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LIFE-HISTORIES OF SYRPHIDAE III.

C. L. METCALF.

Syrphus Americanus Wiedemann.

This is one of the most common species in the state, the adults especially abundant about all kinds of blossoms in July and August, as well as very early in the spring. The larvæ are active and greedy and found preying on a number of different aphids in large numbers. It would seem to be one of the most important species of Syrphidae in the state from an economic standpoint

Egg.

Elongated-ovate in outline, sub-cylindrical, narrower and truncate at micropylar end, nicely rounded off at the opposite end, broadest in front of the middle (Fig. 42); somewhat flattened to the surface to which it is attached, slightly humped or rounded up above (Fig. 41). Length about 0.9 mm., diameter at middle about 0.3 mm. Color chalk white, hence conspicuous on the darker surface of leaf or twig on which it is usually deposited.

The entire exposed surface of the egg is beautifully sculptured except a small region around the dark micropyle. This sculpturing consists of microscopic projections of the surface arranged in lines running longitudinally-obliquely around the egg. Each projection consists of a long, slender, irregular body (seven or eight times as long as broad) sometimes bent, with about twelve to twenty slender arms reaching out in all directions from it. The space between these bodies is roughly a half wider than the body itself. Into these spaces the arms project, most of them meeting similar projections from the same or another body, many branching so as to form a delicate network of slender white arms between the larger bodies. Fig. 43 is a fair representation of a small part of the surface of the egg-shell, highly magnified. The projections are chalk white, the depressions between them shaded, appearing

grayish or yellowish. The bodies are of such a size that one may count about 25 the length of the egg and about 50 around it transversely.

Eggs of this species were deposited on braches and leaves of apple at Columbus, the spring of 1911, from about May 8 to May 15. As this was a late season, however, oviposition for the first spring generation may usually be expected somewhat earlier.

Two females taken on May 8, about blossoming apple oviposited late the same day and on the following day. 35 to 40 eggs were deposited by each female. Oviposition, although rapid at times, extended over parts of two days. Apparently at times the hind legs assisted in deposition of the eggs. They are deposited singly sometimes not over a minute apart but usually some little distance away.

At Cedar Point, Ohio, eggs were found on *Phragmites* from June 20 to July 10. At Lakeville, Ohio, on Dock (*Rumex* sp.) June 15-20.

Duration in the egg stage indoors at a temperature of about 90° Fahr. was from 55 to 60 hours.

On apple these eggs were laid on the smaller, tenderer shoots and on young leaves, the parts most affected by plant lice. On dock they are placed on leaves, on buds, in leaf-axils, or on the stems. On *Phragmites* the eggs were found on both the under and the upper side of the leaves. On Black Willow along the smaller outer twigs.

The eggs are deposited on the surface of the twigs and leaves. They lie flat and are glued rather firmly so that sometimes they break before being dislodged. Flies imprisoned in glass jars oviposit mostly on the surface toward the light although twigs or leaves enclosed receive some eggs.

The eggs of *Syrphidæ* so far as known to me have a rather characteristic appearance. The shape and white color may serve to distinguish them from eggs of many other insects. I know of no naked eye characters that are specific. The size of the egg and number and characteristics of the microscopic, sculptured bodies, as described above, may serve to distinguish those of *Syrphus americanus*.

I have noted no methods of natural protection unless it be the sheltered positions in which they are sometimes placed; nor have I discovered any egg parasites.

Larva.

There is a considerable change in appearance and characteristics during the growth of the larva. Just after hatching the characters are as follows (Fig. 45): Length 1.2 mm., width 0.2 to 0.3 mm. Shape sub-cylindrical, smaller anteriorly, not enlarged medially. Color, light yellow or with a greenish tinge. Body

surface wrinkled, sides irregular. Segmental spines on second thoracic (4th) to penultimate (11th) segments, inclusive, and the dorso-lateral ones on the prothoracic (3rd) very long, slender, black, giving the young larva a very hairy appearance, so far as I know characteristic of this species. The posterior breathing appendages are short, slightly divergent (Fig. 45, *a*). General body surface bare. The dorsal blood-vessel shows faintly in the posterior half of the body.

During subsequent growth these slender segmental hairs are replaced by shorter, stouter, more spine-like bristles; the posterior breathing appendages are slightly elevated becoming united on the median line; and minute black spines appear all over the dorsal surface of the body.

Mature larva: Length 11 mm., width 2.5 mm., height 2 mm. (Fig. 46). Eruciform, legless. The segments are not all definitely marked. On the basis of the segmental spines ten segments can be clearly made out posterior to, and including, the one bearing the anterior spiracles (Fig. 46, *b*). These spiracles may be considered prothoracic, hence we have ten segments exclusive of the head. The head segments are small retractile somewhat indefinite with some appearance of being two in number. For convenience of reference, therefore, the total number has been considered as 12, making the prothoracic, number 3.

Compared with many other aphidaphagous larvæ those of this species are noticeably slenderer, in outline with more nearly parallel sides. Segments 6 to 11 are of nearly equal width; the last one is narrower and much depressed; while anterior to segment 6 the body tapers evenly to the mouth-parts when extended, or rounds off at segment 4 when at rest, with the head segments retracted.

The body wall is prominently wrinkled, transversely, and with the usual two longitudinal carinæ at each side. From above as in Figure 46, the ventral of these carinæ is hidden by the dorsal one.

General color yellowish, or salmon-brown, marked with black and white or yellowish white. The whitish markings consist of a transverse rectangular bar on each segment from 6 to 11 and a narrow line along each side of the larva in the dorsal lateral carinæ. Interrupted by the transverse white bars in the median line is the heart line or dorsal blood-vessel, consisting of six, elongate, wedge-shaped black marks broadly margined with brown. Laterad of the brown are other prominent black blotches extending obliquely outward and back to the whitish lateral carinæ. The anterior end for two or three segments is unmarked with the black or brown and is light greenish yellow in color.

Examined more in detail the color markings may be described as follows: The brown color is resident in bodies of globular fatty material which is visible through the thin and transparent, though tough, body wall. It begins in the head segments where there is

a small rounded mass; runs in a narrow median line back to segment 5; forks around the first division of the heart line; and thence the forks extend as broader and broader lines to the posterior end of the body. In each segment back of 5 these forks are connected by a whitish bar, already mentioned, just beneath the two median segmental bristles; and more or less by scattered brownish globules between the dorsal segmental bristles.

These bundles of fat, and consequently the amount of brown color, vary considerably in extent in different individuals, or at different times in the same individual. Frequently they cover the entire dorsum except the blood-vessel in segments 10, 11, 12. Usually anterior to this the black body-fluid appears again next the surface in the lateral pockets, already described, entirely surrounded and somewhat interrupted by the adipose mass. The sides of the body appear yellowish white.

When magnified the entire dorsum of the larva is seen to be covered with short, close set black spines. The segmental bristles are larger, but light in color and not conspicuous, about equal in size, situated on slight elevations. Ten of the body segments show twelve such bristles, situated as previously described in *Paragus bicolor*.*

The posterior breathing appendages on the dorsum of the last segment, (Figs. 46, *c*; 49; and 50) are short (0.2–0.25 mm. long) and nearly twice as broad (0.4–0.5 mm.); divergent for half their length; the dorsal spiracular spines (Figs. 49 and 50, *a*) moderately long, sharply conical, with a very small lateral sub-basal spur. The six elongate spiracles (*b*) are irregularly and considerably curved, about 0.2–0.25 mm. long, the median one on each side nearer to the ventral than to the dorsal one.

The anterior prothoracic spiracles on the third segment (Figs. 46, *b*; 47, *a*) are small, sub-crescent shaped, the lip of the spiracle marked by nine rounded, tooth-like lobes, (Fig. 48).

The head segments bear antennæ, (Figs. 46, *a*; 47, *b*) and mouth parts (Fig. 47, *c*, *d*, *e*). The antennæ are short, fleshy, rudimentary. The mouth parts consist of the usual pair of beak-like jaws (*c*, *d*) and three pairs of mouth-hooks (*e*). The jaws are V-shaped, sharp, slightly hooked at the tip, somewhat shorter than usual, the dorsal extending slightly beyond the ventral when apposed. The latter has a ventrally projecting basal spur on each side. The mouth hooklets are unequal in size the outer pair largest; the other two pairs are situated close beside the jaws, the dorsal ones heavier, the ventral pair small, slender.

To the mouth parts is attached internally a complex system of strong muscles and a broad, chitinous, oesophageal framework (Fig. 51, *d*).

*The Ohio Naturalist, Vol. XII, No. 1, p. 397, Nov., 1911.

The ventrum of the body is bare; seven pairs of ventral folds of the body-wall making fairly well-defined prolegs.

The larva emerges from the egg very slowly. The anterior end of the egg splits and the sides spread under the contractions and expansions of the larva. Then by stretching out and clinging to some object it pulls itself out little by little. The egg shell is tough rather than rigid and yields to the contortions of the larva.

When first hatched the larvæ are inactive and will lie quietly for hours if undisturbed. If an aphid is forced upon them they will often attack it and attempt to eat it frequently with the result that they are carried away by the larger insect and finally dislodged. However, after the lapse of eight or ten hours the larvæ begin active crawling movements in search of food. Apparently their prey is located not by a chemotropism but by thigmotropism as they frequently pass by an aphid so closely as almost to touch it and go on in search of others. The characteristic movements of these larvæ when searching for food are familiar to many and have been described for another species (*l. c.*). Frequently the larvæ grasp first a leg or antennæ of the aphid and cling to it until they can reach the thorax or abdomen.

A young, one-day-old larva barely a millimeter and a half long looks preposterous attacking an aphid fully three times its size. Yet so firmly does the larva cling or become cemented to the surface by its posterior end that the aphid is unable to escape.

These younger larvæ do not eat rapidly. I have at various times observed them in one place sucking the juices of a single aphid for from a half to two-and-a-half hours. Sometimes the aphids continued to struggle for an hour or more.

Growth is rapid. By the end of the second day some of the specimens had reached a length of 7 or 8 mm. and a width of 1.2 mm.

In order to determine something of the capacity of these insects for devouring plant lice and hence their degree of economic importance, the writer tried feeding them with cabbage aphids (*Aphis brassicæ*. Linn.) The aphids were touched to the mouth of a larva which had not been kept from food. A four day old larva devoured the first aphid in 4.5 minutes, a second, third, fourth, and fifth smaller than the first in 2, 1, 1, and 0.5 minutes respectively. The sixth a larger one was retained for 3.25 minutes. These were very thoroughly eaten, all the viscera and body fluids being picked and sucked out. After this the lice tendered were not eaten so closely, but killed, a seventh in 2 minutes an eighth in 1.75 minutes and a ninth in 1.5 minutes.

On another occasion the same test was made with an older larva which devoured a dozen or two before the writer's patience became exhausted. The tests were sufficient, however, to establish the voraciousness of the appetites of these larvæ.

It is, of course, not probable that any larva would ever normally devour aphids so rapidly. Yet when plenty are at hand the number eaten by a larva during its life of eight days to two weeks or more must be very considerable. It should be kept in mind also that it is not the actual individuals eaten, alone, that determines the amount of benefit from these insects; but the fact that in this way the production of enormous numbers of aphids may be prevented. If as Reaumur has calculated, and others have substantiated, one aphid may be the progenitor of over 5,000,000-000 individuals during her existence of a month or six weeks, we can see at once the important benefit that must arise from the destruction of one or two of these aphids early in the establishment of the colony. It is a fact that the eggs of Syrphidæ are often deposited on the host-plant very early or even in anticipation of the arrival of the aphids.

The great factor in determining the duration in the larval stage seems to be the abundance or scarcity of food. Indoors with plenty of food at hand the larval period from emergence from egg to formation of puparium was 8 to 9 days. When less food was supplied this period was extended frequently to two weeks sometimes as much as 20 days. The larvæ are very tenacious of life, some of them existing for over three weeks with very little food.

Out-of-doors the larvæ seem to be little affected by climatic conditions so long as food is available. They endure very wet weather and I have seen them in Autumn survive several periods of cold freezing weather.

In my experience these larvæ may be expected wherever aphids or other soft-bodied insects occur in colonies. They are not restricted to one kind of prey. I have found them most abundantly on cabbage and some other cruciferae at Columbus the latter half of May in an open greenhouse, and out-of-doors in Autumn from the latter part of September to the middle of October; and on Phragmites at Cedar Point from the last week in June to the first week in August.

On cabbage they are very destructive to *Aphis brassicae* Linn. On Phragmites they were predaceous in large numbers on a very abundant unidentified aphid. I have also found them commonly on apple feeding on the European grain aphid (*Siphocoryne avenae* Fab.) during May. Occasionally on curled Dock (*Rumex crispus* L.) and broad-leafed Dock (*R. obtusifolius* L.) among *Aphis rumicus* Linn. the first of June. One of these larvæ was observed devouring a Syrphid larva (*Paragus bicolor* Fab.) from the same host plant. On Black Willow the larvæ parasitized colonies of the Willow Grove Plant-house (*Melanoxanthus solliciti* Harris.) on the University campus the first half of October.

On these plants the position of the larvæ is determined by that of the aphids. On cabbage they are largely on the under side of the outer drooping leaves but may be found well in among the more compact leaves of the head. On Phragmites they are mostly on the upper, but also on the under side of the long linear leaves; on *Rumex* spp. chiefly among the flower spikes, and lower leaves; and on apple and willow on the outer small and tender twigs.

Parasites.

I have noted one very bad enemy of *Syrphus americanus*—the Ichneumonid parasite, *Bassus laetatorius* Fabr. I have reared this species from larvæ and pupæ not only of *S. americanus* but also of *Paragus bicolor*, *Paragus tibialis*, *Allograpta obliqua*, and *Sphaerophoria cylindrica*.

It appears most abundantly on *S. americanus* especially during midsummer, July and August, on Phragmites and again in September to November on specimens from cabbage. At times I have found fully 75% of those collected were destroyed by this parasite. I have not reared the parasite from specimens taken previous to July.

This parasite oviposits through the body wall of the larvæ, the eggs hatch and the larvæ develop without preventing the formation of a more or less complete puparium by the host. Within the puparium the development of the larval parasite goes on at the expense of the Syrphid. The latter is entirely devoured and the parasitic larva reaches in size nearly the capacity of the puparium. Pupation then takes place and the adult emerges by gnawing a small irregular hole in the anterior end of the dipterous puparium about 3 or 4 weeks after pupation of the host. Only one parasite develops in each host individual.

The larvæ when full grown measure about 4 mm. in length by 1.8 mm. in height, by 2 mm. in width. They are plump, whitish, erusiform, ovate in outline; median segments largest, humped dorsally and with the posterior end smaller than the anterior. As their orientation is the same as that of the puparium it will be seen that the full grown larva fits very nicely, in size and shape, the puparium of the host. There are 14 body-segments clearly shown; the only conspicuous appendage is a U- or V-shaped chitinous piece in the region of the mouth. Sketches of a larva and a pupa are given as Figures 58, 59.

The adult may easily be recognized by the following description from G. C. Davis' "A monograph of the Tribe Bassini" Trans. Am. Ento. Soc. XXII, p. 19, Feb. '95, who also states that it is one of the most common and wide spread species in Europe and America.

“♀. Length 6 mm. Head, thorax, base and tip of abdomen, hind tarsi, base and lower middle of hind tibiæ black; four anterior legs, posterior coxæ, femora, and often tips of tibiæ, tip of abdominal segment 1, whole of 2 and 3 and more or less of 4, rufous; anterior orbits, mouth, tegulæ, spot in front, line beneath, cuneiform spots on mesonotum, scutellum, post-scutellum, and band on posterior tibiæ white.

♂—Differs only in having the face, scape beneath and a stripe on pleura yellowish white.”

As previously pointed out for *Paragus bicolor* (*l. c.*) the presence of the parasite is usually indicated at the time of pupation by a failure of the puparium to inflate completely anteriorly and dorsally, and retract on the ventral side, and also by its darker color. The following are the average dimensions of 15 puparia from which *Bassus laetatorius* had emerged: length 6 mm., height 2.25 mm., width 2.45 mm. Compared with the dimensions of an equal number of unparasitized individuals as given below, it will be seen that these are slightly less in all dimensions than the normal ones, with a little more difference in height than in length or width. The difference in shape is more conspicuous than these figures would indicate (See Fig. 56) and together with the difference in color makes them rather easy to distinguish when once the characteristics are learned.

As suggested in the previous paper it ought to be easy to accomplish a great deal of good by destroying these parasitized puparia before the parasite emerges.

Puparium.

Dimensions, average of 15: length 6.5 mm., height 2.5 mm., width 2.6 mm. (Fig. 55). Pupation occurs within the indurated larval skin after shortening and dorsal and lateral inflation especially at the anterior end. The head segments are retracted ventrally so that segments 3 to 5 lie at the anterior pole and the tip of the mouth-parts (terminal in the larva) are about 0.5 cm., back on the ventral side. The wrinkling of the skin, characteristic in the larva is largely lost, due to the inflation. The vestiture remains as in the larva, the segmental spines inconspicuous, but the exposed parts of the wrinkles of the larva, densely covered with very small, short, sharp, black spines. Sometimes this gives a rather prominent transverse banding of black where the spines are thickest.

The posterior three segments are proportionately less inflated than the middle ones. Shape from dorsal aspect ovate with the last segment and its respiratory appendage projecting; very slightly broadest in front of the middle, nicely rounded out in front. From the side (Fig. 56) the anterior and dorsal inflation

is evident; the puparium is not strongly elevated posteriorly, being convexly depressed gradually from about the middle. From in front the puparium appears nearly circular in outline, very slightly flattened ventrally.

The posterior breathing appendage (Fig. 55, *a*) is as in the larva but entirely black, the segment inflated beneath it. The anterior spiracles remain visible externally, antero-dorsal to the tip of the mouth-parts, with parts of the tracheæ leading from them visible flattened against the inside of the puparium (Fig. 51, *a*). The larval mouth parts also become flattened against the puparium on their right or left side. (Fig. 51, *b, c, d*). At first the pupa shrinks away from these parts but later as the adult head develops fills up the space again. A line of weakness develops in the puparium running from the apex of the mouth-parts dorsally between segments 6 and 7. The expanse of the ventral part of the face then forces off a circular operculum along this line for the emergence of the adult. Posteriorly part of the large tracheal trunks remain in connection with the spiracles.

Color of the puparium, empty: pale brown, transparent; with pupa enclosed: variable, darker brown, strongly tinted with salmon. A day or two before emergence the prominent colors of the adult become plainly visible.

Pupa.

The coarctate pupa (Fig. 54) is covered with a delicate transparent membrane (*a*) with pockets encasing the developing legs, wings, etc. The changes visible externally are gradually produced and give little indication of the radical internal histolysis and histogenesis.

At an early stage (Fig. 53) when the dorsal part of the abdomen is simply a mass of fatty granules as in the larva with the position of the dorsal blood vessel indicated and the head and thorax irregular, angular masses; the legs, or the cases enclosing them (Fig. 53, *a, b, c*) have already reached their full size; although there is no vestiture developed on them and their outline and segmentation are indefinite. The wing-pads, also, (*d*), are as large as they will become before emergence but show no signs of the venation which is prominent at a later stage. They are folded ventrally about the sides of the body.

The mouth-parts are visible as long, cylindrical, fleshy buds (*e*). The eyes are not indicated externally except as irregular oval areas about half the size of the adult eye antero-dorsal in position, bounded by a slightly elevated ridge.

A considerably later stage shows the abdomen still cylindrical without color and with only a little vestiture, the segments faintly indicated by constrictions, the fatty granules gone. The head is

well developed, the eyes pale but full sized, the facets faintly marked. The ocelli are white, rounded projections. The antennæ full-sized but colorless, bent ventrally, arista pale extending laterally. The thorax is hardly fully expanded, pale fleshy, the vestiture very faint. A decided flexure at the junction of thorax and abdomen throws the scutellum beneath the anterior part of the abdomen.

The mouth-parts are short, thick, fleshy cylinders. The eyes approach each other at the lower part of the head more closely than in the adult. The legs are definitely segmented and of definite outline the vestiture and claws pale. The femora extend antero-laterally, the fore and middle tibiæ and tarsi postero-medially parallel to the femora. The hind tibiæ however develops a strong flexure (Fig. 52, *a*). This leg is bent up under the wing-pad and back, the tarsus projecting to the tip of the abdomen on the median ventral line. The tibia is bent beyond the middle at an angle of 150° thus shortening the extent of the leg posteriorly.

The wings are pale and fleshy but show the development of the adult venation. There is a prominent U-shaped loop about the middle of the costal margin and the rest of the wing is very much crumpled and folded.

In a later stage (Fig. 54) very shortly before emergence, the dark reddish-brown color of the eyes and the black and yellow banding of the abdomen showed clearly; the vestiture was well developed and the shape and segmentation that of the adult with the following exceptions: The scutellum is broader and flatter than in the adult condition, the thorax fleshy, without any of the adult coloring, but with the vestiture well developed, showing three longitudinal bands. The mouth-parts are fleshy, flattened, unextended. Wings much as in the earlier stage but with hairs on the margin, veins black. The two wing membranes are not apposed and much corrugated, blue-gray in color.

Since the generations are considerably confused during any season, the date of pupation can be stated only in a general way. This may be inferred from the dates given for the occurrence of the larvæ. In experiments indoors from the first eggs deposited in spring, I secured pupæ on May 22. Winter is sometimes passed in the pupa stage but whether this is the only method of wintering I cannot say.

This stage is for the most part passed in the same location as the larval. I have found puparia glued by the posterior segment to leaves of cabbage and among flower- and leaf-axils of *Rumex crispus*. Some of the specimens kept on potted cabbage, were found as pupæ buried under a half inch or more of the soil in the pot. The puparium becomes very hard and more or less impervious.

Adult.

Description after Wiedemann, *Auss. Zw. Ins.* II, 129, 22, and Osten Sacken, *Proc. Bost. Soc. Nat. Hist.* XVIII, 145.

♂, ♀. Length 8–10 mm. Female. Face yellow, in certain positions with a pearly luster, *with a brown stripe* in the middle, which begins at the oral margin but does not reach the antennæ; the latter brownish-black, reddish on the underside of the third joint. Cheeks blackish, *but separated from the mouth by a narrow yellow border*, which on the underside of the mouth completely cuts off connection between the black color on both sides. Front brownish bronze color, powdered with yellow on each side. Immediately above each antenna there is a brownish spot sometimes continued above into an indefinite black stripe; vertex metallic bronze or black, eyes bare. Thorax metallic greenish black, unstriped; with scattered luteous pile; on the sides, in front of the base of the wing, yellowish; elsewhere metallic green; scutellum metallic yellow, with a bluish reflection and sparse yellow pile. First abdominal segment metallic blue; the rest of the abdomen black with bright yellow cross-bands. The first abdominal cross-band is not interrupted but co-arcuate in the middle; its ends do not touch the margin of the abdomen, but are separated from it by a narrow black border; sometimes a brownish mark in the middle of this band gives it the appearance of being sub-interrupted. The second cross-band is nearly as broad as the black cross-band between it and the next yellow band; it is usually perfectly straight (in some specimens the hind margin is gently sinuate); its ends do not touch the lateral margin of the abdomen; they are cut obliquely, forming a sharp angle anteriorly, and a rounded one posteriorly; the former almost touches the margin of the abdomen. The third band is similar to the second, only its hind margin is more perceptibly arcuated. The posterior margin of the fourth segment has as usual, a narrow yellow border; the fifth likewise, and two yellow spots at the base besides. Femora yellow; the four anterior ones in some specimens brownish at the extreme base only; the hind pair with a more or less distinct brown ring on the distal half; four anterior tibiæ and tarsi yellow; the hind tibiæ sometimes with a brownish ring, the hind tarsi brownish.

Male (Fig. 44). Front yellow, with a more or less distinct brown spot above each antenna; cross-bands on the abdomen broader than in the female, and distinctly broader than the black interval between them; posteriorly, they are often nearly straight, sometimes distinctly arcuate, especially the third band. The yellow spots on the second segment are not coalescent, but separated by a narrow black interval (in some specimens sub-coalescent); the fifth segment is yellow, with a black spot in the middle. The four anterior femora are black at the base; the hind femora

are usually black, with a yellow tip; sometimes there is a trace of yellow at the base; hind tibiae usually with a brown ring in the middle.

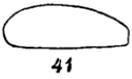
The adults have been taken in large numbers about blossoming willow (*Salix* sp.) as early as the last few days of March and the first of April, and again about blossoming apple and pear, the first of May. They are abundant in mid-summer and can be taken about all kinds of blossoms.

They are pollen and nectar feeders and doubtless of considerable importance as pollenizers of fruit trees and other plants. For this, and their work in checking aphids, they are worthy every protection that can possibly be afforded them.

EXPLANATION OF PLATE XXIII.

- Fig. 41. Egg from the side x 17.
 Fig. 42. Dorsal view of egg x 17.
 Fig. 43. A small part of the surface of egg-shell showing sculpturing, highly magnified.
 Fig. 44. Adult ♂ about 5 times natural size.
 Fig. 45. Larva just hatched x 50; *a*, posterior respiratory appendage.
 Fig. 46. Full-grown larva x 7; *a*, antenna, *b*, anterior spiracle, *c*, posterior respiratory appendage.
 Fig. 47. Anterior view of larva, much enlarged, showing mouth-parts, antennae, etc.; *a*, right anterior spiracle; *b*, antenna; *c*, upper jaw; *d*, lower jaw; *e*, the three pairs of mouth-hooks.
 Fig. 48. Dorsal view of right anterior spiracle, highly magnified.
 Fig. 49. End or posterior view of posterior respiratory organ x 55; *a*, dorsal spiracular spine; *b*, one of the three pairs of slit-like spiracles.
 Fig. 50. Side or dorsal view of posterior respiratory organ x 55; lettering as in Fig. 49.
 Fig. 51. Appearance of a part of the puparium externally in the region of the mouth-parts much enlarged; *a*, right anterior spiracle with short piece of trachea attached; *b*, lower jaw of larva; *c*, upper jaw of larva; *d*, chitinous oesophageal framework; *e*, mouth-hooks of larva.
 Fig. 52. Hind leg of pupa showing flexure of tibia at *a*.
 Fig. 53. An early pupal stage from the side; *a*, *b*, and *c*, developing legs; *d*, wing-pad; *e*, mouth-parts.
 Fig. 54. A much later pupal stage, ventral view; *a*, the delicate investing membrane.
 Fig. 55. Dorsal view of puparium x 5; *a*, posterior respiratory organ.
 Fig. 56. Outline of puparium from the side. The dotted outline is given to show the typical shape of a parasitized puparium.
 Fig. 57. Lateral view of head of female x 7.
 Fig. 58. Larva of parasite, *Bassus laetatorius*, mouth-parts at *a*, ventral view.
 Fig. 59. Pupa of *B. laetatorius*, ventral view.

Figs. 53, 54, 58, and 59 each about 5 times natural size.



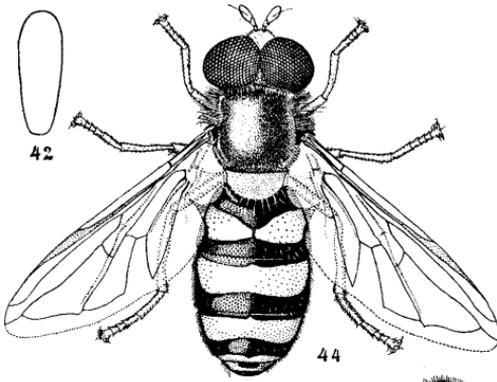
41



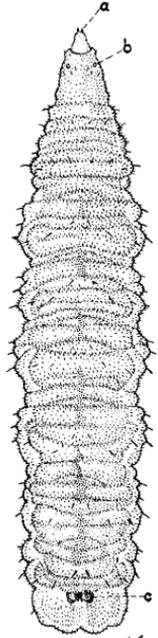
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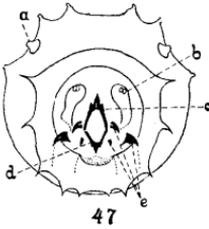
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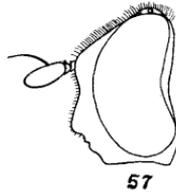
44



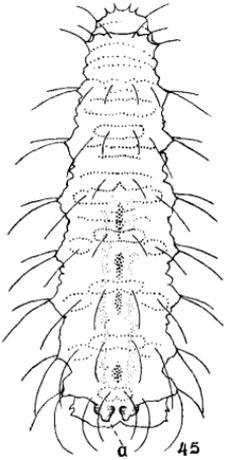
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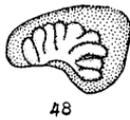
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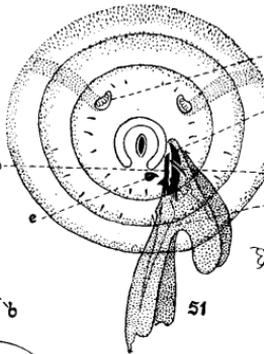
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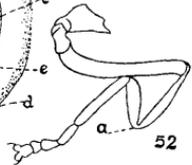
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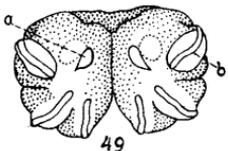
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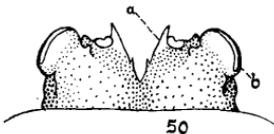
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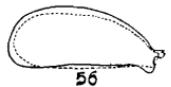
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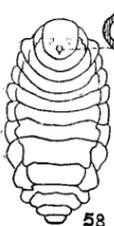
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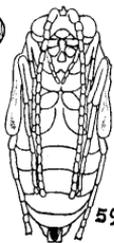
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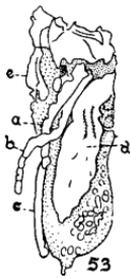
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59a



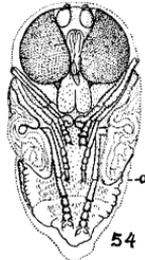
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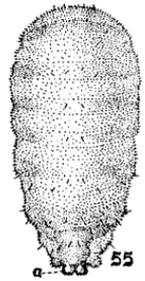
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54



54



55

Metcalf on "Life-Histories of Syrphidae III."