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# TABLE OF CONTENTS

A Pictorial Key and Annotated List of Michigan Pseudoscorpions (Arachnida: Pseudoscorpionida)
Gary V. Manley ........................................ 2

United States Records of Williamsonia fletcheri (Odonata: Corduliidae)
G.H. & A.F. Beatty ................................. 13

Shoreline Aggregation Behavior of Adults of a Midge, *Chironomus* sp. (Diptera: Chironomidae) at Solberg Lake, Wisconsin
Louis F. Wilson ........................................ 14

An Emergence Trap for Aquatic Insects
Arnold E. Lemke and Vincent R. Mattson .......... 19

Odonata New to the Wisconsin State List
Mary Davis Ries ...................................... 22

A New Species of *Xiphosomella* (Hymenoptera: Ichneumonidae)
Keith R. Johnson .................................... 27

The Tarantula *Atypus milberti* in Michigan (Araneae: Atypidae)
David E. Bixler ...................................... 29

A Study of Spiders on Maple Trees
George W. Uetz and Dean G. Dillery ............... 31

Three New Species and a Key for the Genus *Callidora* (Hymenoptera: Ichneumonidae)
Timothy C. Tigner .................................. 36

The Capability of Some Butterflies as Carriers of Common Milkweed Pollen
Louis F. Wilson ...................................... 40

Reviews of Recent Literature .......................... 42

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**COVER PHOTO**

A robber fly, probably *Diogmites miscitus* Loew, at rest. Photograph by Richard W. Holzman, Detroit, Michigan.

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INTRODUCTION

Berlese or Tullgren funnel methods of extraction of forest litter fauna often produce minute arthropods called pseudoscorpions. These are relatively common but have received little attention. Because of the author's involvement with the Michigan State University soil zoology research project the potential significance of these animals has become a matter of interest. The Pictorial Key (Figs. 1 and 2) has been designed to assist in the identification of Michigan pseudoscorpions, and will be a useful starting point for further study of our species. Because pseudoscorpions are predaceous on many soil arthropods (Hoff, 1949), they are important in soil arthropod population dynamics, food chain and humification-fertility studies, and pesticide residue detoxication.

During this study, collecting was limited mostly to forest situations. Samples were taken from 40 counties throughout Michigan, during four major time periods. During the summer of 1963, a substantial amount of material was collected from Alpena County. In March 1966, forest litter was collected from 20 counties. In the summer of 1966, specimens were collected from Grand Traverse County and surrounding areas. In the spring of 1968, collections were made throughout the northern Lower and Upper Peninsulas.

Litter material was taken at random from a wide variety of forest habitats. When a suitable habitat was observed, the ground litter was scraped off at the soil level, and placed in plastic bags. These samples were transported to the laboratory and stored in a cool place until they could be extracted with Berlese funnels.

Before being treated, the material was allowed to warm at room temperature for two or three hours. The litter was then placed in the funnels under a 100 watt bulb until completely desiccated. As the amount of moisture varied in each sample, drying time differed considerably.

Specimens taken during March 1966 were extracted into ethylene glycol. All other specimens were extracted into 70 per cent ethyl alcohol. Specimens were cleared in lacto-phenol for at least 24 hours and placed in 70 per cent ethyl alcohol for storage until identifications could be made. Most of the specimens were examined in alcohol. Specimens which could not be determined in this manner were mounted on microscope slides in diaphane, as described by Hoff (1949).

*This study was supported by Public Health Service Research Grant CO0246 from the National Communicable Disease Center, Atlanta, Georgia and by the Michigan Agricultural Experiment Station No. 4446. The cooperation of the Entomology Research Division, U. S. D. A. is gratefully appreciated.
Fig. 1. Pictorial key to the pseudoscorpions of Michigan

**A**  
Leg one and two with five segments, leg three and four with six segments beyond the coxa.  
CHTHONIIDAE  
*CHTHONIUS TETRACHE LATUS*

---

**B**  
Each leg with five segments, tarsus not divided.  
Carapace with prominent eyes.  
*PSEUDOGARYPUS NESTORUS*

---

Accessory teeth present on chelal fingers.  
*CHERNETIDAE*

---

**C**  
Each leg with six segments, coxae not counted.  
Tactile setae of two to two and one-half socket diameters from tactile seta of  
*MICROBISIUM CONFUSUM*

---

Accessory teeth absent on chelal fingers.  
*CHEULIFERIDAE*

---

**Setae present only on margins of posterior dorsal sclerites of the abdomen.**  
**Tibia and tarsus of leg four subequal in length; ceased without spurs in males.**  
*IDIOCHEULIFER NIGRILAPUS*

---

**Setae on palps long and acuminate.**  
*LAMPROCHERNITINAE*

---

Chela hand subquadrate in shape.  
*LAMPROCHERNES OB- LUNGUS*

---

Chela hand subovate in shape.  
*LAMPROCHERNES MINOR*

---

Tactile setae of fixed finger on same level as est, or proximal of it.  
*PSEUDOGARYPUS PAVRUS*

---

**Setae on palps short and acuminate.**  
*ACUMINOCHERNES sp.*

---

**Pseudoscorpion shaped as above.**  
*ACUMINOCHERNES sp.*

---

**Tarsal claws not split.**  
*DACTYLOCHEULIFER COSPIOSUS*

---

**Tarsal claws split distally or at least with an accessory tooth, particularly on legs one and two.**  
*CHEULIFER CANCROIDES*
RESULTS AND DISCUSSION

Fenstermacher (1959) conducted the first survey of Michigan pseudoscorpions. The present study revealed several genera and species previously unrecorded in Michigan, as well as many new distributional records and ecological associations.

Prior to these studies, only one record of Idiochelifer nigripalpus (Ewing) was known for the state. Pselaphocernes parcus Hoff and Dactylochelifer copiosus Hoff, previously recorded only from the southern part of the state, are now known to exist in the northern part of the lower peninsula. For Microbisium brunneum (Hagen), the most northern previous record was Midland County. This species has now been collected in Grand Traverse, Alpena, and Montmorency Counties in northern lower Michigan. Lamprochernes minor Hoff had never been reported from farther north than Midland County, but was taken in Alpena County in these collections.

Microbisium confusum Hoff is distributed throughout the state and is probably present in all counties. This species appears to have a wide habitat tolerance and is found in many types of litter. The species was by far the most common pseudoscorpion in most of our Berlese samples and is commonly found in samples which contain microorganisms. In some cases the species may outnumber any other arthropod in the sample.

This study added considerable ecological information to our knowledge of pseudoscorpions. New habitats were recorded for some species, such as Lamprochernes oblongus (Say). Except for a specimen found under the elytra of a beetle (Fenstermacher 1959), Michigan ecological data had been lacking.
for this species. *Lamprochernes minor* Hoff, previously known only from grain bin situations, was collected from a forest habitat. *Idiochelifer nigripalpus* was found under bark and in the rotten wood of an old barn. It would thus appear that pseudoscorpions inhabit a wide variety of ecological situations. Many types of habitats yielded species of pseudoscorpions. In forests, pseudoscorpions were collected from both litter and soil, as well as rotting logs, hollow trees, and stumps. In litter samples from the forest floor, more than one species was often collected per sample.
AN ANNOTATED LIST OF MICHIGAN PSEUDOSCORPIONS

Chthonius tetrachelatus (Preyssler) (Fig. 3). Lower Peninsula (LP): April 24-August 16. This is the only species of the Order Heterosphyonida so far collected from Michigan. The species can be distinguished from others in the state by having a divided tarsus on the fourth leg and the first leg. This species has a very characteristic appearance with a long thin chela and large prominent chelicera. Its movements are faster than those of other pseudoscorpions I have observed.

*C. tetrachelatus* has been collected from Berlese extractions of forest litter, liverworts growing on sandstone outcroppings, and from under debris in an old barn. I have cultured this species on a diet of live Collembola.

Microbisium confusum Hoff (Fig. 4). Upper Peninsula (LP): Aug. 2-Sept. 4. LP: all year.

Since *Microbisium* is the only member of the suborder Diplosphyronida known from Michigan it can easily be distinguished from other genera. It is the only known genus in the state which lacks a "galea." *M. confusum* is separated from the closely related *M. brunneum* (Hagen) by the positioning of tactile setae on the chela fingers (Fig. 1). The femur length of *confusum* is between 2.42 and 2.89 times the width and under 0.4mm in length.

*M. confusum* is collected from very diverse habitats and has been taken from very dry situations, such as open fields of *Carex pensylvanica*, as well as forests, swamps, and flood plain conditions. It is by far the most abundant pseudoscorpion in litter collections. *M. confusum* is distributed throughout the midwestern and eastern United States (Fenstermacher, 1949).

Microbisium brunneum (Hagen) (Fig. 5). LP: March-August.

This species can be separated from *M. confusum* by the placement of the tactile setae (Fig. 1). It is the larger of the two species, with the palpal femur more than 0.4mm in length and between 2.87 to 3.2 times longer than wide.

The species is most commonly taken from sphagnum bogs. It appears to be associated with acid substrates. *M. brunneum* has been collected from
sphagnum bogs, from dense moss cover beneath jack pine in northern Michigan, and from under elm bark in a flooded area near Lansing. While the species appears to be more limited in habitat diversity than *M. confusum*, it is not uncommon to find the two species in the same sample.

**Pseudogarypus hesperus** Chamberlin (Fig. 6). UP: April-June. This species is in the Monosphyronida, Superfamily Feaelloidea, and differs from all others in the suborder by having four eyes. Previously known in Michigan from a unique female (Fenstermacher, 1949), this species has been collected in substantial numbers in widely separated areas of the Upper Peninsula. It has been collected from hollow trees, under bark, and in rotten logs in various parts of Keweenaw Co.

---

**Lamprochernes oblongus** (Say) (Fig. 7). LP: March 25-September 23.

The genus *Lamprochernes* is readily separated from other Michigan genera by accessory teeth and acuminate setae on the palps. Acuminate setae are the best spot characters for this genus. They are often denticulate near the distal end. With *L. oblongus*, and to a lesser degree *L. minor*, body form will help to separate the species. The abdomen generally is elongate and appears somewhat truncate. *L. oblongus* can be separated from *L. minor* by the shape of the chela hand (Fig. 1).

All the examined *L. oblongus* were single collections taken from under bark of dead logs and stumps. The species has been taken from and around grain bins (Fenstermacher, 1949). One *oblongus* specimen was found on June 9, 1967 in a silken cocoon under the bark of a hickory stump. When collected, the specimen had a definite blue cast. In approximately five days the exoskeleton had hardened, and the specimen assumed a typical reddish-brown color. This species is widely distributed, covering most of the eastern United States.

**Lamprochernes minor** Hoff (Fig. 8). LP: August 8-October 24.

This species is much like *L. oblongus* in having long acuminate setae on the palps. The two can readily be separated by the shape of the chela hand, which
is subovate in *L. minor* (Fig. 1) and subquadrate in *L. oblongus*.

Collections of this species were hitherto confined to grain bins and other situations near grain. In Alpena County several specimens were collected from under boards lying on a sawdust pile.

**Pselaphochernes parvus** Hoff (Fig. 9). LP: May 11-September 8.

This species is separated from others by the placement of tactile setae on the fixed finger of the chela (Fig. 1). *P. parvus* is of a median size. It is most commonly collected from rotten wood and forest litter. I took one specimen from a mouse nest.

**Dendrochernes morosus** (Banks) (Fig. 10). UP: March 11.

The species is characterized by having venom apparatus only in the movable chelal finger. Pleural membrane either rugose or granulate, and movable chelal finger with the subterminal tactile seta nearer the subbasal
than the terminal.

Previously known only from Isle Royale, several specimens were taken in 1969 from under the bark of a dead spruce on the mainland of Keweenaw Co.

**Chelifer cancroides** (L.) (Fig. 11). (The Domestic Pseudoscorpion) LP: all year.

The most important characters for identification are the lack of accessory teeth, large dorsal plates with setae in the middle, plus peripheral setae and the characteristic split tarsal claw on the fourth leg (Fig. 1).

This species has a world-wide distribution, and is commonly collected in houses and such other buildings as barns and abandoned structures. *C. cancroides* is large and active. It is aggressive, and will attack and feed readily when hungry.

**Dactylochelifer copiosus** Hoff (Fig. 12). UP: March 22-October 14.

Superficially *D. copiosus* looks much like other species in the Cheliferinae. Like *C. cancroides*, the dorsal abdominal plates contain setae in their centers, but the species lacks the split tarsal claw.

*D. copiosus* is associated with forest situations where relative humidity is fairly low; apparently it can withstand extreme periods of drought. Specimens taken from Oscoda County were extracted from extremely dry "reindeer moss" in a cut-over jack-pine area.

**Idiochelifer nigripalpus** (Ewing) (Fig. 13). LP: all year.

The male of this species is readily identified by the large coxal spine present on the fourth coxa. The relation of the length of the tibia to the tarsus will help to separate the females of the species (Fig. 1).

Only one record previously existed from the state, and no ecological information is available on that specimen. Hoff (1949) reported collections in Illinois from under bark, and my data support his information in Michigan.

**Paisochelifer callus** (Hoff) (Fig. 14). LP: October 24.

This species can be separated from other Cheliferidae, as it has dorsal abdo-
men plates with only peripheral setae and the male is without a coxal spine. Also, the tibia and tarsus of the fourth leg are subequal in length, opposed to *Idiochelifer* in which the tibia of leg four is 1-1/4 times as long as the tarsus corresponding.

The one specimen collected in Michigan was taken in a grain bin (Fenstermacher, 1959).

*Acuminochernes* sp. (Fig. 15), LP: April 25.

The genus can be separated from others in the subfamily Chernatinae by the tactile setae on the chelicerae. In particular, seta "b" and "sb" are both acuminate on the chelicera. Setae on the palps are for the most part clavate and denticulate. Dorsal abdominal setae are strongly clubbed and toothed.

*Acuminochernes* has not been previously collected in Michigan. Several specimens were taken by Berlese extraction of a rodent nest located inside
a large, hollow red maple (Acer rubrum) log. The log was filled with leaves and other debris. Both nymphs and adults were removed from the sample, collected in T4N, R1E, Sec. 4, Ingham County.

Dinocheirus pallidus (Banks) (Fig. 16). LP: all year.

This species is previously unrecorded from the state. It can be separated from Acumincherines by seta "b" being acuminate and setae "sb" denticulate on the chelicera, and from other known Michigan species of Dinocheirus by the shape of palp femur (Fig. 1).

All Michigan specimens have come from similar habitats. The first collection came from the dry, dead, insect-chewed wood found in the center of a hollow ironwood tree. Some specimens were collected by hand, and the rest were extracted with a Berlese funnel.

Dinocheirus sp. LP: all year.

This species differs from D. pallidus by the shape of the palp femur.

Specimens of this species were collected from straw under a collapsed barn.

**SYSTEMATIC LIST**

Order: Pseudoscorpiona
suborder: Heterosphyronida
family: Chthoniidae

   genus: Chthonius
   species: tetrachelatus

suborder: Diplosphyronida
superfamily: Neobisioidea
family: Neobisiidae
subfamily: Neobisiinae

   genus: Microbisium
   species: confusum
   brunneum
suborder: Monosphyronida  
superfamily: Feaelloidea  
family: Pseudogarypidae  
genus: *Pseudogarypus*  
   species: *hesperus*  

superfamily: Cheliferoidea  
family: Chernetidae  
   subfamily: Chernetinae  
genus: *Dendrochernes*  
   species: *morosus*  
genus: *Pselaphochernes*  
   species: *parvus*  
genus: *Acuminochernes*  
genus: *Dinocheirius*  
   species: *pallidus*  
subfamily: Lamprochernesinae  
genus: *Lamprochernes*  
   species: *oblongus*  
   minor  

family: Cheliferidae  
   subfamily: Cheliferinae  
genus: *Chelifer*  
   species: *cancroides*  
genus: *Dactylochelifer*  
   species: *copiosus*  
genus: *Paisochelifer*  
   species: *callus*  
genus: *Idiochelifer*  
   species: *nigripalpus*  

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Thanks go also to those who have contributed specimens: Dr. Roland Fischer, Curator of Insects, Michigan State University; W. L. Manley, R. S. Snider, G. Klee, N. Barker, D. Siler, and to J. P. Donahue for specimens and advice in preparation of the pictorial key.

LITERATURE CITED


UNITED STATES RECORDS OF WILLIAMSONIA FLETCHERI (ODONATA: CORDULIIDAE)

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State College, Pennsylvania 16801

Foley (1966) reported specimens of Williamsonia fletcheri Williamson from Grand Traverse County, Michigan as the first record of the species from the lower peninsula and "the second for the United States." However, two other records for the United States were overlooked and this was actually the fourth.

An earlier paper summarizing records of the two species of Williamsonia (Montgomery, 1943) includes, besides the original Michigan record (Gloyd, 1932), a record of fletcheri from Mount Desert Island, Maine, and citation of a previously published record (Davis, 1940) from Harvard, Massachusetts wherein fletcheri was misidentified as Williamsonia lintneri Hagen. Thus three United States occurrences of W. fletcheri stood recorded in literature before Foley's of 1966. In the manual of North American dragonflies (Needham & Westfall, 1955) Maine and Michigan are cited as comprising the known United States distribution of W. fletcheri, but although Montgomery's definitive paper of 1943 is cited under both species of Williamsonia, Davis' Massachusetts record remains under W. lintneri in spite of Montgomery's correction.

Material in the collection of G. H & A. F. Beatty provides a fifth United States record, hitherto unpublished, of the occurrence of Williamsonia fletcheri. This is a female specimen of fletcheri collected by John Gillespie at Chenango Valley State Park, Broome County, New York, on 1 June, 1947. Thus both species of Williamsonia are now known to occur in New York as well as in Massachusetts, only fletcheri in Maine and Michigan, and only lintneri in New Jersey and Rhode Island.

LITERATURE CITED


SHORELINE AGGREGATION BEHAVIOR OF ADULTS OF A MIDGE, CHIRONOMUS SP. (DIPTERA: CHIRONOMIDAE) AT SOLBERG LAKE, WISCONSIN

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INTRODUCTION

Adult chironomid midges are well known to visitors at northern Wisconsin lakes during the spring and summer. Although the larval stages of chironomids supplement the diet of fish, the adults are often a nuisance because they aggregate in huge aerial swarms near beaches, collect at lights, alight on various objects including people, and deposit green specks wherever they rest. The most familiar midge in Wisconsin is *Chironomus plumosus* (L.) which has been studied at Lake Pepin (Johnson and Munger, 1930) and at Lake Winnebago (Burrill, 1913; Hilsenhoff, 1959, 1966, 1967).

In the summers of 1964 and 1965, adult midges were very abundant at Solberg Lake in Wisconsin. There they caused bathers and property owners considerable concern because of their habit of aggregating on the beaches at the water's edge in the evening. Aerial swarming habits of midges are well documented (e.g., Burrill, 1913; Johnson and Munger, 1930), but their aggregating habits on beaches are not. This paper reports the behavior and abundance of this midge on a beach at Solberg Lake.

The midge studied was not positively identified. Several taxonomists placed this midge near *C. plumosus* or *C. staegeri*. According to Sublette (personal communication) it differs from typical *staegeri* in having a higher wing length, a lower leg ratio, a generally paler color, and a shorter tarsal beard; and the genitalia differ in that the dististyles are more clavate and the superior appendage has the apex slightly recurved. Hilsenhoff (personal communication) suggested the midges were not typical *plumosus* either, because *plumosus* is not known to emerge in great numbers in July, the time of the study.

LOCATION AND METHODS

Solberg Lake is a large flowage located 4 miles northwest of Phillips, Wisconsin. Hazel brush, aquatic emergents, and other plants line the shore of most of the lake. About 5 per cent of the shoreline, however, is interrupted by narrow sandy beaches. The study area, which was one of these beaches on the east side of the lake, measured 120 ft. long and varied from 1.5-2.5 ft. wide. Large logs occupied both extremities of the beach.

Ten quadrats (each 1 square foot) placed at regular intervals along the shore were used to count midges when populations were low. Water glasses (10 oz.) placed over midges at various intervals along the length and width of the shore.
were used to count high population levels. The insects trapped in the glasses were usually placed in alcohol and counted later. Counts or collections were made at intervals of a few minutes to an hour. Time is reported in central daylight time.

Most observations and records were taken between 14-18 July 1964. Residents of the lake area that year reported they had noticed midge activity at least one week earlier. Additional notes were taken between 11-16 July 1965 and 8-11 July 1968.

Two shallow V-shaped trenches (2 in. x 12 in.) and 4 conical pits (3-4 in. dia.) were dug in the sandy beach to see if the distribution of midges could be modified. The trenches which were dug to water level were perpendicular to and extended from the water's edge; pits were dug to water level about 8 in. back from the water's edge.

MIDGE BEHAVIOR AND ABUNDANCE

Adult midge behavior was similar each day of the study, but population build-up along the beach was curtailed by strong wind, cool weather, and/or rain on three occasions. Typical behavior for 15-16 July 1964 follows.

In the morning after 1030 hrs. (CDT) and throughout the rest of the day nearly all midges were resting on the undersurface of foliage in the woods near the lake. The highest numbers were on hazel brush and other low-growing plants adjacent to the beach. The number diminished away from the lake, and except for an occasional specimen in a spider web, few were beyond 70 yards from the water's edge.

Midges were rarely seen in the air until 1800 hrs. when a few were noticed over the water. More appeared after that and a few alighted on the moist sand close to the water's edge at 1830 hrs. Midge slowly streamed out of the woods until the sun passed behind the horizon across the lake at 2040 hrs. when the sky became "full" of midges. Burrill (1913) and Johnson and Munger (1930) reported that aerial swarming of the closely related C. plemosus also occurred at dusk in Wisconsin. A few midges alighted on the shore during this swarming period, but then at 2115 hrs. hoards of them suddenly descended and settled on the sand (Fig. 1) and the logs at the ends of the beach (Fig. 2). Midge continued to settle until 2350 hrs. when the population on the shore reached maximum (Fig. 3). Numbers decreased after that but mostly from mortality of those at the water's edge.

The number of midges began to diminish about 0500 hrs. (Fig. 3) when the morning sun brightened the sky. A few midges left the beach at first, then many flew just before 0600 hrs. when the sun shone directly on the beach. Those in the shade under a pier at this time remained on the sand 10-15 minutes longer. By 1030 hrs. midges were difficult to find on the beach. Except for an occasional straggler the only ones on the shore were dead and piled up in the littoral drift line.

Behavior on the beach varied by time and location. The first midges arriving in the evening landed close to the water's edge. They moved slowly when walking and frequently stopped and put their heads down close to the moist sand. When the population increased, however, those nearest the water became crowded up to 7 deep at times. They were continually agitated and moved rapidly over each other apparently competing for moist locations. Waves lapping the shore intensified their movements and carried some of them onto the water which caused short flights or drowning. Midge toward the rear of the beach were less crowded, and also less agitated.
Fig. 1. Aggregation of adult midges on a sandy beach at Solberg Lake. Note the higher density along water's edge.

Fig. 2. Aggregation of adult midges at south end of beach. Note midges on water and regularly arranged ones on log.
Fig. 3. Mean number of adult midges per sample on the beach. Time is CDT. Arrow indicates sunset. Population drop after midnight (dashed line) is due mainly to midge mortality from drowning and other causes.

Apparently the 2-3 inch wide zone along the water's edge was optimum because the numbers were always highest there and diminished directly with the distance behind this zone. For example, the mean distribution of adults at 1000 hrs. (17 July 1964) from the water's edge to dry sand was as follows:

<table>
<thead>
<tr>
<th>Distance from water (in.)</th>
<th>0-3</th>
<th>3-6</th>
<th>6-9</th>
<th>9-12</th>
<th>12-15</th>
<th>15-18</th>
<th>18-21</th>
<th>21-24</th>
<th>24-27</th>
<th>27-30</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean no. midges/9 in.²</td>
<td>119</td>
<td>60</td>
<td>24</td>
<td>17</td>
<td>9</td>
<td>6</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>0</td>
</tr>
</tbody>
</table>

This diminishing density pattern is also evident in Fig. 1.

On warm windless nights midges were abundant all along the beach but particularly abundant at the south end. There they piled up in the corner between the sand and a large log (Fig. 2). On the best-flight night (15 June 1964) near the south end, there averaged over 2,100 midges/square foot in the optimal 0-3 in. zone at the peak of aggregating. Inactive insects took advantage of vertical surfaces, like the log in Fig. 2, and positioned themselves geonegatively and at regular intervals from each other.

Trenches and pits dug in the sand caused the insects to modify their distribution. Within minutes after digging, midges began to congregate in the moist trenches and pits as if they were the regular part of the shoreline at the water's edge. Three pits averaged 147 insects at 1130 hrs. on 15 June 1964 and contained...
up to 6 deep in the center. Similar numbers lined comparable areas of the trenches.

About one-fourth of the midges remained airborne each warm night but there was a continual exchange of places between those on the ground and those in the air. Their buzzing sound was heard all night but reached maximum loudness around 2130 hrs. On the heavy-flight nights the sound could be heard 40-45 feet back from the shore. Johnson and Munger (1930) and Burrill (1913) reported a buzzing (humming) sound for \textit{C. plumosus} and noted it decreased after midnight.

NOTES ON ADULT PREDATION

Crayfish (\textit{Cambarus} spp.) were the commonest predators of this midge along the shoreline. Midges on the water were grasped and pulled under. Occasionally a crayfish would crawl half way out of the water, grab a midge, and retreat again. One evening there were 102 crayfish along the 120 ft. long beach at 2215 hrs., and 165 or more than 1 per foot of shoreline at 2300 hrs.

In addition, frogs (\textit{Rana} sp.) and toads (\textit{Bufo} sp.) fed on the midges nightly between 2200 and 2400 hrs. Small fish occasionally broke the surface and consumed the midges. At least one species of ground beetle (Carabidae) also fed upon the midges at night.

During the day, robber flies (Asilidae), ground beetles (Carabidae), ants (Formicidae), and a few other species of insects fed on the dead and dying insects littering the beach. Midges were common in spider webs, especially in those spun near lights.

DISCUSSION

Adults of \textit{Chironomus} sp. exhibit diel periodicity behavior (regular day to day recurrence of activities) which is extrinsic (dependent on external environmental stimuli; Odum, 1953). Apparently initial flight activities are set off by a drop in light intensity following sunset. Then the midges are attracted to the moist sand of the beach. High populations of midges on the small beach used in this study resulted in highly allelomimetic (contagious) behavior in a narrow band along the water’s edge. In the morning with the increase of light intensity the adults reverse the response by first vacating the beach, then shelter seeking, and finally inactivity. This cycle is repeated daily during the adult flight period, but the evening phase of the cycle is curtailed or eliminated during cool, windy, and/or rainy weather.

The midges’ morning and evening reactions to sunlight probably is a simple negative photokinesis whereby activity ceases above a light intensity threshold and begins again below the same or different threshold. Their distribution pattern and activities on the sand at night appears to be a response to a moisture gradient. Syrjamaki (1960, 1963) reported that water content of chironomid adults is high at emergence but decreases with age. Studying \textit{Allochironomus crassiforceps} Kieff., he found that fresh-trapped specimens showed dry reactions, while netted specimens which were older than 1 day showed moist reactions in an alternate-humidity chamber. He also found an inverse correlation between water content of the insect’s body and the intensity of the humidity reaction. His studies on \textit{Cricotopus silvestris} Fabr. revealed that males showed dry reactions at the beginning of the swarming period but gave increasingly stronger moist reactions as the swarming period progressed and the males aged.

Perhaps the adults (both sexes and intersexes too) of \textit{Chironomus} sp. aggre-
gate on the beach at night to stabilize or decrease water loss. Most of the insects
were older than 1 day and probably lost considerable amounts of moisture
while resting in the woods during the day.

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AN EMERGENCE TRAP FOR AQUATIC INSECTS

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The identification of organisms is a prerequisite to developing water quality
criteria for aquatic life. Identification is necessary because differences in
water quality requirements are specific and may be different for closely
allied species. The taxonomy of various species, particularly those associated
with the aquatic environment, is much more detailed and better known for
adults than for immature instars. To facilitate correlation of adult and larval
forms, a trap was needed to collect the emerging adults from the various
streams.

Traps and collecting devices reported in the literature usually lacked one
of the following factors and in some cases were deficient in several of them.
Corbet (1965) describes a trap which he used in a pond. He states that the trap
was affected by wave action and therefore was not suitable. Mundie (1956)
describes three types of traps used in sampling three types of collection sites.
His stream trap is a small gauze-covered frame which would not withstand
stream fluctuations. Ide (1940) and Sprules (1947) report using a net of wire window screen stretched over a light wood frame. This was also very fragile and was dislodged by a rise in water level of about six inches. It was of such dimensions that the individual collecting the emerged adults had to kneel or squat to work in the trap.

The trap described here is designed to eliminate these undesirable features.

![Figure 1. General plan of the emergence trap.](image)

The streams in northern Minnesota have a steep gradient and are subject to rapid fluctuations in flow and depth; a change of two feet in an hour is quite common after a heavy summer shower. Requirements of the trap include: ease of collection of the adults, transportability, an adequate size to cover a bottom area large enough to encompass a variety of microhabitats, and ruggedness to cope with the rapidly changing stream levels. Preliminary work indicated that a square trap was distorted by water pressure and the screen was torn by floating debris.

The design (Figure 1) which was finally developed, consists of a triangular wood frame fastened together with nails and covered with Fiberglas window screen for retaining insects. The long sides were eight feet, the base of the triangle which contained the door was six feet across and the height was six feet. The upstream anchoring member of the triangle was a 2" x 4" of a good quality wood. All other members were 1" x 2" pine and the door was of 1" x 3" pine. Ordinary brass or Fiberglas screen and kitchen cabinet hardware were used. To minimize tearing of the trap by floating debris, 2' x 8' sheets of 1/2" exterior grade plywood were applied to the outside bottom of the upstream sides of the trap. Trap corners were braced as shown in Figure 2. The bottom of the trap was left open; the top was covered with Fiberglas screening. The screen used was 16 by 18 mesh and retained most insects except the smallest midges.

The door was hinged from the top to swing upward. This kept the hinges out of the water and allowed the door to close by its own weight. This was useful when both hands were burdened.
The trap was anchored by a length of line running from an eyebolt through the 2 x 4 to a suitable anchor such as a large rock or strong tree upstream of the trap. It was found that if the anchor point was on the inside of a curve in the stream the trap would swing out of the main channel under high water conditions without damage. The trap was easily repositioned when water conditions returned to normal. Five of the traps were constructed and four were still usable after a full summer of use. One trap was demolished when a miscalculation in anchoring allowed it to smash against a bridge abutment under high water conditions.

The approximately 175 pound traps were constructed at the laboratory and transported to sampling sites on a flatbed trailer. One of the traps was hauled for 50 miles over rough roads with no difficulty. Trapping success was very good; as many as 1,000 individuals were collected within 48 hours. We are of the opinion that the trap would also be excellent for quantitative work if collections were made at more frequent intervals. One trap was moved periodically to bottom types that had various numbers of aquatic insects; the number of emerging adults correlated with the abundance of larval forms. Most common types of aquatic insects were collected with the exception of some, such as Neuroptera, which pupate in the bank soil and do not emerge directly from the water.

LITERATURE CITED
ODONATA NEW TO THE WISCONSIN STATE LIST

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The only extensive paper dealing primarily with the Odonata of Wisconsin is that of Muttkowski (1908), in which he included not only 78 species taken but 30 to be expected in the state. Subsequent records and corrections leave a total of 103 species for which definite evidence has been published (Ries, 1967:113).

The following account of new records of Anisoptera and Zygoptera taken during five seasons of collecting in the northern part of Wisconsin confirms the presence of four of the expected species mentioned by Muttkowski, and includes eleven others, making a total of 15 additions to the state list. As 12 of these species also occur in the Upper Peninsula of Michigan (Hebard, 1910; Combs, 1917; Byers, 1927; and Kormondy, 1958) few of the records are surprising. Rather, they are the result of the first intensive collecting in the area. Most of them extend the known range of the species concerned, some to a considerable degree. Unless otherwise specified, all these new records are from near Sayner in Vilas County, an area in which I have collected 73 species.

In addition to specimens listed below, several males of most of the species were sent to Dr. Robert W. Cruden, now at the University of Iowa, Iowa City, for chromosome counts (Cruden, 1968); these remain in his possession.

NEW RECORDS FOR THE STATE
Species marked with an asterisk (*) were predicted by Muttkowski.

1. **Cordulegaster maculata** Selys. Eighteen males have been taken on Plum Creek from about June 9, when individuals were already mature, through July 23, and numerous others have been seen each year. Unlike Combs, who found *Cordulegaster maculata* "only patrolling roadways thru the forest", I have so far found it only patrolling long stretches of the stream itself.

2. **Ophiogomphus aspersus** Morse. I am indebted to Dr. Paul D. Harwood of Ashland, Ohio, for one male of this species captured by him at Siren, Burnett Co., Wisconsin on June 12, 1952. He reports that this specimen was "taken on the main street of the village much to the amusement of the natives." This specimen has been returned to Dr. Harwood to remain in his collection.

3. **Stylurus scudderii** (Selys). This species was collected during August 1963 and August 1965 on Plum Creek, an excellent trout stream about 4½ miles long. Seven mature males are in my collection and a number of others were seen although they never seemed numerous.

*4. **Cordulia shuttleffi** Scudder was not included in any of Muttkowski's work on the dragonflies of Wisconsin other than the statement (1908:103): "The species may be expected in Wisconsin, since it is found in Transitional regions." The expeditions to northern Wisconsin conducted by the Milwaukee Public Museum in 1905 and 1907, which resulted in most of Muttkowski's northern records, apparently failed to find this species although they were well within its season of greatest abundance. In the vicinity of Sayner it usually seems to
be everywhere, around lakes, streams, bogs, and roadways; so common in fact that I cannot understand how it has escaped previous notice. In most years it is one of the most widespread and easily caught of the Anisoptera of the area. Forty-four males and fifteen females have been collected from June 3 through July 19 and one mating pair on June 19. Many more have been netted but released.

5. *Somatochlora forcipata* (Scudder). Judged by the few specimens in collections this species is rare as far west as northern Michigan. The distribution map in Walker’s excellent monograph on the genus (1925:140) barely indicated any expectation that the species might be found on the extreme northern edge of Wisconsin.

There is in my collection a male, badly damaged and slightly teneral but readily recognized as *S. forcipata* by its abdominal appendages. The specimen was taken on June 19, 1964 along Razorback Road near the Forest Genetics Station lane. This record is about a hundred miles west of the most northwestern one reported by Kormondy (1958:26), for Dickinson and Marquette Counties of the Upper Peninsula of Michigan.

6. *Somatochlora kennedyi* Walker. So far in my collecting, Somatochloras as a group have seemed very scarce. A female of *kennedyi* was taken on July 12, 1965 at Harer’s Landing near the south end of Razorback Lake. Walker’s map (1925:132) indicated the probable occurrence of this species in Wisconsin.

7. *Somatochlora wallshii* (Scudder). The occurrence of this species in Wisconsin was clearly forecast on the distribution map in Walker’s monograph (1925:32). One male was collected on July 12, 1962 at Aurora Creek where it crosses under Razorback Road.

8. *Leucorrhinia frigida* Hagen was included in the key in Muttkowski’s paper on the dragonflies of Wisconsin (1908:112) but was not listed otherwise. Recently its occurrence in Minnesota has been reported (Hamrum, Carlson, and Glass, 1965:25).

In northern Wisconsin this is the commonest species of *Leucorrhinia* during the early part of the season, starting as early as June 6 and still to be found as late as August 19 at almost any bog or swampy lake. Between these dates seventy-five males and eighteen females have been collected. Many more have been netted and released. Twenty-seven mating pairs were caught between June 7 and August 14. In addition one male was found in a small sun-dew plant where apparently it had been caught and held until death.

*9. Leucorrhinia proxima* Calvert. Perhaps some of the early Wisconsin records of *Leucorrhinia*, ascribed originally to other species by sight or from nymphal material, may on re-examination turn out to be this species or perhaps *frigida*. Muttkowski stated (1908:113) only that it is “quite probable that it occurs within the borders of the state.” *L. proxima* has also recently been recorded from Minnesota (Hamrum, Carlson, and Glass 1965:25).

This species is common from June 10 until August 16 at such locations as Stella Creek, Aurora Lake and Creek, Lone Tree Swamp, Bear Springs, and “Texakeck Bog,” occurring in greater numbers where conditions are muddier and more swampy than a typical sphagnum bog. In the latter locale *L. glacialis* tends to be more numerous though the two species often fly together and are indistinguishable on the wing. Twenty-six males and six pairs have been collected, the latter between June 22 and August 10.
10. *Nannothemis bella* (Uhler). One or two individuals of this species have been collected at nearly every bog lake visited frequently but it is usually common only at a small unnamed bog and lake on the east side of Old White Birch Road, located in the Town of Plum Lake-East, or Sec. 8 T 41 N Range 9 E on the Boulder Junction quadrangle of the U.S. Geological Survey. The bog is listed as No. 8-3 in the "Surface Water Resources of Vilas County" (Black, Andrews, and Threinen 1963:292) but for convenience I refer to this interesting spot as "Nannothemis Bog" because of the predominant species found there.

*Nannothemis* has been seen as early as June 13, when females were teneral, and as late as August 3. Collected specimens number twenty-five males, nine females, and four pairs. Many more individuals were observed.

It is probably not surprising that *Nannothemis bella* so often escapes detection that it is seldom reported. In my experience adults have always been found close to the shrubs and other vegetation at the wettest and most quivering edge of the bog lake where few people venture, never near dry land.

This record is a little south and west of the one for Baraga Co., Michigan (Kormondy 1958:37).

*11. Lestes congener* Hagen. This species was one of two *Lestes* included by Muttkowski in his key (1909:69) with the statement "two others may also be found in Wisconsin, but they have not been recorded thus far." Distribution of the species has usually been so generally stated that its presence in Wisconsin might be inferred but so far as I can ascertain specimens have still not been actually reported. In Vilas County it is widely distributed late in the season from about August 8, when pairs were already mating, until September 1 when mating was still common, and perhaps even later if there are no heavy frosts. In my collection are twenty-seven males, four females, and fifteen pairs from Aurora Lake and the small bog west of Frank Lake Road as well as various other small swampy pools.

12. *Anomalagrion hastatum* (Say) has never been reported from either Michigan or Wisconsin. Yet on August 30, 1962 a teneral male was taken at the small bog on the west side of Frank Lake Road. Intensive search then and since has failed to produce further specimens. The bog is small and entirely surrounded by forest; the specimen was so soft that it is inconceivable that it could have been carried there from any great distance by the wind.

This tropical and subtropical species has been reported from northern Illinois by Needham and Heywood (1929:358), and in Iowa from Fairport by Wilson (1920:235), as far west as Des Moines by Elrod (1908:8), and as far north as Waterloo by Miller (1906:360). Finding it in Vilas County is not only a northern extension of the western part of its range, but of its entire range as it is farther north than any definite record for Maine (Borror 1944:140) or any records for Canada (Walker 1953:275).

13. *Coenagrion interrogation* (Hagen). Walker (1953:181) summarized the range of this species as entirely Canadian except for the state of Maine. Kormondy (1958:18) added a record for Isle Royale but the species apparently has not been reported from the mainland portion of the Upper Peninsula of Michigan or from Wisconsin.

In 1962, 1965, and 1966 a number of individuals were collected in and near three sphagnum bogs in Vilas County: "Texakeck Bog" at the end of Camp
Highlands Road across the road from the camp entrance, “Nannothemis Bog” on Old White Birch Road, and from the floating mat beside the fishermen’s landing on Aurora Lake. A total of nine single males and two mating pairs were collected between June 7 and 25. The earliest specimen was netted on the far side of the wooded hillside surrounding “Texakeck Bog.” Later in the season specimens were always found deep among the leatherleaf, cranberry, and other bog plants at the edge of the water. One mating pair was caught by hand on June 13 and another by net on June 25. No single females were sighted or collected and individuals always seemed scarce.

Of the eleven male specimens, two have complete antehumeral stripes instead of the interrupted stripe more characteristic of *C. interrogatum*. Also from the same areas, males of *C. resolutum* (Hagen) were occasionally found with the antehumeral stripe interrupted instead of complete. However, both species are readily identified by other characters.

*14. *Enallagma aspersum* (Hagen) has not definitely been reported from the Upper Peninsula of Michigan nor from Wisconsin although Muttkowski (1908:75) included the species in his table of *Enallagma* “species that have been taken in Wisconsin or are likely to be found” and stated that it belongs in the Upper Austral Life Zone (1908:77). In his North American Catalogue (1910:55) he listed the distribution of *aspersum* as “Carolinian, N.Y. & N.C. to Mo. & Wisc.” Probably on the basis of this report Needham & Heywood (1929:339) listed the species from Wisconsin.

*Enallagma aspersum* is common in the Boreal Zone of northern Wisconsin during the latter half of the summer. It is numerous around sphagnum bog lakes but it is not restricted to these. I found it also around a number of shallow lakes with sandy bottoms and gently sloping, damp sand beaches such as Weber Lake, Vandercook Lake, and Little John Jr. The last is a particularly interesting locality. There *Enallagma aspersum*, when disturbed, arose from the grass in clouds thicker than I have ever observed with any damselfly anywhere. Flying with it were a few *Enallagma hageni* (Walsh). Forty-one males were collected between July 9 and August 31 and ten pairs between July 9 and August 14. Many more were seen.

The present record is the most northwestern one for the species, the nearest ones to it being Chicago, Illinois (Hagen 1861:97) and Fairport, Iowa (Wells 1917:330). It is within less than half a degree latitude of the northern record for the species, namely that of Robert (1953:318) in the Province of Quebec, Canada.

15. *Enallagma cyathigerum* (Charpentier). This circumboreal or holarctic species has been known from Michigan’s Lower Peninsula for many years but has apparently not yet been reported from the Upper Peninsula. It was not included by Muttkowski in his list of *Enallagma* species likely to be found in Wisconsin. Nevertheless, it is common around most bog lakes during the first half of the season. It decreases in numbers as *E. aspersum* appears and gradually disappears entirely. Disregarding single females my collection includes thirty-three males collected from June 10 to August 8 and fourteen mating pairs from June 15 to July 17.

ACKNOWLEDGMENTS

I wish to thank Dr. B. E. Montgomery for making available to me informa-
tion contained in his Williamson-Montgomery Index; Mrs. Leonora K. Gloyd for helpful suggestions and criticisms at various stages of this study and for confirming many of my identifications; Dr. Philip S. Corbet who searched Dr. E. M. Walker's notes and typescript for the future third volume of his monumental *Odonata of Canada and Alaska*, which he is completing for Dr. Walker, to reassure me that he had no Wisconsin records of *Leucorrhinia frigida*, *L. proxima*, and *Cordulia shurtleffi* that I might have overlooked; and Dr. Minter J. Westfall, Jr. who likewise checked his records of *Lestes congener*, *Enallagma aspersum*, and *E. cyathigerum*.

The material upon which this paper is based will be deposited in the collections of the Illinois Natural History Survey, the University of Michigan (Museum of Zoology), the U.S. National Museum, and the University of Wisconsin.

LITERATURE CITED


While the above paper was in press the Editor was informed of the death of Mrs. Marv Davis Ries on December 16, 1968.

A NEW SPECIES OF XIPHOSOMELLA
(HYMENOPTERA: ICHNEUMONIDAE)

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The genus Xiphosomella belongs in the subfamily Cremastinae. This genus and Pristomerus differ from other genera of the subfamily in having a distinct thyridium on the second tergite. In Xiphosomella the thyridium is some distance from the base of the second tergite, while in Pristomerus the thyridium is very close to the base. Both genera may or may not have a spine on the under side of the hind femur. Xiphosomella may have an areolet. Most species of Xiphosomella are Neotropic. One species (dubia) has been described from the United States. This paper adds a second species.

Unless otherwise stated, all specimens are in the Townes collection, Ann Arbor, Michigan.

KEY TO THE TWO NEARCTIC SPECIES OF XIPHOSOMELLA

1. Hind femur without a spine. Flagellum with 28 to 32 segments. Nervellus weakly inclivous to vertical . . . . . . . . X. setoni, new species

Hind femur with a spine on its distal, ventral surface. Flagellum with 33 to 36 segments. Nervellus strongly inclivous . . . X. dubia Brues

Xiphosomella setoni, new species

♂ and ♀: Body 4.5 to 6.1 mm. long; front wing 3.0 to 3.75 mm. long; flagellum possessing 28 to 32 segments; basal transverse carina of propodeum not obviously raised at middle to form a ridge; areola mat textured; distal, ventral surface of hind femur without a spine.

Coloration: The ground color of the entire insect is fulvous. Face, cheeks, clypeus, mandibles, and temples can be whitish yellow. First coxa and trochanters and second coxa and trochanters can be white. Vertex, post-occiput, median lobe of mesoscutum, scutellum, postscutellum, basal area of propodeum, dorsal edges of the first lateral areas, areola, and the petiolar area of propodeum often darkened to a dark brown. The dorsal surface and entire distal part of the petiole, the second tergite, and the basal one-half of the remain-
ing tergites can be dark brown. Hind femur, tibia, and tarsus can be variously darkened to brown.

Diagnosis: This species very closely resembles *Xiphosomella dubia* Brues in color pattern. *Xiphosomella setoni* differs from *X. dubia* by virtue of the latter possessing a spine on the distal, ventral surface of the hind femur; being larger in size (6.8 to 8.3 mm. long); flagellar segments ranging in number from 33 to 36; basal transverse carina of the propodeum being raised (forming a ridge); and the areola being transversely wrinkled.


This species occurs throughout the southeastern United States.

*Xiphosomella dubia* Brues


_X. dubia_ is found throughout the eastern United States and adjacent Canada.
THE TARANTULA ATYPUS MILBERTI IN MICHIGAN
(ARANEAE: ATYPIDAE)

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The arachnid genus Atypus (family Atypidae, suborder Mygalomorphae) contains four species in North America. These tarantulas are atypical because they have retained remnants of the primitive segmentation characteristic of Mesozoic spiders; the dorsum of the abdomen has tergites which differ little or not at all from those found on Oligocene spiders in the Florissant shales or in Baltic amber. The atypical tarantulas are among the most generalized of all living spiders, lacking the specialized morphological features of more advanced families. They lack reduction, migration, or enlargement of eyes; they have simple dry silk glands only; their legs lack specialization for running or silk handling; the carapace is unspecialized.

This genus seems to remain successful in interspecific competition, not because of morphological specialization, but due to behavioral uniqueness. The spider constructs a vertical tube web from an underground burrow up the trunk of a tree. The web acts as a shield, making the spider unrecognizable as a potential predator. The prey is attacked through the silk, pulled inside the tube, and sucked dry. Afterwards the carcass is thrown out and the tube is repaired.

Two species of Atypus are known to occur in temperate North America. A. milberti (Walckenaer) and A. niger Hentz have been recorded as far north as Ohio, Indiana and Illinois (Gertsch, 1936). These two species have been taken on three occasions in Wisconsin (Levi, 1954; Levi et al., 1958), but only Atypus milberti has been recorded from Michigan. Lowrie (1948) reports a specimen from a lakeside subclimax forest in Berrien County, and Chickering (1952) records a specimen sifted from leaves in the spring in Jackson County. In two separate studies, Drew (1957, 1967) made detailed collections of the spider fauna as related to mesic forests in a southern Michigan woodlot and on Beaver Island, without turning up Atypus. Despite intensive collecting by Drew, Chickering and others, only two Michigan records for this species are thus far known. This raises the question of whether the animal is an established rare species in Michigan, or whether the previous records are the result of dispersal without establishment of a population.

During the spring, summer, and fall of 1966 approximately 100 pitfall traps were placed in the major forest types of central Michigan at the Rose Lake Wildlife Experiment Station, Clinton County, by Thomas Hlavac and myself. The traps were plastic cottage cheese cartons, 4.5 in. diameter by 3 in. depth, filled with one-fourth inch of ethylene glycol. The traps remained in the field for the entire summer and were checked at roughly one week intervals.

For the period of 13-23 June 1966, three male Atypus milberti (Walckenaer) were recovered. The specimens were from three separate traps of six in an oak, hickory, elm, and ash association. The soil is sandy in this habitat but is still quite moist even in the driest parts of the summer and would thus appear to be a suitable substrate for burrowing spiders.

This species is not well adapted to a ground-running type of existence, as are
many of the true tarantulas. This is well illustrated by the experiment of Fitch (1963) where an *Atypus* was killed by a jumping spider (*Phidippus*) when the two were confined in a glass jar. The jumping spider is the lesser in size.

The majority of the records for males of *Atypus* are from a week in late spring when the males apparently leave their webs and wander in search of a mate. The remainder of the year is presumably spent in a tube web described above.

Fitch (1963) records *Atypus milberti* during late spring in Kansas from an upland oak-hickory association. Available records from other states give little or no ecological data. It would seem that this species has an affinity for dry upland forests, and that the movements of the males are extremely seasonal, apparently related to their search for mates. The lack of records for the species from mesic forests indicates an extremely narrow niche for the species.

The occurrence of three male specimens during a single collecting period would seem to indicate that *A. milberti* is an established species in southern Michigan. The animal is apparently restricted to the sandy soils in the oak-hickory association.

ACKNOWLEDGMENTS

I would like to thank the Department of Entomology, Michigan State University and Dr. Roland L. Fischer for support of this project.

LITERATURE CITED


A STUDY OF SPIDERS (ARANEAE) ON MAPLE TREES (ACER SPP.)

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We began this study to determine whether spider species occur randomly on maple species or whether they are selective in picking either their host species or their position on that host. Several papers have been published on habitat selection of spiders in relation to structural components or microclimate (Barnes, 1953; Barnes & Barnes, 1954, 1955; Cherrett, 1964; Duffey, 1962a, 1962b, 1966; Hackmann, 1957; Kuenzler, 1958; Norgaard, 1951). Duffey (1956) and Kuenzler (1958) also discussed the influence of microclimate on the activities of spiders. None of the above, however, dealt with arboreal spiders with the exception of Duffey (1956) who discussed aerial dispersal rather than habitat selection.

METHODS

The spiders were collected from maple trees in Albion, Michigan, in September through November, 1967. Six species of maples were sampled, sugar maple (Acer saccharum Marsh.), box elder (A. negundo L.), silver maple (A. saccharinum L.), Norway maple (A. platanoides L.), red maple (A. rubrum L.), and black maple (A. nigrum Michx.). The trees utilized were in residential areas, some of which bordered parks, rivers or open fields. Some trees were solitary, others were in groups, some with intermingling branches. Collections were made from trees with trunk diameters of 6 inches to 3 feet and those parts of each tree were searched that could easily be examined while standing on the ground.

The specimens were collected individually and placed in numbered vials containing 70 per cent alcohol. Field notes were taken for each individual including tree species, location on tree, location on leaf, shape of leaf, web construction, and presence of insects. In the laboratory the specimens were separated and regrouped according to tree species, location on tree, and location on leaf. This preliminary separation facilitated identification. Kaston (1948) was used for identification of spider species.

One or more specimens of each species of spider was confined in separate 4 x 6 x 1½ inch plastic boxes on live maple leaves bearing aphids. In the case of Araniella displicata, aphids were placed in the web. Some vinegar flies (Drosophilidae) and flower flies (Syrphidae) were later introduced in some of the boxes.

OBSERVATIONS

Nine species of spiders were found on maple trees in Albion. All were small to medium-sized species, 2 to 9 mm. in length, and represented six families.

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Most have been reported by various authors as being collected in other habitats by sweeping grasses or from shrubs or leaf litter and two are common "house spiders." Most specimens seen in this study were on leaves. The species and the numbers collected are given in Table 1.

Table 1. Numbers of each spider species collected from each maple species.

<table>
<thead>
<tr>
<th>Species of Spiders</th>
<th>Species of Trees</th>
<th>Sugar</th>
<th>Box E.</th>
<th>Silver</th>
<th>Norway</th>
<th>Red</th>
<th>Black</th>
<th>Totals</th>
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</thead>
<tbody>
<tr>
<td><strong>Argiophidae</strong></td>
<td>Araniella displicata</td>
<td>28</td>
<td>10</td>
<td>2</td>
<td>2</td>
<td>4</td>
<td>3</td>
<td>49</td>
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<tr>
<td></td>
<td>Tetragnatha viridis</td>
<td>9</td>
<td>5</td>
<td>-</td>
<td>4</td>
<td>4</td>
<td>2</td>
<td>24</td>
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<tr>
<td><strong>Clubionidae</strong></td>
<td>Chiracanthium inclusum</td>
<td>19</td>
<td>8</td>
<td>-</td>
<td>-</td>
<td>2</td>
<td>-</td>
<td>29</td>
</tr>
<tr>
<td><strong>Dictynidae</strong></td>
<td>Dictyna sublata</td>
<td>4</td>
<td>2</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>6</td>
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<tr>
<td><strong>Linyphiidae</strong></td>
<td>Pityohyphantes phrygianus</td>
<td>9</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>9</td>
</tr>
<tr>
<td><strong>Theridiidae</strong></td>
<td>Achearanea tepidariorum</td>
<td>6</td>
<td>-</td>
<td>1</td>
<td>4</td>
<td>-</td>
<td>-</td>
<td>11</td>
</tr>
<tr>
<td></td>
<td>Theridion murarium</td>
<td>7</td>
<td>-</td>
<td>1</td>
<td>2</td>
<td>4</td>
<td>-</td>
<td>14</td>
</tr>
<tr>
<td><strong>Thomididae</strong></td>
<td>Philodromus pernix</td>
<td>4</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>Philodromus rufus</td>
<td>12</td>
<td>2</td>
<td>-</td>
<td>-</td>
<td>3</td>
<td>5</td>
<td>22</td>
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<tr>
<td>No. of Spiders</td>
<td></td>
<td>98</td>
<td>27</td>
<td>4</td>
<td>12</td>
<td>17</td>
<td>10</td>
<td>168</td>
</tr>
<tr>
<td>No. of Trees Sampled</td>
<td></td>
<td>52</td>
<td>24</td>
<td>16</td>
<td>11</td>
<td>7</td>
<td>3</td>
<td>113</td>
</tr>
<tr>
<td>Spiders per Tree</td>
<td></td>
<td>1.88</td>
<td>1.12</td>
<td>0.25</td>
<td>1.09</td>
<td>2.43</td>
<td>3.33</td>
<td>1.49</td>
</tr>
</tbody>
</table>
Each species of spider was consistently found occupying a specific portion of the leaf with little overlap between species. The web and spider positions for each species are illustrated in Figures 1 to 7. All species were found on the underside of the leaf except Dictyna sublata (Hentz) which utilized small indentations on the top of the leaf for its web (Fig. 1). Comstock (1948) reported that this is a common spider on buildings where it builds sheet webs over a retreat in some small opening. Araniella displicata Hentz, an orb weaver, completely covers the center of the leaf with its web (Fig. 2). Tetragnatha viridis Walckenaer, another orb weaver, sometimes rolls one corner of a leaf which it uses as a retreat and its orb web is found between the leaf and twigs (Fig. 3b). Chiracanthium inclusum Hentz (Fig. 4) and Philodromus pernix Blackwall (Fig. 3a) roll one edge of the leaf as a retreat and run out after prey. Philodromus rufus (Walckenaer) also runs down its prey but does not roll the leaf edge. It frequently sits on the edge of the leaf in a position where it can see both leaf surfaces at the same time. (Fig. 5). Pityohyphantes phrygianus (Koch) (Fig. 6), Achaearanea tepidariorum (Koch) (Fig. 7a), and Theridion murarium Emerton (Fig. 7b) seemed to overlap most in their micro-
habitats; all three were found at the leaf base. The latter two built much smaller webs and were found on more host species than the first named.

The immatures in most cases were found on the leaves of the lower branches on the outer margin of the tree. Many molted skins were found in that area also. Molted skins found closer to the center of the tree were larger. The mature and nearly mature specimens of each species were taken closest to the center of the tree from leaves with well established webs or retreats.

In the feeding experiments with caged spiders the spiders did not appear to eat aphids. They were observed eating vinegar flies and flower flies when those were introduced.

**DISCUSSION**

We believe the interspecific subdivision of the maple leaf by spider species is an indication of preference in selection of microhabitat. We also believe the differences in occurrence and density of spider species between tree species may be indicative of microhabitat selection. There are probably several factors which enter into the selection.

The size and shape of the leaves are probably the most important factors in microhabitat selection. Cherrett (1964) found that the distribution of two species of orb-weavers in a bog was restricted to sites of a particular architecture. Duf- fey (1962a, 1962b, 1966) also found that plant form and other structural aspects of the microenvironment play an important role in the numbers and distribution of spiders and their webs in a habitat. The sugar maple leaf is approximately in the middle of the range of possible sizes and shapes of maple leaves and all nine species of spiders were found on sugar maple. Black and red maple leaves are less lobed than sugar maple and had higher proportions of spiders per tree. However, there were so few specimens of black and red maples sampled that the findings are not conclusive. Silver maples, of which we sampled several, have the narrowest leaves of the maples sampled and they had the fewest spiders per tree. Ranking between black, red and sugar maples, with two to three spiders per tree, and silver maple with one spider per four trees, were box elder and Norway maple, with one spider per tree. Box elder generally has non-lobed leaflets narrower than sugar maple leaves. Norway maple has broad leaves yet had a low spider population. We saw no obvious structural characteristic to account for the low spider population on Norway maples. This is not a native tree but we do not believe that fact in itself would affect the size of spider populations.

Correlated with leaf structure and tree shape there are probably microclimatic differences between maple species comparable to those found by Platt and Wolfe (1950) on oak leaves. These differences would be greatest at the leaf surfaces where the spiders are. It seems to us that the narrow leaves of silver maple would give less shielding and thus allow greater environmental extremes than would the leaves of other species. Several workers have shown that microclimatic factors are important in the microdistribution of spiders though some species are stimulated by different factors than are other species (Barnes & Barnes, 1954, 1955; Cherrett, 1964; Norgaard, 1951; Turnbull, 1964).

Food supply is important. The presence of a population of spiders is dependent upon an even greater population of insects to sustain it. Cherrett (1964) found that prey availability did not influence the location of webs of two orb-weavers. Turnbull (1964), however, working with *Achaearanea tepidariorum* inside a laboratory, found that the spider selects sites randomly and readily
moves if no prey is caught. If prey is caught, the spider remains and fills the area with webbing.

Of the various insects available as food to spiders on maple trees, aphids are usually the most abundant. However, even though aphids have been found in spider webs, they probably do not constitute any major portion of the spider's food. There are no records of spiders eating aphids and all attempts to feed aphids to spiders in captivity failed. We assume that the spiders prey on other insects that come to feed on aphids or their honeydew. If it is true, and if the numbers of other insects are correlated with numbers of aphids, this might account for the low numbers of spiders on Norway maple. Our subjective judgment is that Norway maple has smaller aphid populations than the other species used in this study.

The spider data were taken in such a way that we do not know how many spiders were taken from any one tree. We do know they were not evenly distributed among trees, and trees that contained spiders tended to have several species while many trees seemed bare of spiders. Without empirical data our subjective judgment is that good “spider trees” were also good “aphid trees.”

When young spiderlings emerge they travel by ballooning and often balloon toward light which probably accounts for their distribution at the tree edges. The movement of the population toward the center of the tree with maturity might be due to reactions to microclimatic factors or to some form of intra- or interspecific competition. As the young spiders mature their food requirements increase and change. Muma and Muma (1949), in a study of prairie spiders, reported that specific maturity peaks are extremely important in interspecies competition, causing subsequent fluctuations in density and changes in distribution. Differences in maturity peaks of the nine species on maples and resultant differences in food requirements are possible factors influencing radial position on the tree through interspecific competition.

In conclusion, we suggest that the establishment of these spider species is dependent upon their finding broad, lobed leaves which provide adequate site architecture for their particular webs. Their subsequent survival and movements are dependent upon an adequate food supply.

ACKNOWLEDGMENTS

We are indebted to A. R. Brady, Hope College, Holland, Michigan, and C. D. Dondale, Canadian Department of Agricultural Research, Belleville, Ontario, who very kindly assisted with the identification of some species of spiders.

LITERATURE CITED

THREE NEW SPECIES AND A KEY FOR THE GENUS CALLIDORA (HYMENOPTERA: ICHNEUMONIDAE)

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The genus Callidora (subfamily Porizontinae) has traditionally contained a single European species, Callidora albovincta (Holmgren). Townes (1969) redefined the genus and included a second species (Campoplex analis Gravenhorst). At the same time he referred to three undescribed species, two from North America and one from the Philippines. Descriptions of these three are presented here together with a key to all five species now in Callidora.

Several relationships within this genus are noteworthy. The two North American species, tegularis and surata, are morphologically most alike. Quite distinct from these, but similar in body shape and propodeal sculpture is the European species analis. The remaining two, albovincta and atrognatha, have distinctive propodeal carinae in addition to a thorax which is more elongate in profile than that of the other species. Thus Callidora can be divided into two species groups which are easily distinguished on the basis of body shape and propodeal sculpture.

It should be noted that among the specimens of albovincta cited below, one is from Japan. Previously this species has been recorded only in Europe. This makes the apparent relationship between albovincta and atrognatha (the Philippine species) more understandable.
ARTIFICIAL KEY TO THE SPECIES OF *CALLIDORA*

1. Nervulus opposite basal vein; mandible black.
   1. *atrognatha*

1. Nervulus distad of basal vein by at least its thickness; mandible yellow

2. Tranverse carina at base of areola not swollen, distinctly separated from basal margin of propodeum; basal carina complete behind first lateral area. Female antenna with median white band.
   2. *albovincta*

2. Transverse carina at base of areola swollen and situated at basal margin of propodeum or, if not swollen, then basal carina incomplete behind first lateral area. Female antenna brown to black.

3. Genal carina flared strongly outward from mandible; inside spur of hind tibia 0.8 to 0.9 as long as first segment of hind tarsus.
   3. *analis*

3. Genal carina not flared outward from mandible; inside spur of hind tibia 0.5 to 0.75 as long as first segment of hind tarsus.

4. Flagellum with 31 to 33 segments; tegula strongly convex; propodeal spiracle usually adjacent to pleural carina; hind tibia without yellow stripe.
   4. *tegularis*

4. Flagellum with 27 to 30 segments; tegula moderately convex; propodeal spiracle separated from pleural carina by a distance approximating spiracular diameter; hind tibia with median dorsal yellow stripe.

5. *surata*

1. *Callidora atrognatha*, new species

Front wing 4.5 to 5.5 mm. long. Flagellum with 34 to 36 segments. Propodeal carinae as in *albovincta*—basal transverse carina complete behind first lateral area, removed from propodeal margin at base of areola (and not swollen) so that noticeable basal area is present.

Antenna, head, mandible, thorax, coxae, first trochanters, and petiole black; second trochanters brown to black. Tegula, labial palpus, and basal segment of maxillary palpus brown; terminal three segments of maxillary palpus yellow. Basal 0.75 or more of second abdominal tergite black, the rest of the abdomen unevenly orange to orange-brown. Front femur tawny to orange-brown, its tibia stramineous to tawny; first two tarsal segments stramineous to gray-brown, last three gray-brown to brown. Middle femur and tibia colored like those of front leg, usually slightly darker; middle tarsus brown. Hind femur and tibia orange-brown to ferruginous, tibia becoming dark brown apically and basally, darkest dorsally; hind tarsus brown to black.

Type: , Mt. St. Tomas, elev. 7200 ft., near Baguio, Philippines, Nov. 29,
1953, H., M., & D. Townes (Townes collection).

2. *Callidora albovincta* (Holmgren)


*Callidora annellata* Thomson, 1887. *Opuscula entomologica* 11:1136. Types: 1 ♂, 1 ♀ , Sweden: Palsjö in Skåne, and Germany: Munich (Lund?).


3. *Callidora analis* (Gravenhorst)

*Campoplex analis* Gravenhorst, 1829. *Ichneumonomologia europaea* 3:583. Type: ♀ , no locality given (Berlin).

Specimens examined: 2 ♀♀ , Vecāki, Latvia, June 24, 1957, E. Ozols (Townes collection). 1 ♀ , Upper Bavaria, near Andechs, W. Germany, June 17, 1959, Haeselbarth (Townes collection).

4. *Callidora tegularis*, new species

Front wing 4.5 to 6.0 mm. long. Flagellum with 31 to 33 segments. Basal transverse carina of propodeum greatly swollen at base of areola and situated at basal margin of propodeum. Tegula strongly, unevenly convex so that outer half of hind margin C-shaped when seen from behind. Propodeal spiracle usually adjacent to pleural carina. Propodeum in profile evenly shallowly convex to slightly angulate.

Antenna, head, thorax, coxae, and petiole black. Tegula, mandibles, and palpi yellow. Postpetiole and tergites 2-4 as seen from above usually black with wide apical orange bands, sometimes only tergites 2 and 3 with orange bands, or sometimes bands on more than three segments. Tergite 3 usually as least half of hind margin C-shaped when seen from behind. Propodeal spiracle usually adjacent to pleural carina. Propodeum in profile evenly shallowly convex to slightly angulate.

Antenna, head, thorax, coxae, and petiole black. Tegula, mandibles, and palpi yellow. Postpetiole and tergites 2-4 as seen from above usually black with wide apical orange bands, sometimes only tergites 2 and 3 with orange bands, or sometimes bands on more than three segments. Tergite 3 usually as least half of hind margin C-shaped when seen from behind. Propodeal spiracle usually adjacent to pleural carina. Propodeum in profile evenly shallowly convex to slightly angulate.

First middle trochanter stramineous to rufous. Second trochanter yellowish-white to tan; middle femur stramineous to rufous. Its tibia stramineous dorsally, grading to tawny beneath; middle tarsus colored as that of front leg. First hind trochanter from black dorsally and brown beneath to completely black, second hind trochanter yellowish-white to tan; hind femur tawny to rufous, its tibia similar, but becoming gray-brown to black toward apex and
base, darkest dorsally; hind tarsus gray-brown to brown.


5. Callidora surata, new species

Front wing 4.0 to 6.0 mm. long. Flagellum with 27 to 30 segments. Basal transverse carina of propodeum greatly swollen at base of areola and situated at basal margin of propodeum. Tegula moderately evenly convex so that hind margin smoothly shallowly curved when seen from behind. Propodeal spiracle separated from pleural carina by a distance approximating spiracular diameter. Propodeum in profile moderately convex and slightly angulate. Face with small tubercle just below and between antennal sockets, connected to them by faint carinae (present occasionally in tegularis also, but seldom as prominent).

Coloration like that of tegularis with the following exceptions: Hind tibia gray-brown to black with obvious to obscure median dorsal yellow stripe. Abdomen as seen from above black, usually with narrow apical orange bands on tergites 2 and 3; postpetiole with narrow yellow line on apical margin; tergite 3 usually more than half black.

Type: ♀, Glenwood, Alberta, June 19, 1938, R. W. Salt (Townes collection).


ACKNOWLEDGMENTS

The kind advice and careful supervision of Prof. Henry Townes have made this paper possible. Most of the specimens examined were his also. Additional specimens were provided by Dr. Robert Carlson and by Mr. John Bain.

LITERATURE CITED

THE CAPABILITY OF SOME BUTTERFLIES AS CARRIERS OF COMMON MILKWEED POLLEN

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INTRODUCTION

The common milkweed, *Asclepias syriaca* L., is remarkably adapted for cross pollination by insects. Its pollen sacs (pollinia) are often found attached to the appendages of bees, wasps, butterflies, and other insects that visit milkweed for its nectar (Judd, 1955; Matheson, 1951; Müller, 1883).

In the summer of 1966 and 1967 I collected numerous pierid and nymphalid butterflies associated with milkweed plants in Michigan in order to examine them for their pollen-carrying capability. Species of butterflies collected were *Colias interior* Scudder, *C. eurytheme* Boisduval, *Pieris rapae* (L.), and *Speyeria aphrodite* (Fab.). These insects were taken while feeding on or flying near milkweed plants between 3 July and 22 July each year—the period when milkweed was in full bloom—in Crawford, Montmorency, and Oscoda Counties, Michigan.

THE MILKWEED FLOWER AND POLLINATION

Müller (1883) and Matheson (1951) discuss the flower structure and the role played by insects in the transfer of pollinia of the milkweed.

The flowers are massed into umbels, the calyx and corolla of each are reflexed so that the 5 smooth glossy stamens surrounding the pistil are fully exposed (Fig. 1A). Each stamen unites with its fellows in a way which forms a slit between them. There is a clip-like organ (corpusculum) at the apex of each slit (Fig. 1A) which unites the concealed anther sacs (pollinia) in pairs by short strap-like retinacula (Fig. 1B). The stigmatic surfaces lie within the slits.

Normally, an insect visiting the flower for nectar slips on the smooth surface of the stamens and gets its foot in the slit between them. Then as the insect draws its foot up the slit, the clip clamps onto the hairs, claw, or segment of the tarsus. When the insect frees its foot it carries away the whole pollinial apparatus. The paired pollinia are moist and divergent when first extracted but soon rotate inward as they dry so their surfaces become nearly parallel (Fig. 1B). They then fit easily into similar slits, stick to the stigmatic surfaces, and break away from the clip when the insect visits a new flower. The clip remains attached to the insect.

OBSERVATIONS

In all, 236 pollinia (or clips) were observed on 107 butterflies out of 1144 butterflies collected. All the species studied were capable of picking up the pollinia but the data indicate that some species carry far more pollinia than others. Pollinia were very scarce on *Colias*, common on *Pieris*, and abundant on *Spey-
The common milkweed, *Asclepias*, carried more than twice as many pollinia as *Pieris* and more than 100 times as many as *Colias* (Table 1). *Pieris* and *Speyeria* frequently carried more than one pair of pollinia, but only one *Colias* out of 894 specimens examined had two pollinia attached to its extremities (Table 2). *Pieris* and *Speyeria*, which were netted in far less numbers than *Colias*, had some representatives with as many as 8 and 6 pollinia respectively.

Pollinia were located on all 3 pairs of legs of *Pieris* and *Colias* but only on the meso- and metathoracic legs of *Speyeria*. The "brush-feet" of *Speyeria* are probably incapable of acquiring pollinia. Most of the pollinial clips were attached to the claws or terminal tarsal segments. The maximum number of clips on one foot was five—on one *Speyeria*. In addition, five clips with one or both pollinia were attached to the proboscises of five butterflies; 3 on *Pieris* and one each on a *Colias* and a *Speyeria*. All were very near the tip so feeding was probably hindered or prevented.

**Table 1. Summary of milkweed pollinia per species of butterfly.**

<table>
<thead>
<tr>
<th>Species</th>
<th>No. butterflies collected</th>
<th>Percentage butterflies with pollinia</th>
<th>Mean no. pollinia per butterfly</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Colias</em> spp.</td>
<td>894</td>
<td>0.7</td>
<td>0.01</td>
</tr>
<tr>
<td><em>Pieris rapae</em></td>
<td>156</td>
<td>23.7</td>
<td>0.61</td>
</tr>
<tr>
<td><em>Speyeria aphrodite</em></td>
<td>94</td>
<td>67.0</td>
<td>1.43</td>
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</tbody>
</table>

**Table 2. Frequency of butterflies carrying different numbers of pollinia.**

<table>
<thead>
<tr>
<th>Species</th>
<th>Frequency of butterflies by number of pollinia:</th>
<th>Total butterflies</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0  1  2  3  4  5  6  7  8</td>
<td></td>
</tr>
<tr>
<td><em>Colias</em> spp.</td>
<td>888 5 1 0 0 0 0 0 0</td>
<td>894</td>
</tr>
<tr>
<td><em>Pieris rapae</em></td>
<td>119 15 8 3 5 3 2 0 1</td>
<td>156</td>
</tr>
<tr>
<td><em>Speyeria aphrodite</em></td>
<td>31 25 23 5 4 4 2 0 0</td>
<td>94</td>
</tr>
</tbody>
</table>

|                  |                                              |                   |
|                  |                                              | 1,144             |
DISCUSSION

*Speyeria aphrodite* appears to be the most capable pollen carrier of the milkweed visitors in the area of this study. It was not ascertained if *Speyeria* was the best milkweed pollinator there, but the numerous individuals collected with naked clips suggest it was at least a very good pollinator. *Pieris rapae* was a fair pollen carrier, while *Colias interior* and *C. eurytheme* were very poor carriers. These last three species are similar in size and structure and they appear to visit milkweed with almost equal regularity, so the variability was probably due mostly to behavioral differences. Perhaps *Colias* manages to grasp the flower better and thus prevent slipping on the stamens, or if it slips perhaps it does not recover its foothold in a way that is conducive to pollen collecting.

It is not surprising that some of the butterflies had pollinia attached to their proboscises. All of the species studied probe across a flower to reach the nectaries located behind the anther sacs. This probing sometimes places the curved proboscis in the groove or slit near the clip, so that a sudden movement upward would cause the clip to catch hold. Judd (1955) found calliphorid flies with pollinia clasped to the labellum of the labium indicating they too were searching for nectar.

LITERATURE CITED


Müller, H. 1883. The fertilization of flowers. London.

REVIEWS OF RECENT LITERATURE


Plant galls or cecidia have always fascinated and bewildered the biologist and the layman, and only recently has there been much attention paid to the biology of gall makers and the physiology of gall development. There are several "early" definitive books on galls by British, German, and American authors, but most are out of print or are replete with errors. Few are useful for quick identification of galls in the field.

This pocket encyclopedia definitely fills a vacancy not occupied by other works on galls. It is one of the "Blandford Colour Series" of books on natural history subjects, and is thus similar to the American Field Guide Series in style and method of usage. Though published in the United States it is based entirely upon representative galls of Great Britain.

The book is divided into several brief introductory chapters, a section composed of colored plates, and a long annotated list of British galls. In the introductory chapters the author introduces the reader to fundamentals of
galls and their makers and discusses the basic life histories, alternation of generations, and effects of the agent on the host. He concludes with a short chapter on collecting and preserving galls.

The book is generous with its illustrations—some 293 photos and drawings in full color and nearly two dozen in black and white showing representative galls, gall occupants, and a few 'non-galls'. The annotated list, which occupies one-half of the book, is arranged systematically by order of host plant according to Warburg's *Flora of the British Isles* (1962), and covers galls of ferns, coniferous and deciduous trees, shrubs, flowers, and grasses. Each annotation lists the host, location and description of the gall, type and name of the agent, biology of the agent, and other interesting addenda.

The author's objectives are three-fold: to provide a means of gall identification from easily found field characters; to outline the mode of life of the principal gall-causing agents; and to suggest means of investigating galls in the field and in the home. He has certainly fulfilled these objectives. At the same time he has attempted to attain a measure of simplicity in order to appeal to a wide audience, but still maintain precision and accuracy.

This book has limited use for gall identification in America. Gall-makers are often highly host specific, so only a few of the galls represented are common to both sides of the Atlantic, and then mainly because the same hosts are in both places. Yet *The Pocket Encyclopedia of Plant Galls* will be of great interest to the American entomologist because of the excellent treatment of its non-taxonomic aspects. It should be useful to the amateur who has a casual interest in galls, and to the more seasoned gall-oriented veteran.

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This book would delight the traditional zoologist as its emphasis is on systematics and evolution, primarily based on morphology. By the author's own admission he neglects areas concerning histology, embryology, physiology and genetics, while giving little time to areas he terms animal biology—symbiosis, parthenogenesis, behavior and parasitism. Dr. Savory feels the aforementioned areas warrant volumes of their own. Yet this book is titled *Introduction to Zoology.* Perhaps a better title would be *Introduction to Zoology, Part I. Systematics and Evolution.*

The book is divided into four parts. Part One, Introductory Zoology, is concerned with the approach pursued in the succeeding pages. Part Two, Systematic Zoology, includes fundamental concepts related to the classificatory system, its basis, aims and limitations. Included within this section are actual classificatory schemes with emphasis on variability in different schemes due to ignorance, uncertainty and personal opinion. Part Two is culminated by a brief treatise on nomenclature. With this systematic basis it is unfortunate that the book was published without italicizing or otherwise denoting generic and species names.
Parts Three and Four concern invertebrates and vertebrates respectively. Each chapter begins with the characteristics of a taxon followed by the characteristics of lower taxa. A discussion follows using representative species. In these sections, little known groups such as Tardigrada and Pycnogonida are included. These groups ordinarily are not present in introductory works and represent a welcome addition.

The critical reader might question several statements made by the author. One would argue as to the viability of the ookinete, the diploblastic nature of ctenophorans, whether nematodes are acelomate, and the absence of eyes in millipedes, to mention a few. In addition, many illustrations used in the text have questionable value, especially since they lack labels.

In spite of the above criticism, I would recommend this book to laymen interested in systematics and evolution, by no means as a definitive work, but as a guide to important concepts. Its place as an introductory text remains doubtful, although in conjunction with other volumes its niche would be filled. However, the combined price would be excessive.

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BRIEF NOTICES


The near simultaneous appearance of these two paperbacks on arachnids, myriapods, and terrestrial crustaceans, written in an informative and non-technical manner, will be welcomed by those seeking a general survey of these groups.

Cloudsley-Thompson's book, a corrected and slightly revised edition of the 1958 publication, gives equal treatment to the various groups, with emphasis on their biology. It is well illustrated with 40 text figures and 18 halftone plates. Following the 11 chapters are a general bibliography, classificatory index, glossary and index of scientific terms, and an index of general topics.

The Levis' book is another in the excellent Golden Nature Guide series. It is profusely illustrated with color paintings by Nicholas Strekalovsky, and is primarily concerned with North American spiders, with brief introductory comments on biology, collecting, preserving, and rearing. This attractive little book will serve as an identification guide for the non-specialist, and should stimulate further interest in these neglected and often-feared animals.

J. P. D.
INFORMATION FOR AUTHORS

Papers dealing with any aspect of entomology will be considered for publication in The Michigan Entomologist. We solicit subjects of particular interest to amateur and professional entomologists in the North Central States and Canada, as well as general papers and revisions directed to a larger audience while retaining an interest to readers in our geographical area. Books will be reviewed with this larger audience in mind. Notes on collecting methods and new techniques are welcomed, as are subjects in the history and bibliography of entomology.

Manuscripts are submitted to one or more qualified referees and are judged on scholarly merit as well as clarity of presentation. Articles of 10 or more printed pages may be published in the course of several issues unless the extra pages are subsidized at cost. Especially meritorious papers of at least 28 pages may be published as single issues if subsidized.

Illustrations are encouraged and will be printed without charge. Photographs should be glossy and 8" x 10" in size while drawings, charts, graphs and maps may be of any size, allowing for reduction. Contributors should follow the recommendations of the Style Manual for Biological Journals, available at $3.00 per copy from the American Institute of Biological Sciences, 3900 Wisconsin Avenue, N. W. Washington, D. C. 20016. A pedantic style should be avoided, for scientific accuracy and lucid, interesting prose can exist together.

Manuscripts must be typed, double-spaced, with wide margins on white 8½" x 11" or equivalent foreign size paper, and submitted in duplicate. Footnotes, legends, and captions for illustrations should be typed on separate sheets of paper. Proofs will be submitted to authors, and must be returned within one week of receipt. Titles should be concise, identifying the order and family discussed. The author of each species mentioned must be given fully at least once in the text. A common name for each species or group should be given at least once when such a name exists. The format of references should follow that used in recent issues. While every care will be taken of authors' manuscripts, neither the Editor nor the Michigan Entomological Society will accept responsibility for accidental loss or damage.

Each author or co-author will receive 25 gratis separates of his paper; authors of notes will receive 10 separates. Additional separates may be ordered upon acceptance of manuscript.

All manuscripts for The Michigan Entomologist should be sent to the Editor, Dr. Ronald S. Wilkinson, The Library, Michigan State University, East Lansing, Michigan 48823, USA. Other correspondence should be directed to the Executive Secretary (see inside front cover).