

THE PARASITES OF THE PINE TIP MOTH, *RHYACIONIA FRUSTRANA* (COMSTOCK)¹

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INTRODUCTION

The Nebraska National Forest is an entirely artificial plantation of pines of various species, situated in the sand hills just west of Halsey, Nebr. Unfortunately, with some of the young trees brought in for planting, certain pine-infesting insects were introduced into the forest. Among these was a tip moth, *Rhyacionia frustrana* var. *bushnelli* Busck, which has increased to such an extent that it has killed or badly stunted a very large percentage of the western yellow pines, the most favorable species for the development and increase of the pest.

In 1924 the Forest Service and the Bureau of Entomology instituted an attempt to control the insect by means of parasites.

To determine what eastern insects were available for introduction, the writer in 1924 made a preliminary study of the parasites of the eastern form of the tip moth, *Rhyacionia frustrana* (Comstock). Several thousand tips of *Pinus virginiana* infested by the summer generation of the tip moth were collected, principally in the vicinity of Falls Church, Va., and the insects contained in these were reared. A few parasitized tip worms were also collected in the spring of 1925. In the rearings were 21 species of parasitic Hymenoptera and two species of parasitic flies. A small lot of material collected at Bogalusa, La., by R. A. St. George, of the Bureau of Entomology, produced six species of parasitic Hymenoptera.

There had previously been recorded only three species of parasites of *Rhyacionia frustrana*. In 1890 Packard² reported as parasites a species of Bracon and a species of Perilampus, and in 1921 Cushman³ listed this insect among the hosts of *Itoplectis conquisitor* (Say). In the meantime Carl Heinrich, then of the Division of Forest Insect Investigations, had reared some parasites from Virginia and Massachusetts; and a few other parasites of the species from other localities had been reared by members of the division.

All of these parasites are classified and discussed below on the basis of their relation to the host insect. A key for the identification of the parasites is appended.

¹ Received for publication Jan. 18, 1927; issued May, 1927.

² PACKARD, A. S. INSECTS INJURIOUS TO FOREST AND SHADE TREES. U. S. Ent. Comn. Rpt. 5: 751. 1890. (Rev. and enl. ed. U. S. Ent. Comn. Bul. 7, 1881.)

³ CUSHMAN, R. A. THE NORTH AMERICAN ICHNEUMON-FLIES OF THE TRIBE EPHIALTINI. U. S. Natl. Mus. Proc. 58: 350. 1921.

EXTERNAL PARASITES OF LARVA

HYMENOPTERA

BETHYLIDAE

GONIOZUS LONGICEPS KIEFFER

Goniozus longiceps, originally described from Texas, has been reared in small numbers from tip-moth larvae from Bogalusa, La. It is probably gregarious on full-grown or nearly full-grown larvae.

ICHNEUMONIDAE

EPIURUS INDAGATOR (CRESSON)

Epiurus indagator is a common parasite of internally feeding microlepidopterous larvae, with many known hosts. It attacks full-grown or large larvae and does not confine its attack to insects infesting coniferous trees. Its distribution covers the eastern half of the United States and southern Canada. In the rearings of 1924, at Falls Church, it was rather rare. This species is solitary; the cocoon consists of a thin silken lining to the burrow of the host.

CALLIEPHIALTES COMSTOCKII (CRESSON)

Calliephialtes comstockii apparently confines its attack to lepidopterous larvae infesting coniferous trees, but prefers larger species than *frustrana*. It might do well on variety *bushnelli*, which is larger, but the rearings of 1924 at Falls Church on *frustrana* produced only a few undersized males. It is solitary on full-grown larvae. It spins a light brownish, semitransparent cocoon. Its distribution is about like that of *Epiurus*, except that it is confined to regions of coniferous forests.

BRACONIDAE

MICROBRACON MELLITOR (SAY)

This is a very common species, of catholic taste as regards hosts, attacking almost any internally feeding larva, whether lepidopterous or coleopterous. It is one of the principal parasites of the cotton boll weevil and of the pink bollworm. It is distributed throughout the eastern half of the country. In the 1924 Falls Church rearings from *frustrana* it was rare. It is solitary on full-grown or nearly full-grown larvae, and pupates in a white to brownish, opaque cocoon.

MICROBRACON GEMMAECOLA (CUSHMAN)

A few specimens of this species were reared at Falls Church in 1925 but none in 1924. In 1926 it was the most abundant parasite in Nantucket. It is very similar in its habits to *mellitor*.

MICROBRACON GELECHIAE (ASHMEAD)

Microbracon gelechiae is a gregarious parasite of internally feeding microlepidopterous larvae, from a few to several developing on a single host. It attacks large larvae. It occurs in the eastern half of the country and on the west coast. In the 1924 rearings at Falls Church it was very rare. It spins a dense brown cocoon.

EURYTOMIDAE

EURYTOMA TYLODERMATIS (ASHMEAD)

Eurytoma tylodermatis was the most abundant of all the parasites in the 1924 rearings at Falls Church. It is normally primary but occasionally secondary. It attacks large larvae, and is parasitic on many internally feeding lepidopterous and coleopterous larvae over at least the eastern half of the United States and southern Canada. The species is solitary.

EULOPHIDAE

SECODELLA SUBOPACA (GAHAN)

This is a solitary parasite of small larvae. There were a few females in the 1924 rearings at Falls Church and a single male from Bogalusa, La.

HYSSOPUS THYMUS (GIRAULT)

Hyssopus thymus is a minute gregarious parasite of full-grown or nearly full-grown larvae, from 3 to 10 or 12 developing on a single host. It was rather rare in the 1924 and 1925 rearings at Falls Church. It was originally described from Lincoln, Nebr.

HYSSOPUS RHYACIONIAE (GAHAN)

Hyssopus rhyacioniae is exactly similar in habit to *H. thymus*, but is less common. It was reared at Falls Church in 1924.

ELACHERTUS PINI GAHAN

This is another gregarious parasite, similar in its host relations to the species of *Hyssopus*, but less abundant. It was reared only at Falls Church.

PTEROMALIDAE

HABROCYTUS THYRIDOPTERIGIS HOWARD

Habrocytus thyridopterigis was reared sparingly at Falls Church in 1924 as a solitary primary parasite and in 1925 as a primary and in one case as a secondary parasite, the intermediate host being *Campoplex frustranae*, a cocoon of which produced five males of *Habrocytus*. In 1916 *H. thyridopterigis* was reared at Falls Church by Heinrich, and in that year it was apparently one of the most abundant parasites of the tip moth. Heretofore it has been recorded only as a secondary parasite of the bagworm, *Thyridopteryx ephemeraeformis* Haworth, and the white-marked tussock moth, *Hemerocampa leucostigma* Smith and Abbot.

INTERNAL PARASITES OF LARVA

HYMENOPTERA

ICHNEUMONIDAE

COMPOPLEX FRUSTRANAE CUSHMAN

Next to *Eurytoma tylodermais*, *Campoplex frustranae* was the most abundant parasite in the 1924 rearings at Falls Church. It attacks its host probably when the latter is comparatively young, and spins its white cocoon within the shattered shell of the newly formed pupa of the host.

CREMASTUS EPAGOGES CUSHMAN

This species was of rare occurrence in the 1924 rearings at Falls Church. In habit it is similar to *Campoplex*, but leaves its host while the latter is still in the larval stage and spins a dense dark-brown cocoon. It was originally described from specimens reared at Nashville, Tenn., from *Epagoge sulfureana* Clemens.

GLYPTA VARIPES CRESSON

Glypta varipes was reared from the tip moth only at Sharon Heights, Mass., in 1916, and at Nantucket, Mass., in 1926, where it appears to have been one of the more important parasites. This species is solitary.

BRACONIDAE

PHANEROTOMA RHYACIONIAE CUSHMAN

Phanerotoma rhyacioniae is known only from the tip moth and only from Bogalusa, La., where, judging from the small amount of material available, it was apparently the most important parasite. No observations on its life history have been reported, but probably it deposits its egg in the egg of the tip moth, its larva leaving the host when the latter is full-grown and pupating in a cocoon in the burrow of the host. It is probably solitary.

APANTELES SPECIES

There was a single specimen of *Apanteles* from Bogalusa, La.; it probably attacks the very young larva, leaving its host when the latter is nearly full-grown.

DIPTERA

TACHINIDAE

LIXOPHAGA MEDIOCRIS ALDRICH

The third most abundant parasite in the 1924 rearings at Falls Church was *Lixophaga mediocris*. The full-grown larva emerges from the larva of the host and pupates in the host burrow. It was described as a new species from these specimens.

LIXOPHAGA PLUMBEEA ALDRICH

This is another new species with habits exactly similar to those of *Lixophaga mediocris*. It was much less abundant than the latter species at Falls Church in 1924.

PARASITES OF PUPA

HYMENOPTERA

ICHNEUMONIDAE

ITOPLECTIS CONQUISITOR (SAY)

This is one of the most common Ichneumonidae throughout the eastern half of the United States, southern Canada, and the West Indies, parasitizing lepidopterous pupae of nearly all groups. It is rare as a parasite of the tip moth, which is too small to be a favorable host; only a few undersized males were reared. It pupates within the host pupa.

CHALCIDIDAE

HALTICHELLA RHYACIONIAE GAHAN

Of all the parasites in the 1924 rearings at Falls Church, *Haltichella rhyacioniae* ranked fourth in point of abundance, and it was also one of the most abundant in Heinrich's 1916 rearings. There was one specimen from Nantucket, Mass. This species pupates in the host pupa.

SECONDARY PARASITES AND THOSE OF UNKNOWN STATUS

Under this head are placed seven species of chalcidoids and one braconid, all reared in small numbers, on which no definite observations for determining their status were made. The first three, because of the known habits of their congeners, are almost certainly secondaries.

HYMENOPTERA

CHALCIDIDAE

SPILOCHALCIS DELIRA (CRESSON)

SPILOCHALCIS SPECIES

These are secondarily parasitic through pupal parasites.

PERILAMPIDAE

PERILAMPUS SPECIES

EUELMIDAE

EUELMUS CYANICEPS ASHMEAD

Eupelmus cyaniceps is a ubiquitous species of very wide distribution and catholic taste in the matter of hosts. It attacks Lepidoptera, Coleoptera, and Hymenoptera, sometimes as a primary parasite and sometimes as a secondary parasite. Its exact relationship to the tip moth is unknown, but very likely it is both a primary and a secondary parasite.

EULOPHIDAE

EPITETRASTICHUS CUNEIFORMIS GIRAULT

This species was reared in small numbers at Falls Church in 1924 and by Heinrich in 1916. It is probably not associated in any way with the tip moth, but rather with some species of midge infesting the tips. It was originally reared in such an association.

TETRASTICHUS SPECIES

There were two specimens from the Bogalusa, La., material.

ELASMIDAE

ELASMUS SETOSISCUTELLATUS CRAWFORD

One specimen of this species was reared at Falls Church in 1924, probably from a midge, such an insect having been the host in a previous rearing.

BRACONIDAE

HETEROSPILUS SPECIES

A single specimen of *Heterospilus* was reared from infested tips at Nantucket, Mass. Most likely *Heterospilus* is not parasitic on the tip moth, but in this instance was associated with some coleopterous borer.

HOW TO RECOGNIZE THE PARASITES

The following key will serve to identify the parasites listed above:

1. With one pair of wings and having the general appearance of a small house fly (Diptera).... *Lixophaga mediocris* Aldrich and *Lixophaga plumbea* Aldrich. (These two flies are very similar in appearance and distinguishable only to the trained eye.)
- With two pairs of wings and more wasplike in appearance, some very minute (Hymenoptera)..... 2
2. Wings with many veins (fig. 1, *a-e*)..... 3
- Wings with veins only along front margin (Chalcidoidea) (fig. 1, *f*)... 15
3. Antennae very short and placed close to mouth; eyes very small (fig. 1, *h*); wings as in figure 1, *a* (Bethyidae).... *Goniozus longiceps* Kieffer
- Antennae long and slender and placed far above mouth; eyes large (fig. 1, *g, i*)..... 4
4. Front wing about as in Figure 1, *b* or *c* (Ichneumonidae)..... 5
- Front wing about as in Figure 1, *d* or *e* (Braconidae)..... 10
5. Abdomen flattened below, rounded above (fig. 1, *j*), the first segment broad at the base..... 6
- Abdomen compressed from side to side, the first segment long and very narrow at base (fig. 1, *k*)..... 9
6. Abdomen with segments edged above with whitish or yellowish *Itoplectis conquisitor* (Say) 7
- Abdomen with segments entirely black above..... 7
7. Middle segments of abdomen with deep oblique furrows extending from middle of base toward hind angles (fig. 1, *j*).... *Glypta varipes* Cresson
- Middle segments of abdomen without oblique furrows..... 8
8. Hind tibia with alternate rings of white and black *Epiurus indagator* (Cresson)
- Hind tibia white only at base..... *Calliephialtes comstockii* (Cresson)
9. Head entirely black; front wing with the small cell marked *a* in Figure 1, *b*..... *Campoplex frustranae* Cushman
- Head with yellow rings surrounding the eyes; front wing as in Figure 1, *c*, without cell *a*..... *Cremastus epagoges* Cushman

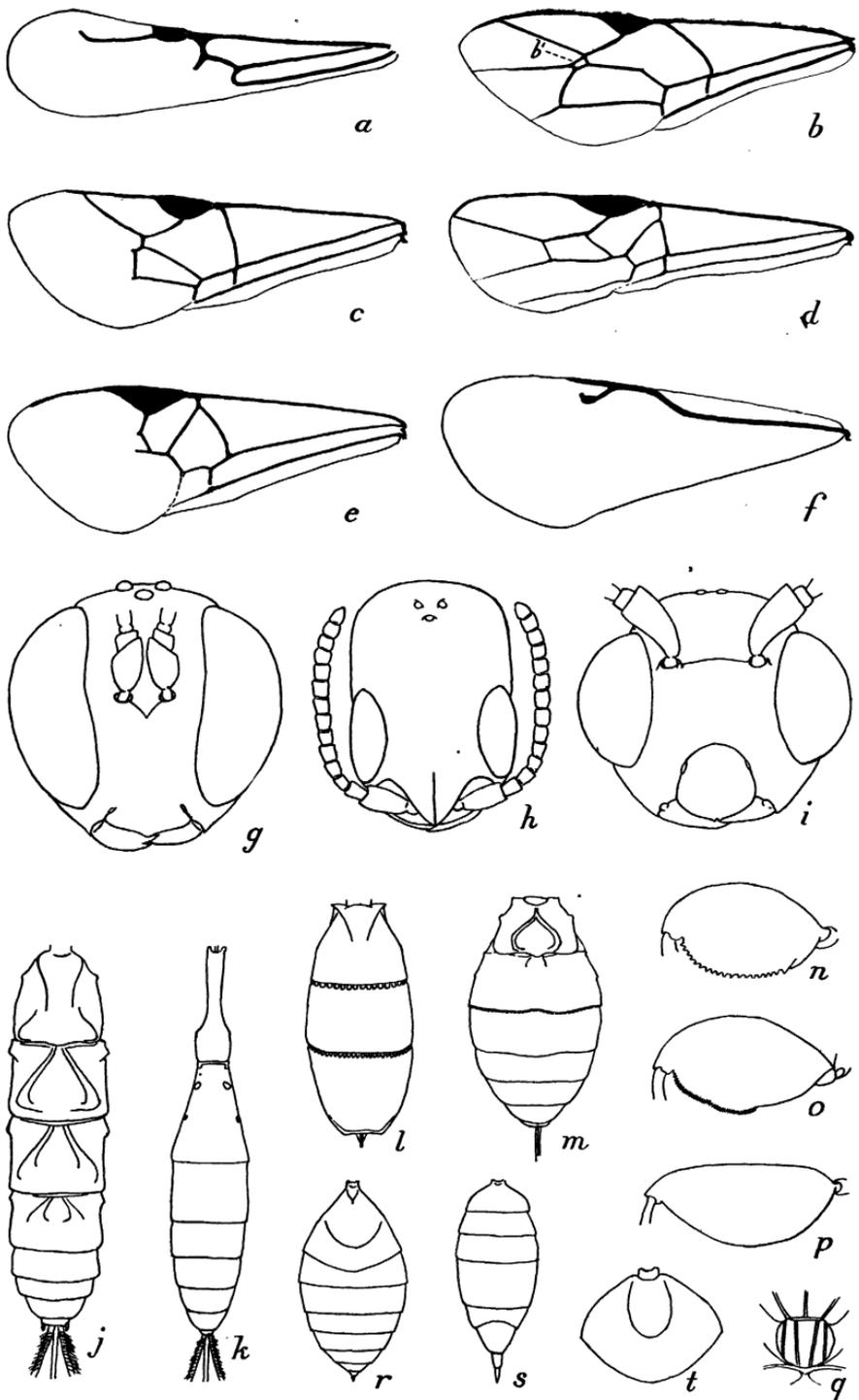


FIG. 1.—a, Forewing of *Goniozus longiceps* Kieffer; b, forewing of *Epiurus indagator* (Cresson); c, forewing of *Cremastrus epagoges* Cushman; d, forewing of *Microbracon gemmaecola* Cushman; e, forewing of *Apanteles* species; f, forewing of *Eurytoma tylodermitis* Ashmead; g, head of *Eurytoma tylodermitis* Ashmead; h, head of *Goniozus longiceps* Kieffer; i, head of *Phanerotoma rhyacioniae* Cushman; j, abdomen of *Glypta varipes* Cresson; k, abdomen of *Campoplex frustranae* Cushman; l, abdomen of *Phanerotoma rhyacioniae* Cushman; m, abdomen of *Microbracon gemmaecola* Cushman; n, hind femur of *Spilochalcis delira* (Cresson); o, hind femur of *Haltichella rhyacioniae* Gahan; p, hind femur of *Elasmus setosiscutellatus* Crawford; q, scutellum of *Epitetrastichus cuneiformis* Girault; r, abdomen of *Hyssopus thymus* Girault; s, abdomen of *Eurytoma tylodermitis* Ashmead; t, abdomen of *Perilampus* species

10. Wings as in Figure 1, e; body entirely black..... *Apanteles* sp.
 Wings more similar to Figure 1, d; body usually more or less yellowish
 or reddish..... 11
11. Abdomen with only three visible segments (fig. 1, l)
Phanerotoma rhyacioniae Cushman
 Abdomen with more than three visible segments (fig. 1, m)..... 12
12. Largely blackish..... *Microbracon gelechia* Ashmead
 Largely reddish yellow..... 13
13. First segment of abdomen with a triangular area set off by deep
 grooves as in Figure 1, m..... 14
 First segment of abdomen without such an area..... *Heterospilus* sp.
14. Wings distinctly smoky; ovipositor fully as long as abdomen
Microbracon mellitor (Say)
 Wings clear; ovipositor shorter than abdomen
Microbracon gemmaecola Cushman
15. Hind femur very deep (fig. 1, n-p)..... 16
 Hind femur not especially deep..... 19
16. Body entirely black..... 17
 Body more or less spotted with yellow..... 18
17. Body and legs strongly flattened from side to side and having some-
 what the appearance of a winged flea; minute
Elasmus setosiscutellatus Crawford
 Body stout, not flattened from side to side..... *Haltichella rhyacioniae* Gahan
18. Abdomen largely reddish with several yellow spots
Spilochalcis delira (Cresson)
 Abdomen black with two yellow spots..... *Spilochalcis* sp.
19. Bright metallic green, blue, or bronze..... 20
 Black with at most faint metallic luster..... 22
20. Blue; very minute..... *Secodella subopaca* Gahan
 Green or bronze..... 21
21. Body entirely bright green; ovipositor (the sting) not protruding
Habrocytus thyridopterigis Howard
 Not entirely bright green; ovipositor protruding and ringed with
 yellow..... *Eupelmus cyaniceps* (Ashmead) (female)
22. Dark blue..... *Eupelmus cyaniceps* (Ashmead) (male)
 Black or black and brown..... 23
23. Scutellum with four longitudinal grooves (fig. 1, q)..... 24
 Scutellum with at most two longitudinal grooves..... 25
24. Head more or less brownish..... *Epitetrastichus cuneiformis* Girault
 Head black..... *Tetrastichus* sp.
25. Abdomen very broadly oval, much broader than deep (fig. 1, r; very
 minute)..... 26
 Abdomen not broadly oval above, lanceolate or broadly triangular
 (fig. 1, s, t)..... 28
26. Abdomen with a whitish spot at base..... *Elachertus pini* Gahan
 Abdomen entirely black..... 27
27. Thorax prolonged in front so that the head appears to be set out on a
 neck..... *Hyssopus rhyacioniae* Gahan
 Thorax not prolonged in front..... *Hyssopus thymus* Girault
28. Abdomen flattened from side to side (fig. 1, s); joints of antennae in
 male beadlike, with long hair..... *Eurytoma tylodermatis* Ashmead
 Abdomen triangular (fig. 1, t); antennae in male not as above
Perilampus sp.