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NEW TAXA OF COLUMBID (AVES) FEATHER MITES (FALCULIFERIDAE) WITH SUPRATEGUMENTAL SHIELDS[1]

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Abstract *Hyperaspidacarus*, n. gen., and 2 new species, *H. tridentatus* and *H. abbreviatus*, are described from American ground doves (Columbidae). The males have suprategumental excrescences originating from the anterior hysterosoma and extending anteriorly *over* the propodosoma.

Marked male polymorphism occurs in the falculiferid genera *Falculifer* Railliet, *Cheiloceras* Trouessart, and *Hexoplostomus* Gaud. In these groups the polymorphism is expressed in the meso- and heteromorphs as modified gnathosomata with enlarged chelicerae, and the anterior legs and propodosomata are unlike those of the females and homeomorphic males. We suspect that the males on which the new taxa are based are heteromorphs, even though the gnathosoma is not modified. The males have spectacular internal vertical setae and anterior legs. The epimerites of legs I are elongated and parallel at their posterior terminations and the dorsal idiosoma is heavily sclerotized. The females are typical for the Falculiferidae. They have simple vertical setae and anterior legs, the epimerites I are short and distant, and the dorsal idiosoma has lightly sclerotized shields.

In *Hyperaspidacarus*, n. gen., each male has a suprategumental excrescence originating near the sejugal region and extending anteriorly. Using scanning electron (SEM) and phase microscopy, an interpretation of the 3-tined excrescence over the gnathosoma of *H. tridentatus*, n. sp., can be made (Fig. 1, 2, 8). From about the level of setae *l 1*, the excrescence arises from the dorsal idiosoma and continues anteriorly as a wide, thin plate *over* the propodosoma much like the pronotal horn of rhinoceros beetles; curved subtegumental thickenings form the supporting structure. As seen with phase microscopy, there are 2 pairs of setae under the trident excrescence, the internal verticals (*vi*) and the 1st pair of hysterosomal dorsals (*d 1*). With SEM, *vi* are seen to be highly modified but normally positioned at the anterior margin of the prodorsal shield (Fig. 2, 3, 5). However, setae *d 1* are inserted on the ventral surface of the excrescence and thus positioned *above* the posterior margin of the propodosoma. In the 2nd species, *H. abbreviatus*, n. sp. (Fig. 4, 9), the excrescence is short and ends over the posterior margin of the propodosoma; setae *d 1* are also inserted on the ventral surface but are at the level of the 1st pair of lateral hysterosomals. Because of the origin and positions of setae *d 1*, we can conclude that the projections are hysterosomal in origin and should be termed hysterosomal excrescences.

Common to most Acaridida is the opisthonotal gland. In the males and females of *Hyperaspidacarus*, these glands are apparently absent; however, cupules *ia* near setae *l 1* and cupules *im* between *l 2* and *l 3* are present. The latter cupules are not common in feather mites.

These mites, assigned to the feather mite family Falculiferidae (Pterolichoidea), are known only from American ground doves. This group of birds consists of 17 species in 5 genera (Goodwin 1970). We have limited material from 6 species representing 3 of the genera. *Hyperaspidacarus tridentatus* has been taken from species of *Columbina* and *Scardafella* and *H. abbreviatus* from *Claravis pretiosa* (Ferrari-Perez). In the future we will collect from other species of ground doves to see if there is parallel evolution between the parasites and the birds as depicted by Goodwin (1970, p. 215).

The terminology in the descriptions follows Atyeo & Gaud (1966). Primary types are deposited in the American Museum of Natural History (AMNH); secondary types are deposited in AMNH and in the University of Georgia (UGA). In the type data and other materials sections, the accession numbers of the bird skins from AMNH and the University of Florida (UF) plus the accession numbers for the mite collections from the University of Georgia (UGA) and the University of Nebraska (NU) are noted. For birds either field collected or from smaller museums, only the mite accession numbers are appropriate.

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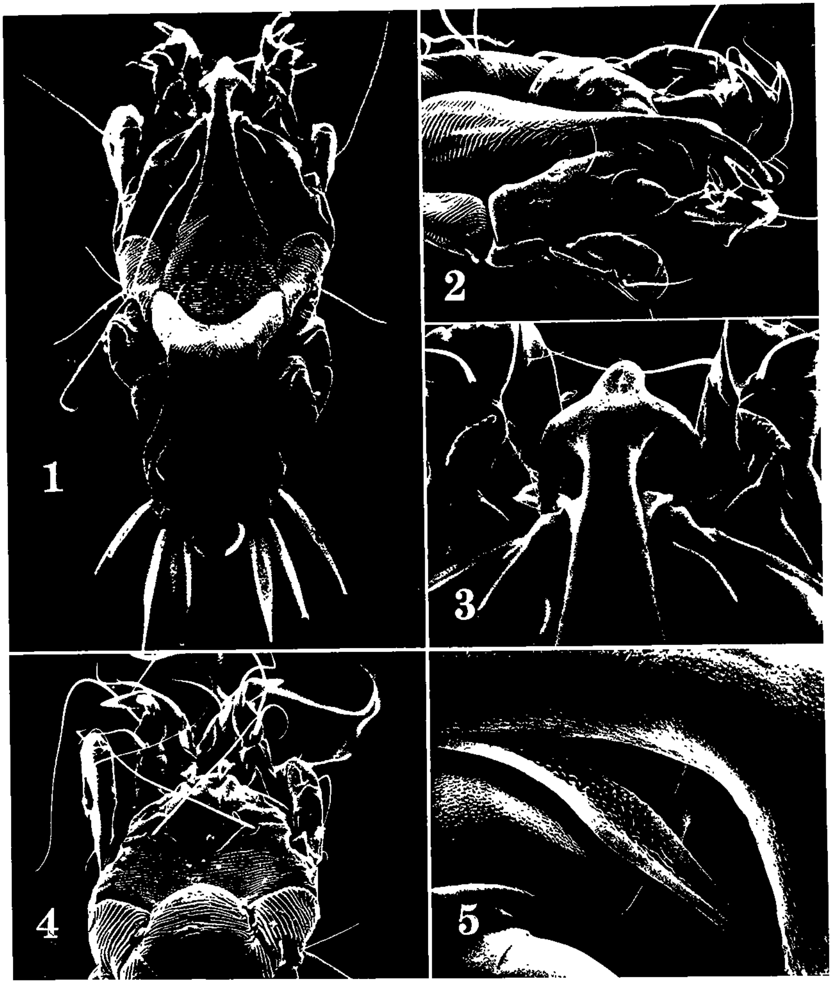

FIG. 1–5. SEM's of *Hyperaspidacarus* ♂: **1–3**, *H. tridentatus*, n. sp., aspects of idiosoma; **4**. *H. abbreviatus*, n. sp., **5**, *H. tridentatus*, spindle-shaped vertical seta beneath excrescence.

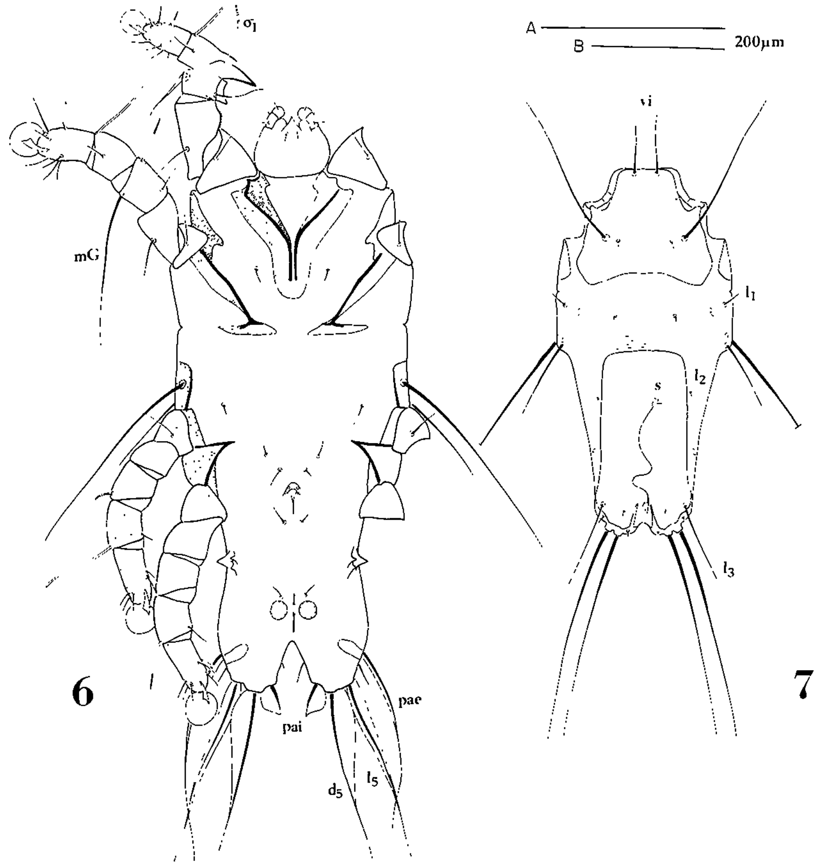

FIG. 6, 7. *Hyperaspidacarus tridentatus*, n. sp.: **6**, ventral aspect of ♂; **7**, dorsal idiosoma of ♀. Setae: *d 1–5*, *l 1–5*, dorsal and lateral hysterosomals. *mG*, genual seta; *pae*, *pai*, external and internal postanals. *vi*, internal verticals; *σ I*, genual solenidion. Structures. s, spermatheca. Scales. A, Fig. 6; B, Fig. 7.

Hyperaspidacarus Atyeo & Smith, **new genus**

Type-species. Hyperaspidacarus tridentatus, n. sp.

Diagnosis. Falculiferid mites with 3 ventral setae on tarsi III, IV, all tarsi with setae *p*, *q*; ambulacra nonretractible, with L-shaped condylophores without condylophore guides; trochanters I–III each with 1 seta, tibiae III, IV each with seta *kT*; setae *sh* longer than *h*; 2 internal vertical setae; setae *ve* represented by pits, opisthonotal gland apparently absent; cupules *ia*, *im* present. Males with epimerites I parallel at terminations; setae *vi* expanded, stalked, setae *sci* anteromesal to *sce*; semicircular subtegumental thickening posterior to sejugal suture continuous with suprategumental excrescences, excrescences bearing setae *d 1* on ventral surface, terminus with triangular

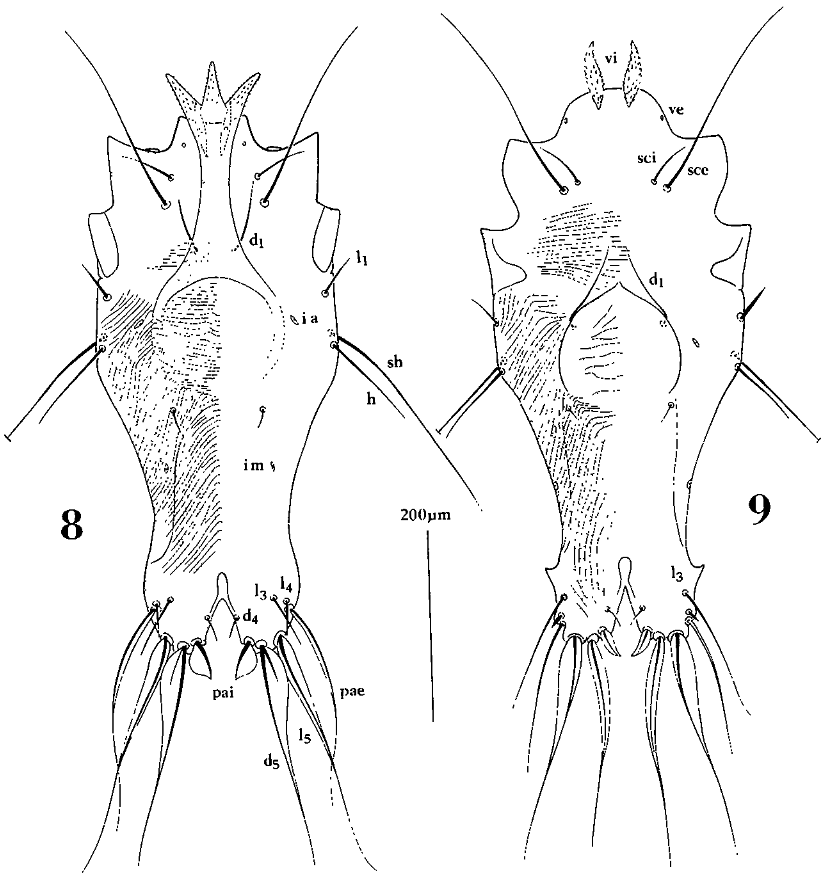

FIG. 8, 9. *Hyperaspidacarus* ♂, dorsal aspects: 8. *H. tridentatus*, n. sp.; 9. *H. abbreviatus*, n. sp. Setae: *d 1–5*, *l 1–5*, dorsal and lateral hysterosomals; *h*, humeral; *pae pai*, external and internal postanals; *sce*, *sci*, external and internal scapulars; *sh*, subhumerals; *ve*, *vi*, external and internal verticals. Structures: *ia*, *im*, hysterosomal cupules.

cleft; setae *d 5*, *l 5*, *pai* leaflike; adanal discs sclerotized, dentate. Female similar to *Falculifer* with striated tegument except as illustrated; epimerites I short, not approximate, parallel at terminations; pregenital apodeme absent, primary spermpore terminal in cleft; setae *l 3*, *d 5*, *l 5* long. Probably restricted to American ground doves.

Etymology. From the Greek *hyper* (over, above) + *aspisos* (shield) + *akari* (mite); masculine. The name refers to the suprategumental expansion of the hysterosoma over the dorsal surface of the male propodosoma.

This new genus is easily distinguished from the related *Rhipiurus* Gaud & Mouchet. *Hyperaspidacarus* has 2 internal vertical setae, setae *sh* are not basally dilated and are longer than setae *h*, solenidia *σ 1* on genua II are longer than the segment, the male genital region is between legs III and IV, and the female has the hysterosomal shield extending anteriorly to about the midpoint between setae *d 1* and *l 2*. In contrast, *Rhipiurus* has 1 internal vertical seta, setae *sh* are basally dilated and shorter than *h*, *σ 1* on genua II are much shorter than the segment, the male genital region is posterior to legs IV, and the female has the hysterosomal shield extending to setae *d 1*.

Hyperaspidacarus tridentatus Atyeo & Smith, **new species** FIG. 1–3, 5–8

♂ (holotype, Fig. 1–3, 5, 6, 8). Length, including gnathosoma, 640 μm. Dorsal idiosoma: propodosoma covered mesally by 3-tined excrescence ending over the gnathosoma, setae *vi* spindle-shaped, setae *sci* anterior to *sce*, tegument lightly punctate except posteromesally. Hysterosoma with heavy ridges (illustrated as lines); trident excrescences, including supporting ring, 370 μm; setae *l 4* rigid, 41 μm long; setae *pae* slightly expanded; setae *pai* broadly expanded. Ventral idiosoma striated except in areas surrounding epimerites. Each tibia I expanded dorsomesally to form short spine; each genu I with large dorsal spine bearing elongated *σ 1*, seta *mG* basally dilated, antaxial platelike crest. Each femur I with 2 toothed ridges, 1 dorsal, 1 antaxial.

♀ (paratype, Fig. 7). Similar to *Falculifer*. Length, including gnathosoma, 601 μm. Prodorsal shield 122 μm long, 167 μm wide; distance between setae *sce*, 98 μm. Hysterosomal shield 207 μm long, ending midway between setae *l 1*, *l 2*.

Type data. From *Columbina* (=*Columbigallina*) *talpacoti rufipennis* (Bonaparte, 1855), holotype ♂, 1♂ paratype, HONDURAS: Caliche, near Orica, Francisco Morazan, 16.VII.1937, C.F. Underwood (AMNH 329396, UGA 6034); 3♂, 1♀, TRINIDAD: St. George Co., Waller Field, 19.VI.1964, C. F. Collins (UF 10,790, UGA 11,355); 3♂, 1♀, St. George Co., Fort Reed, 12.VI.1964, C. F. Collins (UF 10,791, UGA 11,357). From *C. talpacoti* (Temminck, 1811): 2♂, 2♀ paratypes, MEXICO: Boca del Rio, Vera Cruz, 19.VII.1942, D. Donalson (NU 1646). The holotype is deposited in AMNH; paratypes are deposited at UGA.

Additional specimens examined. From *Columbina passerina* (L., 1758), 4♂, 4♀, USA: Texas (NU 1137-9). From *C. p. passerina*, 1♀, USA: Florida (UGA 6031). From *C. p. griseola* Spix, 1825, 4♀, BRAZIL: Maranhão (AMNH 241139, UGA 6036). From *C. m. minuta* (L., 1766), 1♂, COLOMBIA: Meta (UGA 8057). From *C. p. picui* (Temminck, 1813), 1♂, 3♀, ARGENTINA: Misiones and Corrientes (AMNH 792609, 792607, 792598, respectively, UGA 6028-30). From *Scardafella inca* (Lesson, 1847), 3♂, 4♀, USA: Texas (NU 1135-6). From *S. s. squamata* (Lesson, 1831), 4♂, 2♀, BRAZIL: Bahia and Goiás (AMNH 473248, UGA 6023; AMNH 163121, UGA 6024).

Etymology. From *tridens* (L., trident), in reference to the apex of the hysterosomal excrescence.

Remarks. The 2 new species recognized in *Hyperaspidacarus* are distinct; *H. tridentatus* has a highly modified trident hysterosomal excrescence and *H. abbreviatus* has a small excrescence ending slightly anterior to the sejugal region.

Hyperaspidacarus abbreviatus Atyeo & Smith, **new species** FIG. 4, 9

♂ (holotype, Fig. 4, 9). Length, including gnathosoma, 632 μm. Dorsal idiosoma, propodosoma covered posteriorly by small extension of hysterosoma; setae *vi* enlarged, attached basally; setae *sci* anteromesal, approximate to *sce*; tegument lightly punctate except for striated area posterior to scapular setae. Hysterosoma with heavy ridges (illustrated by lines) except for mesal region; excrescence small, ending anterior to level of setae *l 1*; setae *l 4* thornlike, 19.6 μm long; setae *pae* not expanded, setae *pai* as small leaves. Ventral idiosoma with mesal sclerotization surrounding genital region, otherwise similar to *tridentatus*. Legs I similar to *tridentatus* except dorsal spines of equal length; toothed areas, crest absent; setae *mG* simple, long (about $\frac{1}{12}$ idiosomal length).

♀ (paratype). Indistiguishable from *H. tridentatus*.

Type data. From *Claravis pretiosa* (Ferrari-Perez, 1886), holotype ♂, 1♂ paratype, BOLIVIA: Guayaramerín, Beni, 25.VIII.1964, coll. unknown (AMNH 791754, UGA 6040); 1♂, 1♀ paratype, MEXICO: Oaxaca, 38 km N Matiás Romero, 19.III.1962, W.J. Schaldach (AMNH 778240, UGA 6039). The holotype is deposited in AMNH; paratypes are deposited at UGA.

Etymology. From *brevis* (L., short) for the shortened hysterosomal projection or excrescence.

Remarks. In addition to the obvious differences in the hysterosomal excrescences between the 2 species of *Hyperaspidacarus*, *H. abbreviatus* has differently modified internal vertical setae, has setae *sci* approximate to *sce* (cf. Fig. 8, 9), and has the spines of the tibiae and genua of legs I of equal length.

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MULTIPLE AUTOGENY AND BURROW OVIPOSITION BY A MARINE HORSE FLY (DIPTERA: TABANIDAE)

Abstract. The pangoniine horse fly *Apatolestes actites*, whose immatures inhabit coastal sandy beaches in California, USA, was found to be bi-autogenous and to have much-reduced mouthparts. This is the first report of multiple autogeny in a wild-caught member of a predominantly bloodsucking brachycerous family; females of nearly all other known autogenous flies normally either require a blood meal to complete their 2nd gonotrophic cycle or are incapable of producing a 2nd batch of eggs. Gravid *A. actites* females search for, and oviposit in, subterranean burrows of amphipods or isopods. All other tabanids whose oviposition habits have been studied lay their eggs on objects aboveground. Multiple autogeny and subterranean oviposition, plus other physiological and behavioral adaptations, have enabled this horse fly to colonize a generally inhospitable environment.

Roubaud (1929, C. R. Acad. Sci. **188:** 735–38) first used the term autogeny to describe the phenomenon whereby female mosquitoes produced their 1st batch of eggs without having fed on blood. Since then some autogenous species have been identified among most families of lower Diptera (Nematocera and Brachycera) having blood feeders (Downes, 1971. The ecology of blood-sucking Diptera: an evolutionary perspective, p. 232–58. *In:* Fallis, ed., *Ecology and physiology of parasites: a symposium held at Univ. of Toronto 19 & 20 Feb. 1970.* Univ. of Toronto Press). Autogeny may be either an obligatory or facultative phenomenon, and heretofore it has been associated only with production of the females' 1st batch of eggs in Brachycera; production of subsequent egg batches has depended on ingestion and digestion of a blood meal from vertebrates. Among Nematocera, *Culex pipiens molestus* Forsk. has been shown experimentally to rarely produce 2 batches of eggs autogenously under particularly favorable larval growth conditions (Kal'chenko. 1962. Entomol. Rev. **41:** 52–54), and females from northern populations of another mosquito, *Wyeomyia smithii* (Coquillett), each produced 3 to 5 egg masses autogenously in the laboratory (O'Meara, Lounibos & Brust, 1981. Ann. Entomol. Soc. Am. **74:** 68–72). In obligatorily autogenous species having just 1 gonotrophic cycle, the females never feed on blood, and nutrient reserves are depleted during oogenesis (Rubtsov, 1956, Entomol. Obozr. **35:** 731–51; Rubtsov, 1961, Entomol. Rev. **39:** 392–405; Smith & Brust, 1970. Can. Entomol. **102:** 253–56; Downes, 1971, loc. cit.). Here we present the first case of multiple autogeny in a wild-caught member of a predominantly bloodsucking brachycerous family. This is also the first time that subterranean oviposition behavior has been reported in a species of horse fly (Diptera: Tabanidae).

Apatolestes actites Philip & Steffan, a member of the primitive subfamily Pangoniinae, is native to sandy beaches along the California coast, an environment not known to be exploited by any of the other 72 tabanids recorded from the state (Middlekauff & Lane, 1980, Bull. Calif. Insect Surv. **22:** 1–99). A South American species, *Scepsis nivalis* Walker, is the only other New World pangoniine that reportedly inhabits sandy ocean beaches (Coscaron, 1976, Rev. Mus. La Plata N.S. Zool. **12:** 75–116). The *A. actites* population studied inhabited a beach ca. 23 km NW of San Francisco. Immatures were found in the supralittoral zone 8–36 cm deep in sand having a low moisture content ($\bar{x}$ = 0.9%) and a fairly high salt concentration ($\bar{x}$ = ca. 110 meq/l) in the summer. Although the supralittoral may be considered a transitional area between exclusively marine and terrestrial habitats, soil arthropods living there year-round are subject to marinelike conditions, including relatively high salinity and periodic inundation by storms or very high tides, particularly during the winter.

On the beach, gravid *A. actites* females were observed searching for, entering, or inside amphipod or isopod burrows from 1045–1335 h (PST). The oviposition-site-seeking behavior of these females was characterized by a slow, roundabout flight pattern undertaken a few centimetres aboveground in the supralittoral zone. This behavior differed from that of males and nongravid females, whose flight was normally rapid and fairly direct, and who were active in both the littoral and supralittoral zones. While searching for burrow oviposition sites, females landed intermittently and usually crawled into several burrows. After a brief inspection, shallow burrows were rejected and females resumed their search for a deeper burrow. Three females removed from burrows up to 13 cm deep contained mature eggs, as did a 4th fly captured as it searched for a burrow; 3 deposited eggs in containers within a few hours and the 4th was dissected. Three other newly emerged females, held in experimental oviposition chambers while their eggs developed autogenously, also entered and laid eggs in simulated sandy burrows. Eggs were never found on objects (e.g., beach wrack, driftwood) aboveground on the beach, but one afternoon after high winds had obliterated burrows in the supralittoral, an *A. actites* female was seen entering a deep crack in a log from which eggs were recovered 2 h later. These findings demonstrate that *A. actites* usually lays its eggs in burrows and, alternatively, in deep crevices in logs. All other tabanids whose oviposition habits have been studied place their eggs on vegetation or other objects aboveground.

Dissections of 25 newly emerged females that had been maintained on a carbohydrate-water diet for periods of <1–17 days revealed that flies developed their 1st batch of eggs autogenously in 6 days (25 °C, 67% RH). Females (n = 8) produced a mean of 322 (218–415) eggs in the 1st gonotrophic cycle. Two wild females caught in mid-season laid only 32 and 54 eggs, respectively. Subsequent examination of these females, which were determined to be biparous by Polovodova's technique (*In:* Detinova, 1962, Age-grouping methods in Diptera of medical im-