University of Maine

Maine Agricultural Experiment Station

ORONO

BULLETIN 263 AUGUST, 1917

SYRPHIDAE OF MAINE—SECOND REPORT

CONTENTS.

This bulletin discusses the life history of the following beneficial Flower-flies, all of which feed in the larval stage on aphids:

MAINE
AGRICULTURAL EXPERIMENT STATION
ORONO, MAINE.

THE STATION COUNCIL.

PRESIDENT ROBERT J. ALEY,	*President*
DIRECTOR CHARLES D. WOODS,	*Secretary*
FREELAND JONES, Bangor,	*Committee of Board of Trustees*
THOMAS V. DOHERTY, Houlton,	*Committee of Board of Trustees*
FRANK E. GUERNSEY, Dover,	*Committee of Board of Trustees*
JOHN A. ROBERTS,	*Commissioner of Agriculture*
EUGENE H. LIBBY, Auburn,	*State Grange*
WILSON W. CONANT, Buckfield,	*State Pomological Society*
FRANK S. ADAMS, Bowdoinham,	*State Dairymen's Association*
LEONARD C. HOLSTON, Cornish,	*Maine Livestock Breeders' Ass'n.*
WILLIAM G. HUNTON, Readfield,	*Maine Seed Improvement Ass'n.*

And the Heads and Associates of Station Departments, and the Dean of the College of Agriculture.

THE STATION STAFF.

ADMINISTRATION	CHARLES D. WOODS, Sc D.	*Director*
	MARIAN AVERY	*Clerk*
	MARIAN WHITE	*Stenographer*
BIOLOGY	RAYMOND PEARL, Ph. D.,	*Biologist**
	FRANK M. SURFACE, Ph. D.,	*Biologist**
	JOHN W. GOWEN, Ph. D.,	*Assistant*
	SILVIA PARKER, A. B.,	*Assistant*
	JOHN R. MINER, A. B.,	*Computer**
	MILDRED R. COVELL,	*Clerk*
CHEMISTRY	JAMES M. BARTLETT, M. S.,	*Chemist*
	HERMAN H. HANSON, M. S.,	*Chemist*
	HAROLD L. KING, B. S.	*Assistant*
	THOMAS J. SHATNEY,	*Laboratory Assistant*
ENTOMOLOGY	EDITH M. PATCH, Ph. D.,	*Entomologist*
	ALICE W. AVERILL,	*Laboratory Assistant*
PLANT PATHOLOGY	WARNER J. MORSE, Ph. D.,	*Pathologist*
	†MICHAEL SHAPOVALOV, M. S.,	*Assistant*
	†GLEN B. RAMSEY, A. M.,	*Assistant*
	VIOLA L. MORRIS,	*Laboratory Assistant*
AROOSTOOK FARM	JACOB ZINN, Agr. D.,	*Assistant Biologist*
	C. HARRY WHITE,	*Scientific Aid*
	JEREMIAH E. SULLIVAN,	*Superintendent*
HIGHMOOR FARM	WELLINGTON SINCLAIR,	*Superintendent*
	WALTER E. CURTIS,	*Scientific Aid*
ROYDEN L. HAMMOND,		*Seed Analyst and Photographer*
CHARLES C. INMAN,		*Assistant*

* Absent on leave during period of war.

† In collaboration with U. S. Department of Agriculture.

BULLETIN 263

SYRPHIDAE OF MAINE.
SECOND REPORT: LIFE HISTORY STUDIES.[1]

C. L. METCALF.[2]

The investigation of the biology, ecology, and economic status of the Flower-flies of Maine, the first report of which appeared as Bulletin 253 of this station, has been continued during the summers of 1916 and 1917. The data secured on the following species seems of sufficient interest to warrant publication at this time.

The species discussed below are all aphidophagous, depending for growth and development on aphids, which are ravenously devoured during the larval stage of the fly. They must therefore be recognized as beneficial insects and their presence in any locality must be looked upon as an agricultural asset of no mean importance. To illustrate,—in an experiment with one of the species described below (see page 156) the writer found that, in five hours less than two days, three larvae had devoured a total of 325 plant-lice, or an average of not less than 54 a day for each larva. There is no reason to believe that this record is in any way exceptional. In fact in this case the thoroughness with which the aphids were devoured indicated a still greater capacity of the larvae.

So far as I am aware no previous record has been made of the metamorphoses of these species.

The species, *Syrphus oronoensis,* appears to be an important predator of the aphids affecting stone fruits; the species *Xanthogramma divisa* and *Syrphus knabi* are, so far as observed, of more benefit to certain shade and forest trees; while the chosen food of *Platychirus perpallidus* has not been determined.

The latter species is of faunistic interest since it is not hitherto recorded outside of Britain. I have also taken the follow-

---

[1]Papers from the Maine Agricultural Experiment Station: Entomology No. 94.

[2]Member of the Station Summer Staff.

ing European species of *Platychirus* in Maine: *P. scutatus* Meig.; *P. immarginatus* Zett.; *P. discimanus* Loew (Dr. Edith M. Patch, collector); and *P. angustatus* Zett.

It is of particular interest to record species of the two genera *Platychirus* and *Xanthogramma* as aphidophagus since they have each been recorded as having species which are scavengers in the larval stage. These two genera should be added to the list of ten genera given in the author's previous bulletin as aphidophagous, at least in part.

The Aphididae named in this bulletin have all been determined by Dr. Edith M. Patch, Entomologist. The writer is also indebted to Messrs. W. F. Pride, Geo. B. Newman and Robert K. Fletcher for assistance in collecting and caring for material.

XANTHOGRAMMA DIVISA Williston.

This is an aphidophagous species occurring sparsely in the larval stage among aphids on a number of our shade and forest trees, and occasionally increasing to abundance when a favorable infestation of aphids is available.

It is the handsomest larva of Syrphidae that I have seen and all stages present interesting structural characteristics.

Verrall[1] says of the genus: "Not much is known about the metamorphoses, but the larva has been reared from heaps of turf," so that the members of the genus have been believed to be scavengers. However, a report of the Hawaiian Sugar Planter's Experiment Station gives a photograph of the adult of a species of *Xanthogramma* among the predaceous insects of the island.

The records of the immature stages are as follows:

A well-grown brown larva collected by Mr. W. F. Pride, July 6, 1915, among *Aphis cerasifoliae* Fitch on choke cherry *(Prunus virginiana)*, succumbed in the laboratory after a long-drawn-out period of slow starvation, during which it failed to pupate.

A very small larva collected on *Cornus* sp. *(Aphis cornifoliae* Fitch), July 12, 1915 was ashy-gray in color instead of brownish. It was fed in confinement from *Aphis cornifoliae* and in about a week had attained full size and become a beautiful tan in color. It was fed every other day until July 31, when it

[1]Verrall, G. H., British Flies, Vol. VIII, Syrphidae, p. 448.

was placed out-of-doors on the original *Cornus* leaves, inside a cheese-cloth bag. Here it remained without striking change, gradually becoming dryer and more attenuated, until Sept. 12 when it was recovered but later died.

On July 24, 1916, Mr. G. B. Newman collected a nearly full grown, and three very small, larvae of this species among *Chaitophorus populicola* Thomas on poplar. The smaller ones were decidedly greenish in color, the large one tan. This green color gave place in the laboratory to an ashy- or faint-green which persisted for a week or more. On August 2, two of them were decidedly tan colored and by August 5 all had become so.

There was as yet no clue whatever to the identity of the larvae under consideration, and it proved a most difficult species to rear. Those kept in pint jars in-doors, even when most attentively supplied with their chosen food, fresh daily, fed and grew rapidly to full size, and then gradually became senescent, more and more sluggish, and after a time refused to feed or to move or to pupate, becoming more and more attenuated, thinner and dryer, and moving about only when disturbed until months later when they appeared finally to be lifeless. Sterile soil and decayed wood were provided in the bottom of the cages for pupation but without success. Much the same experience resulted from attempts to rear them in field cages or cheese-cloth enclosures on the living infested plants out-of-doors.

On August 8, 1916 a number of eggs were found in company with a dozen or so of larvae of various sizes scattered along the smaller twigs of willow trees infested with *Pterocomma smithiae* (Monell). These eggs began hatching on August 13 and at once disclosed the fact that they were conspecific with the flattened brownish larvae. The eggs, while of about the average size for this group, presented a microscopic spider-web sort of pattern on the chorion which was so characteristic that, in view of the difficulty of rearing adults from the larvae, the attempt was at once made to capture gravid females which should disclose the same kind of egg and so accomplish the determination of the species.

Finally on August 25, Mr. Newman captured about one of the infested trees a female of *Xanthogramma divisa*. She was confined indoors about 10 A. M. and by 2 P. M. had deposited a single egg, another by 2.45 P. M. and four more during the

next hour. She died over night without any further oviposition; but the few eggs were sufficient to establish the identity of the unusual larvae. These eggs hatched in the laboratory between 8 A. M. August 28 and 8 A. M. August 29, and speedily developed into larvae of the characteristic appearance.

The first puparium was formed August 24 in moist earth in the bottom of the jar confining larvae collected August 7 from willow; two others August 27 and two others August 29.

The first adult (from a puparium formed August 27) was disclosed Sept. 12; the others during shipment from Maine to Ohio between Sept. 13 and 20, the exact date not determined; except for one specimen which yielded a parasite (species undetermined) some days later.

Noting the voraciousness of the young larvae of this species the following tests were made of their capacity for destroying aphids:

Sept. 7, 9.30 A. M., three larvae were enclosed with 150 aphids of *Pterocomma smithiae*. At 8 A. M., Sept. 8, not a single whole aphid, living or dead, was found in the vial,—nothing but the cast-off skins. In other words each of the three larvae had devoured, on the average, 50 aphids in 22½ hours. At 11.40 A. M. of the same day the same three larvae were enclosed with 175 aphids of the same species, some of them actively reproducing. At 5 P. M. many of the aphids were still living, but by 8 A. M., Sept. 9, all had been devoured, most of the feeding in this case having taken place at night.

On August 31, another female was captured in the field about the infested willow but was slightly injured and died before ovipositing.

On Sept. 1, several full-sized larvae were found under loose pieces of dead bark on the infested willow trees, presumably seeking a site for pupation and possibly for hibernation. The larvae taken into confinement however died without pupating.

On my return to Orono, June 7, 1917, an examination of the trees, infested the previous season disclosed four puparia, three of them glued to loose pieces of bark on the trunk or principle branches of the tree, the other on the ground among fallen pieces of bark.[1]

---

[1]It may be noted that the puparium found on the ground is the only one of the lot which failed to yield either a living fly or parasites; this specimen (a male) died without emerging.

From one of these puparia left out-of-doors, a female emerged June 18, another June 22, while a third disclosed 26 parasites (undetermined) July 8th, the entire lot emerging from a single small hole gnawed thru the anterior end of the puparium (Fig. 9, B). The exact date of pupation, i.e., whether the full-grown larvae passed the winter, pupating in spring, or whether pupation occurred sometime in autumn has not been determined,—probably the latter. Several full-grown larvae were collected by Mr.Fletcher among *Myzus cerasi* (Fab.) on cherry, July 18, 1917.

It appears likely that there are two more or less complete generations of this species, annually, though not occurring in very definite broods. Adults from overwintering larvae or pupae evidently giving rise to the larvae which have been found full sized by early July; and the adults from these larvae producing another generation, the larvae of which occur especially during August. A partial third generation from eggs deposited by females visiting the colonies of aphids the last week in August, seems probable.

Egg (Fig. 8, A). Lengths of seven eggs measured were 0.861, 0.8815, 0.89175, 0.9225, 0.9532, 0.975, and 0.9942 mm., respectively, the average 0.925 mm.; their greatest diameters were respectively 0.3075, 0.308, 0.315, 0.328, 0.3375, 0.3485, and 0.3485 mm., the average 0.3275 mm.

The egg is of about the usual sub-cylindrical shape, somewhat inflated in the middle and with the micropylar end a little smaller and more truncate than the opposite end; also with the ventral surface flattened somewhat to the twig on which it is deposited. Color white, glistening.

The characteristic thing is the sculpturing of the chorion the microscopic pattern of which (Fig. 8, B) suggests at first glance a very large number of minute, 8-rayed spider webs, or hexagonal wheels, contiguous to each other, with a very small elevated body in the center of each. Taking each "web" as a unit it may be described as consisting of a very small, sub-conical, elevated body in the center of the web (the hub) from which radiate eight, slender, slightly elevated arms arranged in four pairs. The two arms extending from the central elevation, or hub, toward either pole of the egg, radiate like the spokes of a wheel; while the two which extend in the transverse direction from either side of the hub (i. e. perpendicular to the long axis of the egg in a plane parallel to it) run practically parallel to each other. A series of these *parallel* arms, together with the hubs they connect make a ladder-like chain running almost transversely (sometimes somewhat obliquely) around the egg. The individual units are closely contiguous to each other so that each arm forms a spoke for two central bodies or hubs, and the rim of the imaged wheel is formed only by adapting the contiguous spokes of adjoining wheels. The pattern

is of such a size that about forty of the ladder-like chains are traversed in passing from one pole of the egg to the other, the elevated bodies being approximately 0.02 mm. apart.

The eggs have been taken in the field only on the small twigs of willow directly among the aphids, *Pterocomma smithiae* (Monell), in early August. They were also deposited in captivity from a female caught hovering about this infestation in late August. There is at least one other time of occurrence for the egg stage, those giving rise to the first generation of larvae in the spring probably being deposited in June. It is further probable that adults emerging in September, (as specimens in the laboratory did) may deposit eggs for a third generation; although it seems doubtful if these larvae could mature at this latitude before cold weather cut short their food supply.

The eggs are glued by the ventral surface to the bark of the young twigs, and occur singly.

The duration in the egg stage, from eggs deposited indoors, was between 2⅔ and 3¾ days, while some eggs brought in from the field on August 8 did not hatch until August 13, this stage exceeding five days. At time of hatching the micropylar end of the egg shell is pushed off as a roughly circular cap, leaving the rest of the shell intact.

Larva (Fig. 8, C to H). The newly hatched larva (Fig. 8, C) is elongate ovate in outline with the posterior end truncated or even excised. It measured 0.95 mm. in length by 0.39 mm. in its greatest width, a little caudad of mid-length. It thus appears, from the first, proportionately broader and is more flattened than the other described aphidophagous species. The color is pale yellow more or less blackened on the mid-dorsal line by the interrupted pulsating dorsal blood-vessel. The whitish longitudinal tracheal trunks also are faintly visible thru the integument. The young larva appears very bristly (cf. *Syrphus americana* Wied.[1]), the segmental bristles being quite conspicuous. There are eight transverse rows of twelve bristles each, besides additional ones on the terminal segment, the individual setae measuring about 0.0666 mm. in length,—of two segments, the basal one about 0.008 mm. long and of equal diameter, the distal one 0.06 mm. long and about 0.0035 mm. in diameter, tapering slightly to the tip. The integument is wrinkled transversely and the lateral margins are irregularly serrate.

The posterior respiratory tubes are well separated, fairly prominent, nodular; the slit-like spiracles short and situated near together. There is no integumental vestiture in addition to the segmental setae.

As growth continues the larva becomes more and more flattened so that by the time it is full grown it is more than half as broad as long,

[1]The Ohio Naturalist, Vol. VII, No. 5, p. 479, Mch. 1912.

measuring 10 to 11 mm. in length by 5 to 5½ mm. in maximum width, and only about 1⅓ mm. in height.

Very different in shape from the usual aphidophagous larva, suggesting somewhat the larva of *Microdon* and indeed forming a most interesting intermediate step, structurally, between the typical aphidophagous larva, such as *Syphus americana, S. torvus, Sphaerophoria cylindrica*, and others and the extremely specialized larvae which live in the nests of ants.

When the larva is resting its shape from above is broadly ovate, somewhat narrower and less truncate at the anterior end. The entire lateral and anterior margins are deeply serrate, there being three large and subequal and one much smaller serration to each of the seven principal segments (Fig. 8, F & H). The three larger serrations bear at their tips the lateral, posterior ventro-lateral and anterior ventro-lateral segmental spines; the median, dorsal and dorso-lateral ones retaining their normal positions on the dorsal surface of the somites. The fourth and smaller serration is nude of bristles. Each of these principle serrations, or lateral, cone-shaped processes, is covered with papillae similar to those over the entire dorsum of the larva, so that in outline they appear secondarily serrated with ten or a dozen papillae on each side. The segmental spines are pale, colorless, of the usual two segments, the basal one 0.035 to 0.04 mm. in length and of about equal width, the distal one peg-like, 0.055 to 0.075 mm. in length, by 0.015 to 0.0185 mm. in diameter, accuminate toward the tip. The median, dorsal, and dorso-lateral spines are considerably smaller, measuring not more than 0.05 mm. in length, and exceedingly inconspicuous, it being almost impossible to detect them in the dorsal view, though visible at good magnifications in profile (See Fig 8, D).

The anterior segments, retracted under segment four when the larva rests, are, when it is active, protruded as a blunt, cone-shaped projection bearing dorsally the anterior spiracles and, terminally, the retractile antennae and mouth parts. As seen in caudal aspect (Fig. 8, D) or in cross-section the larva is very broadly sub-triangular, the apex of the triangle being at the mid-dorsal line and the lateral margins bearing the fringe of serrations already described.

The length of the posterior respiratory organ of the larvae measured, (Fig. 8, E, G) varied from 0.8625 mm. to 0.9525 mm., with an average of practically 0.9 mm.; the width at the tip varied from 0.4875 mm. to 0.5025 mm., averaging 0.494 mm.; the height at the tip ranged from 0.2625 mm. to 0.285 mm., averaging 0.27 mm. The median, slit-like spiracle ranged in length from 0.1275 mm. to 0.1387 mm. (averaging 0.134 mm.) by 0.015 mm. in width. The diameter of the circular plate varied from 0.0675 to 0.075 mm. averaging 0.0712 mm.; and these are situated with their median margins from 0.08 to 0.09 mm. apart. The color of the respiratory tube is brown, its surface rugose, with a shallow impression on the median line and a very moderate incision between the stigmal plates. The dorsal spiracular spine is very inconspicuous but the other interspiracular spaces bear broad rugose carinae, somewhat more elevated than the slit-like spiracles.

The integument of the larva is glabrous, finely and regularly papillose, very thin and transparent. The colors of the larva which are therefore resident in the viscera, are during development either an ashy or yellowish green, or more often, a yellowish brown. The young larvae collected from poplar were at first a delicate pea-green but soon changed indoors to the pinkish buff; and all the larvae found on willow at whatever age, as well as those reared indoors from the egg were constantly tan-colored. The full grown larva in any case is "tan-colored," a salmon buff or pinkish buff or warm vinaceous, the dorsum being mostly covered with small, globular masses of adipose tissue of this color. Where these globules are wanting the color is black as follows: A faint, interrupted, black, mid-dorsal line; and an irregular, elongate, blackish spot, obliquely-placed on either side of each of the principle segments; about six such spots on each side of the body running from near the mid-dorsal line obliquely laterad and caudad to the lateral margin. Sometimes these black blotches are so large as to give the larvae a prominent, V-shaped, banded appearance, the apex of the Vs directed cephalad on the middle line.

Growth is rapid, the young larvae apparently reaching full size within ten days of hatching. They are quite active and voracious during this time, moving about over the willow twigs tirelessly if the aphids are scarce.

However the full-sized larvae are exceedingly sluggish and apparently pass thru a pre-pupal period, from a week to several weeks, during which there is little or no feeding or motion.

The larvae were found on the under side of the leaves of wild cherry, poplar and dogwood, but on willow almost exclusively on the young twigs, their location being determined of course by the position of the aphids attacked. They appear to be quite rare during the first half of the season but occurred in abundance during August, 1916 on willow.

It seems likely that this may be the species referred to by C. W. Johnson in Psyche Vol. XIII, p. 3, Feb., 1906, as follows:

"Figure 7 represents a larva found by Mr. Owen Bryant at Cohasset, during the latter part of September, among some "woolly" aphids on the wild lettuce (*Lactuca elongata*). The larva was very flat, about 7 mm., in length, slightly roughened, and of a dull yellowish color. It evidently belongs to the Syrphidae. I did not succeed in getting it to pupate."

Puparium (Fig. 8, I, J). Length 6.6 to 7.75 mm., average 7 mm.; including the posterior respiratory organ, 7 mm. to 8.2 mm., average 7.6 mm. Width 3.5 to 4.1 mm., average 3.87mm. Height 2.3 to 3 mm., average 2.75 mm. In outline elongate oval with nearly parallel sides, the margins prominently serrated with the somewhat shrunken lateral processes of the larva, slightly widest a little caudad of the middle. Similar to the larva but the anterior end somewhat narrowed and considerably inflated dorsad.

It is noticed that the anterior end of the larva is but little retracted caudad on the ventral line; the larval mouth-parts remaining near the anterior pole of the puparium.

As seen from the side the anterior face is a little less than perpendicular rounding dorso-caudad to reach the greatest height about the anterior third. The dorsal line continues convex to a little beyond mid-length whence it is usually more or less concave to the tip. The ventral line is gently concave in the anterior two-thirds, thence straight or convex. As seen from in front, the outline is considerably flattened on the ventral side.

Color and pattern at first similar to that of the larva but soon loosing the warm tan or vinaceous and becoming a colder, dull clay color. The pupal envelope becomes marked with six or seven prominent transverse blackish bands not reaching the side margins, expanding a little on the middle line and irregularly prolonged backwards, hooklike, at their outer ends. The anterior ones are broader, the posterior ones narrower,—without the lateral expansions, and stopping much short of the lateral margins.

Adult (Fig. 12, K). The specimens so far reared from these larvae are all females. Of the described species they fit most nearly the *Xanthogramma divisa*[1], of Williston though in some respects they agree rather better with *X. felix* O. S. If these should prove synonymous, as Williston thought possible, the species would take the older name *felix*.

I quote Williston's description with emendations to apply to the specimens reared:

"♀. Length 9 to 11mm. Face and cheeks yellow or reddish yellow" with an opalescent reflection. "Face nearly perpendicular, gently concave below the antennae, and with a large obtuse tubercle below," from which the face retreats, being not at all produced again to the upper mouth edge. Labellae yellow. "Front above metallic greenish black, continued as a broad stripe to the base of the antennae," (the stripe occupies only about one-third the width of the front) "somewhat expanded below; on the sides yellow. Antennae black; somewhat reddish below on the sides of the second, and of the third joint near the base." The yellow is more extensive in my specimens, occupying much of the first and second joints and a large area on the under side of the third. "Dorsum of thorax deep metallic green with rather ill-defined yellow lateral stripes. Pleurae with a large ill-defined spot. Scutellum a somewhat translucent yellow, its base" very "narrowly black."

Abdomen opaque black; first segment broadly yellow on the sides encroaching minutely on the anterior corners of the second segment.

"Second segment with an oval spot on each side," two-and-a-half to three times as long as broad, the outer end cut off parallel with and "not reaching the lateral margin, somewhat attenuated toward the inner end." The spots separated by two-thirds their maximum width, or about ⅓ mm. "Third and fourth segments with large rectangular spots" a little longer than those on the second segment and the posterior lateral and median corners both somewhat rounded off, these spots separated by a third to a

[1]Proc. Am. Phil. Soc., XX, 311.

half their width (those on the third segment are from 0.15 to 0.22 mm. apart, those on the fourth 0.23 to 0.27 mm.) "and not quite reaching the lateral margin." The anterior lateral corners of these segments are narrowly yellow, the posterior margin of the third narrowly so in the middle and of the fourth more broadly. Fifth segment with an arcuate black band reaching the anterior margin in the middle, leaving the posterior margin, more broadly in the middle, and the anterior corners yellow, which latter make with the yellow of the preceding segment an arcuate yellow band attenuated in the middle. Venter yellow except for small black patches at the posterior corners of the principle segments. Legs rather more yellowish than in Williston's specimens, the anterior and middle pairs being entirely yellow, the hind ones infuscated somewhat on the middle of the femur and from the basal third of the tibia outward. "Wings hyaline, with a slight smoky tinge; stigma yellowish."

In all my specimens the abdomen reaches its greatest width at the tip of the second segment, which Williston states is characteristic of his specimen of *felix*, but the yellow spots of the abdomen are much too widely and distinctly separated to fit Osten Sacken's description of *felix*.

No adults have been taken in the field except the two females mentioned above which were captured about aphid colonies. However I have an Ohio specimen which agrees with the Maine specimens in detail.

SYRPHUS ORONOENSIS n. sp.

Larva (Fig. 10, A). Length about 11 mm., width 2.5 to 3.5 mm., height 1.5 to 2.5 mm. In outline the larva may be described as very elongate, subtriangular; somewhat more flattened than the ordinary aphidophagous larva, being sub-triangular in cross-section. The lateral margins are serrated and the posterior end convex rather than truncate.

Conspicuously colored, the posterior two-thirds or three-fifths of the body being chalky white, except along the margins; the anterior third or two-fifths as well as the entire lateral margins and the terminal segments, bright tan, maroon, or even quite black, depending on the stage of development of the larva. This sharp contrast of colors gives to the larva an appearance quite suggestive of bird-droppings especially when found curled about small twigs.

A more detailed examination of the color and pattern, which appears to vary only in details, shows that the anterior segments of the body vary from dark greenish gray to black as a ground color, with a median narrow stripe of white in segments four, five and six, and more or less extensive mottling with clusters of globular adipose bodies which vary from tan to dark maroon, the lighter colors prevailing on the younger larvae. The darker colors which occupy all except the narrow, mid-dorsal line throughout the first six segments, become restricted to progressively narrower and narrower lateral margins throughout segments 7 to 11, but again occupy the entire dorsum in segment 12.

The chalky-white median line of adipose tissue, which is scarcely a third of a millimeter wide throughout the anterior segments, *ends abruptly between segments 6 and 7 where the body is always quite blackish in larvae of all stages. On the anterior part of segment 7, the white adipose mass begins again, quite as abruptly,* with two U-shaped loops opening caudad, and separated by the black heart-line; the white mass occupying perhaps a third or fourth of the body width in segments 7 and 8. In segments 9 to 11, inclusive, the white masses expand in laterally-directed, angular wings to occupy four-fifths or more of the width. The large mass is not uniformly white, but is interrupted in each segment from 9 to 11 by the pulsating black heart-line and at the sides of this by large irregular pockets and smaller areas of greenish gray where the body fluids are unobscured by the globular masses of white. In very young larvae, the whole mass above described as white may be more or less tinged with tan. The venter is maroon to black, the margins whitish.

The transparent integument is uniformly papillose but without integumental vestiture. The segmental spines are small, light in color, and only moderately elevated, 0.045 to 0.075 mm. long, of two sub-equal, sub-cylindrical segments, the basal one 0.025 to 0.03 mm. in diameter, the distal one half as broad. The body wrinkles are moderately prominent. The posterior respiratory organ (Fig. 10, D, E) is very characteristic, being considerably longer than in the described members of this genus. *About two-thirds the distance from the base is a prominent constriction,* the tube being much depressed and somewhat compressed at this point. The basal two-thirds is very rugose with rounded papillae and dark maroon or black in color, while beyond the constriction the tube is smoother, polished and light brown in color. The entire respiratory organ measured as follows: length 0.702, 0.756, 0.756, 0.878, 0.918, 0.922 mm., the average 0.822 mm.; width at base 0.41 to 0.54 mm., the average 0.485 mm.; width at tip 0.325 to 0.35 mm., the average 0.334 mm.; height at base 0.35 to 0.43 mm., the average 0.54 mm.; height at tip 0.164 to 0.189 mm., the average 0.173 mm.

The stigmal plates are somewhat divergent at the tip with a noticeable emargination between them, the slit-like spiracles only moderately elevated and short measuring 0.055 to 0.06 mm. in length by about 0.02 mm. wide.

The rugose, black, dorsal spiracular spine is rather prominent, elongate dorso-ventrad, somewhat crescent shaped and bending laterad somewhat over the circular plate. The latter is very inconspicuous and appears to be elongate dorso-ventrad and narrower at the ventral end, rather than round. In each inter-spiracular space is a slight ridge with a single, tiny, whitish hair about 0.015 to 0.02 mm. long arising from a minute circular crater.

These larvae are aphidophagous, having been taken first in early July, 1916 at Orono on a willow infested with *Pterocomma smithiae* (Monell). In captivity one pupated July 28, the adult emerging August 6. Another pupated a few days later and on August 12 a puparium was found in the field, glued to a small twig of willow near an infestation of this aphid; this specimen

emerged August 13. Full grown larvae were again found on August 27 among the same species of aphid.

In 1917, on June 29, Mr. R. K. Fletcher and the writer found a number of larvae among *Myzus cerasi* (Fab.) on cultivated cherry and among *Phorodon humuli* (Schrank) and *Rhopalosiphum nympheae* (Linné) on cultivated plum. These varied from larvae but recently hatched to full grown, all of which showed the characteristic pattern described above, the younger larvae however being lighter in color. Pupation of these larvae began July 8th. The type female emerged August 2 from a puparium formed July 24.

There thus appears to be at least two generations of this species annually, one occurring as larvae chiefly during June, the other occurring in the larval stage chiefly during August. A one-fourth grown larva was taken among *Myzus cerasi* (Fab.) on July 14, indicating that the generations are somewhat irregular.

The larva does not appear to be much restricted in its choice of food, the known hosts representing four different genera.

It is a species offering considerable possibilities in the control of aphids affecting the stone fruits and its ability to live on aphids of other hosts is at least an advantage in the maintenance of the species.

The larvae are to be found on the under, infested, side of the leaves of the trees mentioned and also on the smaller twigs. With the green of the leaf as a background or when removed from their natural surroundings, their colors make them quite conspicuous. But when surrounded thickly by aphids or, more especially, when wound around a small infested twig they are quite inconspicuous. When I first found the larva on an uninfested twig, in which situation they appear to pupate, I was strongly impressed with its resemblance to the droppings from a bird.

Puparium (Fig. 10, B). Length about 7 mm., exclusive of the posterior respiratory organ which may project half a millimeter farther or be directed more dorsad. Maximum width 3.25 mm., maximum height 2.75 mm. The anterior half is irregularly globose, the puparium somewhat suddenly depressed about mid-length, the posterior half remaining flattened much as in the larva. It is interesting to note that this depression, or lack of inflation, begins at the point on the seventh larval segment where the white adipose mass gives way to the black area of segment six. The pu-

parium is widest about 2 mm. caudad of the anterior extremity, or in the region of the fifth and sixth larval segments which are of about equal width in the puparium. Anterior to this point the outline from above is unevenly rounded. Cephalad of the fifth segment the puparium narrows noticeably to a width of 2.25 mm. in half that length and in front of this constriction the outline is semicircular. Caudad of the sixth segment, or widest point, is a similar constriction to a width of about 2.25 mm. at the beginning of the eight larval segment. From this point the body is more regularly attenuated; and the puparium, inflated a little at each segment, narrows to a width of 1.25 to 1.75 mm. at about half a millimeter from the posterior end. Thence it is rapidly attenuated to the respiratory organ, if this is terminal, or is more nearly truncate if the respiratory organ is directed dorsad. As seen from the side the ventral line beginning with the region of the larval mouthparts is at first gently convex downward, then more or less strongly concave to a point well caudad of the middle, thence again convex to the posterior end. The dorsal line is strongly and evenly convex dorsad and caudad to about the region of the seventh larval segment, about three millimeters caudad of the anterior end. It is then abruptly depressed or concave throughout segments seven to nine and finally gently convex to the posterior end. The shape as seen from in front is a short oval with the long axis transversely and spherical angles at the sides. The posterior half of the body retains the shape of the larva to an unusual degree and is sub-triangular except that in some specimens the lateral margins show moderate dorsal carinae.

The predominating color of the puparium is maroon to black, extensively mottled with patches of white and of pinkish brown. The dark mid-dorsal line of the larva is evident over the posterior half of the puparium, and is bordered with more or less extensive irregular masses of the white adipose tissue of the larva. In the region of larval segment six is usually a large dark area, while in front of this the color is quite dark, overlaid with irregular areas of lighter color. The posterior end of the puparium, including the base of the respiratory organ is almost black, the distal end of the latter brown.

Syrphus oronoensis n. sp.

Adult (Fig. 10, C). ♂. A small species, the abdomen with nearly parallel sides, the three principle segments opaque black and each with a pair of yellow sub-triangular spots, the first pair small and far apart, the others larger and more approximate.

Length about 8 or 9 mm. Head large, broader than the thorax or abdomen. Eyes bare. Frontal triangle somewhat swollen, bronze black, shining, with rather long black pile which continues somewhat thickly down the sides of the face to the mouth edge. Vertical triangle with long black pile. Face below the antennae at first convex then very slightly concave to the tubercle which is not prominent; mouth edge retreating, cheeks convex below. Face opalescent yellow, thinly whitish pollinose on the

sides, the yellow encroaching somewhat on the frons at the sides. No black stripe over the tubercle but the cheeks in front and narrowly margining the anterior mouth edge, metallic black; behind and across behind the mouth thickly whitish pollinose like the posterior orbits. Antennae chiefly reddish yellow but, in one specimen, considerably darkened on upper part of second and upper half and tip of third segment; short, the third segment considerably broader than its length beyond the tip of second segment; arista two-and-a-half times this length, black.

Mesonotum brilliant shining black, lateral stripes obscurely yellow and with the sides of the thorax pollinose; pile rather long, dusky white.

Scutellum opalescent yellow like the face, the extreme base and corners blackened; pile long, whitish yellow.

Abdomen narrow, with nearly parallel sides, a little widest near the middle of the third segment. The first, fifth and following segments shining metallic; elsewhere opaque black. The second segment with a pair of small, sub-triangular spots about mid-length, separated by a little more than half the length of this segment and distinctly separated from the lateral margins. Third and fourth segments each with a pair of larger, sub-triangular spots situated near, but distinct from, the anterior margin as well as from the lateral margins; at their widest point occupying nearly half the length of the segment; separated by a fourth or fifth the length of their respective segments. Pile of the abdomen abundant, whitish, very long at the base and decreasing regularly in length toward the genitalia. Length of wing 7 mm., exceeding the tip of the abdomen; most of the sub-costal cell infuscated; veins black, anterior cross-vein quite perpendicular. The fore and middle legs chiefly dull yellow, base of femora, coxae and trochanters infuscated; the hind pair chiefly brownish, lighter about the knees, the femora with rather abundant long delicate dusky pile. Squamae, plumulae and halteres whitish, the latter somewhat infuscated.

♀. Eyes bare, face without a black stripe; mesonotum with yellow lateral margins, scutellum with base and anterior corners very narrowly black. Abdominal segments 2 to 5, inclusive, with brilliant, shining, steel-blue bands on the anterior part which are largely occupied by yellow, sub-triangular spots, of which there are four pairs, going over the side margins in their full width but distinctly separated from each other; elsewhere opaque black.

Vertex deep blue-black, shining, continued as a broad, more coppery stripe, evenly of about half the width of the frons, almost to the antennae. The sides of the frons nearly to the vertex, the entire face, cheeks and occiput pale yellow. The sides of the pale frontal stripes, the face (except a pale yellow oval area on the tubercle and the jowls) and the occiput thickly covered with silvery white pollen and with delicate white pile. Pile of vertex and frons black.

Mesonotum brilliant metallic bronze, the lateral margins yellow from the humeri almost to the scutellum, as far as the suture the yellow obscured with white pollen. Pleurae whitish pollinose and with moderately abundant white pile. Scutellum golden yellow, the extreme base and corners

black. Pile of the mesonotum dusky, that of the scutellum short, sparse, yellow and black mixed.

First abdominal segment metallic, blue-black the antero-lateral margins broadly yellow. Second segment with an anterior, opaque, black band much attenuated toward, but reaching the extreme lateral margins; at the middle occupying about one-fourth the length of the segment; joining at the middle to a similar opaque band occupying the posterior three-fifths of the segment. Between these two bands an interrupted, metallic, steel-blue band, most of which is occupied with a yellow spot on each side, attenuated mesad and strongly bent forward about the lateral third, not reaching the anterior margin. Third segment with an entire steel-blue anterior cross-band occupying one-third the length of the segment and underlaid with a pair of sub-triangular, yellow spots, which reach the lateral margins in their full width but are distinctly, though narrowly separated from the anterior margin except at the extreme corners. The two spots are separated from each other by more than half their maximum width. Posterior three-fifths of the segment opaque black. Fourth segment similar. Fifth similar to third and fourth except that the posterior band is proportionately narrower and less opaque and the yellow spots only about half as long, reaching the anterior margin on their outer part and even encroaching minutely on the preceding segment. Remaining segments shining blue-black. Venter with a broad, black band on each of the principal segments . Pubescence at base of abdomen moderately long, delicate, whitish; elsewhere short, sparse, colored like the integument.

Fore and middle legs pale yellow except slight infuscation on basal half of femora and at tip of tibiae; hind femur black except broad base and tip, the tibia infuscated on outer part and the hind tarsi much so. Pile of legs whitish. Length 7 mm.

This species approaches the genus *Xanthogramma* but the indistinctness of the yellow on the thoracic margins and pleurae, and especially the slender abdomen with long pile at the base are sufficient to place it in *Syrphus*.

The *types* are in the author's collection. *Cotypes* in the collection of the Maine Agricultural Experiment Station. It should be stated that in these reared specimens the abdomens upon drying have shrunken and curled under so as to present a very different appearance (See Fig. 10, H) from that of the fresh specimens from which Figure 10, C and the description were taken.

PLATYCHIRUS PERPALLIDUS Verrall.

This British species described by Verrall in 1901, and not hitherto recorded from America, has probably been confused with *P. quadratus* Say, to which it is closely allied. The two species may be distinguished as follows:

P. quadratus Say. ♂	*P. perpallidus* Verrall. ♂
Front tibia on the inner side slightly but distinctly concave.	Front tibia on the inner side hardly at all concave or quite straight.
Middle femur with a cluster of long dense pubescence at the base.	*Middle femur entirely without a basal cluster of pubescence.*
The tip of middle femur with a somewhat denser clump of slightly finer hairs.	The tip of middle femur with fewer but heavier hairs.
Middle tibia more flattened and broader; and the first segment of the tarsus somewhat flattened.	Middle tibia less flattened and the first segment of middle tarsus entirely cylindrical.
Last two joints of hind tarsus black; the tip of the front tibia behind is indefinitely infuscated, the only black markings appearing as three or four broken transverse hair lines.	Last two joints of hind tarsus somewhat less blackened and the tip of the front tibia behind with a more distinct black spot.
Abdomen with a distinct median longitudinal black stripe .11 mm. to .17 mm. wide; i. e. roughly one-tenth to one-twelfth the width of the segment thruout segments two to four inclusive; *and a distinct, posterior black crossband of about equal width on each of these segments,* which occupies from one-sixth to one-ninth the length of the segment.	*Abdomen much less distinctly marked with black;* except the first segment and a median anterior triangle on the second segment, *nearly pure orange yellow, the black mid-dorsal line* on segments two to four *nearly or entirely obsolete and the hind margins of these segments very narrowly and inconspicuously black.* The yellow abdomen contrasts strikingly with the brilliant black thorax in a manner suggestive of *Pyrophaena* spp.

The females, as in this entire genus, are distinguished with difficulty. The specimens at hand have the median black line and the black crossbands narrower than in *quadratus*, the abdominal markings more yellow and less reddish than in *quadratus* and the fifth segment with the yellow not interrupted by the median black line and not excised with black behind.

A female of *Platychirus perpallidus,* taken about wild mustard and pea vine on August 3, 1916, deposited about 100 eggs in the laboratory August 4 and 5, which began hatching on August 7; the egg stage occupying about three days. The larvae were fed on *Aphis cornifoliae* Fitch which they took in preference to certain other species offered. They appeared to be full grown by August 21, but did not begin pupation until August 28.

This species was of particular interest because the genus seems not to have been definitely recorded as aphidophagous in the larval stage, although Professor J. W. Folsom[1] suspected from the presence of the adults of *P. quadratus* Say about clover aphids that they might have developed on them.

According to Verrall[2], *P. scutatus,* an European species of the genus, "is said to have been bred from rotten fungi."

I have recently taken males and females of *P. scutatus,* at Orono, about spirea infested with *Aphis spireacola.* The females oviposited in the laboratory and the larvae from these eggs are at the present writing feeding contentedly on these aphids. So that it may be doubted if the larvae of this species developed on rotten fungi.

Egg (Fig. 11, A). The length of a dozen eggs measured, ranged from 1.025 mm. to 1.085 mm., with an average of 1.046 mm.; the maximum width varied from 0.232 mm. to 0.256 mm. with an average of 0.244 mm. *An unusually elongate, straight-sided egg, almost cylindrical and more than four times as long as its greatest diameter,* instead of about three times, as is usual in this group. The sculpturing of the chorion is similar to that of such species as *Syrphus americana, Sphaerophoria cylindrica, Allograpta obliqua,* and others, consisting of irregular elevated bodies surrounded by irregularly radiating elevated arms. There are about forty such elevated bodies the length of the egg, each measuring from 0.025 mm. to 0.045 mm. in length and each surrounded by from 15 to 20 short, thick arms.

In captivity the female deposited the eggs in a somewhat characteristic manner, to some extent similar to that of *Melanostoma mellinum,*[3] three or four being ranked side by side; but also with a strong tendency to place the eggs end to end. As many as four were so placed in a line with the ends contiguous, suggesting very much in their arrangement a string of sausages. (See Fig. 11, A). Whether this same habit prevails in the field I am unable to say.

---

[1]Univ. Ill. Agr. Exp. Sta. Bul. 134, 1909.

[2]British Flies, Vol. VIII, p. 263.

[3]Me. Agr. Exp. Sta. Bul. 253, p. 228.

Larva (Fig. 11, C). Length 10 to 11 mm., width at middle 1.75 to 2 mm., height about 1 mm. An elongate, slender-bodied, nearly parallel-sided larva more than five times as long as broad, with moderate transverse wrinkling and gently, irregularly-serrated margins. The color is a beautiful bright tan; the mid-dorsal blood-vessel forms a continuously black line throughout most of the length and is margined on each side with a broad, whitish stripe of adipose tissue, giving off at the sides irregular, slender, curved tongues of similar color which together form another, indefinite, narrow, irregularly curved and broken stripe of white. A third pair of whitish stripes, slender, broken and irregular, lie close to the lateral margins. The integument is finely and evenly papillose but is devoid of integumental vestiture. The segmental spines are light, concolorous and small,—of two segments, the basal one about 0.015 mm. long by 0.022 mm. broad, truncate-cone-shaped, the distal one 0.007 mm. in diameter and about 0.03 mm. long, tapering slightly but blunt at the tip. The anterior larval spiracles (Fig. 11, B) show five minute denticles arranged in a semicircle.

The stigmal plates (Fig. 11, H) are almost sessile, the respiratory tubes which bear them being about 0.18 mm. long by about 0.25 mm. in width by about 0.12 mm. in height. The circular plates or buttons are quite distinct and circular, 0.04 mm. in diameter, and each slit-like spiracle about 0.0375 mm. in length by about 0.0075 mm. in width, but its sides lined with a row of separate minute, rounded denticles which increase the apparent width to 0.015 mm. There are ten to a dozen such denticles along each side of each spiracle. I find no trace of interspiracular ornamentation except a very small rounded nodule, the surface of the stigmal plate appearing quite smooth except for the spiracles. The end of the respiratory organ is decidedly emarginated between the two stigmal plates and the plates turned outward giving the tubes the appearance of being somewhat divergent at their tips.

Puparium (Fig. 11, I, J,). Length 5.5 mm., maximum width 1.85 mm., maximum height 1.75 mm. The colors of the larvae are at first carried over into the pupa stage but are gradually transformed to a more uniform reddish brown although the black and white stripes of the mid-dorsum persist for a longer time. The integument becomes fairly smooth, much indurated and glazed.

The puparium is moderately inflated, globose in front, broadest about the anterior third thence somewhat irregularly and gradually attenuated to the posterior end. In side view (Fig. 11, I) the ventral line is seen to be gently convex, the dorsal line arising nearly perpendicularly from it, but soon rounding away to its maximum height about the anterior third. Thence it descends with a moderate hump over the posterior third to the posterior respiratory organ which is terminal.

Adult (Fig. 11, D, E, F, G). I quote in full Verrall's original description:[1]

---

[1]British Flies, Vol. VIII, pp. 290-292.

"*P. perpallidus* n. sp. Face scarcely at all produced; front tibiae of the male gradually dilating from base to tip, front femora with moderate pale pubescence behind; abdomen and legs nearly all orange in both sexes.

"♂. Face and frons obscured by yellowish grey dust, which leaves only the central knob, the front mouth-edge, and the space above the antennae shining black; the hairs on the face are fairly abundant, rather short and mostly pale, but on the frons they are longer and partly black; the space before the jowls is blackish; the jowls themselves and the back of the head are yellowish grey, but more aenous towards the occiput; the pubescence on these is luteous, becoming longer on the upper part, and nearly all black on the raised shining aenous black vertex. Antennae entirely brownish black; arista dark orange to blackish, about as long as the antennae.

"Thorax and scutellum intensely shining aenous with rather abundant mostly equal tawny pubescence, which is however longer round the scutellum, and longer and more shaggy on the back part of the mesopleurae; there are a few black hairs about the lowest part of the sternopleurae.

"Abdomen all orange or tawny except at the black base which converges about the middle of the second segment to a narrow dorsal line which extends to the end of the fourth segment, while the hind-margins of the second, third, fourth, and fifth segments are very narrowly and inconspicuously blackish (but not quite so narrowly in the specimen from Kingussie). Pubescence nearly all yellow, and as usual longest about the basal corners; belly all orange. Genitalia small, mostly shining aeneous black.

"Legs all orange except on the black coxae and trochanters, while the hind tarsi are partly brownish on the moderately dilated basal joint and less distinctly so on the two last joints; the hind femora and tibiae bear a blackish ring about the middle in the specimen from Kingussie, and there are faint traces of such ring in the Sutton Park specimens. Front tibiae slowly and gradually dilated from soon after the base to the tip, which is the widest part; this tip is rather whitened and is a little obscured; the front tarsi are not so much widened as the tip of the tibiae and they very gradually diminish in width, being dilated even up to the tip; the basal joint is longer than the next two and more than twice as long as the second joint. The *pubescence behind the front femora* is moderate and is *all yellow* and inconspicuous, the long woolly white hair at the base behind being present as usual in this group; the front tibiae bear a slight fringe behind about the middle. Middle trochanters bearing some strong black bristles, while the middle femora bear a moderate pubescence which is nearly all yellow and amongst which are no small black bristles, but towards the front at the tip almost beneath are about five unusually long recurrent hairs, which form a peculiar distinctive character for this species; the tibiae are slightly dilated about the middle and bear a long dense fringe in front almost beneath and a slighter fringe behind; hind tibiae without any fringe; the tiny bristles on the legs are all yellow.

"Wings considerably brownish, but rather tawny about the base and the stigma. Squamae and their fringes brownish yellow. Halteres orange.

"♀. Rather similar, but even the hind tarsi are almost all orange being

only a little discolored above the base of the basal joint; the second, third, and fourth abdominal segments have black hind-margins which occupy about one-fifth of each segment, and the inner hind corners of the orange spots are more rounded than in the male, but less than in the female of *P. fulviventris.* Frons broad, being at the vertex about one-third the width of the head; it is shining blue-black there, but the side dust spots are so large as to leave only an indistinct middle line connecting to the indistinct shining black space above the antennae; the pubescence on the upper half of the frons is partly black.

"Length about 8 mm."

This species is much commoner in Maine than *P. quadratus,* being represented in the collections by about 50 males and an equal number of females. Especial abundance was noted at Orono the tenth and eleventh of August, 1915 and the thirteenth to the eighteenth of June, 1917. Other dates for Orono are July 31, Aug. 1, 6, 12, 15, 16, 19, and 25. Specimens were also taken at Fort Kent, July 5 and 6, Presque Isle, July 8, and Bar Harbor, July 25.

The adults are commonest in tall grass, seeming to show a preference for the proximity of open ditches where they hover about, alighting frequently on the grass blades or spikes, males as well as females teetering up and down with the abdomen as though about to oviposit. Examination of these sites has so far not revealed any other stage of the insect.

SYRPHUS KNABI Shannon.

(*Syrphus xanthostomus* Willist. of Metcalf in Ohio Nat., Vol. XIII, No. 5, pp. 81-83.)

In the Ohio Naturalist for March, 1913, I published a description of what was called the Pemphigus-Gall Syrphus-Fly, under the name of *Syrphus xanthostomus* Williston.

I was aware at the time that Williston's rather brief description did not fully cover the adults under observation, particularly in regard to the distinctly yellowish lateral margins of the thorax and the absence of the median, narrow, deep, emargination in the posterior margin of the second and third yellow abdominal bands. However as Williston's type was not examined, certain points of discrepancy were simply incorporated in the description of the adult and no new name created for the species discussed.

Mr. R. C. Shannon[1] has recognized and recently described this species as distinct from *xanthostomus*, under the name of *Syrphus knabi*. The Ohio specimens from Pemphigus galls agree quite closely with Shannon's description. The "Pemphigus-Gall Syrphus-Fly" therefore should be called *Syrphus knabi* and not *Syrphus xanthostomus*. *Syrphus knabi* has also been reared in Maine from the pseudo-galls formed of ash leaves by *Prociphilus fraxinifolii* Fitch. The galls of *Pemphigus oestlundi* Cockerell *(P. vagabundus* of authors) have never been recorded from Maine.

The metamorphoses of *Syrphus xanthostomus* Williston are also under observation at the present time; and, if there were any possible room for doubt as to the specific separation of these two species from examination of the adult alone, the immature stages and biology show them to be abundantly distinct.

These larvae were first taken in Maine on July 7, 1915, exactly the date on which, four years previously, they were found in the Pemphigus galls in Ohio. Additional specimens were collected July 16 and 21 and again on July 18, 1917. The larvae, at least when nearly full grown, are found in the rather tightly-curled parts of the leaves surrounded by numbers of empty skins of the aphids, an eloquent witness to their ravages during growth. In such situations they are only slightly less protected than in the Pemphigus galls.

The Pemphigus-gall larvae were described as follows:

"*Larva.* Length about 10 mm. (8 to 11.5), width 3.75 to 4 mm., height 2.5 to 3 mm. Fat, thick, grub-like, sluggish larvae, elongate oviform in outline, strongly arched dorsally (Fig. 12, B). Wrinkles prominent, produced laterally into an irregular, dorso-lateral carina; the ventral folds of the body in the principal segments serve as very imperfect prolegs. General color very pale, pinkish-yellow. Heart line not conspicuous. Skin bare, the segmental bristles short and light in color, very inconspicuous." About 0.07 mm. long, of the usual two segments, the basal one about 0.23 mm. in diameter by a little longer, the distal one less than half as broad at the base and accuminate.

"The jaws of the mouth-parts are unusually short, their width at base equal to their length, the lower jaw the heavier. Mouth-hooklets apparently three pairs: two near the jaws of which the ventral pair is the heavier, the third pair lateral in position, heaviest of all. There are a number of sensory papillae around the mouth-parts and antennae. The antennae are

[1]Proceedings of the Biological Society of Washington Vol. XXIX, p. 200, Sept. 22, 1916.

small, situated close together above the jaws, of the usual form (see Fig 12, A).

"The prothoracic spiracles are slightly elevated, blunt, short, horn-shaped as seen from the side (Fig. 12, A, g), the semi-circular slit apparently guarded by six, blunt teeth, one of the median ones emarginate or imperfectly divided (Fig. 12, C). The posterior respiratory appendage (Fig. 12, D, E) is" a little "longer than broad, testaceous brown, ringed about mid-length, thence slightly constricted. The spiracles (*a*) moderately long, somewhat elevated above the surface; the inter-spiracular spines (*b*) short" sharp ridge-like, "rather prominent. Dorsal spiracular spine (*c*) short compressed; its breadth about equal to diameter of the approximate circular plate (*d*).

"These larvae were found, full-grown, at Cedar Point, July 7, 1911. The larval stage continued indoors to July 11 and 12.

"They were collected on the Poplar or American Aspen (*Populus tremuloides Mx.*) in the well-known, characteristic galls on the ends of the twigs, made by the aphid, *Pemphigus" oestlundi* Cockerell.

The larvae taken from the Ash pseudo-galls, in correlation with the greater freedom of motion afforded them all during development, did not present such exceptional height and thickness. While unusually corpulent, they retained the typical *Syrphus* shape, as in *torvus* for example, and were less sluggish than those described above.

The length of the full grown larvae when extended exceeded 17 mm., their greatest width fully 4 mm. and their height about 2.5 mm. Cross-section semi-circular. The ground color of these larvae (the body fluids showing through the integument) is a dull ashy gray with areas of orange and black where viscera of these colors showed faintly. The ashy gray is overlaid extensively with ashy white adipose masses in the usual position; beginning at the anterior end with a narrow, mid-dorsal line which widens wedge-shaped caudad until in the posterior half of the body it occupies most of the width of the body. It is interrupted at each segment by a prominent emargination at each side and by an elongate, pulsating area on the middle line. The posterior respiratory organ is a warm brown in contrast with the whitish body.

While the respiratory tube is not elongate, the stigmal plates are noticeably more elevated than in *Syrphus torvus, ribesii,* etc. *The respiratory organ in knabi is at least as long as its width at the tip; in that of torvus the length does not exceed two-thirds the width.* The length of the tube is from 0.53 to 0.61 mm., its width from 0.49 to 0.57 mm., with an average of 0.525 mm. and its height 0.31 to 0.335 mm., average 0.325 mm. The transverse diameter of the circular plate is about 0.06 mm. its dorso-ventral diameter about 0.09 mm.; the inner margins of the two about 0.129 mm. distant. The median spiracle measures about 0.16 mm. in a straight line, its width about 0.012 mm.

The surface of the respiratory tube is only indistinctly and irregularly papillose, polished; with shallow grooves along the median line, dorsad

and ventrad, which meet across the tip in a moderate emargination between the two stigmal plates which are only a very little divergent.

The slit-like spiracles are a little elevated on carinae, are almost exactly straight in surface view, and about equi-distant and equally divergent from each other.

The interspiracular ornamentation consists of short, sharp, elevated irregular ridges, or carinae, (instead of nodules), much more elevated than the spiracles; hardly at all continued down the sides of the tube; pale brown in the larva, black during the pupal stage.

Puparium (Fig. 12, F, G). Average length 7.2 mm., height 3.5 mm., width 3.8 mm.

"These puparia (Fig. 12, G) are exceptionally inflated dorsally, the ratio of height to length being greater than in any of the other species I have examined. It is characteristic of them also that the posterior inflation is equal to, or greater than, that anteriorly; in outline, as seen from the side, the dorsal half of the puparium makes an almost perfect semi-circle," reaching its greatest height a little in front of the middle. "The ventral line is sinuate. The respiratory appendage (*a*) projects from the lower posterior part. From above, the outline is sub-ovoid, broadest in front of the middle, thence narrowing gradually to the posterior third; whence the puparium is strongly and unevenly compressed to the tip of the respiratory appendage.

"Color at first grayish brown, sometimes marked with oblique patches of black; posterior breathing appendage darker. As the pupa approaches metamorphosis the anterior end darkens to deep reddish-brown in the region of the eyes; while on the posterior half, the three principal, yellow abdominal bands of the adult become visible through the transparent wall." Color of the empty puparium light testaceous brown.

"The segmental spines remain, as in the larva, very inconspicuous. The posterior breathing appendage also retains its characteristics."

The larvae from Ash developed as follows:

One pupated	July 16th,		
One "	July 19th,	emerged	July 30.
Two "	July 20th,	"	July 30.
Three "	July 24th,	"	Aug. 1.

The duration in this stage under laboratory conditions was therefore from eight to eleven days. The pupation record for the Ohio specimens was seven to eight days.

Adult (Fig. 12, H, I). Shannon's description is as follows:

"Squamae with rather long, light yellow pile; ground color of the sides of thorax bright yellow, with yellow pile; bands on the third and fourth abdominal segments entire and extending over the margins almost in their full width.

"Male: Frons yellow with bluish green reflection, a black spot above each antenna, and with fine rather long, black hairs which continue a short distance down between the antennae and eyes. First two antennal joints reddish-brown, the third joint darker, reddish beneath and some-

what pointed apically (See Fig. 12, J); arista brownish, a little longer than antenna. Face and cheeks yellow and with light pile. Mesonotum greenish aeneous with two obvious median stripes and bright yellow sides clothed with light golden pile; pleurae a somewhat lighter yellow than the lateral stripes of dorsum, and with golden pile; scutellum yellow with a greenish sheen and with black pile, the sides with yellow pile. Band on the second abdominal segment interrupted and outwardly produced forward where it extends over the sides and up onto the sides of the first segment. The bands on the third and fourth segments run straight across, extending over the sides in almost their full width. Fore coxae and trochanters cinereous, the hind trochanters yellowish, front and middle legs entirely yellow; hind pair yellow, the femora with dark band beyond the middle, yellow posteriorly; hind tibiae darkened on outer side of apical half and clothed with black pile; last four tarsal joints darkened. Length about 11.5 mm.; wing about 11 mm.

"Female: Width of frons at vertex about equal to length of third antennal joint, but widening quite rapidly down to the antennae. Frons yellow, brightly so for about one-fourth its extent above antennae above this a region with a greenish-black reflection which has an ill-defined triangular mark; the last section, which includes the ocelli, is nearly as long as broad and is shining black; a black spot above each antenna.

"This species.....has been confused with *ribesii, grossulariae, and xanthostomus.* It differs from *ribesii* and *rectus* in its bright yellow mesonotal side margins; apically pointed third antennal joint; bases of femora in male yellow, and second and third yellow bands of abdomen but little narrowed laterally.....the small bristles on the under side of the middle tarsi yellow instead of black."

EXPLANATION OF FIGURE 8.

Immature stages of *Xanthogramma divisa* Willist.

A. Eggs of *Xanthogramma divisa*, the two above in dorsal view, the one below in side view, X 40.

B. Characteristic sculpturing of the shell of the egg as it appears at a magnification of 300 diameters.

C. Dorsal view of larva just after hatching, X 50.

D. View of full-grown larva from the caudal aspect, X 8, to show its unusual flatness.

E. End view of the posterior respiratory organ of the larva, X 115, showing circular plates, slit-like spiracles, and the irregularly-rugose inter-spiracular ridges.

F. Dorsal view of the larva, X 5, to show color pattern.

G. Dorsal view of the posterior respiratory organ, X 40.

H. A part of the marginal serrations of the larva more enlarged, showing the three large and one smaller serration occurring to each segment and the minute, integumental papillae.

I. Dorsal view of the puparium, X 8, showing shape and color markings.

J. Outline drawing of the puparium, X 8, showing shape from the side.

For other figures of *Xanthogramma divisa*, see 9 and 12 K.

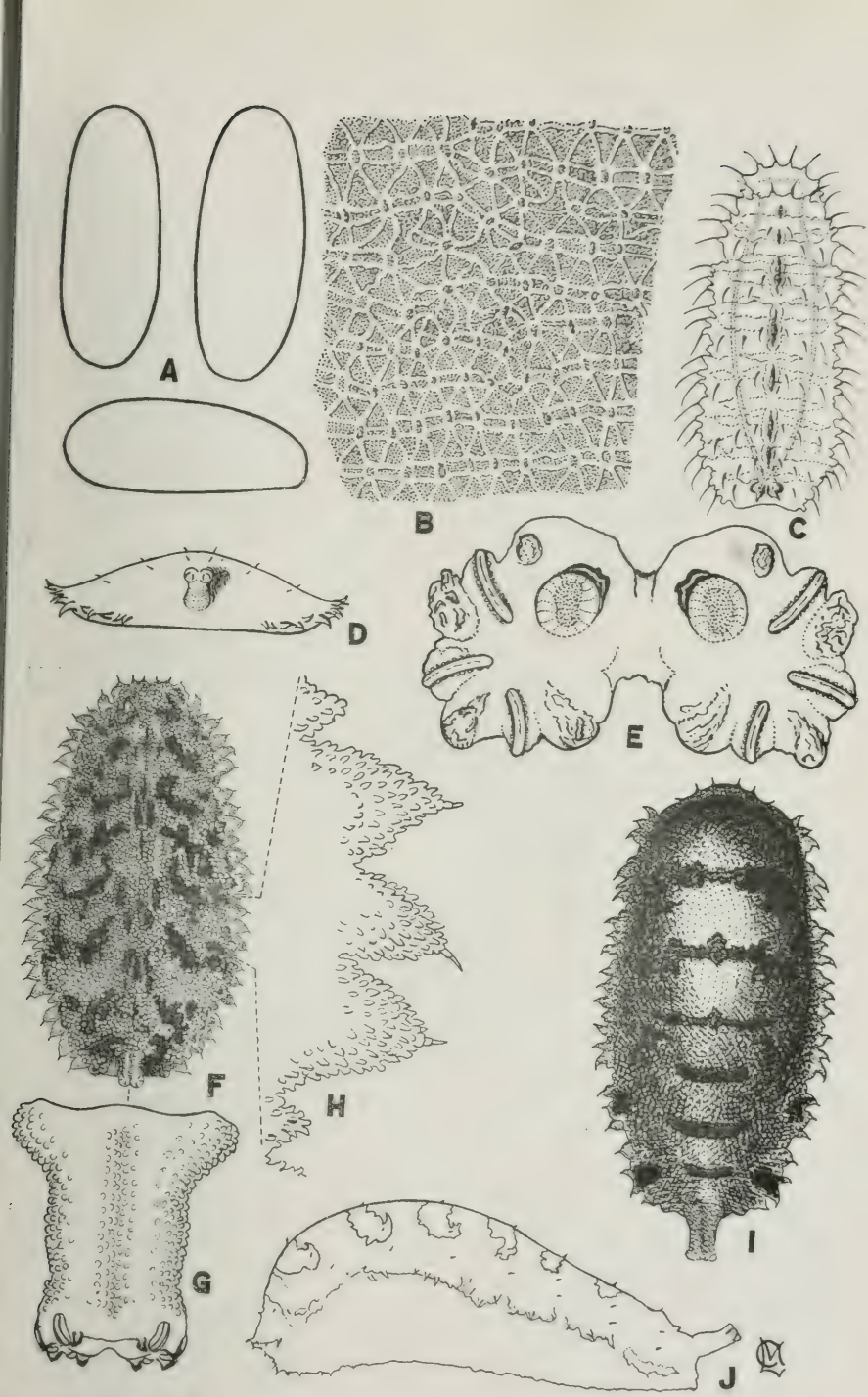

Figure 8. Immature stages of *Xanthogramma divisa*.

EXPLANATION OF FIGURE 9.

Life stages of *Xanthogramma divisa* Willist.

From photographs by R. L. Hammond; enlarged two diameters.

A. Larvae taken under loose bark of a willow tree in Autumn.

B. Puparia; the three above, found under loose bark and on the ground under the same tree in June. The one above the letter B shows an emergence hole from which 26 parasites (species undetermined) issued July 8. The one immediately below the letter B is an empty puparium from which the adult has emerged. The larval mouth-parts may be seen as an anterior, ventral, black V.

C. Adult females reared from the larvae.

See also figures 8 and 12, K.

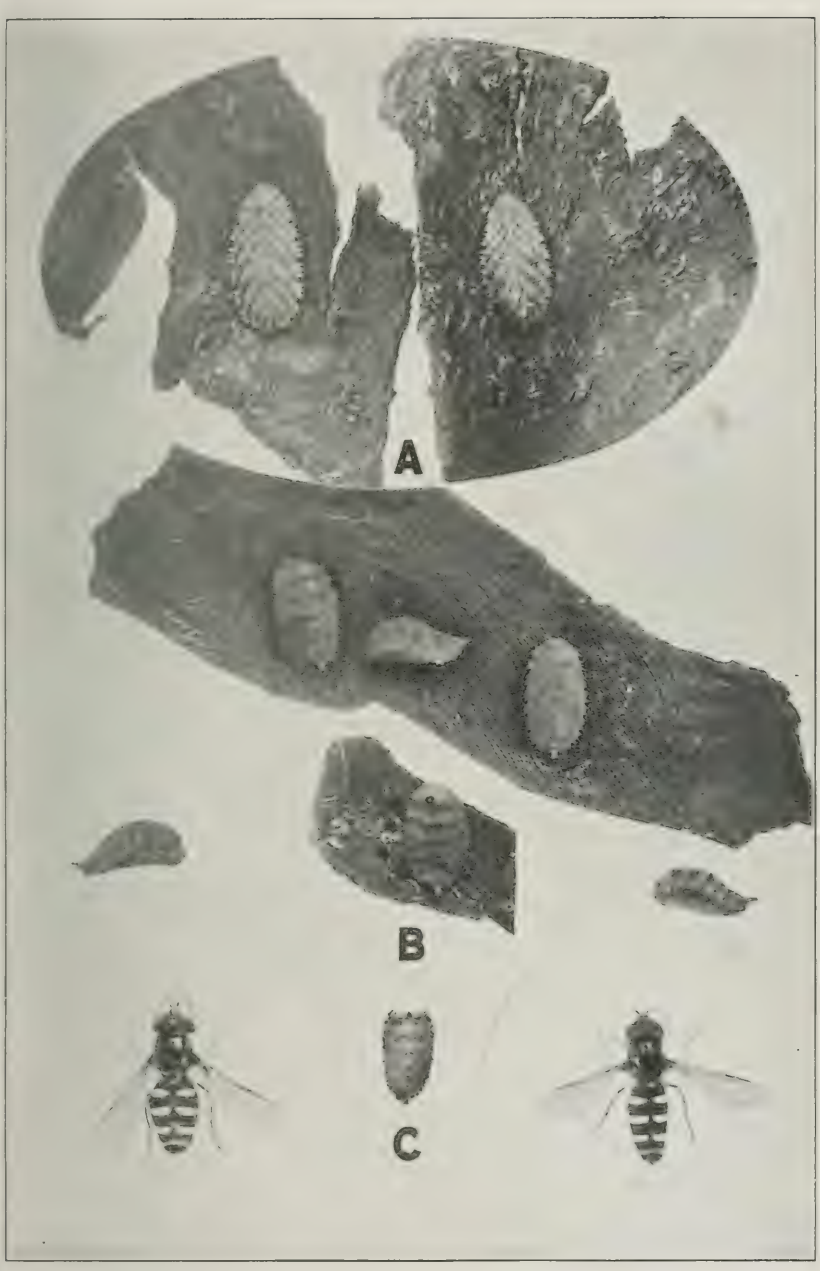

Figure 9. Life stages of *Xanthogramma divisa*.

EXPLANATION OF FIGURE 10.

Life stages of *Syrphus oronoensis* n. sp.

A. Dorsal view of larva to show color pattern; X 7.

B. Dorsal view of the puparium, X 8, showing shape and color pattern.

C. Adult male, X 9 (legs and right wing omitted). The abdomen is here shown as it appears during life (cf. fig. 10, H).

D. Posterior respiratory organ of the larva, dorsal view, X 40.

E. Posterior respiratory organ from the side, X 40. Note the characteristic constriction two-thirds the way from the base.

F. End view of the posterior respiratory organ X 170, showing median dorsal spiracular ridge, the irregular shape of the button or circular plate, the slit-like spiracles, and the minute inter-spiracular spines.

G. Puparium from the side, X 8.

H. Abdomen of the type male, X 6, as it appears after drying and shrinking.

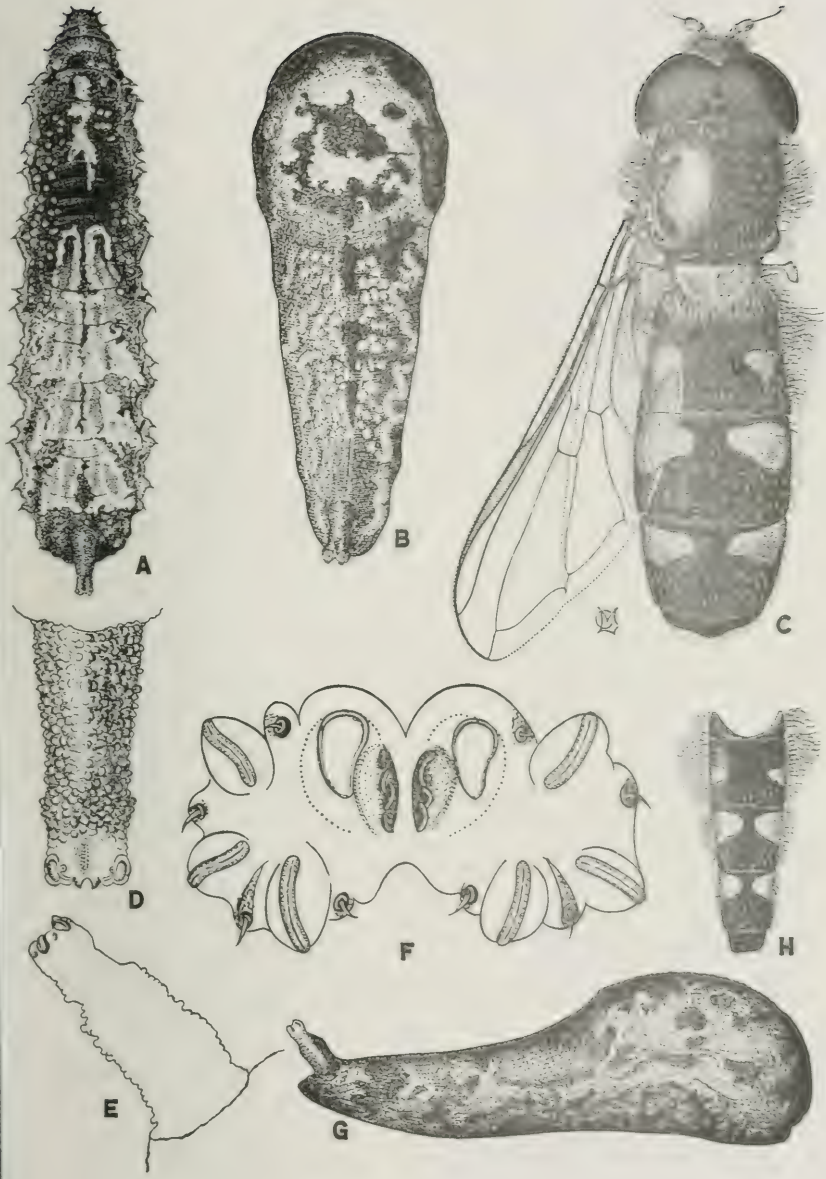

Figure 10. Life stages of *Syrphus oronoensis*.

EXPLANATION OF FIGURE 11.

Life-stages of *Platychirus perpallidus* Verrall.

A. Three groups of eggs as placed by female in captivity, X 17.
B. Two views of the anterior larval spiracle, highly magnified.
C. Dorsal view of full-grown larva, X 8.5.
D. Front femur, tibia and tarsus of male, redrawn from Verrall on comparison of specimens.
E. Middle leg of male, redrawn from Verrall on comparison of specimens.
F. Part of thorax and abdomen of the female, X 10.
G. Part of the thorax and abdomen of the male, X 10.
H. End view of posterior, larval respiratory organ, showing circular plates, stigmal plates, slit-like spiracles and inter-spiracular nodules, X 300.
I. Outline to show shape of the puparium from the side, X 10.
J. Dorsal view of the puparium, X 10.

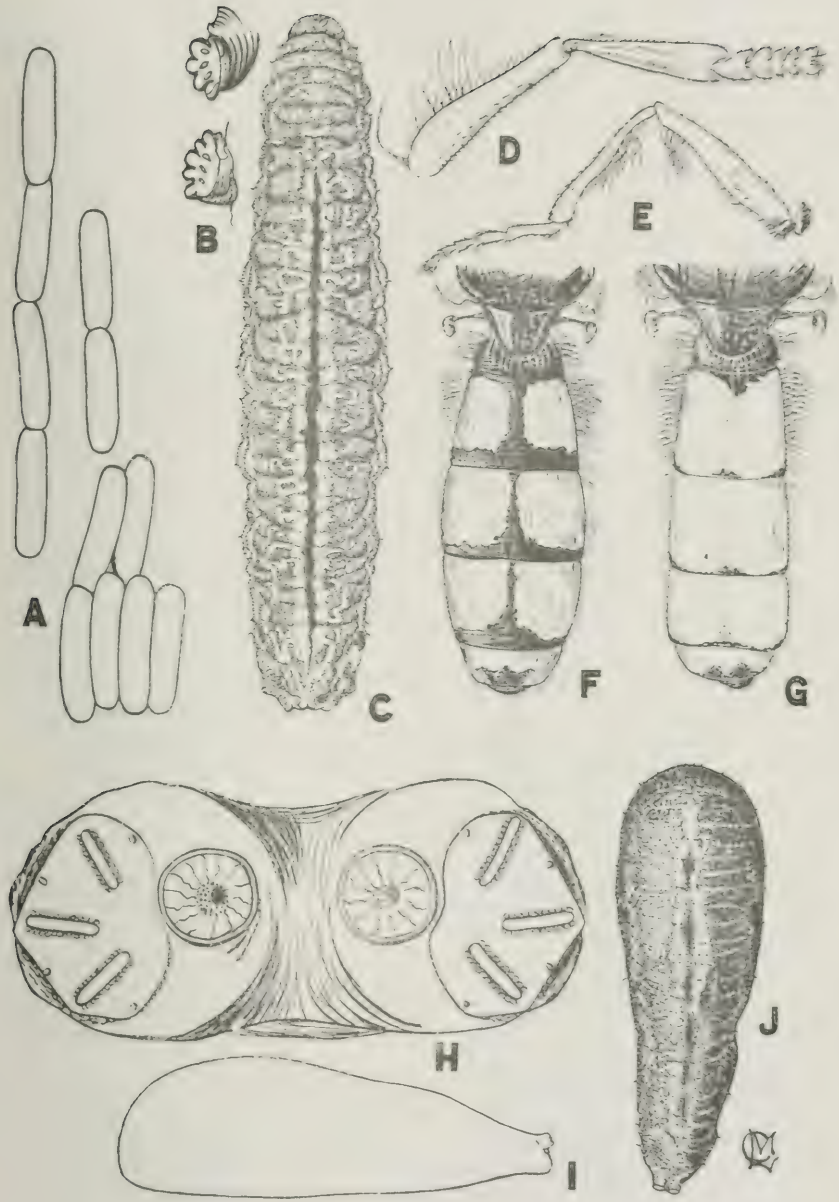

Figure 11. Life stages of *Platychirus perpallidus*.

EXPLANATION OF FIGURE 12.

A to J, inclusive, life stages of *Syrphus knabi* Shannon.

A. Antero-ventral view of head of larva much enlarged; *a*, sensory papillae; *b*, antenna; *c*, upper jaw; *d*, outer pair of mouth-hooks; *e*, other mouth hooklets; *f*, lower jaw; *g*, anterior spiracles or larval respiratory cornua; *h*, cephalo-pharyngeal framework within the body.

B. Lateral view of larva, X6; *a*, median segmental spines; *b*, posterior respiratory organ.

C. End view of anterior spiracle, highly magnified.

D. Dorsal view of posterior respiratory organ, X 40; *a*, one of the three pairs of slit-like spiracles; *b*, one of the inter-spiracular ridges; *c*, the median dorsal spiracular spur; *d*, the circular plate.

E. End view of the posterior respiratory organ, X 40. Lettering as in D.

F. Outline of the puparium, dorsal view, X 3; *a*, posterior respiratory organ.

G. Outline of the puparium from the side, X 3.

H. Scutellum and abdomen of adult ♀, X 5.

I. Wing, X 5.

J. Antenna of male.

(Figures A to I redrawn from the Ohio Naturalist).

K. Abdomen of *Xanthogramma divisa*, X 10, to show arrangement of the yellow markings.

For other figures of *Xanthogramma divisa*, see figures 8 and 9.

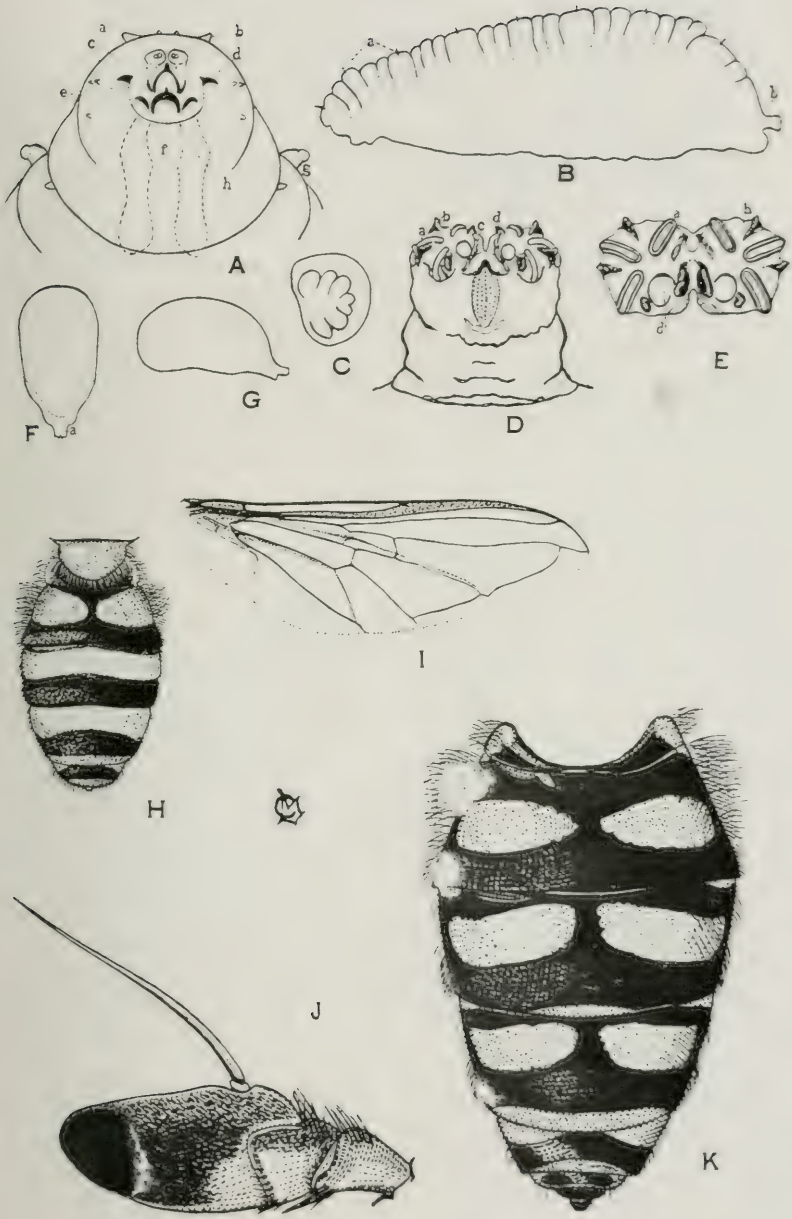

Figure 12. Life stages of *Syrphus knabi; K,* abdomen of *Xanthogramma divisa.*