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**A PRELIMINARY ACCOUNT OF TWO SERPHOID
(PROCTOTRYPOID) PARASITES OF THE HESSIAN FLY.¹**

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INTRODUCTION

The Serphoids (Proctotrypoids), (*Polygnotus*) *Platygaster vernalis* Myers and (*Polygnotus*) *Platygaster hiemalis* Forbes, two important parasites of the Hessian fly, *Phytophaga destructor* Say, have been confused in the past as the same species by entomologists of this country. Although Webster (19)² predicted more than one species of *Polygnotus* as being involved with the Hessian fly, it was not until 1917 when Myers (27) published his description of *Polygnotus vernalis*, that two separate species were definitely distinguished. Recently, however, many inquiries concerning them have arisen among workers on the Hessian fly because of the similarity in appearance of their adult stages and the lack of information concerning their respective life histories. It has, therefore, been deemed advisable to publish without further delay a brief treatise on these two species rather than to await the completion of the more exhaustive investigations under way.

In a recent article on the genus *Platygaster* Latreille by Fouts (29), the genera *Polygnotus* Förster and *Platygaster* Latreille are declared synonymous, with priority given to *Platygaster* Latreille. Both species under discussion, therefore, rightly belong to the genus *Platygaster*.

In the following account the life history observations were made on material reared in confinement from carefully determined adults. Nearly all the phases of development were also obtained from the field for comparison and checking of results.

HISTORY

Herrick (1) in 1841 was the first investigator to record the occurrence in this country of a parasite which oviposited into

¹The author wishes to express his appreciation for kindly criticisms by Mr. P. R. Myers, Mr. A. B. Gahan and Dr. R. W. Leiby.

²Reference is made by number (*italic*) to Bibliography, p. 115.

the egg of the Hessian fly, and from his description of the habits of the parasite under his observation it was evidently the species *Platygaster hiemalis*. He briefly recorded observing it oviposit in the egg of the Hessian fly in autumn, and mentioned that four or five eggs were laid in a single egg of the fly, and that the host continued its development but never reached the adult stage. All of these habits conform identically to those of *Platygaster hiemalis*. In 1847 (2) and again in 1862 (3) Asa Fitch reviewed Herrick's account of this insect but added no original observations. Herrick's account was again quoted by Packard both in 1880 (4) and in 1883 (5). In these articles the statements of Herrick were assumed to refer to the larger proctotrypoid parasite *Platygaster herrickii* Pack.

According to Ashmead (10) *Platygaster hiemalis* was first reared by Riley in 1876 and again by Forbes in 1888, in which year Forbes published the original description (7). The following year, Riley (8) called attention to Forbes' description, and in 1891, (9), he listed the species. Two years later Ashmead (10) incorporated Forbes' description in his "Monograph of the North American Proctotrypidae," and in 1897 the species was again listed by Paul Marchal (11). Osborn (12), in 1898, cited the original description, and in 1899 Lugger (13) recorded finding six cocoons of this parasite in a Hessian fly puparium. In an article by Webster and Newell (14), published in 1902, this parasite was mentioned as being reared in quantities in Ohio, and in 1906 Tucker (16) discussed the economic importance of this parasite, citing a letter by Webster in which was mentioned the introduction of *P. hiemalis* from North Dakota into Kentucky, Tennessee, and California. This same year Webster (17) gave a brief discussion of *P. hiemalis*, and Gossard and Houser (15) mentioned the abundance of *P. hiemalis* in Ohio. The following year Bruner and Swenk (18) referred to *P. hiemalis* in Nebraska, and Webster (19) recounted the great importance of this parasite in control of the Hessian fly and discussed its possible polyembryonic nature. In 1907 (21) he also gave a very interesting economic account of this parasite and related various attempts to introduce it from one part of the country to another. He attributed two generations a year to *Polygnotus*, but more recent observations have shown that each species normally has but one generation a year. The erroneous conclusion was undoubtedly due to a confusion of the two species one of which emerges in the spring, the other in the fall. In 1908 C. N. Ainslie (20) gave an account of the parasitism of *Polygnotus* by *Tetrastichus*. In so far as this material was taken from wheat stubbles collected during July, the species involved was very likely *vernalis*. In this same article Mr. Ainslie told of the attempted introduction of *Polygnotus* into Sharpsburg, Md., con-

ducted by F. M. Webster.¹ *P. hiemalis* was listed by Smith (22) in 1910, and the same year a brief mention of this parasite as a means of control of the Hessian fly in Michigan was made by R. W. Pettit (23). In 1915 a reference to *P. hiemalis* was made by Webster (25), and in 1916 it was briefly redescribed by Viereck (26). Early in the year of 1916, Myers (27) identified the species *vernalis* from the other parasites of the Hessian fly which resulted in the publication of his original description the following year. In 1920 *P. hiemalis* was again mentioned by Walton (28).

(*Polygnotus*) *Platygaster vernalis* Myers.

GEOGRAPHICAL DISTRIBUTION

This species occurs in New York, New Jersey, Pennsylvania, Delaware, Maryland, Virginia, West Virginia, Michigan, Ohio, Indiana and Missouri. Records so far obtained show that its distribution extends as far west as Charleston, Mo., and as far south as Buchanan, Va.²

LIFE HISTORY

The egg is highly refractive, claviform in shape, and before oviposition measures about 0.07 mm. long by 0.016 mm. wide. Immediately after oviposition the main body of the egg is usually found dilated to about twice the above width. A minute projecting piece of membrane may sometimes be found at the swollen extremity of the egg.

The eggs are deposited singly in the eggs of the host, and sometimes in the newly hatched larvae before they have left the exposed surface of the leaf.

¹Mr. Ainslie said that "wheat plants containing Hessian fly larvae" infested with *Polygnotus* were transferred from Marion, Pa., to Sharpsburg, Md., and that in July of the same year "ripening straw containing numerous flaxseeds" was gathered and sent to Washington. The account further stated that examinations of these flaxseeds revealed the presence of *Polygnotus*, which was thought to have proved the success of the introduction. It might be mentioned that, in another review of this experiment made by Dr. Howard, (24) the *Polygnotus* introduced were referred to as being the species *hiemalis*. Our present knowledge of the life histories of these parasites in these localities indicates that in this experiment a mistake was made in the identity of the parasites used, because *hiemalis* does not emerge in this locality in time to parasitize the summer generation of the Hessian fly. This generation of the fly is, however, parasitized by *vernalis* which accounts for *Polygnotus* being found in the flaxseeds secured from the ripening wheat straws.

²The records from Michigan and Indiana were obtained from Mr. W. H. Larrimer, those from Ohio, through the kindness of Mr. Larrimer and Mr. Parks, and those from Missouri from Mr. A. F. Satterthwait.

The egg differs in its manner of development from those of most insects by being polyembryonic in nature. The original germ-cell, instead of giving rise to a single embryo, develops many separate embryos. At the same time the nutritive functioning plasma of the egg develops in a remarkable way to accommodate the rapidly multiplying embryos. The egg always develops in the mid-intestine of the host and during its early growth, is constantly tossed back and forth in the chyle of the mid-intestine by peristaltic action.

The primary larva is bluntly rounded at extremities, with length of body about three times its width. Before it has become very much inflated with food, a broad, deep constriction is evident on each side slightly posterior to the mouth. This is caused by the greatly enlarged and projecting bases of the mandibles. The large size of the mandibles is characteristic of this stage, the length of each being nearly one-third the width of the head. They are slightly curved, setosous toward the extremity, and practically colorless. During this stage the body segments are not distinct.

In the succeeding larval development the mandibles are replaced by small, distinctly chitinized mandibles, the body segments become apparent, and the body assumes a more obtusely ellipsoidal form.

When the primary larvae have freed themselves from the surrounding gelatinous-like mass, they commence to imbibe the chyle from the host stomach and soon ingest particles of the stomach wall itself. They shortly pass into the advanced larval stage of development, and it is not long before nearly the entire contents of the host is consumed. At this point each larva forms for itself a separate cocoon in which it pupates and transforms to the adult. The parasitized host larva very seldom succeeds in pupating.

The cocoons are broadly ellipsoidal, pale yellowish brown in color, and made of a tough, flexible material. The number which develop in a single flaxseed varies somewhat. An examination of 100 Hessian fly puparia taken from the field and containing *Platygaster vernalis* cocoons showed an average of 7.91 cocoons per puparium with a maximum number of 13 and a minimum of 3. The average number of cocoons in which adults developed was 5.49. All these adults, however, did not emerge. This was probably due to the artificial conditions under which they were reared.

SEASONAL HISTORY

Normally this parasite emerges in the early spring when the Hessian flies are beginning to lay their eggs. It begins at once to oviposit into the host eggs. Development progresses

rapidly and pupation usually takes place about the last of July, the exact date varying considerably in different years according to meteorological conditions. By the end of the first week in August the adult stage is usually reached and the remainder of the summer, fall, and winter is passed inside the cocoons as adults. Occasionally adults emerge in the fall and oviposit into the fall generation of the fly, but field observations indicate that these ovipositions fail to mature.

(*Polygnotus*) *Platygaster hiemalis* Forbes.

GEOGRAPHICAL DISTRIBUTION

This species occurs throughout most of the wheat growing region where the fly is found. According to F. M. Webster (21, 25) this parasite was introduced several years ago into Washington and California and has been found in abundance in Washington since that time. Mr. C. M. Packard informs me, however, that this species has never been reared from rather extensive collections of Hessian fly material made in California.

LIFE HISTORY

The egg, like that of *Platygaster vernalis*, is highly refractive. In form it is ellipsoidal, slightly flattened along one side, and with two tiny, flagellum-like processes at one extremity. Freshly oviposited eggs measure approximately 0.02 mm. long by 0.01 mm. wide. The size and shape of the egg undergoes no appreciable change upon oviposition.

The parasite oviposits in the host egg, or occasionally in the newly hatched larva while the latter is exposed to attack. From the examination of 81 ovipositions it has been found that from 1 to 7 eggs with an average of 4.22, are laid at each single oviposition.

The eggs always develop in the body cavity of the host and never in the mid-intestine as is the case with *Platygaster vernalis*. The young embryos may nearly always be found as colorless, spherical masses entirely separated from each other and loose in the haemolymph of the host larva.

In the larval stage the segments are always discernible and the mandibles are very small. Upon reaching the larval stage development usually proceeds rapidly. The contents of the host are soon almost entirely devoured, and the larvae form individual cocoons which are broadly ellipsoidal, pale yellowish brown in color, and made of tough, flexible material, being similar to those made by *Platygaster vernalis*. From 1 to 23 cocoons have been found in a single puparium, and from 100 puparia examined, an average of 6.52 cocoons were found.

Within these cocoons adults developed to the average number of 6.31 per host puparium, although, as in the case of *P. vernalis*, all did not emerge. The host larva very seldom succeeds in pupating, although a well developed puparium case is always formed.

SEASONAL HISTORY

In the eastern states in winter wheat this parasite normally has but one generation a year. The adults emerge in the fall at the time the Hessian flies are laying their eggs for the overwintering generation. They begin at once to oviposit into the eggs of the fly. Cold weather setting in now greatly retards the development of the growing embryos, and usually the entire winter and spring, and frequently the early summer are passed in the embryonic stage. The larvae and pupae commence to develop during July, and by the end of August most of them have transformed into adults within their cocoons. Weather conditions modify the rapidity of development, and sweeping records prove that adults occasionally emerge throughout the summer months.

COMPARISON OF THE TWO SPECIES

The immature stages of *Platygaster vernalis* may be distinguished from those of *P. hiemalis* by the following characteristics and habits:

<i>P. vernalis</i>	<i>P. hiemalis</i>
Egg claviform; about 0.07 mm. long by 0.016 mm. wide.	Egg ellipsoidal, slightly flattened along one side; about 0.02 mm. long by 0.01 mm. wide.
Embryos held together in a spherical or ellipsoidal, elastic polyembryonic mass.	Embryos individual, spherical masses separated one from the other except in rare instances.
Embryos always develop inside the mid-intestine of the host.	Embryos always develop in the haemolymph of the body cavity of the host.
Primary larva with greatly enlarged, setosous mandibles.	Mandibles very small and smooth throughout larval period.
Mandibles of mature larva distinctly curved.	Mandibles of mature larva almost straight.

The two species may also be distinguished by certain habits of the adults. *Platygaster vernalis* is rather sluggish and seldom flies when in captivity. *P. hiemalis*, on the other hand, is normally very active and flies readily. In ovipositing, *P. vernalis* holds the body parallel to the long axis of the Hessian fly egg, while *P. hiemalis* poises

the body at right angles to this axis of the host egg. These habits of oviposition furnish a positive means of identification sometimes very convenient.

The adults of the two species may also be distinguished by certain structural characteristics. Mr. P. R. Myers has kindly outlined the following comparison of outstanding features:

<i>P. vernalis</i>	<i>P. hiemalis</i>
Head quadrate; about as wide as thorax.	Head subquadrate, distinctly wider than thorax.
Face convex.	Face nearly flat.
Occiput, vertex, and face distinctly transversely rugulose.	Occiput transversely rugulose, vertex and face shining with faint aciculations running obliquely away from an indistinct median carina.
Antenna with base of scape black.	Antenna with base of scape pale yellow.
Scutellum laterally margined.	Scutellum not laterally margined.
Legs entirely piceous; tarsi fuscous.	Legs dark brown to piceous; tarsal joints pale brown except apical joint which is fuscous.
Wings $2\frac{1}{2}$ to 3 times as long as abdomen.	Wings about twice the length of abdomen.
Ovipositor straight; slightly enlarged and blunt at apex.	Ovipositor curved and attenuated.

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