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# THE MICHIGAN ENTOMOLOGIST

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## COVER PHOTO

The grasshopper *Chortophaga viridifasciata* De Geer. Photograph by Richard Holzman, determined by Irving Cantrall.
AN ANNOTATED LIST OF THE SPITTLEBUGS OF MICHIGAN (HOMOPTERA: CERCOPIDAE)

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Representatives of the family Cercopidae are commonly known as "spittlebugs" because the nymphs cover themselves with saliva-like frothy masses composed of bubbles of air trapped by motions of the abdomen in fluids discharged from the alimentary canal. Spittle protects nymphs from desiccation, but they are able to abandon it for brief periods while migrating to new feeding sites or to other host plants where new masses are produced. Gas exchange by nymphs immersed in spittle is accomplished through spiraculae situated in a protective chamber formed on the ventral side of the abdomen by extended tergites. Fig. 1 shows a mass of spittle produced by *Aphrophora alni* nymphs at the base of a plant stem.

![Fig. 1. Mass of spittle produced by *Aphrophora alni* nymphs at the base of a plant stem.](image)

Adult spittlebugs differ from other Homoptera in having hind tibiae armed with two stout lateral spurs and a cluster of terminal spines. Soft sounds produced by vibrating tergal abdominal timbals of a few adult spittlebugs collected in Michigan were analyzed by Moore (1961). Comparison of such sounds provided a basis for recognizing the taxonomic relationships of certain cicadas (Alexander and Moore, 1962). Moore (1956) observed that the family Cercopidae appears closely related to the family Cicadidae; his observations are based on similarity in structure of the abdomen and antennae among nymphs of the two families. He suggested that the higher categories of the Cercopidae evolved along four major lines of specialization represented by the subfamilies Aphrophorinae, Cercopinae, Clastopterinae, and Machaerotinae. The first three subfamilies are represented in Michigan. The subfamily Machaerotinae is not represented in North America, but embraces curious species known as "tube-building" spittlebugs which construct remarkable shelters from
hardened spittle.

A few spittlebugs are of economic importance. Plant damage may result from (1) excessive feeding and extraction of plant juices by nymphs in maintaining protective spittle masses, (2) excessive extraction of plant juices by adults to meet metabolic requirements, (3) injection of toxic substances by adult spittlebugs (and nymphs?) while feeding, (4) transmission of virus entities, and (5) feeding punctures which predispose hosts to attack by bacteria and fungi.

Severin (1950) reviewed the importance of spittlebugs as vectors of plant diseases. McDaniel (1937) reported that the pine spittlebug is capable of killing young trees or may reduce the vigor of the host so that the plant succumbs to some other insect or disease. Ewan (1961) described feeding punctures on pine in the Lake States area caused by
Saratoga spittlebug. Large-scale control programs, including aerial spraying, have been directed against Saratoga spittlebug adults in the northern part of the lower peninsula of Michigan during the past eighteen years. The effects of such treatments on non-target organisms are not completely known. Research by Wilson and Kennedy (1968) suggests that control efforts directed at nymphs may prove more acceptable.

The meadow spittlebug is the most abundant and most generally distributed spittlebug in Michigan. Both nymphs and adults feed on a great variety of cultivated plants. It is a good flier and has shown some tendency to migrate. Wilson and Rupple (1964) reported capturing adults in flight at altitudes of over 1000 feet. Weaver and King (1954) investigated the taxonomy, biology, ecology, and control of the meadow spittlebug.

Doering (1930) published a comprehensive synopsis of the family Cercopidae in North America. Metcalf (1960-62) catalogued the Cercopoidea of the world listing slightly fewer than 4000 species and varieties. Some species which occur in Michigan are dimorphic or polymorphic, but the causes and significance of intraspecific variations are poorly understood. Hanna and Moore (1966) included extensive records on distribution, illustrated keys to genera, and descriptions by which the 21 species known from Michigan can be identified.

Fig. 2 is a map showing the names and locations of the counties in the state of Michigan. Odd numbered figs. 3-47 indicate the counties in which each species has been collected. Only a few species have broad host ranges and occur in a variety of environments. Usually, particular habitats harbor particular compliments of species. Even numbered figs. 4-48 show dorsal and lateral views of adult female specimens collected in Michigan. A line near the bottom margin demonstrates the actual length of the specimen illustrated. The earliest and latest dates that adult specimens have been collected during the season are listed for each species. Most species have one generation per year and winter as eggs, but a few notable exceptions are known.

Order HOMOPTERA

The Spittlebugs

Family Cercopidae

Genus APHROPHORA Germar

*Alni* (Fallen) 1805 (Figs. 3 and 4). Shrubby edges of woods where locally it predominates in association with *Leporynia quadrangularis*, *Philaeus lineatus*, and *P. spumarius*. Nymphs, June at soil level on stems of *Agrimonia* sp., *Arctium* sp., *Aster* sp., *Cirsium* sp., *Daucus carota*, *Erigeron philadelphicus*, *Geum* sp., *Nepeta hederaceae*, *Rumex crispis*, *Solidago canadensis*, *Sonchus* sp., *Taraxacum* sp., and *Urtica* sp. Adults, on goldenrod and deciduous shrubs; Monroe Co. June 17, 1964 to September 13, 1961. Monroe Co. Probably this Eurasian species was brought to North America from Europe with nursery stock.

*Parallela* (Say) 1824 (Pine Spittlebug). (Figs. 5 and 6). June 4 to October 10. Coniferous trees, especially pine where it often predominates in association with *A. saratogensis*, *A. signoreti*, *Clastoptera testacea*, and *Philaeus spumarius*. Nymphs, May-June. Injury is more apparent in Scotch pine plantations than in native coniferous forests.

*Quadrinotata* Say 1831 (Figs. 7 and 8). June 28 to September 20. Deciduous trees, especially alder, and low vegetation at edges of woods and along stream banks; often in association with *Clastoptera obtusa* and *Leporynia quadrangularis*. Widespread, but strangely never abundant.

*Saratogensis* (Fitch) 1851 (Saratoga Spittlebug). Two forms occur which occupy separate habitats within a similar geographical range. No significant differences in structure of male
Aphrophora alni

Aphrophora parallela

1. Light form (typical Saratoga spittlebug of authors). June 17 to October 9. Individuals with light brown markings; commonly occurring on pine, occasionally on other conifers including tamarack. The specimen illustrated was collected in Clare Co., July 17, 1962 on Pinus. (Figs. 9 and 10). Nymphs, May-June, usually near soil line on low vegetation, especially Rubus spp. and sweet fern. Because no adult specimens were retained, Fig. 9 does not indicate the occurrence of A. saratogensis in Cheboygan, Emmet, Iosco, Kalkaska, Lake, Manistee, and Otsego Counties where Patrick C. Kennedy (personal communication) recently observed characteristic feeding punctures on red pine while making Saratoga spittlebug damage surveys for the U.S. Forest Service.

2. Dark form: Individuals with dark markings (rarely all black) June 28 to September 22. Occurring principally on tamarack, sometimes abundant; specimens have been taken in
northern localities on balsam fir. The specimen illustrated was collected in Ingham Co., July 23, 1964 on Larix. (Figs. 11 and 12). Nymphs, May-June near ground level or concealed under moss on low vegetation including Rubus spp., seedling tamarack, and numerous herbs. Occasional individuals are parasitized by a dipterous larva which inhabits the abdominal cavity of both sexes.

signoreti Fitch 1856 (Figs. 13 and 14). June 19 to September 1. Coniferous trees, especially pine, but seldom abundant. Nymphs, June on stems and foliage of low vegetation. In June 1951 cloth sacks were placed over spittle masses occupied by nymphs of this species on Daucus, Laportea, Quercus, and Rubus plants growing near pines at the southwest corner of Baker woodlot on the grounds of Michigan State University, East Lansing. On July 1, 1951 transformation to adults had occurred. Plant succession and growth of the canopy during the intervening interval has rendered the site less suitable for this species, which no longer appears to be present.
**Genus CLASTOPTERA** Germar

**achatina** Germar 1839 (Pecan Spittlebug). Figs. 15 and 16. *Carya* groves and solitary trees, especially shagbark hickory; abundant when present. Nymphs, May-September. The Ingham Co. specimen was taken on July 1, 1951 near the transmitter of Michigan State University radio station WKAR, in a woodlot which has since been destroyed. In Genesee Co., numerous individuals were found on October 11 crawling on bee hives in a hickory grove after having been detached from plant hosts by wind and rain. Two generations frequently occur in one season.

juniperina Ball 1919 (Figs. 19 and 20). July 12 to September 24. Occurs infrequently in plantings of ornamental junipers; usually abundant when present, but not known to occur on native red cedar in Michigan. Nymphs, June-July. Probably this western species was introduced into many isolated localities with nursery stock.

obtusa (Say) 1825 (Alder Spittlebug). June 25 to September 22. (Figs. 21 and 22). Deciduous forests, especially representatives of the birch family; predominates in association with Aphrophora quadrinotata on alder, but seldom abundant on hickory in association with C. achatina. Nymphs, June-July.

proteus Fitch 1851 (Dogwood Spittlebug). June 22 to August 29. (Figs. 23 and 24). Stream banks and edges of swales on dogwood, sometimes Vaccinium; abundant when present. Nymphs, June-July.
Clastoptera juniperina

FIG. 19

Clastoptera obtusa

FIG. 20

saintcyri Provancher 1872 (Heath Spittlebug). June 30 to August 11. (Figs. 25 and 26). Upland blueberry stands, but especially bogs with leatherleaf or Vaccinium; abundant when present. Nymphs, June-July. C. obtusa, C. proteus, and C. saintcyri sometimes occur in close association in leatherleaf bogs bordered by alder and dogwood.

testacea Fitch 1851 (Figs. 27 and 28). June 24 to October 5. Occurs on pine and sometimes tamarack, numerous individuals taken at porch lights in a heavily wooded area. In late July 1969, Louis F. Wilson placed cages over spittle masses occupied by nymphs on oak leaves in Alcona County. On July 30, newly transformed adults of both sexes were recovered.

Genus LEPYRONIA Amyot and Serville
Clastoptera proteus

FIG. 23

Clastoptera proteus

FIG. 24

Clastoptera saintcyr i angulifera Uhler 1876 (Figs. 29 and 30). Males, August 26 to October 18. Females, April 20 to November 4. Occurs on low sedges growing in association with cinquefoil, gentian, and pitcher plants at the edge of small bog-like lakes; abundant when present. Nymphs, August. Transformation from nymph to adult occurs within the spittle. Adult females winter.

Clastoptera saintcyr i gibbosa Ball 1898 (Figs. 31 and 32). July 11 - August 2. Relict prairies: sometimes occurring on low vegetation in open woods which have succeeded prairie. Intense collecting will be necessary to determine accurately when adults first appear and how long they remain. Apparently, this western species is rare in Michigan.

Clastoptera saintcyr i quadrangularis (Say) 1825 (Diamond-backed Spittlebug). (Figs. 33 and 34). Males, July 14 - October 7. Females, May 11 - October 10. Edges of woods on grasses and weeds, especially in seepage and shady areas, sometimes in orchards. Nymphs, June - August.
Clastoptera testacea

Common; often in association with other spittlebug species, but seldom predominates. Adult females winter.

Genus PHILAENUS Stal

abjectus Uhler 1876 (Figs. 35 and 36). May 28 to October 11. Occurs on goldenrod in shady meadows bordering arbor-vitae swamps; abundant when present (Hanna 1967). Nymphs, July-September. Adults of both sexes winter.

bilineatus (Say) 1831. Two forms occur which occupy similar habitats in separate geographical ranges. Apparently consistent differences in structure of male genitalia of the two forms have been observed. Occasionally, late stage nymphs of both forms produce
spittle masses on broad-leaved herbs which are not usual hosts.

1. Petite form: individuals in the populations occurring in the southernmost counties generally are smaller and exhibit more uniform coloration than individuals in more northern localities. June 24 - September 20. The specimen illustrated was collected July 24, 1962 in Grand Traverse Co. (Figs. 37 and 38). Dry prairies on *Andropogon scoparius* and other grasses; discontinuously distributed, but sometimes locally abundant. Nymphs with dark transverse bands on the thorax and abdomen, June. Predominates in arid plant communities where *P. spumarius* seldom occurs.

2. Robust form: populations in the northernmost counties include individuals that are larger, more conspicuously marked, and often referable to varieties *nigricans, orbiculatus,* or *reticulatus* described by Ball (1919). June 18 to September 4. The specimen illustrated was collected August 16, 1961 in Charlevoix Co. (Figs. 39 and 40). Meadows and abandoned fields on grasses, roadsides; moderately evenly distributed, sometimes abundant.
Nymphs with dark transverse bands on the thorax and abdomen, June. Frequently occurs in association with *P. spumarius*.


*C. parallelus* Stearns 1918 (Figs. 43 and 44). June 29 to September 13. This bog species inhabits tall sedge clumps; not rare when present. Nymphs, June. Transformation from nymph to adult occurs within the spittle. Endemic to the region surrounding Lake Michigan; known westward to Otter Tail Co., Minnesota, August 22, 1922 (H. H. Knight, collector). Specific environmental requirements apparently restrict the occurrence of this species.
spumarius (Linnaeus) 1758 (Meadow Spittlebug). (Figs. 45 and 46). June 9 to November 25. This circumpolar species occurs on native and cultivated grasses, herbs, vines, shrubs, and trees, including stone fruits and pines. Nymphs, May-June. Collected in Calhoun Co. after applications of granular dieldrin at Fort Custer flushed numerous individuals from vegetation onto patches of snow. Polymorphic; colonies in northern localities frequently exhibit a greater diversity of pigmentation than the population studied in Livingston Co. by Owen and Wiegert (1962). By far, the most abundant spittlebug in Michigan.

Genus PROSAPIA Fennah

bicincta (Say) 1831. Known in Michigan only from the geographical subspecies P. bicincta ignipecta (Fitch) 1856. (Figs. 47 and 48). July 26 to September 10. Abandoned fields and sandy ridges on grasses in association with Philaenus bilineatus; occurring in small colonies which occupy diminutive portions of territories available; conspicuous in nature because of
its bold color. Probably, prudent collecting would demonstrate that adults appear much earlier in the season than available records indicate.

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The help and kindness of Thomas E. Moore and Irving J. Cantrell, both of the Museum of Zoology, The University of Michigan, Ann Arbor, have made the task of preparing the manuscript and illustrations more worthwhile and enjoyable.

LITERATURE CITED

Prosapia bicincta ignipicta


FOOD PLANTS OF SOME ADULT SPHINX MOTHS
(LEPIDOPTERA: SPHINGIDAE)

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While food plants of many species of sphinx moth larvae are well known, food plants of
the adults are not. Many observations of the feeding habits of adult sphinx moths
undoubtedly have been made, but much of the information is probably resting in the field
notebooks and memories of the observers.

To my knowledge no summary of known feeding information has been presented
previously for American Sphingidae. A rather thorough list of food plants for adult
European sphinx moths has been published by Wahlgren (1941). This list also includes other
moth families as well and it can be a useful reference for many workers.

For the most part I have restricted the present paper to sphinx moths of the eastern
United States, but it has not been possible to include all of these as no information was
uncovered for some species. The dearth of observations of our Western species makes such
restriction necessary and, while unfortunate, unavoidable at the present time.

Data for this study were compiled from personal information based on many years of
observing and collecting sphinx moths, from questionnaires sent to other workers in the
field, and from published information. Several appropriate references to Sphingidae feeding
on carrion have been included, although this literature has not been searched exhaustively.

ANNOTATED LIST OF FOOD PLANTS

In the following list feeding times (FT) are indicated as (D) diurnal, (C) crepuscular, and
(N) nocturnal. Average proboscis length (PL) is given in millimeters. In several cases these
data are not available. Flowers visited by the moths (their nectar presumably was
used as food) are indicated as food source (FS).

SPHINGINAE

Most insects of this subfamily have a moderate to extremely well-developed proboscis and
well-developed sucking pump and proboscis extension muscles. Despite complete
morphological feeding capability, however, many species do not seem to be as active feeders
as many feeding species in other subfamilies. Some species have degenerate feeding
apparatus and do not feed as adults.

*Manduca sexta* (Johansson)

FS: *Lonicera japonica* (Japanese honeysuckle), *Calonyction aculeata* (moonflower),
*Petunia hybrida* (petunia). FT: C, N. PL: 80.0 mm.

*Manduca quinquemaculata* (Haworth)

FS: *Lonicera japonica, Petunia hybrida, Saponaria officinalis* (bouncing bet), *Phlox*
sp. (phlox), *Nicotiana* sp. (tobacco). FT: C, N. PL: 90.0 mm.

I have several times observed *M. sexta* and *M. quinquemaculata* feeding at honeysuckle
well after dark, apparently later than most other evening feeding species. In some
remarkable photographs, Tillet (1966) shows some feeding attitudes of *M. sexta* at
moonflowers.
Dolba hylaeus (Drury)
FS: Saponaria officinalis. FT: Probably C. PL: 32.0 mm.

Ceratomia amyntor (Hübner), Ceratomia undulosa (Walker),
Ceratomia catalpae (Boisduval)

No feeding observations for moths of the genus Ceratomia have been made. Fleming (1968) demonstrated the morphological incapability of C. undulosa and C. catalpae to feed. The proboscis is reduced to lengths of 9.8 mm. and 4.4 mm. respectively, and the proboscis extensor musculature is considerably reduced in both insects as compared to feeding species. The sucking pump, too, is reduced. The proboscis length in C. amyntor is 12.0 mm. While this is still long enough to form a functional sucking tube, it is noteworthy that it is shorter than that possessed by any feeding species within my knowledge. Other representatives of this subfamily have reduced feeding parts and probably they have lost feeding ability. Included here are Lapara bombycoides Walker (PL: 3.5 mm.) and Isogramma hageni (Grote), among others.

Sphinx eremitus (Hübner)

Sphinx chersis (Hübner)
FS: Lonicera japonica, Saponaria officinalis. FT: C. PL: 46.0 mm.

Sphinx kalmiae (J. E. Smith)
FS: Lonicera japonica, Saponaria officinalis. FT: C. PL: 40.0 mm.
Platt (1969) caught this insect in a hanging bait trap using bait consisting of a mixture of stale beer, brown sugar, unsulfured blackstrap molasses, and fermenting fruit.

Sphinx drupiferarum (J. E. Smith)
FS: Lonicera japonica. FT: C. PL: 44.0 mm.
Smith (1943) reports this species fairly common at fruit blossoms during April and May in Kansas.

Sphinx gordius Cramer
FS: Saponaria officinalis. FT: Probably C.

Sphinx luscitiosa Clemens
No feeding observations were uncovered for this species but I suspect that it should be looked for around plants that are visited by other members of its genus.

Sphinx perelegans Hy. Edwards
Essig (1926) reports that: “The moths visit flowers of the evening primroses and rhododendron . . .”

Sphinx sequoia Boisduval
Essig (1926) states: “The moths frequent the flowers of wild cherry and buckeye.”
SMERINTHINAE

Smerinthus geminatus Say, Smerinthus cerisyi (Kirby), Paonias excacaeta (J. E. Smith), Paonias myops (J. E. Smith), Cressonia juglandis (J. E. Smith), Pachysphinx modesta (Harris).

Apparently no known feeding observations for North American moths of this subfamily have been made. Morphological investigations by Fleming (1968) suggest that the insects are not capable of any feeding activity. The proboscis is reduced, depending on species, to lengths ranging from 2.5 to 5 mm – too short to be of much use. Also the proboscis extensor muscles have been reduced to only one pair. Three pairs are present in all feeding sphinx moths examined by Fleming. Schmitt (1938) points out that the minimum number of proboscis extensor muscles for feeding members of any lepidopteran family he examined is two pairs. Rothschild and Jordan (1903) state that the proboscis of the moths of the neotropical genus Protambulyx is not particularly reduced and remains functional. Knuth (1895) considered, erroneously, Smerinthus ocellatus (Linnaeus) to be a feeding species.

MACROGLOSSINAE

Feeding observations have been recorded for only a few species, most of them in the genus Haemorrhagia (=Hemaris). Members of that genus prove to be very active feeders indeed. These moths possess highly developed morphological features associated with feeding, although the proboscis is not particularly long.

Erinnyis ello (Linnaeus)

FS: Saponaria officinalis.

Haemorrhagia thysbe (Fabricius)

FS: Lonicera japonica, Cirsium muticum (swamp thistle), Cirsium sp. (other thistle), Monarda fistulosa (beebalm, wild bergamot), Trifolium pratense (red clover), Syringa vulgaris ( lilac), Saponaria officinalis, Phlox sp., Philadelphus coronarius ( mock orange), Pontederia cordata (pickerelweed), Viola sp. (vetch), Symphoricarpos albus (snowberry), Vaccinium sp. (cranberry and blueberry genus), Ledum groenlandicum (Labrador tea), Hieracium aurantiacum (orange hawkweed), Asclepias syriaca (common milkweed). FT: D, but may feed well into the evening until sundown. PL: 19.4 mm.

Haemorrhagia gracilis Grote & Robinson

FS: Phlox sp., Pontederia cordata, Rubus sp. (blackberry and raspberry genus), Taraxacum officinale (dandelion), Hieracium aurantiacum. FT: D. PL: 14.0 mm.

Haemorrhagia diffinis (Boisduval)


Smith (1943) indicates that these insects: “... visit flowers, particularly fruit and wild currant blossoms.”

Haemorrhagia senta Strecker

Holland (1903) notes the insect: “... frequenting the blossoms of Lupinus.”

PHILAMPELINAE
Insects of this subfamily usually have moderate to well-developed musculature associated with sucking and proboscis extension. Some of the species are active feeders.

**Pholus satellitia pandorus** (Hübner)

FS: *Petunia hybrida*, *Saponaria officinalis*, *Phlox* sp., *Philadelphus coronarius*, *Lychnis alba* (white campion). FT: C. PL: 34.5 mm.

M. C. Nielsen (personal communication) has attracted this species to beer and molasses bait.

**Pholus achemon** (Drury)

FS: *Lonicera japonica*, *Petunia hybrida*, *Phlox* sp., *Philadelphus coronarius*. FT: C.

Essig (1926) records observations of this species: “... visiting flowers of evening primroses, rhododendrons, and petunias.”

Feeding information for other members of the genus *Pholus* was not uncovered. I have observed *P. fasciatus* (Sulzer) on the wing in Louisiana but have never seen it visit flowers. Morphological feeding mechanisms of this species are probably similar to *P. s. pandorus* and one would expect similarity of feeding habits as well.

**Ampeloeca versicolor** (Harris)

No definite recorded plant visitations were found for this species, but W. E. Sieker (personal communication) reports that he has attracted it and the following species while “sugaring.”

**Ampeloeca myron** (Cramer)


**Darapsa pholus** (Cramer)

FS: *Lonicera japonica*, *Lychnis alba*. FT: C. PL: 22.0 mm.

M. C. Nielsen, R. W. Holzman, and W. E. Sieker (personal communication) indicate that they have attracted this species to bait. Nielsen used beer and molasses. Sieker and Holzman did not specify the type of bait. Platt (1969) found the insect commonly in the bait trap previously mentioned under *S. kalmiae*.

**Sphecodina abbotti** (Swainson)

FS: *Syringa vulgaris*, *Viburnum carlesi*. FT: C. PL: 19.5 mm.

On one occasion I saw an individual of this species visit an unidentified species of *Lonicera* (honeysuckle). The moth poised itself over one or two blossoms for a few seconds and then flew off. I was not able to tell whether or not it actually fed. Since this, and the next species, fly rather early in the season comparatively few plants that would satisfy their feeding needs are available to them.

J. P. Donahue (personal communication) collected *S. abbotti* at human feces. Reed (1958) found the species feeding on dog carcasses in advanced decay.

**Deidamia inscriptum** (Harris)

FS: *Syringa vulgaris*, *Phlox* sp. FT: C. PL: 12.2 mm.

**Amphion nescus** (Cramer)

FS: *Syringa vulgaris*, *Geranium robertianum* (herbrobert), *Kolkwitzia amabilis* (beauty bush), *Philadelphus coronarius*, *Phlox* sp. FT: D, especially on cloudy afternoons, and C.
Platt (1969) has taken this insect at the bait trap mentioned under S. kalmiae above. Payne and King (1969) observed the species feeding at soupy pig carrion, and Reed (1958) reports it at dog carcasses in advanced decay.

*Proserpinus flavofasciata* (Walker)

FS: *Taraxacum officinale.*
Holland (1903) states: “It is found in very early summer hovering over flowers.” FT: D.

**CHOEROCPINAE**

Members of this subfamily have a moderately developed proboscis. Head musculature associated with feeding in *Celerio lineata* (Fabricius) is very well-developed. I have not had the opportunity to examine the cranial muscles of any other representatives of the subfamily, but I suspect internal examination of some other species would reveal the pattern indicated in *C. lineata*.

*Xylophanes tersa* (Linnaeus)

FS: *Lonicera* sp.
This insect, which is at times common in southern United States, probably sips nectar from a variety of plants, despite the single definite record indicated.

*Celerio lineata* (Fabricius)

Essig (1926) states: “The moths appear at dusk and visit columbines, honeysuckle, moonvine, Jimpson weed, larkspurs, petunias, and many other flowers.”
Wahlgren (1941) reports the European *C. l. livornica* (Esper) at *Lonicera caprifolium*.

*Celerio galli intermedia* (Kirby)

FS: *Saponaria officinalis.*
Wahlgren (1941) reports the European *C. galli* (Rottemburg) at *Centaurea scabiosa, Lonicera periclymenum, L. caprifolium, Echium vulgare, Lavandula spica,* and *Syringa* sp.

**MODE OF FEEDING**

Close observation of the mode of feeding of adult sphinx moths has been neglected and could be a fruitful field of investigation. Very little may be found in the literature concerning it. In the past most individuals interested in Sphingidae have concerned themselves with the taxonomy of the group, or have been collectors who swept up the sphingid prizes and placed them in orderly rows in cabinets. Such individuals seldom took the time to watch their prey’s activity.

The following account, superficial though it is, may be of some interest. The observations were made in Van Buren County, Michigan, on 5 June 1969. A small patch of garden phlox was under observation on a rather cool (55°-60°F.) evening in hopes that it would be visited by sphinx moths. At 8:05 PM. EST a single *A. nesus* flew to the phlox patch. As it approached to a distance of about 5 cm. from a blossom the moth extended its proboscis and directed it to the center of a flower. The insect hovered as the proboscis was thrust into the flower. The prothoracic legs, well spread apart, usually but not always came in contact with the flower and probably helped steady the insect as it fed. The mesothoracic legs were
spread outward and downward from the body and seldom made contact with the petals. The metathoracic legs were held close to the body along its lateroventral surface. As the insect fed it made at least two, and never more than three, plunges of the head and proboscis into the center of the flower. The proboscis was then withdrawn and the moth flew to another blossom. At a flight distance from the blossoms of up to two meters the insect held its proboscis only partly coiled. I attempted to determine the number of individual flower visits but lost count after about 20. The flowers were white and various shades of red and lavender. I did not observe any preference for one color over another.

At 8:20 PM three more moths of the same species joined the first. All followed the same general feeding pattern. One extremely large individual always touched the petals with four feet; another would sometimes use three feet. On one occasion one of the insects came to rest on a flower for about two seconds. By 8:30 PM all but one moth had left.

DISCUSSION

The data presented in this study are not complete enough to indicate preferences for specific food plants by each species of sphinx moth, but it would be misleading to suggest that specific preferences do not exist. Apparently the range of food plants for feeding species of sphinx moths is broad for some species and narrow for others. Good reasons for this situation are not presently available.

Obviously any species is morphologically limited to certain plants according to the length of the proboscis. A moth with a tongue length in the 15 to 20 mm. range would have difficulty in extracting nectar from a flower with a throat much deeper. Thus while a long-tongued species like *Mesembria* might be successful at a lily, a species like *D. myron* would not. Such conditions would allow long-tongued species to have a wider variety of food plants than short-tongued species. Interestingly enough, those of the moths observed with proboscis lengths of over 50 mm. did not show a wide variety in their choice of food plant. One very long-tongued moth, *Herse cingulata* (Fabricius), a relatively common species in the South, has not been included on the list since its feeding habits were not observed.

Besides morphological restrictions inherent in some species there are certainly behavioral limitations as well. Simply stated, a moth of a given species could feed at a given flower but it does not. This of course suggests the matter of attraction to food plants, but how a moth finds its way to its nectarian feast is a question that is not yet answered.

Knoll (1927) demonstrated that several European twilight-flying sphinx moths could find flowers by sight alone. But as Wahlgren (1941) points out, it is not known what role odor plays. One of the apparently “favorite” plants of crepuscular sphinx moths, *Lonicerajaponica*, presents a pleasant and far reaching odor to humans. Yet a moth’s reaction to this odor cannot be gauged similarly. It may be noteworthy that crepuscular-feeding sphinx moths are usually attracted to flowers relatively light in color and stronger than average in aroma. It would be foolish to suggest that smell does not play a role in attraction.

Moths attracted to bait almost certainly find their way there through olfactory stimuli. The odors created by most baits are identical or very similar to odors encountered by a given species for thousands of years and hence may be programmed into the moth’s behavior and be effective in rendering a certain response. The appearance of some baits and, of course, bait traps are not common in nature and moths have probably not had time to become attracted to them by simply visual stimuli.

It is quite possible that the penetrating aroma of certain flowers attracts moths at considerable distances and as they fly nearer the aroma producing plant, visual sensations take over as behavior-controlling agents and aid the moth in orientating itself in an advantageous feeding position over the flower.

The recorded variety of food plants is greatest for the day-flying moths of the genus *Haemorrhiagia*. This may however be because the moths are diurnal in habit and thus are more frequently observed. For many of the evening-flying species, the range of food plants is probably greater than indicated. Some of these moths are not particularly abundant, and are less apt to be seen at their time of flight. Several species of the genus *Sphinx* fall into this group. Of the approximately three dozen kinds of plants recorded for all moth species in this study, *Lonicerajaponica*, *Saponaria officinalis*, and *Phlox* sp. stand out as favorites for feeding sphinx moths.
Several species of sphinx moths have lost their feeding capabilities. In our geographic area these include members of the subfamily Smerinthinae and members of the genus *Ceratonia* and the genus *Lapara* of the Sphinginae. The lack of feeding ability may be viewed as an evolutionary “mixed blessing.” If the adult insect has eliminated its need for feeding, it has eliminated certain associated risks, but the life-span may be shortened so much that mate-finding may be jeopardized. (Feeding might play a secondary role in mate-location in some Lepidoptera since potential mates are brought together at the feeding site, although this has not been demonstrated with sphinx moths.) Although the evidence is slim, some sphinx moths which apparently feed less often than others may ultimately dispense with feeding altogether. The behavioral trend to feed less frequently indicates a shift into a new niche and possibly morphological changes follow.

**ACKNOWLEDGMENTS**


**LITERATURE CITED**

SOME TETRANYCHOID MITES OF MICHIGAN

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Tetranychoid mites are plant feeders, and many of them are of considerable economic importance. Prior to the present study, only seven species of these mites were known from Michigan; *Oligonychus ilicis* (McGregor) (McGregor, 1931); *Tetranychus medanelli* McGregor (McGregor, 1931; Pritchard and Baker, 1955); *Eurytetranychus buxi* (Garman) (Ries, 1935; McGregor, 1950); *Tetranychus atlanticus* McGregor (Tuttle and Baker, 1964); *Bryobia praetiosa* Koch, *Panonychus ulmi* (Koch), and *Tetranychus telarius* (L.) (Ghate and Howitt, 1965).

During 1966-1968, surveys of many counties were made and 21 species of tetranychoid mites, belonging to the two families Tetranychidae and Tenuipalpidae, were collected. Due to lack of funds, many counties were not surveyed, and in some cases, specific determinations could not be made because of the lack of males. It is expected that future surveys of other counties will yield many more species. For excellent illustrations of the species reported in this paper, and other details, readers are referred to Baker (1949); McGregor (1950); Pritchard and Baker (1952, 1955, 1958); Reeves (1963), and Tuttle and Baker (1964, 1968).

All collections, unless otherwise stated, were made by the author. Collection records are arranged alphabetically by counties. Numbers in parentheses at the end of collection data are my collection numbers. *Eurytetranychus buxi* and *Oligonychus ilicis*, previously reported from Michigan, were not collected in the present study. The total number of tetranychoid mites now known from Michigan is 23.

TETRANYCHIDAE

1. *Bryobia praetiosa* Koch

*Bryobia praetiosa* Koch, 1836: 8.

This is mainly a grass-infecting species. It has world-wide distribution, and invades houses in fall and winter in many parts of the world. This species is very close to *Bryobia rubrioculus* but differs from it in having a tactile seta on tarsus III and IV proximal and approximate to the solenidion, and about one-half to three-fourths of its length.

Collection records -- Chippewa County: Sheridan Park, July 29, 1968, from *Cornus canadensis* (68-52); Ingham County: Michigan State University campus, East Lansing, September 9, 1967, from *Elymus* sp., grape, and grass (67-60, 62, 67); Oakland County: Highland Recreation Park, May 18, 1968, from *Arisaema triphyllum* (68-51F); St. Clair County: Algonac State Park, June 1, 1968, from *Acer* sp., and *Prunus* sp. (68-14, 15); Washtenaw County: University of Michigan campus, Ann Arbor, September 10, 1967, from grass (67-72); Wayne County: Wayne State University campus, Detroit, April 13, 1967, from dead pigeon lying on grass (67-3); Prentis and Lysander streets, Detroit, July 30, 1967, from *Saponaria* sp. and grass (67-28, 29); Dearborn, August 27, 1967, from grass (67-46); Wayne State University campus, Detroit, April 23, 1968, from *Taraxacum officinale* (68-13F).

2. *Eotetranychus multidigituli* (Ewing)

This species is known only from honey locust. Tibia II in the female has five tactile setae and the peritreme anastomoses distally. The dorsal hysterosomal setae both in male and female are shorter than the interval between their bases. The aedeagus is bent ventrally and has a terminal knob.

Collection records — Wayne County: Wayne State University campus, Detroit, September 10, 1967, from Gleditsia triacanthos (67-77); Tuxedo, September 17, 1968, from Gleditsia triacanthos (68-55).

3. Eotetranychus populii (Koch)

*Eotetranychus populii* Koch, 1838: 14.


This species is known from poplar and willow. The peritremes in both the sexes anastomose distally and tarsus II is with proximal member of duplex setae much shorter than distal member. The female genital flap has longitudinal striae on the anterior portion. The aedeagus has a medial curve.

Collection record — Oakland County: Northwestern Highway and Telegraph Road, August 11, 1967, from *Salix* sp. (67-33).

4. Eurytetranychus buxi (Garman)


This species was first recorded from Oakland and Wayne Counties, Michigan, on boxwood. It is widespread in the United States and is known mainly to infest boxwood. It is distinctive in having the dorsal body setae about as long as the intervals between the bases of next setae. The sensory setae on tibia III and IV are absent in the female. The aedeagus is dorsally bent. The species was not collected in the present study.

5. *Oligonychus aceris* (Shimer)

*Acaris aceris* Shimer, 1869: 320.


This species is known from maple, feeding on the lower surface of the leaf. The body setae in adults are set on small tubercles. The tibia I in females has only six tactile setae and one sensory seta which is more than half as long as the dorsal tactile seta. The aedeagus is ventrally bent.

Collection records — Ingham County: Michigan State University campus, East Lansing, September 9, 1967, from *Acer* sp. (67-66); Oakland County: Pontiac Lake Recreation Area, June 24, 1967, from *Acer* sp. (67-8); St. Clair County: Algonac State Park, June 1, 1968, from *Acer* sp. (68-14).

6. *Oligonychus endytus* Pritchard and Baker

*Oligonychus endytus* Pritchard and Baker, 1955: 301.

This species is known previously from California and has been found on the dorsal side of oak and chestnut leaves. The adults are distinctive in having long and thick dorsal body setae which are borne on strong tubercles. Tibia I in Michigan specimens (females) bears five tactile setae and one sensory seta which is less than half as long as dorsal tactile seta. The aedeagus is ventrally bent.
Collection records — Chippewa County: One half-mile south of St. Mary’s River, Sugar Island, July 27, 1968, from *Acer* sp., and *Cornus* sp. (68-38, 39, 40).

7. *Oligonychus ilicis* (McGregor)


McGregor (1931) reported *O. ilicis* occurring on raspberry in Berrien County, Michigan. No other record of this species is known from Michigan. It is distinctive in that the females have seven tactile setae on tibia I and only three tactile setae proximal to duplex setae on tarsus I. The outer sacral setae in females are smaller than the inner sacrals. The aedeagus in the male is close to *Oligonychus platani* (McGregor).

8. *Oligonychus propetes* Pritchard and Baker


Hysterosomal integumentary striae in females are transverse between the third pair of dorsocentral setae and inner and outer sacral setae, and peritremes end into a simple bulb.

Collection record — St. Clair County: Algonac State Park, June 1, 1968, from *Forsythia* sp./*Cornus* sp. (68-17).

9. *Oligonychus ununguis* (Jacobi)

*Tetranychus ununguis* Jacobi, 1905: 239.


This species, which is known from many parts of the United States and Europe, infests conifers. Tarsus I in female Michigan specimens has four tactile setae proximal to duplex setae and tibia I has seven tactile setae. The aedeagus is bent ventrally at a right angle to the shaft.


10. *Panonychus ulmi* (Koch)

*Panonychus ulmi* Koch, 1836: 11.


This is a well-known pest of deciduous fruit trees. It is easily recognized from other species in that the outer sacral setae on the hysterosoma are about two-thirds as long as the inner sacrals; the genital flap in females possesses longitudinal striae on the anterior portion. All the dorsal body setae are set on strong tubercles.

Collection records — Macomb County: Melrose Court, July 16, 1967, from *Ulmus* sp. (67-21); Oakland County: Pontiac Lake Recreation Area, June 24, 1967, from *Symlocarpus foetidus* (67-6); St. Clair County: Algonac State Park, June 1, 1968, from *Prunus* sp. (68-15); Wayne County: Greenfield Village, August 17, 1967, from *Rosa* sp. and *Ulmus* sp. (67-39,40).

11. *Petrobia hartii* (Ewing)


*Petrobia hartii*, Pritchard and Baker. 1955: 45.
P. hartii is recorded from various parts of the world and is known to feed primarily on Oxalis. The first pair of legs in females are very long, about twice as long as the body, and the chonal setae on the hysterosoma are shorter than other dorsal hysterosomal setae. All the dorsal body setae are set on strong tubercles.


12. Petrobia latens (Muller)

Acarus latens Muller, 1776: 187.
Petrobia latens, Oudemans, 1915: 44.

P. latens has world-wide distribution. It feeds mainly on monocotyledonous plants and is known to invade houses. The dorsal body setae in females are shorter than distances between their bases and are not set on tubercles. All the dorsal hysterosomal setae are approximately equal in length. Males are unknown.

Collection records — St. Clair County: Algonac State Park, June 1, 1968, from Prunus sp., Geranium sp. Ambrosia sp. , and Asclepias sp. (68-10, 12, 13).

13. Schizotetranychus garmani Pritchard and Baker


Dorsal hysterosomal setae in female are longer than interval between their bases and tibia I has nine tactile setae. Aedeagus is very long, pointed, and wavy.


14. Schizotetranychus schizopus (Zacher)

Tetranychus schizopus Zacher, 1913: 40.

The dorsal body setae in females are lanceolate and reach to the base of next setae. Tibia I in the female has eight tactile setae and tarsus I has three sensory setae. Aedeagus is bent dorsally and has a knob distally. It is known to infest willow.

Collection records — Wayne County: Dearborn, August 27, 1967, from fern and Pieris sp. (67-64, 65).

15. Schizotetranychus spireafolia Garman


This species is known only from Spirea. The female is distinctive in having lanceolate dorsal setae which are shorter than the longitudinal intervals between their bases. Tibia I in male and female has eight tactile setae. The aedeagus is bent upward.


16. Tetranychus atlanticus McGregor

This species is known to feed mainly on low-growing plants. The earliest Michigan
collection record is from Bay City on red raspberry (Tuttle and Baker, 1964). The females
have longitudinal striae between the third pair of dorsocentral setae on the hysterosoma and
tibia I has nine tactile setae. The aedeagus has an enlarged knob which is about one-fourth as
long as the dorsal margin of shaft.

Collection records—Oakland County: Northwestern Highway and Telegraph Road, Stream
Wood, August 11, 1967, from Asarum canadense, and Sanguinaria canadensis (67-37, 38);
Oakwood, August 27, 1967, from Aralua sp. (67-42); Gildow Street, University of Michigan,
Dearborn Center, August 27, 1967, from Viola sp. (67-48); Washtenaw County: University

17. Tetranychus canadensis (McGregor)


This species is known from several parts of the country. The females have transverse striae
between the third pair of dorsocentral setae and longitudinal striae between the inner sacral
setae on the hysterosoma. Tibiae I have nine tactile setae in the female, eight in the male. The
knob of the male aedeagus is about one-fourth as long as dorsal margin of the shaft.

Collection records—Wayne County: Wayne State University campus, Detroit, July 13,
1967, from Ulmus sp. (67-19); West Canfield and Prentis streets, Detroit, July 29, 1967,
from Aesculus hippocastanum (67-23); West Canfield street, Detroit, from Ulmus sp.
(67-26).

18. Tetranychus medanieli McGregor


This species was first collected and described from Bridgman and Byron Creek (Berrien
County), Michigan, on cultivated raspberry. The females have transverse striae between the
third and inner sacral setae on the hysterosoma. Tibia I in the female has seven tactile setae.

Collection records—St. Clair County: Algonac State Park, June 1, 1968, from raspberry
(68-16).

19. Tetranychus schoenei McGregor

Tetranychus schoenei McGregor, 1941b: 223.

T. schoenei may be confused with T. canadensis. The females of T. schoenei and T.
canadensis have transverse striae between the third pair and longitudinal striae between the
inner sacral setae on the hysterosoma. However, the aedeagus in males of T. schoenei has a
strongly enlarged knob. This knob in T. schoenei is about one-half and in T. canadensis is
about one-fourth as long as the dorsal margin of the shaft.

Collection records—Oakland County: Pontiac Lake Recreation Area, July 9, 1967, from
Symploricarpus foetidus (67-15); Washtenaw County: Nichols Arboretum, Ann Arbor,
September 10, 1967, from Spirea sp. (67-73); Wayne County: Gildow street, University of
Michigan, Dearborn Center, August 27, 1967, from Tilia sp. (67-47).

20. Tetranychus urticae Koch

Tetranychus urticae Koch, 1836: 10.
Tetranychus urticae, Tuttle and Baker, 1968: 129.
This species is widely distributed in temperate regions and is known from numerous hosts. The females have longitudinal striae between the third pair of dorsocentral setae on the hysterosoma and have nine tactile setae on tibia I. The aedeagus knob is very small, less than one-sixth as long as the dorsal margin of the shaft. The green form, earlier known as *Tetranychus telarius*, is included here in *T. urticae* (Tuttle and Baker, 1968).

**Collection records**—Bay County: Two miles south of Freeland, July 26, 1968, from *Melilotus alba* (68-21); Chippewa County: Half-mile south of St. Mary River, Sugar Island, July 27, 1968, from *Aegopodium* sp. (68-50); Sheridan Park, July 29, 1968, from fern and *Cornus canadensis* (68-51, 52); Ingham County: Michigan State University campus, East Lansing, September 9, 1967, from *Viola* sp., *Arctium* sp., and grape (67-56, 59, 62); Macomb County: Melrose Court, July 16, 1967, from *Salvia* sp. (67-22); Oakland County: Summit Drive, Novi, October 26, 1966, from indoor balsam plant (D. R. Cook) (66-1); Pontiac Lake Recreation Area, June 24, 1967, from *Symyplocarpus foetidus* (67-6); Highland Recreation Area, August 11, 1967, from *Smilacina racemosa* (67-30); Washtenaw County: The Nichols Arboretum, Ann Arbor, September 10, 1967, from lily (67-75); Wayne County: Third and West Hancock, Detroit, June 24, 1967, from hollyhock (67-5); Wayne State University campus, Detroit, July 6, 1967, from *Ambrosia* sp. (67-14); Wayne State University campus, Detroit, July 13, 1967, from *Viola* sp. and *Deutzia* sp. (67-18, 20); West Canfield and Lysander, Detroit, July 29, 1967, from *Arctium minus* (67-24); Third and West Hancock, Detroit, July 29, 1967, from *Linocera* sp. (67-25); Prentis and Lysander, Detroit, July 30, 1967, from *Lactuca* sp. (67-27); Greenfield Village, Dearborn, August 17, 1967, from *Canna* sp. (67-41); Henry Ford Museum, Dearborn, August 27, 1967, from *Forsythia* sp. (67-53).

**Tenuipalpidae**

21. *Brevipalpus bicolpus* Pritchard and Baker


This species is very close to *Brevipalpus garmani* Baker and differs from it in that the females have two sensory rods on tarsus II. It was previously known only from Maryland on pawpaw.

**Collection record**—Oakland County: Highland Recreation Area, August 11, 1967, from *Smilacina racemosa* (67-31).

22. *Brevipalpus garmani* Baker


Females of *B. garmani* have only one sensory rod on tarsus II, and the propodosoma has a few longitudinal striae mediodorsally.

**Collection record**—Ingham County: Michigan State University campus, East Lansing, September 9, 1967, from *Elymus* sp. (67-60).

23. *Pentamerismus erythreus* (Ewing)

*Tenuipalpus erythreus* Ewing, 1917a: 152.  

This species is known from conifers in several states. The females have two pairs of dorsosublateral and seven pairs of minute dorsolateral setae on the hysterosoma.

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LITERATURE CITED


——. 1968. Spider mites of southwestern United States and a revision of the family Tetranychidae. Tucson.


REVIEWS OF RECENT LITERATURE


Knowing of the excellence of the author's work especially as an artist of Diptera, entomologists have been waiting for this much-needed volume since the completion of the first manuscript in 1932. The work deals with two-winged flies (Diptera) of North America west of the 104th meridian, south of the 70th parallel and north of Mexico, but including Baja California. There are 38 double-columned pages of introductory matter, keys to families and genera, notes on species and the localities from which they are known, a glossary, selected bibliography, and index to species. There are some 180 of the author's beautiful drawings of flies as well as many illustrations from other sources.

Great caution will be needed in using this work. There are unfortunately many errors in spelling of names, beginning with “philicornis” for pilicornis on the frontispiece. The keys in several instances are adaptations of keys which have been superseded. The bibliography includes nothing later than one reference dated 1963. It is recommended that names be checked in Stone et al., 1965 (A Catalog of the Diptera of America North of Mexico, U.S. Dept. of Agr., Agr. Handbook no. 276) before using them. The Catalog is referred to in the text many times, but no citation of it appears.

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In a short span, this encyclopedic work summarizes the historical problems of the nature of life. Blandino conducts his narrative in a condensed and highly-packed form that assumes the nature of an outline. His own ideas are explained in the second part of the book. In the author's words, his conception is that vegetative biological phenomena (1) are material deterministic phenomena and therefore, in order to produce them, fixed laws inherent in matter are both necessary and sufficient; (2) are regular, specific phenomena and therefore must be produced by specific preferential laws which do not exist in an average chance universe. Blandino is both a Jesuit and the recipient of a doctorate in biological sciences from the University of Rome, so that this work in theoretical biology will claim more attention than if it were the work of a theologian. His concise summary of historical thought is useful.

R. S. W.

Alexander Adams seems, if unconsciously, to be following in the footsteps of Donald Culross Peattie. Like Peattie, he wrote a volume on Audubon and then essayed a biographical survey of a number of important naturalists. Eternal Quest is the latter, and interestingly enough, it is the first book of its precise kind since Peattie's Green Laurels (1936) to evoke the same emotion.

Eternal Quest is a popularization of the history of science, written for a non-professional audience, but it is the sort of book that accomplishes more in the long run that a professional treatise. Like the immensely popular Green Laurels, Adams' work will urge others to the study of biology through the often inspiring examples of early investigators. Beginning with man's earliest natural speculations, Adams weaves a sprightly narrative of biological endeavor that ends with Mendel, T. H. Morgan and the discovery of DNA. His in-depth portraits are scholarly and sound; they provide no fresh information, but are not meant to do so. Undeniably we need a popular biographical narrative of the history of biology every twenty-five years or so, which will take into account the scholarship produced in the interim. Eternal Quest succeeds admirably in this specific role. It is recommended especially to students, but professional biologists and even the fact-hardened historian of science will find it good reading. Adams even points a moral, but it is not such a bad one; writing of the naturalists, he comments that "in these confused times we might well take to heart the lessons their lives so closely reveal to us and learn that problems are conquered only by fresh and open minds. We might also respect what they have taught us about natural history: that man is not necessarily here to stay unless he can find a better means of preserving himself and his environment."

R. S. W.

BOOKS RECEIVED FOR REVIEW


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).