhardia*, is not clear. In that species there are two types of males (both homeo- and heteromorphic) and the hypopus does not correspond exactly with that of *Acotyledon*. It seems, however, more close to the latter than to *Cosmoglyphus* or *Sancassania* (= *Caloglyphus*). The drawing of Türk & Türk (1957) does not correspond with the original figure of Michael (1903). A re-examination of the types (holotype or syntypes) of *E. michaeli* is necessary before a definite status can be assigned to that species.

Acotyledon paradoxa Oudemans, 1903 (figs. 1-16)

Female (figs. 1, 2, 6-9): Our largest female specimen (ovigerous) is 590 μ long (idiosoma) and 320 μ wide. In four other specimens these measurements are: 510 μ × 290 μ; 460 μ × 280 μ; 420 μ × 230 μ; 400 μ × 210 μ. Setae *d 1*, *d 2*, *l 1* and *l 2* are 27 μ to 33 μ long. The *d 4* and *d 5* are longer (150 μ) than the *d 3* (120 μ). The *l 3*, *l 4* and *l 5* are 150, 45 and 150 μ long, respectively. The anal setae are slightly unequal. Copulatory pore ventral, close to posterior border of body; there is a very small and flat papilla.

Male (figs. 3, 10): All the males are homeomorphic. Measurements of 3 specimens (length of idiosoma × width): 459 μ × 258 μ, 445 μ × 240 μ and 375 μ × 220 μ. The genital sclerite is a little more posterior than the vulva in the female. It is triangular in shape. The penis is short and slightly

curved. Leg chaetotaxy: as in the female, there are no foliate setae on tarsi I-IV.

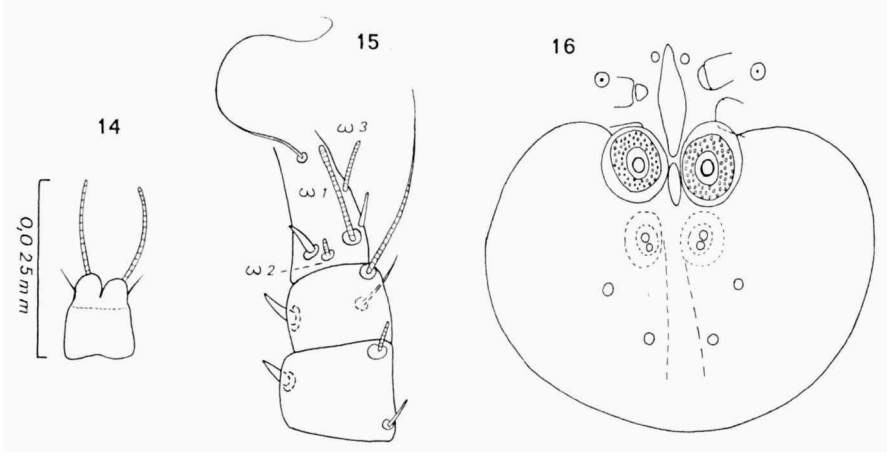
Tritonymph: Idiosoma 340 μ long and 175 μ wide.

Protonymph: Idiosoma 245 μ to 300 μ long and 140 μ to 170 μ wide.

Larva: Idiosoma 196 μ long and 117 μ wide.

Hypopus: The holotype is actually 216 μ long and 150 μ wide. It is in a rather poor condition and we give here drawings of some of its principal organs (figs. 14-16).

In the hypopi collected in the nest of *Otus asio* the size varies from 213 μ × 141 μ (the smallest) to 270 μ × 165 μ (the largest), with all the intermediate sizes. The length and width of the setae or spines and of the palposoma may also vary slightly according to the specimen (figs. 4, 5, 11-13).



Figs. 14-16. *Acotyledon paradoxa* Oudemans. Holotype hypopus. Palposoma (14), part of leg I (15), suctorial plate and genital slit (16).

Systematic position of the genus *Acotyledon*

The genus *Cosmoglyphus* Oudemans, 1932 (type species *Tyroglyphus krameri* Berlese, 1881 = syn. *Eberhardia (Cosmoglyphus) redikorzevi* Zachvatkin, 1937) differs from the genus *Acotyledon* mainly by the structure of the hypopi. The borders of the body in the hypopi are flattened, membraneous and very wide, the anterior margin is truncate, more or less concave and with a median "rostrum-like" projection; the suctorial plate is far remote from the posterior border of the body, it is wider than long and bears 2 pairs of well developed suckers; the genua IV are elongate and distinctly longer than the femora IV; the tibiae and genua I-II bear long and strong spines; the epimera III and IV are not fused; the anterior coxal shields are separated

from posterior ones by a convex furrow originating at the bases of epimera III. In the adult of *Cosmoglyphus* the *s-cx* setae are thick and distinctly barbulated, the ventral seta of tibiae (I-IV) are spinous as well as the two ventral setae of tarsi.

The genus *Sancassania* Oudemans, 1916, type species: *Sancassania chelone* Oudemans, 1916 (syn. *Caloglyphus* Berlese, 1923, type species: *Tyroglyphus berlesei* Michael, 1903) is distinguished from *Acotyledon* by the following characters: the size of the body in adults and hypopi is distinctly greater. In the hypopi the suctorial plate is larger and relatively wider and bears two pairs of larger suckers and two pairs of conoids, the latter being not situated on a transverse line, also the palposoma is relatively longer. The adults differ by the spinous aspect of the ventral setae of tibiae I-IV and of some median setae of the tarsi and by the constant presence of 1-3 foliate setae on the apices of tarsi I-II and sometimes of tarsi III-IV.

Habitat of *Acotyledon paradoxa*

1. The holotype hypopus was collected from a bat in U.S.S.R. (Prof. Wagner, Aug. 1898).
2. Zachvatkin (1941) found hypopi and protonymphs of that species in wheat and granaries in Irkoutsk (U.S.S.R.).
3. Numerous specimens have been collected by the junior author from the nest of *Otus asio*, from Syracuse, N.Y., U.S.A. (12.iii.1976) (2000 hypopi, 277 females, 221 males, 696 tritonymphs, 547 protonymphs, 5 larvae). Most ovigerous females contained 1-2 eggs, some contained up to 7 eggs. Many additional specimens have also been found in a nest of a great horned owl, *Bubo virginianus*, in West Monroe, N.Y. (26.vii.1977) and in a nest box used by *Otus asio* and red squirrels, *Tamiasciurus hudsonicus*, in Jamesville, N.Y. (24.vi.1976).
4. Hypopi (29 in number) were collected from 13 different nests of *Peromyscus* sp. in Patuxent Wildlife Refuge, U.S.A. (Coll. R.O. Drummond) (Nests nos: 2, 3, 4, 6, 11, 12, 14, 18, 20, 22, 23, 25 and 26; dates of collections from December 1954 until March 1955). These hypopi were sent for study to us by Prof. D. Johnston.
5. Several hypopi found in a nest of *Peromyscus leucopus* in U.S.A. were sent to us by Mr. G. S. Ide.

Türk and Türk (1957) recorded hypopi of *A. paradoxa* from the nest of a squirrel in Erlangen (Germany). These hypopi, however, are markedly larger than the holotype or those from U.S.A. and they have better formed suckers. They probably do not belong to *A. paradoxa*.

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