

NOTES ON APHIDOPHAGOUS SYRPHIDÆ OF SOUTHERN CALIFORNIA

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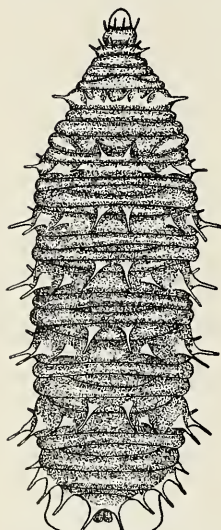
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(Continued from January-February Issue)

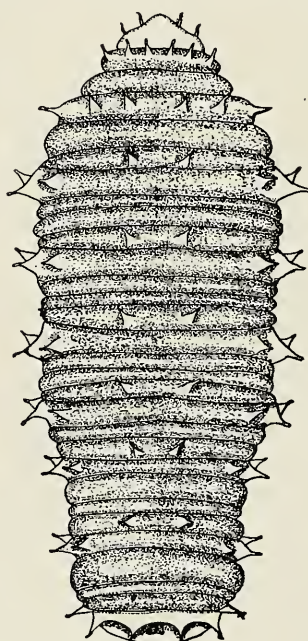
ALLOGRAPTA OBLIQUA Say.

This species ranks very close to *Eupeodes volucris* in abundance. In fact, during the summer season, and on such hosts as the melon aphid, it is much more abundant than *Eupeodes*, but although it can be taken during any month in the year, it fails to maintain itself in such numbers during the winter.

A. obliqua is one of the smaller elongate species, the adults being from 6 to 8 mm. long. They are bright-colored and iridescent in the sunlight. The male has large bright red eyes, while those of the female are brownish red. General characters: Face yellow, with a facial stripe variable in extent and boldness, generally fading from center laterally; color brown. Thorax deep shining green, with yellow or light orange lateral stripes. Scutellum gamboge, with black pile. Abdomen brownish black: First segment, except a slender transverse spot on each side behind, yellow; second segment with a slender yellow anterior fascia, and a broader one in the middle; third segment with a broad, arcuate yellow band; fourth segment with two slender parallel stripes, leaving a slender black stripe between them, on each side a broader, oblique, oval spot, touching or



1. *Baccha clavata*. Fabr.



2. *Eupeodes volucris*. O.S.



3. *Paragus tibialis fallax*.

PLATE E.

All figures enlarged.



narrowly separated from the anterior end of the yellow longitudinal stripe, and reaching to the posterior angles; fifth segment similar, but side spots less oblique.

The egg is elongate oval, .8 mm. long, .3 mm. in diameter; chalk-white, elevations of the chorion 3 or 4 times as long as broad, elevations about two-thirds as wide as the interstices.

The incubation period varies from 2 to 3 days in summer up to as long as 8 days in mid-winter.

The newly-hatched larvae are pale-yellow, almost white, apparently devoid of vestiture, .85 to 1 mm. long by .2 to .35 mm. wide. As growth proceeds the color slowly deepens until toward the end of the penultimate instar a greenish hue is visible, and after the final molt the color is bright green.

Full-grown larvae are 10 mm. long and 2.5 mm. wide; general color pea green, somewhat lighter at sides and anterior end. The broad whitish-green median stripe, with narrow darker heart line showing through, in some specimens gives the appearance of a double stripe. Body somewhat flattened, especially so at posterior end, wrinkled; segments showing indistinctly. Segmental spines short, white, inconspicuous. Posterior spiracular tubes prominent, 1 mm. long, a fused pair, divergent at tips, length twice as much as combined width; color light brown. In some specimens the dorsal line shows pinkish or reddish. The general appearance of *Allograpta* larvae is comparatively smooth and slug-like.

The larvae grow rapidly under favorable conditions, and require only from 9 to 15 days to complete their development. During summer and fall the average period of development is only 9 or 10 days. During mid-winter, however, the development is slow, and the larval stage is from 16 to 21 days.

Allograpta larvae feed greedily, as the following food records will show: 174, 188, 184 *Aphis gossypii* (stages ii-v); 124, 155 and 188 *Aphis gossypii* and *Chromaphis juglandicola* (all stages); 210, 228 *Myzus persicae* (stages i-iv); 205 *M. persicae* (alates).

However, larvae can mature on much fewer aphids, as the following records show: 57 *Aphis brassicae* (all stages); 79 *Macrosiphum rosae* (stages i-iv). Also a lack of food prolongs the larval stage. Thus three larvae hatching at the same time had daily access, for practically their entire life, to the following number of aphids: 4, 8 and up to 38 *Myzus persicae* (stages iii-v). The first one consumed a total of 132 aphids and matured in 39 days; the second ate 154 and

In confinement larvae readily ate the mealy bug *Pseudococcus citri* Risso, but refused the red spider, *Tetranychus telarius* Linne. They were not reared successfully on *Aphis rumicis*, on several occasions being unable to free their jaws from this aphid.

Newly-hatched larvae maintained themselves on corn and beet foliage for three days without having access to aphid or other animal food. On the fourth day they were observed to have slightly grown, and aphids were fed them, whereupon they developed normally. Older but not full-fed larvae were able to transform after as long a fast as 5 days. A fast of 8 days did not kill them outright, but pre-matured in 34 days; while the third larva, which had daily access to abundant food supply, consumed 167 and matured in 16 days. vented subsequent transformation. The fact that larvae can subsist for several days without aphids must be of considerable assistance to the species if the parent happens to oviposit where aphids are not immediately available, or where those present disappear before the egg hatches.

The larvae are better adapted to stand excessive moisture than are those of other species, such as *E. volucris*, *B. clavata* or *P. tibialis*; on the other hand they appear to succumb to drought more easily. The larvae seek out some dark locations, as curled leaves, along mid-ribs, and lie there when not feeding. On walnut trees they have a penchant for resting in the obscure locations at the base of a nut cluster. On these trees pupation occurs chiefly on the upper surface of the leaf, but also on the lower surface, petioles and nuts. Observations suggest that in the summer broods, pupation always occurs above ground. On melon vines, larvae congregate under the fruit at the soil surface to pupate, but many also pupate on the foliage. (Fig. 3a)

When first formed the pupa is bright pea green, the markings of the larva showing very distinctly. As development takes place the larval coloration is lost, and the puparium becomes a darker green with a brownish tinge. The anterior end is bulbous; the insect is broadest and deepest in front of the middle, the dorsum broadly rounded, tapering to a tip at posterior end; venter slightly concave. Posterior spiracular tubes prominent, 1 mm. long, and longer than their combined width, color light brown. Length 5.5 to 6 mm., width 2.5 to 2.75 mm.; height 2 to 2.5 mm.

A few days before emergence the bright reddish brown eyes and yellow striped abdomen of the imago show very plainly through the puparium shell.

In the summer the pupal stage varies from 8 to 10 days, while in mid-winter it requires from 18 to 33 days.

During the period June to November many attempts were made to induce adults to breed in confinement. Altogether 75 males and 92 females were employed in these tests, most of which occurred in large wire screen cages where the flies were provided with honey-bearing plants (*Alyssum*) and sugar-water. The flies were newly-hatched and lived in the cages for an average of 15 days, but not a single egg was deposited nor was copulation ever observed.

Nine gravid females were caught in the field and observed for egg-laying records. The maximum number of eggs was 173, deposited in 6 days on screened plants infested with aphids (July). In general thirty eggs and over were often deposited within 24 hours by these flies. More than 90 per cent of the total number (563) were fertile.

Judging from the habits of flies kept in captivity the adults move about but little before the sun is well up in the morning. At night they were observed resting on the foliage and cage sides and tops. The flies exhibit their greatest activity in full sunlight.

In the field the flies fed on blossoms, and have been observed on many varieties; in field cages they readily fed on alyssum; in captivity they readily lapped up and gorged themselves on honey water.

Out of 145 bred flies, 77 were females and 68 males.

The figures given above for the various stages show that the period from egg to adult varies from 19 to 25 days in summer, and from 42 to 62 days in winter. Indications are that there are from 6 to 8 generations per annum.

A. obliqua larvae have been taken feeding on the following aphids: *Aphis atriplicis* L., *A. gossypii*, *A. maidis*, *A. roseus* Baker, *A. medicaginis* Koch., *A. nerii* Fons, *A. pomi* DeGeer, *A. prunifoliae* Fitch, *A. rumicis*, *A. viburnicolens* Swain, *Brevicoryne brassicae*, *Chromaphis juglandicola*, *Macrosiphum cucurbitae*, *M. pisi*, *M. rosae*, *Myzocallis bellus* Walsh, *Myzus braggii*, *M. rosarum* and *Toxoptera aurantii*.

The internal parasites, *Diplazon laetatorius* and *Pachyneuron californicum* have been bred from puparia of *A. obliqua*.

In the fall of 1919 in Los Angeles and Orange Counties 84 larvae and puparia were collected and reared for parasite data. Of these but 4 yielded parasites, 1 *Diplazon* and 3 *Pachyneuron*. From the three puparia parasitized by the latter there issued respectively 6 females, 7 males and 5 females, 5 males and 3 females. The *Pachyneuron* imagoes emerged through single holes cut in the puparia shells of the hosts, while the single *Diplazon* cut a jagged hole in the operculum.

The record indicates a parasitism of about 5 per cent.

ALLOGRAPTA FRACTA O. S.

This species is very much like *A. obliqua*, except that it is a little smaller. The chief differences which enable the two to be separated are as follows: In *fracta*, there is a bluish-black facial stripe extending in the oral margin, while in *obliqua* it is brown. In *fracta* the first abdominal segment is not more than half yellow above, while in *obliqua* considerably more than half of the segment is yellow. The scuteelar pile of *obliqua* is all black, while in *fracta* it is almost all yellow. In *obliqua*, on the fifth segment of the female the longitudinal stripes are parallel, while in the *fracta* female they diverge anteriorly. The immature stages are practically indistinguishable.

For Southern California generally *fracta* is a much less common species than *obliqua*, but in the Imperial Valley *fracta* is very abundant and *obliqua* scarce.

The egg is white, microscopically sculptured, elongate oval, .55 mm. x .25 mm.

The incubation period varies from 2 to 3 days in the Imperial Valley and 5 to 6 days at Alhambra at about the same time of year.

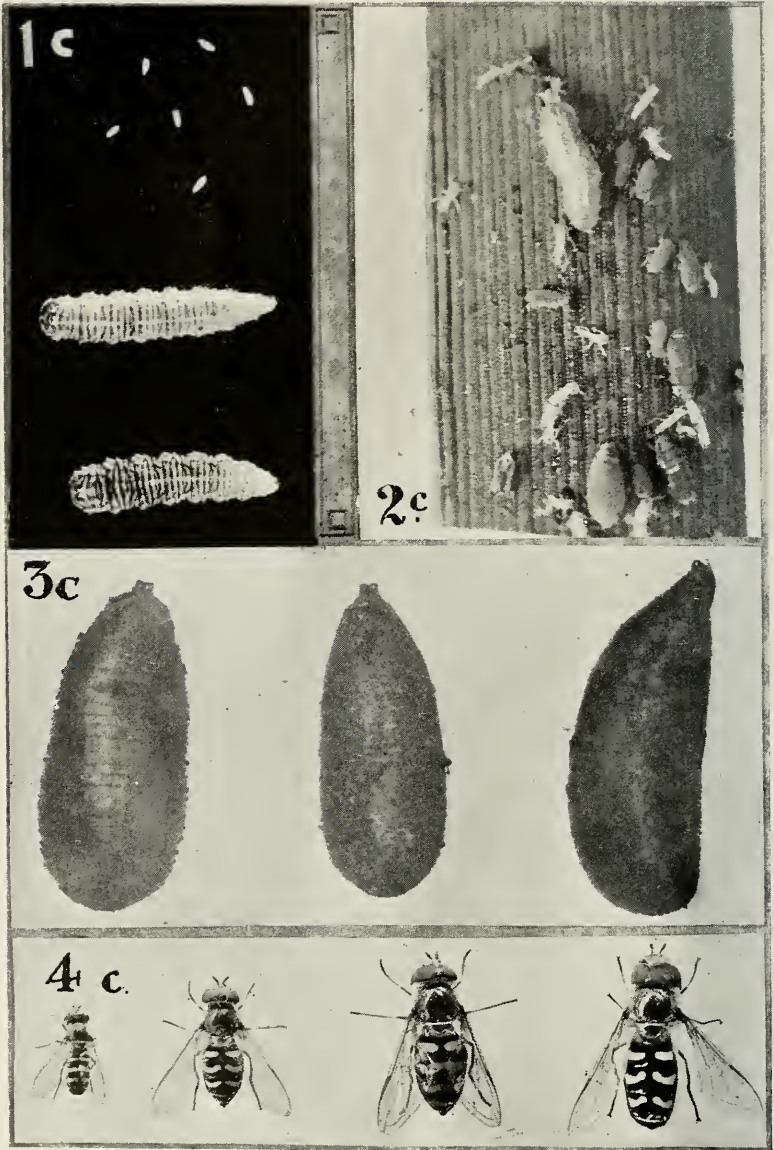
The newly-hatched larvae are whitish, narrow, cylindrical, the mouth parts gray; on each segment are two small fleshy conical elevations. The posterior spiracular tubes are light brown, wartlike, not contiguous.

As growth proceeds the body becomes pea-green in color. In younger larvae the dorsal strip has a pinkish tinge, but this gradually fades away.

The full-grown larvae are 8 to 9 mm. long, 2 mm. wide and 1.2 mm. in height, elongate oval, somewhat flattened. Integument papillose, transversely wrinkled; color green with two narrow whitish stripes flanking the dorsal vessel; posterior spiracular tubes prominent, .5 mm. long, about half as wide at bases.

The larval stage in the Imperial Valley in March was from 11 to 12 days, and at Alhambra 13 to 15 days in April and May and 25 to 27 days in February.

PLATE O.



Only two complete feeding records of *fracta* larvae were observed, as follows: 185 and 209 *Macrosiphum rosae*, stages i-iv.

Pupation takes place on the plant foliage. The puparia are green and at first show the larval markings. These gradually disappear and the eyes and abdomen of the adult begin to show. Anterior face of the puparium bulbous, outline of dorsum convex, curving downward toward the base of the respiratory tubes, venter gently concave. Length 5 to 6.5 mm.; width 2 to 2.5 mm.; height 1.7 mm. to 2.1 mm.

The duration of the pupal stage was 5 to 12 days at El Centro; 13 days in April and May, and 23 to 26 days in March, at Alhambra.

Breeding in confinement was not successful, although adults lived as long as 18 days. Two females captured in the field laid 52 and 60 eggs in 5 and 9 days respectively.

The length of life from egg to adult for this species varies from 18 to 27 days in the Imperial Valley (March-April), while at Alhambra it is from 31 to 34 days in April and May, and 53 to 59 days in February and March.

A. fracta larvae were taken on the following aphids: *Aphis gossypii*, *A. maidis*, *A. prunifoliae*, *Illinoia pisi*, *Macrosiphum rosae*, *Myzus rosarum*, *Toxoptera graminum*, *B. brassicae*.

From *A. fracta* have been bred the same parasites as from *A. obliqua*. In the spring of 1918 *Diplazon laetatorius* was bred frequently and *Pachyneuron californicum* occasionally in Imperial County.

CATABOMBA PYRASTRI L.

This species is also one of the common Syrphus flies. It is seldom quite as numerous as *Eupeodes* or *Allograpta*, but ranks about with the *Syrphus* species, which it closely resembles both in structure and appearance. It is common during the cooler parts of the year, being most abundant in the spring and fall, and scarce during June, July and August.

The adult is the largest of our aphidophagous Syrphids, being from 11 to 13 mm. in length, with the chief characters as follows: Face light yellow, a brown spot on tubercle extending more broadly to the oral margin, pile abundant, whitish. Cheeks greenish black. Eyes of male contiguous for a distance about half as long as the median length of the frontal triangle. Thorax shining greenish black; scutellum yellow, very translucent bluish opalescent. Abdomen black, subopaque, with 3 pairs of arcuated whitish yellow spots, those of each segment distinctly separated and from one another narrowly so from lateral margins.

Occasionally there are sporadic occurrences of a melanic form of the female in which the three pairs of whitish spots on the abdomen are absent (var. *unicolor*) (Fig. 4a). In some seasons these are fairly frequent, but in other seasons they are quite scarce or absent.

The eggs are chalk white, 1.02 x .44 mm. slightly broader at the non-micropylar end. Elevations barely 1/2 as wide as the interstices, about 6 times as long as broad, irregular in outline and connected by a network of ridges.

The incubation period varies from 3 to 10 days, according to the season. The newly-hatched larvae are pale yellow, with rows of long black hairs, body narrow, narrowing anteriorly from cauda. After feeding and a few days' growth, the larvae become greenish, some with a pinkish tinge, and have white lateral stripes. The larvae are very active, especially when the weather is warm, and reach maturity in from 12 to 25 days. The full-grown larvae are from 14 to 16 mm. in length and 3.5 to 4 mm. in width. The general color is pea green

to brownish green, paler toward the anterior end. There is a distinct white median stripe, and two fainter and more irregular white dorso-lateral stripes. The body is wrinkled, and the segments distinct. The segmental spines are short and inconspicuous. The integument is beset with fine microscopic hairs. Caudal end square. Posterior spiracular tubes dark brown, contiguous, very short.

Catabomba larvae (Fig. 1c) attain a large size, and are capable of eating a large number of aphids, although, as with the other species, the number required for the larvae to reach maturity varies considerably. For single larvae the following food records were obtained: 302 *Illinoia pisi* (stage ii), 403 (stages i-iv); 326 *M. rosae* (stages i-iv), 361 (stages i-iv), 412 (stages i-iv). Another record indicated that 2 larvae matured on 331 *Myzus persicae*, but produced undersized adults.

Pupation usually takes place on the soil under debris, but sometimes about half an inch in the soil. When first formed, the pupa is greenish-brown, with the whitish mid-dorsal stripe showing plainly. After a few days the pupa becomes a light chocolate to a sordid brown. It is broadly rounded at the anterior end, broadest in front of middle, tapering slightly to posterior end. Dorsum broadly convex, venter fairly straight, slightly concave toward posterior end. Segmentation indistinct. Integument papillose and armed with sparse pale hairs. Posterior spiracular tubes dark brown, shorter than their combined width, basally contiguous, apically slightly divergent. Length, 7 to 9 mm.; width 3 to 4 mm.; height, 3 to 3.5 mm.

The duration of the pupal stage varied from 12 to 22 days.

The adult is a strong, vigorous flier, and when confined in a cage, flies usually injured themselves in a few days by flying against the sides. None lived longer than 8 days.

All attempts to breed this species in confinement failed. Oviposition records of females captured in the field and placed in cages infested with aphids varied from 17 to 85 eggs during a period of from 1 to 5 days. Some or all of these females may have been partly spent when captured, and also might have laid more in confinement if they had not injured themselves in the cages.

Oviposition was irregular, one female depositing 29 eggs in a single day and dying 4 days thereafter. Another produced its entire quota of 47, while in captivity, in 2 days, and died two days later.

The above figures for the different stages of this species show that the period from egg to adult may vary from 27 to 57 days. As with the other species, development depends both on weather conditions and food supply. There doubtless are half a dozen generations in the year.

Catabomba larvae have been taken feeding on the following aphids: *Aphis gossypii*, *A. maidis*, *Brevicoryne brassicae*, *B. pseudo-brassicae*, *Illinoia pisi*, *Macrosiphum albifrons* Essig, *M. rosae*, *Myzus persicae*, and *Chromaphis juglandicola*.

SYRPHUS NITENS Zett.

Both the *Syrphus* species occurring commonly in Southern California are to be found in about the same abundance and at the same seasons. As is the case with *Catabomba*, they are found during the cooler months of the year, most commonly in the spring and fall, and quite scarcely during the summer.

They are both large species, being a little smaller than *Catabomba* but a little larger than *Eupeodes*. (Fig. 5b.)

Syrphus nitens adults are 10 to 11 mm. in length. The eyes are bare, face yellow, with narrow black stripe from tubercle to mouth cavity; cheeks blackish, thorax shining olivaceous; scutellum dull yellow; abdomen black, with three yellow cross bands, which do not reach the lateral margins of the segment; first band interrupted entirely in center, the other two notched on lower margin in the center. Legs yellowish, coxae and base of femora black.

The egg is chalk white, elliptic, about equally broad at either end; elevations about 4 to 8 times as long as broad; their width $\frac{1}{3}$ to $\frac{1}{2}$ as great as that of the interstices, irregular in outline and connected with a network of ridges. Length 1 mm.; width .37 mm. The period of incubation varies from 2 to 7 days.

The newly-hatched larva is 1.25 mm. long, .25 mm. wide, pale yellow, elongate, and armed with black hair. On the whole the younger larvae of this species resemble those of *Eupeodes*, but are more elongate and lack the greenish color of *Eupeodes* larvae of the same age. They are a sordid light gray with brown markings on the posterior portion. After the first molt the general color is brown. The posterior half is ridged with transverse yellow bands, the anterior segments are greenish-white. The body is laterally ridged and bears short pale spines surmounting conical protuberances of the derm. Spines and elevations similar to *Eupeodes*, but not as prominent as in the larva of *Baccha clavata*.

The larvae are quite active, at least when conditions are favorable, and reach maturity in from 13 to 25 days. The full-grown larvae are 12 to 15 mm. long and 3 mm. wide. Observed closely, the color is greenish white, but the numerous light brown fat bodies beneath the derm give a light brown color to the larva as a whole. The dorsal vessel is blackish. The derm bears many areas of close-set minute blackish papillae. Posterior spiracular tubes fuscous, slightly divergent apically, each tube about as long as its basal width. Venter greenish white; segmental hairs pale, rather short.

Individual larval feeding records were as follows: 302 *Aphis gossypii* (Stages i-iv); 362 *Macrosiphum rosae* (stages i-iv); 366, 374 and 378 *Myzus persicae* (stages i-iv).

The larvae pupate under debris on the ground. The puparium is light brown, with many small blackish spots and dots, and a narrow dark dorsal line. The dorsum is broadly convex, and the venter slightly concave. Anterior face has abundant short white pile; elsewhere each segment has a transverse row of 12 pale hairs; integument with areas of thickly-set black papillae as in larvae. Posterior spiracular tubes dark brown, short; basally contiguous; apically slightly divergent.

The duration of the pupal stage varies from 11 to 48 days. Adults bred in captivity lived from 4 to 9 days, while females captured in the field lived as long as 17 days.

Reared specimens would not mate in captivity. Several females taken in the field laid from 27 to 101 eggs, in oviposition periods extending from 2 to 11 days. Another female, taken in September, deposited 175 eggs in 8 days, dying 3 days thereafter. Deposition was irregular, 92 being laid in 2 days, 30 on another, and the rest scattered.

The total of the various stages, leaving out of consideration a pre-oviposition period, indicates that the egg-to-adult period varies from 26 to 80 days. There are probably about 6 generations in the year.

Syrphus nitens larvae were taken feeding on the following aphids: *Aphis avenae*, *A. gossypii*, *A. rumicis*, *Brevicoryne brassicae*, *Illinoia pisi*, *Macrosiphum cucurbitae*, *M. rosae*, *M. perlagonii* Kalt. *Myzus braggii*, *M. persicae*, *M. rosarum*, and *Thomasia salicola* Essig.

SYRPHUS OPINATOR O. S.

This species (Figs. 4d, 5a) closely resembles the preceding, both in size and appearance. The two may be distinguished by the fact that *opinator* has yellow cheeks, femora of female with the proximal half or more black, and the first pair of yellow abdominal spots reaching the lateral margin, while *nitens* has blackish cheeks and only the bases of the femora black, and none of the yellow markings normally reach the lateral margin of the abdomen. *Opinator* is perhaps slightly the larger of the two and the abdominal bands are a bright yellow.

The ovum is white, oval, with vertical elevations, appearing as if its surface were studded all over with short stoutish spicules. Broadest about 5/8 from micropylar end. Length 1.3 mm.; width, .6 mm. The egg sculpture is characteristic and dissimilar to that of the 3 previous species.

The incubation period varies from 4 to 7 days. The newly-hatched larvae are light yellow, cylindrical, with somewhat long and recurrent pale spines. Posterior respiratory tubes prominent, remote.

Full growth is reached ordinarily in from 12 to 32 days. Several records, however, during mid-winter, were considerably longer. One of 40, and another of 52 days were noted. Still another larva, hatching November 18th, reached full growth by January 1st, and then remained in that condition without movement for 3 weeks, pupating on January 22nd. This made a larval period of 65 days. The adult emerged on February 15th.

The full-grown larvae are light lemon yellow or yellowish-pink in color, paler along sides and toward anterior end. Dorsal vessel brownish or pinkish, lighter toward anterior end. Body obscurely ridged, pale spinose. Posterior spiracular tubes fairly prominent, 1 mm. in length, brown, fused, length equal to combined width at bases. Integument papillose, the closely-ranked papillae hyaline. Length 12 to 14 mm.; width 6.5 mm.

This species is another voracious eater; but only one complete feeding record of it was obtained. An individual larva consumed 296 *Macrosiphum rosae*, stages i-iv.

The larvae seek some sheltered place for pupation, usually on the ground under leaves, etc., or in the ground. The puparia are light to salmon brown in color, at first with a paler greenish tinge toward anterior end. Hairs in transverse rows, pale, very short; integument closely papillose, papillae hyaline. Posterior spiracular tubes fairly conspicuous, fused, dark brown, reddish at tips, as long as combined basal width. Anterior face and dorsum broadly convex, dorsum sharply arcuate and concave before posterior spiracles, venter gently concave. The body narrows on the posterior half more noticeably than in *S. nitens* or *Eupeodes volucris*.

Later the color becomes a uniform light sordid brown, and a few days before emergence the reddish eyes and yellow striped dorsum of the imago show plainly through the puparium. Length 8 mm.; height 3.5 mm.; width 3 mm. (Fig. 3b.)

The pupal stage varies from 16 to 27 days. Bred specimens did not mate or oviposit in confinement, but several records of oviposition were secured; three females taken in the field on Brassica flowers (February) deposited 2, 12 and 24 eggs and died within two days. Adults lived as long as 14 days.

The figures given above for the various stages show that the period from egg to adult varies from 32 to 99 days. The number of generations per year is probably the same as for *S. nitens*.

S. opinator larvae were taken feeding on the following aphids: *Aphis gossypii*, *A. rumicis*, *Brevicoryne brassicae*, *Illinoia pisi*, *Macrosiphum rosae*, *M. albifrons* and *Myzus braggii*. In addition larvae in captivity fed readily on *Thomasia salicola*, *Myzus persicae* and *Macrosiphum acrosiphum pelargonii*.

SPHAEROPHORIA

There is some confusion in the present condition of the taxonomy of this genus, due chiefly to the fact that great variations in coloration and pattern exist, and that structural characters are rather weakly defined. A study of the male hypopygium indicates that among the species inhabiting Southern California *S. cylindrica* Say may be recognized as separable from the others by reason of the long hairs of the claspers. *S. sulphuripes* Thompson and *S. melanosa* Williston have short hairs on the claspers. Not unlikely there are more species in the material collected by the writers.

S. micrura O. S. is easily separable by reason of the small male hypopygium.

Life history records were made of two species, *S. cylindrica* Say and *S. melanosa* O. S.

All the species observed in Southern California are small and rather slender, and superficially resemble those of the genus *Allograpta*. They occur chiefly from late winter to mid-summer, and abound in April, May and June.

Considering the several species as a whole, the individuals are more numerous than *Paragus tibialis*, but not quite as abundant as either *Syrphus nitens* or *S. opinator*.

From 25 to 35 per cent of the individuals are the species *S. cylindrica* Say. About 85 per cent of the remainder are referable to *S. sulphuripes* and *S. melanosa* together.

SPHAEROPHORIA CYLINDRICA Say.

The adults (Fig. 4c) are 7-8 mm. long, the males longer and with a narrower abdomen than the female. The main characters are as follows: Face pale yellow, with a brownish median blotch variable in extent. Eyes bare. Antennae light orange. Thorax with cinereous stripes and a yellow lateral stripe from the humeri to the roots of the wings; scutellum yellow with yellow pile. Legs yellow, the basal half of the femora sometimes testaceous. Abdomen black, with yellow cross-bands in the male, the posterior half often largely reddish-yellow, in the female the bands are more arcuate and narrower.

Egg. Length, .9 mm. diameter .3 mm. Elongate oval, chalk white, elevations of the chorion 2 or 3 times as long as wide and about twice as wide as the interstices.

The incubation period was 4 to 5 days in April.

The newly-hatched larvae are pale yellow, .95 mm. long and .25 mm. wide, cylindrical, devoid of vestiture.

Full-grown larva pea green, with white median longitudinal stripe (Fig. 2b). The color is a little darker green than *Allograpta*, and the body in general stouter. In shape and armature the species are very similar. Posterior respiratory tubes noticeably shorter than *Allograpta*, light brown, not divergent distally, fused, except at tips, about 1 1/2 times as long as combined basal width.

The larval period was 11 to 12 days in warm weather. Pupation took place on the leaves, or under debris on the ground.

The pupae are greenish, rather narrow, anterior face bulbous, dorsum convex, evenly descending from top of arch to respiratory tubes; venter gently concave; the sides taper evenly from third segmental region to the cauda; posterior respiratory tubes as in full-grown larvae. Vestiture short and inconspicuous.

The pupal stage was 8 to 9 days. Attempts to breed in captivity were not successful. One female taken in the field produced 12 eggs in 3 days. In captivity adults lived as long as 10 days.

Larvae of this species were taken feeding on *Aphis gossypii*, *A. rumicis*, *Chromaphis juglandicola*, *Brevicoryne brassicae*, *Myzus rosarum* and *Illinoia pisi*.

SPHAEROPHORIA MELANOSA Williston.

This species occurs frequently during the summer months, but is not so common as *cylindrica*. The adult female has a little larger abdomen than *cylindrica*. The abdomen has more black and the 3 cross bands are as follows: 2nd, 3rd and 4th segments each with a slender, gently arcuate, yellow cross band, the first and second of which are interrupted in the middle.

The male has more black on the abdomen, second segment with a narrowly interrupted arcuate yellow band, third segment with a broader entire one, fourth with two narrowly interrupted yellow spots in front, fifth with two smaller ones. Legs brown.

The ovum is chalk white, oval, .8 x .3 mm., the extremities more truncate than in other Syrphid eggs, raised portion of chorion in alternate longitudinal lines, of varied shape, asteroid, each about 3 times as long as wide, broader than the intervening hyaline spaces; connecting ridges, very fine; dorsum of ovum convex.

The larvae and pupae are very similar to those of *cylindrica*.

In April and May the period of incubation was 4 to 5 days, the larval stage 18 to 23 days and the pupal stage 10 to 12 days.

Individual larvae consumed 161, 175, 211, 240 *Myzus rosarum* (stages ii-iv).

Melanosa larvae have been taken feeding on *Aphis gossypii*.

BACCHA CLAVATA Fabr. (*Babista* Walker).

This Syrphid is entirely different in appearance from any of the others, having a long, slender abdomen, very narrow toward the base. Moreover, it is one of the summer forms, appearing first in June, becoming most abundant in July, August and September, and disappearing in November. Although the adults of this species are less common than *Melanostoma*, the larvae have been observed much more frequently.

The adult is 10 to 11 mm. long; the abdomen itself being 6 to 7 mm. The chief characters are as follows: Eyes large and red, face yellow, cheeks black. Thorax shining greenish blue. Scutellum yellow, brown or brownish across the disc. Abdomen long, slender at second segment, rather broadly spatulate at distal end, black or brownish black. A pair of divergent white spots occur on second and third segments.

The eggs are chalky white, .65 mm. by .16 mm., slightly more truncate at the non-micropylar end, somewhat depressed and compressed at the narrower extremity. The whitish elevations of the chorion are elongate oval in form, four or five times as long as broad.

The duration of the incubation period was from 2 to 3 days.

The young larvae are yellowish grey with prominent pale spines. The larvae are not as active as those of some of the larger species, but full growth is reached in a comparatively short time, the period extending from 8 to 11 days.

Larvae in the last instar vary somewhat in color, specimens feeding on *Aphis gossypii* being lighter than those feeding on *A. medicaginis*. The larvae are chiefly characterized by their unusually prominent spines and short posterior spiracular tubes. They slightly resemble the larvae of *Eupeodes*, which, however, have shorter spines. The general color is a greenish brown with a mid-dorsal stripe of light orange, and the tenth and eleventh segments flesh-colored.

The full-grown larvae are sordid whitish, cylindrical; cauda truncate; on the dorsum from 4th to caudal segment color varying from

green to pink and light brown; numerous whitish fat bodies show under integument; on dorsum and along sides of integument occur small areas of black granulations. Each segment is armed with hyaline spines in transverse rows, the sides markedly ridged and the derm produced into conical spiniferous protuberances. Posterior spiracular tubes brown, short, each as wide as long. The extended larvae are 9 mm. to 10 mm. long. They somewhat resemble those of *Paragus tibialis* in shape and spine arrangement, but may be separated by their short respiratory tubes and prominent dorsolateral stripe. *P. tibialis* larvae are also flatter and the body tapers abruptly before the posterior extremity.

But one food record was obtained, in which a larva consumed 181 *Aphis medicaginis* Koch (stages i-iv).

Pupation takes place on the plant on which the aphid host lived. The pupa at first is the same color as the full-grown larva and later turns yellowish-gray. Dorsum evenly convex, anterior face bulbous; venter concave. Sides evenly narrowing caudad of third segment. Armature of pale conspicuous spines not unlike those of *Paragus tibialis*; integument punctate and papillose, papilli fine and short; posterior spiracular tubes short, singly as broad as long, cylindrical, slightly divergent, not fused basally, brown. Length 4.5 to 5 mm.; width 2 to 2.2 mm.; height 1.9 to 2.1 mm.

The pupal period varied from 6 to 10 days. In confinement adults lived as long as ten days.

Attempts to breed reared specimens in confinement were not successful. One female captured in the field deposited 34 eggs in 5 days. Another laid 17 eggs in one day.

Although this species is active only about half of the year, it is probable, due to the short time it takes to mature (16 to 24 days) that there are 5 or 6 generations per year. The winter is passed in the pupal stage, the adult fly not appearing until the beginning of summer.

Larvae were taken feeding only on *Aphis gossypii*, *A. rumicis* and *A. medicaginis*. *Pachyneuron californiconi* was bred from this host.

PARAGUS TIBALIS Fallen.

This Syrphid is one of the summer-appearing forms, being fairly abundant around certain plants in June, July, August and September. A few specimens may be taken in October, and one was recorded in February. In abundance it ranks a little above *B. clavata*.

It is the smallest aphidophagous species, with a rather stout body. The length is from 3 to 5 mm. Eyes black, face yellowish-white; cheeks dark; thorax black or black green; scutellum black; first and second segment of abdomen black, third, fourth and part of fifth reddish; tip black. Some individuals have the abdomen entirely black.

The incubation period varies from two to three days. The newly-hatched larvae are cylindrical, light yellow, black pilose. The larvae are not as active as those of the more common species, but reach maturity in from 10 to 14 days. The full-grown larvae are light yellow, with the anterior third or less pink on the dorsum. Each segment is armed with a transverse row of pale spines. The posterior spiracular tubes are rather long, tipped with brown.

Pupation takes place on the infested leaves, on the ground under leaves or debris, or at the base of the stem of the infested plant. The pupae are light sordid to medium or dirty brown, darker at cephalic end, a transverse row of six short, white spines on each segment;

integument finely punctate; posterior spiracular tubes cylindrical, prominent, dark brown, blackish at their apices, a little longer than combined base width. Dorsum convex, the curve sloping gently from the highest point to the base of posterior spiracles, anterior face convex, venter gently concave. The general shape is similar to *Allograpta*, but the latter is smooth.

The duration of the pupal stage varied from 10 to 14 days.

Adults lived in captivity as long as 18 days. Attempts at breeding in confinement were all failures. Females captured in the field deposited 25 and 48 eggs in 11 and 6 days respectively.

Larvae have been taken feeding on *Aphis gossypii*, *Aphis maidis* and *Aphis rumicis*. A few were parasitized by *Pachyneuron*.

Although this species is only present for about 5 months in the year, its rapid development, varying from 23 to 30 days from egg to adult, indicates that there are about 5 generations in the year.

PARAGUS BICOLOR, Fab.

This is a very similar species, closely resembling *tibialis*, but a little larger, and the scutellum has a yellow border. Larvae of this species were taken but once in Southern California feeding on *Aphis rumicis*. It was also taken once not far from the south-eastern border of the San Francisco Bay. It appears to be rare in the Sonoran region, but may be commoner in the Sierran.

EXPLANATIONS OF FIGURES

- 1a. Eggs of *Eupeodes volucris* O. S. on young cabbage seedling.
Colony of *Brevicoryne brassicae*.
 - 1b. Eggs of *Allograpta obliqua* Say on corn seedling.
 - 1c. Eggs and larvae of *Catabomba pyrastris* L.
 - 2a. Half-grown larva of *Eupeodes volucris* O. S. on grass blade.
 - 2b. Full-grown larvae of *Sphaerophoria* on bean leaf.
 - 2c. Half-grown larva of *Allograpta fracta* O. S. on grass blade.
Colony of *Aphis maidis*.
 - 3a. Puparia of *Allograpta obliqua* Say on pods of *Sterculia* sp.
 - 3b. Puparium (side view) of *Syrphus opinator* O. S.
 - 3c. Puparia of *Melanostoma stegnum* Say.
 - 4a. Adult flies of *Catabomba pyrastris* L.; male, melanoid female (var. unicolor), normal female.
 - 4b. Adult flies of *Eupeodes volucris* O. S., female and male.
 - 4c. Adults of four species of aphidophagous flies; *Sphaerophoria* female; *Eupeodes volucris*, female; *Syrphus nitens* Zett., female; *Catabomba pyrastris*, male.
 - 4d. Adults and puparium of *Syrphus opinator* O. S.; male and female flies.
 - 5a. Adult female of *Syrphus opinator* O. S.
 - 5b. Adult female of *Syrphus nitens* Zett.
- Figures 1a, 1c, 2c, 4b, 4c, 4d enlarged. Figs. 2a, 2b, 3b, 3c, 5a 5b greatly enlarged.

Plate E. Larvae of *Bichavata*, *E. volveris* and *P. tibialis*.

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Subscription—\$2.00 per year

Free to Life Members and Unlimited Annual Members of the Academy.
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