NOTES ON PARASITES OF SITONA IN EUROPE, WITH
ESPECIAL REFERENCE TO CAMPOGASTER EXIGUA (MEIG.)

(Diptera, Larvaeoridiae)¹

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In connection with the problem of biological control of the
sweetclover weevil, Sitona cylindricollis Fahr., in the United
States, the European parasite laboratory, of the Bureau of
Entomology and Plant Quarantine, located at Rueil—Malmaison, France, began searches for parasites of Sitona species
in August 1947.

Known Parasites of Sitona in Europe

D. J. Jackson (1920, 1922, 1928) has reared the following
parasites of Sitona in Europe: Perilitus rutilus (Nees) from
S. lineata and S. hispidula; Microctonus aethiops (Nees)
from S. hispidula; Perilitus cerealium Hal. from S. sulcifrons
and S. flavescens; an undescribed species of Perilitus from S.
crinula; and Pygostolus falcatus (Nees) and Leiophron
muricatus Hal. from S. lineata.

The staff of the European parasite laboratory has reared²
Perilitus rutilus (Nees) from adults of Sitona spp. and
Hypera postica (Gyll.), the alfalfa weevil, in northern and
southern France; Microctonus aethiops (Nees) from Sitona
spp. in northern and southern France; and Campogaster
exigua (Meig.) from Sitona spp. and Hypera postica in north-
ern France.

Perilitus rutilus, Microctonus aethiops, and Campogaster
exigua were imported into the United States in rather small
numbers up to 1949 for release under a cooperative project
with the North Dakota Agricultural Experiment Station.
This work is being continued.

Campogaster exigua is a rather unusual parasite about
which little is known. It therefore seems desirable to publish
the few facts that have been ascertained about it so far in
order to facilitate the manipulation and breeding of this
species.

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and Diptera; Mademoiselle Dongé for drawings of the fly Campogaster;
and J. Balakine for helping in general collecting work.

²Three other insects, which are suspected of being parasites of adult
Sitona, were also reared from bulk collections. They are (Diptera,
Dorilaidae) Dorilas sp. and Chalarus sp., as well as (Hymenoptera)
Pygostolus sp. probably stictus (F.). Absolute data on the host rela-
tions of these have not been obtained, however.
Host Preferences
Various species of *Sitona* are present in France, particularly on alfalfa and clover, sainfoin and vetch. In one random collection from alfalfa and clover sent to the United States National Museum for identification, the following species (number of specimens in parentheses) were identified: *humeralis* Steph. (750), *lineata* L. (92), "*lineata*" (5), *puncticollis* Steph. (68), *sulcifrons* Thunb. (23), *hispidula* F. (18), *crinita* Hbst. (3), *crinita* (2), *flavescens* Marsh (3).

*Sitona cylindricollis* is said to occur in northern and west-central France on sweetclover. As this plant is rare, the writers have done little collecting on it, and have taken no *S. cylindricollis*, unless some of this species appears in sendings to the United States National Museum not yet identified.

Individual hosts (remains) from which *Campogaster exigua* issued were identified as *Sitona humeralis* Steph., *S. lineata* L., and *S. hispidula* F.

The writers have also reared *C. exigua* from adults of *Hypera postica* Gyll. in northern France.

It is probably a parasite of several, if not all, of the above mentioned species of the *Sitona*, and possibly of *Hypera nigrirostis* F. and *H. meles* F.

Systematic Position of Campogaster exigua
The fly *Campogaster exigua* is placed taxonomically by Townsend (1936) in the superfamily Oestroidea, family Gymnesomatidae, tribe Strongygastrini. It was described in 1824 by Meigen under the name of *Tachina exigua*. According to Mesnil (1939) it is placed in the subtribe Doufouriina of the Phasiini.

Description of Stages of Campogaster exigua
Adult. The adult (Figs. 1, 2) is a small, dark-gray fly, 2.5 mm. long with wings about 5 mm. long.

The female reproductive system (Fig. 5) consists of six short ovarioles on each side, which are joined by oviducts to the upper uterus. Two black spermathecae (not three as is often the case) are attached to the upper uterus by rather long slender ducts, into the bases of which open the accessory gland ducts. The uterus is large, rather short, and surrounded with numerous tracheae. The eggs are found tightly packed in the uterus, those lowest down containing completely developed larvae, and those farthest up being successively less developed.

The average 10-day-old fly that has not previously deposited larvae produces about 100 or possibly 150 eggs. About 20 of the eggs are

Plate 40. Campogaster exigua (Meigen)
Figs. 1 and 2, adult female; figs. 3 and 4, puparium; fig. 5, female reproductive system; fig. 6, posterior spiracles of puparium.
Plate 41. Campogaster exigua (Meigen)

Fig. 7, anterior portion of body of first-stage larva; fig. 8, buccopharyngeal armature of first-stage larva; fig. 9, first-stage larva, lateral view; fig. 10, third-stage larva.
well down in the uterus and 20 to 25 farther up. One complete egg is in the lower chamber of each of the 12 ovarioles. The fifth abdominal segment is cylindrical and somewhat prolonged, and the sixth consists of short, bractlike plates. Posterior to the sixth abdominal segment are three scleromes comprising the ovipositor. The scleromes consist of two sharp, superior hooks curving downwards, and one stronger, central hook beneath these two, also curving downwards, which is evidently the ovipositor proper.

Egg. The egg is of the ordinary membranous type with thin, transparent chorion. It is large for a small fly, being approximately 0.4 mm. long.

**First-stage Larva.** The first-stage larva (Figs. 7, 9) is slightly pyriform, pointed anteriorly, with 11 rows of spines extending around the body, those of the first thoracic and last abdominal segments being slightly heavier. The buccopharyngeal armature (Fig. 8) is simple.

**Third-stage Larva.** The last-stage larva (Fig. 10) is distinctly pyriform, having the posterior end greatly distended. It has no remarkable armament. The prothoracic spiracles are apparently bifarian, while the posterior ones consist of two slightly protruding double openings and a single opening on each side.

**Puparium.** The puparium (Fig. 3, 4), formed within the body of the host (Sitona) adult, is approximately 2.5 mm. long by 1.25 mm. wide, of a very thin texture, and a pale brownish color. Its form is irregular, being slightly flattened dorso-ventrally. The posterior fourth of the puparium is set off from the anterior portion by a deep constriction, especially pronounced dorsally; there is an elongate bulge or lobe on each side approximately midway. The posterior end is flattened in a caudo-cephalic direction, a more or less flat posterior surface being formed, which is of a deep brown color. Two tiny spicules dorso-laterally on the thorax represent the anterior thoracic cornicles. The posterior spiracles (Fig. 6) consist of three pairs of very slightly protruding tubercles situated on two posterior plates, which are but slightly heavier than the surrounding cuticle. These spiracles appear to have simple openings.

The form of the puparium undoubtedly conforms to the shape of the host's body cavity. The posterior lobe of the puparium evidently develops in the last two thoracic segments of the host weevil and the anterior four-fifths in the abdominal part of the body cavity. The position of the puparium in the host is reversed, i.e., the cephalic end of the puparium is directed caudad to the host.

The opening made by the fly in the puparium on issuing is situated dorsally. Apparently a single piece of the pupal shell is broken off to permit exit of the fly. The dotted line anteriorly on figure 3 and 4 indicates the position of this break.
Biology

Adults of *Campogaster exigua* live from 20 to 30 days in the laboratory. They mate and, after a gestation period of 10 to 15 days, begin larviposition. During the gestation period they are fed on sugar and honey water. Townsend (1936) states that "*Campogaster* females evidently inject membranous chorion subcylindric unincubated eggs within the host integument. These habits are interpreted from the structure of the female hypopygium in each case and necessarily require verification." This statement is evidently based on examination of dead material and is correct only insofar as the "injection" part is concerned. The fact that the uterus is well supplied with trachea would have been seen in live material and would have clarified this aspect.

Larviposition. Warm sunlight and high humidity are most favorable to larviposition. The female approaches the weevil from the side, and jumping upon it suddenly, holds onto the weevil with her feet. She bends her abdomen underneath her thorax and, thrusting forward, deposits a larva apparently on the outside of the weevil between the head and thorax or between the first and second thoracic segments. The deposition is completed so quickly, and the fly breaks away so rapidly, that it does not seem possible that in this quick gesture she could have inserted the ovipositor into the body.

Examinations of weevils immediately after the single strike revealed no parasite larvae inside or out. However, dissection of these weevils one day later showed a first-stage parasite larvae in the body cavity. In practically all cases the larva was in the neck.

Larval Development. At the completion of the first stage or early in the second stage the larva becomes fixed into a trachea near a thoracic spiracle or near a spiracle of the anterior abdominal segment. It then forms the customary respiratory sheath in which the posterior half of the body is retained until the completion of the larval period.

The time from larviposition until pupation is about 20 days.

Seasonal History

*Campogaster exigua* adults emerged from overwintering puparia in 1948 between April 8 and 19, when 25 adult flies issued. *Campogaster exigua* was reared in the laboratory on a very limited scale, but from available data the minimum prelarviposition period was 10 to 15 days when fed on honey and water. The larval stage in the host was 20 to 30 days, and the pupal stage was 18 to 25 days, or a minimum of 48 to 70 days for a complete generation. The duration of the life cycle
probably varies to some extent, depending on climatic factors and availability of food for the host beetles. The _C. exigua_ larvae probably overwinter in the live host beetles, but this has not been definitely proved. In any case, it is known that the duration of the larval stage of _C. exigua_ is prolonged indefinitely during cold weather.

**Collecting, Rearing, and Shipping Parasites of _Sitona_**

_Sitona_ adults were collected mostly by sweeping alfalfa and clover. They were removed from the net by an ordinary suction tube arrangement and placed in small tin cans for transportation to the laboratory. From August 1947 to November 1948 approximately 115,000 adults, including some _Hypera postica_, were obtained.

For rearing, the adults were placed in wooden cages 15 by 15 by 12 inches. The ends of the cages were covered with fine screen wire; one side was enclosed with glass, and the other side was made of wood with a sliding door. The top and bottom were covered with cloth, so that the cage could be manipulated and the parasites retrieved. Most of the hymenopterous larvae left the host and spun their cocoons on the cloth on the bottom of the cage. When sufficient cocoons were formed, the cage was turned upside down and the cloth bottom torn off; at the same time the beetles were shaken into the cage. The cocoons of the parasites remained attached to the cloth and were easily removed. This method was the most satisfactory found. For the dipterous parasites, the dead beetles were collected from the cage and held for emergence of parasites, or were shipped to the United States.

The beetles were fed on alfalfa plants that were kept fresh by placing the cut ends of the stems in water. The food was changed two or three times a week, depending on its condition.

Four hundred and thirty hymenopterous cocoons, in good condition for shipping, were collected from the 115,000 beetles. The cocoons were placed in small glass vials with strips of tissue paper and were shipped by air to Fargo, North Dakota. Most of the cocoons arrived in good condition and a fair percent of dipterous parasites emerged.

In lots containing a fair percent of dipterous parasites all dead adults were removed from the rearing cages and shipped in small tin boxes, some in wet, some in slightly damp, and some in dry sphagnum moss. The slightly damp sphagnum moss was probably preferable to the dry or wet moss, but good emergence was obtained from all lots shipped. A total of 175 active adults of _Campogaster exigua_ were obtained from the material forwarded during 1947 and 1948.
Distribution and Abundance

Large collections of *Sitona* spp. have been made in southern France in the Department of Gard, Vaucluse, and Drome, and in the Department of Seine-et-Oise in northern France. *Campogaster exigua* has been found only in the Seine-et-Oise area, but the survey has been too limited for its distribution to be determined. If *C. exigua* is present in southern France, it is not of economic importance.

Dissections of small samples collected in the Department of Seine-et-Oise in July and August showed a parasitism of 10 to 50 percent by *C. exigua*. The highest parasitization was recorded on July 12, 1948. During September 1947, 1,200 *Sitona* adults were dissected and only 4 larvae of *C. exigua* were found. From collections of 22,577 adult beetles, most of which lived through the winter of 1947-48 in the laboratory, there were reared 23 adults of *C. exigua*.

*Campogaster exigua* is the most promising parasite of *Sitona* species that has been found in France. In general it does not appear to effect a control of this group of beetles, but the fact that at times it attacks a high percent of the beetles indicates that it has a high potential and may become a controlling factor under some conditions.

The maximum parasitization of *Sitona* species by the combined species of hymenopterous parasites has never exceeded 2 percent in the north and 6 percent in the south of France.

The climate of southern France is much milder than that of northern France, and the climate of northern France is much milder than that of North Dakota and the other areas in which *Sitona* sp. is found in North America. The fact that the hymenopterous parasites are more abundant in southern than in northern France would indicate that they would be less likely to become effective in the United States. *Campogaster exigua*, which is found only in northern France, would thus appear to have a good chance of survival in the United States.

Literature Cited


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