NOTES ON THE STREPSIPTERA AND THEIR HYMENOPTEROUS HOSTS.¹

BY GEORGE SALT.

In the course of a study of the effects of stylopization on aculeate Hymenoptera, a number of new and interesting host records and various notes on parasitism by Strepsiptera have been accumulated. Although their varied nature render it somewhat disjointed, it seems wise to bring these miscellaneous facts together in the present paper.

The following is an annotated list of the eighty-one species of Hymenoptera of which I have examined stylopized specimens. Two genera, Zethus and Montezumia, and several species apparently constitute new host records.

Sphecidae.

Ammophila


*pictipennis* Walsh and Riley, det. Fernald. Virginia: Falls Church and Great Falls (N. Banks).

*vulgaris* Cress., det. Robertson. Illinois: Carlinville (Chas. Robertson); Florida: Inverness (Chas. Robertson).

Chlorion (Isodontia)


(Proterosphex)

*ichneumoneum* (Linn.), det. Salt. Illinois: Carlinville (Chas. Robertson); Texas: Fedor.


¹Contributions from the Entomological Laboratory of the Bussey Institution, Harvard University, No. 270.
Notes on the Strepsiptera and their Hosts

Vespidae.

Zethinae.

Zethus


Eumeninae.

Eumenes


Montezuma


Odynerus


\textit{anormis} Say, det. Robertson. Illinois: Carlinville (Chas. Robertson).


**Psyche**


*histrionalis* Robt., det. Robertson. No locality label.

*manifestus* Cress., det. Bequaert. Texas: (Fedor).

*perennis* Sauss., det. Bequaert. Virginia: Great Falls, Falls Church and Dyke (N. Banks).


**Pachodynerus**


*erynnis* (Lepel.), det. Bequaert. Florida: Lakeland (Wm. T. Davis), Miami (Jos. Bequaert), Inverness (Chas. Robertson).


**Ancistrocerus**


*fulvipes* (Sauss.), det. Bequaert. Texas: Lee Co. (Birkman), New Braunfels.


*tigris* (Sauss.), det. Bequaert. New Jersey: (Ramsey), Fort Lee (Jos. Bequaert); Virginia: Falls Church and Glen-carly (N. Banks); Pennsylvania: Melsh; Connecticut: Colebrook (W. M. Wheeler).

**Belonogaster**


**Ropalidia**


**Polistes**


gallicus (Linn.), det. Bequaërt. No locality label.


**Apidae**

**Chloralictus**

sp. Washington: Pullman (A. D.)

sp. (N. B. Several species are probably here grouped to-gether). Connecticut: Colebrook (W. M. Wheeler); Massachusetts: Forest Hills (George Salt).


zephyrus Sm., det. Robertson. Illinois: Carlinville (Chas. Robertson).
Andrena


*miranda* Sm., det. Viereck. Connecticut: Colebrook (W. M. Wheeler); Wisconsin.


Panurginus

Pseudopanurgus
æthiops Cress., Colorado: Wray.

Various writers have given data on the extent of parasitism by Strepsiptera, and in his monograph and its supplements, Pierce (1909, 1911, 1918) has brought together these records and added others. Most of the published notes, however, deal with Polistes and Andrena, whereas the following have to do largely with other genera.

In 1922, Dr. W. M. Wheeler collected a total of 373 specimens of Andrena hirticincta Prov. Forty-four of these or 11.9% were stylopized, 6 of 23 males or 26.1%, and 38 of 350 females or 10.9%. His collecting records for the same year of species of Chloralictus, mostly albipennis, show 98 stylopized of a total of 470 specimens collected, an infestation of 20.9%; 88 of 378 males or 23.3% were stylopized, and 10 of 92 females or 10.9%

No collecting records are available for the Vespidae other than Polistes but some indication of the extent to which they suffer from strepsipterous attack may be obtained from the frequency of the occurrence of stylopized individuals in collections. Of 4525 specimens of miscellaneous Eumeninae examined by the writer, 74, or 1.64%, were stylopized. Collections of particular genera contained stylopized specimens as follows:

| Masarinæ | of 96 specimens, 0 stylopized, or 0 %.
| Zethus | of 53 " 2 " 3.8%. |
| Eumenes | of 214 " 3 " 1.4 %.

In addition, 217 specimens of *Synagris* were examined rather summarily but none was observed to be stylopized.

To give detail of the sex, number, and position of the parasites in the various species of hosts would require more space than is at our disposal, but the general conditions are indicated by the following analyses of the parasitism in four of the better-known genera.

*Odynerus (sens. lat.).*

<table>
<thead>
<tr>
<th></th>
<th>n</th>
<th>Sex</th>
<th>Parasites (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Nortonia</em></td>
<td>5</td>
<td>0</td>
<td>0 %</td>
</tr>
<tr>
<td><em>Pachymenes</em></td>
<td>42</td>
<td>0</td>
<td>0 %</td>
</tr>
<tr>
<td><em>Monobia</em></td>
<td>52</td>
<td>0</td>
<td>0 %</td>
</tr>
<tr>
<td><em>Alastor</em></td>
<td>33</td>
<td>0</td>
<td>0 %</td>
</tr>
<tr>
<td><em>Pterochelus</em></td>
<td>43</td>
<td>0</td>
<td>0 %</td>
</tr>
<tr>
<td><em>Stenogaster</em></td>
<td>5</td>
<td>0</td>
<td>0 %</td>
</tr>
<tr>
<td><em>Belonogaster</em></td>
<td>104</td>
<td>2</td>
<td>1.9 %</td>
</tr>
<tr>
<td><em>Ropalidia</em></td>
<td>160</td>
<td>2</td>
<td>1.3 %</td>
</tr>
</tbody>
</table>

Average infestation:—1.43 parasites per host.

99 parasites (28♂, 71♀) situated as follows:—42 on the right, 56 on the left, 1 median;

- under the 2nd, 3rd, 4th, 5th abdominal segments.
  - ♂ parasites: 1 21 6
  - ♀ parasites: 6 45 19 1

In this genus of hosts the female parasites prefer a position anterior to that of the male.
### Notes on the Strepsiptera and their Hosts

**Polistes.**

<table>
<thead>
<tr>
<th>Specimens</th>
<th>Carrying</th>
<th>Parasites</th>
</tr>
</thead>
<tbody>
<tr>
<td>29</td>
<td>1</td>
<td>1 parasite (21♂, 8♀).</td>
</tr>
<tr>
<td>11</td>
<td>1♂, 10♀</td>
<td>2♂ parasites (22♂).</td>
</tr>
<tr>
<td>2</td>
<td>1♂, 1♀</td>
<td>2♀</td>
</tr>
<tr>
<td>6</td>
<td>6♀</td>
<td>1♂, 1♀</td>
</tr>
<tr>
<td>6</td>
<td>6♀</td>
<td>3♂</td>
</tr>
<tr>
<td>2</td>
<td>2♀</td>
<td>2♂, 1♀</td>
</tr>
<tr>
<td>2</td>
<td>2♀</td>
<td>1♂, 2♀</td>
</tr>
<tr>
<td>1</td>
<td>1♀</td>
<td>4♂</td>
</tr>
<tr>
<td>2</td>
<td>2♀</td>
<td>5♂</td>
</tr>
<tr>
<td>1</td>
<td>1♀</td>
<td>7♂</td>
</tr>
<tr>
<td>3</td>
<td>3♀</td>
<td>larval</td>
</tr>
<tr>
<td>65</td>
<td>(5♂, 60♀)</td>
<td>118. larval (94♂, 24♀).</td>
</tr>
</tbody>
</table>

Average infestation of wasps carrying adult parasites: 1.9 parasites per wasp.

118 parasites (94♂, 24♀) situated as follows:—54 on the right, 63 on the left, 1 median; 105 dorsal, 3 lateral, 10 ventral; under the 2nd, 3rd, 4th, 5th. abdominal segments.

♂ parasites: 1 44 41 8
♀ parasites: 1 2 21

The normal position for the male is here obviously under the 3rd. and 4th. segments. In the eight cases in which a male was found under the 5th. segment, only once was it the only parasite; twice it was one of two, twice one of three, once one of four, and twice one of five parasites, and may be considered to have been crowded from its normal position. On the other hand, the female usually occurs under the 5th. segment; where it was under the 3rd. it was one of three parasites, where it was under the fourth it was one of two or one of three parasites. This condition, in which the males normally lie anterior to the females in the body of the host, is exactly the opposite of that in Odynerus where the females lie anteriorly, the males behind.

**Chloralictus**

<table>
<thead>
<tr>
<th>Specimens</th>
<th>Carrying</th>
<th>Parasites</th>
</tr>
</thead>
<tbody>
<tr>
<td>313</td>
<td>1</td>
<td>1 parasite.</td>
</tr>
<tr>
<td>161</td>
<td>(142♂, 19♀)</td>
<td>2 parasites.</td>
</tr>
<tr>
<td>45</td>
<td>(44♂, 1♀)</td>
<td>3</td>
</tr>
<tr>
<td>1</td>
<td>(1♂)</td>
<td>4</td>
</tr>
<tr>
<td>520</td>
<td>(463♂, 57♀)</td>
<td>774</td>
</tr>
</tbody>
</table>

Average infestation: 1.5 parasites per host.
774 parasites, all females, situated as follows—386 on the right, 358 on the left, 30 median; 763 dorsal, 4 lateral, 7 ventral; 40 under the 3rd., 712 under the 4th., and 22 under the 5th. abdominal segments. In seven of the eleven cases in which the parasite was lateral or ventral, it was one of three parasites; in three cases, one of two; and in only one case was it the only parasite. The normal position of the parasite in Chloralictus, therefore, is dorsal, under the 4th. abdominal segment.

It will be noticed that here, as also in the case of the stylopized Halicti studied by Perkins (1892, 1918), all of the parasites found were females; no males or male exuvia were seen in Halictus. This fact at once raises the question of parthenogenesis among the females of Halictoxenos already suggested by Perkins. Mrs. Schrader (1924), to be sure, has shown that the females of Acroschismus must be fertilized to produce their young; but in that genus males are of common occurrence and, indeed, in the present study were found in much larger numbers than the females. Pierce (1918) claims to be the only one who has ever captured an Halictus with a male parasite. In view of the very rare occurrence of males of Halictoxenos, then, or their almost complete absence, parthenogenesis is strongly suggested in this group notwithstanding Mrs. Schrader's contrary observations on Acroschismus.

Andrena.

<table>
<thead>
<tr>
<th>Specimens</th>
<th>Carrying 1 parasite</th>
<th>Parasites</th>
<th>Average infestation: 1.1 parasites per host.</th>
</tr>
</thead>
<tbody>
<tr>
<td>147</td>
<td>(41♂, 106 ♀)</td>
<td>(40♂, 107 ♀)</td>
<td>200 parasites (49♂, 149 ♀, 2 larval) situated as follows:—97 on the right, 93 on the left, 1 median, 3 unextruded, 6 unrecorded; 187 under the 4th., 9 under the 3rd., 1 under the 5th. abdominal segments, 3 unextruded. The normal position for the parasites of Andrena is obviously under the 4th. abdominal segment.</td>
</tr>
<tr>
<td>18</td>
<td>(4♂, 14 ♀)</td>
<td>2 ♀ parasites (36 ♀)</td>
<td>200 parasites (49♂, 149 ♀, 2 larval) situated as follows:—97 on the right, 93 on the left, 1 median, 3 unextruded, 6 unrecorded; 187 under the 4th., 9 under the 3rd., 1 under the 5th. abdominal segments, 3 unextruded. The normal position for the parasites of Andrena is obviously under the 4th. abdominal segment.</td>
</tr>
<tr>
<td>3</td>
<td>(3 ♀)</td>
<td>2♂ parasites (6♂)</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>(3 ♀)</td>
<td>1♂, 1 ♀ (3♂, 3 ♀)</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>(1 ♀)</td>
<td>3 ♀ (3 ♀)</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>(2 ♀)</td>
<td>1 larval parasite</td>
<td></td>
</tr>
</tbody>
</table>

Average infestation:—1.1 parasites per host.
Finally, attention must be drawn to a matter of nomenclature. It appears to have been overlooked that von Heyden (1868, p. 398) used the name *Xenos smithii* for two male parasites of *Sphex ichneumoneus* L. from North America. Pierce (1909, p. 185) notes the specimens but apparently does not recognize the description. There can be no doubt of the validity of the name, however, for not only is the insect partly described, but also the name of the host, the essential part of many a more recent description of a strepsipterous parasite, is given. *Homilops bishoppi* Pierce (1909, p. 146), parasitic on *Sphex ichneumoneus* L. at Waco, Texas, is known only in the female sex, while *Xenos smithii* was described by von Heyden from two males only. It is therefore possible to consider the former the female of the latter, especially as it is a common practice to couple male and female strepsiptera simply by their infestation of a single species of host.

For loan of specimens I am very grateful to Mr. N. Banks of the Museum of Comparative Zoology, Mr. C. W. Johnson of the Boston Society of Natural History, Mr. Chas. Robertson of Carlinville, Illinois, Prof. W. M. Wheeler and Prof. C. T. Brues of the Bussey Institution, Harvard University, and Prof. Joseph Bequaert of the Harvard Medical School. My thanks are due to the various authorities to whom the host determinations are individually credited. To Dr. Joseph Bequaert I am especially grateful, not only for determination of the Vespidæ and for the gift of specimens, but also for generously allowing me to search for stylopized individuals in his large and valuable collection.

References.


1918, Further notes on *Stylops* and stylopized bees. *Ent. Mon. Mag.*, 54, 115-129.

