ROGAS UNICOLOR (WESM.), A BRACONID PARASITE OF THE SATIN MOTH1 2

By PHILIP B. DOWDEN 3

Assistant entomologist, Division of Forest Insect Investigations, Bureau of Entomology and Plant Quarantine, United States Department of Agriculture

INTRODUCTION

Rogas unicolor (Wesm.) is a European species parasitic on the satin moth (Stilpnotia salicis L.). It was first reared by workers of the Bureau of Entomology, United States Department of Agriculture, at Budapest, Hungary, in 1927. At that time only two adults were recovered, but in 1932 about 250 cocoons were obtained by rearing, and in 1933 and 1934 more than 7,000 cocoons were sent to the United States. Several colonies of adults have been liberated in areas infested with the satin moth in New England and Washington. Although the species is not known to have become definitely established, numerous observations have been made in the laboratory regarding its biology and morphology, and this paper gives the results of these observations.

REVIEW OF LITERATURE

Although the genus Rogas includes many species that are parasitic on common lepidopterous pests throughout the world, notes on their biology and habits are scattered and incomplete. Rogas unicolor was mentioned briefly as a parasite of Stilpnotia salicis in Hungary by Brown (1) 4 in 1931. De Fluiter (4) listed Petalodes (Rogas) unicolor (Wesm.) 5 as a parasite of S. salicis in Holland in 1933, giving a list of secondary parasites reared from the cocoons. Petalodes unicolor (Wesm.) and Rogas unicolor (Wesm.) are distinct, but apparently Rogas unicolor is the species that De Fluiter reared from the satin moth. Dustan (2) gave an excellent account of the internal anatomy of the full-grown larva of Rogas hyphantriae Gahan, which has been very helpful in this study. Fiske (3) gave brief notes on what he called “Rogas intermedias Cresson” 6 as a parasite of Clisiocampa (=Malacosoma) americana F., emphasizing the role played by its hyperparasites. This species, however, is an undescribed one which was obviously misidentified. Pennington (7) briefly discussed the life history of Rogas terminalis (Cress.), parasite of Cirphis unipuncta Haw., and noted the production of males in parthenogenesis. Hyslop (6) noted Rogas autographae Cress. as a parasite of Autographa gamma L. (californica Speyer) and described cocoon formation. Tothill (9) gave a few notes on Rogas sp. as a parasite of Hyphantria cunea.

1 Received for publication Oct. 23, 1937; issued May 1938.
2 This study was conducted under the direction of C. W. Collins at Melrose Highlands, Mass., in 1932, 1933, and 1934, and under the direction of R. C. Brown at Melrose Highlands, Mass., and New Haven, Conn., in 1935.
3 The writer wishes to express his gratitude to W. F. Sellers for collections and notes made at Budapest, Hungary; to Karoly Mihalyi for field collections; and to Mary F. Benson for the drawing of the adult.
4 Reference is made by number (italic) to Literature Cited p. 635.
5 The writer is indebted to C. F. W. Muesebeck, of the Division Insect of Identification, for these notes regarding identifications.
(Drury). Husain and Mathur (5) briefly noted the life history of "Rogas testaceus Grav. var." parasite of Earias insulana Boisd. and E. fabia Stoll. Apparently R. testaceus (Spin.) was intended, for Gravenhost did not describe a species of Rogas under this name. Hyslop (6), Tothill (9, pl. 8), and Pennington (7) gave good figures of the adults and cocoons of the species they worked with, and Pennington also gave a figure of the egg.

ECONOMIC IMPORTANCE

Rogas unicolor has been recorded from Belgium, Holland, Germany, and Hungary, and it seems probable that it is present in many of the places where Stilpnotia salicis occurs in Europe. So far as is known, it has been reared only from this host. Apparently it is of slight economic importance. De Fluiter (4) notes recovering it from S. salicis in Holland, but he does not give the number of cocoons obtained. The Bureau of Entomology conducted large-scale rearing work at several points in Austria and Hungary from 1927 through 1934 for the recovery of parasites of S. salicis, but R. unicolor was never recorded in appreciable numbers except at Budapest, Hungary. At that point from 1929 to 1934 there was a light infestation of the satin moth on a sand bar in the Danube River. This sand bar, about 1½ miles long and from 100 to 200 yards wide, supports a bushy growth of poplar ranging in height from 3 to 8 feet. In 1931, 11 cocoons were reared from 6,000 larvae. In 1932, 286 cocoons were recovered from collections totaling 26,980 larvae. In 1933, 364 cocoons were obtained from collections of 35,950 larvae, and 1,890 cocoons were collected in the field. In 1934 rearing work was discontinued, but 5,065 R. unicolor cocoons were collected in the field for shipment to the United States, and it was estimated that, if funds had been available, from 2,000 to 3,000 more might have been brought together.

In spite of the low percentage of parasitization by Rogas, the field collections showed that, barring very high secondary attack, there were enough cocoons in the field to supply a large number of adults. It was therefore felt that possibly under somewhat different conditions, such as might exist in the United States, the species could have an excellent chance of becoming more effective.

It should be pointed out at this time that cocoon collection in the field was greatly facilitated by the fact that the parasitized host larva spins a conspicuous white web, inside of which the parasite cocoon is formed.

INTRODUCTION INTO THE UNITED STATES

There were 256 Rogas unicolor cocoons in the first shipment sent to the United States in 1932. Out of 225 adults that emerged, 224 were females. There seemed a strong possibility, therefore, that this species normally produced females in parthenogenesis; so only females were liberated. This possibility was later confirmed, and all liberations have consisted entirely of unmated females. The number and extent of colonizations is shown in table 1.

Unfortunately for this work, during the period when liberations were made in New England the satin moth was on the decline and, although good infestations were present at the time of colonization, they practically disappeared in the following year. In Washington conditions
were far better for colonization, for a general infestation has persisted throughout the area. The adult parasite has never been recovered in the United States, although in 1934, the winter following liberations, a first-instar *Rogas* larva was dissected from a hibernating satin moth larva collected at the colonization point in Portland, Maine.

### Table 1.—Colonization of *Rogas unicolor* in the United States

<table>
<thead>
<tr>
<th>Point of liberation</th>
<th>Year</th>
<th>Females shipped</th>
<th>Living females liberated</th>
</tr>
</thead>
<tbody>
<tr>
<td>Portland, Maine</td>
<td>1933</td>
<td>500</td>
<td>500</td>
</tr>
<tr>
<td>Topsham, Maine</td>
<td>1933</td>
<td>500</td>
<td>500</td>
</tr>
<tr>
<td>South Harpswell, Maine</td>
<td>1934</td>
<td>500</td>
<td>500</td>
</tr>
<tr>
<td>Concord, N. H.</td>
<td>1933</td>
<td>150</td>
<td>150</td>
</tr>
<tr>
<td>Taunton, Mass.</td>
<td>1932</td>
<td>200</td>
<td>200</td>
</tr>
<tr>
<td>South Yarmouth, Mass.</td>
<td>1933</td>
<td>500</td>
<td>500</td>
</tr>
<tr>
<td>Woonsocket, R. I.</td>
<td>1934</td>
<td>500</td>
<td>500</td>
</tr>
<tr>
<td>New Haven, Conn.</td>
<td>1934</td>
<td>300</td>
<td>293</td>
</tr>
<tr>
<td>Olympia, Wash.</td>
<td>1934</td>
<td>432</td>
<td>430</td>
</tr>
<tr>
<td>Bellingham, Wash.</td>
<td>1934</td>
<td>500</td>
<td>497</td>
</tr>
<tr>
<td>Stanwood, Wash.</td>
<td>1934</td>
<td>500</td>
<td>457</td>
</tr>
<tr>
<td>Kent, Wash.</td>
<td>1934</td>
<td>500</td>
<td>492</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td><strong>5,082</strong></td>
<td><strong>5,019</strong></td>
</tr>
</tbody>
</table>

### Descriptions

#### The Adult

The adult (fig. 1) was described by Wesmael (12) in 1838 as a species of the genus *Aleiodes*. In 1863 Reinhard (8) placed it under Nees’ genus *Rogas*.

#### The Egg

The newly laid egg (fig. 2, A) measures 0.40 mm long and 0.11 mm wide. It is very slightly curved, bluntly rounded at the ends, and slightly broader at the cephalic extremity. The chorion is smooth and hyaline except for a slightly roughened area at the cephalic end. A conspicuous round, light area may be observed near the caudal end of the embryo. This is the gonad of the first-instar larva.

#### The Larva

There are five larval instars. The first and the last are distinct, but the intermediate instars differ little from one another except in size and mandibular measurements. Each of the first four instars has an extremely delicate skin, and often the next larval instar may be distinguished as it develops under the skin about to be molted.

##### First Instar

The first-instar larva (fig. 2, B) averages 0.40 mm long and 0.12 mm wide when hatched. It attains a size of about 0.60 mm long and 0.15 mm wide preparatory to hibernation, and in the spring develops to almost three times this size before molting to the second instar. It possesses a head and 13 well-differentiated segments. The cuticle is smooth, without spines or setae, and there is no tracheal system. The head (fig. 2, C) has a well-developed hypostoma and pleurostoma. The epistoma, instead of constituting a continuous arch

---

6 The terminology of the head structures is that of Vance and Smith (10).
above the mouth opening, is represented by two well-developed struts
which run vertically above the superior pleurostomal rami. The
maxillae and labium are defined by lightly sclerotized markings,
bearing four pairs of setae. There are four sensoria just above the
mouth opening. The mandibles (fig. 2, D) are simple, sharply curved
hooks, measuring 0.02 mm. The internal anatomy is similar to that
of the full-grown larva, which will be described fully, except that in
the first instar the gonads are well developed and conspicuous.
They are circular in outline and occupy a large part of segments 10
and 11 above the hind-intestine.

SECOND INSTAR

Second-instar larvae range from 1.8 mm long and 0.56 mm wide to 3.75
mm long and 0.95 mm wide. The tracheal system is developed, and,

although there are no spiracles, there are spiracular stubs in the
second and third thoracic and first eight abdominal segments. The
head structures are weakly sclerotized. The hypostoma is well
defined, but the mandibular and maxillary lobes are weakly shown
and the epistoma forms a barely discernible arch over the mouth.
The mandibles have the same general form as those of the full-grown
larva. They measure 0.04 mm. The gonads are inconspicuous.

THIRD INSTAR

Third-instar larvae exhibit but slight differences from those of the
preceding instar. They range from 4.0 mm long and 1.0 mm wide to
5.0 mm long and 1.32 mm wide. The mandibles measure 0.06 mm.
FOURTH INSTAR

Fourth-instar larvae range from 5.0 mm long and 1.5 mm wide to 9.0 mm long and 2.0 mm wide. There are still no open spiracles, the integument is bare, and except for the hypostoma and pleurostoma the head skeleton is practically undefined. The mandibles measure 0.10 mm.

FIFTH INSTAR

The full-grown larva (fig. 3, A) measures about 10 mm long and 2.5 mm wide. It is yellowish white, and when quiet assumes the char-
acteristic shape, with head curved downward, as shown in the figure. The first eight abdominal segments bear prominent lateral folds. The integument bears tiny cuticular spines as indicated. The last abdominal segment bears, in addition, several (about 12) pairs of sensory setae. Sensory setae are also present on the other segments, but owing to similarity with the cuticular spines and unevenness of distribution their exact number and location were not determined.

The head, seen from the front (fig. 3, C), presents well-defined characters. The antennal rudiments are somewhat darkened areas containing two or three minute papillae. They are surrounded by

**Figure 3.** Rogen unicolor. A, Full-grown larva; sp, spiracle; lf, lateral fold, X 11. B, Full-grown larva, internal anatomy; skgld, silk gland; mint, midintestine; mal, malpighian tube; vnc, ventral nerve cord; hint, hindintestine, X 11. C, Head of full-grown larva, front view; a, antenna; dtm, dorsal tentorial mark; po, postoccipt; sts, stipital sclerome; pl, pleurostoma; hy, hypostoma; lea, lateral epicranial angle; mas, maxillary sclerome; las, labial sclerome, X 72.
large oval areas, the antennal foramina. The postocci put is well defined laterally. Just below the antennal foramina pronounced grooves extend inward from the postocci put. These grooves may be the temporal fossae. The hypostoma widens and divides at the lateral epicranial angles, where one side is fused to the strong transverse tentorial bar. The stipital sclerome is apparently not attached to the hypostoma. It sets off the heavy fold of the maxillary region. The maxillary and labial palpi each have two slightly raised round sensoria. The mandibles (fig. 2, E) are simple and broadly oval at the base. On the inner side of the basal part they bear a number of minute spines. They measure 0.14 mm. An area on the ventral portion of the head is armed with cuticular spines.

The tracheal system is composed of a pair of lateral trunks, which give rise to a main dorsal and a main ventral branch in each segment except the head and the last segment. There are nine pairs of spiracles. A pair occurs on the mesothoracic segment and a pair on each of the first eight abdominal segments. They are joined to the longitudinal trunks by short spiracular branches. A spiracular stub occurs in the metathoracic segment, but there is no spiracle. The mesothoracic spiracle measures 0.04 mm in diameter. The main dorsal branches in the first segment are connected, and in each of the first eight abdominal segments small tracheae arising from the main ventral branches unite to form a ventral transverse commissure. The head and the last segment receive branches from the main longitudinal trunks. The main dorsal and ventral branches give off numerous small tracheae, which branch profusely. Some small tracheae also arise from the longitudinal trunks.

The digestive system (fig. 3, B) is similar to that described by Dustan (2) for Rogas hyphantriae Gahan, although larvae of R. unicolor were not sectioned, and many of the details described for R. hyphantriae were not studied.

The alimentary canal consists of a short, slender foreintestine, a large midintestine, occupying most of the body cavity from the first to the eighth abdominal segment, and a short hindintestine. The contents of the midintestine are brownish pink. The hindintestine is composed of three well-defined areas—a short bulbous section just behind the midintestine, an even shorter constricted section, and a large saclike rectum. The malpighian tubes are attached to the first section. The rectum is about three times as wide as it is high. The salivary glands are well-developed tubes lying on each side of the body. They unite in a short, common duct, which has a U-shaped opening on the floor of the mouth. The common duct divides into two tubes at the posterior border of the head. Each tube extends upward to the third segment, where it bifurcates. Each branch possesses many actively secreting cells that are grouped in conspicuous oval nodules joined along the main tube. Posteriorly these nodules are more numerous, and consequently the tubes become considerably widened. There is only one pair of malpighian tubes, but they are exceedingly long and are attached very closely to one another at the base of the hindintestine. They do not have a common lumen as in Rogas hyphantriae. They separate almost immediately, running just above the ventral nerve cord to the third thoracic segment, where they turn, run posteriorly almost as far as the hind intestine, turn again, and run
anteriorly almost to the second thoracic segment, where there is another short turn before they end. They are for the most part straight-sided tubes, but here and there a slight swelling occurs.

The brain and the nerve cord are distinct. The ventral nerve chain includes 11 double ganglia, the terminal one being in the eighth abdominal segment. The abdominal ganglia are fused. Each is located at the anterior border of the segment, and gives off a pair of long nerve fibers running posteriorly and laterally through the segment. The terminal ganglion is evidently a fusion of the last three segments, for it sends out three pairs of nerves.

The heart, or dorsal blood vessel, may be distinguished readily in living specimens. It runs from the first segment just behind the brain abruptly dorsad to the median line, and along this line to the twelfth segment.

The urate cells are conspicuous just beneath the cuticle. They are irregular in shape, semiopaque, and occur from the second to the seventh abdominal segments, inclusive.

The histoblasts of the various external organs are easily distinguishable, since they lie just underneath the cuticle and are semiopaque. The antennal histoblasts are situated behind the antennal rudiments; those of the legs are on the venter of the thoracic segments; those of the wings are found laterally on the second and third thoracic segments; and the histoblasts of the female genitalia are located ventrally in the eighth and ninth abdominal segments.

The rudiments of the ovaries are located in the seventh abdominal segment. They consist of two spindle-shaped bodies with long, narrow stalks ventrally and numerous tiny filaments dorsally. The stalks are attached to the ventral wall on each side of the ventral nerve chain, and the filaments are joined dorsally.

THE COCOON AND PUPA

Characteristic of the genus, the cocoon of *Bogas unicolor* is formed inside the dead host larva's skin. The contents of the host larva are almost entirely consumed, and the parasite spins a light, but tough, brown cocoon within the host skin. As the skin dries it forms a dry, taut case, conforming closely to the shape of the full-grown parasite larva. The head of the dead host larva remains attached to the skin and is curved downward.

The pupa is of the usual hymenopterous type. It is oriented toward the caudal end of the host larva.

BIOLOGY

*Bogas unicolor* has one generation a year. It passes the winter as a first-instar larva within the hibernating host larva. Development proceeds slowly in the spring, and the parasite larva does not become full grown until the host larva is in the penultimate instar. Under insectary conditions in New England on an average 12 days is spent in a cocoon. *Bogas* adults issue from June 21 to July 7, the majority appearing the end of June. Probably issuance would be somewhat later under field conditions. Satin moth eggs are deposited late in June and in July. They hatch in about 15 days, and 5 to 6 days are spent in the first instar. *Bogas* females attack the second-instar larvae. Females issuing the first of July probably do not find an
abundant supply of suitable host material for 2 or 3 weeks, but undoubtedly some larvae are present soon after they appear.

As in other species of *Rogas*, the adults issue by gnawing an irregular hole through the dorsal side of the cocoon near the caudal extremity of the dead host's larval skin. In one or two instances the emergence hole has been found on the venter. The adults are rather inactive, slow-moving insects. At the laboratory they were confined in glass-topped wooden boxes and fed dry lump sugar and a honey solution (1 part honey to 5 parts water) held on absorbent cotton or sponges. When placed in a cool, dark room they lived on an average 34 days. When placed in 8-inch glass vials for continuous reproductive work, they lived a somewhat shorter time. Six females used in reproduction-capacity work in 1933 lived on an average 22 days, with a minimum of 12 and a maximum of 32 days. In 1934 the females used in similar work were held for 3 to 4 weeks before suitable host larvae could be provided, and they lived on an average only 8 days after beginning oviposition.

As already indicated, experiments have shown that *Rogas unicolor* normally produces females by parthenogenesis. A number of larvae were attacked at the laboratory by both mated and unmated females. In all 90 adults were reared, and 89 of them were females. The one male was the progeny of an unfertilized female. Apparently about the same proportion of females are produced under natural conditions, for during a 3-year period out of 5,492 adult *Rogas* issuing from cocoons received from Europe only 40 were males.

Although females are normally produced in parthenogenesis, the sexes mate fairly readily. Eight pairs averaged 30 seconds in coitus. *Rogas* females oviposit very readily in second-instar host larvae. First-instar larvae are so small that the ovipositor cannot be successfully inserted. When a *Rogas* female comes near a host larva, she quickly touches it with her antennae and moves toward it with abdomen curved downward ready to strike. If the larva stops, she often stands still over it a moment and then prods it gently with her abdomen. When the larva is moving, she inserts her ovipositor by a quick forward thrust of the abdomen. Oviposition requires about a second, and the parasite then hurries away. Since the parasite's ovipositor is very short and the host larva small, the larva is often lifted up, and frequently rolls itself into a tight ball. If the larva rolls up before the ovipositor is actually inserted, the parasite may make use of her long antennae and palpi to hold it in position for attack. The parasite shows no discrimination, frequently attacking the same host larva a number of times, but she always walks away a short distance after each egg is laid, and is therefore not immediately attracted to the same larva. Observations conducted during two seasons on isolated females indicated that *Rogas unicolor* has a rather high reproductive capacity. The maximum number of eggs laid by one female was 322, but when this female was dissected there were still a number of eggs in her ovaries and ovarioles. Each ovary has two very long ovarioles, and it is very difficult to count all the eggs present. This particular female had at least 100 more eggs in the process of formation, and it is quite possible that more might have been developed. The maximum number of eggs laid by a single female over a 2-day period was 88.
When it is first deposited, the egg apparently floats freely in the body cavity of the host larva, for it floats out very readily upon dissection. After about 24 hours, however, it seems to be lightly attached to various host organs, but most frequently to the silk glands, malpighian tubes, or fat body. The egg hatches in about 53 hours. The tiny parasite larva floats freely in the body cavity of the host. It ingests a small quantity of the host body fluids, increasing slightly in size before hibernation. In the spring it develops very slowly, first-instar larvae having been dissected out as late as June. The next three instars are completed within 3 or 4 days, and it is difficult to find a larva of an intermediate instar without traces of the next one already apparent through the thin skin. Several days are spent in the last larval instar. The contents of the host larva are almost entirely consumed and then the parasite cocoon is spun. During the greater part of this instar the head of the parasite is oriented similarly to that of the host. As the cocoon is spun the parasite reverses its position completely, and pupation takes place with the head of the parasite toward the posterior segments of the host and its venter toward the host dorsum. Upon completion of the cocoon the larva voids its meconium and pupation takes place within about 24 hours.

Vickery (11) found that just before cocoon formation the larva of *Rogas laphygmae* Vier. cuts through the skin and pushes the fluids and material it does not eat out of the host larva's body. The drying of these fluids attaches the cocoon to the plant on which it is resting. Fiske (8) reported that larvae of "*Rhogas intermedias* Cresson" attach their cocoons with a bit of brown silk extruded from a puncture on the ventral thoracic surface. *Rogas unicolor* does not cut through the host larval skin. The cocoons are dry and unattached.

**EFFECT OF PARASITE ON HOST**

The growth of *Stilpnotia salicis* larvae parasitized by *Rogas unicolor* is considerably retarded. There is no apparent difference in parasitized and unparasitized larvae until the penultimate instar. Those that are unparasitized develop rapidly through the last instar and begin to pupate, while those that are parasitized fail to molt to the last instar and become very sluggish. Finally, about the time the parasite enters the fourth instar, the caterpillar seeks a sheltered
place and spins a dense, white web that is usually oval (fig. 4). In the field this web is usually spun between leaves. The parasite cocoon is formed inside this protective covering.

**HYPERPARASITES**

Unfortunately *Rhogas unicolor* is attacked by a number of hyperparasites. Fourteen species have been reared from cocoons collected from the field at Budapest, and De Fluitier (4) records four species reared from "*Petalodes (Rhogas) unicolor* (Wesm.)" in Holland. *Dibrachys cavus* (Walk.) was the most important hyperparasite at Budapest. During 1933 and 1934 it parasitized more individuals than all the other species together. It is gregarious, and during the 2-year period on an average 15 adults were reared from each *Rhogas* cocoon. This species is present in New England, and Fiske (5) has recorded *Dibrachys boucheanus* (=cavus Walk.) as an important parasite of "*Rhogas intermedias* (Cresson)."

Data concerning the hyperparasites reared from *Rhogas unicolor* cocoons collected at Budapest have been summarized in table 2.

In 1933 hyperparasites issued from 14 percent of the cocoons that produced adults, and in 1934 from 17 percent. Since this material was collected in the field, it gives some indication of natural conditions, but probably a much higher percentage would have been destroyed if the cocoons had been left there until the adults emerged.

**Table 2.—Parasitization of field-collected cocoons of *Rhogas unicolor* from Budapest, Hungary, in 1933 and 1934**

<table>
<thead>
<tr>
<th>Species of parasite</th>
<th>1933</th>
<th>1934</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Parasitized cocoons</td>
<td>Parasites issued</td>
</tr>
<tr>
<td>Itoplectis scanka</td>
<td>25</td>
<td>25</td>
</tr>
<tr>
<td>Theronia atalanta</td>
<td>19</td>
<td>19</td>
</tr>
<tr>
<td>Hemitea cretator</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Mesochorus tuberculiger</td>
<td>34</td>
<td>34</td>
</tr>
<tr>
<td>Mesochorus pallidus</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Brachymeria intermedia</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Catolaccus ater Ratz.</td>
<td>9</td>
<td>9</td>
</tr>
<tr>
<td>Monodonterus dentipes Boh.</td>
<td>4</td>
<td>12</td>
</tr>
<tr>
<td>Tetrastichus rapo Walk.</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Pleurotropis facialis (Gir.1)</td>
<td>1</td>
<td>16</td>
</tr>
<tr>
<td>Cnephasia picta (Nees)</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Dibrachys cavus (Walk.)4</td>
<td>125</td>
<td>1,875</td>
</tr>
<tr>
<td>Eurytoma sp.1 (gregarious)</td>
<td>12</td>
<td>210</td>
</tr>
<tr>
<td>Eurytoma sp.1 (solitary)</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>Total killed by parasites</td>
<td>240</td>
<td>1,528</td>
</tr>
<tr>
<td>Adults issued</td>
<td>3,583</td>
<td>725</td>
</tr>
<tr>
<td>Dead from unknown causes</td>
<td>307</td>
<td>757</td>
</tr>
</tbody>
</table>

1 Determinations made by C. F. W. Muesebeck, A. B. Gahan, and R. A. Cushman, of the Bureau of Entomology and Plant Quarantine, Division of Insect Identification.

2 1 cocoon produced 16 *Pleurotropis* and 4 *Dibrachys*.

3 1 cocoon produced 3 *Dibrachys* and 1 *Euphotomaus*.

4 A. B. Gahan, of the Bureau of Entomology and Plant Quarantine, Division of Insect Identification, states that this species of *Euphotomas* is "very close" to *E. nidulans* Foerst., and that the large solitary specimens are probably large specimens of the same species.
De Flui ter (4) reared *Dibrachys boucheanus* Ratz. (=cavus Walk.), *Eurytoma appendigaster* Boh., *Habrocytus emerus* (Ratz.), and *Meso-chorus marginatus* Thoms. from *Rogas* cocoons in Holland. *D. cavus* is the only one of these species that was also present at Budapest.

*Rogas* spends about 12 days in the cocoon, but all the hyperparasites except the two species of *Mesochorus* attack this stage. *Mesochorus tuberculiger* Thoms. attacks the tiny hibernating *Rogas* inside the *Stilpnottia salicis* larva. *Mesochorus* females pay practically no attention to unparasitized *S. salicis*, but upon encountering a parasitized larva the hyperparasite strokes it rapidly with its antennae and jabs it repeatedly with its ovipositor. Upon dissection the attacked *Rogas* larva is found to contain a tiny gourd-shaped *Mesochorus* egg.

**FACTORS LIMITING THE EFFECTIVENESS OF THIS PARASITE**

The only obvious factor limiting the effectiveness of *Rogas unicolor* as a parasite of *Stilpnottia salicis* is the hyperparasitism. There are numerous parasites, however, that are apparently just as severely attacked by hyperparasites, which prove to be far more effective as control factors of their respective hosts. Although *S. salicis* has been reared at many points in Europe, *R. unicolor* has been recorded in appreciable numbers only at Budapest, Hungary, and at Wageningen, Holland. It seems that there must be some unknown factors, possibly climatic, that keep it from becoming a more important parasite of this host in Europe.

**SUMMARY**

*Rogas unicolor* (Wesm.) is a braconid parasite of minor importance on *Stilpnottia salicis* L. in Europe. In 1933 and 1934 about 7,000 cocoons were collected at Budapest, Hungary, and sent to the United States. Adults were colonized in New England and in Washington, but the species has not yet been definitely recovered.

The various stages of the parasite are described in detail. *Rogas unicolor* has one generation a year. The winter is passed as a first-instar larva within the hibernating host larva. Development proceeds slowly in the spring, and the parasite becomes full grown when the host larva is in the penultimate instar. The cocoon is formed inside the skin of the dead host larva. About 12 days is spent in the cocoon, and adults issue the last of June. Parthenogenetic reproduction results in female progeny, although an occasional male appears. A maximum of 322 eggs was obtained from a single female.

Host larvae that are parasitized by *Rogas unicolor* are considerably retarded in growth. Just before the parasite becomes full grown, the host larva spins a dense white web, within which the parasite cocoon is formed.

*Rogas unicolor* is attacked by a number of hyperparasites. Fourteen species were reared from *Rogas* cocoons collected in the field at Budapest, Hungary. The most important hyperparasite was *Dibrachys cavus* (Walk.), which has been noted by Fiske as an important parasite of "*Rhogas intermedias* (Cresson)" in New England. Hyperparasitism is the most apparent factor limiting the effectiveness of this parasite, although climate or other, unknown factors may actually be more important.
LITERATURE CITED


