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THE GENUS CALVOLIA OUDEMANS, 1911
(ACARI : SARCOPTIFORMES)

BY

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Introduction:

The purpose of this paper is (1) to give full descriptions of Calvolia transversostriata (Oudemans, 1931), C. romanova Zachvatkin, 1941 and C. bakeri nov. n.; (2) to give an account of the genus Calvolia and to define it; and (3) to list the species that have been described in adult and deutonymphal (hypopial) stage.

Calvolia transversostriata (Oudemans, 1931) comb. nov.

Czenspinskia heterocoma Oudemans, 1927 (not Michael, 1903); Dondorffia transversostriata Oudemans, 1931; Czenspinskia lordi, Nesbitt, 1946; syn. nov.
Calvolia heterocoma E. and F. Türk, 1957 (not Michael, 1903).

Female (fig. 1). Length of idiosoma of ten specimens: 230 to 274 µ.

The idiosoma is pale yellow in colour, contrasting with the bright reddish-brown contents of the latero-abdominal glands; it has a transverse constriction between the second and third pairs of legs and the hysterosomal region is covered with a finely wrinkled cuticle. This wrinkling is mainly transverse and extends over the dorsal side of the hysterosoma and the area behind coxae IV on the ventral side, with the exception of the cuticle covering the latero-abdominal glands and that surrounding the setae. Posterior to the d 3 setae, the wrinkling is almost longitudinal, as shown in fig. 1, and a longitudinal fold runs down the side of the body. The dorsal side of the propodosoma is partially covered with a faintly-patterned shield and on the lateral corners of this is a pair of colourless corneae.

The body setae are smooth and arranged as in fig. 1. Except for v i, sc e and p a, they are short (less than 10% of the idiosoma in length), the distance between the base of d 1 and d 2 being more than twice the length of d 1 . Sc e are more than three

Acarologia, t. IV, fasc. 1, 1962.
times longer than sc i and arise from distinct tubercles, sc i being considerably nearer to sc e than to each other. Ve are missing. Grandjean's organ is a small rod and the supracoxal seta is similar to the short body setae. Two pairs of coxal and three pairs of genital setae are present and the anus is bordered by three pairs of anal setae, the post anals being about the same length as sc e (fig. 2).

Ventrally, the apodemes are slender and feebly cuticularised; those of legs I meet to form a short sternum and apodemes IV and epimerites III merge with one another. The genital opening is covered by lontigudinal folds and its anterior end is overhung by a transverse fold of cuticle attached to the epigynium (fig. 3 a).

The gnathosoma is of the usual sarcoptiform type. The legs are slender and feebly tanned; each terminates in a membranous pretarsus to which is attached

_Acarologia_, t. IV, fasc. 1, 1962.
a small claw. At the base of the pretarsus on leg I are inserted the solenidion $\omega_2$, two setae (d and f) and three small ventral spines. On tarsus I (fig. 4 a), the solenidion $\omega_3$ is a slightly tapering rod and it and the famulus arise from the same depression in the cuticle midway along this segment and distal to the origin of the seta wa. On tarsus II (fig. 4 b), $\omega_4$ is more proximal in position and the base of wa is distal to it. On genu I, $\sigma_2$ is more than twice as long as $\sigma_1$.

No male or hypopus has been found and the nymphal stages closely resemble the adult.

The larva (fig. 5) is about 120 $\mu$ long and has a colourless smooth cuticle. The same transparent corneae are present on the propodosoma and a pair of small blunt coxal rods, as well as coxal setae, arise from coxae I.

**Biology**

This mite is found on the under surface of leaves close to the midrib and it feeds on the epidermis and also on fungal mycelium. According to G. Dosse & I. Schnei-der (1957) it can do a certain amount of damage to the leaf tissue in May and June, but later on it grazes on the sooty mould growing on the honeydew excretion of Aphids. This observation was also made by P. Garman (1948). The mite over-winters in the tritonymphal stage and has three generations yearly in the neighbourhood of Stuttgart-Hohenheim, Germany. It is parthenogenetic, and the white, oval eggs are attached to "hairs" arising from the leaf epidermis.
Distribution:

*C. transversostriata* is widely distributed in Europe, Holland, France, Italy, Switzerland and Spain on a number of trees and herbaceous plants, e.g. apple, pear, plum, walnut, alder, oak, violet, etc. (G. DOSSE & I. SCHNEIDER, 1957; F. GRANDJEAN, 1942). In North America it has been found on apple trees in Connecticut (P. GARMAN, 1948) and Nova Scotia (F.T. Lord, 1949) where it was the only mite destroyed by fungicides containing copper. In Maryland, W. C. ATCHESON (1953) found it on lime, and it also occurs in very large numbers on filbert in Oregon (B. AINSCOUGH coll.). In Australia, it has been found in Queensland (D. MACFARLANE). In this country, it is often found on the leaves of apple, cherry, lime

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**Fig. 3.** — Genital region Of (a) *Calvulia transversostriata* (Oud.) ♀, (b) *C. romanovae* Zach. ♀, (c) *C. romanovae* ♂ and (d) *C. bakeri* nov. n. ♀. ep III epimerite III; ap IV apodeme IV; epg epigynium; H H-shaped sclerite; gf genital fold; P penis.
Fig. 4. — Dorsal view of right legs I (a) and (b) of Calvolia transversostriata (Oud.) $\sigma_1$, $\omega_1$, $\omega_2$, $\sigma_2$ and $\sigma_3$ solenidia; $\varepsilon$ famulus; $d$, $f$, wa setae.

Fig. 5. — Calvolia transversostriata (Oud.). Dorsal view of larva.
FIG. 6. — *Calvolia romanovae* Zach. ♀. Dorsal view: c cornea; a, d₁, d₃, sc e, sc i setae of the idiosoma.
(G. Rich coll.), oak and hawthorn in Kent, Sussex, Surrey and Hampshire. E. and F. Türk (1957) found it in very large numbers under the cast skins of Coccids in Erlangen, Germany and A. C. Oudemans' specimens were living on elm, lime and Heliotrope in Holland.

*C. tarsoinfracta* Türk & Türk, 1957 syn. nov.

*Female* (fig. 6). Length of idiosoma of ten specimens: 288 to 361 μ.

The idiosoma is colourless and has a smooth, translucent cuticle; the propodosomal shield is ill-defined, its anterior angles marked by a pair of colourless cornaeae. The contents of the latero-abdominal glands are also colourless.

The dorsal setae do not vary greatly in length, *d₃* being less than twice as long as *d₁*; they are longer than in *Calvolia transversostriata*, the distance between the base of *d₁* and *d₂* being less than twice the length of *d₁*. The sc i setae are nearer to one another than in the previous species, the distance between them being less than 1.5 times that separating them from sc e.

Ventrally, the apodemes are feebly sclerotized and apodemes IV and epi-merites III are not fused, although the two sclerites are close together (fig. 3 b). The most anterior pair of anal setae is considerably in front of the anus (fig. 6).

![Fig. 7.](image-url) Calvolia romanovae Zachvatkin, 1941. (a) Dorsal view of right leg I of ♀; (b) ventral view of left leg I of ♂; (c) dorsal view of right leg I of hypopus. *ω₁, ω₂, ω₃* solenidia; *e* famulus; *d*, *la*, *ra*, *wa* setae.
On leg I, d and ω₃ always lie close together (fig. 7 a) and ω₁ and the famulus are proximal to wa and near the base of the tarsus. On genu, σ₂ is less than twice as long as τ₁. Apart from this, the chaetotaxy of the legs is the same as in the preceding species.

**Male** (fig. 8): Length of idiosoma of ten specimens = 260 to 288 μ.

The general appearance of the male is similar to that of the female. The genital opening is between coxae IV, the vas deferens terminating in a curved penis which is posterior to an H-shaped strut. The penis is covered by genital folds and, in front of these, apodemes IV are connected by a fine transverse sclerite (fig. 3 c).

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**Fig. 8. — Calvolia romanovae Zach. ♂. Lateral view.**
Legs I and II differ from those of the female in having a single, membranous sucker at the ventral, distal end of the tarsus (fig. 7 b). Also, the ventral setae la, ra and wa are clustered round the base of the sucker. The solenidion ω₃ and d on tarsus I are separate from one another.

_Hypopus_ (figs 9, 10). Length of idiosoma: about 200 μ. The hypopus has a smooth, yellowish cuticle with traces of reticulations on the dorsal side of the propodosoma. On the sides of the rostrum is a pair of corneae lying above a pigmented sclerite. Ventrally, the sternal shield is outlined posteriorly by a curved line continuous with epimerites II; apodemes III and IV are joined to a longitudinal sclerite as shown in fig. 10. Paired setae arise in front of apodemes III, at the junction of apodemes IV in the midline and anterior to the sucker plate. The sucker plate is removed from the hind edge of the body and bears three pairs of suckers, two additional pairs of suckers are associated with it.

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_Fig. 9. — Calvolia romanovae Zach. Hypopus. Dorsal view._
The first three pairs of legs are long and slender and each terminates in a well-developed pretarsus and claw. The fourth pair is short, its tarsus bearing two long setae of unequal length, of these the base of the shorter is more proximal. The chaetotaxy of leg I (fig. 7 c) is similar to that of the adult, except that immediately in front of $o_1$ and the famulus, there arises a long seta which is not present on tarsus II. On genu I only one solenidion ($\sigma$) is present, as is customary in the hypopus.

**Fig. 10.** *Calvotia romanovae* Zach. Hypopus. Ventral view.
ep II epimerite II; ap III and IV apodemes III and IV.

**Biology and Distribution:**

*C. romanovae* was found by ZACHVATKIN (1941) with *Acarus siro* on stored wheat in Moscow. E. and F. TÜRK (1957) found all stages on rotting potatoes in Erlangen, Germany. My specimens were found on New Zealand cheese by E. POWELL.
FIG. 11. — Calvolia bakeri nov. n. ♀. Dorsal view. c cornea; d₁, d₃ setae of the idiosoma.
Calvolia bakeri nov. n.

Oulenzia arboricola Baker & Wharton, 1952 (not Oudemans, 1928).

Female (fig. 11). Length of idiosoma of three specimens: 288 to 360 μ.

The idiosoma is rather more rounded in outline than in the previous species and its proportions are rather different; thus, the corneae are more posterior in position (cf.: fig. 1 and 11) owing to the fact that the distance between the base of v i and the supracoxal setae is greater. The posterior edge of the propodosomal shield is lobed. The arrangement of the dorsal setae is the same as in C. romanovae, but the dorsal setae vary more in length and δ₀ are more than twice as long as δ₁. Ventrally, the apodemes are slender and apodemes IV and epimerites III are united. The epigynium is a transversely elongated sclerite lying at the anterior end of a fold of cuticle which overhangs the genital opening (fig. 3 d) as in Calvolia transversostriata.

The chaetotaxy of leg I differs from that of C. romanovae in that the seta wa arises at almost the same level as ω₁ (fig. 12 a), and on genu I σ₂ is more than twice as long as σ₁.

Male. Length of idiosoma of one specimen: 230 μ.

The genital opening is between coxae III and IV. On leg I the seta wa is nearer to ω₁ than to the base of the terminal sucker. A similar sucker is also found on leg II as is characteristic for the genus (fig. 12 b and c).

Distribution:

C. bakeri was found on the leaves of Hevea in Sumatra and on jute in India (C. Baker & G. W. Wharton, 1952). The specimens figured in this paper were also found on jute in Dacca, India (G. M. Das coll.).
According to A. C. Oudemans' unpublished drawing of Calvolia (= Lenzia) arboricola, C. bakeri differs in the following respects:

1. It possesses a dorsal shield.
2. The dorsal setae $d_4$ are anterior to the latero-abdominal glands and to $l_p$. In C. arboricola these glands and the $l_p$ setae are further forward and $d_4$ are posterior to them.
3. The corneae are intermediate between $v_i$ and the supra-coxal setae. In C. arboricola they are almost on the same transverse line as the supra-coxal setae.
4. On leg I, the solenidion $s_1$ tapers slightly towards its distal end; in C. arboricola it is expanded.

**Discussion:**

The genus Calvolia was erected by A. C. Oudemans in 1911 to include the hypopul or deutonymphal form of Calvolia hagensis Oudemans, 1911; this is distinguished by having a pair of corneae lying external to a band of reddish-brown pigment on the rostrum. No adults were described. In the same paper Oudemans recognised that the hypopus of A. D. Michael's species Tyroglyphus heterocomus also had the same structures. He did not, however, include this species in the genus Calvolia and in 1927 erected the genus Czenspinskia with A. D. Michael's species as type, but with no further diagnosis of the genus. Four years later, A. C. Oudemans founded the genus Dondorfia, and described the type species: D. transversostriata Oud., 1931, the most prominent characters of which were the fine wrinkling of the cuticle and the reddish-brown contents of the latero-abdominal glands.

I have examined three slides of "Czenspinskia heterocoma Michael, 1903" from the Oudemans' collection in Leiden, dated 1896, 1900 and 1921 and find that these are, in fact, specimens of Calvolia (={Dondorfia) transversostriata. As these specimens were found before 1927, it seems likely that these specimens were used in founding the genus Czenspinskia.

The genus Lenzia (type species: Lenzia arboricola Oud., 1928) was erected by A. C. Oudemans in 1928 to include those forms which lack the $v_e$ setae, but possess a pair of corneae in the same region. Similar corneae are also present in C. transversostriata and C. romanovae and possibly in other species as well. C. Radford (1950) found that the name Lenzia was pre-occupied and consequently he changed it to Oulenzia.

Zachvatkin (1941) recognised the close affinity between Calvolia and Czenspinskia (judging from Michael's description of Tyroglyphus heterocomus) and he united the two genera. Subsequent examination of Oulenzia bakeri and Calvolia romanovae (which possesses a typical Calvolia-like hypopus) also shows the close relationship between these two genera and, in my opinion, justifies the inclusion of Oulenzia, as well as Czenspinskia, into the genus Calvolia.

The following diagnosis can be given of the genus Calvolia: Acarid mites having a smooth, or more rarely, a wrinkled cuticle and a transverse constriction between propodosoma and hysterosoma, and usually with a pair of corneae in the position of the anterior corners of the propodosomal shield.
The setae of the idiosoma are smooth and ve are always lacking. Sc e are usually more than three times longer than sc i.

The genital opening is between coxae III and IV or coxae IV in both sexes and anal suckers are absent in the male. An epigynum is usually developed in the female.

The legs end in prominent pretarsi and claws, and no prominent spines are developed. Males possess a single sucker at the distal end of tarsi I and II.

The hypopi are often yellowish in colour, sometimes with a sculptured dorsal surface. They always possess a pair of corneae situated close together at the tip of the rostrum. On leg IV the claw is replaced by one or two setae which exceed half the length of the idiosoma. A well-developed sucker plate is present.

Type species: *Calvolia hagensis* Oudemans, 1911.

In addition to the three species described here, the following have been described as adults: — *Calvolia (=Lenzia) arboricola* (Oud., 1928) from *Hevea* leaves, Sumatra; *C. heterocoma* (Michael, 1903) from oak trees and a squirrel's nest, New Forest, Hampshire, England; *C. kamenski* Zach, 1941, from plant refuse, Bashkeria, U.S.S.R.; *C. knessli* Krausse, 1919 from the debris of Scotch pine or, more rarely, spruce (Türk and Türk, 1957). The hypopi are carried on *Orthotomicus loricis* (Fabr.) (see Krausse, 1919), *Clerus formicarius* and a variety of other insects (Türk and Türk, 1957; Samsinák, 1957); *C. ruelmi* Türk and Türk, 1957 found in galleries of *Dryocoetes villosus* on an American oak, Erlangen, Germany; *C. tuberculata* Zach, 1941 on maize seedlings, Georgia, U.S.S.R.; *C. hebeclinii* Sicher on a hot house plant *Hebeclinium macrophyllum* D. C. Sicily (Canestrini, 1899).

The following have been described only in the hypopial stage — *Calvolia astoma* Türk and Türk, 1957 on *Lasius fuliginosus* and *Formica rufa*, Erlangen, Germany; *C. bulgarica* Storkán, 1935, Bulgaria; it has also been found by Zachvatkin, 1941 on the flax flea *Aphthona euphorbiae* in the U.S.S.R.; *C. calliphorae* Vitzthum, 1922 was found on a bluebottle *Calliphora vomitoria* in Germany; *C. circumspectans* Vitzthum, 1920 on *Ips stebbi* Strohm, Tibet; *C. fraxini* Türk and Türk, 1957 on *Leperisinus omi*, Múnich, Germany; *C. elliptica* Zach, 1941 on *Ellobius talpinus* Pall, U.S.S.R.; *C. fusiformis* Zach., 1941 on a bark-boring beetle *Blastophagus minor* Ratz., near Moscow, U.S.S.R.; *C. goetzae* Türk and Türk, 1957 on *Aphodius prodromus*, Erlangen, Germany; *C. hagensis* Oud., 1911 on rotting leaves, Holland; *C. longipes* Türk and Türk, 1957 on *Cheilidura acanthopygia*, Erlangen, Germany; *C. minima* Türk and Türk, 1957 on *Scolytus intricatus*, Erlangen, Germany; *C. nataliae* Zach, 1941 on a bark-boring beetle *Hylesinus fraxini* Pzn. near Moscow, U.S.S.R.; *C. reticulata* Zach, 1941 on *Osmia (Anthocopa) dalmatina* F. Mor., Switzerland; *C. striata* Vitzthum, 1914 on a bark borer: *Taphrorynchus* sp., Italy and *Pityogenes lepidus* Wichm., Africa (Vitzthum, 1922); *C. thraca* Vitzthum, 1922 from a fly found near Sofia, Bulgaria and in dung on a collective farm, U.S.S.R. (Zachvatkin, 1941); *C. weichmanni* Türk and Türk, 1957 on *Pyrrhidium sanguineum* and in oak debris, Erlangen, Germany; *C. zacheri* Oud., 1929 from mouldy cheese, Germany.
Summary:

1. Descriptions are given of *Calvolia transversostriata* (Oud., 1931). *C. romanovae* Zach., 1941 and *C. bakeri* nov. n.

2. The genera *Czensinskia* Oud., 1927, *Donorofia* Oud., 1931, and *Oulenzia* Radford, 1950 (= *Lenzia* Oud., 1928) are considered to form part of the genus *Calvolia*.

3. A list is given of the known species of the genus *Calvolia*.

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