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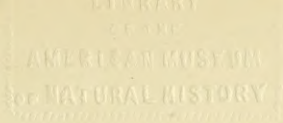
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ALEXANDER G. RUTHVEN,  
Director of the Museum of Zoology,  
University of Michigan.



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## NOTES ON THE ORTHOPTERA OF NORTH DAKOTA

BY THEODORE H. HUBBELL

During the summers of 1919 and 1920 field studies of the Orthoptera of North Dakota were made by Miss Ada Olson and the writer in a number of localities representative of some of the principal faunal conditions found in the state. This work was undertaken as a part of a biological survey of the state which is being carried on by the North Dakota Biological Station in coöperation with the Museum of Zoology of the University of Michigan, under the direction of Crystal Thompson, Curator of the Station Museum. It was made possible through the efforts and coöperation of Dr. R. T. Young, Director of the State Biological Station.

Comparatively little has been known regarding the Orthoptera of the state. Records from North Dakota are few and for the most part scattered, although in the adjacent regions of Minnesota, Manitoba, and Montana there has been a fair amount of investigation of this group. In the present paper

no attempt has been made to gather together these scattered records; this is in no sense a list of the Orthoptera of the state, but is intended merely as a contribution to the knowledge of its fauna. It makes no pretense to completeness; indeed, another season's work in the northeastern, southeastern, and western parts of the state, where it is most urgently needed, might easily add 15 or 20 species to the 78 here listed. With the addition of previously published records, the number of species definitely known from the state must be in the neighborhood of 85 or 90. The fact that the earlier authors seldom gave a more specific locality than "Dakota" makes the placing of many of their records difficult or impossible.

All of the collections of the season of 1919 were made by Miss Olson with the assistance of Miss Thompson, those of 1920 in large part by the writer. A number of the specimens which have been included in this report were taken by other collectors, whose names are noted in the annotated list of species. In this paper there is recorded a total of 4,805 specimens from North Dakota and 39 from other localities, representing a total of 78 species. The entire collection is preserved in the Museum of Zoology of the University of Michigan, with the exception of a synoptic series deposited in the Biological Station at Devils Lake, and of a number of specimens of species determined by Rehn and Hebard, which are in the collection of the Academy of Natural Sciences of Philadelphia.

The writer wishes here to acknowledge his indebtedness to Miss Crystal Thompson, under whose direction the work was carried on; to Dr. R. T. Young; and to Messrs. James A. G. Rehn, Morgan Hebard, and Dr. A. P. Morse, by whom a number of species were determined and many of the author's determinations verified. Acknowledgments are also due in particular

to Mr. A. H. Eastgate, of Bottineau, and to Mr. Charles Eastgate, County Agent of Slope County, whose hospitality and generosity in the matter of furnishing transportation and information concerning local conditions made possible a greater degree of success in the field work than would otherwise have been attained.

#### NOTES ON THE MAJOR ENVIRONMENTAL CONDITIONS

In order that the environmental conditions governing the distribution of the Orthoptera within the state may be better appreciated, the following brief sketch of the physiographic conditions found within its boundaries is given. It is taken chiefly from the detailed reports of Simpson<sup>1</sup> and Leonard.<sup>2</sup>

The surface of the state of North Dakota consists of three well-marked plains which rise successively from east to west by distinct escarpments, these being the Red River Valley, the Drift Prairie Plain, and the Great Plains Plateau. The first two of these physiographic regions are placed by Fenneman<sup>3</sup> under the Western Lake Section of the Central Lowland Province; the westernmost and highest as a part of the Missouri Plateau Section of the Great Plains Province.

The Red River Valley occupies a comparatively narrow strip running north and south along the eastern edge of the state, with an elevation above sea-level of from 800 to 975 feet. It is bounded on the west by an escarpment 300 to 500 feet high, known in the northern part of the state as the Pembina Mountains, and in South Dakota as the *Coteau des*

<sup>1</sup> Simpson, H. E., 1912, The Physiography of the Devils-Stump Lake Region, North Dakota. Sixth Biennial Report, *State Geological Survey of North Dakota*, pp. 103-157.

<sup>2</sup> Leonard, A. G., 1908, The Geology of Southwestern North Dakota, . . . etc. Fifth Biennial Report, *State Geological Survey of North Dakota*, pp. 27-114.

<sup>3</sup> Fenneman, N. M., 1916, Physiographic Divisions of the United States. *Ann. Assoc. Amer. Geogr.*, vi, pp. 19-98 (32, 61).

*Prairies.* This marks the eastern boundary of the Drift Prairie Plain, which has a general elevation of from 1,500 to 1,800 feet, rising gradually toward the west. It is bounded in that direction by an abrupt escarpment 600 to 700 feet high, marking the eastern boundary of the Great Plains, and known as the *Coteau du Missouri*; this runs from near the northwest corner of the state in a general southeasterly direction to the southern border. Within the boundaries of the broader portion of the Drift Prairie Plain are two minor physiographic features, the Mouse River Valley and the Turtle Mountains, which depart somewhat from the general character of this region. That entire portion of the state, constituting approximately half of its area, which lies to the southwest of the *Coteau du Missouri* is occupied by the Missouri Plateau section of the Great Plains province. Its surface varies from 1,800 to considerably more than 2,700 feet elevation, increasing in height toward the southwest. Subordinate but striking topographic features are the valleys of the Missouri River and its tributaries, and the "Little Bad Lands" of the Little Missouri River near the western edge of the state.

The humidity decreases as one goes from east to west across the state; the Red River Valley is comparatively moist, the Drift Prairie Plain semi-arid, and the Great Plains section an arid, semi-desert steppe. The vegetation corresponds rather closely to this change in humidity; in the eastern part of the state the streams and lakes are bordered by heavy forest, and the prairie is covered with a fairly thick and sometimes tall growth of grasses and other herbaceous plants; as one proceeds westward the trees rapidly disappear, the vegetation becomes scantier and more stunted, and the characteristic plants of semi-desert regions, such as sage-brush and cacti, become more numerous. These changes are gradual, corre-



sponding to the gradual nature of the westward increase in aridity.

There is as yet too little data available on the distribution of the Orthoptera within the state to make generalizations possible, but this fauna will probably be found to resemble the flora in being characterized by comparative uniformity from north to south across the state, but by marked changes from east to west. Most of the species, in common with the vascular plants,<sup>4</sup> could probably be placed in three broad categories according to their distribution in North Dakota—(1) generally distributed, (2) eastern, and (3) western. Comparatively few could be designated as forms of northern or southern distribution within the state.

#### NOTES ON COLLECTING LOCALITIES

*Red River Valley.*—Only a small amount of collecting was done in this part of the state. A few days' collecting in the fields and groves bordering the Bois-de-Sioux River at Fargo, and a few specimens from Grand Forks and Pembina give an altogether inadequate idea of the fauna of the valley.

*Drift Prairie Plain.*—A. *Devils-Stump Lake Region* (Devils Lake, Ramsey and Benson counties; Stump Lake, Nelson County; Sheyenne River, Eddy and Nelson counties).—The region about Devils Lake is typical rolling drift prairie, but little dissected, with glacial lakes occupying many of the depressions. Devils Lake is the largest of these, with Stump Lake next in size; within a few miles are a considerable number of small lakes and ponds. All of these lakes at a not far distant time occupied a much larger area than they do at present; the rapid recession of the water in the lakes has left

<sup>4</sup>Stevens, O. A., 1920, *The Geographical Distribution of North Dakota Plants*. *Amer. Journ. Bot.*, vii, pp. 231-242, 1 fig.

large areas of mud and sand flats and stony beach exposed, which are among the striking features of the region. The neighborhood is largely under cultivation, and almost no areas of untouched prairie of any size remain. The only natural wooded areas occurring in this part of the state are found about the margins of the lakes and streams; these forests are largely of oak, mingled with elm, aspen, and other trees, and are of considerable extent, being from a quarter to one-half mile in depth in places around the margins of Devils and Stump lakes. There are, however, large numbers of planted groves everywhere on the prairies, usually of poplars or other swift-growing trees, which are probably exercising a considerable influence on the fauna. From among the woods on the south side of Devils Lake there rises a dry, grassy elevation of considerable height, known as Sully's Hill, where were found *Melanoplus conspersus* and *Phoetaliotes nebrascensis*, not taken elsewhere in the eastern part of the state. The cultivated fields, grassy prairie, exposed sandy and gravelly flats around the lakes, woodland, the grassy swales in the moist depressions and the marshes about the margins of the lakes and ponds constitute the principal Orthopteran habitats in this region. Although collections were made at a large number of localities in the vicinity of Devils Lake, in this paper no attempt has been made to mention them in detail; instead they have been grouped under the general name of Devils Lake.

B. *Turtle Mountains* (Lake Upsilon, Rolette County; Lake Metagoshe, Bottineau County).—The Turtle Mountains lie midway across the Canadian boundary, occupying portions of Rolette and Bottineau counties in North Dakota, and projecting north into Manitoba; they have an area of from 600 to 800 square miles. They consist of a group of low, drift-covered hills forming a rough table-land, which rises abruptly

on all sides from the surrounding prairie; their surface lies from 400 to 800 feet above the plain, with a maximum elevation of 2,860 feet. They are covered with forests of aspen, balsam poplar, oak, paper birch, and alder, in most places with dense undergrowth; most of the trees are small on account of the destructive fires which have swept this region in the past. Some farming is carried on, and grassy or shrubby clearings surround the farmhouses scattered through the hills; abandoned clearings are also found in different stages of reversion to natural conditions. The region is well watered and poorly drained; many of the valleys are occupied by small glacial lakes, bordered by marshes or by sandy or gravelly beaches, and in the moist depressions there are numerous meadows and swales of tall grass and herbage.

C. *Mouse River Valley* (Bottineau, Bottineau County).—The only collecting done in this area was at Bottineau, near the southwestern foot of the Turtle Mountains. The region is an old lake plain, almost unbelievably level and monotonous; so far as vegetation and insect fauna are concerned it seems to be practically the same as the prairie in the vicinity of Devils Lake. Very little of the original prairie vegetation remains in this vicinity; most of the land is under cultivation, and much of the remainder is overrun with dense mats of Russian thistle.<sup>5</sup> During the summers of 1919 and 1920 crops in this vicinity were almost completely destroyed by plagues of grasshoppers, and for some years previous they had been very troublesome. An examination of the fields in the neighborhood during both summers showed that *Melanoplus mexicanus atlanis*, *Melanoplus bivittatus* and *Camnula pellucida* were the most abundant species in the swarms of grasshoppers which covered the plants and the ground beneath; other common

<sup>5</sup>*Salsola kali* L., var. *tennifolia* G. F. W. Mey.

species which were present in numbers were *Melanoplus infan-*  
*tilis*, *Melanoplus packardii*, and *Melanoplus dawsoni*.

*Missouri Plateau Section of the Great Plains Province.*—

A. *Northern Portion* (Buford and Williston, Williams County).—During the latter part of July, 1920, Miss Thompson and Miss Olson spent a few days in this vicinity. Collecting was done chiefly on the flats of the Missouri River Valley and on the slopes and crests of the bluffs overlooking them. Orthoptera were abundant in the cultivated fields and among the xerophytic vegetation along the bluffs, but there were comparatively few on the clay bottom lands. These localities are the only ones where any collecting was done in the northwestern part of the state.

B. *Southwestern Portion* (Medora, Billings County; Amidon, Slope County).—Four general topographic types are represented in this region: uplands, lowlands along the stream valleys, bad lands, and river terraces. The upland areas occupy most of the region; their surface is a rolling plain, the elevation of which varies from 2,700 to nearly 3,200 feet above sea level. The surface of the plain is studded with high buttes, standing 400 to 600 feet above the level of the surrounding plain, and forming a conspicuous feature of the landscape. The upland is well drained, being covered with a network of small watercourses, the majority of them dry throughout the year; lakes and ponds are of rare occurrence. The most prominent topographic feature of the region is the valley of the Little Missouri River and its bordering strip of Bad Lands. The river at Medora lies over 400 feet below the plains. Its valley at the bottom is one-half to one mile wide, and stretching away on each side are broad terraces several miles in width, intermediate in height between the lower valley and the plains above. The Bad Lands border the valley on each

side, and between Medora and Amidon average 15 to 20 miles across.

Medora is situated in the valley of the Little Missouri where the Northern Pacific Railroad crosses the river. The elevation of the town is approximately 2,250 feet. Miss Thompson and Miss Olson spent a few days here during July and August, 1920. Orthoptera were found in abundance on the dry, sandy flood-plain and the arid clay and sand slopes of the buttes and terraces, among the rather scanty growth of sage-brush, clumps of grasses, low cacti, and other xerophytic vegetation found in these situations; they were also abundant in cultivated fields on the terraces.

Conditions at Amidon are more typical of the region as a whole. The town is situated on the uplands, near the edge of the Bad Lands bordering the big bend of the Little Missouri River, to the southeast of Medora. The uplands in general are covered with thick, tough sod, but the vegetation of short grasses and low herbaceous plants is scanty and during the greater part of the season appears parched and brown. Rank growths of tall grasses and herbage are scarce, and are confined to small areas in the bottoms of the watercourses. The steep, sandy clay slopes in the Bad Lands are usually nearly bare, but the Bad Lands as a whole are covered with vegetation. The summits of the ridges and the broader level areas are covered with scanty growths of grasses, cacti, etc., and along the "breaks" (where the upland drops away into Bad Lands) there are often quite dense patches of low shrubbery and small groves or clumps of aspens. Some of the buttes rising above the plain support a growth of shrubs and small trees on their steep, rough slopes; the vegetation of their flat-topped summits is similar to that of the plain below. Near the "breaks" along the watercourses there are occasional scattered

groves of willows and aspens, but on the uplands themselves there is not a sign of tree or shrub to relieve the monotony. Much of the region is now being dry-farmed, and the areas of untouched upland are continually being encroached upon. All of the collecting in this region was done during the last week in August. Orthoptera were common on the upland areas, but somewhat less so among the Bad Lands.

LIST OF SPECIES<sup>6</sup>

## BLATTIDAE

*Blattella germanica* (Linnæus).—Fargo, Sept. 2, 1920, 5 females.

This species was common in one of the hotels.

*Nyctibora noctivaga* Rehn.<sup>7</sup>—Grand Forks, Grand Forks County, Sept. 6, 1891 (A. H. Eastgate), 1 male.

Collected under a street light. Adventive.

## MANTIDAE

*Litaneutria skinneri* Rehn?—Amidon, Aug. 24, 1920, 1 male; Medora, July 31, 1920, 1 juvenile.

The specimen from Amidon was taken in the edge of the Bad Lands, on a dry, sun-scorched hillside covered with a scanty growth of short grasses and other low plants. It was so colored as to be almost invisible when motionless on the ground among the brown grass tufts, and when it ran swiftly about among the low, scattered plants one could scarcely follow the shadow-like form with the eye. The nymph from Medora was taken in a similar situation on the side of a butte in the Bad Lands, among dry grasses and clumps of *Artemisia*.

The specimens are both males. The adult from Amidon,

<sup>6</sup> All determinations and systematic notes in the following list are to be charged to the writer, unless otherwise noted.

<sup>7</sup> Determination verified by J. A. G. Rehn.

has tegmina and wings abbreviate, and agrees well with Rehn's description<sup>8</sup> of *skinneri*, described from southern Arizona, and since reported from Texas, New Mexico, California, Colorado, and Nebraska. However, as Caudell<sup>9</sup> has suggested, it is possible that males of other species of *Litaneutria* may sometimes be brachypterous, and that of *L. borealis* Scudder (described<sup>10</sup> very briefly from Nebraska and also known from Colorado) is unknown, so that there is some doubt about the correct determination of these specimens.

## PHASMIDAE

*Diapheromera femorata* (Say).—Grand Forks, Grand Forks County, summer 1892 (A. H. Eastgate), 1 male.

Taken on shrubbery growing on the bank of the Red River.

## ACRIDIDAE

## ACRYDIINAE

*Acrydium granulatum* Kirby.—Stump Lake, July 24, 1920, 1 female; Lake Upsilon, Turtle Mountains, Aug. 4, 1920, 2 juveniles; Fargo, Aug. 31, 1920, 1 juvenile.

A single female was taken at Stump Lake near the edge of a spring on a wet, mucky hillside among clumps of bushes and tall shrubbery; several nymphs were swept from the grassy borders of the small stream flowing away from the spring. Nymphs of several instars of this species were very common on the gravelly beach of Lake Upsilon, among the thin growth of grasses and low herbaceous plants, and especially among the patches of moss which cover parts of the upper beach in places. At Fargo a single nymph was taken on a mass of dead, matted grass near the muddy margin of the Bois-de-Sioux River.

<sup>8</sup> *Proc. Acad. Nat. Sci. Phil.*, lix, 1907, pp. 26-28, fig. 1.

<sup>9</sup> *Proc. U. S. Nat. Mus.*, xlv, 1913, pp. 606-607.

<sup>10</sup> *Canad. Ent.*, xxviii, 1896, p. 209.

*Acrydium hancocki* (Morse).—Lake Upsilon, Turtle Mountains, Aug. 4, 1920, 1 male.

A single male was found in a small opening among the willows and aspens growing along the upper margin of the beach of Lake Upsilon, on a patch of nearly bare earth scattered with dead leaves and twigs and with occasional small patches of moss. An hour's search in the vicinity revealed no other specimens.

#### TRYXALINAE

*Pseudopomala brachyptera* (Scudder).—Medora, July 31, 1920, 1 juvenile male; Amidon, Aug. 25, 1920, 1 male.

The immature male from Medora was taken among scanty vegetation on the flood-plain of the Little Missouri River. The Amidon specimen was beaten from a thicket of herbaceous plants and bushes (among which wild roses were conspicuous) forming a growth about four feet tall, in the head of a gully in the "breaks" of the Bad Lands. It was the only one found, in spite of a considerable amount of collecting in this vicinity.

*Acrolophitus hirtipes* (Say).—Buford, July 23, 1920, 3 males; Amidon, Aug. 25, 1920, 1 male.

At Buford this species occurred in small numbers on a dry hillside among a scanty growth of xerophytic vegetation. The single specimen taken at Amidon was found on the edge of the Bad Lands among scattered clumps and patches of grass and sage-brush on the nearly bare, dry clay soil. When in flight it has considerable resemblance to *Spharagemon collare*, with which it was associated both at Buford and at Amidon.

*Eritettix tricarinatus* (Thomas).—Devils Lake, Aug. 26, 1919, 1 juvenile male.

A single nymph of this species was taken by Miss Olson on the dry, grassy slopes of Sully's Hill.



*Amphitornus coloradus* (Thomas).—Medora, July 30, 1920, 3 females; Amidon, Aug. 21-28, 1920, 8 males, 5 females.

At Medora this species was found among sparse, dry vegetation on the sides of a clay butte. At Amidon it was fairly common on the upland plains among the characteristic vegetation of dry grasses, clumps of *Artemisia*, etc. Specimens were taken on the top of Black Butte, on the plains at the base of Chalky or White Butte, among the "breaks" of the Bad Lands, and in pastures and fields near town. While quite numerous, on account of their great agility specimens were seldom taken except by sweeping, or in the case of the males by tracing them down by means of their stridulation.

This consists of a series of rather slow notes—zzzzz—zzzzz—zzzzz—zzzzz—repeated at the rate of approximately three in two seconds. The sound is apparently produced as follows: during each separate note the closed femur and tibia make one complete movement across the tegmina from the highest to the lowest position which they occupy in stridulation, and back to the highest, but this is not accomplished in a single uniform motion. During this movement through a comparatively large angle the leg is vibrated very rapidly back and forth over a much smaller arc at the estimated rate of 15 to 20 vibrations per second. The resulting note is rather faint.

*Opeia obscura* (Scudder).—Buford, July 23, 1920, 1 male, 2 juveniles; Medora, July 30-Aug. 3, 1920, 26 males, 12 females, 1 juvenile; Amidon, Aug. 21-28, 1920, 23 males, 54 females.

At Buford this species was scarce among dry grass and *Artemisia* patches on the sides of a barren hill; at Medora it was common in similar situations. In the vicinity of Amidon it was common and in places abundant on dry grassland; on the plains in the vicinity of town, on the slopes and summits

of the buttes, and on the patches of grass, *Artemisia*, *Opuntia*, etc., growing on the ridges and gentler slopes in the Bad Lands this species was one of those most constant in occurrence.

*Alpha cinerea* (Bruner).—Medora, July 29-30, 1920, 19 males, 21 females.

Found in considerable numbers on the dry, sparsely vegetated flood-plain of the Little Missouri River, and on the slopes and river terraces above the inner valley. It was taken among clumps of dry grass and sage-brush.

*Phlibostroma quadrimaculatum* (Thomas).—Bismark, Burleigh Co., Aug. 9, 1885, 1 male, 1 female (collection Mich. Agr. Coll.); Buford, July 23, 1920, 25 males, 8 females, 1 juvenile male; Medora, July 30-Aug. 3, 1920, 20 males, 19 females, 3 juveniles; Amidon, Aug. 25-27, 1920, 1 male, 4 females.

Common on the top and sides of a dry hill at Buford, among clumps of grass and sage-brush. At Medora it was common in similar situations, on the flood-plain and terraces. A single female was taken at Amidon on a dry, grassy hillside in the "breaks," and three specimens in a dry pasture near the town; two of the latter were in copula.

*Orphulella pelidna* (Burmeister).—Devils Lake, July 20-Aug. 16, 1920, 24 males, 8 females; Stump Lake, July 24, 1920, 8 males, 9 females; Bottineau, Aug. 1, 1920, 1 female; Fargo, Aug. 31, 1920, 1 male.

This species was fairly common throughout the eastern part of the state. It was taken in considerable numbers among the sparse vegetation of grasses, liquorice, and other plants on the dry sandy or stony flats around the margins of Devils Lake and Stump Lake, and was also common in the short grass of dry pastures and the taller and denser grass of roadsides and waste fields in the vicinity. The single specimen

from Bottineau was swept from the tall grass and herbage filling a small, dry watercourse where it ran through a bare pasture. One male was taken at Fargo with *O. speciosa* in a low, moist area among clumps of tall grass and occasional sedges.

*O. pelidna* makes a sharp, buzzing noise while in flight; the sound is short, a second or less in duration, and while distinct is not loud. It usually comes near the end of the flight, just before the insect dives into the grass. The species is very quick and agile, as well as being inconspicuously colored, which makes it rather hard to collect where it is not numerous.

*Orphulella speciosa* (Scudder).—Devils Lake, Aug. 7, 1920, 1 female; Stump Lake, July 24, 1920, 15 males, 10 females; Sheyenne River, Eddy Co., Aug. 8, 1920, 1 male, 4 females; Aug. 31-Sept. 2, 1920, 9 males, 5 females; Medora, July 31, 1920, 1 male; Amidon, Aug. 24, 1920, 6 males.

Common on sandy and loamy soils throughout the state. It was frequently taken in company with *Orphulella pelidna* in the eastern part of the state, but the latter species was not found in any of the western localities. In the Devils-Stump Lake region *O. speciosa* was common in dry fields and pastures, usually where the sandy or gravelly soil was rather sparsely covered with dry grass, with occasional clumps of such plants as goldenrod, *Grindelia squarrosa*, and *Artemisia*. At Fargo it was taken in similar situations, and also with *O. pelidna* in a low, moist area of mucky soil, among clumps of tall grasses and sedges. In the western part of the state it was found among dry grasses and clumps of *Artemisia* in the valley of the Little Missouri at Medora, and on dry, sandy clay soil covered with low, sparse vegetation among the "breaks" of the Bad Lands at Amidon.

*Chlocaltis conspersa* Harris.—Devils Lake, July 18-28, 1920,

4 males, 2 females; Stump Lake, July 24, 1920, 1 female; Lake Upsilon, Turtle Mountains, July 15, 1919, July 30-Aug. 4, 1920, 5 males, 5 females.

This species was found only in the vicinity of areas of natural woodland of some size. In the Devils-Stump Lake region it was rather common in brushy fields and along paths and roads through the woods and through patches of tall shrubbery bordering them. In the Turtle Mountains specimens were taken in the grassy margins of groves of aspen and balsam poplar, among scattered clumps of beaked hazel, raspberry bushes, and other shrubbery. Others were found along the edges of roads running through the woods and on the dry, gravelly beach of Lake Upsilon, near the edge of the willow-aspen thicket which bordered it.

*Chloealtis conspersa* is probably common throughout the Red River Valley and the Drift Prairie Plain regions, along the streams and around the lakes where they are bordered with natural forest. Neither this nor any of the other species of Orthoptera typically associated with woodland conditions were found in any of the small groves planted around farms on the originally treeless prairie, but it is probable that in time the distribution of these forms will be considerably modified by this artificial extension of forest habitats into the prairie region.

*Chortippus curtipennis* (Harris).—Devils Lake, July 9, 1919, 1 male; July 18-Aug. 16, 1920, 26 males, 13 females; Stump Lake, July 24-25, 1920, 5 males, 4 females; Sheyenne River, Nelson Co., July 25, 1919, 1 male; Gravel Lake, Turtle Mountains, July 15, 1919, 1 female; Lake Upsilon, Turtle Mountains, July 30-Aug. 6, 1920, 23 males, 29 females; Fargo, Aug. 31, 1920, 11 males, 6 females; Amidon, Aug. 21-26, 1920, 3 males, 2 females.

This species was one of the most abundant and ubiquitous of the grass-land inhabiting forms found in the eastern part of the state. It occurred in both wet and dry situations on all types of soil. Though commonest in rather tall vegetation in moist places, it was found in considerable numbers among sparse growths of grass and other herbaceous plants on dry soil. It was abundant in the marshes around the lakes in the Devils Lake and Turtle Mountain regions. This species seemed to be somewhat less common in the western than in the eastern part of North Dakota; it was not found at Buford, Williston, or Medora, and was not common at Amidon.

*Gomphocerus clavatus* Thomas.—Devils Lake, Aug. 7, 1919, 1 female; July 15-Aug. 7, 1920, 13 males, 23 females; Stump Lake, July 24, 1920, 8 males, 4 females; Sheyenne River, Eddy Co., Aug. 8, 1920, 1 female; Buford, July 23, 1920, 4 males, 1 female; Williston, July 24, 1920, 4 males, 2 females; Medora, July 29-Aug. 3, 1920, 2 males, 4 females; Amidon, Aug. 21-28, 1920, 12 males, 23 females.

This species was common in dry, grassy fields and pastures in the Devils-Stump Lake region; it probably occurs in similar situations throughout the eastern part of the state, although for some reason none were taken in the Turtle Mountains, at Bottineau, or at Fargo. It was one of the commonest species in the more arid western portion of North Dakota, where it occurred abundantly on the dry, grassy uplands and on the grassy slopes and ridges in the Bad Lands.

The males of this species are very agile and difficult to capture, much more so than the larger and more clumsy females. Their stridulation has been described by Rehn and Hebard<sup>11</sup> as “. . . -sik-sik-sik-sik—a sound louder but similar to that produced by *Stauroderus* [*Chortippus*] *curtipennis*.” While

<sup>11</sup> *Proc. Acad. Nat. Sci. Phil.*, lviii, 1906, p. 371.

the stridulation of a species is known to vary with changing conditions of temperature, humidity, etc., on none of the occasions on which notes were made on the stridulation of this species did it resemble that of *Chortippus curtipennis*. The closed caudal femur and tibia are held at a rather high angle with the body and vibrated back and forth very rapidly through a small arc, the resultant sound being a buzzing trill, reminiscent of the notes of some species of *Conocephalus*; some of the individuals observed prefaced each trill with a series of two to four brief clicks, still further increasing the resemblance. The notes of some of the specimens observed were approximately four seconds in length, separated by intervals of from three to six seconds; in other cases the notes were only one or two seconds long, separated by variable intervals up to five seconds in length. The coloration of this species is nearly as variable as that of *Chortippus curtipennis*.

*Platybothrus brunneus* (Thomas).—Amidon, Aug. 21, 1920, 2 males, 2 females.

Four specimens were taken in the course of an hour's collecting on the flat mesa top of Black Butte, south of Amidon, among the thin, very dry growth of grasses and other low herbaceous plants. It occurred in company with *Ageneotettix deorum*, but was very much less common than that species.

*Stirapleura decussata* Scudder.—Devils Lake, July 8, 1919, 1 female.

A single specimen of this species was collected by Miss Olson. It was taken by sweeping the rather sparse growth of grasses, liquorice, and other vegetation on the gravelly flats on the north shore of Devils Lake. In spite of careful collecting in the same vicinity for a period of several weeks the following season, no more specimens were found.

*Ageneotettix deorum* (Scudder).—Devils Lake, Aug. 12,

1920, 1 male; Lake Upsilon, Turtle Mountains, July 30, 1920, 1 female; Buford, July 23, 1920, 1 male, 2 females; Medora, July 30-31, 1920, 4 males, 1 female; Amidon, Aug. 21-28, 1920, 13 males, 13 females.

One specimen was taken in each of two localities in eastern North Dakota; in the west it was common at Buford and Medora, and very common in the vicinity of Amidon. In all cases this species was found among dry grasses, frequently where a considerable amount of bare soil was exposed among the scanty vegetation. At Amidon it was most numerous on the dry, grassy uplands, but also occurred among the xerophytic vegetation on the barren slopes in the Bad Lands. It seemed to be more abundant in the late summer and fall than in the earlier part of the season. The fact that most of the collecting in the eastern part of the state was done in July may account for its apparent scarcity in that region; although no nymphs were found, it may possibly become more numerous in August and September.

*Ageneotettix deorum* stridulates in somewhat the same manner as *Chortippus curtispennis*. Each series of notes consists usually of four or five rapid but distinct strokes, the whole occupying approximately one second; the periods of stridulation are separated by intervals of approximately the same length. It may be represented as follows: —sik-sik-sik-sik—  
——sik-sik-sik-sik——sik-sik-sik-sik——.

*Aulocara ellioti* (Thomas).—Buford, July 23, 1920, 1 male; Amidon, Aug. 23-26, 1920, 2 females.

The specimen taken at Buford was found in dry grass at the side of a road on the bluffs above the flood-plain. At Amidon one female was found on the hard, sun-cracked clay margins of a small, shallow alkali lake on the uplands east of town, among scattered tufts of grass and chenopodious

plants; the other among short grass and occasional clumps of *Artemisia* in a dry upland pasture. It was one of the least common of the Acrididae in this region.

*Arcyptera gracilis* Scudder.—Lake Upsilon, Turtle Mountains, July 15, 1919, 1 male; Aug. 6, 1920, 10 males, 5 females.

This species was fairly common in some of the low, moist meadows and grassy marshes bordering the ponds and occupying the depressions in the Turtle Mountains. Specimens were also taken in low fields in growths of tall herbaceous plants, such as goldenrod, fireweed, *Helianthus*, nettles, and others; in this rank herbage it was especially numerous, but very difficult to capture on account of its habit of dropping to the ground and burrowing into the thickest parts of the tangled mass of vegetation when alarmed. No females would have been taken had it not happened that a low meadow of tall grass was being cut for wild hay, and a large number of specimens of this and other species were crowded into the small patch of uncut grass, sedges, and cat-tails bordering a small pond in the center of the field. In the field the females present considerable superficial resemblance in actions and appearance to large, lubberly females of *Melanoplus bivittatus*, the light coloring of the dorsal margins of the closed tegmina adding to the likeness.

#### OEDIPODINAE

*Arphia pseudonietana* (Thomas).—Devils Lake, Aug. 7-26, 1919, 3 males, 1 female; July 20-Aug. 13, 1920, 8 males, 2 females; Sheyenne River, Eddy Co., Aug. 8, 1920, 8 males, 7 females; Bottineau, Aug. 1, 1920, 1 male; Fargo, Aug. 31, 1920, 1 male; Medora, July 31-Aug. 3, 1920, 6 males, 2 juvenile females; Amidon, Aug. 21-28, 1920, 16 males, 7 females.

This species was common throughout the state on dry grass-



land and sparsely vegetated soils during the latter part of the season.

*Chortophaga viridifasciata* (DeGeer).—Stump Lake, July 24-25, 1920, 3 males, 1 female; Devils Lake, May 7-11, 1921 (N. A. Wood), 3 females.

A few specimens were taken on the sparsely vegetated flats on the south shore of Stump Lake in the latter part of July, but by this date the species seemed for the most part to have disappeared. Mr. Wood found it common in similar situations on the shores of Devils Lake in May, in company with *Hippiscus apiculatus*.

*Encoptolophus costalis* (Scudder).<sup>12</sup>—Devils Lake, Aug. 26, 1919, 1 male, 1 female; July 22-Aug. 16, 1920, 22 males, 12 females, 3 juveniles; Sheyenne River, Eddy Co., Aug. 8, 1920, 2 males, 8 females; Aug. 8, 1920, 2 males, 8 females; Stump Lake, July 24, 1920, 6 males, 4 females, 2 juveniles; Bottineau, Aug. 1, 1920, 1 female; Sept. 12, 1920 (A. H. Eastgate), 1 female; Fargo, Aug. 31-Sept. 2, 1920, 6 males, 3 females; Medora, July 29, 1920, 2 females; Amidon, Aug. 21-28, 1920, 16 males, 14 females, 2 juveniles.

This species apparently matures in the eastern part of the state in the latter part of July. On July 22 nymphs were very abundant at Devils Lake, but the only adults seen were three teneral specimens; a week later adults were common, though many were still found in the teneral condition. The species was quite generally distributed in North Dakota on dry, sparsely vegetated soils; it was common in dry pastures, waste lands, and on the flats around the lake shores in the east, while in the southwest it was abundant on the uplands and on grassy slopes and ridges among the Bad Lands. One

<sup>12</sup> Determined by J. A. G. Rehn.

specimen was attracted to a lighted sheet set up at night on the shore of Devils Lake near the edge of the woods.

*Cammula pellucida* (Scudder).—Devils Lake, July 9-Aug. 26, 1919, 6 males, 4 females; July 15-Aug. 17, 1920, 58 males, 25 females; Stump Lake, July 24, 1919, 1 male; July 24-25, 1920, 6 males; Sheyenne River, Eddy Co., July 25, 1919, 1 female; Aug. 8, 1920, 1 male, 2 females; Lake Upsilon, Turtle Mountains, July 14-18, 1919, 12 males, 5 females; July 30-Aug. 4, 1920, 11 males, 8 females; Lake Metagoshe, Turtle Mountains, July 16, 1919, 1 male; Bottineau, July 16, 1919, 2 males; July 31-Aug. 1, 1920, 3 males, 4 females; Fargo, Aug. 31, 1920, 2 males, 1 female; Pembina, Pembina Co., July 12, 1921 (C. Thompson), 1 female; Buford, July 23, 1920, 11 males, 15 females; Williston, July 24-25, 1920, 3 males, 5 females; Medora, July 30-Aug. 3, 1920, 1 male, 6 females; Amidon, Aug. 21-27, 1920, 7 males, 2 females.

This was one of the most abundant and generally distributed of the campestral species inhabiting the region. It was found in almost as many situations as *Melanoplus mexicanus atlanis*, and frequently in as great or greater abundance; but in common with that species its normal habitat is dry grassland. In the grassy fields and pastures of the eastern part of the state it frequently outnumbered all other species. Observations made by Miss Olson in the vicinity of Bottineau show that *Cammula pellucida* ranked about third in abundance—and probably also in destructiveness—in the grain fields of that region. It was surpassed only by *Melanoplus m. atlanis* and *Melanoplus bivittatus*. In the western part of the state it seemed in general to be somewhat less abundant than in the east; it was common on the grassy uplands and on grass-covered slopes and tops of buttes in the Bad Lands.

*Hippiscus haldemani* (Scudder).<sup>13</sup>—Amidon, Aug. 23, 1920, 1 female; ? Aug. 25, 1920, 1 juvenile.

A single female was taken on the grassy uplands near Amidon. A nymph taken two days later is placed here merely because it resembles this species more than it does *Metator pardalinum*, these being the only two species of this group which were found in the region.

*Hippiscus apiculatus* (Harris).—Devils Lake, May 11-18, 1921 (N. A. Wood), 1 male, 1 female.

Taken on the sparsely vegetated, sandy flats around the shore of Devils Lake. By the middle of July this species had entirely disappeared.

*Metator pardalinum* (Saussure).—Buford, July 23, 1920, 1 male, 4 females; Medora, July 29-Aug. 3, 1920, 2 females; Amidon, Aug. 22-28, 1920, 7 males, 3 females.

At Buford this species was found among sage-brush and scattered xerophytic vegetation on dry hillsides, and in dry, grassy situations on the bluffs above the valley; at Medora it was taken in similar habitats. It was only moderately common at Amidon, where it occurred on the grassy uplands, always where there was a considerable amount of bare soil exposed among the scanty vegetation.

*Dissosteira carolina* (Linnæus).—Devils Lake, Aug. 8-26, 1919, 3 females; July 19-Aug. 16, 1920, 14 males, 5 females; Stump Lake, July 24, 1919, 1 female; July 24-25, 1920, 4 males; Sheyenne River, Eddy Co., Aug. 8, 1920, 3 males, 1 female; Lake Upsilon, Turtle Mountains, July 30-Aug. 6, 1920, 8 males; Bottineau, Sept. 12, 1920 (A. H. Eastgate), 1 female; Fargo, Aug. 31, 1920, 1 male; Buford, July 23, 1920, 8 males, 6 females; Williston, July 24, 1920, 18 males, 13 females;

<sup>13</sup> Determination verified by J. A. G. Rehn.

Medora, July 29-Aug. 3, 1920, 3 males, 3 females; Amidon, Aug. 21-23, 1920, 2 females.

Common along roads and in cultivated fields and sparsely vegetated areas throughout the state.

*Spharagemon aequale* (Say).<sup>14</sup>—Amidon, Aug. 21-28, 1920, 35 males, 17 females.

Common on the grassy uplands in the vicinity of Amidon, but rather local in distribution. Specimens were taken around the sparsely vegetated rocky edges of the mesa top of Black Butte and in bare, dry pastures near the town. It seemed to frequent drier and more sparsely vegetated areas than those preferred by *S. collare*, and was much less generally distributed than that species. In this region *S. collare* was frequently entirely absent from areas inhabited by *S. aequale*, and where the two species were found together the latter in most cases considerably outnumbered the former.

*Spharagemon collare* (Scudder).—Devils Lake, Aug. 7-26, 1919, 3 females; July 19-Aug. 15, 1920, 33 males, 22 females; Stump Lake, July 24, 1920, 12 males, 3 females; Sheyenne River, Eddy Co., Aug. 8, 1920, 1 female; Lake Upsilon, Turtle Mountains, July 30-Aug. 6, 1920, 15 males, 11 females; Bottineau, July 31-Aug. 1, 1920, 9 males, 12 females; Fargo, Aug. 31, 1920, 1 male; Buford, July 23, 1920, 1 male; Medora, July 29-30, 1920, 1 male, 1 female; Amidon, Aug. 21-28, 1920, 23 males, 17 females.

Common throughout the state in dry, grassy fields and similar situations. In the Turtle Mountains it was common in brushy fields and pastures. At Amidon it was very common on the grassy uplands, but no specimens were taken in the Bad Lands. *Trimerotropis monticola* frequently occurs with

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<sup>14</sup> Determination verified by A. P. Morse and J. A. G. Rehn; according to the former, these specimens are "not typical."

this species, and bears considerable resemblance to the form with the light pronotum; in the southwest *S. collare* is quite often found with *S. aequale*, though it seems to prefer less barren habitats than that species.

A series of 60 specimens, representing all of the above localities, was sent for determination to Dr. A. P. Morse. All but three of these specimens were determined by him as *Spharagemon collare* (Scudder); the remaining three specimens, two males from Devils Lake and one male from Bottineau, were named *Spharagemon collare wyomingianum* (Thomas). A series of 35 specimens sent to Mr. J. A. G. Rehn was determined by him as *Spharagemon collare collare* (Scudder). On examining the entire series of 167 specimens I was unable to separate them into racial groups, although great differences of size and amount of development of the pronotal crest are evident. A number of the males from the eastern part of the state are similar to Michigan specimens of *S. c. wyomingianum* determined by Rehn and Morse, but the females seem too robust for that race, with more rounded head and less prominent eyes. This eastern material may represent a transitional group of the species with average intermediate characters, although there is great individual variation shown. The western material is much less variable, all of the specimens being typical *collare*, and averaging larger than the eastern material, though a number of the females from the eastern part of the state are fully as large as any of the western specimens.

*Derotmema haydenii haydenii* (Thomas).—Buford, July 23, 1920, 1 male; Medora, July 29, 1920, 1 male, 1 female; Amidon, Aug. 23, 1920, 11 males, 14 females.

At Buford and Medora this species was taken among sparse vegetation on arid hillsides. At Amidon a rather numerous colony was discovered on the dry, sparsely vegetated margins

of a small alkali lake on the grassy upland near the town; here they were common on the alkali-crusted flats among scattered tufts of grass and other low plants. Both red and yellow-winged forms occurred together in about equal numbers; of the 25 specimens captured, 15 have red and 10 yellow wings. The species was evidently local in occurrence in this region, as it was not found elsewhere in a week's collecting in the vicinity.

*Mestobregma kiowa* (Thomas).<sup>15</sup>—Devils Lake, July 8-15, 1919, 3 males, 1 female; July 19-Aug. 16, 1920, 22 males, 15 females; Stump Lake, July 24, 1920, 6 males, 8 females; Sheyenne River, Eddy Co., Aug. 8, 1920, 2 females; Lake Upsilon, Turtle Mountains, July 30-Aug. 6, 1920, 7 males, 3 females; Bottineau, July 31-Aug. 1, 1920, 5 males, 10 females; Buford, July 23, 1920, 5 males, 5 females; Williston, July 24, 1920, 4 males, 1 female; Medora, July 29-Aug. 3, 1920, 155 males, 128 females; Amidon, Aug. 21-27, 1920, 27 males, 24 females.

This species occurred throughout the state; it was extremely abundant on the western plains, but somewhat less numerous in the east. It was fairly common in grassy fields and pastures, roadsides, cultivated fields, and on the stony and sandy flats around the margins of the lakes in the Devils-Stump Lake region. On the western side of the state it was the most abundant of the bare-ground Oedipodinae in all of the localities where collecting was done. Its favorite habitat appears to be the dry uplands, where a considerable amount of bare soil is exposed among the scanty vegetation of grasses and xerophytic plants.

Great variability of color and color pattern exists in this

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<sup>15</sup> Determined by J. A. G. Rehn.

species. The ground color of the majority of individuals is dull brownish or grayish, without conspicuous markings of any kind, but a number of individuals with variegated and more or less conspicuous color patterns may be found in any large series. On August 28 the following types were observed in a barren pasture near Amidon: (1) uniform brownish gray, with rather indistinct fuscous markings (a common type); (2) dark brownish fuscous, markings obscured; (3) brownish gray, metazona of pronotum light brick red, light yellowish stripes along the dorsal angulations of the closed tegmina, ground-color light, markings distinct; (4) same general pattern as last, but metazona of pronotum brownish fuscous, and tegminal stripes reddish brown; (5) ground-color uniform gray or brown, markings distinct, closed tegmina with the overlapping anal fields forming a conspicuous light stripe, sometimes divided at base by a median dark stripe; (6) light brownish gray ground-color, markings distinct, posterior edge of pronotum narrowly edged with yellowish white, tegminal stripes faintly indicated; (7) ground-color light green, dark markings very strongly defined; (8) ground-color light gray or yellowish white, dark markings faintly visible. These are only a few of the many variations found in *Mestobregma kiowa*. This would seem to be a promising form for investigation from the genetical standpoint, the principal objection being that it is probably only single-brooded.

A single one of the entire series of 431 specimens has the wings slightly tinged with yellow near the base; this was the only individual among the thousands of specimens seen in the field in which any color was noticeable during flight. All of the other specimens have the wings either entirely hyaline or with very slight fuscous shadings, usually near the apex.

*Trimerotropis cincta* (Thomas).<sup>16</sup>—Amidon, Aug. 24, 1920, 1 male.

A single specimen of this species was taken in the road between a bare pasture and a wheat field on the uplands near Amidon. It is a swift flier, and was captured with difficulty. While in flight this species stridulates with a rapid buzz similar to that made by *Chortophaga viridifasciata* or *Encoptolophus costalis*.

*Trimerotropis monticola* Saussure.<sup>17</sup>—Devils Lake, July 19, 1920, 1 male; Lake Upsilon, Turtle Mountains, July 30-Aug. 4, 1920, 5 males, 2 females; Bottineau, July 31-Aug. 1, 1920, 15 males, 9 females; Amidon, Aug. 21-28, 1920, 17 males, 8 females; Ft. Buford, Williams Co., 1883, 1 female (collection Mich. Agr. Coll.).

This species was fairly common in the prairie and plains regions, in semi-arid situations. A single specimen was taken on the dry, grassy slopes of Sully's Hill on the south shore of Devils Lake. It was common in dry, grassy fields and pastures in the vicinity of Bottineau, and specimens were taken in brushy clearings in the Turtle Mountains among tall, dry grass. In the eastern part of the state it seemed to be more local in occurrence and not so abundant as farther west. At Amidon it was found in dry upland pastures, on the rock-strewn slopes and the grassy mesa top of Black Butte, and among the scanty vegetation on ridges and slopes in the "breaks" of the Bad Lands. It is everywhere accompanied by *Spharagemon collare*, to the collared form of which *T. monticola* bears a striking superficial resemblance.

*Trimerotropis bruneri* McNeill.—Devils Lake, Aug. 11-17, 1920, 37 males, 37 females; Amidon, Aug. 21-26, 1920, 4 females.

<sup>16</sup> Determination verified by J. A. G. Rehn.

<sup>17</sup> Determination verified by J. A. G. Rehn.



At Devils Lake this species was found in a restricted area on the flats bordering the lake at the Narrows, intermediate between the beach zone and the zone of tall herbage and low shrubbery on the upper part of the flats. In this area the vegetation was scanty and occurred in patches separated by nearly bare spaces of sandy or pebbly soil, in many places incrustated with a thin deposit of alkali; the conditions were distinctly xerophytic. This was the favorite habitat of *Trimerotropis vinculata*, which was found with *T. bruneri*, though present in much greater numbers. In the southwest *T. bruneri* was taken on the sparsely vegetated, rocky edges of the mesa top of Black Butte, and in dry fields and pastures in the vicinity of Amidon. Though scarce, the conditions under which it was found make it probable that it is of general occurrence in this region. In the field this species has much the appearance of a miniature *Hadrotettix*. In flight it stridulates with a rapid, crackling noise; it may stridulate during the entire flight or for only a brief portion of it at the start or near the end.

In this series of 78 specimens the following deviations from McNeill's description<sup>18</sup> can be noted: *Pronotum* with crest of prozona in nearly all specimens slightly or distinctly bilobed; no distinct light markings on lateral lobes in majority of specimens; posterior angle of metazona varying from slightly more to slightly less than a right angle. *Tegmina* with the basal band always distinct, solid; the area between the base of the tegmen and the basal band varies from light reddish brown, with the basal band standing out prominently as a narrow, dark bar at the basal third, to dark fuscous, fusing with the basal band to form a broad infuscation of the entire basal third of the tegmen; median band in most cases solid.

<sup>18</sup> *Proc. U. S. Nat. Mus.*, xxiii, 1901, pp. 423-425.

and distinct, but in a few specimens reduced to a faint transverse shading and in others to an aggregation of fuscous spots; in several of the most intensively colored specimens a faint but easily distinguishable apical band present, but this is represented in most cases by scattered fuscous punctations. *Wings* with the wing-band varying in breadth from one-quarter to one-third the length of the wing from base to apex; taenia of the wing-band reaching from one-third to one-half the distance to the base. *Hind femora* yellow within, with a reddish suffusion strongest basally; the inner surface crossed by a distinct distal black band, a continuation of that on the outer face, but the two proximal bands described by McNeill represented in most of the specimens by a diffused infuscation of the basal half, strongest distally; the outer face crossed by a distinct subapical band, often with an infuscation extending from it proximad; a few specimens with indications of a second, median band on the upper surface and upper half of the pagina.

*Trimerotropis vinculata* Scudder?—Devils Lake, Aug. 8, 1919, 1 male, 1 female; July 20-Aug. 17, 1920, 62 males, 56 females, 2 juveniles; Stump Lake, July 24-25, 1920, 6 males, 9 females; Williston, July 24, 1920, 3 males, 5 females; Amidon, Aug. 23, 1920, 9 males, 7 females.

This species was found in great abundance on the dry flats bordering the lakes in the Devils-Stump Lake region. It was most numerous among the sparse vegetation of the middle flats, between the bare sandy or gravelly beach and the taller vegetation of the upper portion of the flats. Though most common in this type of habitat, it was also found in smaller numbers in dry pastures in the vicinity of the lakes, especially in the areas of more scanty vegetation. At Williston a number of specimens were collected on dry clay slopes sparsely

covered with xerophytic vegetation, and the Amidon specimens were all taken on the nearly bare clay flats around the margins of a small, shallow alkali lake on the uplands near the town, with the exception of a single male which was taken on a bare area of sun-baked clay soil in a dry upland pasture.

*Trimerotropis vinculata* evidently matures soon after the middle of July in the eastern part of the state, since many of the specimens taken between the 20th and the 25th of that month were in a teneral condition, and since many last stage nymphs were still present at that time. In this region this species is not very active nor a very swift flier; it seems to rely largely on its inconspicuous coloration for protection, and is rather hard to flush. When an individual is alarmed it starts up with a peculiar butterfly-like fluttering, which soon steadies into a direct, slightly undulating flight. They are usually silent in the air, but on a number of occasions their stridulation was heard; it reminds one somewhat of that of *Trimerotropis huroniana* in certain respects. The sound is a short buzz, repeated at brief intervals during the flight; in a flight of ten feet an individual may stridulate two or three times. At every repetition it appears to fall a little, recovering during the intervals of silence. The end of the flight is usually abrupt, the insect dropping suddenly to the ground in a way that is often bewildering.

What this form should be called is not clear. With regard to material determined as *Trimerotropis salina* McNeill by the author which was sent to Mr. J. A. G. Rehn for verification, he wrote as follows: "Regarding *Trimerotropis salina*—I wish we knew more about it. We have topotypes which came in the Bruner Collection, but the types are gone, like all the McNeill types, destroyed during a lengthy illness of his. . . . What *salina* will prove to be remains to be seen.

Width of wing-band *per se* is a dangerous feature in this genus. *Salina* may be distinct, it may be a geographic race of *vinculata*, or it may be valueless. I have been very conservative with regard to uncertain forms of this type, and used *vinculata* until I know more definitely about the status of *salina*." Later the specimens were returned with the following notes: "*Trimerotropis vinculata* group. Apparently two species, but at this writing (July, 1921) do not care to apply names, as it is too hazardous before intensive study." The specimens agree fairly well with McNeill's descriptions of *salina*, and are superficially very different in appearance from typical *vinculata* by reason of the very broad and heavy wing-band.

*Trimerotropis sordida* E. M. Walker.<sup>19</sup>?—Stump Lake, Nelson Co., July 24, 1920, 1 male.

This specimen was included with a lot of the preceding species which was taken on the gravelly beach of Stump Lake, among occasional clumps of grass and other herbaceous plants, and in an area about 100 yards from the shore, on sandy soil covered with a thin growth of short, dry grass.

*Aerochoreutes carlinianus carlinianus* (Thomas).—Buford, July 23, 1920, 11 males, 5 females; Williston, July 24, 1920, 1 female; Amidon, Aug. 23-28, 1920, 10 males, 3 females.

Common along the roads and in bare fields near Buford. At Williston one specimen was taken on a sparsely vegetated clay hillside. In the southwestern part of the state it was common on the sparsely vegetated clay flats around the margins of a small alkali lake on the uplands near Amidon, on nearly bare clay slopes among the "breaks" of the Bad Lands,

<sup>19</sup> Determined with some doubt by J. A. G. Rehn. Regarding it he writes: "I have never recognized this species before, and the specimen may not be it. As the condition is general, certain discrepancies from the description may thus be accounted for."

and in dry, grassy pastures where there were considerable areas of bare soil exposed. Although fairly common in this vicinity, it was much less numerous and more local in occurrence than *Circotettix rabula*, with which it was usually found in company.

*A. carlinianus* stridulates on the wing in a somewhat similar manner to the species of *Circotettix*. The sound produced is a loud, whirring noise, very different and very much less startling than the crackling of its companion *C. rabula*. While the sound is being produced the insects will hover in the air, often practically motionless, or moving slowly along, and rising and falling gently. They sometimes remain in the air stridulating for periods of a minute or more. This species is extremely alert and wary on bright, sunny days, but specimens are rather easily captured in cloudy weather.

*Circotettix rabula* Rehn and Hebard (showing tendencies toward race *nigrafasciatus* Beamer).<sup>20</sup>—Medora, July 30-Aug. 3, 1920, 4 males, 9 females; Amidon, Aug. 21-25, 1920, 14 males, 10 females.

This species was common in the southwestern part of North Dakota wherever exposures of bare, dry soil were found. It was common in the more sparsely vegetated areas on the dry, grassy uplands, in company with *Aerochoreutes carlinianus*, but more numerous than that species. In the region about Amidon it was found in large numbers on the rocky slopes and top of Black Butte and on the nearly bare clay slopes in the "breaks" of the Bad Lands. This species was by far the noisiest grasshopper found in the state, its loud, crackling stridulation being audible for a quarter of a mile or more on a still day.

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<sup>20</sup> *Circotettix rabula* Rehn and Hebard (= *Cicotettix undulatus* of most authors).

*Circotettix azureescens* (Bruner).—Medora, July 30, 1920, 2 females; Amidon, Aug. 24-25, 1920, 27 males, 8 females.

Taken only in the valley of the Little Missouri River and its bordering Bad Lands in the southwestern part of the state. It was found on bare clay slopes among the Bad Lands, and was taken on a dry butte covered with a scattered growth of bunch-grasses and sage-brush in the river valley at Medora. It is apparently a much more characteristically xerophilous form than either *A. carlinianus* or *C. rabula*.

The coloration of this species is light, corresponding in a remarkable way with that of the whitish or grayish clay surfaces upon which it is normally found. When motionless against such a background it is almost impossible to distinguish individuals from their surroundings, even when the spot where they are resting has been marked down within a few inches. The disinclination of this form to take flight is probably connected with this fact. It seems to be a remarkably unwary species for a member of this genus; while alert and ready to take flight, it will allow a close approach before actually taking alarm, and then instead of flying a long distance it usually goes only a few yards, often circling around so as to alight a short distance from where it started. It will continue to do this even after several unsuccessful attempts to capture it have been made. The flight is usually low and direct. The stridulation of *Circotettix azureescens* is not loud; it consists of a rapid series of notes—zzzt-zzzt-zzzt-zzzt—uttered at the rate of one and a half or two per second for short periods while in flight.

#### LOCUSTINAE

*Hypochlora alba* (Dodge).—Amidon, Aug. 21-28, 1920, 11 males, 3 females.

In the vicinity of Amidon this species was fairly common on the dry, grassy uplands, on the slopes of the buttes, and among the "breaks" of the Bad Lands, always in close association with the white sage (*Artemisia* spp.). Most of the specimens were taken by sweeping patches and clumps of *Artemisia* with the net. A few individuals were found on other types of vegetation, but always in the immediate vicinity of patches of sage-brush. The color of *Hypochlora alba* absolutely reproduces that of its food-plant, and the grasshoppers are invisible when clinging to the *Artemisia* stems so long as they remain motionless.

*Hesperotettix prdtensis* Scudder.<sup>21</sup>—Lake Upsilon, Turtle Mountains, Aug. 6, 1920, 1 female; Williston, July 24, 1920, 1 male; Medora, July 29-Aug. 3, 1920, 5 males, 8 females; Amidon, Aug. 21-28, 1920, 5 females.

A single specimen of this species was taken near Lake Upsilon in a thick growth of tall weeds—goldenrod, fireweed, nettles, *Helianthus*, and many others—standing three to four feet high on the higher ground around the borders of a grassy marsh. In the Great Plains region it is fairly common, though it was not abundant in any of the localities visited. In this region it was found in dry, grassy fields and pastures on the uplands, and among sparse vegetation on barren clay and sandy soils in the Bad Lands and on the flood-plain of the Little Missouri River.

*Aeoloplus bruneri* Caudell.—Buford, July 23, 1920, 3 males, 3 females; Medora, July 29-Aug. 3, 1920, 21 males, 16 females; Amidon, Aug. 21-24, 1920, 15 males, 15 females.

Abundant on the uplands near Amidon, on the dry, sparsely vegetated flats and sloping banks around the margins of a small alkali lake. The insects are very active, and leap and

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<sup>21</sup> Determination verified by J. A. G. Rehn.

fly well, though only for short distances. Elsewhere in this neighborhood the species was found in small numbers, but was quite generally distributed; it was usually taken among sparse vegetation, seldom in bare areas. At Medora and Buford it was found on sage-brush-covered slopes and in dry, grassy situations.

*Melanoplus occidentalis* (Thomas).<sup>22</sup>—Amidon, Aug. 26-27, 1920, 2 males.

The only specimens of this species were found in a dry pasture on the uplands near Amidon, among a low growth of parched grasses and other plants interspersed with occasional clumps of *Artemisia* and Russian thistle.

*Melanoplus flavidus* Scudder.—Devils Lake, July 24, 1919, 1 male; Aug. 11-17, 1920, 4 males, 10 females; Buford, July 23, 1920, 2 males, 2 females; Medora, July 29-Aug. 3, 1920, 18 males, 25 females.

This species was fairly common on the sandy and stony flats around the shores of Devils Lake, in bare areas and among scanty vegetation of grasses, liquorice, *Grindelia squarrosa*, and many other plants. Here it was found with *M. packardii*, to which it bears considerable resemblance in the field. It was found in great abundance at Medora on the arid, sandy flood-plain and the sides of the valley of the Little Missouri River, among the dry grasses and sage-brush which compose the greater part of the scanty vegetation. At Buford it was scarce, occurring in similar situations.

*Melanoplus bruneri* Scudder.—Lake Upsilon, Turtle Mountains, Aug. 2, 1920, 3 males, 3 females.

Quite common in a dry clearing covered with low bushes and shrubs of various kinds (*Corylus rostrata*, young aspens, willows, birches, etc.) and tall herbaceous plants such as fire-

<sup>22</sup> Determination verified by J. A. G. Rehn.



weed and goldenrod, interspersed with small, grassy areas. This species and *M. m. atlantis* occurred together here in about equal numbers. *M. bruneri* was not taken elsewhere in the state, though some of the larger, heavier-bodied females of *M. m. atlantis* taken in the grain fields at Bottineau were mistaken for this species in the field.

*Melanoplus mexicanus atlantis* (Riley).—Devils Lake, July 25-Aug. 8, 1919, 4 males, 2 females; July 19-Aug. 17, 1920, 24 males, 17 females; Stump Lake, July 24, 1920, 1 male; Sheyenne River, Nelson Co., July 25, 1919, 1 male; Lake Metagoshe, Turtle Mountains, July 16, 1919, 1 male, 1 female; Lake Upsilon, Turtle Mountains, July 30-Aug. 6, 1920, 29 males, 18 females; Bottineau, July 16, 1919, 35 males, 17 females; July 31-Aug. 1, 1920, 20 males, 23 females; August, 1920 (A. H. Eastgate), 1 male; Buford, July 23, 1920, 24 males, 24 females; Williston, July 24-25, 18 males, 14 females; Medora, July 29-Aug. 3, 1920, 34 males, 47 females; Amidon, Aug. 21-28, 1920, 59 males, 45 females.

This species was probably the most abundant grasshopper occurring in the state. It was found in greatest numbers in dry fields of tall grass and on cultivated land, being especially abundant in grain fields. It occurred, however, in a considerable variety of habitats. In point of view of destructiveness this species surpasses all others in North Dakota. At Bottineau an examination of some of the devastated grain fields in the vicinity showed that this species outnumbered all others, although it was accompanied by great numbers of *Melanoplus bivittatus* and *Camnula pellucida*.

*Melanoplus darwsoni* (Scudder).—Devils Lake, July 23-Aug. 26, 1919, 4 males, 12 females; July 19-Aug. 15, 1920, 37 males, 37 females; Stump Lake, July 24-25, 1920, 1 male, 3 females; Sheyenne River, Nelson Co., July 25, 1919, 1 male,

1 female; Sheyenne River, Eddy Co., Aug. 8, 1920, 5 males, 10 females; Lake Upsilon, Turtle Mountains, July 30-Aug. 6, 1920, 10 males, 8 females; Bottineau, July 31-Aug. 1, 1920, 7 males, 5 females; Fargo, Aug. 31-Sept. 2, 1920, 21 males, 14 females; Williston, July 24, 1920, 1 male; Amidon, Aug. 21-28, 1920, 7 males, 7 females.

One of the most common of the campestral Orthoptera occurring in the eastern part of the state. In the eastern localities it was found in nearly all grassland habitats and was common and in many places abundant in dry pastures and stubble-fields and on the sandy flats around the lakes. In the Turtle Mountains it was very numerous in brushy clearings, and was also taken in a tall growth of rank herbage in a low, moist meadow. In the grain fields and on the waste lands covered with Russian thistle in the vicinity of Bottineau it was abundant; it is probably of considerable economic importance, in spite of its diminutive size. In the western part of the state *Melanoplus dawsoni* seemed to be less common; at Amidon it was rather scarce on the dry, grassy plains, on the slopes of the buttes, and on grassy ridges among the Bad Lands, while Miss Olson took only a single specimen at Williston, and did not find it at all at Buford or Medora. That this scarcity was not due to the lateness of the season is shown by the fact that after leaving Amidon I found it to be common at Fargo in similar situations to those in which it was taken at Devils Lake.

A number of macropterous specimens were taken in various parts of the state, as follows: Devils Lake, 1 male, 5 females; Sheyenne River, 1 male, 1 female; Turtle Mountains, 1 female; Fargo, 2 males, 1 female; Amidon, 1 female; in all a total of 4 males and 9 females. Most of these were taken by sweeping. The macropterous form is very rare in this part of the

range of the species, and seems to be unknown farther east.

*Melanoplus fasciatus* (F. Walker).—Lake Upsilon, Turtle Mountains, July 18, 1919 (Crystal Thompson), 1 male; July 30-Aug. 4, 1920, 11 males, 11 females; Pembina, Pembina Co., July 15, 1921 (Crystal Thompson), 1 male, 1 female.

This northern species has been taken in North Dakota only along the Canadian boundary. In the Turtle Mountains it was common in suitable habitats. Specimens were taken in brushy clearings among woods of aspen, balsam poplar, paper birch, and other trees; along roads through shrubbery and forest; and in open, grassy groves of birches and poplars. On August 2 a pair was taken in copula among the branches of a tall clump of willows on the edge of a grassy marsh. Other specimens were taken on the gravelly beach of Lake Upsilon, near the marginal thicket of willows and birches. The Pembina specimens were found in the margins of the woods along the Tongue River.

*Melanoplus femur-rubrum femur-rubrum* (DeGeer).—Devils Lake, July 9-Aug. 8, 1919, 4 males, 2 females; July 15-Aug. 17, 1920, 35 males, 42 females; Stump Lake, July 24, 1919, 1 female; July 24-25, 1920, 9 males, 4 females; Turtle Mountains, July 15-16, 1919, 3 males, 3 females; Lake Upsilon, Turtle Mountains, July 15, 1919, 3 males, 3 females; July 30-Aug. 6, 1920, 10 males, 7 females; Bottineau, July 16, 1919, 5 males, 3 females; July 31-Aug. 1, 1920, 23 males, 16 females; Buford, July 23, 1920, 2 males, 1 female; Williston, July 24, 1920, 6 males, 2 females; Medora, July 31, 1920, 1 male; Amidon, Aug. 21-27, 1920, 11 males, 8 females; Fargo, Aug. 31-Sept. 2, 1920, 8 males, 7 females.

Very common on the eastern side of the state, though less abundant than *M. m. atlantis*, *M. bivittatus*, and *Camnula pelucida*, except locally. On the gravelly and sandy flats around

the margins of the lakes in the Devils-Stump Lake region it was the most abundant species of the genus, with the exception of *M. angustipennis*. It is more frequent in moist habitats, or those characterized by thick growths of herbaceous plants, than in dry and sparsely vegetated ones, in this respect showing a nearly opposite type of habitat preference to that of *M. m. atlantis*. On the western side of the state *M. femur-rubrum* seems to be less common than in the east, presumably on account of the more arid conditions.

This species appears to be of secondary importance in this region from the economic standpoint. Observations made in the vicinity of Bottineau showed that while *M. femur-rubrum* was very abundant in the waste fields overrun with Russian thistle and other weeds, it was only fourth or fifth in relative abundance in the grain fields.

*Melanophus borealis junius* (Dodge).—Devils Lake, Aug. 8, 1919, 1 male; July 23, 1920, 2 males, 3 females, 1 juvenile; Sheyenne River, Eddy Co., July 25, 1919, 1 male; Lake Upsilon, Turtle Mountains, July 15, 1919, 1 female; Aug. 6, 1920, 2 males, 4 females.

A few specimens were taken by sweeping the growth of sedges, grasses and tall herbage around the margins of a small pond on the flats between Devils Lake and East Bay; search of over an hour in this locality revealed only five adults, although nymphs which may have belonged to this species were fairly common. In the Turtle Mountains a single female was taken among a thick growth of tall herbaceous plants composed largely of goldenrod, fireweed, nettles, and Helianthus, bordering a low, marshy area, and others in a similar but somewhat drier situation on a hillside. One specimen was found among a clump of cat-tails bordering a small pond in the center of a marsh.

*Melanoplus angustipennis* (Dodge).—Devils Lake, July 9-25, 1919, 7 males, 11 females; July 19-Aug. 17, 1920, 41 males, 42 females; Stump Lake, July 24-25, 1920, 1 male, 2 females; Sheyenne River, Eddy Co., Aug. 8, 1920, 1 male, 1 female; Lake Upsilon, Turtle Mountains, July 30-Aug. 6, 1920, 3 males, 2 females; Buford, July 23, 1920, 1 female; Medora, July 23-Aug. 3, 1920, 7 males, 4 females; Amidon, Aug. 21-28, 1920, 6 males, 8 females.

This species occurred in great abundance on the flats around the shores of the lakes in the Drift Prairie region. It was common among sparse vegetation on dry soils throughout the state. Although in the eastern part of its range, in Illinois, Indiana, and Michigan, *M. angustipennis* is quite characteristic of light, sandy soils, in North Dakota there seemed to be no such correlation; the species was found to be almost as common on the grass-covered clay slopes in the Bad Lands of the southwest as on the sandy flats around the shores of Devils Lake.

The hind tibiae of this species are usually either red or blue; in the vicinity of Devils Lake the population seemed to be about equally divided between these two types, while at Amidon specimens with blue tibiae seemed to be about twice as numerous as those with red. A number of the specimens in this large series have the tibiae some shade of yellow, brown, or dull green.

*Melanoplus packardii* Scudder.—Devils Lake, July 9-Aug. 26, 1919, 2 females; July 19-Aug. 17, 1920, 3 males, 8 females; Stump Lake, July 24, 1920, 1 female; Sheyenne River, Nelson Co., July 25, 1919, 1 male; Lake Metagoshe, Turtle Mountains, July 16, 1919, 2 males; Lake Upsilon, Turtle Mountains, July 30-Aug. 6, 1920, 4 males, 2 females; Bottineau, July 16, 1919, 10 males, 15 females; July 31-Aug. 1, 1920, 2 males, 7 females;

August, 1920 (A. H. Eastgate), 1 female; Buford, July 23, 1920, 4 females; Williston, July 24, 1920, 3 males, 2 females; Amidon, Aug. 21-28, 1920, 14 males, 16 females.

Moderately common throughout the state, locally abundant, on dry, usually sparsely vegetated soils. Specimens were taken on the flats around Devils and Stump Lakes, in dry pastures and grain fields at Bottineau and Devils Lake, and in brushy clearings and roadside vegetation in the Turtle Mountains. The species was common in the grain fields and waste lands at Bottineau, but was surpassed in numbers by several others; elsewhere in the eastern part of the state it was of regular occurrence, but not numerous. In the more arid western part of North Dakota *M. packardii* seems to be considerably more abundant, to some extent taking the place occupied in the east by *M. bivittatus*. It was very common on the grassy uplands in the vicinity of Amidon, as well as on the rocky slopes and summit of Black Butte, on the sparsely vegetated clay slopes and ridges in the "breaks" of the Bad Lands, and in the thickets of tall herbage growing in the gullies and depressions on the uplands and in the edges of the Bad Lands.

In a series of 80 specimens the coloration of the hind tibiae is as follows: various hues of blue, 69; part blue and part yellow or pink, 2; pale yellowish white, 2; dark violaceous, nearly black, 1; red or pink, 5.

*Melanoplus conspersus* Scudder.<sup>23</sup>—Devils Lake, Aug. 26, 1919, 2 males, 1 female; Amidon, Aug. 23-28, 5 males, 4 females.

Apparently a rather scarce species. The only specimens from the eastern part of the state were taken by Miss Olson on the grassy slopes of Sully's Hill on the south shore of Devils Lake. Visits to this locality earlier in the season were

<sup>23</sup> Determination verified by J. A. G. Rehn.

made both in 1919 and 1920, but no specimens were then found; it may be more common than is supposed, having been overlooked on account of maturing late in the season. At Amidon specimens were taken in dry pastures and among roadside herbage on the uplands in the vicinity of the town; it was one of the less common of the Acrididae in this region. Two of the males, taken the 23d and 24th of August, were teneral. In the field the light markings on the pronotum and the striped hind femora make it quite conspicuous and easily distinguishable from its congeners.

*Melanoplus infantilis* Scudder.—Devils Lake, July 26, 1919, 1 female; July 15-Aug. 13, 1920, 28 males, 23 females; Stump Lake, July 24-25, 1920, 7 males, 5 females; Sheyenne River, Eddy Co., Aug. 8, 1920, 4 males, 3 females; Lake Upsilon, Turtle Mountains, July 30-Aug. 6, 1920, 18 males, 2 females; Bottineau, July 16, 1919, 2 males; July 31-Aug. 1, 1920, 2 males, 6 females; Buford, July 23, 1920, 2 males, 4 females; Williston, July 24, 1920, 6 males, 2 females; Medora, July 29-31, 1920, 23 males, 18 females; Amidon, Aug. 21-28, 1920, 10 males, 15 females.

This diminutive locust was abundant in most part of the state on dry grassland areas on sandy, gravelly, or clay soils. It was not taken at Fargo (where only a small amount of collecting was done, however), and is probably less common in the Red River Valley than in the other parts of the state, since this is near the border of its range; east of the Red River it is known only from Detroit and Fergus Falls, Minnesota.<sup>24</sup> In the dry pastures and stubble-fields at Devils Lake and Bottineau this species fairly swarms during July and August. On account of its small size and inconspicuous col-

<sup>24</sup> Somes, M. P., 1914, The Acridiidae of Minnesota. *Univ. Minn. Agr. Exp. Sta. Bull.*, No. 141, Technical, pp. 1-100, pls. i-iv (p. 90).

oration it attracts but little attention among the crowds of larger Melanopli, but it is probably responsible for a considerable amount of damage to crops in the central and western parts of the state.

*Melanoplus confusus* Scudder.—Devils Lake, July 23, 1919, 1 female; July 19-22, 1920, 6 males, 2 females; Stump Lake, July 24, 1920, 1 female; Williston, July 24, 1920, 3 males; Medora, July 29-31, 1920, 2 males, 1 female; Amidon, Aug. 21-25, 1920, 6 males, 2 females.

Though nowhere found in numbers, this species seemed to be rather generally distributed through the state in dry grassland habitats. In the east it was taken in dry pastures, stubble-fields, and on the flats around the lake shores. At Williston it was taken on the grassy railroad right-of-way on the flats of the Missouri River. At Medora it was found among scattered vegetation of dry grasses and *Artemisia* on dry, sandy soil on the slopes of the buttes. It was rather scarce at Amidon; specimens were collected on the sparsely vegetated mesa top of Black Butte, on the plains near town, and on the sparsely vegetated slopes where the uplands "break" into the Bad Lands.

*Melanoplus keeleri luridus* (Dodge).—Devils Lake, Aug. 26, 1919, 2 males, 2 females; Fargo, Aug. 31, 1920, 15 males, 9 females.

This species is probably of common occurrence in the eastern part of the state, but owing probably to its late appearance in the adult stage it was taken in only two localities. At Devils Lake it was found on the grassy slopes of Sully's Hill; at Fargo, in a dry field among a sparse growth of low grass and weeds intermingled with patches of bare soil.



*Melanoplus bivittatus* (Say).<sup>25</sup>—Devils Lake, July 9-Aug. 26, 1919, 13 males, 13 females; July 18-Aug. 15, 1920, 21 males, 11 females; Stump Lake, July 24, 1919, 8 males, 10 females; July 25, 1920, 3 males, 1 female; Sheyenne River, Nelson Co., July 25, 1919, 8 males, 5 females; Sheyenne River, Eddy Co., July 25, 1919, 6 males, 1 female, 1 juvenile; Aug. 8, 1920, 3 males, 2 females; Lake Upsilon, Turtle Mountains, July 15-16, 1919, 9 males, 13 females; July 30-Aug. 6, 1920, 13 males, 7 females; Bottineau, July 16, 1919, 9 males, 13 females; July 31-Aug. 1, 1920, 4 males, 2 females; Aug. 9, 1920 (N. A. Wood), 1 female; Pembina, Pembina Co., July 12, 1921 (C. Thompson), 1 male; Fargo, Aug. 31, 1920, 1 female; Buford, July 23, 1920, 9 males, 7 females; Williston, July 24-25, 1920, 4 males, 4 females; Medora, July 30-Aug. 3, 1920, 3 males, 2 females; Amidon, Aug. 22-25, 1920, 1 male, 6 females.

In the eastern part of the state this was one of the most abundant and omnipresent of the Acrididae. It occurred in greater or less numbers in every habitat of the region, with the exception of the denser types of forest, but was less common in sparsely vegetated, arid situations than in more humid, thickly vegetated ones. In the grain fields and cultivated lands of this region it was often extremely abundant, and a considerable proportion of the locust injuries are undoubtedly due to the ravages of this species. *Melanoplus bivittatus* was common on the flats of the Missouri River at Buford and Williston, in grassland and cultivated fields. It was taken among xerophytic vegetation on the barren hillsides in the valley of the Little Missouri River at Medora, and occurred in rather small numbers on the plains in the vicinity of Ami-

<sup>25</sup> Determined as *Melanoplus bivittatus bivittatus* (Say) by Morgan Hebard.

don, in patches of tall vegetation along the roadsides and in depressions on the uplands, and in cultivated fields. It seemed to be somewhat less common in the southwest than in other parts of North Dakota.

All of the specimens of the very large series collected are of the typical *bivittatus* type, and not a single example of the red-legged *femoratus* was seen among the thousands of specimens observed in the field. However, it seems more likely that this difference in tibial coloration is in the nature of a response to local environmental conditions, such as food, humidity, etc., than that it is a genetic character of racial or varietal significance. The tibiae of these North Dakota specimens are usually at least in part yellow, and are almost always infuscated to a greater or less degree; but many of the specimens have bluish, brownish, purplish, or black tibiae, and in several specimens at hand they are dark yellow or brown, with the outer face faintly flushed with deep red.

*Phoetaliotes nebrascensis* (Thomas).—Devils Lake, Aug. 26, 1919, 1 male, 1 female; Amidon, Aug. 22-28, 1920, 3 males, 7 females.

Although this species was taken in only two localities, it is probably widely distributed and fairly common within the state. A single pair was taken on the grassy slopes of Sully's Hill on the south shore of Devils Lake. At Amidon it was found on a number of occasions in patches of tall weeds or clumps of low bushes in depressions on the uplands and in the "breaks" of the Bad Lands, sometimes on *Artemisia* in company with *Hypochlora alba*.

TETTIGONIDAE  
PHANEROPTERINAE

*Scudderia pistillata* Brunner.—Devils Lake, July 19-Aug. 16, 1920, 6 males, 2 females, 1 juvenile; Stump Lake, July 25, 1920, 7 males, 17 females; Sheyenne River, Eddy Co., July 25, 1919, 1 female; Aug. 8, 1920, 3 males, 1 female; Lake Upsilon, Turtle Mountains, July 30-Aug. 6, 1920, 12 males, 7 females; Bottineau, Aug. 1, 1920, 1 female; Aug. 9, 1920 (N. A. Wood), 1 female; Buford, July 23, 1920, 1 female; Amidon, Aug. 25, 1920, 1 male.

In the eastern part of the state this species seemed to be quite common. It was numerous on the upper part of the flats around Devils and Stump lakes, among bushes and tall herbaceous vegetation; also in the margins of the woods bordering the lakes and streams of this region. In the Turtle Mountains the species was very common in similar habitats; specimens were taken in brushy clearings, roadside thickets, and meadows of tall herbage. At Bottineau specimens were found in a thick growth of low bushes—silverleaf, honeysuckle, and roses—mingled with tall Compositae and other plants, in a small depression on the prairie. *Scudderia pistillata* was less common in the drier western portion of the state; a single female was taken in tall grass along the side of a road on the flats of the Missouri River at Buford, and at Amidon a male was beaten from a thick tangle of low bushes and tall weeds in the head of a gully in the Bad Lands.

*Scudderia furcata furcata* Brunner.—Sheyenne River south of Warwick, Eddy Co., Aug. 8, 1920, 1 male, 3 females, 1 juvenile male; Fargo, Aug. 31, 1920, 1 male, 2 females.

Although only taken in two localities, this species is probably quite common in the eastern part of the state in suitable

habitats. In Eddy County it was found on shrubbery and young trees in the margins of the woods bordering the Sheyenne River; nymphs were more common here than adults. At Fargo specimens were taken in company with *Amblycorypha oblongifolia* in a clump of shrubbery and tall nettles, in the margins of an open grove near the banks of the Bois-de-Sioux River.

*Amblycorypha oblongifolia* (DeGeer).—Fargo, Aug. 31, 1920, 2 females.

Found with the preceding. Probably occurs at least throughout the southeastern part of the state.

#### CONOCEPHALINAE

*Orchelimum gladiator* Bruner.—Devils Lake, July 18-Aug. 8, 1919, 3 males; July 19-Aug. 15, 1920, 33 males, 24 females; Stump Lake, July 25, 1920, 11 males, 9 females; Lake Upsilon, Turtle Mountains, Aug. 2-6, 1920, 2 males; Bottineau, Aug. 1, 1920, 2 males; Fargo, Aug. 31, 1920, 1 male.

Common in the Red River Valley and the Drift Prairie Plains region in a variety of grassland habitats, especially during the earlier part of the season. It occurred in large numbers on the flats around the margins of Devils and Stump lakes, and was extremely abundant in patches of pigweed growing on a rocky island in Devils Lake; in these habitats it was found in company with the next species. *O. gladiator* was also common in tall herbaceous vegetation on dry soil and in grassy and sedgy marshes in this region.

*Orchelimum concinnum* Scudder.—Devils Lake, Aug. 8, 1919, 1 male; July 21-Aug. 15, 1920, 32 males, 17 females.

Although not taken elsewhere in the state, this species proved to be very abundant in many places on the flats around Devils Lake, where it occurred in company with the less

graceful *O. gladiator*; the comparative numbers of the species varied from place to place, but in general they seemed to be about equally common. *O. concinnum* was usually the only one found in the thick patches of sedges which grow in places on the shores of the lake. Two specimens were taken in other habitats, one in a clump of honeysuckle in a bare pasture near the edge of the woods, the other in tall, dry grass in a dry coulee half a mile south of the lake.

*Conocephalus fasciatus fasciatus* (DeGeer).—Devils Lake, July 23, 1919, 1 male; July 19-Aug. 13, 1920, 32 males, 27 females; Stump Lake, July 24, 1919 (C. Thompson), 1 male; July 24-25, 1920, 2 males; Sheyenne River, Eddy Co., Aug. 8, 1920, 3 males, 1 female; Lake Upsilon, Turtle Mountains, Aug. 4-6, 1920, 9 males, 7 females; Fargo, Aug. 31, 1920, 8 males, 6 females.

Common in all grassland habitats in eastern North Dakota, where it was the most common Tettigoniid. It seems to prefer slightly more humid conditions than *C. viridifrons*, but the two species are very frequently found together. Specimens were taken on the dry flats around the lake shores, in grass and sedge marshes, in moist meadows, in brushy fields and pastures, in dry grassland, and in cultivated fields. *C. fasciatus* was not taken in the western part of the state.

*Conocephalus viridifrons* Blatchley.<sup>26</sup>—Devils Lake, July 23, 1919, 1 male, 2 females; July 18-Aug. 16, 1920, 40 males, 27 females, 1 juvenile female; Sheyenne River, Eddy Co., Aug. 8, 1920, 1 female; Stump Lake, July 24, 1920, 1 female; Lake Upsilon, Turtle Mountains, Aug. 2, 1920, 1 female; Bottineau, Aug. 1, 1920, 2 males, 2 females; Fargo, Aug. 31, 1920, 4

<sup>26</sup> Rehn, in letter, seems to doubt the distinctness of this species from *saltans* Sc.

males, 3 females; Amidon, Aug. 22-26, 1920, 7 males, 6 females.

Common in company with the last in nearly all the campesstral habitats in the eastern part of North Dakota; while fairly common in moist situations such as marshes, grassy meadows, etc., it seemed to be more typical of dry grassland habitats. In the dry fields and pastures of the eastern part of the state it was usually more numerous than *C. fasciatus*, and in the western areas was common on the dry plains and in the Bad Lands in the vicinity of Amidon, where *fasciatus* was not found at all. *C. viridifrons* was found in the greatest abundance on the upper portions of the dry flats around the shores of Devils Lake, where the sandy soil was covered with a sparse growth of tall grasses, liquorice plants, and low shrubbery.

#### DECTICINAE

*Anabrus simplex* Haldeman, var. *maculatus* Caudell.—Stump Lake, July 25, 1920, 1 male; Bottineau, July 31-Aug. 1, 1920, 5 males; Sept. 12, 1920 (A. H. Eastgate), 1 male.

This species seemed to be fairly common on the dry prairies in the eastern part of the state. None were taken in the Red River Valley in North Dakota, but a male is at hand which was taken at Donaldson, in the valley on the Minnesota side of the river;<sup>27</sup> it is said to be quite common in that vicinity. The specimen taken at Stump Lake was found among a thick growth of dry grasses, clumps of *Artemisia* and goldenrod, and other herbaceous plants on the dry flats north of the lake. Attention was attracted to it by its very loud stridulation, audible at a distance of over one hundred yards. This consisted of sharp staccato notes, repeated in rapid succession at

<sup>27</sup> Minnesota: 5 miles west of Donaldson, Kittson Co., July 4, 1920 (O. B. Olson), 1 male.

the rate of three or four per second for an indefinite length of time. Before starting its song the insect usually assumes a position six to twelve inches above the ground on a stout weed stem; at the first sign of danger it drops to the ground and hides among the bases of the plants. Its characteristic notes were heard on several occasions near Devils Lake, coming from the vegetation of roadsides and dry pastures, but at times when it was impossible to stop to search for their source. In the vicinity of Bottineau *Anabrus simplex* was common in the waste lands and stubble-fields; the thick, tangled growth of Russian thistles covering much of the uncultivated land in the neighborhood seemed to be a favorite habitat for the species. No specimens were taken in the western part of the state, although it almost certainly occurs there.

## STENOPELMATINAE

*Stenopelmatus fuscus* Haldeman.<sup>28</sup>—Marmarth, Slope Co., Sept. 12, 1920 (Chas. A. Kinnie), 1 male.

In a letter dated September 25, 1920, Mr. Kinnie gives the following information: "Since this was taken two more have been found. It is called by the Mexicans *mima* (niña?) or *childus*. They say that it is found on the west coast of Mexico, and that the bite is deadly, 'worse than a rattlesnake'—also that it is slow in biting; when approached it rears back with its legs in the air, and when it bites one it does not let go until all the poison is injected. There is no cure for the bite, and persons bitten will die in an hour. It is a close relative of the 'Vinegar Roan'; both bugs bore in the ground and come out at night. The three taken were all found after sundown." The belief concerning the poisonous nature of this insect seems to be widespread. The specimen is fully adult and of the extreme megacephalic type.

<sup>28</sup> Determination verified by J. A. G. Rehn.

## RHAPHIDOPHORINAE

*Ceuthophilus* sp.—Bottineau, Aug. 9-20, 1920 (A. H. Eastgate and N. A. Wood), 2 males, 3 females.

These specimens were collected in an outside covered staircase leading to the cellar of a house in Bottineau. Five other adults captured on the 10th of August were placed by Mr. Eastgate in a tin can, from which they escaped during the night by chewing their way through the cloth cover.

It has been impossible to get this species determined. Specimens sent to Mr. Rehn were returned with the statement that the western forms of this genus were in too much confusion to make it possible to say what this species was. The coloration, male genitalia, armature of the posterior femora, and female ovipositor are all distinctive, but the descriptions in Scudder's monograph<sup>29</sup> are so unsatisfactory that it has been impossible to place the species by their means.

*Ceuthophilus* sp.—Grand Forks, Grand Forks Co. (H. A. Shaw), 1 female.

A single specimen taken many years ago by Mr. Shaw was received from Mr. Eastgate. The remarks made concerning the last species apply also to this. It seems to be fairly close to *C. gracilipes* Haldeman (as used by Blatchley), but differs notably in the lighter coloration, less distinct dorsal stripe, larger size, and considerably smaller ovipositor.

*Ceuthophilus maculatus* (Harris).—Devils Lake, July 9; 1919, 2 males; (?) May 7-11, 1921 (N. A. Wood), 3 juveniles; Grand Forks, Grand Forks Co., July 20-21, 1921 (C. Thompson), 2 males, 5 females; Pembina, Pembina Co., July 15, 1921 (C. Thompson), 1 male, 2 females.

This species was taken in the woods bordering the lakes

<sup>29</sup> Scudder, S. H., 1894, The North American *Ceuthophili*. *Proc. Amer. Acad. Arts and Sci.*, xxx, 17-111.



and streams in the eastern part of the state. The specimens from Devils Lake were all taken under logs in the woods on the north shore or among tall shrubbery on the upper portion of the flats around the lake. The other specimens were taken in the woods bordering the Red River at Grand Forks and in the Tongue River woods near Pembina. It seems to be the most common of the forms occurring in this part of the country.

*Udeopsylla robusta* Haldeman.—Stump Lake, summer 1904 (A. H. Eastgate), 1 male; Elm Township schoolhouse, 5 miles southeast of Lansford, Bottineau Co., July 28, 1920 (A. C. Burrill), 1 male; Bottineau, Aug. 20, 1920 (A. H. Eastgate), 1 male.

The Stump Lake specimen was taken in an outhouse near the edge of the woods bordering the lake. According to Mr. Eastgate this species is common at times in the Turtle Mountains, in moist, shady situations along the shores of the lakes. All three specimens are of the typical form.

GRYLLIDAE

GRYLLINAE

*Nemobius fasciatus fasciatus* (DeGeer).<sup>30</sup>—Devils Lake, Aug. 7-15, 1920, 12 males, 11 females; Stump Lake, July 24-25, 1920, 3 females; Sheyenne River, Eddy Co., Aug. 8, 1920, 7 males, 20 females; Lake Upsilon, Turtle Mountains, July 30-Aug. 6, 1920, 7 males, 13 females; Fargo, Aug. 31-Sept. 2, 1920, 6 males, 19 females.

A very common species in the eastern part of the state, both on the dry, grassy uplands and in moist meadows and marshes on lower ground. Nymphs were very common everywhere during July, but it was not until the 24th of that month that the first adult specimens were seen; from then until the end of the collecting season they became increasingly abun-

dant. For some reason this species was not found in any of the western localities where collections were made.

These specimens belong to the typical race, *fasciatus fasciatus*, but they average somewhat smaller and darker than a similar series of Michigan specimens. No specimens of the northwestern race, *N. fasciatus abortivus* Caudell, were taken in any of the localities studied, but Caudell has reported *abortivus* from Portal, Burke County, in the northwestern part of the state close to the Canadian boundary, and just within the Drift Prairie region.<sup>31</sup>

It may be of interest to note that the caudal femur-ovipositor ratios of 24 female specimens, 12 from Devils Lake and 12 from the Turtle Mountains, when plotted according to the scheme devised by Hebard,<sup>32</sup> are distributed as follows: With few exceptions the plotted ratios lie close to the point of junction of the areas designated as typical of the three races, *fasciatus*, *abortivus*, and *socius*; a total of 16 fall within the *abortivus* area, 5 just over the line separating *abortivus* from *socius*, and 3 well within the *fasciatus* area. Hebard has emphasized the fact that no single character can be relied upon to distinguish these races, but that it is necessary to consider the sum of all of them in order to arrive at correct conclusions.

*Gryllus assimilis* (Fabricius).—Devils Lake, July 9, 1919, 1 juvenile female; July 19-Aug. 15, 1920, 26 males, 30 females; Stump Lake, July 24, 1919, 4 juveniles; Sheyenne River, Nelson Co., July 25, 1919, 1 juvenile female; Pembina, Pembina Co., July 12, 1921 (C. Thompson), 1 juvenile female; Bottineau, Aug. 1, 1920, 1 juvenile female; Aug. 9, 1920 (A. H.

<sup>30</sup> Determined by Morgan Hebard.

<sup>31</sup> *Proc. U. S. Nat. Mus.*, xxxiv, 1908, p. 81.

<sup>32</sup> *Proc. Acad. Nat. Sci. Phil.*, lxy, 1913, p. 413.

Eastgate), 1 male; Fargo, Aug. 31-Sept. 2, 1920, 4 males, 7 females; Amidon, Aug. 23, 1920, 1 male, 2 females.

This species is common in the same situations as the last; it is apparently more numerous in the eastern portion of the state than in the west. The series exhibits considerable variation, but the majority of the specimens are of the *luctuosus* type.

#### OECANTHINAE

*Oecanthus quadripunctatus* Beutenmuller.—Devils Lake, July 20-Aug. 14, 1920, 48 males, 35 females, 10 juveniles; Sheyenne River, Eddy Co., Aug. 8, 1920, 1 male, 4 females; Fargo, Aug. 31, 1920, 3 males, 7 females; Buford, July 23, 1920, 1 juvenile; Amidon, Aug. 21-27, 1920, 26 males, 17 females.

This species was common throughout the state in grassy fields, roadside vegetation, patches of tall herbage, and in the brushy margins of woods in the eastern part of the state. Although nymphs were very abundant during the earlier part of July, the first adult was not taken until the 28th of that month; adults were common by the end of the first week in August. This species was common on the upper flats around Devils Lake, among the tall herbaceous growth and low bushes; it seemed to be especially fond of the sticky flowers of *Grindelia squarrosa*, and in a patch of these plants almost every other blossom would have an *Oecanthus* stretched out across its disc. Nymphs were seen at Bottineau, but no adults were taken there.

All of the specimens in this large series (78 males, 63 females, 11 juveniles) are very light in coloration, without or with only the faintest traces of the fuscous markings characteristic of *Oecanthus nigricornis*. They undoubtedly all belong to the same species. Nevertheless, the antennal mark-

ings in this series vary from the rather light, narrow, and distinctly separated parallel marks characteristic of most eastern specimens of *quadripunctatus* to marks of a much broader, heavily infuscated, and frequently confluent type. The infuscation is usually confined to the markings themselves, the margins of which are sharply delimited; it does not tend to shade out over the remaining portions of the basal antennal segments, as is so frequently the case in *nigricornis*. In series at hand from Fort Sill, Oklahoma,<sup>33</sup> and Lawrence, Kansas,<sup>34</sup> all of the specimens are of this same type with the heavy antennal markings. In a series from Colorado Springs, Colorado,<sup>35</sup> one specimen is of the heavily marked type, the rest similar to eastern specimens, as are the other Colorado specimens examined. None of the eastern material of this species which I have examined shows this heavily infuscated type of antennal markings. It may be material of this type that Blatchley regards as intermediate between *nigricornis* and *quadripunctatus*.

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<sup>33</sup> Fort Sill, Comanche Co., Oklahoma, Sept. 27-Nov. 10, 1918 (T. H. Hubbell), 5 males, 3 females.

<sup>34</sup> Lawrence, Douglas Co., Kansas, Sept. 18-24, 1921 (Carl Brown), 3 males, 9 females.

<sup>35</sup> Colorado Springs, El Paso Co., Colorado (H. B. Baker), 15 males, 4 females.

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## A LIST OF NORTHERN MICHIGAN LEPIDOPTERA

BY SHERMAN MOORE

The list of Lepidoptera herein presented represents the results of five seasons of collecting, 1917 to 1921 inclusive, along the shores of the north end of Lake Michigan and of the Straits of Mackinac, covering parts of the counties of Schoolcraft, Mackinac, Charlevoix, Emmet, and Cheboygan. Collecting usually has been continuous from some time in May until about the first of November, and an average of two to three days per week has been devoted to the work. While some of the earliest forms may have been missed, the collecting period has covered the greater part of the insect season.

Collecting has been confined largely to the immediate vicinity of the lake shores, and at no point have specimens been taken more than three miles inland. The collection therefore does not represent fairly the lepidopterous fauna of the various counties, but only that of a narrow strip along the shores

of the lake. Certain habitats have been entirely missing, notably low grassy meads and open upland woods. Such habitats are found, however, farther inland. As a matter of fact, the whole of the northern shores of Lake Michigan are of a singularly monotonous character.

Collecting was done in Schoolcraft County in 1917, from Pt. aux Barques, about twelve miles south of Manistique, to the eastern boundary of the county at Hughes Point. The shore over this stretch is generally sandy, the sandy beach being broken at intervals by rocky points. Back of the beach there are ridges of sand dunes, rising at some places to considerable heights, covered largely with a scattering growth of scrubby birch and poplar. At Pt. aux Barques a hardwood ridge approaches closely to the shore, and along the Manistique River there are some patches of hardwoods.

Collecting in Mackinac County has covered the entire shore from Hughes Point to Les Cheneaux Islands, and the years 1918 to 1921, inclusive. There is much less sand beach along this portion of the shore, the beach being rather flat and rocky with short stretches of sand. Back of the beach the country is low and flat, covered with a dense growth of balsam, spruce, and cedar, intermixed with some scattering birch and poplar. The greater part of the collecting was done near Naubinway, around St. Ignace, and in St. Martin Bay.

In Cheboygan County only two or three days were spent along the beach in the immediate vicinity of Cheboygan. In Emmet County the collecting was confined to the beach from Mackinaw City to Waugoshance Island. The beach here is generally sandy, followed by ridges of sand, between which are wet swamps.

The only collecting in Charlevoix County was on the islands known as the Beaver Island group. These islands, lying in the northern end of Lake Michigan, twelve to twenty miles

from the mainland, are geographically a part of Emmet County, being a continuation of Waugoshance Point, but for political reasons they are attached to Charlevoix County. Beaver Island, the largest of the group, was scarcely touched, a little collecting having been done near St. James only. Garden Island, the second in size, about five miles long by two miles wide, was thoroughly covered in 1919. The beaches of this island are for the most part rocky, and behind them is the usual growth of conifers. The interior of the island, however, is high, and covered with a heavy growth of maple, beech, and birch. There are several old clearings and some small lakes. This island affords the most diversified habitat of any territory along this portion of the lake, and is an excellent collecting ground.

Hog Island, somewhat smaller than Garden Island, is low and flat, and covered with a dense growth of mixed timber. There are a few sand ridges near the northern end and a black ash swamp of considerable size in the interior. It was thoroughly covered during the season of 1920, but offers little to the collector. The other islands of the group, Squaw, Whiskey, and Hat, are all small, low, and rocky, with a scanty growth of mixed trees. Hat Island, the smallest of the three, is a breeding place of the herring gull and the great blue heron.

Combined in this list with the results of the writer's collecting along the Straits of Mackinac are two small lists of Lepidoptera from different localities. In July, 1919, T. H. Hubbell was sent to Gogebic County to collect Orthoptera for the Museum of Zoology of the University of Michigan. In the course of his work there he took 13 species of Lepidoptera. Ten of these species were butterflies and included one specimen of *Nathalis iole* Bdv., which is a record for the state. All of the other species have been taken along the Straits. Of

the three species of moths, two were not found in the vicinity of the Straits.

The other list is from Huron Mountains, Marquette County. In 1919 A. W. Andrews collected some Lepidoptera there early in July, and Bryant Walker added some specimens later in the season. In 1921 T. H. Hubbell collected some specimens. The compiled list contains 19 species of Rhopalocera and 22 species of Heterocera. Five species of moths in this list have not been taken in the vicinity of the Straits.

Considerable care has been taken in the determination of the specimens. For much valuable assistance in this work I am deeply indebted to Dr. W. W. Newcomb, of Detroit. He has checked practically all of the determinations and has devoted considerable time and the use of his extensive library to the work. Where there exists any doubt in regard to the identity of a species, it has either been omitted from the list or a note of explanation has been made. The list includes but 20 species of the super-family Tineoidea. A number of other species have been taken, but the literature and the time necessary for their determination has been lacking. In addition to 32 undetermined species of this group, the collection contains 10 species of Noctuidae and 7 species of Geometridae which have not been determined satisfactorily.

The nomenclature of the Check List by Barnes and McDunnough, published in 1917, has been followed in the list, with one or two changes in conformity with later publications by the same authors. The list indicates the counties in which specimens of each species have been taken and gives the earliest and latest dates on which each species has been taken in any of the counties.

A comparison of this list with others previously published may be of interest. In the Fourteenth Report of the Michigan



Academy of Science, 1912, Dr. W. W. Newcomb published a list of the butterflies of Michigan, based on all earlier lists and upon the results of his own collecting. This list contains the names of 101 species. In Entomological News, March, 1915, Paul S. Welch published a list of Lepidoptera taken in the vicinity of Douglas Lake, Cheboygan County. This list includes but 26 species of butterflies, and adds no new species to Dr. Newcomb's list. In May, 1918, the University of Michigan published a list of Lepidoptera from Whitefish Point, by W. S. McAlpine, the results of the Shiras Expedition of 1914. (Occasional Papers of the Museum of Zoology, No. 54.) This list includes 42 species of butterflies and adds two species to Dr. Newcomb's list. In the present list there are 68 species of butterflies, seven of which are not included in any previously published list. Two additional species have been taken during the past season by Dr. Newcomb at Detroit. This makes the total number of species of Rhopalocera known to occur in Michigan 112. Of the total number of species recorded from the state, 67, or about 60 per cent, occur in the territory bordering the Straits of Mackinac.

The species in the present list which have been included in no previously published list are as follows:

*Zegris olympia rosa* Edw. The only <sup>other</sup> specimens known to have been taken in Michigan were secured by N. A. Wood, in Berrien County, in the spring of 1920.

*Coenonympha inornata* Edw. Probably taken in Schoolcraft County in 1915 by W. S. McAlpine, although I have not seen his specimens.

*Nathalis iole* Bdv. One female was taken by T. H. Hubbell in Gogebic County. The occurrence of this southern form in the Northern Peninsula is remarkable.

*Oeneis chryxus* Dbldy. & Hew. Taken in only one locality

in Schoolcraft County in 1917 by the writer. It appeared to be quite common.

*Strymon melinus* Hbn. The writer took one specimen on Squaw Island, Charlevoix County, in 1919.

*Incisalia polios* C. & W. Taken in Schoolcraft and Mackinac counties. This butterfly has been taken near the Michigan boundary in Indiana, but its discovery in the Northern Peninsula was a surprise.

*Carterocephalus palaemon* Pall. Found in considerable abundance in Mackinac County.

In addition to the published records for Douglas Lake by Welch and for Whitefish Point by McAlpine, the only other list of Michigan Heterocera known to the writer is of Sphingidae by W. W. Newcomb in the Report of the Michigan Academy of Science, 1913, which includes 29 species. Only three species are noted by Welch from Douglas Lake, and five by McAlpine from Whitefish Point, all of which occur in Dr. Newcomb's report. The present list includes eight species of Sphingidae, two of which, *Smerinthus cerisyi* Kirby and *Haemorrhagia gracilis* G. & R., represent records for Michigan.

In comparing the present list of moths with those for Douglas Lake and Whitefish Point, surprise is occasioned by the comparatively few species that are common to the three regions. From Douglas Lake there are 127 species, of which 35 belong to the Tineoidea. From Whitefish Point there are 129 species, of which 32 are Tineoidea. In the present list are 211 species, of which 21 are Tineoidea. Combining the three lists, there are 357 species, of which 72 are Tineoidea.

Because of the great difficulty in the determination of species of the Tineoidea for the average student, the number of species of this group included in any list is a relatively small percentage of the species collected, unless it is possible to

have them determined by a specialist. In the present list somewhat less than 40 per cent of the species collected have been determined, and largely because of the difficulty of determination no particular effort has been made to collect members of this group. It would appear to be proper, therefore, to omit them in the comparison of lists by different collectors.

Of the 285 species of moths, exclusive of the Tineoidea, in the three lists, 38 have been taken only at Douglas Lake, 52 only at Whitefish Point, one only in Gogebic County, one only in Marquette County, and 117 only in the vicinity of the Straits. Out of 283 species, only 74 have been taken in more than one of the three localities for which there are extended lists, and only 18 have been taken in all of the three. The list for the Straits of Mackinac includes 49 species that were recorded from Douglas Lake and 40 species that were noted from Whitefish Point. Only five species are listed from both Douglas Lake and Whitefish Point that were not taken at the Straits.

The same phenomenon will be noted if the distribution of species from the different counties included in the Straits list is studied, although not to quite such a degree. The majority of the species have been taken in but one county. A further fact bearing on the subject is to be found in the great number of species that are represented by only one or two individuals. Furthermore, each year of collecting adds twenty to thirty new species from the same localities. In view of these facts, any further comparison between lists of this nature would lead only to what probably would be erroneous conclusions.

Two explanations are possible. First, that the distribution of the species of Heterocera is not at all uniform, species being confined to certain localities with very narrow limits, although such localities may be rather widely scattered over

a given region. Second, that none of these collections is fully representative of the Heterocerous fauna of its locality. The latter appears to be the more reasonable assumption. In the check list are given 661 species of Rhopalocera. Of these, 73 are known to occur in the region under consideration. Using the same proportion, there should be about 450 species of Heterocera in the same region, excluding the Tineoidea, whereas there are but 285. One thing at least is apparent: a great deal of field work remains to be done before a representative list of Michigan Heterocera can be compiled.

## PAPILIONIDAE

1. *Papilio polyxenes* Fabr.—Schoolcraft; June 12. One male. Rare.
2. *Papilio glaucus* Linn.—Schoolcraft, Mackinac, Charlevoix; May 20-July 16. Abundant.

## PIERIDAE

3. *Pieris protodice* Bdv. & Lec.—Mackinac; August 21-October 14. Rare. All specimens taken have been females.
4. *Pieris napi* Linn., form *oleracea* Harris.—Mackinac, Charlevoix, Emmet, Cheboygan; May 26-July 5. Common, especially in heavy woods.  
Form *cruciferarum* Bdv.—Mackinac, Charlevoix, Emmet; June 26-September 8. Common in open fields.
5. *Pieris rapae* Linn.—Schoolcraft, Mackinac, Charlevoix, Marquette; May 20-September 3. Two specimens of the form *immaculata* Ckll. were taken at St. Ignace, June 1.
6. *Nathalis iole* Bdv.—Gogebic; July 29. One female, taken by sweeping roadside bushes.
7. *Zegris olympia rosa* Edw.—Cheboygan; May 12. Two specimens, a male and a female, taken near Cheboygan, and a second male seen.

8. *Eurymus curytheme* Bdv., form *amphidusa* Bdv.—Schoolcraft, Mackinac; July 4-October 15. Not common.

9. *Eurymus philodice* Godt.—Schoolcraft, Mackinac, Charlevoix, Emmet; May 29-October 14.

Form *luteitincta* Wollc.—Schoolcraft, Mackinac; August 21-September 22. This form appears to be not uncommon, as six or seven specimens have been taken.

10. *Eurymus interior* Scud.—Schoolcraft, Mackinac, Charlevoix, Emmet, Marquette; May 28-August 5. Fairly common.

11. *Eurema lisa* Bdv.—Mackinac, Charlevoix, Emmet, Marquette; June 18-September 14. Rather rare until 1921, during which season it was quite abundant, even as far north as the Huron Mountains.

DANAIDAE

12. *Danaus archippus* Fabr.—Schoolcraft, Mackinac, Emmet, Charlevoix; May 20-September 26. Very abundant in 1917 and 1918, migrating by thousands. During 1919 and 1920 it was very scarce, only a few individuals having been seen. During 1921 it appeared to be increasing in numbers again.

SATYRIDAE

13. *Enodia portlandia* Fabr.—Mackinac; June 30, July 8. Only two specimens taken.

14. *Satyroides canthus* Linn.—Schoolcraft, Mackinac, Charlevoix; June 30-August 15. Common.

15. *Coenonympha inornata* Edw.—Schoolcraft, Mackinac; June 18-August 2. Quite common among low bushes along rocky shores.

16. *Cercyonis alope* Fabr., form *nephele* Kirby.—Schoolcraft, Mackinac, Charlevoix, Marquette, Gogebic; July 8-August 20. Abundant.

17. *Oeneis chryxus* Dbldy. & Hew.—~~Mackinac~~<sup>Schoolcraft</sup>; May 27-June 12. Occurs in considerable numbers on the sand dunes near Manistique in early spring.

## NYMPHALIDAE

18. *Argynnis cybele* Fabr.—Schoolcraft, Mackinac, Emmet, Charlevoix, Marquette; June 24-August 11. Common. The females show great variation in color, running from very dark specimens to those as light as the specimens taken in the Porcupine Mountains.

19. *Argynnis aphrodite* Fabr.—Schoolcraft, Mackinac, Emmet, Charlevoix, Marquette; July 8-August 11. Normally not quite so common as *cybele*, but in 1921 it was almost the only Argynnid seen. All of the specimens approach the form *cypris* Edw.

20. *Argynnis atlantis* Edw.—Schoolcraft, Mackinac, Marquette, Gogebic; June 20-September 10. Common, at times very abundant. I have seen bushes actually bending beneath the weight of thousands of these butterflies.

21. *Brenthis myrina* Cram.—Schoolcraft, Mackinac, Charlevoix, Cheboygan, Gogebic; May 28-August 20. Common.

22. *Brenthis bellona* Fabr.—Schoolcraft, Mackinac, Charlevoix, Gogebic; May 28-August 20. Not so common as *myrina*.

23. *Euphydryas phaeton* Dru.—Mackinac; June 20-30. Taken only in one locality, where four specimens were found in each of two years.

24. *Phyciodes nycteis* Dbldy. & Hew.—Schoolcraft, Mackinac; June 8-July 16. Common.

25. *Phyciodes tharos* Dru.—Schoolcraft, Mackinac, Emmet, Charlevoix; June 7-September 8. Abundant. Both the form *morpheus* Fabr. and the form *marcia* Edw. occur, apparently simultaneously, and every gradation between these forms may be found.

26. *Polygonia comma* Harris, form *dryas* Edw.—Charlevoix, Marquette; July 8-13. Not at all common.

27. *Polygonia satyrus* Edw.—Mackinac, Schoolcraft, Marquette; July 6-September 18. Rather uncommon.

28. *Polygonia faunus* Edw.—Schoolcraft, Mackinac, Charlevoix, Marquette; July 10-September 12. Common.

29. *Polygonia progne* Cram.—Schoolcraft, Mackinac, Charlevoix, Emmet, Marquette, Gogebic; May 12-October 3. Common.

30. *Aglais j-album* Bdv. & Lec.—Schoolcraft, Mackinac, Charlevoix, Marquette; July 13-October 21. Common. In 1919 the most plentiful butterfly in this region.

31. *Aglais milberti* Godt.—Schoolcraft, Mackinac, Charlevoix, Marquette, Gogebic; June 26-October 2. Common, but in rather restricted localities.

32. *Aglais antiopa* Linn.—Schoolcraft, Mackinac, Charlevoix, Emmet, Marquette, Gogebic; May 26-October 13.

33. *Vanessa atalanta* Linn.—Mackinac, Charlevoix, Marquette; May 25-October 13. Normally rather scarce, but in 1919 it was very abundant.

34. *Vanessa virginiensis* Dru.—Schoolcraft, Mackinac, Marquette; June 2-October 12. Common.

35. *Vanessa cardui* Linn.—Schoolcraft, Mackinac, Charlevoix; August 20-September 17. Only four specimens taken.

36. *Junonia coenia* Hbn.—Schoolcraft, Mackinac, Marquette; June 10-September 7. Not common. One specimen was taken at Manistique in 1917, and no other specimens were seen until September, 1921, when for a few days they appeared to be quite numerous.

37. *Basilarchia arthemis* Dru.—Schoolcraft, Mackinac, Charlevoix, Marquette, Gogebic; June 15-August 15.

<sup>Form</sup>  
Var. *proserpina* Edw.—This form was not at all uncommon

in 1919. All of the specimens seen were of the form in which the white bands on the wings are entirely suppressed.

38. *Basilarchia archippus* Cram.—Schoolcraft, Mackinac, Emmet; June 26-September 2. Fairly common.

## LYCAENIDAE

39. *Strymon melinus* Hbn.—Charlevoix; July 29. One specimen taken on Squaw Island.

40. *Strymon titus* Fabr.—Mackinac; August 1-15. Two specimens only.

41. *Strymon calanus* Hbn.—Charlevoix, Marquette; July 10-12. Two specimens.

42. *Strymon liparops* Bdv. & Lec.—Mackinac; August 5. Only one specimen.

43. *Incisalia augustus* Kirby.—Schoolcraft, Mackinac, Charlevoix, Cheboygan; May 19-July 16. Common on dry, sandy upper beaches.

44. *Incisalia polios* C. & W.—Schoolcraft, Mackinac; May 27-30. Rather rare. Appears somewhat earlier than *augustus* in the same localities.

45. *Incisalia niphon* Hbn.—Mackinac; May 18-30. Two specimens.

46. *Feniseca tarquinius* Fabr.—Mackinac; June 18-23. Appears to be rare.

47. *Heodes thoe* Bdv.—Schoolcraft; August 1-September 16. Two specimens only.

48. *Heodes helloides* Bdv.—Schoolcraft, Mackinac; June 17-September 16. Not common.

49. *Heodes dorcas* Kirby.—Mackinac; July 2-August 18. Common.

50. *Heodes epixanthe* Bdv. & Lec.—Schoolcraft; August 21. One pair taken near Manistique.



51. *Heodes hypophlaeas* Bdv.—Schoolcraft, Mackinac; June 4-October 1. Quite common.

52. *Everes comyntas* Godt.—Schoolcraft, Mackinac; May 31-October 2. The specimens vary greatly in size and color. A very small, dark form was common at Manistique in September, 1917.

53. *Plebeius saepiolus* Bdv.—Schoolcraft, Mackinac, Charlevoix; June 5-July 24. Common.

54. *Glaucopsyche lygdamus* Dbldy.—Mackinac; May 25-June 28. Not nearly so common as *saepiolus*, and is more closely restricted to certain localities.

55. *Lycaenopsis pseudargiolus* Bdv. & Lec.—Schoolcraft, Mackinac, Charlevoix, Cheboygan, Emmet; May 23-July 1. The common form is *marginata* Edw. Form *lucia* Kirby is somewhat less common, and form *violacea* Edw. still less so. The butterfly appears to be single brooded in this region, but one specimen of the summer form *neglecta* Edw. having been taken, August 16, near St. Ignace.

## HESPERIIDAE

56. *Cocceius pylades* Scud.—Mackinac; May 29-June 26. Common.

57. *Thanaos icelus* Lint.—Schoolcraft, Mackinac, Charlevoix; May 18-July 4. Common.

58. *Thanaos brizo* Bdv. & Lec.—Mackinac; July 4. One specimen only.

59. *Thanaos juvenalis* Fabr.—Schoolcraft; June 21. One only.

60. *Carterocephalus palaemon* Pall.—Mackinac; June 4-28. Quite common.

62. *Pamphila comma* Linn., var. *manitoba* Scud.—School-  
61. *Ancyloxypha numitor* Fabr.—Mackinac,  
Charlevoix, Emmet; June 20—August 23. Common.

craft, Mackinac, Charlevoix, Emmet, Gogebic; July 19-August 23. Very common.

63. *Polites cernes* Bdv. & Lec.—Schoolcraft, Mackinac, Charlevoix, Marquette; June 8-August 2. Common.

64. *Polites mystic* Scud.—Schoolcraft, Mackinac; June 15-July 24. Common.

65. *Polites peckius* Kirby.—Mackinac; June 30-July 7. Not common.

66. *Poanes hobomok* Harris.—Schoolcraft, Mackinac, Charlevoix; June 1-July 13. Common.

67. *Euphyes vestris* Bdv.—Schoolcraft, Mackinac, Charlevoix; June 30-August 3. Quite common.

68. *Amblycirtes vialis* Edw.—Mackinac, Charlevoix; May 30-July 27. Very common.

## SPHINGIDAE

69. *Ceraetomia undulosa* Wlk.—Charlevoix; June 22-August 3. Two specimens.

70. *Sphinx chersis* Hbn.—Mackinac, Charlevoix; July 2-21. Two specimens.

71. *Smerinthus jamaicensis* Dru., normal form ~~geminatus~~ Say.—Mackinac; June 21. A single specimen.

72. *Smerinthus cerisyi* Kirby.—Mackinac; June 20-July 4. Only two specimens.

73. *Pachysphinx modesta* Harris.—Mackinac; July 3-10. Four specimens, one taken in each of four years.

74. *Haemorrhagia gracilis* G. & R.—Mackinac; June 5. A single specimen.

75. *Haemorrhagia diffinis* Bdv.—Mackinac, Cheboygan; May 26-July 1. Common.

76. *Celerio gallii* Rott., var. *intermedia* Kirby.—Mackinac; June 1-30. Not uncommon.

77. *Celerio lineata* Fabr.—Gogebic; August 21. One only.

## SATURNIIDAE

78. *Tropaea luna* Linn.—Mackinac; June 6. One specimen taken at night at St. Ignace.

79. *Telea polyphemus* Cram.—Schoolcraft, Mackinac; July 12. One specimen taken at Seul Choix Lighthouse, and one reared from larva.

## CERATOCAMPIDAE

80. *Anisota rubicunda* Fabr.—Charlevoix; July 29. One specimen taken on Squaw Island.

## SYNTOMIDAE

81. *Scepsis fulvicollis* Hbn.—Mackinac, Charlevoix; June 30-September 24. Common.

82. *Lycomorpha pholus* Dru.—Mackinac, Marquette; July 10-20. Two specimens.

83. *Ctenucha virginica* Charp.—Schoolcraft, Mackinac, Charlevoix; June 11-July 20. Common.

## ARCTIIDAE

84. *Hypoprepia miniata* Kirby.—Charlevoix; July 26. One taken on Hog Island.

85. *Halisidota maculata* Harr.—Schoolcraft, Mackinac; June 7-July 26. Several specimens.

86. *Eubaphe aurantiaca* Hbn., <sup>var.</sup> ~~form~~ *ferruginosa* Wlk.—Schoolcraft, Mackinac, Emmet; June 20-September 9.

<sup>var.</sup> ~~Form~~ *brevicornis* Wlk.—Mackinac, Emmet; July 14-30. Two specimens.

87. *Diacrisia virginica* Fabr.—Schoolcraft, Mackinac, Charlevoix; June 17-July 26. Common.

88. *Isia isabella* A. & S.—Mackinac; June 18-30. Two specimens.

89. *Hyphantria textor* Harr.—Schoolcraft, Mackinac, Charlevoix; June 7-August 10. Four specimens.

90. *Estigmene acraea* Dru.—Mackinac; July 4. One specimen, taken at light.

91. *Estigmene prima* Slosson.—Mackinac; June 22. One specimen.

92. *Apantesis parthenice* Kirby.—Mackinac, Emmet; July 16-August 18. Four specimens.

93. *Arctia caja* Linn.—Marquette; July. One large yellow female.

94. *Utetheisa bella* Linn.—Mackinac, Charlevoix; July 27-September 6. Quite common.

95. *Haploa confusa* Lyman.—Mackinac; June 20-July 24. Three specimens taken at the same locality.

#### AGARISTIDAE

96. *Alypia octomaculata* Fabr.—Schoolcraft, Charlevoix; June 11-July 16. One specimen from Manistique. Quite common on Garden Island, the only locality in this region where the wild grape grows.

97. *Alypia langtoni* Couper.—Schoolcraft, Mackinac, Charlevoix; June 23-August 1. Quite common.

#### NOCTUIDAE

98. *Heliothis obsoleta* Fabr.—Mackinac; July 16-October 13. Abundant.

99. *Euxoa detersa* Wlk.—Schoolcraft, Mackinac, Emmet, Charlevoix; September 8-18. Common at light.

100. *Feltia venerabilis* Wlk.—Mackinac; August 29-September 7. Common at light.

101. *Feltia subgothica* Haw.—Mackinac; August 6-22. Quite common, especially at light.

102. *Feltia herilis* Grt.—Mackinac; August 9-10. Several specimens at light.

103. *Agrotis geniculata* G. & R.—Mackinac; August 8. One specimen at light.

104. *Agrotis ypsilon* Rott.—Mackinac; July 7-23. Several at sugar.

105. *Agrotis c-nigrum* Linn.—Schoolcraft, Mackinac; September 1-October 3. Common.

106. *Agrotis*<sup>Treati Grt.</sup>~~*lucanella*~~ Gn.—Mackinac; July 19. One at light.

107. *Agrotis baja* Fabr.—Schoolcraft; August 19. One at light.

108. *Agrotis unimacula* Morr.—Mackinac; July 23. Two specimens at sugar.

109. *Agrotis unicolor* Wlk.—Marquette; July 10. One only.

110. *Epipsilia littoralis* Pack.—Mackinac; June 22. One specimen at light.

111. *Lycophotia nigra* Sm.—Mackinac; July 23. Four females at sugar.

112. *Lycophotia occulta* Linn.—Mackinac; June 30-August 16. Three specimens.

113. *Lycophotia margaritosa* Haw.—Mackinac; July 9-October 5. Several specimens of both the typical form and the form *saucia* Hbn. taken at light and reared from larvae.

114. *Rynchagrotis alternata* Grt.—Mackinac; July 18. One specimen taken at light.

115. *Rynchagrotis anchocelioides* Gn.—Schoolcraft; August 18. One specimen at light.

116. *Euretagrotis sigmoides* Grt.—Mackinac; July 23. One specimen taken at sugar.

117. *Euretagrotis perattenta* Grt.—Mackinac, Marquette; June 28-July 23. Several taken at sugar and at light.

118. *Polia purpurissata* Grt.—Mackinac; August 14. One taken at sugar.
119. *Polia adjuncta* Bdv.—Mackinac. One specimen reared from larva.
120. *Polia renigera* Steph.—Mackinac; July 19-August 16. Quite common at light.
121. *Chabuata signata* Wlk.—Mackinac; June 28-August 16. Not uncommon at light.
122. *Nephelodes emmedonia* Cram.—Schoolcraft, Mackinac; August 25-September 11. Quite common at light.
123. *Cirphis commoides* Gn.—Mackinac; July 2-12. Two only.
124. *Cirphis phragmatidicola* Gn.—Mackinac; May 22-July 23. Two specimens, one taken at sugar.
125. *Cirphis unipuncta* Haw.—Mackinac; May 24-October 3. Very common.
126. *Leucania luteopallens* Sm.—Mackinac; June 28-August 4. Quite common at light.
127. *Cucullia intermedia* Speyer.—Mackinac; June 11. One only.
128. *Oncocnemis riparia* Morr.—Schoolcraft; October 13. One at light.
129. *Graptolitha amanda* Sm.—Mackinac; September 10. Only one specimen.
130. *Graptolitha georgii* Grt., var. *holocinerea* Sm.—Mackinac; September 9-October 21. Two only.
131. *Xylena nupera* Lint.—Mackinac. One reared from larva.
132. *Xylena curvamacula* Morr.—Mackinac; September 18. Only one specimen.
133. *Parastichtis bicolorago* Gn., <sup>form</sup> ~~var.~~ *ferrugineoides* Gn.—Mackinac; August 27-September 25. Two only.

134. *Xanthia lutea* Strom.—Mackinac, Charlevoix; September 14-October 18. Three specimens.
135. *Septis arctica* Bdv.—Schoolcraft, Mackinac; July 12-31. Four specimens.
136. *Trachea mactata* Gn.—Mackinac; September 24. Only one specimen.
137. *Trachea modica* Gn.—Mackinac; July 16. One only.
138. *Euplexia lucipara* Linn.—Mackinac; July 12. One taken at sugar.
139. *Agroperina dubitans* Wlk.—Mackinac; July 19-August 30. Very common at light.
140. *Agroperina lateritia* Hufn.—Mackinac; June 27-July 24. Several specimens.
141. *Sidema devastator* Brace.—Mackinac, Charlevoix; July 12-August 21. Common at both light and sugar.
142. *Chutapha periculosa* Gn., form *v-brunneum* Grt.—Mackinac; July 12. One at sugar.
143. *Acronycta superans* Gn.—Mackinac; June 15. Only one specimen.
144. *Acronycta grisea* Wlk.—Mackinac; June 16. One only.
145. *Acronycta spinigera* Gn.—Mackinac. One specimen reared from larva.
146. *Acronycta innotata* Gn.—Mackinac, Marquette; June 16-July 23. Four specimens.
147. *Acronycta dactylina* Grt.—Mackinac; August 15. Only one specimen.
148. *Hyppa xylinoides* Gn.—Mackinac; September 22. One specimen taken at sugar.
149. *Balsa malana* Fitch.—Cheboygan; August 19. One specimen taken at light.
150. *Apamea nictitans* Linn., var. *americana* Speyer.—Mackinac; August 6-16. Three at light.

151. *Pyrrhia umbra* Hufn.—Mackinac, Charlevoix, Marquette; July 11-12. Three specimens.
152. *Papaipema cataphracta* Grt.—Mackinac; September 21. One specimen taken at light.
153. *Ogdoconta cinereola* Gn.—Mackinac; July 12. One specimen taken at sugar.
154. *Lithacodia carneola* Gn.—Mackinac; July 14-August 10. Several specimens taken at light.
155. *Catocala antinympha* Hbn.—Charlevoix; July 31. One specimen taken at light.
156. *Catocala coelebs* Grt.—Mackinac. One reared from larva. Believed to be the first record of this species for Michigan.
157. *Catocala relictta* Wlk.—Mackinac, Emmet; August 14-September 9. Both the typical form and the form *clara* Beut. are common.
158. *Catocala parta* Gn.—Emmet; August 15. One only.
159. *Catocala briseis* Edw.—Mackinac, Gogebic, Charlevoix, Marquette; July 15-September 22. Common.
160. *Catocala unijuga* Wlk.—Schoolcraft, Mackinac, Charlevoix; July 19-September 18. Common.
161. *Catocala semirelictta* Grt.—Mackinac; August 14-19. Three specimens. No previous record for Michigan.
162. *Catocala concumbens* Wlk.—Mackinac; August 14-19. Three specimens taken at sugar.
163. *Catocala ultronia* Hbn.—Mackinac; August 9. One specimen taken at light.
164. *Parallelia bistriaris* Hbn.—Schoolcraft, Mackinac; June 10-July 21. Two specimens.
165. *Euclidia cuspidata* Hbn.—Mackinac, Charlevoix; May 27-June 27. Very common.
166. *Caenurgia crassiuscula* Haw.—See next species.



167. *Caenurgia erectea* Cram.—Schoolcraft, Mackinac, Charlevoix, Emmet, Cheboygan; May 12-September 28. Both this and the preceding species are common and occur together. The difference between them is so slight that their separation is very unsatisfactory. There is no doubt, however, that both species have been taken.

168. *Zale minerea* Gn.—Mackinac; June 13. One only.

169. *Autographa falcifera* Kirby, form *simplex* Gn.—Schoolcraft, Mackinac, Charlevoix, Emmet, Cheboygan; May 26-October 1. Very common. Some of the specimens approach closely to the typical form.

170. *Autographa brassicae* Riley.—Mackinac; June 29-October 3. Not common.

171. *Autographa precatationis* Gn.—Mackinac; August 3-9. Only two specimens.

172. *Autographa bimaculata* Steph.—Mackinac, Marquette; July 1-10. One specimen reared from larva.

173. *Autographa mappa* G. & R.—Mackinac; June 18. Only one specimen.

174. *Autographa ou* Gn.—Mackinac; June 29. One only.

175. *Plusia aereoides* Grt.—Mackinac; July 19. One specimen taken at light.

176. *Drasteria graphica* Hbn.—Schoolcraft, Mackinac; May 30-June 18. Common in restricted localities.

177. *Syneda adumbrata* Behr. (?).—Mackinac; June 15-27. Two specimens. The determination of this species is not satisfactory, being based wholly upon Holland's plate. The specimen is very different from *graphica*.

178. *Scoliopteryx libatrix* Linn.—Mackinac, Emmet, Marquette; July 19-September 3. Three specimens.

179. *Alabama argillacea* Hbn.—Mackinac; September 5-October 2. Very common. This moth was especially abun-

dant in the vicinity of Naubinway, Mackinac County, in September, 1920. Hundreds were attracted to the lights, and on one morning thousands were seen on the surface of Lake Michigan. They appeared to lie in patches, often covering more than one hundred square yards in extent, and occurred as far as four miles from the shore.

180. *Epizeuxis aemula* Hbn.—Marquette; July 10.

181. *Epizeuxis lubricalis* Geyer.—Marquette; July 10.

182. *Zanclognatha lituralis* Hbn.—Mackinac; June 15.

183. *Zanclognatha theralis* Wlk.—Charlevoix; August 3.

184. *Zanclognatha inconspicualis* Grt.—Mackinac; June 21.

185. *Zanclognatha laevigata* Grt. (?)—Charlevoix; August

3. Specimen badly worn, so determination is somewhat doubtful.

186. *Renia flavipunctalis* Geyer.—Mackinac; August 6. One specimen taken at light.

187. *Phalaenophana pyramusalis* Wlk.—Charlevoix; June 22. Three specimens.

188. *Palthis angulalis* Hbn.—Mackinac, Charlevoix; June 8-July 28. Three specimens.

189. *Bomolocha deceptalis* Wlk.—Mackinac; July 12. One taken at sugar.

190. *Plathypena scabra* Fabr.—Mackinac, Charlevoix, Gogebic; June 15-August 29. Common.

#### NOTODONTIDAE

191. *Datana ministra* Dru.—Mackinac; June 30. One specimen taken at light. Larvae which appear to be those of this moth are quite common, but adults are seldom seen.

192. *Heterocampa manteo* Dbldy.—Mackinac, Charlevoix; July 21-August 12. Three specimens.

193. *Schizura unicornis* A. & S.—Mackinac; June 16. Only one specimen.

194. *Gluphisia septentrionalis* Wlk.—Mackinac; July 2-August 10. Several at light.

THYATIRIDAE

195. *Habrosyne scripta* Gosse.—Mackinac; July 23. Several at sugar.

196. *Habrosyne rectangularata* Ottol.—Charlevoix. One specimen from pupa. Determined only by comparison with plate of Barnes and McDunnough.

197. *Pseudothyatira cymatophoroides* Gn.—Mackinac; June 18-July 12. Two specimens of the typical form and one of the form *expultrix* Grt. taken at sugar.

LYMANTRIDAE

198. *Notolophus antiqua* Linn.—Mackinac, Emmet; July 16-September 24. Common. Most of the specimens at hand were reared from larvae.

LASIOCAMPIDAE

199. *Malacosoma americana* Fabr.—Mackinac; July 12-18. Common. Two specimens reared from larvae, others from pupae.

200. *Epicnaptera americana* Harris.—Mackinac; June 5. One only.

DREPANIDAE

201. *Drepana arcuata* Wlk.—Mackinac; June 19-August 15. Several specimens.

202. *Drepana bilineata* Pack.—Cheboygan; May 10. One taken at light.

## GEOMETRIDAE

203. *Alsophila pometaria* Harris.—Mackinac; November 2. Several males taken flying in a snow storm.
204. *Nemoria mimosaria* Gn.—Schoolcraft; June 10. One male.
205. *Synchlora aerata* Fabr.—Mackinac; August 9-16. Several specimens taken at light.
206. *Mesotheca incertata* Wlk.—Schoolcraft, Charlevoix; May 30-June 10.
207. *Acidalia emuleata* Gn.—Mackinac; June 23-July 19.
208. *Haematopis grataria* Fabr.—Mackinac, Cheboygan; August 19-September 6. Common.
209. *Trichodesia albovittata* Gn.—Charlevoix, Marquette; May 26-July 12. Quite common on Garden Island in heavy maple woods.
210. *Lobophora montanata* Pack.—Schoolcraft, Mackinac; May 30-June 18. Two specimens.
211. *Triphosa affirmaria* Wlk.—Mackinac; September 14. Three specimens.
212. *Calocalpe undulata* Linn.—Mackinac; June 10. Four specimens.
213. *Lygris diversilineata* Hbn.—Schoolcraft, Mackinac; July 25-September 1. Frequent at light.
214. *Lygris testata* Linn.—Mackinac; July 19. One only.
215. *Dystroma hersiliata* Gn.—Charlevoix; July 28.
216. *Hydriomena coerulea* Fabr.—Mackinac, Charlevoix; June 25-July 8. Common.
217. *Xanthorhoe lacustrata* Gn.—Mackinac; July 19. Taken at light.
218. *Xanthorhoe designata* Hufn.—Charlevoix; June 1.
219. *Xanthorhoe ferrugata* Clerk. — Mackinac, Emmet, June 9-20. Two specimens.

220. *Orthonama obstipata* Fabr.—Mackinac; June 17-September 20. Several taken at light.
221. *Spargania magnoliata* Gn.—Mackinac, Marquette; July 1-15. Two specimens.
222. *Euphyia centrostrigaria* Woll.—Mackinac, Charlevoix; June 4-22. Two specimens.
223. *Mesoleuca ruficillata* Gn.—Mackinac, Charlevoix; June 11-24.
224. *Eulype hastata* Linn.—Mackinac, Charlevoix, Marquette; May 17-July 29. Very common.
225. *Hydrelia lucata* Gn.—Mackinac; June 15. One only.
226. *Eudule mendica* Wlk.—Mackinac, Charlevoix, Marquette; June 16-July 28. Quite common.
227. *Eupithecia miserulata* Grt. (?).—Mackinac; May 25-September 26. Determination not certain.
228. *Isturgia truncataria* Wlk.—Schoolcraft, Mackinac; May 19-June 10. Quite common in dry, sandy woods.
229. *Isturgia amitaria* Gn.—Emmet; May 28. Two specimens.
230. *Bapta semiclarata* Wlk.—Mackinac, Charlevoix; May 26-June 23. Common.
231. *Physostegania pustularia* Gn.—Schoolcraft, Mackinac, Marquette; August 1-25. Quite common.
232. *Cabera variolaria* Gn.—Schoolcraft, Mackinac, Charlevoix; June 10-September 24. Common.
233. *Philobia aemulataria* Wlk.—Mackinac, Charlevoix; June 11-28.
234. *Macaria granitata* Gn.—Mackinac, Charlevoix; May 27-July 30. Common.
235. *Phasiane neptaria* Gn., var. *trifasciata* Pack.—Charlevoix; June 8-July 29. Two specimens.
236. *Phasiane atrofasciata* Pack.—Mackinac; June 27. Only

one specimen. There is some doubt in this determination. The specimen may be *excurvata* Pack.

237. *Phasiane eremiata* Gn.—Charlevoix; July 26. One only.
238. *Itame brunneata* Thun.—Mackinac, Marquette, June 18-July 14. Not uncommon.
239. *Apaecasia subaequaria* Wlk.—Mackinac, Charlevoix; May 27-June 29. Common.
240. *Catopyrrha coloraria* Fabr.—Schoolcraft; July 16.
241. *Caripeta divisata* Wlk.—Mackinac, Charlevoix, Marquette. Four specimens.
242. *Nepytia semiclusaria* Wlk.—Mackinac; September 7.
243. *Cleora larvaria* Gn.—Mackinac; June 15. One only.
244. *Ectropis crepuscularia* D. & S.—Mackinac, Charlevoix; May 29-August 3. Quite common.
245. *Erannis tiliaria* Harris.—Mackinac; October 5-19.
246. *Cingilia catenaria* Dru.—Schoolcraft; September 25.
247. *Anagoga pulveraria* Linn.—Mackinac; July 17.
248. *Ellopia fiscellaria* Gn.—Schoolcraft, Mackinac, Charlevoix, Emmet; May 27-September 22. Common.
249. *Campaea perlata* Gn.—Schoolcraft, Marquette; July 10-August 20. Several specimens.
250. *Ennomos subsignarius* Hbn.—Schoolcraft, Mackinac, Charlevoix, Marquette; July 13-August 27.
251. *Ennomos magnarius* Gn.—Mackinac; August 29. One only.
252. *Xanthotype crocataria* Fabr.—Schoolcraft, Mackinac, Charlevoix; June 18-July 23. Common.
253. *Hyperetis amicaria* H. S.—Mackinac, Charlevoix; May 26-June 16.
254. *Gonodontis hypochlaria* H. S.—Charlevoix; June 24. One female.

255. *Gonodontis duaria* Gn.—Schoolcraft, Mackinac, Charlevoix; June 10-July 5. Not common.

256. *Euchlaena johnsonaria* Fitch.—Mackinac; August 14.

257. *Euchlaena pectinaria* D. & S.—Mackinac; May 31. One specimen, so badly worn that the determination is a little doubtful.

258. *Metanema inatomaria* Gn.—Mackinac; June 15-24.

259. *Tetracis crocallata* Gn.—Mackinac; May 30-June 23.

260. *Sabulodes lorata* Grt.—Charlevoix; June 22. One only.

261. *Sabulodes transversata* Dru.—Mackinac; August 14-September 24. Several specimens.

## LIMACODIDAE

262. *Prolimacodes badia* Hbn.—Mackinac; July 19. One specimen taken at light.

## PYRALIDAE

263. *Diaphania hyalinata* Linn.—Mackinac; October 2. One specimen taken at light.

264. *Evergestis straminealis* Hbn.—Schoolcraft, Mackinac; June 12-September 7. Quite common at light.

265. *Loxostege chortalis* Grt.—Mackinac; May 31. One only.

266. *Pyrausta fodinalis* Led.—Mackinac, Charlevoix; June 28-August 30. Several specimens.

267. *Pyrausta ochosalis* Dyar.—Mackinac; June 15-July 25. Two specimens.

268. *Pyrausta funebris* Strom.—Mackinac, Charlevoix; June 10-25. Quite common.

269. *Nymphula badiusalis* Wlk.—Cheboygan; August 19. Very abundant at light on one night.

270. *Pyralis farinalis* Linn.—Mackinac; June 13-30. Two specimens taken at light.

271. *Crambus pascuellus* Linn.—Charlevoix; July 21. One taken at light.

272. *Crambus leachellus* Zinck.—Mackinac; August 21. Only one specimen.

273. *Crambus unistriatellus* Pack.—Mackinac; July 3-19.

274. *Crambus dumetellus* Hbn.—Mackinac; June 8-13.

275. *Crambus hortueilus* Hbn.—Mackinac; June 15.

276. *Crambus vulgivagellus* Clem.—Mackinac; August 30. One specimen taken at light.

277. *Crambus ruricolellus* Zell.—Cheboygan; August 19. Taken only at light.

278. *Crambus trisectus* Wlk.—Cheboygan; August 19.

279. *Crambus inornatellus* Wlk.—Mackinac, Emmet; July 4-August 23. The most common Crambid of the region.

#### AEGERIIDAE

280. *Bembecia marginata* Harris.—Marquette, Gogebic; July 13-28.

#### EUCOSMIDAE

281. *Argyroploce bipartitana* Clem.—Mackinac; June 28.

#### TORTRICIDAE

282. *Sparganothis flavedana* Clem.—Mackinac; June 30. Taken at light.

283. *Cacoecia cerasivorana* Fitch.—Mackinac; July 7-25. Two specimens.



OCCASIONAL PAPERS OF THE MUSEUM OF  
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ON SOME HEMIPTERA FROM NORTH DAKOTA<sup>1</sup>

BY ROLAND F. HUSSEY

The present status of our knowledge concerning the distribution of the North American Hemiptera is very far from satisfactory. The work which has been done is sufficient to give us only a general idea of the distribution of many of the species, and there are many serious gaps which can be filled only by careful studies on the fauna of the neglected regions. This fauna will not necessarily be identical with that of the past, however. The hand of man produces changes in the character of a region: the flora and the insect fauna so intimately related to it are altered. A splendid opportunity for investigating the primitive fauna of the western United States was lost when the biological reconnaissance work of the Geological and Geographical Survey was discontinued: very few regions have received any extensive study since that time.

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<sup>1</sup> Contribution from the Entomological Laboratory of the Bussey Institution, Harvard University, No. 203.

North Dakota is an especially favorable region for such investigations. Three distinct faunal elements meet here: the boreal is found along the northern boundary of the state; the characteristic fauna of the eastern states is well represented in a large part of eastern North Dakota; and the fauna of the Great Plains and the Rocky Mountains is found in the southwestern corner of the state. But although faunistic work was very auspiciously begun here by the early surveys, it was soon neglected, and no paper dealing with the Hemiptera of Dakota has appeared since 1878, when Uhler published his last list of Hemiptera from this region. Only a few isolated North Dakota records have been published since that time, and they are widely scattered in the literature.

In 1919 the North Dakota Biological Station in coöperation with the Museum of Zoology of the University of Michigan undertook, under the direction of Crystal Thompson, a biological survey of the state, and has continued this during succeeding summers. The continued progress of the work has been made possible through the untiring efforts and generous assistance of Dr. R. T. Young, Director of the State Biological Station. As a part of this reconnaissance, my friend T. H. Hubbell made a collection of insects in various parts of North Dakota during the summer of 1920. About seven weeks were devoted to the field work, and while Hubbell gave his attention primarily to the Orthoptera, he was able to pick up a goodly number of Hemiptera. His collection, augmented by a number of specimens taken by other collectors, has been submitted to me for determination, and forms the basis of the present paper.

Mr. Hubbell's itinerary was as follows: From July 19 to July 29 he worked in the region about Devils Lake, making short expeditions to Stump Lake (July 24 and 25) and to

Spring Lake (July 25), both of which are in Nelson County. He then went to the Turtle Mountains, where he remained from July 30 till August 6, save for two days (July 31 and August 1) which were spent at Bottineau. From the Turtle Mountains he returned to Devils Lake, and was there until August 17; during this time he made but one short trip, to the Sheyenne River in Eddy County, about three miles south of Warwick, on August 8. From August 21 to 28 he worked in the region about Amidon, in Slope County, where he spent a large part of his time in the Bad Lands west of the town. The last locality he visited was Fargo, where he obtained a number of specimens on August 31 and September 2. His collection also contains several Hemiptera taken by Ada L. Olson at the Sheyenne River (August 8), and at Buford (July 23) and Williston (July 24) in Williams County. The comparatively few specimens taken by other collectors will be noted under the respective species.

A careful search of the literature has yielded definite records from North Dakota for only 42 species, while 39 others are listed simply from "Dakota." Mr. Hubbell's collection contains about 110 species, of which 99 can be named at present. Of these, 26 have previously been reported from North Dakota, so that the total number of species now recorded from the state stands at 115. In the annotated list which follows I have incorporated all the previously published North Dakota records, together with the data from the specimens in the collection before me. Species not previously recorded from the state are marked with an asterisk.

Acknowledgments are due to several of my friends for their assistance in determining several of the species recorded here. Thus Mr. Bueno has identified the three species of Saldidae in the collection; Professor Knight has determined the Ortho-

tylinae and the Phylinae, as well as several of the other Mirid species; and Professor Parshley has named the Tingidae and a few of the other forms.

## LIST OF SPECIES

## SCUTELLERIDAE

*Homœmus œneifrons* (Say).—Specimens were taken at Devils Lake, July 25, at the Turtle Mountains, and at Fargo. One of the individuals from the Turtle Mountains has a pale vitta on either side of the head, similar in position to that found in *H. bijugis*, though somewhat narrower. Its other characters are those of *œneifrons*, and it must be referred here. This species was also recorded by Uhler (1878, p. 503) from Pembina and the Mouse River.

*Eurygaster alternatus* (Say).—There are six specimens in the collection. Four were taken at Devils Lake, July 25-28; one was found on the vegetation on the arid Chalky Buttes south of Amidon, August 22; and the other was taken at the edge of a wheat field at Amidon, August 24. Uhler (1878, p. 503) lists the species from Pembina, Turtle Mountains, and the Mouse River.

## CYDNIDAE

\**Corimelana pulicaria* (Germar).—Four individuals were found on the vegetation in an open woods by the Sheyenne River; one was taken on Ambrosia at Devils Lake, August 14; and three were collected at Fargo. Uhler (1876, p. 271; 1878, p. 503) records this species from "Dakota."

*Galgupha nitiduloides* (Wolff).—Van Duzee (1917, p. 14, No. 28) lists this species as occurring in North Dakota. It does not occur in Mr. Hubbell's collection.

*Sehirus cinctus* (Palisot de Beauvois).—This species is

recorded by Uhler (1878, p. 503) from Pembina and the Mouse River. I have not seen any North Dakota specimens.

## PENTATOMIDAE

*Sciocoris microphthalmus* Flor.—One specimen was taken on the herbaceous growth on the rocky side of Black Butte, near Amidon, August 21. I have previously reported this specimen (1921, p. 9).

\**Peribalus abbreviatus* (Uhler).—Two specimens are in the collection. One was taken at Bottineau, from herbage in a depression in a pasture; the other was found in a shrub-filled clearing at the Turtle Mountains.

\**Peribalus limbolarius* Stål.—Two specimens from Amidon, both taken from vegetation in which ragweed was predominant.

\**Rhytidolomia faceta* (Say).—Eight individuals were taken from a small area on the shore of Devils Lake at the Narrows, July 21, where they occurred among the sparse vegetation. Reported by Uhler (1872, p. 399) from "Dakota."

\**Chlorochroa uhleri* Stål.—This species occurred commonly at Bottineau; and one individual was taken from the shore vegetation behind the mud flats at Spring Lake.

*Carpocoris remotus* Horváth.—One, from a tall growth of mustard grass and thistles on the prairie near Amidon, August 23. Miss Olson also took four specimens at Buford. Van Duzee (1904, p. 42) records this species from Williston, as *Carpocoris lynx*.

\**Euschistus tristigmus* (Say).—Four specimens were taken. One is from Devils Lake, July 28, where it was found in the undergrowth in an oak woods, and the others are from a similar situation near the Sheyenne River.

\**Euschistus euschistoides* (Van Vollenhoven).—A good series of specimens was brought from Devils Lake and from Amidon.

*Coenus delius* (Say).—This species is also represented by numerous specimens. It was found at Devils Lake, Stump Lake, the Turtle Mountains, and Amidon (Hubbell), and at the Sheyenne River (Olson), while Uhler (1878, p. 504) lists it from the Mouse River region.

\**Neottiglossa undata* (Say).—One specimen was taken from the vegetation beside the Bois de Sioux River at Fargo.

*Cosmopepla bimaculata* (Thomas).—One individual from the Turtle Mountains, taken on willow in a moist meadow. Uhler (1878, p. 504) also records this species as taken near the Turtle Mountains.

*Thyanta punctiventris* Van Duzee.—This species is reported from Williston by Van Duzee (1904, p. 55). No species of this genus occurs in Hubbell's collection.

*Perillus bioculatus claudus* (Say).—Mr. N. A. Wood took one specimen of this species at Devils Lake, in May, 1921. Uhler (1878, p. 504) records it from Turtle Mountains.

\**Perillus circumcinctus* Stål.—One specimen was collected at Bottineau, August 1; and a second was captured on a raspberry bush at Devils Lake, July 28, while it was feeding on a Chrysomelid larva. The species is reported from "Dakota" by Uhler (1876, p. 282).

*Apateticus cynicus* (Say).—Dr. Uhler (1878, p. 504) listed this species from Pembina and the Mouse River, but possibly this record may refer to the next species. *A. cynicus* was not taken by Hubbell.

\**Apateticus bracteatus* (Fitch).—One individual was taken at Bottineau, from the vegetation beside a dry creek bed.

#### COREIDAE

\**Protenor belfragei* Haglund.—The collection contains five adults and several nymphs of this species. The latter were

taken at Devils Lake in July; one adult was taken in a marshy area at the Turtle Mountains, and the other four at Devils Lake during August.

\**Megalotomus quinquespinosus* (Say).—Two individuals were brought from the Turtle Mountains, and one was taken at the Sheyenne River.

*Coriscus*<sup>1</sup> *eurinus* (Say).—The two specimens in the collection are from Devils Lake, where they were taken July 20, running about on the sand among the sparse beach grasses. Uhler (1878, p. 504) lists this species from Pembina and Turtle Mountains.

\**Coriscus conspersus* (Montandon).—Numerous specimens were taken at Devils Lake (July), as well as at Stump Lake, Spring Lake, the Sheyenne River, and the Turtle Mountains. Montandon (1893, p. 16) lists this species from "Dakota."

\**Coriscus tomentosus* (Fracker).—One specimen, taken in flight at Amidon, August 23, has been placed here. Its coloration is very nearly identical with that of *C. pluto* (Uhler), as described by Fracker (1918, p. 266-68), but the antennal and genital characters are those of *tomentosus*. On the other hand, I have a specimen of *pluto* from Dilley, Oregon, given to me by Mr. Barber, which agrees exactly in color with Fracker's description of *tomentosus*. Such color variations, however, are analogous to those found in *C. conspersus* and its variety *infuscatus* (Fracker). *C. tomentosus* has previously been recorded only from Colorado.

\**Coriomerus humilis* (Uhler).—One individual was taken on the arid Chalky Buttes near Amidon, August 24; and Mr. Bueno has a specimen taken at Fargo, May 26, 1900, which he has kindly permitted me to record here.

<sup>1</sup> Horváth has shown (1917, p. 378) that *Cimex calcaratus* Linné is the type species of both *Alydus* Fabr., 1803, and *Coriscus* Schrank, 1796. *Alydus* is therefore a strict synonym of *Coriscus*.

Parshley (1921 b, p. 3) has recently questioned the validity of this species. I have examined too few specimens to have reached any definite conclusions on this point, but I may note that I have seen two apparently distinct North American forms in this genus, quite different in habitus but very difficult to distinguish on a structural basis. I hope to publish further on this genus in the near future.

One specimen of the brachypterous form which has commonly been referred to this species, even by Uhler himself, was taken at Amidon, August 24, from goldenrod in the bottom of a gully in the "breaks" of the Bad Lands. This form cannot possibly be referred to *C. humilis*, or even to the genus *Coriomerus*, for the structure of the metathoracic orifices excludes it from the subfamily Pseudophlecinæ: I have seen only brachypterous individuals, and so can give no information regarding the venation of the membrane and the alae. This insect possesses some characters in common with *Scelopocerus*, but differs from that genus in the position of the spiracles. In all probability it represents a genus still undescribed, as has been suggested to me by Mr. Barber.

*Harmostes reflexulus* (Say).—One specimen, from the Chalky Buttes near Amidon, August 22, is in the collection. Uhler (1878, p. 505) lists it from the Mouse River.

*Corizus lateralis* (Say).—Uhler (1878, p. 505) records this form from the Turtle Mountains. Neither this nor the next species was taken by Hubbell.

*Corizus crassicornis* (Linné).—Reported from Pembina by Uhler (1878, p. 505), under the name *C. punctiventris* Dallas.

\**Leptocoris trivittatus* (Say).—Collected at Devils Lake, May 7, 1921 (N. A. Wood), and at Grand Forks (H. A. Shaw).



## ARADIDAE

*Aradus robustus* Uhler.—Dr. Parshley (1921 a, p. 41) has recorded the single specimen taken by Hubbell at Devils Lake, July 22.

*Aradus lugubris* Fallen.—Recorded from Valley City by Parshley (*op. cit.*, p. 80).

## NEIDIDAE

*Neides muticus* (Say).—Uhler lists this form from Pembina (1878, p. 504). It was not taken by Hubbell.

## LYGAEIDAE

\**Lygaeus kalmii* Stål.—The eastern race *angustomarginatus* Parshley was taken only at Devils Lake, together with a few specimens intermediate between this form and the typical *kalmii*. The latter was found in small numbers at Devils Lake, and commonly at Amidon (Hubbell) and at Buford (Olson). Thus it appears that the ranges of the two subspecies overlap in central North Dakota.

*Nysius ericae* (Schilling).—I have placed here all the specimens of this genus which were taken at Devils Lake during July. Uhler (1878, p. 505) lists this species, under the name *N. angustatus*, from Pembina and Mouse River; and it is possible that the specimens from "Dakota" that he mentions (1895, p. 22) in connection with the description of *N. minutus* should also be referred to this species.

\**Nysius thymi* (Wolff).—One specimen was brought from the Turtle Mountains and six from Amidon.

\**Ischnodemus falicus* (Say).—Mr. Hubbell took a single individual at Devils Lake, July 22. Uhler (1876, p. 305) lists the species from "Dakota."

*Blissus leucopterus* (Say).—This species is stated to occur

but rarely in North Dakota (cf. Bull. 34, N. D. Agr. Exp. Sta., 1898, p. 294). It was not taken by Hubbell.

*Geocoris bullatus bullatus* (Say).—Seven specimens are in the collection. Three are from Devils Lake (July 19 and August 13), two are from the Turtle Mountains (July 30, August 6), one from the Sheyenne River, and the other from the summit of Black Butte, which rises from the plains south of Amidon. Uhler (1878, p. 505) lists this species from Pembina.

\**Geocoris uliginosus uliginosus* (Say).—One specimen was found in company with numerous Saldidae, on the shore of East Bay at Devils Lake, where the mud is covered with a thin saline crust from the evaporation of the strongly alkaline water. Uhler (1876) lists this form and the variety *limbatus* Stål as occurring in "Dakota."

\**Spharobius insignis* (Uhler).—One individual was brought from the summit of Black Butte, August 21, and three were taken in the Turtle Mountains, August 6, where they were running about on the ground in a dry field.

\**Zeridoneus costalis* (Van Duzee).—One specimen was taken from the vegetation beside the Bois de Sioux River at Fargo, August 31.

\**Ligyrocoris diffusus* Uhler.—The collection contains three specimens from Amidon, one from the Turtle Mountains, and one from Fargo.

\**Ligyrocoris sylvestris* (Linné).—Nine specimens were collected in the Turtle Mountains, July 30 to August 6.

\**Peritrechus fraternus* Uhler.—Two individuals were collected from a dry pasture at Bottineau; and thirty were taken at a lighted sheet in the grassy yard of the Devils Lake Biological Station, on the very warm evening of August 8.

\**Sphragisticus nebulosus* (Fallén).—The collection contains nine specimens. Three were taken from weeds at the edge of Stump Lake, four at Bottineau, one in the Turtle Mountains, and one at Devils Lake (at light, August 8). Listed from "Dakota" by Van Duzee (1917, p. 193, No. 592).

*Emblethis vicarius* Horváth.—Seven specimens are in the collection. Four are from the Turtle Mountains, one from the prairie at Amidon, and two from the bare sand flats beside Devils Lake. Horváth (1908, p. 563) records this species from North Dakota, but without any definite locality.

## TINGIDAE

\**Melanorhopala lurida* Stål.—Seven specimens were brought from Devils Lake, where they were taken from roadside vegetation in the woods on the military reservation, July 22.

\**Leptoypa mutica* (Say).—One of the two individuals in the collection was taken with the preceding species, July 22, and the other was found in a similar situation near Devils Lake, July 28.

\**Corythucha marmorata* Uhler.—The two examples of the typical form were taken at Devils Lake, July 22, from the same locality as the two preceding species. Four specimens of the variety *informis* Parshley were collected in the Turtle Mountains, in a field covered with goldenrod and other Compositae.

\**Corythucha cydoniæ* Fitch.—Of the ten specimens from Devils Lake, nine were taken from undergrowth in an oak woods on July 22, while the other, according to Hubbell's notes, was found on choke cherry, August 13. In Michigan I have taken this species only on *Amelanchier canadensis*.

\**Corythucha arcuata* (Say).—The four specimens from Devils Lake were taken on July 22 from the same locality as

the preceding species, while a fifth individual was found in a similar situation near the Sheyenne River, August 8.

## PHYMATIDAE

*Phymata erosa fasciata* (Gray).—Twenty-seven specimens are in the collection. Ten of these were taken at Amidon while the remainder are from Devils Lake, Fargo, and Bottineau (Hubbell), and from the Sheyenne River (Olson). Uhler (1878, p. 507) lists this species from Pembina and the Mouse River.

## REDUVIIDAE

*Rhynocoris ventralis* (Say).—Recorded by Uhler (1878, p. 508) from Pembina. It was not taken by Hubbell.

*Sinea diadema* (Fabricius).—Represented by thirty-seven specimens, of which twenty-two were taken on August 12 from a dense growth of tall weeds on the flats by Devils Lake. Mr. Hubbell writes, "The . . . Reduviid is extremely abundant everywhere in this region, in similar locations." Other specimens were collected at Devils Lake, Stump Lake, Fargo, and Amidon; while Uhler (1878, p. 508) lists the species from Turtle Mountains.

## NABIDAE

*Nabis subcoleoptratus* (Kirby).—Specimens were secured at Devils Lake, Stump Lake, Spring Lake, Sheyenne River, and Amidon. Uhler (*loc. cit.*) lists the species from Pembina and Turtle Mountains.

\**Nabis propinquus* Reuter.—Three apterous individuals were taken at Devils Lake, July 22 and 25; and one example of the very rare macropterous form was found there on August 15.

*Nabis ferus* (Linné).—This species was taken by Hubbell

at Devils Lake, the Turtle Mountains, and Amidon, and by Miss Olson at Williston. Uhler (1878, p. 508) records it from Pembina and the Mouse River region.

\**Nabis rufusculus* Reuter.—Six individuals were secured at Devils Lake, August 13, from undergrowth in a moist wood of elm and box elder, and from grasses in the clearings.

ANTHOCORIDAE

\**Triphleps insidiosus tricolor* White.—One of the two specimens at hand is from the Turtle Mountains, the other from Spring Lake.

MIRIDAE

*Stenodema vicinum* (Provancher).—Reported from Pembina by Uhler (1878, p. 506), under the name *Miris instabilis* Uhler.

\**Stenodema trispinosum* Reuter.—Taken at light near the Devils Lake Biological Station, August 8.

\**Megalocera debilis* Uhler.—Two individuals were found on the roadside vegetation at the Odessa Narrows on Devils Lake, July 23; and one was found in the grass in a dry creek bed at Bottineau, August 1.

*Trigonotylus ruficornis* (Fallén).—One specimen was taken in the Turtle Mountains, August 6; and a second came to light at Devils Lake, August 8. Uhler (1878, p. 506) lists the species from Pembina.

\**Trigonotylus tarsalis* (Reuter).—Three specimens were secured at Devils Lake, July 19 and 25.

\**Platytyllus circumcinctus* (Say).—Three individuals were brought from the Turtle Mountains, where they were beaten from undergrowth in a second-growth aspen woods, August 4. (Determined by Knight.)

\**Platytyrellus nigricollis* (Reuter), var.—Several specimens were taken with the preceding species, and others were taken in the Turtle Mountains, at Bottineau, and at Devils Lake. (Determined by Knight.)

*Platytyrellus insignis* (Say).—Reported by Uhler (1878, p. 507) from the Turtle Mountains. This species is not in Hubbell's collection.

\**Phytocoris lasiomerus* Reuter.—Three examples were taken in the Turtle Mountains, both from willows and from other vegetation in a moist meadow. A mutilated specimen from Devils Lake (August 7) appears to belong here.

\**Phytocoris salicis* Knight.—Taken on willow in the Turtle Mountains, August 2. Also found on the undergrowth in the various types of woodland at Devils Lake. (Determination verified by Knight.)

\**Phytocoris lacunosus* Knight.—Taken on willow in a moist meadow at the Turtle Mountains, August 4. Dr. Knight writes me that these are the first specimens he has seen other than the types, which were taken on *Carpinus caroliniana* at McLean, N. Y.

*Adelphocoris rapidus* (Say).—Five typical specimens from Fargo are at hand, while one specimen from Devils Lake tends toward *superbus*. Recorded from the Turtle Mountains by Uhler (1878, p. 506).

\**Adelphocoris* ?*superbus* (Uhler).—I have placed here three specimens from the Turtle Mountains and one from Amidon. I am unable to separate this species from the preceding on any structural basis, and am of the opinion that *superbus* constitutes a western form of *rapidus*.

*Paciloscytus unifasciatus* (Fabricius).—Taken from the vegetation beside a moist meadow at the Turtle Mountains,

August 6. (Determined by Knight.) Uhler (1878, p. 507) also recorded this species from the Turtle Mountains.

\**Pæciloscytus venaticus* Uhler.—Taken in Sully's Hill National Park, near Devils Lake, July 19. A variety of this species was taken on sedges in the Turtle Mountains, July 30. (Determined by Knight.)

*Pæcilocapsus lineatus* (Fabricius).—Listed by Uhler (1878, p. 506) from Pembina. Neither this species nor the next one was taken by Hubbell.

*Horcias dislocatus goniphorus* (Say).—Recorded from Pembina by Uhler (*loc. cit.*), as "the red variety of *Lygus dislocatus*."

\**Lygidea rubecula* (Uhler).—Nine specimens were beaten from willow in a moist meadow at the Turtle Mountains, August 4. Four of these belong to the variety *obscura* Reuter, and the remainder to one of the paler forms.

*Lygus pratensis* (Linné).—A long series of specimens is at hand from Devils Lake, Stump Lake, Bottineau, Turtle Mountains, Fargo, and Amidon (Hubbell), and from Buford and Williston (Olson). Uhler (1878, p. 506) records this species from Mouse River, under the name *L. lineolaris*.

Nearly half of the specimens can be referred to the variety *oblineatus* (Say), while only two belong to the variety *strigulatus* (Walker): these specimens were all taken in the eastern part of the state and in the Turtle Mountains. The specimens from western North Dakota, as well as a number of those taken at Devils Lake and in the Turtle Mountains, belong to an unnamed variety which is characterized by the very pale-green coloration, the extreme reduction of the dark markings, and the semi-hyaline hemelytra: the markings of the hemelytra are commonly reduced to a pair of very small geminate dark

spots near the apex of the corium, and a dark spot on the tip of the clavus, much as in *L. elisus*.

\**Lygus vanduzeei* Knight.—One individual was secured at the Turtle Mountains, and two at Fargo.

\**Lygus plagiatus* Uhler.—A few specimens were taken from the vegetation by the Bois de Sioux River at Fargo; and nine specimens were collected from ragweed at the edge of a woods by Stump Lake.

\**Lygus campestris* Linné.—Several specimens were brought from the Turtle Mountains, where they were swept from the herbaceous plants in the fields. (Determined by Knight.)

*Lygus invitus* (Say).—Uhler (1878, p. 505) records the capture of this species in the Turtle Mountains, July 24, 1873. This record requires confirmation, as the *Lygus invitus* of Uhler included several additional species as now distinguished.

\**Neoborus amœnus amœnus* (Reuter).—Three individuals were taken from roadside vegetation in a moist woods by the Sheyenne River, August 8. As is the case in Michigan specimens collected at this season, these have not acquired their permanent definitive coloration, but still have the dark areas of the mature form bright red in color.

\**Deracocoris fasciolus* Knight.—Two specimens were secured in the Turtle Mountains, one from roadside vegetation consisting chiefly of *Corylus rostrata* and various seedlings, the other from the plants by the shore of Lake Upsilon. (Determined by Knight.)

\**Deracocoris nitenatus* Knight.—One male was taken at Devils Lake, July 23, from undergrowth in a grove of elm and box elder.

*Deracocoris aphidiphagus* Knight.—Professor Knight (1921, p. 135) records a specimen taken in Kidder County, July 14, by A. A. Nichol. This species is not in Hubbell's collection.



\**Deræocoris histrio* (Reuter).—One individual came to the light at Devils Lake, August 8.

\**Orectoderus obliquus* Uhler.—Two of the myrmeciform females of this species were collected at Devils Lake, July 19 and 23. (Determined by Knight.)

\**Coquilletia insignis* Uhler.—Several individuals of both sexes were brought from Amidon. The majority of them were found on the buttes south of the town. (Determination verified by Knight.) Uhler (1890, p. 79) listed the species from "Dakota."

\**Hyaliodes vitripennis* (Say).—Five specimens from the Turtle Mountains, August 4, swept from undergrowth in a thick stand of second-growth aspens and balsam poplars.

\**Strongylocoris stygicus* (Say).—A good series of specimens was secured at Bottineau, the Turtle Mountains, and Devils Lake. Uhler (1878, p. 507) records the species from Pembina.

\**Pilophorus clavatus* (Linné).—One specimen was taken from the grasses in a dry creek bed at Bottineau, August 1. (Determined by Knight.)

\**Ceratocapsus pumilus* (Uhler).—A number of specimens were collected at Devils Lake. Most of these came to the light during the warm evenings in early August; and the remainder were swept from low shrubbery and undergrowth in the woods. (Determined by Knight.)

\**Lopidea instabilis* (Reuter).—Taken at Amidon on rose bushes, at Devils Lake on *Fraxinus*, and at the Sheyenne River. (Determined by Knight.)

\**Lopidea media* (Say).—Miss Olson took two females of this species at Williston, July 24. (Determined by Knight.)

Uhler (1878, p. 506) listed this species from the Mouse River, but this record may not refer to *L. media* as now understood.

*Lopidea* spp.—The collection contains specimens of two undescribed species of this genus. One of these forms was taken only in the Turtle Mountains, the other at the Turtle Mountains and at Devils Lake.

\**Diaphnidia pellucida* Uhler.—Taken from undergrowth in a stand of elm and box elder at Devils Lake, July 28; and from the low vegetation in a stand of second-growth aspen in the Turtle Mountains, August 4. (Determined by Knight.)

*Reuteria irrorata* (Say).—Uhler (1878, p. 507) reports this species from Pembina and the Turtle Mountains. It does not occur in Hubbell's collection.

\**Orthotylus flavosparsus* (J. Sahlberg).—Taken at Devils Lake, Stump Lake, and Fargo. (Determined by Knight.)

\**Orthotylus coagulatus* (Uhler).—Specimens were secured at the Turtle Mountains, at Devils Lake (at light), and at Amidon (on thistle).

\**Orthotylus fumatus* Van Duzee.—Two specimens were brought from Devils Lake. Both were taken at the light, August 8 and August 15. (Determined by Knight.)

\**Ilnacora stålîi* Reuter.—Represented by specimens from Devils Lake, Bottineau, the Turtle Mountains, and the Sheyenne River.

\**Plagiognathus obscurus* Uhler, var.—A good series of specimens was brought from Devils Lake, Stump Lake, Fargo, Bottineau, and the Turtle Mountains. (Determined by Knight.)

\**Plagiognathus guttatipes* (Uhler).—Several individuals were taken at Devils Lake, July 19-25. Dr. Uhler described this species as a Lygus, and it is so listed in Van Duzee's

Catalogue. Dr. Knight writes me that these are the first specimens he has seen which have been taken in any locality outside of Colorado.

*Plagiognathus* spp.—Two other species of this genus appear to be represented by a single specimen each. One is from Fargo, the other from the Turtle Mountains.

\**Chlamydatus associatus* (Uhler).—Specimens were taken at Amidon and at Fargo. (Determined by Knight.)

#### GERRIDAE

\**Gerris marginatus* Say.—Five specimens were collected on the Sheyenne River near Warwick, August 8.

\**Gerris buenoi* Kirkaldy.—Five individuals were taken with the preceding, and eleven were secured from a small fresh-water pond near Stump Lake.

*Limnoporus rufoscutellatus* (Latreille).—The collection contains nine individuals, taken on a small spring-fed brook near Stump Lake. Uhler (1878, p. 508) reports this species from Pembina.

#### MESOVELIADAE

\**Mesovelia mulsanti* White.—Three specimens are at hand. One was taken on a small pasture pond near Devils Lake, July 20, and the others were found at Stump Lake, July 24.

#### SALDIDAE

\**Salda coriacea* Uhler.—The collection contains ten specimens of this species. Seven are from Odessa Narrows at Devils Lake, where they occurred on the margin of a small pond. One was taken at Stump Lake, from marshy ground by a brook. One was found in a slough in the Turtle Mountains; and the tenth is from the Sheyenne River.

\**Pentacora signoreti* (Guérin).—Common on the mud flats about Spring Lake, where the soft muck is encrusted with alkali salts.

\**Saldula interstitialis* (Say).—A good series was collected on the muddy margin of a pasture pond at Devils Lake, July 20. Other specimens were taken at Devils Lake (at light), at Odessa Narrows, and on the shore of Lake Upsilon in the Turtle Mountains. Uhler (1877, p. 444) records this species from "Dakota."

#### NOTONECTIDAE

\**Notonecta undulata* Say.—This species was taken at Odessa Narrows on Devils Lake, at Lake Upsilon in the Turtle Mountains, and at Stump Lake. The specimen from Stump Lake lacks head and prothorax, but is readily identified by the form of the gonapophyses.

#### BELOSTOMATIDAE

\**Lethocerus americanus* (Leidy).—Crystal Thompson took an adult, a nymph, and an egg-mass of this species in Fort Totten Lake during July, 1919. Mr. A. H. Eastgate kindly gave Hubbell two other adults, which were collected under street-lights in Fargo by H. A. Shaw in August, 1892.

\**Belostoma flumineum* Say.—Hubbell took two adults from the Bois de Sioux River near Fargo, September 2. One of these individuals was seen to fly over the river and to drop into shallow water near the shore.

## CORIXIDAE

*Cymatia americana* Hussey.—A number of the paratypes of this species were taken by Crystal Thompson while making plankton collections in Fort Totten Lake, August 7, 1919. They have already been recorded elsewhere (Hussey, 1920, p. 80).

*Arctocorisa* spp. Several species of this genus were taken at Devils Lake and in the Turtle Mountains. They had best be left unnamed at present.

*Corixa* spp. The remarks in connection with the preceding genus may be applied here also.

The following species, not mentioned above, are recorded from "Dakota" in the literature, but I have not found any records for them from definite localities in North Dakota. Many or all of them may be expected to occur within the state.

*Homaemus bijugis* Uhl.—Uhler, 1876, p. 272.

*Corimelaena extensa* Uhl.—Uhler, 1872, p. 193; 1876, p. 271.

*Mormidea lugens* (Fabr.).—Uhler, 1876, p. 285.

*Euschistus servus* (Say).—Uhler, 1876, p. 286. This record requires confirmation.

*Hymenarcys nervosa* (Say).—Uhler, 1876, p. 287.

*Hymenarcys aequalis* (Say).—Van Duzee, 1917, p. 46. I have been unable to find any other Dakota record.

*Aelia americana* Dall.—Uhler, 1876, p. 284.

*Neottiglossa trilineata* Kirby.—Uhler, 1877, p. 401.

*Thyanta custator* (Fabr.).—Uhler, 1876, p. 290.

*Thyanta rugulosa* (Say).—Uhler, 1876, p. 290.

*Banasa dimidiata* (Say).—Van Duzee, 1904, p. 60.

*Perillus exaptus* (Say).—Uhler, 1876, p. 281.

*Podisus modestus* Dall.—Uhler, 1876, p. 283.

*Catorhintha mendica* Stål.—Uhler, 1876, p. 292.

*Stachiocnemus apicalis* (Dall.).—Uhler, 1877, p. 402.

*Aufeis impressicollis* Stål.—Uhler, 1876, p. 300.

*Corizus hyalinus* (Fabr.).—Uhler, 1876, p. 300.

*Corizus viridicatus* Uhler.—Uhler, 1877, p. 404; Horváth, 1908, p. 566.

*Lygacus reclinatus* Say.—Uhler, 1876, p. 302. The Dakota records for this species and the next should be confirmed.

*Nysius californicus* Stål.—Uhler, 1872, p. 406; 1876, p. 304.

*Zelus socius* (Uhl).—Uhler, 1872, p. 420; 1876, p. 328.

*Nabis inscriptus* (Kirby).—Uhler, 1876, p. 325. This record requires verification.

*Miris amoenus* (Uhl).—Uhler, 1872, p. 409; 1876, p. 316.

*Deracocoris nebulosus* (Uhl).—Uhler, 1876, p. 319.

*Dacota hesperia* Uhl.—Uhler, 1872, p. 413; 1876, p. 318.

*Dicyphus vestitus* Uhl.—Uhler, 1895, p. 46.

*Hadronema picta* Uhl.—Uhler, 1895, p. 31.

*Saldula major* (Prov.).—Uhler, 1877, p. 443, as *Salda deplanata*.

*Notonecta insulata* Kirby.—Van Duzee, 1917, p. 453, No. 1357.

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OCCASIONAL PAPERS OF THE MUSEUM OF  
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THE DERMAPTERA AND ORTHOPTERA OF  
BERRIEN COUNTY, MICHIGAN

BY THEODORE H. HUBBELL

Although the Orthopteran fauna of Michigan is better known than that of many of the other states of the middle west, the number of papers dealing with it which have so far been published is small.<sup>1</sup> Of these, all except two have been concerned with the Northern Peninsula and the northern half of the Southern Peninsula. The southern portion of the state has received but little attention; Townsend's brief list of Acrididae from Constantine, St. Joseph County, and Hancock's "Nature Studies in Temperate North America" are the only papers treating the Orthoptera of this region. The latter is based largely on field observations made in the vicinity of Lakeside, Berrien County,<sup>2</sup> in the same region covered by this report. Hancock gives detailed notes concerning the habits and habitat of many of the species, but few definite locality records.

<sup>1</sup> For a list of these see the bibliography at the end of the paper.

<sup>2</sup> *Loc. cit.*, pp. viii, 324, and 387.

Berrien County lies in the southwest corner of the state, bounded on the south by Indiana and on the west by Lake Michigan. Here the writer, as a member of the Michigan Geological and Biological Survey, carried on field studies on the Orthoptera during the early summer and fall of 1919 and 1920; four visits were made to the region, amounting in all to about six weeks. R. F. Hussey accompanied the writer on the first three of these occasions, and also worked among the dunes along the lake shore during the entire month of July, 1920. The most important part of the seasonal range of the group was thus covered; but no collecting was done during the spring or late fall, which would undoubtedly have added a few species to the list.

During the course of the work the writer became deeply indebted to a number of persons. Much of the success of the field work was due to the interest and coöperation of George R. Fox, Curator of the Chamberlain Museum of Three Oaks, who placed his detailed knowledge of the region and a considerable portion of his time at the disposal of the party, besides furnishing transportation and aiding the work in many other ways. Mr. Hussey added to the burden of his own studies on the Hemiptera that of collecting a large series of Orthoptera in the dune region during the latter part of July, which furnished the basis for some records which would not otherwise have been obtained. To Mr. Carrol Rawcliffe the writer is indebted for the gift of a number of specimens. Mr. James A. G. Rehn and Mr. Morgan Hebard kindly determined a number of the species here recorded, and verified the author's determinations of a number of the more difficult forms.

All of the specimens recorded in this paper are deposited

in the Museum of Zoology of the University of Michigan, with the exception of a few specimens of a number of the species determined by Rehn and Hebard, which are in the collection of the Academy of Natural Sciences of Philadelphia.

#### GENERAL DESCRIPTION OF THE REGION

The area studied lies in the western part of Berrien County, in the extreme southwestern corner of the state. It comprises a portion of the sand dune area along the shore of Lake Michigan and certain fairly typical areas on the clay and loam soils of the inland region. The field work was done chiefly upon and in the vicinity of the Warren Woods and Warren Dunes, which together form a state preserve under the E. K. Warren Foundation. Collections were also made at several other points in the western part of the county, notably at New Buffalo, Three Oaks, Lakeside, Harbert, and Stevensville.

#### THE SAND-DUNE REGION

In southwestern Berrien County the dune region extends along the shore of Lake Michigan as a well-developed belt of varying breadth from New Buffalo north to Stevensville, at which point it nearly disappears. It was studied chiefly in the region between Sawyer and Bridgman, where it is from half a mile to nearly a mile wide. The Warren Dune Preserve is situated at the point where the dunes attain their greatest development, and includes some of the largest dunes on the lake. It lies nearly midway between Bridgman and Sawyer. The lake frontage of the preserve is slightly over a mile, and it covers nearly the entire width of the dune area at this point. Much of the field work was done in the Warren Preserve, but since it was extended over the entire dune area between

Harbert and Bridgman all records from this area are given merely as "Sawyer Dunes."

The topography of the dune belt consists typically of a broad, gently rising beach sloping up from the lake, succeeded by a number of parallel ridges and valleys having the same general trend as the lake shore. The usual number of ridges is from three to six, but is quite variable; they do not form continuous rows, but are frequently interrupted, the length of a single ridge seldom exceeding half or three-quarters of a mile. This series of ridges is frequently broken in upon by "blowouts"; these are broad troughs of nearly bare, wind-swept sand, which slope gradually up to a horseshoe-shaped crest, from which the sand drops away on the landward side with a forty-five degree slope. These blowout dunes are often considerably higher than the rest, several of them in this region rising more than three hundred and one to very nearly four hundred feet above the lake. Many of these blowout dunes are actively advancing inland; others exhibit various stages of capture by vegetation. In most cases they do not break more than half-way through the dune belt, but in one or two places they cut through almost the entire series of ridges. The distance from crest to shore in some of the larger blowout dunes is half to three-quarters of a mile.

Along the inland margin of the dune area between Sawyer and Bridgman a series of "dune ponds" has been formed by the damming of small creeks by the drifting sand. Small streams break through the line of dune ridges to the beach at Sawyer and at Bridgman.

More than seven-eighths of the dune area at this point is forested, the remainder consisting of bare sand and sparsely vegetated areas, grassy clearings, and sandy swamps and

marshes. The vegetation of the upper beach and foredunes consists of a scattered growth of beach grass and cottonwoods, behind which there frequently occurs a zone of bunch grass. This gives way on the slopes of the dune ridges to forested conditions. Here and there remnants of a narrow belt of pines are found along the lake face of the first row of dunes, and near Sawyer the crests of some of the ridges are covered with a growth of juniper and yew. Nearly everywhere, however, the bunch grass is succeeded by an oak forest. This forest, in places rather xerophytic near the lake, is in general of the mesophytic type. Toward the landward margin of the dune area this oak forest gives place gradually to the climatic beech-maple forest characteristic of the region; this appears first in the valleys and moist depressions. Other habitats are represented by the marshes and low woods around the dune ponds and the moist sandy shores and sand-bar herbage along the streams which traverse the dune region.

The forest conditions have been modified over most of this area by a certain amount of lumbering, and by the fires which have occasionally, and in places repeatedly, swept the dunes. Only small patches of the original forest of large trees remain here and there. There has been no recent lumbering or burning of any extent, however, so that the effect of this past destruction of the forests is principally noticeable at the present time in the small size of the trees over the greater part of the dune area. On the whole, in spite of the changes the forests have undergone, conditions in the dune region seem more nearly to approximate the original conditions than in any other area of similar extent in this part of the state.

The habitats for Orthoptera recognized in the section of the dune region studied may be listed as follows:

UNMODIFIED	MODIFIED OR ARTIFICIAL
(Lake strand)	Grassy clearing habitat
Shore habitat	(Pine dune habitat)
Reed marsh habitat	Open hardwood forest habitat
Sedge marsh habitat	Oak dune forest habitat
Sand-bar herbage habitat	(Beech-maple forest habitat)
Bare dry sand habitat	Edificarian habitat
Beach grass-cottonwood habitat	
Bunch grass habitat	
Upland forest margin thicket habitat	
Lowland forest margin thicket habitat	
Lowland forest habitat	

The pine dune and beech-maple forest habitats are not well developed in this region and were but little studied. The lake strand is not a true Orthopteran habitat, but is included on account of the large number of insects of this order found in the beach drift.

#### THE INLAND REGION

The Orthoptera and Orthopteran habitats of the inland region were studied chiefly in the vicinity of the Warren Woods Preserve, situated about three miles north of Three Oaks. This preserve contains about two hundred acres, of which nearly half is in clearing and the rest mostly covered with forest.

The topography is nearly level, except for the moderately broad valley of the Galien River, which cuts across the northern forested portion of the preserve, and for a number of ravines draining into it. Flood plains of moderate size occur along the meandering course of the stream.

On the flood plain a few small buttonbush swamps are found, and along the margins of the river are a few freshly formed mud-bars which have not yet become forested, but most of the flood plain area is covered with heavy forest. The higher ground, except that in the clearing, is covered with

heavy beech-maple forest. Several types of habitat are represented in the clearing. Some of the cleared ravines contain a thick growth of sedges and *Iris*; the higher land is covered chiefly with grass, with patches of upland sedges and rushes. In parts of the clearing blackberries and other shrubs have grown up to form thickets, and in many places, especially along the edges of the ravines, second-growth trees of oak, maple, and beech grow among the thickets or form small groves.

In the vicinity of the preserve several other types of habitat are found. In the cleared ravines and flood plains there are moist meadows of close-cropped grass and hollows filled with luxuriant growths of lizard's tail, cut-grass, and other moisture-loving plants. On the higher ground there are roads and other areas of bare and sparsely vegetated dry soil, cultivated fields and orchards, thickets of tall weeds, and considerable areas covered with various types of shrub and young tree growth.

The Warren Woods was the only place in the region where any considerable extent of untouched forest was seen, and is probably one of the few such areas remaining in the southwestern part of the state. Most of the other habitats found on the preserve are of general occurrence throughout the region. A few of them are better represented in other parts of the county than in the vicinity of the preserve; the marsh habitats are not as well developed there, for example, as at New Buffalo and around Klute's lakes, south of Three Oaks.

The majority of the habitats of the inland region have been modified from the original condition in greater or less degree. On the preserve all of the area in clearing and about half of the forested portion have been and are at present being heavily pastured by horses and cattle; as a result conditions in this

part of the preserve are very much altered from natural ones. Clearing and cultivation have resulted in the introduction of a number of new habitats and in greatly changing many of the old ones; one of their principal effects has been to reduce the size of the areas occupied by unbroken and uniform habitat conditions. As has been pointed out by Shull (1911, p. 221) and Vestal (1913, pp. 158, 162), this close intermingling of various habitats in units of small size tends to complicate considerably the study of the habitat relationships of forms so mobile as the majority of the Orthoptera.

The Orthopteran habitats of the inland region here recognized may be listed as follows:

UNMODIFIED	MODIFIED OR ARTIFICIAL
Shore habitat	Bare or sparsely vegetated dry soil habitat
Sedge marsh habitat	Grassy upland habitat
Buttonbush swamp habitat	Lizard's tail marsh habitat
Lowland forest-margin thicket habitat	Moist meadow habitat
Upland forest-margin thicket habitat	Second growth scrub habitat
Flood plain and lowland forest habitat	Open hardwood forest habitat
Beech-maple forest habitat	Cultivated field and orchard habitat
	Edificarian habitat

#### HABITATS AND HABITAT DISTRIBUTION

In the arrangement of habitats adopted in this paper the writer has followed Fox<sup>3</sup> in classifying them primarily into xerophytic, mesophytic, and hydrophytic. Under these main headings they have been arranged according to the character of their vegetation. At the end are grouped three habitats which do not fall naturally under this scheme of classification, namely, cultivated fields, orchards, and edificarian.

<sup>3</sup> Fox, H., 1914, Data on the Orthopteran Faunistics of eastern Pennsylvania and southern New Jersey. *Proc. Acad. Nat. Sci. Phil.*, 1914, p. 450, footnote 10.



In a recent paper by Dice and Sherman<sup>4</sup> they have expressed themselves as follows: "We are firmly convinced that it is better to describe a great number of habitats rather than to lump different kinds of environments together. It is infinitely easier for a later worker to combine several habitats which have been split too finely than it is to separate the component habitats which may have been lumped together under one name." With this view the writer fully concurs.

In the lists of species under the different habitats, an asterisk (\*) indicates that the species is common or abundant, a dagger (†) that it is of infrequent or rare (perhaps accidental) occurrence in the habitat.

#### *Xerophytic Habitats*

*Bare dry sand habitat.* This is one of the typical habitats of the dune area, where it is extensively developed. It comprises the middle beach, lying between the moist strand line and the cottonwood-beach grass zone, and the areas of bare, wind-swept sand forming the floors and sides of the blow-outs. The sand is dry and loose, and vegetation is almost completely absent; the surface is usually scattered with a small amount of driftwood and other debris, especially along the beach. In times of storm the entire beach to the very foot of the dunes is swept by the waves. The scarcity of food and shelter makes it evident that the Orthoptera found here must be of only transitory occurrence. The following species were taken in this situation:

*Dissosteira carolina*†                      *Gryllus assimilis*†  
*Trimerotropis maritima*†

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<sup>4</sup> Dice, L. R., and Sherman, H. B., 1922, Notes on the Mammals of Gogebic and Ontonagon Counties, Michigan, 1920. *Occ. Pap. Mus. Zool., Univ. Mich.*, No. 109, p. 5.

*Bare or sparsely vegetated dry soil habitat.* Roads, paths, stubble fields, trampled ground in pastures, and other similar areas of exposed soil make up this habitat. In this region such conditions are nearly always the result of disturbance; few natural areas of bare soil occur. In this habitat the following species were taken:

<i>Acrydium ornatum</i>	<i>Encoptolophus sordidus*</i>
<i>Acrydium hancocki</i> †	<i>Dissosteira carolina*</i>
<i>Acrydium arenosum angustum</i>	<i>Spharagemon bolli</i> †
<i>Paratettix cucullatus</i>	<i>Spharagemon collare wyomingianum*</i>
<i>Tettigidea lateralis parvipennis</i>	
<i>Chloecalis conspersa</i> †	<i>Melanoplus angustipennis</i>
<i>Arphia xanthoptera*</i>	<i>Tridactylus apicalis</i> (near water)†
<i>Arphia pseudonietana</i>	<i>Ellipes minuta</i> (near water)†

*Beach grass-cottonwood habitat.* Along the upper margin of the beach at the foot of the dunes is a zone of variable width where the sand is sparsely covered with a thin growth of beach grass (*Ammophila breviligulata* Fernald) and where the cottonwood (*Populus deltoides* Marsh.) grows in scattered patches and groups. In many places considerable stretches of this habitat are without any tree growth. Mingled with the beach grass are a few other species of grasses and xerophytic plants in small numbers. In this habitat were taken the following species:

<i>Dissosteira carolina</i>	<i>Melanoplus angustipennis*</i>
<i>Spharagemon bolli</i>	<i>Melanoplus keeleri luridus</i>
<i>Spharagemon collare wyomingianum*</i>	<i>Melanoplus differentialis</i> †
<i>Trimerotropis maritima*</i>	<i>Scudderia texensis</i> †
<i>Melanoplus mexicanus atlanis*</i>	<i>Orchelimum gladiator</i> †
<i>Melanoplus femur-rubrum femur-rubrum</i> †	<i>Gryllus assimilis</i>

*Bunch grass habitat.* Between the beach grass-cottonwood zone of the upper beach and the margin of the forest on the slopes of the first row of dunes is a more or less well-defined

zone dominated by bunch grasses; this habitat covers large areas on the side slopes of many of the blowouts in this region. The bunch grasses grow in irregularly scattered clumps separated by bare spaces of dry sand, the surface of which is frequently covered with a thin layer of dead grass stems and leaves; several species of grasses are typically found here, among which *Calamovilfa longifolia* Hack. is the most prominent. A few other plants, such as *Euphorbia corollata* Linn., *Lithospermum gmelini* Hitchc., and an occasional *Asclepias syriaca* Linn. are found sparingly among the clumps of bunch grass. In this habitat the following species were taken:

<i>Dissosteira carolina</i>	<i>Melanoplus angustipennis</i> *
<i>Spharagemon collaris wyomingianum</i> *	<i>Scudderia texensis</i> †
<i>Psinidia fenestralis</i>	<i>Scudderia furcata furcata</i> †
<i>Trimerotropis maritima</i> *	<i>Orchelimum vulgare</i>
<i>Melanoplus mexicanus atlanis</i> *	<i>Orchelimum nigripes</i> †
<i>Melanoplus flavidus</i> †	<i>Conocephalus nemoralis</i> †
	<i>Gryllus assimilis</i>

*Grassy upland habitat.* This is found in two phases, one occurring on sandy and the other on loamy or clay soils.

a. On sandy soils. Examples of this type of habitat are fairly common in the dune area in old abandoned clearings on the dune ridges, and on the high ground immediately back of the dunes. The sand is covered with a very thin and uneven layer of humus and dead vegetation, and with a sparse growth of grass and xerophytic weeds. Many of these fields are overrun with dewberry, vetch, and wild grapevines. Few of them are pastured, so that the grass is usually from a foot to eighteen inches high in the later part of the summer. The following species were taken in this habitat:

<i>Arphia xanthoptera</i> *	<i>Melanoplus angustipennis</i> *
<i>Arphia sulphurea</i> *	<i>Melanoplus confusus</i>
<i>Arphia pseudonietana</i>	<i>Melanoplus keeleri luridus</i>
<i>Schistocerca alutacea rubiginosa</i> *	<i>Neoconocephalus robustus crepitans</i>
<i>Melanoplus mexicanus atlanis</i> *	

b. On loamy and clay soils. Examples of this habitat were studied in the cleared portion of the Warren Woods Preserve and in the vicinity of Three Oaks. On these areas the blue grass (*Poa pratensis* L. and *compressa* L.) is the dominant plant, growing to a height of about eighteen inches. Associated with it are occasional thistles, several other species of grasses, yarrow, mullein, and a few other plants. This habitat is heavily pastured on the preserve, and throughout the region is most frequently found in the form of pasture land. During the greater part of the season this habitat is very dry, the grass being withered and brown by the first of July and remaining so during the rest of the summer and autumn. Here the following species were taken:

<i>Nomotettix cristatus</i> , probably subspecies <i>cristatus</i> †	<i>Melanoplus confusus</i> *
<i>Orphulella speciosa</i> *	<i>Melanoplus keeleri</i> <i>luridus</i>
<i>Chloealtis conspersa</i> †	<i>Melanoplus bivittatus</i>
<i>Ageneotettix deorum</i> †	<i>Scudderia texensis</i>
<i>Arphia xanthoptera</i> *	<i>Scudderia curvicauda curvicauda</i>
<i>Arphia sulphurea</i> *	<i>Neoconocephalus ensiger</i> *
<i>Chortophaga viridifasciata</i> *	<i>Orchelimum vulgare</i> *
<i>Encoptolophus sordidus</i> *	<i>Conocephalus fasciatus fasciatus</i> †
<i>Camnula pellucida</i> *	<i>Conocephalus brevipennis</i> *
<i>Dissosteira carolina</i> *	<i>Conocephalus strictus</i> *
<i>Spharagemon bolli</i>	<i>Nemobius fasciatus fasciatus</i> *
<i>Spharagemon collare wyomingia-</i> <i>num</i> *	<i>Gryllus assimilis</i> *
<i>Melanoplus mexicanus atlantis</i> *	<i>Oecanthus quadripunctatus</i>
<i>Melanoplus femur-rubrum femur-</i> <i>rubrum</i> *	<i>Oecanthus nigricornis</i>

*Pine dune habitat.* Near Sawyer the crests of some of the dunes of the lake series are covered with an irregular growth of juniper and yew, the sand between the shrubby trees being covered with grasses and vines. No collecting was done in this habitat.

Small open groves of white pine are found here and there

on the lake face of the first row of dunes. The pines in these groves are in most places of large size, and are frequently mixed with oaks and other trees. The undergrowth is occasionally quite thick, composed of choke cherry, seedlings of oak and pine, and many other young trees and shrubs; in other places the thin deposit of humus is covered chiefly with a layer of pine needles and low herbaceous plants. This habitat is so ill-defined and of such small extent as to make it difficult to distinguish its fauna from that of the beach grass or bunch grass and the oak woods which usually border it on either side; for this reason it was given little attention. Here the following species were taken:

<i>Parcoblatta virginica</i>	<i>Melanoplus mexicanus atlantis</i>
<i>Parcoblatta pennsylvanica</i>	<i>Melanoplus angustipennis</i>
<i>Melanoplus viridipes</i>	

#### *Mesophytic Habitats*

*Mud-bar and sand-bar herbage habitat.* Along the shores of the Galien River where it flows through the Warren Woods a few small mud-bars have not yet become forested. Their outer margins are usually composed of bare mud or sand; this portion is included under the shore habitat. Between the bare margin and the forest, on their higher and older portions, they are covered with a thick growth of herbaceous plants and grasses, with occasional tree seedlings. Similar habitats occur on the sand-bars and sandy shores of the small creeks cutting through the dunes at Sawyer and Bridgman. About the margins of some of the dune ponds studied, during July and August there were exposed sandy flats from ten to twenty feet wide, which soon became covered with vegetation. Near the wet, muddy margin this consisted principally of mosses and low herbaceous plants, but farther back near the surrounding thicket of willows it was composed of taller plants.

such as Joe-pye weed (*Eupatorium purpureum* L.), swamp dock (*Rumex verticillatus* L.), swamp milkweed (*Asclepias incarnata* L.), grasses, sedges, and cottonwood and willow seedlings, forming a thick growth eighteen inches or more in height. Among the herbage of this habitat the following species were found to occur:

<i>Acrydium granulatum</i>	<i>Dichromorpha viridis</i>
<i>Acrydium ornatum</i>	<i>Melanoplus mexicanus atlantis</i> †
<i>Acrydium arenosum angustum</i> *	<i>Paroxya clavuliger hoosieri</i> *
<i>Paratettix cucullatus</i> *	<i>Nemobius fasciatus fasciatus</i> *
<i>Tettigidea lateralis parvipennis</i> *	<i>Nemobius carolinus carolinus</i>
<i>Tettigidea armata</i> †	<i>Gryllus assimilis</i>
<i>Chortophaga viridifasciata</i> *	

*Moist meadow habitat.* Moist, grassy meadows are found in some of the ravines and in parts of the Galien River floodplain in cleared areas near the Warren Woods. Most of these are pastured; the grazing of the stock keeps the grass in them smooth and short, so that a thick, rich carpet of grass resembling a lawn is formed. In the wetter portions there are occasional patches of sedges, lizard's tail (*Saururus cernuus* L.), and iris. Similar conditions, except for the taller, more luxuriant growth of grass and herbage, were found in a hummocky meadow bordering Klute's lakes, three miles south of Three Oaks, and also in a low, moist field just back of the dunes between Bridgman and Sawyer. The following species were taken in this habitat:

<i>Acrydium ornatum</i>	<i>Melanoplus bivittatus</i> *
<i>Tettigidea lateralis parvipennis</i>	<i>Scudderia pistillata</i> *
<i>Tryxalis brevicornis</i>	<i>Amblycorypha oblongifolia</i>
<i>Chloealtis conspersa</i>	<i>Orchelimum vulgare</i> *
<i>Chortippus curtipennis</i> *	<i>Orchelimum gladiator</i> *
<i>Dissosteira carolina</i> †	<i>Gryllotalpa hexadactyla</i>
<i>Spharagemon bolli</i> †	<i>Nemobius fasciatus fasciatus</i> *
	<i>Nemobius carolinus carolinus</i> *

*Lowland thicket habitat.* Under natural conditions in this region this habitat is typically a narrow zone bounding the lowland forest margin wherever the forest is interrupted by streams, ponds, marshes, or grassland. The plant species composing it are numerous, and vary from one example to the next; about the margins of bodies of water willows are almost always present, and among the many other bushes and shrubs of common occurrence are the bladder nut (*Staphylea trifolia* L.), elder (*Sambucus canadensis* L.), and prickly ash (*Zanthoxylum americanum* Mill.). Examples of this habitat in its natural condition are found about the margins of some of the dune ponds where they are surrounded by moist lowland forest.

Although this habitat in its typical forest margin form is usually rather limited in extent, in regions where the forests have been removed it generally occupies considerable areas in a somewhat modified form. As Shelford<sup>5</sup> has shown, the thickets of roadsides and fence-rows may probably be regarded, from the ecological standpoint, as a modification of the forest margin thicket type. In this region brushy pastures and clearings, if neglected, soon grow up to shrubbery and weeds as a stage in their reversion to forested conditions; such areas form a further extension of this type of habitat. Such a thicket was found between the marshy shores of Klute's lakes and the edge of the swampy forest which formerly bordered them. The soil is moist black muck; among the clumps of taller shrubs and young trees which grow in irregular groups throughout the area the ground is covered with a rank growth of tall herbaceous plants—ironweed, ragweed, nettles, and many others—and with low bushes and seedlings, while vines

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<sup>5</sup> Shelford, V. E., 1913, *Animal Communities in Temperate North America*, p. 275.

spread over the ground and hang in tangled masses from the shrubbery.

Although the conditions grouped under this heading are quite diverse in character, they appear to form a natural habitat unit so far as the Orthoptera are concerned. In this habitat the following species were found:

<i>Chortippus curtipennis*</i>	<i>Scudderia curvicauda curvicauda*</i>
<i>Melanoplus gracilis*</i>	<i>Scudderia furcata furcata*</i>
<i>Melanoplus walshii†</i>	<i>Amblycorypha oblongifolia*</i>
<i>Melanoplus mexicanus atlantis</i>	<i>Neoconocephalus ensiger</i>
<i>Melanoplus femur-rubrum femur-rubrum*</i>	<i>Orchelimum vulgare*</i>
<i>Melanoplus differentialis</i>	<i>Orchelimum gladiator*</i>
<i>Melanoplus bivittatus*</i>	<i>Conocephalus brevipennis*</i>
<i>Scudderia texensis*</i>	<i>Nemobius fasciatus fasciatus</i>
<i>Scudderia pistillata*</i>	<i>Oecanthus quadripunctatus</i>
	<i>Oecanthus nigricornis*</i>

*Upland thicket and scrub habitat.* The typical example of this habitat is the thicket which normally borders the upland forest wherever it gives place to grassland. The plant species composing it vary from one locality to another; young trees, hawthorn, sumac, brambles, many species of shrubs and bushes, and grape and other vines are found here, and among these in the more open parts grow tall composites, grasses, and other herbaceous plants. This forest margin thicket is absent over much of the area in which it should occur in this region, chiefly on account of its destruction by stock grazing. On the Warren Woods Preserve it is absent or greatly modified in all portions accessible to the cattle and horses pastured there, and similar conditions prevail throughout the region. On the other hand, as noted under the discussion of the lowland thicket, the shrubby growths of roadsides and fence-rows may be considered an extension of this habitat, at least as regards most of the insect inhabitants.

Differing chiefly from the forest margin thicket in extent



are the areas of second growth scrub to be found in the vicinity of the Warren Woods and elsewhere in the region. In the cleared areas on and about the Warren Woods Preserve small trees and brush have grown up to form thickets and open scrub in many places along the edges of the ravines and in the cleared flood-plain and ravine bottoms. The trees are chiefly young oaks, maples, and hawthorns; the shrubbery is composed of a large number of species differing with each individual locality. Conspicuous among these are blackberry and raspberry (in many places the dominant forms), rose, spice bush (*Benzoin aestivale* (L.) Nees.), dogwood (*Cornus* sp.), witch-hazel (*Hamamelis virginiana* L.), and bladder nut (*Staphylea trifolia* L.). Among the trees and shrubs the ground is usually covered by tall grass and weeds, dry during the greater part of the season.

It will be seen that a rather wide variety of environmental conditions has been grouped under this head; they seem, however, to be essentially similar when regarded as Orthopteran habitats. Though nearly equalled by that of the sedge marsh, the number of species of Orthoptera found in the upland thicket and scrub habitat exceeds that of any of the other habitats of the region. The following is the list of the species taken here:

<i>Diapheromera femorata</i> *	<i>Schistocerca alutacea rubiginosa</i>
<i>Tettigidea lateralis parvipennis</i>	<i>Melanoplus viridipes</i> *
<i>Chlocaltis conspersa</i> *	<i>Melanoplus mexicanus atlantis</i> *
<i>Arphia sulphurea</i>	<i>Melanoplus walshii</i> †
<i>Arphia xanthoptera</i>	<i>Melanoplus femur-rubrum femur-</i> <i>rubrum</i>
<i>Chortophaga viridifasciata</i>	<i>Melanoplus confusus</i>
<i>Encoptolophus sordidus</i>	<i>Melanoplus keeleri luridus</i>
<i>Camnula pellucida</i>	<i>Melanoplus bivittatus</i>
<i>Dissosteira carolina</i>	<i>Scudderia texensis</i> *
<i>Spharagemon bolli</i> *	<i>Scudderia pistillata</i>
<i>Spharagemon collare wyomingia-</i> <i>num</i>	<i>Scudderia curvicauda curvicauda</i>

<i>Scudderia furcata furcata*</i>	<i>Conocephalus brevipennis</i>
<i>Amblycorypha oblongifolia</i>	<i>Atlanticus testaceus</i>
<i>Neoconocephalus nebrascensis</i>	<i>Nemobius fasciatus fasciatus*</i>
<i>Neoconocephalus ensiger*</i>	<i>Gryllus assimilis*</i>
<i>Orchelimum vulgare*</i>	<i>Oecanthus quadripunctatus*</i>
<i>Orchelimum nigripes*</i>	<i>Oecanthus nigricornis*</i>
<i>Conocephalus fasciatus fasciatus*</i>	

*Open hardwood forest habitat.* Among the dunes in many places the borders of the oak dune forest are open, with a growth of thin, dry grass covering the ground under the trees. Occasionally small openings are found among the woods, where the ground is covered with a low growth of herbaceous plants and tree seedlings. In these situations the following species were taken:

<i>Diapheromera femorata</i>	<i>Melanoplus keeleri luridus*</i>
<i>Chloeahtis conspersa*</i>	<i>Melanoplus bivittatus</i>
<i>Arphia sulphurea</i>	<i>Scudderia furcata furcata</i>
<i>Cannula pellucida</i>	<i>Neoconocephalus robustus crepi-</i>
<i>Spharagemon bolli*</i>	<i>tans†</i>
<i>Spharagemon collare wyomingia-</i>	<i>Orchelimum vulgare</i>
<i>num</i>	<i>Conocephalus brevipennis</i>
<i>Melanoplus viridipes*</i>	<i>Conocephalus nemoralis†</i>
<i>Melanoplus mexicanus atlantis*</i>	<i>Nemobius fasciatus fasciatus*</i>
<i>Melanoplus angustipennis*</i>	<i>Gryllus assimilis</i>

An open grove consisting chiefly of hard maple, beech, black oak, and a few other hardwoods, mingled with which are a number of good-sized white pines, was found at New Buffalo on a sandy ridge about a quarter of a mile from the lake. The ground in the shadier parts of the grove is covered with wintergreen and other low herbaceous plants. There is some undergrowth of young trees and shrubs, and around the more open margins the woods are invaded by grass. Here were taken the following species:

<i>Dichromorpha viridis†</i>	<i>Melanoplus viridipes†</i>
<i>Chloeahtis conspersa</i>	<i>Melanoplus fasciatus†</i>
<i>Spharagemon bolli*</i>	<i>Melanoplus keeleri luridus*</i>
<i>Spharagemon collare wyomingia-</i>	<i>Nemobius fasciatus fasciatus*</i>
<i>num</i>	

In the inland region this habitat is extensively developed, due largely to the pasturing of stock along the borders of the woods, which prevents the natural growth of young trees and shrubbery. On the Warren Woods Preserve all of the forest margin accessible to the stock pastured there is open, and the ground beneath the trees covered with grass. Near the preserve are patches of woods which have been thinned by cutting, where similar conditions prevail throughout. The following species were taken in this habitat:

<i>Parcoblatta virginica</i>	<i>Melanoplus viridipes*</i>
<i>Diapheromera femorata</i>	<i>Melanoplus mexicanus atlantis*</i>
<i>Chloealtis conspersa*</i>	<i>Melanoplus confusus*</i>
<i>Arphia sulphurea</i>	<i>Melanoplus keeleri luridus*</i>
<i>Chortophaga viridifasciata</i>	<i>Melanoplus bivittatus</i>
<i>Camnula pellucida</i>	<i>Scudderia furcata furcata</i>
<i>Dissosteira carolina</i>	<i>Nemobius fasciatus fasciatus*</i>
<i>Spharagemon bolli</i>	<i>Gryllus assimilis*</i>
<i>Spharagemon collare wyomingianum</i>	

*Flood-plain and lowland forest habitat.* A good example of this type of habitat is found on the flood-plain of the Galien River where it flows through the Warren Woods. Except for the mud-bars along the shores of the river, and a few buttonbush swamps, the entire flood-plain is covered with a heavy mixed forest in which basswood, elm, and sycamore are the most conspicuous trees. There is little underbrush; the herbaceous undergrowth consists of ferns, grasses, and sedges, but is sparse and in many places absent. The flood-plain is subjected to flooding in the spring; when the water recedes many small pools are left to disappear gradually, in time becoming mere patches of damp mud on the forest floor, and eventually drying up. It was on such moist muddy areas that the only Orthoptera taken in this forest were found.

Similar forests were seen in several places on low, wet ground, in depressions in the sand-dune and inland regions.

In the wetter localities the elm seems usually to be the dominant tree, though basswood and ash are commonly associated with it. The ground in these situations is of damp black muck, often covered with a thick undergrowth of ferns and low herbaceous vegetation. In many places these forests contain maples and other trees, showing transition toward the climax beech-maple forest.

Three species of Tetrigids are the only Orthoptera which were found in this habitat; *Paratettix cucullatus* (Burmeister) and *Acrydium arenosum angustum* Hancock were taken on muddy patches and among low herbage on moist ground in the Galien River flood-plain, and a single specimen of *Acrydium granulatum* Kirby was seen on a patch of moist mucky soil in a swampy forest near Klute's lakes, but was not captured.

*Second growth upland forest habitat.* In several places in the cleared portion of the Warren Woods Preserve there are small groves of second growth forest. All of these are heavily pastured, and have scarcely any undergrowth; the ground under them is in places worn bare by the trampling of the cattle. A better example of this habitat occurs near the preserve on a bank overlooking the Galien River flood-plain. It consists of a thick stand of young oaks, maples, occasional beeches, and scattered trees of other species, most of them under four inches in diameter. The undergrowth is sparse, consisting of a few herbaceous plants and small seedlings; the ground is well drained and dry, covered with dead leaves, and strewn with fallen twigs and branches, with here and there a large rotting log or stump.

*Ceuthophilus latens* Scudder and *Melanoplus viridipes* Scudder are the only Orthoptera which were taken in this habitat.

*Oak dune forest habitat.* Much of the dune area is covered

with a heavy oak forest composed largely of second growth trees under six inches in diameter. On the younger dunes near the shore this forest is more xerophytic, with less undergrowth, and occasional areas of nearly bare ground under the trees, approaching the xerophytic black oak dune forest type. Inland it becomes more mesophytic in character and grades off into the climax beech-maple-hemlock forest of the region.

The principal trees of this forest are black oak, red oak, white oak, basswood, white ash, sassafras, and an occasional hard maple, blue beech, and hop hornbeam. The black oak is the dominant form near the beach; inland the red oak and white oak become more numerous. There is a considerable amount of underbrush, consisting of such small trees and shrubs as choke cherry (*Prunus virginiana* L.), spice bush (*Benzoin aestivale* L. Nees.), wild gooseberry (*Ribes cynosbati* L.), and leatherwood (*Dirca palustris* L.). Many of the trees and shrubs are overrun with green brier (*Smilax hispida* Muhl.) and other vines. The ground in many places is covered with a thick growth of low herbage; below the layer of dead leaves the dune sand is covered by several inches of humus.

The following species were taken in this habitat:

<i>Parcoblatta virginica</i> *	<i>Melanoplus viridipes</i> *
<i>Parcoblatta uhleriana</i> *	<i>Atlanticus testaceus</i> *
<i>Parcoblatta pennsylvanica</i> *	<i>Ceuthophilus nigricans</i> †
<i>Diapheromera femorata</i>	<i>Ceuthophilus latens</i> *

*Beech-maple forest habitat.* This is the climax forest of the region, occurring not only upon the morainic uplands but also upon the older portions of the sand dunes. It is found in almost original condition on the forested upland portion of the Warren Woods Preserve. These woods consist of a nearly pure stand of hard maple (*Acer saccharum* Marsh.) and

beech (*Fagus grandifolia* Ehrh.); the trees are of very large size, so that the forest crown is high and the shade dense. The forest is very open; the underbrush in most places is scanty, consisting chiefly of young trees of beech and maple, with occasional leatherwood, spice bush, or other shrubs. The soil is rich humus, which remains always moist; it is covered with a thick layer of decaying leaves. In the spring and early summer a dense growth of low herbage covers the ground, but it largely disappears later in the season. Fallen twigs and branches litter the ground, but most of the logs have been removed and the dead timber is cut out; this constitutes the chief modification from natural conditions. The scarcity of cockroaches and camel-cricket noted here may be attributed to the dearth of suitable shelter thus created.

In the dune area the beech-maple forest occurs on the older (inland) rows of dunes; on account of the cutting and burning to which the dunes have been subjected it is less perfectly developed than in the Warren Woods Preserve. The mesophytic oak forest of the younger dunes shows a gradual transition to the beech-maple forest, the latter appearing first in the moister parts of the dune valleys. The most conspicuous difference between this dune forest and that on the uplands is the presence in the former of occasional hemlocks, which in a few places form small groves. The beech-maple forest was but little studied in the dune region.

The following species were found in this habitat:

<i>Parcoblatta virginica</i> †	<i>Pterophylla camellifolia</i> camelli-
<i>Parcoblatta pennsylvanica</i> †	folia
<i>Diapheromera femorata</i>	<i>Ceuthophilus nigricans</i> †
	<i>Ceuthophilus latens</i> *

*Hydrophytic Habitats*

(*Lake strand.*) During their stay in the dune region Hussey and the writer had the good fortune to witness several insect drifts of varying size which were washed up on the shore of Lake Michigan. These drifts contained a great variety of insects, particularly of Coleoptera; but numbers of Orthoptera, Hemiptera, and Hymenoptera, and occasional insects of other orders were noted. The proportion of aquatic or marsh-inhabiting forms found in the drift was very large; this fact, together with certain observations made by Hussey on the direction of the wind during and previous to the occurrence of the principal drifts, seem to make it probable that a large number of the insects came from the vicinity of Stevensville, where the extensive marshes known as the "Grand Marais" occur. The likelihood of this is increased by the fact that the line of dunes, which elsewhere probably constitutes a considerable barrier to insects coming from the landward side, at that point nearly disappears, offering free access to the lake from the interior.

Since a considerable number of Orthoptera were taken in the drift along the lake strand, it seemed desirable to record them here, though this is obviously not a normal Orthopteran habitat. A large number of the Acridids came ashore apparently uninjured, and were able to fly in a short time. The majority of the specimens taken exhibit the extreme macrop-terous condition found in the species. A few apterous or brachypterous specimens were taken in the drift, which were probably caught by the waves while hiding under debris on the beach, or while feeding on dead fish or insects previously washed ashore. Species common in the drift on certain occasions are indicated in the following list by a star:

<i>Parcoblatta pennsylvanica</i> ? (juv.)	<i>Schistocerca serialis</i>
<i>Paratettix cucullatus</i>	<i>Melanoplus mexicanus atlanis</i> *
<i>Orphulella speciosa</i>	<i>Melanoplus angustipennis</i>
<i>Chortippus curtispennis</i> *	<i>Melanoplus bivittatus</i> *
<i>Arcyptera lineata</i>	<i>Scudderia pistillata</i>
<i>Camnula pellucida</i> *	<i>Scudderia curvicauda curvicauda</i>
<i>Dissosteira carolina</i>	<i>Orchelimum gladiator</i>
<i>Spharagemon bolli</i>	<i>Gryllus assimilis</i> (macropterous
<i>Spharagemon collare wyomingianum</i>	and brachypterous)
<i>Trimerotropis maritima</i>	

*Shore habitat.* Along the Galien River where it flows through the Warren Woods are narrow shores of bare moist mud or sand, in places attaining a width of five or ten feet. Along the small streams flowing through the dune area at Bridgman, Sawyer, and New Buffalo moist sandy shores also occur. Similar shores of bare mud or sand are found around small pools in the cleared ravines on the Warren Woods Preserve, and about the margins of the numerous ponds among the dunes. A number of species were taken on the small wet, sandy shores about the margins of spring pools and the streams by which they discharge, on a marshy hillside near the Warren Woods.

In this habitat the following species were taken:

<i>Acrydium arenosum angustum</i> *	<i>Tridactylus apicalis</i>
<i>Paratettix cucullatus</i> *	<i>Ellipes minuta</i> *
<i>Gryllotalpa hexadactyla</i>	<i>Nemobius fasciatus fasciatus</i>

*Reed marsh habitat.* Where the Galien River flows into Lake Michigan at New Buffalo it broadens into a shallow, vegetation-choked lagoon known as Lake Pottawattamie. Around the margins of the south arm of this lagoon there is a thick growth of *Scirpus*, mixed with *Equisetum* toward the shore, enclosing which is a zone of sedges. On the lakeward side the reeds stand in from several inches to a foot of water, but near the shore the saturated sandy soil is exposed among



the bases of the plants. This growth is quite dense, composed largely of *Equisetum*, and here most of the Orthoptera were taken.

<i>Paratettix cucullatus*</i>	<i>Melanoplus bivittatus</i>
<i>Chortippus curtipennis</i>	<i>Scudderia furcata furcata</i> †
<i>Melanoplus mexicanus atlantis</i> †	<i>Orchelimum nigripes*</i>
<i>Melanoplus femur-rubrum femur-rubrum</i> †	<i>Conocephalus fasciatus fasciatus</i>
<i>Melanoplus angustipennis</i> †	<i>Oecanthus quadripunctatus</i> †
<i>Melanoplus differentialis</i> †	<i>Oecanthus nigricornis</i> †

*Sedge marsh habitat.* Some of the cleared ravines on and in the vicinity of the Warren Woods Preserve have in their moister portions thick growths of sedges, tall grasses, iris, lizard's tail, and cat-tails. The margins of the ponds and small lakes of the inland region are bordered in many cases by a zone of sedges. In the dunes the wet depressions and the margins of the dune ponds are often the sites of sedge growths; and around the lagoons at Stevensville and New Buffalo there are extensive sedge marshes. The spring-fed marshes and those connected with the larger bodies of water never become dry, but a large number of those which occupy moist depressions or border small ponds dry up completely during the later part of the summer.

With the exception of the upland thicket and scrub habitat the sedge marsh habitat yielded the largest number of species of any of those studied. The following species were taken here:

<i>Doru aculeatum</i> †	<i>Arphia sulphurea</i> †
<i>Paratettix cucullatus</i>	<i>Chortophaga viridifasciata</i>
<i>Tettigidea lateralis parvipennis</i>	<i>Dissosteira carolina</i> †
<i>Tryxalis brevicornis*</i>	<i>Schistocerca alutacea alutacea*</i>
<i>Pseudopomala brachyptera*</i>	<i>Paroxya clavuliger hoosieri*</i>
<i>Chortippus curtipennis*</i>	<i>Melanoplus femur-rubrum femur-rubrum*</i>
<i>Chloea conspersa</i> †	<i>Melanoplus differentialis*</i>
<i>Arcyptera lineata</i>	

<i>Melanoplus bivittatus*</i>	<i>Orchelimum concinnum</i> †
<i>Scudderia texensis*</i>	<i>Conocephalus fasciatus fasciatus*</i>
<i>Scudderia pistillata</i>	<i>Conocephalus brevipennis*</i>
<i>Scudderia curvicauda curvicauda</i>	<i>Nemobius fasciatus fasciatus*</i>
<i>Scudderia furcata furcata</i>	<i>Nemobius palustris palustris</i> †
<i>Amblycorypha oblongifolia*</i>	<i>Nemobius carolinus carolinus</i>
<i>Neoconocephalus ensiger</i>	<i>Gryllus assimilis</i> †
<i>Orchelimum vulgare*</i>	<i>Oecanthus quadripunctatus*</i>
<i>Orchelimum gladiator*</i>	<i>Oecanthus nigricornis*</i>
<i>Orchelimum nigripes</i>	

*Lizard's tail marsh habitat.* Near New Buffalo there was found a wet depression, fed by a small spring brook, and covering somewhat less than half an acre, which is filled with a luxuriant growth of herbaceous plants from two to three feet in height, dominated by lizard's tail (*Saururus cernuus* L.), associated with which are cut-grass (*Leersia oryzoides* (L.) Sw.), cat-tails, sedges, and vines in great profusion. Scattered among this thick herbaceous growth are occasional shrubs and bushes, mostly of buttonbush (*Cephalanthus occidentalis* L.), while the center of the marsh is occupied by a thick mass of shrubbery six to ten feet tall. No collecting was done in this thicket, which was difficult even to penetrate; all the specimens were taken in the more open bushy and herbaceous growth. The ground is very soft black muck; on every occasion on which the marsh was visited there was an inch or more of water standing upon the surface. A similar area of smaller extent was found in a depression at the foot of a springy hillside draining into the Galien River near the Warren Woods Preserve.

In this habitat the following species were found:

<i>Tryxalis brevicornis*</i>	<i>Melanoplus differentialis*</i>
<i>Chortippus curtipennis*</i>	<i>Melanoplus bivittatus*</i>
<i>Schistocerca alutacea alutacea</i>	<i>Scudderia pistillata</i>
<i>Paroxya clavuliger hoosieri*</i>	<i>Scudderia curvicauda curvicauda</i>
<i>Melanoplus gracilis</i>	<i>Scudderia furcata furcata</i>

<i>Amblycorypha oblongifolia</i>	<i>Conocephalus nigropleurus*</i>
<i>Orchelimum gladiator*</i>	<i>Nemobius fasciatus fasciatus*</i>
<i>Orchelimum nigripes</i>	<i>Nemobius carolinus carolinus</i>
<i>Conocephalus fasciatus*</i>	<i>Oecanthus quadripunctatus</i>
<i>Conocephalus brevipennis*</i>	<i>Oecanthus nigricornis</i>

*Buttonbush swamp habitat.* A few buttonbush swamps of moderate size are found in the flood-plain of the Galien River on and near the Warren Woods Preserve. In the unpastured flood-plain the swamp is surrounded by the flood-plain forest, and has not changed at all from natural conditions. Here the buttonbush (*Cephalanthus occidentalis* L.) is practically the only plant present; it grows in a close tangled thicket from five to ten feet high. The ground beneath is bare, soft muck, with no vegetation except where here and there a rotting log lies on the surface, offering a foothold for mosses and an occasional fern. The only Orthopteran taken here is *Orchelimum nigripes* Scudder, found stridulating among the leaves of a tall buttonbush.

In the flood-plain south of the river is a large swamp, from which the forest has been cleared away on several sides, and the accessible margins of which have been heavily pastured. Here *Orchelimum nigripes* Scudder and *Melanoplus bivittatus* (Say) were taken among the branches of the shrubbery, and *Acrydium arenosum angustum* Hancock from the mucky margin of a pool under the shade of the bushes at the edge of the swamp.

#### *Artificial Habitats*

*Cultivated field and orchard habitat.* This is a grouping of a series of artificial habitats for the sake of convenience, and not a natural division. Many of the conditions comprised under this heading could no doubt be classified under one or another of the preceding habitat divisions, such as bare ground, grassland, etc. However, since detailed notes were not kept

on specimens from these situations, and since most of the species found in them are of very general distribution in more natural habitats which are ecologically similar, no attempt at classification of these purely artificial habitats has been made. Here were taken the following species :

- Arphia sulphurea* (stubble fields).  
*Chortophaga viridifasciata* (clover and hay fields).  
*Dissosteira carolina* (cultivated, stubble, and wheat fields).  
*Encoptolophus sordidus* (cultivated, stubble, and wheat fields).  
*Spharagemon bolli* (stubble fields at margin of woods).  
*Spharagemon collare wyomingianum* (stubble and wheat fields, orchard).  
*Melanoplus bivittatus* (stubble, grain, and hay fields).  
*Melanoplus differentialis* (stubble and wheat fields).  
*Melanoplus femur-rubrum femur-rubrum* (grain, hay, clover, and stubble fields).  
*Melanoplus keeleri luridus* (stubble fields).  
*Melanoplus mexicanus atlanis* (of almost universal occurrence).  
*Scudderia texensis* (weed-grown stubble field).  
*Scudderia furcata furcata* (orchards, on tall weeds and tree branches).

*Edificarian habitat.* The following species of Orthoptera were taken in buildings at the Warren Woods, Three Oaks, New Buffalo, or in the dune region :

- Blatella germanica* *Parcoblatta pennsylvanica*  
*Gryllus assimilis*

LIST OF SPECIES<sup>6</sup>

FORFICULIDAE

*Doru aculeatum* (Scudder).<sup>7</sup>

Stevensville, July 22, 1920, 2 immature males.

These specimens were swept from *Carex* in the sedge marsh around the margins of the "Grand Marais."

BLATTIDAE

*Blattella germanica* (Linnæus).

Three Oaks, September 5, 1920 (several seen and identified).  
New Buffalo, September 9, 1920, 2 males.

Rather common in the hotels in both localities.

*Parcoblatta virginica* (Brunner).

Warren Woods, June 20 to July 1, 1919, 2 males, 2 females, 1 juvenile.  
Sawyer Dunes, June 24, 1919, 1 female; July 7 to 29, 1920, 7 females,  
10 immature specimens.

This species is usually common in the oak dune and beech-maple forests, under loose bark on dead trees and fallen logs, and under debris on the forest floor. In the Warren Woods

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<sup>6</sup> On page viii of his "Nature Studies in Temperate North America" Hancock makes the statement that "when not otherwise stated, these word sketches have been drawn from my diary notes, covering many years, made at Lakeside, Berrien County, Michigan." Also, on pages 325 and 329 there are illustrations of Orthopteran habitats made from photographs taken at Lakeside, with lists of the species found in them. However, in his notes on the habits and habitat of the species of Orthoptera treated there is in most cases no indication of the locality where the observations were made, so that without careful perusal of the book these records may easily be overlooked, as apparently has been generally the case. Since these Lakeside records are not in such form as to be easily available, in the accompanying list note is made of the fact whenever a species has been recorded by him from that locality.

All determinations of specimens here recorded are by the author unless otherwise noted.

<sup>7</sup> Determined by J. A. G. Rehn.

it is not common, probably because of the lack of such shelter. A few specimens were found under the bark of rotting logs lying in grassy clearings around the Warren Woods. It was also taken under the bark of dead pine stubs and fallen logs in the small groves of white pine on the dune slopes; freshly laid egg-cases were found in this habitat among the loose debris at the foot of a dead pine on July 7. Most of the female specimens taken were captured in molasses-fusel oil traps; no males were taken in this way, however. Males were taken at light on several occasions in the Warren Woods and among the dunes. This constitutes the first published record of the species from the State.

*Parcoblatta uhleriana* (Saussure).

Sawyer Dunes, July 12 to 29, 1920, 3 males, 27 females.

This species was found only in the oak dune woods, though it probably also occurs in the beech-maple forest. In the dune woods it is very common, though no specimens were taken except in molasses-fusel oil traps.

*Parcoblatta pennsylvanica* (DeGeer).

Warren Woods, June 30 and July 2, 1919, 2 males.

Sawyer Dunes, July 7 to 29, 1920, 4 males, 25 females, 1 juvenile.

The commonest cockroach of the region. It is everywhere more numerous than *P. virginica*, but in the oak dune woods is about equalled in numbers by *P. uhleriana*; it occurs in the same places as those species. Most of the females were taken in molasses traps, but very few males were captured in this way; the females of all three of the local species of the genus are much more commonly found in the traps than are the males. Specimens are frequently taken in houses in the country; they were found on several occasions in the food cabinet in the dune camp. Several males and one female were taken

at night in the dune camp on the lighted table where the day's catch was being mounted, and in the Warren Woods one male came to a lighted sheet stretched between trees in the open margins of the forest. On July 19 a nearly full-grown nymph of this species was washed alive onto the beach by the waves.

*Eurycotis floridana* (F. Walker).<sup>8</sup>

Three Oaks, spring of 1918 (G. R. Fox), 1 immature female.

A single immature female was taken by Mr. Fox hidden in the crevice between the base of a leaf and the stem of a potted palm. It was probably introduced with the plant.

PHASMIDAE

*Diapheromera femorata* (Say).

Warren Woods, June 21 to 28, 1919, 2 juveniles; August 31 to September 1, 1919, 4 males.

Sawyer Dunes, June 22 to July 3, 1919, 3 juveniles; July 10 and 29, 1920, 2 juveniles.

Three Oaks, July 15, 1920, 1 juvenile.

New Buffalo, September 2, 1919, 1 female.

Of common occurrence throughout the region in thickets and scrub, around the borders of woods, and on trees and shrubs wherever they are found. In the early summer nymphs are very common on low shrubbery and tall herbaceous vegetation; in the beech-maple forest on the Warren Woods Preserve several were taken on vines and shrubs, and on the tree trunks. Later in the season the species becomes more difficult to find on account of the more strictly arboreal habits of the adults. The majority of the specimens were taken by beating foliage.

Recorded by Hancock from Lakeside, where he found it in greatest abundance among the undergrowth and herbage in the mixed beech forests.

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<sup>8</sup> Determined by J. A. G. Rehn.

## ACRYDIIDAE

## ACRYDIINAE

*Nomotettix cristatus*, probably subspecies *cristatus* (Scudder).<sup>9</sup>

Warren Woods, September 7, 1920, 2 immature specimens.

Swept from low, dry grass on the cleared upland of the Warren Woods Preserve, in an area where much bare ground and small patches of dry moss are exposed among the scant vegetation. No adults could be found.

*Acrydium granulatum* Kirby.

Warren Woods, September 3, 1919, 1 female.

Sawyer Dunes, June 24 to August 31, 1919, 2 males, 4 females; July 11, 1920, 1 male, 1 immature specimen.

This species was taken in a moist meadow pasture near the Warren Woods Preserve; also from the borders of some of the dune ponds, on the bare sandy and muddy margins, among the herbage covering the higher parts of the shores, and among the low ground herbage under the surrounding thickets. It does not seem to be common in the county, though in other parts of the state it appears to be the most abundant species in the genus.

*Acrydium ornatum* Say.

Warren Woods, June 25 to July 2, 1919, 5 males.

Taken on a sandy clay road at the edge of a patch of second growth forest, in company with *A. hancocki* (see below); also found on nearly bare, trampled areas of dried mud about the margins of the water-holes frequented by the cattle, on the banks of the Galien River. Specimens were taken on the river's moist sandy margins, among the herbage of the mud-bars, and by sweeping the grass on a wet, springy hillside

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<sup>9</sup> Determined by J. A. G. Rehn.



near the preserve. It was not found in numbers anywhere. Hancock reports it from Lakeside in June.

*Acrydium hancocki* Morse.<sup>10</sup>

Warren Woods, June 25 to July 1, 1919, 4 males, 1 female.

These specimens were found in a sunken road of sandy clay, partly filled with dead leaves, and bordered on each side by weeds and low bushes. They were all taken within an area of a few square yards, where the road emerges from a second growth woods of small oaks and maples, and descends rather steeply from the upland to the Galien River flood-plain; the five specimens are the result of several hours' collecting at various times. Taken in company with *A. ornatum*.

*Acrydium arenosum angustum* (Hancock).

Warren Woods, June 20 to September 3, 1919, 21 males, 18 females, 1 immature specimen; July 3 to 16, 1920, 1 male, 1 female.

Sawyer Dunes, July 3 to August 31, 1919, 1 male, 3 females; July 11, 1920, 2 males.

This is the commonest species of the genus in this region. It was found to be most abundant on sand and mud shores along the Galien River and about the margins of ponds in both the dune and inland regions. It was also taken on a dry, sandy clay road at the margin of second growth woods; on bare dry mud trampled by cattle; among mud-bar and sand-bar herbage; among the low vegetation springing up in dry creek beds; on moist muddy patches and among low herbage in the flood-plain forest; from the mucky margins of a pool in the edge of a buttonbush swamp in the Galien River flood-plain; and in the low, wet forest surrounding one of the dune ponds.

Recorded by Hancock as *Tetrix obscurus* from Lakeside, September 18.

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<sup>10</sup> Determination verified by J. A. G. Rehn.

*Paratettix cucullatus* (Burmeister).

Warren Woods, June 20 to September 1, 1919, 11 males, 19 females;  
July 3 to 16, 1920, 6 males, 15 females.

Sawyer Dunes, June 22 to July 3, 1919, 4 males, 5 females; July 9  
to 11, 1920, 10 males, 5 females.

Harbert, July 13, 1920, 1 male, 2 females.

New Buffalo, June 30, 1919, 3 males, 3 females; July 5, 1920, 1 male.

The most abundant Tetrigid of the region. Found in nearly the same localities as *Acrydium arenosum angustum*; somewhat less common than that species in the drier situations, but much surpassing it in numbers in the wetter habitats. Very abundant on the moist margins of streams and ponds in both the dune and inland regions. Several specimens were taken on the beach of Lake Michigan, on moist sand flats beside the mouths of the Bridgman and Sawyer creeks; a single specimen was found in beach drift. Others were taken by sweeping in the margins of sandy reed and sedge marshes at New Buffalo.

This series exhibits a considerable amount of color variation. The majority of the specimens are greyish or warm brown in color, most of them being somewhat mottled; but in a series from one of the dune ponds the color varies from light brown with a brick red blotch across the humeri to a form with almost solid black pronotum marked with an inconspicuous light stripe along the margins of its apical portion. The black "saddle-mark" is more or less distinctly present in a little over half of the 85 specimens.

## BATRACHIDINAE

*Tettigidea lateralis parvipennis* (Harris).

Warren Woods, June 20 to August 30, 1919, 1 male, 2 females, 1  
immature specimen; July 3 to September 7, 1920, 4 males.

Sawyer Dunes, June 24 to August 31, 1919, 4 males, 1 female; July  
11, 1920, 1 female.

New Buffalo, September 2, 1919, 1 male, 2 females.

Common and generally distributed, but nowhere abundant. Taken in a moist sandy creek bed with a sparse growth of low herbage; from patches of wet, trampled mud about the margins of a ravine sedge marsh; among the bases of the plants in a thick, waist-high growth of sedges filling a moist ravine; from the damp margins of streams and ponds; among low ground herbage under pond-border thickets; among the herbage of sand and mud-bars; swept from rank grass in the margins of a lizard's tail marsh; taken from trampled dry mud around watering places; from moist meadow pasture; and from open, grassy fields and forest margin thickets.

Recorded by Hancock as *T. pennata*, from Lakeside, September 18.

*Tettigidea armata* Morse.

Warren Woods, September 1, 1919, 1 male.

Sawyer Dunes, June 24 to July 3, 1919, 1 male, 4 females; July 11, 1920, 4 males, 10 females.

New Buffalo, September 2, 1919, 3 males, 2 females.

Local in distribution, but occasionally common in small areas. It was found to be quite numerous about one of the dune ponds, especially on the areas of exposed muck and on the small mossy patches around the margin, but also among the herbaceous growth of the sandy shores, around some small piles of brush, and in the low herbage covering the ground under the willows and aspens forming the pond-margin thicket. All the specimens taken here during both seasons were found in an area of perhaps thirty square yards; none were found on other apparently similar parts of the pond margin. On one occasion forty-five minutes' search for this species yielded fourteen specimens; at no other time were they so numerous. It was also taken in the lizard's tail marsh at New Buffalo, where it was most numerous around the drier

margins. A single male was found on a patch of wet, trampled mud in the margin of a sedge marsh in a cleared ravine near the Warren Woods Preserve.

## ACRIDIDAE

## TRYXALINAE

*Tryxalis brevicornis* (Linnæus).

Warren Woods, August 30 to September 3, 1919, 5 males, 2 females, 1 immature specimen; September 5 to 7, 1920, 9 males, 9 females. Three Oaks (Klute's lakes), September 4, 1920, 15 males, 11 females. New Buffalo, September 2, 1919, 1 male.

Common, frequently abundant, in the sedge and lizard's tail marshes of the region during the latter part of the season. A few specimens were also taken in the reed marsh at New Buffalo and in moist meadow pastures in the vicinity of the Warren Woods Preserve. Recorded by Hancock from Lakeside, where he found it usually associated with the lizard's tail (*Saururus cernuus* L.).

*Pseudopomala brachyptera* Scudder.

Warren Woods, July 16 to September 7, 1920, 4 males, 4 females, 2 immature specimens.

This species was quite common in a marsh in one of the cleared ravines on the Warren Woods Preserve. This marsh is filled with grasses and sedges, with occasional clumps of cat-tails in the wettest spots; the drier margins are covered with tall grass and teasel. All the specimens were taken in the wetter parts of the marsh, where in many places water was standing about the roots of the plants.

The usual stridulation of this species is rather slow and regular, consisting of from two to four strokes per second, repeated from five to fifteen or twenty times. On July 16 a pair was taken in copula on the base of a tall clump of grass at the edge of a small trampled space among the sedges. This

male, just before copulating, was heard to stridulate briefly and jerkily, with a very rapid vibration of the hind femora, as if intensely excited by the final acts of courtship.

Though not uncommon, specimens of this species were not easy to secure. Their form and coloration make them very inconspicuous objects among the brown grass and sedge stems, and their habit of dropping to the ground and hiding among the bases of the grass and sedge clumps when alarmed much increases the difficulty of finding them. The adults were apparently just becoming numerous on July 16, as two last stage nymphs were taken on this date, and several of the adults were teneral. By September 7 the species had become scarce.

*Orphulella speciosa* (Scudder).<sup>11</sup>

Warren Woods, July 4, 1919, 5 immature specimens; September 7 1920, 13 males, 6 females.

Sawyer Dunes, July 18 and 25, 1920, 2 macropterous females.

Three Oaks, September 4, 1920, 1 male.

Abundant on the dry, grassy upland fields on the Warren Woods Preserve. One male was taken in a similar habitat near Three Oaks, and two females, with tegmina and wings of exceptional length, were taken by Hussey in the beach drift. This series exhibits a striking amount of diversity in coloration and pattern.

Recorded by Hancock from Lakeside.

*Dichromorpha viridis* (Scudder).

New Buffalo, September 2, 1919, 8 males, 6 females; September 9 1920, 1 male, 1 female.

Rather common in the drier margins of the lizard's tail marsh; also among dry grass, dewberry vines, and other vegetation along a cinder-strewn railroad embankment. One male

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<sup>11</sup> Determination verified by J. A. G. Rehn.

was taken from a wet, sandy road bordering a reed marsh, and a single female in the grassy margin of an open grove near the lake. Two pairs were taken in copula September 2.

*Chloaltis conspersa* Harris.

Warren Woods, June 20 to July 6, 1919, 19 males, 5 females, 13 immature specimens; July 3 to September 7, 1920, 22 males, 17 females.

Sawyer Dunes, July 10 to 16, 1920, 3 males, 1 female, 1 immature specimen.

Lakeside, July 13, 1920, 1 male.

New Buffalo, September 2, 1919, 1 male; July 5 to September 9 1920, 2 males, 1 female.

Very generally distributed throughout the region. Common in fields of second growth scrub; in thickets along the margins of woods; in open, grassy groves and in small clearings; and in grassy fields bordered by forest or thickets. It was also taken in a wet ravine sedge marsh; from low bushes at the margin of a lizard's tail marsh; in a moist meadow pasture in a cleared ravine on the Warren Woods Preserve; and in a dry, grassy pasture remote from trees or brush. It was common in the dune area as well as inland. June 23 adults were just beginning to appear; they were still abundant in suitable localities September 9. All the specimens of this series are brachypterous.

This species was taken in August and September 18 at Lakeside by Hancock.

*Chortippus curtipennis* (Harris).

Warren Woods, June 26 to September 1, 1919, 6 males, 3 females;  
July 3 to September 7, 1920, 6 males, 6 females.

Sawyer Dunes, July 4 to 21, 1920, 7 males, 27 females.

Lakeside, July 13, 1920, 1 male, 1 female.

Three Oaks, July 15, 1920, 2 males, 1 female.

New Buffalo, September 2, 1919, 1 male, 1 female.

Bridgman, July 12, 1920, 1 male.

One of the most abundant grasshoppers of the region. It

occurs in great numbers in the marshes and wet meadows everywhere; specimens were also taken in fields of long, dry grass, among second growth scrub, and in open, grassy woodland. It was on several occasions the commonest Orthopteran in the beach drift; all of these drift specimens have exceptionally long wings and tegmina.

Hancock records it as having been taken at Lakeside in August and September 18.

*Ageneotettix deorum* Scudder.<sup>12</sup>

Three Oaks, September 4, 1920, 1 female.

A single specimen of this species was found among a thin, dry growth of bluegrass about a foot in height on a roadside a mile south of Three Oaks. No others could be found, in spite of long search in the vicinity. This constitutes the first record for Michigan and is the most eastern record for the species.

*Arcyptera lineata* (Scudder).

Sawyer Dunes, July 14 to 22, 1920, 13 males, 6 females.

New Buffalo, September 9, 1920, 2 males.

All of the specimens recorded from the dune region were taken in the beach drift. As noted under the discussion of the drift, it seems quite likely that the majority of these specimens came from the vicinity of the "Grand Marais" at Stevensville. All of them came ashore alive, and most of them were able to jump and fly in a short time, some specimens proving rather difficult to capture. Two males were also taken at New Buffalo in the border of sedges and *Equisetum* around the shores of Lake Pottawattamie; two other males and one female were seen in the same place, but escaped capture. The species is here recorded for the first time from the Southern Peninsula of Michigan.

<sup>12</sup> Determination verified by J. A. G. Rehn.

## OEDIPODINAE

*Arphia xanthoptera* (Burmeister).

Warren Woods, August 31 to September 3, 1919, 2 males, 1 female;  
 September 7, 1920, 5 males, 4 females.  
 New Buffalo, September 2, 1919, 12 males, 10 females.

Common in dry, grassy fields and pastures in both the dune and inland regions in the latter part of the season.

In this series of 34 specimens 16 have the disk of the wings salmon-pink, 3 deep orange, and 15 deep yellow in color. As observed in the field the yellow-winged form seemed to be somewhat more numerous than the orange- and pink-winged forms. The wings of the yellow-winged form are of a rich hue, slightly tinged with orange, and quite different in color from the lemon-yellow wings of some Massachusetts specimens in the collection of the University Museum.

Taken at Lakeside during August and on September 18 by Hancock.

*Arphia sulphurea* (Fabricius).

- Warren Woods, June 20 to July 4, 1919, 15 males, 21 females; July 3, 1920, 1 male, 1 female.
- Sawyer Dunes, June 22 to July 3, 1919, 2 males, 2 females; June 12, 1920 (N. A. Wood), 2 females; July 12 to 15, 1920, 2 males.
- New Buffalo, July 15, 1920, 1 male, 1 female.

Very common during the late spring and early summer in pastures and dry, grassy fields in the dune and inland regions, in the open, grassy borders of woods, and in fields of second growth scrub. Specimens were also taken in stubble fields, in a field of ripe wheat, and in grassy clearings in the oak dune woods.

Hancock records this species as having been taken in August and September 18 at Lakeside; no specimens were secured by the author later than the middle of July.

*Arphia pseudonietana* (Thomas).

Sawyer Dunes, July 23 to 25, 1920, 11 males, 1 female.  
 Harbert, 5 specimens, collection of Mr. W. R. Hibbs.



This species was taken in a clearing among the oak dune woods near Bridgman. Here the sandy soil was covered with a very thin growth of dry grass about a foot high, with an occasional milkweed or mullein; much bare sand was exposed among the plants. Several specimens of this species were also seen in a small collection made among the dunes in the vicinity of Harbert by Mr. W. R. Hibbs. None were taken in the inland region.

*Chortophaga viridifasciata* (DeGeer).

Warren Woods, June 20 to July 4, 1919, 7 males, 8 females; July 3 and 16, 1920, 1 male, 1 female.

Sawyer Dunes, July 3, 1919, 1 male.

New Buffalo, July 5, 1920, 1 female.

Common in the spring and early summer in grassy fields and marshes. Also taken in clover fields, in the grassy margins of open woods, and among low herbage around the borders of a dune wood. By the middle of July adults were very scarce. Hancock records having taken immature specimens at Lakeside on September 18.

*Encoptolophus sordidus* (Burmeister).

Warren Woods, August 30 to September 1, 1919, 8 males, 4 females; September 7, 1920, 2 males, 1 female.

Three Oaks, September 4, 1920, 1 male, 1 female.

New Buffalo, September 2, 1919, 2 females.

Abundant in the fall on dry, grassy roadsides, in stubble fields, grass-grown orchards, and in dry, grassy fields and pastures throughout the region. Taken September 18 at Lakeside by Hancock.

*Camnula pellucida* (Scudder).

Warren Woods, June 23 to July 5, 1919, 18 males, 10 females, 6 immature specimens; July 3 to September 5, 1920, 10 males, 3 females, 1 immature specimen.

Sawyer Dunes, July 4 to 28, 1920, 2 males, 8 females.

Rather generally distributed, but only locally common. It was taken in rather large numbers in a strip of short, dry grass along the top of a steep bank overlooking the Galien River, on the Warren Woods Preserve. It was also common in dry grass among the shrubbery in a field of second growth scrub and in sandy clearings with a sparse growth of dry grass among the dune woods. Specimens were taken in the grassy margins of open woodland and dry bluegrass pastures. On certain occasions it was fairly common in the insect drift along the shore of Lake Michigan.

In this region the species begins to mature about the middle of June; on the twenty-third of that month adults were few and mostly teneral, but last stage nymphs were abundant. It is still common the first week in September. Hancock records specimens found during August at Lakeside.

*Dissosteira carolina* (Linnæus).

Warren Woods, June 23 to July 6, 1919, 6 immature specimens;

August 30 to September 3, 1919, 6 males, 5 females; July 15 to September 7, 1920, 6 males, 1 female.

Sawyer Dunes, August 31, 1919, 1 male; July 10 to 28, 1920, 6 males, 1 female, 2 immature specimens.

Three Oaks, September 4, 1920, 2 males.

New Buffalo, June 30, 1919, 1 immature specimen; September 2, 1919, 1 female.

The commonest of the bare-ground locusts. Found everywhere on roads, cultivated fields, stubble fields, pastures and fields of sparse dry grass, bare patches trampled by cattle, etc. It is fairly common among the beach grass and bunch grass on the lake shore, and is found in grassy openings in the dune woods. Specimens were also taken in a moist meadow pasture and among the grass and herbage on a springy hillside near the Warren Woods Preserve. Three males were taken in a wet sedge marsh in a cleared ravine on the preserve, where

they were fairly common in places where the rank vegetation had been somewhat trampled down by the cattle. These specimens when disturbed did not fly to the dry ground around the margins of the marsh, their normal habitat, but would alight on a sedge or grass stem, or fly down among the vegetation and hide. The only bare soil exposed in this situation was a small amount of black muck among the bases of the plants. Specimens were also taken in the beach drift on several occasions.

The first adult specimens were taken July 10; the majority of those collected during the next week were teneral. Hancock records this species as occurring at Lakeside in August and September.

*Spharagemon bolli* Scudder.

Warren Woods, June 26 to July 5, 1919, 3 immature specimens; August 30 to September 1, 1919, 4 males, 12 females; July 16 to September 7, 1920, 5 males, 6 females.

Sawyer Dunes, June 24, 1919, 1 immature specimen; July 10, 1920, 1 immature specimen; July 18 to September 6, 1920, 2 males, 2 females, 1 immature specimen.

New Buffalo, September 2, 1919, 3 males, 2 females; July 5, 1920, 1 immature specimen; September 9, 1920, 1 female.

A typical forest border species, found in the open, grassy margins of woods, in shrubby pastures, in the marginal thickets of dune and upland woods, in openings in the oak dune woods, etc. One specimen, taken on a grass-grown, vine-covered railroad embankment at New Buffalo, is the only individual which was found away from the vicinity of trees or brush. This species was quite common in an untended, grassy raspberry and blackberry patch near the Warren Woods Preserve. It was taken September 18 at Lakeside by Hancock.

Many of the females of this series are a light reddish brown in color, with only faint traces of darker markings; but all

the males and about half of the females are dark grayish brown, with a distinct and conspicuous pattern of bands and mottlings of a much darker shade; in a few specimens this pattern is almost obliterated by the general infuscation of the ground color.

*Spharagemon collare wyomingianum* (Thomas).

Warren Woods, June 21 to 23, 1919, 2 immature specimens; August 31, 1919, 3 males; September 7, 1920, 2 males, 2 females.

Sawyer Dunes, June 24, 1919, 1 immature specimen; August 31, 1919, 3 females; July 10 to 29, 1920, 20 males, 12 females, 1 immature specimen.

New Buffalo, September 2, 1919, 11 males, 6 females; July 5, 1920, 1 immature specimen; September 9, 1920, 7 males, 4 females.

Lakeside, July 13, 1920, 1 male, 1 female.

Three Oaks, September 4, 1920, 1 female.

Livingston Dunes, July 22, 1920, 1 male.

Stevensville, July 22, 1920, 1 male, 2 females.

Very common in all dry, sparsely vegetated fields and pastures, in both the dune and inland regions. Also common in the bunch grass zone along the beach grass, and occasional among the beach grass. Specimens were taken in the open, grassy margins of woods; in openings in the oak dune woods, among the low herbaceous growth; and on the bare soil of roads and trampled areas in dry pastures. Specimens were washed up in the beach drift several times.

The coloration of this series shows a large amount of variation, apparently correlated to some extent with the prevailing shade of the immediate environment. All of the specimens taken in a cinder-covered area of some extent along the railroad tracks at New Buffalo are very dark in ground color, some of them being almost black; the same thing is true of the specimens taken in the same neighborhood, in an open oak woods which had suffered from a ground fire early in the

season, leaving the general shade of the ground stratum very dark. On the other hand, the series from the dune region is of very much lighter coloration, with the dark markings distinct but reduced in size.

This species was taken at Lakeside in August and on September 18 by Hancock.

*Psinidia fenestralis* (Serville).

Sawyer Dunes, August 31, 1919, 2 males, 1 female; July 26, 1920, 1 female.

New Buffalo, September 9, 1920, 16 males, 10 females.

All of the specimens from the Sawyer Dunes were taken on the edge of a large blowout, in and near the grassy strip along the top of the side wall, between the steep slope of bare sand and the oak forest which borders the blowout. The species was rather scarce here. At New Buffalo, however, it was found to be very common among the bunch grass growing on the low dunes and upon an abandoned sand-drifted railroad grade along their inland margin. Here it occurred in company with *Melanoplus angustipennis* and *Melanoplus flavidus*. Specimens were easily captured; they fly only short distances, usually less than twenty feet, and after being flushed a few times will often remain motionless on the bare sand among the grass clumps, even allowing themselves to be picked up in the fingers. All of the 30 specimens taken are the red-winged form.

*Trimerotropis maritima* (Harris).

Sawyer Dunes, June 22 and 24, 1919, 2 immature specimens; August 31, 1919, 11 males, 17 females; July 6 to September 6, 1920, 9 males, 5 females, 3 immature specimens.

New Buffalo, September 2, 1919, 4 males; September 9, 1920, 1 male, 3 females.

St. Joseph, September 9, 1918, 1 female.

This is the most characteristic species of Orthoptera of the

dune region. It is most abundant in the beach grass and bunch grass habitats of the upper beach and blowouts. It also occurs in small numbers on the bare dry sand of the middle beach, and occasionally on the bare sand crests of dune ridges near the inland margin of the dune area; no specimens were taken at a distance of more than a half mile from the lake shore. A single mutilated specimen was found in the beach drift.

The first mature specimen was taken July 9; the species was still abundant on September 9, the latest date on which collections were made. Hancock records it from Lakeside in August.

This series of 51 adult specimens exhibits considerable range of variation in the depth of color of the disk of the wings and in the character of the fuscous band. The latter varies greatly in width, from one-fourth to one-seventh of the length of the wing, and also in degree of infuscation, from the solid broad band described by Walker as being typical of his race *interior* to the narrow band somewhat interrupted by the pale radial and cross veins characteristic of the typical form. The tegmina vary from a more or less distinctly banded type to one almost without markings. Similar observations recently led Blatchley to place *interior* in the synonymy under *maritima* (Harris).

LOCUSTINAE (ACRIDINAE)

*Schistocerca alutacea* form *alutacea* (Harris).<sup>13</sup>

Warren Woods, August 31, 1919, 1 male; September 7, 1920, 3 males,  
1 female.

New Buffalo, September 2, 1919, 4 males, 2 females.

? Sawyer Dunes, July 10, 1920, 3 immature specimens.

Moderately common in a wet lizard's tail marsh at New

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<sup>13</sup> Determination verified by J. A. G. Rehn.

Buffalo and in ravine sedge marshes on the Warren Woods Preserve. Several specimens were captured among sparse dry grass and dewberry vines on a cinder-strewn railroad embankment at New Buffalo. In a partially dried up bog just back of the dunes nymphs of this species fairly swarmed in early July among a dense four-foot growth of ferns which filled it; they have been placed under this form, since the habitat was more moist than those which *rubiginosa* usually frequents. The typical form seems to range over a greater variety of habitats than *rubiginosa* in this region.

This species was taken at Lakeside on September 18 by Hancock.

*Schistocerca alutacea* form *rubiginosa* (Scudder).<sup>14</sup>

Warren Woods, August 31, 1919, 2 males.

Sawyer, July 28, 1911, 4 males, 1 female (Collection Mich. Agr. Coll.).

New Buffalo, September 2, 1919, 14 males, 2 females; September 9, 1920, 2 males.

? New Buffalo, June 30, 1919, 4 immature specimens.

Near the Warren Woods this form was taken in a neglected grass-grown raspberry and blackberry patch and in a small shrubby opening in the margin of a patch of second growth woods. At New Buffalo it was abundant in a sandy field covered with a sparse growth of dry grass and overrun with dewberry vines. Along a grassy roadside bordered with shrubs and young trees nymphs of this species (probably form *rubiginosa*, from the character of the habitat) were found in numbers on June 30; on September 2 adults were taken in the same locality.

Three of the male specimens have a fairly evident medio-longitudinal pale stripe on the pronotum and closed tegmina, but are otherwise typical of the *rubiginosa* form.

<sup>14</sup> Determination verified by J. A. G. Rehn.

*Schistocerca serialis* (Thunberg).

Sawyer Dunes, July 14, 1920, 1 female (beach drift).

Harbert, 1 female, collection of Mr. W. R. Hibbs.

One specimen of this species was found in the beach drift on July 14. This drift was at that time about two or three weeks old; it was the largest of those which occurred during the season. A second specimen was seen in the collection of Mr. W. R. Hibbs, which was taken in the vicinity of Harbert; from its condition it was apparently also found in the drift along the shore.

The only other definite published records of this species within the state are those by Pettit,<sup>15</sup> of Berrien Springs, Berrien County; Springville, Lenawee County, and Frankfort, Benzie County. These specimens probably represent strays from farther south, though it is quite possible that the species may be found breeding in the southern part of the state.

*Paroxya clavuliger hoosieri* Blatchley.<sup>16</sup>

Warren Woods, June 26 to July 4, 1919, 2 males, 5 immature specimens; August 30 to September 3, 1919, 6 males; July 3 to September 7, 1920, 6 males, 5 females, 1 immature specimen.

Sawyer Dunes, July 11, 1920, 4 immature specimens; July 26, 1920, 1 male.

New Buffalo, June 30, 1919, 1 female, 9 immature specimens; September 2, 1919, 38 males, 19 females; July 5, 1920, 1 immature specimen; September 9, 1920, 3 males, 1 female.

This species is common in the marshes of both the dune and inland regions. It was very abundant in a wet lizard's tail marsh at New Buffalo; here on September 2 fifty-seven specimens were taken in less than half an hour. It was also common in the sedge marshes occupying many of the cleared ravines on and about the Warren Woods Preserve. In the

<sup>15</sup> Pettit, R. H., 1899. *Mich. State Agr. Exp. Sta. Bull.* No. 175, p. 343.

<sup>16</sup> Determined by Morgan Hebard.



Sawyer Dunes specimens were taken among a thick growth of herbage on the moist sandy flats around the margins of one of the dune ponds. The first adult specimen was taken June 30; adults were still common September 9.

*McJanoplus gracilis* (Bruner).

Warren Woods, September 3, 1919, 2 females.

New Buffalo, September 2, 1919, 7 males, 5 females; September 9, 1920, 5 males.

Three Oaks (Klute's lakes), September 4, 1920, 7 males, 4 females, 1 immature female.

Lakeside, July 13, 1920, 1 female.

Rather common in rank herbage and weed thickets, usually on low, moist ground. At New Buffalo it was common around the margins of the lizard's tail marsh, among the trampled vegetation of grasses and sedges, and among the weeds and low bushes on its borders; but thorough beating of the vegetation in the wetter portions failed to reveal any specimens there. Others were taken in a thicket of tall weeds, low bushes, and grapevines, and at Lakeside from a luxuriant growth of ironweed and nettles along the roadside. On September 4, in the low forest margin thicket at Klute's lakes, among the rank herbaceous growth of ironweed, nettles, vines, and low shrubbery, it was more numerous than in any other locality where collecting was done; nymphs were even more common than adults on this date.

*Melanoplus viridipes* Scudder.

Warren Woods, June 23 to July 2, 1919, 17 males, 9 females; July 3 to 16, 1920, 5 males, 4 females.

Sawyer Dunes, July 7 to 29, 1920, 8 males, 13 females.

New Buffalo, September 9, 1920, 1 male, 1 female.

This species is closely restricted to open woods and forest margin habitats. It was taken in the open, grassy margins of the Warren Woods in considerable numbers in the early part of the season. Other specimens were found among forest

margin thickets, in fields of second growth scrub, and in grassy fields a short distance from the margins of woodland. In the dune area it was common about the margins of the oak and beech-maple woods, and in small openings in them; it was also of regular occurrence, but scarce, in the denser parts of these woods, where several specimens were found among the dead leaves, and others were taken in molasses traps set for Blattids and Ceuthophilus.

Copulating pairs were noted June 28 and July 16. The male and female taken September 9 at New Buffalo are very late records for this species, which is most common in the late spring, and has usually disappeared by the end of July. Hancock records it, however, as occurring at Lakeside in August.

The cerci of all but two of the thirty-one males secured are of a type intermediate between typical *viridipes* (the western form) and the recently described *eurycercus* of Hebard. Two of the males from the Sawyer Dunes taken in company with these intermediates are, however, referable to typical *viridipes*. All of the entire series of sixty specimens show the recessive coloration characteristic of *viridipes*; in many of the specimens the bands of the external face of the hind femora are scarcely visible, and in none are they fused below as in the majority of specimens of *eurycercus*. In a number of specimens, most of which are from the Warren Woods, the cerci are very similar in proportions to those of specimens of atypical *eurycercus* from Ann Arbor, Washtenaw County, Michigan. The latter, however, show much more intensive coloration, the hind femora being conspicuously banded with black, the bands fusing at the lower margin of the pagina. Berrien County evidently lies in the area of intergradation between the two forms, as was to have been expected from the fact that all of Hebard's specimens from Lake County, Indiana, the adjacent region to the west, were intergrades.

One of the females of this series has the tegmina of both sides reduced to very small, slightly crumpled pads about two millimetres in length.

*Melanoplus fasciatus* (F. Walker).<sup>17</sup>

New Buffalo, September 2, 1919, 3 females; July 5, 1920, 5 males, 1 female, 1 immature specimen.

Found in but one locality in the region studied. On September 9, 1919, three females were taken in company with *Melanoplus keeleri luridus* in an open grove containing white oak, maple, white pine, and other trees, on a sandy ridge near New Buffalo. These specimens were taken among the dead leaves and low herbaceous undergrowth in the grove. On July 5, 1920, six adults and one nymph were found around the margins of this grove and in its more open portions. The individuals were all widely scattered, this series being the result of several hours' collecting.

*Melanoplus walshii* Scudder.

Warren Woods, July 16, 1920, 1 male, 1 female.

Three Oaks (Klute's lakes), September 4, 1920, 1 male, 1 immature specimen.

This species is apparently one of the least common of the Locustinae of this region. A single pair was taken near the Warren Woods Preserve, at the margin of a beech-maple forest, in dry grass among the clumps of raspberry bushes and tree seedlings which formed the bordering thicket. Search of about an hour's duration revealed only these two specimens. In the rank growth of nettles, ironwood, vines, and shrubbery in the low forest margin thicket at Klute's lakes a single male and one nymph were taken; a female was seen near the male, but it escaped. These three specimens are all that were found in about forty-five minutes' collecting.

<sup>17</sup> Determination verified by Morgan Hebard.

Hancock, however, apparently found *Melanoplus walshii* rather common at Lakeside; he reports it, as the synonymous *M. blatchleyi*, as occurring between the first and the last of August in the same type of habitat occupied by *Melanoplus viridipes* earlier in the season.

*Melanoplus mexicanus atlantis* (Riley).

Warren Woods, June 20 to September 1, 1919, 50 males, 41 females;

July 3 to September 7, 1920, 35 males, 21 females.

Sawyer Dunes, June 22 to August 31, 1919, 4 males, 7 females; July

4 to 29, 1920, 56 males, 49 females; September 6, 1920, 2 males, 3 females.

New Buffalo, September 2, 1919, 5 males, 5 females; July 5 to

September 9, 1920, 5 males, 4 females.

Lakeside, July 13, 1920, 5 males, 3 females.

Stevensville, July 22, 1920, 1 male.

This species far exceeds all others in abundance in this region. It is found nearly everywhere except in the denser portions of the woods. In the dry, grassy fields and pastures and along the roadsides it flies up in swarms before one at every step in the latter part of the season. Specimens were taken in the open, grassy margins of woodland in the dune and inland regions; in fields of second growth scrub; in sedge and reed marshes; in moist meadow pastures; and among the herbaceous growth of mud-bars and pond margins. In the dune region it is found with *Melanoplus angustipennis* in the beach grass and bunch grass habitats. On several occasions it was very numerous in the beach drift.

Adults were already common June 20, and were still abundant September 9, the latest date on which collections were made. The species was taken at Lakeside by Hancock on September 18.

*Melanoplus flavidus* Scudder.<sup>18</sup>

New Buffalo, September 2, 1919, 1 male; September 9, 1920, 2 females.

<sup>18</sup> Determined by J. A. G. Rehn. Hebard writes, "This is *flavidus* of Scudder's revision, but the name is still *inquirenda*."

Three specimens are all that could be found of this species. They were taken in company with *Psinidia fenestralis* among the clumps of bunch grass on a sand-drifted railroad grade near the inner margin of the dune area. On the occasion of the last visit a search of over two hours yielded only two specimens.

This is the first time the species has been reported from Michigan and is the most eastern record so far as known.

*Melanoplus femur-rubrum femur-rubrum* (DeGeer).

Warren Woods, August 30 to September 1, 1919, 12 males, 15 females; September 5 to 7, 1920, 3 males, 7 females.

Sawyer Dunes, August 31, 1919, 2 males, 1 female.

Bridgman, July 12, 1920, 1 female.

Three Oaks, September 4, 1920, 5 males, 6 females.

New Buffalo, September 2, 1919, 4 males, 7 females.

Very common in marshes, lowland and upland thickets and forest margins, grassy fields and pastures, cultivated fields, etc. Specimens were also taken in the beach grass habitat, in bare pastures and stubble fields, and in the reed marsh at New Buffalo.

*M. femur-rubrum* appears later in the season than does *M. mexicanus atlantis*; the first adult specimen was taken July 12, and the species did not become common until the end of July. It was taken by Hancock at Lakeside in August and September 18. In moist and wet habitats it is much more numerous than *atlantis*, but is frequently abundant in dry situations in company with that species.

*Melanoplus angustipennis* Dodge.

Sawyer Dunes, August 31, 1919, 23 males, 17 females; July 6 to September 6, 1920, 14 males, 6 females, 2 immature specimens.

New Buffalo, September 2, 1919, 1 female; September 9, 1920, 3 males, 3 females.

Livingston, July 22, 1920, 1 male, 1 female.

Bridgman Dunes, July 22, 1920, 1 male.

One of the characteristic dune species. It is most abundant in the beach grass and bunch grass habitats, but is also common in sandy fields covered with sparse, dry grass among and behind the dunes. Specimens were also taken in open pine and oak groves in the dunes, in the grass and low undergrowth among the trees.

The first adult specimen was taken July 4; the species was still very abundant in the bunch grass areas at New Buffalo on September 9. Hancock records it as taken in August and September 18 at Lakeside.

In a series of fifty specimens chosen at random the coloration of the hind tibiae is as follows: 26 red, 3 yellow, 4 brownish or purplish, 1 with blue base and red distal end, 16 blue.

*Melanoplus confusus* Scudder.

Warren Woods, June 20 to July 4, 1919, 20 males, 31 females; July 3 to 16, 1920, 20 males, 11 females.

This species is common in fields and pastures of bluegrass in the vicinity of the Warren Woods Preserve. It is most numerous near the borders of the woods and in their open, grassy margins, where in some places it was found to equal or surpass *Melanoplus mexicanus atlantis* in numbers. It was taken on several occasions in the large pasture on the south side of the preserve and on grassy roadsides in the vicinity.

This species was taken September 18 at Lakeside by Hancock.

*Melanoplus keeleri luridus* (Dodge).

Warren Woods, August 30 to September 1, 1919, 4 males, 12 females; July 16 to September 7, 1920, 3 males, 4 females.

Sawyer Dunes, August 31, 1919, 6 males, 7 females.

New Buffalo, September 2, 1919, 8 males, 6 females; September 9, 1920, 3 males, 3 females.

In the latter part of the season this species was common in grassy fields of second growth scrub, in the open, grassy mar-

gins of woods, and in grass-grown raspberry and blackberry patches near the Warren Woods Preserve. At New Buffalo it was common in an open oak woods among the low herbaceous undergrowth, and about its grassy margins. In the dune area it was found in large numbers in a small opening in the edge of the oak dune woods, among clumps of bunch grass and trailing grapevines, in company with *M. angustipennis* and *M. mexicanus atlantis*. Specimens were also taken on grassy roadsides, in dry pastures, and in sandy fields covered with a sparse growth of dry grass and overrun with dewberry vines.

The entire series taken at New Buffalo in an open oak woods, through which a ground fire had run early in the season, is very dark in color, corresponding to the general tone of the surroundings. This is also true of several of the other species taken here, notably of *Sphragemon bolli*. A series of *M. luridus* taken along the borders of this grove, where it adjoins an area of bare sand and bunch grass, is so light in color as to have been taken at first sight to represent a different species.

This species was taken at Lakeside in August and on September 18 by Hancock.

*Melanoplus differentialis* (Uhler).

Warren Woods, September 1 to 3, 1919, 3 females; September 5 to 7, 1920, 2 males, 1 female.

Sawyer Dunes, September 6, 1920, 1 female.

Harbert, August, 1916 (H. B. Sherman), 2 females.

Three Oaks, September 4, 1920, 1 female.

New Buffalo, September 2, 1919, 5 males, 4 females; September 9, 1920, 4 males, 1 female.

Stevensville, September 25, 1921 (G. R. Fox), 1 male.

Most numerous in the sedge and lizard's tail marshes, but very generally distributed in the region. Specimens were collected in the *Scirpus* beds around Lake Pottawattamie, in dry

pastures and grassy fields in both the dune and inland areas, in the beach grass and bunch grass habitats, and in dry stubble fields near the Warren Woods and Three Oaks. It is quite scarce in such dry situations. Hancock reports it as being taken at Lakeside in August and on September 18.

*Mcclanoplus bivittatus* (Say).

Warren Woods, June 21 to July 25, 1919, 25 males, 1 female, 5 immature specimens; August 30 to September 1, 1919, 4 males, 4 females; July 3 to September 7, 1920, 11 males, 7 females.

Sawyer Dunes, July 10 to 21, 1920, 14 males, 17 females.

Lakeside, July 13, 1920, 3 males.

New Buffalo, June 30 to September 2, 1919, 6 males, 5 females; September 9, 1920, 2 males, 1 female.

Very common in sedge and lizard's tail marshes, low, wet meadows, weed thickets, and other similar situations throughout the region. Specimens were also taken in dry, grassy fields and pastures, the open, grassy margins of woods, fields of second growth scrub, and low forest margin thickets; also among the emergent vegetation in the reed marsh at New Buffalo, and on vegetation in the buttonbush swamps of the Galien River flood-plain. It is fairly common in cultivated fields and orchards.

The males of this species apparently become adult somewhat earlier in the season than the females; males were taken June 21, while the first adult female was not found until July 2. This species was taken by Hancock at Lakeside in August, and has been recorded from Berrien Springs by Riley.<sup>19</sup> All of the specimens here recorded except two are of the red-legged form (*femoratus* Burmeister).

*Melanoplus punctulatus punctulatus* (Scudder).

Warren Woods, September 1, 1919, 3 females.

Sawyer Dunes, August 31, 1919, 1 female.

<sup>19</sup> Riley, C. V., 1891, Destructive Locusts. Bull. 25, U. S. Dept. Agr., Div. Ent., p. 32.



This species is among the least common of the Orthoptera of the region. Two females were beaten from the leafy branches of a hawthorn shrub in a partially cleared, brush-grown ravine at the edge of the Warren Woods Preserve, and one from a raspberry bush among the trees on the margin of a forested ravine in the same vicinity. Two others were seen in the latter situation, but both escaped. A single female was found near the inner margin of the dunes, resting in a sandy road running through an open forest of oaks and aspens, and bordered by roadside vegetation of grasses and vines.

Hancock records having taken a female of this species on one occasion at Lakeside in August.

TETTIGONIIDAE

PHANEROPTERINAE

*Scudderia texensis* (Saussure & Pictet).

Warren Woods, September 7, 1920, 3 males, 2 females.

Sawyer Dunes, September 6, 1920, 2 males.

Three Oaks, September 4 to 8, 1920, 7 males, 1 female.

This species is common along the roadsides and fence-rows on tall herbaceous plants and bushes in the latter part of the season. Specimens were also taken on tall plants in cultivated fields, on low bushes and goldenrod in a moist meadow pasture, and among tall grass in a dry bluegrass pasture on the Warren Woods Preserve; it was also fairly common in a ravine sedge marsh on the preserve, among the tall grass and sedge clumps. Two males were taken among the bunch grass in the Sawyer Dunes, on vetch and grapevines.

This species is recorded by Hancock as having been taken at Lakeside in August and on September 18.

*Scudderia pistillata* Brunner.

Warren Woods, August 30, 1919, 1 male; September 7, 1920, 1 female.

Sawyer Dunes, July 18 to 29, 1920, 8 males.

Bridgman, July 24, 1920, 1 male.

Stevensville, July 21, 1920, 1 female.

New Buffalo, September 2, 1919, 1 female.

Rather common in both the dune and inland regions. Specimens were taken in a field of second growth scrub, in roadside thickets of low bushes and tall weeds, in sedge and lizard's tail marshes, and in a cranberry bog near Stevensville. The species was of fairly regular occurrence in the beach drift; one male was taken at light.

*Scudderia curvicauda curvicauda* (DeGeer).

Sawyer Dunes, July 29, 1920, 1 female.

New Buffalo, September 2, 1919, 1 male, 7 females.

A number of specimens were found along the sides of a railroad embankment at New Buffalo, which was covered with a sparse growth of dry grass and low bushes, and overrun with dewberry vines; also in sandy fields of dry, sparse grass. One specimen was beaten from a bush in a lizard's tail marsh; and a single female was taken in beach drift. The species is apparently not very common in the region.

*Scudderia furcata furcata* Brunner.

Warren Woods, June 26 to September 3, 1919, 5 males, 4 females, 1 immature specimen; September 7, 1920, 3 males, 1 female.

Sawyer Dunes, August 31, 1919, 3 males, 1 female; July 29, 1920, 1 female.

New Buffalo, September 2, 1919, 2 males, 6 females; September 9, 1920, 1 male, 2 females.

Three Oaks, September 4, 1920, 1 male.

This is the most common and generally distributed species of the genus in the region. Specimens were taken in dry fields of second growth scrub; on bushes and tall weeds in the margins of woods; on low herbaceous vegetation in an open oak forest; on the lower limbs of trees in the forest margin, along the roadsides, and in orchards; among tall grass

in dry fields and pastures; and in the dune area, from the grassy ridges along the side rims of the blowouts, and on vines growing among the bunch grass. None were attracted to light nor taken in the beach drift.

At Lakeside Hancock found this species in August.

*Amblycorypha oblongifolia* (DeGeer).

Warren Woods, July 16 to September 7, 1920, 9 males, 1 female,  
1 immature specimen.

Three Oaks, September 4, 1920, 7 males, 8 females.

Common in sedge and lizard's tail marshes, in low forest margin thickets, in roadside thickets of tall weeds and bushes, in clumps of shrubbery in fields and pastures, and about the margins of open woods. On September 4 it was found to be especially numerous among the shrubbery and tall, rank growth of nettles, ironweed, low bushes, and vines around the margins of Klute's lakes, near Three Oaks.

In a marshy area filled with rank vegetation near the Warren Woods Preserve a male was taken, the color of which was yellow with a slight brownish tinge, not at all pinkish.

Hancock<sup>20</sup> has recorded the capture at Lakeside of normal green males, on August 9 and September 10, 1912, and September 2, 1915, which were used in breeding experiments with a pink female from Illinois and her progeny.

PSEUDOPHYLLINAE

*Pterophylla camellifolia camellifolia* (Fabricius).

While this species is of fairly common occurrence in this region during the late summer and fall, no specimens were secured. Numbers of males were heard at various times, stridulating high among the branches of the larger trees in the margins of the Warren Woods, and others were heard in

<sup>20</sup> Hancock, J. L., 1916. *Ent. News*, Vol. 27, pp. 74, 75, 78.

similar situations at Three Oaks and New Buffalo. Considerable beating of shrubbery and the lower branches of trees failed to reveal any specimens.

Hancock records this katydid as having been taken at Lakeside in August.

## CORIPHORINAE

*Neoconocephalus nebrascensis* (Bruner).<sup>21</sup>

Warren Woods, August 30, 1919, 3 males.

? Warren Woods, July 16, 1920, 1 immature female.

All three of the males were taken at night among the shrubbery along the margin of a second growth woods, and in a grassy field of second growth scrub on a cleared portion of the Galien River flood-plain, in the vicinity of bushes and shrubs, rather close to the ground, in company with *Neoconocephalus ensiger*. Both species were stridulating; the song of *nebrascensis* is lower and somewhat softer than that of *ensiger*, each note being several times as long as the short, sharp ones of that species; when one is close to the insect there is plainly audible a kind of clear, resonant humming which is altogether lacking in the song of *ensiger*. *Nebrascensis* was much less common than *ensiger* in this vicinity.

The immature female is placed here with much doubt; Rehn was unwilling to name it, and wrote that "the lateral outline of the pronotum is not as in an allotypic female."

*Neoconocephalus ensiger* (Harris).

Warren Woods, August 30, 1919, 7 males; September 7, 1920, 1 female.

Three Oaks, September 8, 1920, 6 males.

This is the most common species of the genus in this region. It is found in fields of second growth scrub, in shrubbery along roadsides and in the margins of woods, in thickets of

<sup>21</sup> Determined by J. A. G. Rehn.

tall weeds and bushes, in tall grass in fields and pastures, in corn and wheat fields, and in lizard's tail and sedge marshes.

The stridulation of this species is a rapid *zzik-zzik-zzik-zzik* repeated with monotonous regularity, except for an occasional break, as if it had missed fire, and immediate recovery without change of rhythm. On one occasion a specimen was heard to utter a series of fifty-four notes in succession; and others were heard to stridulate for much longer periods. The song is rather loud, and when heard close at hand has a distinct metallic ringing quality. Early in the evening the insects are quite wary, stopping their song when approached within six or eight feet; but after dark it is possible to come within a foot or two of a stridulating individual without disturbing it.

One specimen of a light straw color was taken near Three Oaks; all of the others were of the green phase. Immature specimens, perhaps of this species, were taken between July 3 and 10 at the Warren Woods, Lakeside, and in the Sawyer Dunes. Hancock has recorded finding this species at Lakeside.

*Neoconocephalus robustus crepitans* (Scudder).<sup>22</sup>

New Buffalo, September 2, 1919, 1 male; September 9, 1920, 1 female. Harbert, 1 female, collection of Mr. W. R. Hibbs.

One male was taken among a growth of tall, dry grass and dewberry vines on the sides of a railroad embankment just behind the dunes at New Buffalo; and a female was found among the low undergrowth of grass and small herbaceous plants in an open oak forest on a sandy ridge half a mile from the lake. One other specimen was seen in a small collection made in the dune region in the vicinity of Harbert by Mr. W. R. Hibbs. Several nymphs which may belong to this species were taken in the Sawyer Dunes during July among the

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<sup>22</sup> Determined by J. A. G. Rehn.

herbaceous vegetation on the mud-flats around the dune ponds and along Bridgman Creek. Hancock records having taken it at Lakeside.

The male and female from New Buffalo are smaller than the average for this race. Their measurements are as follows:

Male: length of body, 27.0 mm.; of pronotum, 8.0 mm.; of tegmina, 39.3 mm.; of hind femora, 21.8 mm.

Female: length of body, 28.5 mm.; of pronotum, 7.3 mm.; of tegmina, 45.5 mm.; of hind femora, 23.7 mm.; of ovipositor, 25.5 mm.

Blatchley<sup>23</sup> has recently placed specimens from this region under the typical race *robustus* (Scudder), though Rehn and Hebard state that it does not occur away from the Atlantic coast region.

#### CONOCEPHALINAE

##### *Orchelimum vulgare* Harris.

Warren Woods, August 30 to September 3, 1919, 13 males, 6 females; September 5 to 7, 1920, 5 males, 3 females.

Sawyer Dunes, August 31, 1919, 2 males.

Harbert, August, 1917 (H. B. Sherman), 1 male.

Three Oaks, September 4 to 8, 1920, 8 males, 4 females.

New Buffalo, September 2, 1919, 11 males, 3 females; September 9, 1920, 4 males.

Common in the latter part of the season in sedge and lizard's tail marshes, in tall grass and weeds along roadsides and fences, in thickets along the margins of woods, in fields grown up with bushes and shrubbery, in wheat and clover fields, among tall grass and dewberry vines in dry, sandy fields and pastures, and among grapevines and clumps of bunch grass on the dune slopes. The favorite position of the male when stridulating is perched on the tip of a tall grass or sedge stem or a tall weed. Hancock found the species at Lakeside in

<sup>23</sup> Blatchley, W. S., 1920. *Orth. Northeastern Amer.*, p. 522.

August; his record of *Orchelimum glaberrimum* probably also applies to this species.

*Orchelimum gladiator* Bruner.

Warren Woods, July 1 to 6, 1919, 1 male, 3 females, 3 immature females; July 16, 1920, 3 males, 1 female.

Sawyer Dunes, July 18 and 19, 1920, 2 males, 2 females.

Sawyer, July 3, 1919, 1 male.

Stevensville, July 22, 1920, 1 male.

Three Oaks, July 15, 1920, 1 male.

New Buffalo, June 30, 1919, 2 immature females.

This species is found early in the summer in similar situations to those in which *Orchelimum vulgare* occurs later in the season. It is less common than that species in the drier localities, its favorite habitat being the marshes and wet meadows. Specimens were taken in the drift on two occasions, and a single male was found stridulating on a tall grass stem in the beach grass habitat; these were the only specimens taken in the dune area.

Adults were just beginning to appear July 3; none were found during the two visits made to the region in late August and September. This species seems to have about the same seasonal relationship to *vulgare* that *Arphia sulphurea* has to *Arphia xanthoptera*; it appears early and is replaced during the latter part of the season by the other species.

*Orchelimum nigripes* Scudder.

Warren Woods, August 30 to September 3, 1920, 7 males; September 5 to 7, 1920, 6 males.

New Buffalo, September 9, 1920, 2 males.

Fairly common in the latter part of the season, especially in marshy areas and low thickets. It occurs in a variety of habitats, and is more arboreal than any of the other species of the genus in this region. Specimens were taken on button-bush shrubs in swampy thickets in the Galien River floodplain; in the branches of tall shrubbery and on hanging grape-

vines in the margins of the woods; and in hawthorn, elm, box elder, and other trees in the open portions of the flood-plain forest, often as much as twenty-five or thirty feet from the ground. It was also taken from willows bordering a dune pond and on tall grass clumps and weeds in the bunch grass habitat among the dunes at New Buffalo. A number of specimens were seen in the reed marsh around the shores of Lake Pottawattamie.

The song is quite distinct from that of *Orchelimum vulgare*. It generally consists of from two to four (usually three) rapid clicks, followed by a *tze-e-e-e-e-e-e* of moderate length; this refrain is repeated again and again, with scarcely a break or change in rhythm. The whole song is more rapid and not so loud and coarse in timbre as that of *vulgare*.

*Orchelimum concinnum* Scudder.

Warren Woods, September 1, 1919, 1 female.

Three Oaks (Klute's lakes), September 4, 1920, 2 males, 3 females.

One female was taken on a small patch of sedges and iris in a low meadow pasture near the Warren Woods Preserve; the rest are from the low, marshy borders of Klute's lakes, among the grasses and sedges, and from the low bushes growing around the shores. The species is apparently not common in this region. It is recorded by Hancock under the name of *Orchelimum delicatum* from Lakeside, August, 1910.

*Conocephalus fasciatus fasciatus* (DeGeer).

Warren Woods, July 4 and 5, 1919, 4 males, 1 female; September 1, 1919, 5 males, 3 females; July 15 to September 7, 1920, 3 males, 3 females.

Sawyer Dunes, August 31, 1919, 1 male; July 20, 1920, 1 male. Stevensville, July 22, 1920, 1 female.

Three Oaks, July 15 to September 4, 1920, 6 males, 2 females.

New Buffalo, September 9, 1920, 2 females.

Common, often abundant, in the grassy fields and pastures,



moist meadows, weed thickets, and marshes of the region. It appears to mature earlier in dry than in moist situations; adult specimens were taken in grassy fields and dry pastures about ten days before they appeared in the sedge and lizard's tail marshes. The species appears to be more numerous in moist than in dry habitats. Hancock found this species at Lakeside in August.

*Conocephalus brevipennis* (Scudder).

Warren Woods, August 30 to September 1, 1919, 11 males, 7 females;

September 5 to 7, 1920, 1 male, 4 females.

Sawyer Dunes, August 31, 1919, 1 male.

New Buffalo, September 2, 1919, 4 males, 3 females.

Three Oaks, September 4, 1920, 9 males, 6 females.

This species occurs in the same situations as *fasciatus*, being even more common than that species. It was abundant in the thick, rank growth of nettles, ironweed, low bushes, and vines in the lowland thicket bordering Klute's lakes, south of Three Oaks, and was the only species of the genus found there.

*C. brevipennis* was taken at Lakeside in August by Hancock.

*Conocephalus nemoralis* (Scudder).<sup>24</sup>

New Buffalo, September 9, 1920, 10 males, 1 female.

Taken in the inland side of the dune area, among the clumps of bunch grass near the edge of an open oak woods, and in the margins of this woods. In this locality the clumps of bunch grass are fairly close together, and much of the sand between them is covered with a thin layer of dry grass stems and other debris. The specimens taken here were all found within fifty feet of the edge of the woods; they were stridulating in the clumps of grass, usually in a rather protected situation part way up a stem in the middle of the clump, and never on the tip of a tall stem in plain sight. Other speci-

<sup>24</sup> Determined by J. A. G. Rehn.

mens were taken in the margins of the woods on the stems and lower branches of rose-bushes, on dry ferns, and one about four feet from the ground on the main stem of a hawthorn shrub. The single female was found some distance within the woods, among the low grass, herbage, and dead leaves covering the ground.

This is the first time that this species has been definitely recorded from Michigan.

*Conocephalus strictus* (Scudder).<sup>25</sup>

Warren Woods, September 1, 1919, 2 males, 1 female; September 5 to 7, 1920, 12 males, 4 females.

Three Oaks, September 4, 1920, 6 males, 5 females.

New Buffalo, September 2, 1919, 1 female.

This is by far the most abundant Tettigoniid in the dry, grassy fields and pastures of the region, in such situations exceeding *C. fasciatus* and *C. brevipennis* many times in numbers. It is also common in tall, dry grass and weeds along fences and roadsides, and in the grassy borders of open woods. One female was taken in the dune area at New Buffalo among dry grass in a sandy field overrun with dewberry vines, and two specimens were swept from tall grasses and sedges in the drier margins of a ravine sedge marsh on the Warren Woods Preserve. Hancock records this species from Lakeside in August.

Although this series exhibits a certain amount of variation in size, all of the specimens are considerably smaller than the average for the species. The measurements of two males and two females, representing the extremes in size in this series, are as follows:

Male: length of body, 11.2 mm.; of pronotum, 2.8 mm.; of tegmina, 4.00 mm.; of posterior femora, 9.0 mm.

<sup>25</sup> Determination verified by J. A. G. Rehn.

Male: length of body, 13.3 mm.; of pronotum, 3.1 mm.; of tegmina, 6.3 mm.; of posterior femora, 11.8 mm.

Female: length of body, 9.8 mm.; of pronotum, 2.8 mm.; of tegmina, 2.9 mm.; of posterior femora, 9.6 mm.; of ovipositor, 13.3 mm.

Female: length of body, 15.0 mm.; of pronotum, 3.5 mm.; of tegmina, 3.2 mm.; of posterior femora, 13.5 mm.; of ovipositor, 21.0 mm.

*Conocephalus nigropleurus* (Bruner).

Warren Woods, June 27 to July 1, 1919, 3 juvenile males, 1 juvenile female; September 3, 1919, 2 males, 4 females; July 16, 1920, 1 juvenile female; September 5 to 7, 1920, 6 males, 3 females.

New Buffalo, September 2, 1919, 1 male, 1 female.

Sawyer Dunes, July 10, 1920. (Numerous early stage nymphs observed.)

This species was fairly common in the ravine sedge marshes on and near the Warren Woods Preserve and in the rank herbaceous growth of the lizard's tail marshes near the preserve and at New Buffalo. Nymphs were very common on July 10 among the *Chamaedaphne* and sedges around the margins of a nearly dry sphagnum bog on the inland side of the dunes.

DECTICINAE

*Atlanticus testaceus* (Scudder).

Warren Woods, July 5, 1919, 1 male.

Sawyer Dunes, July 9 to 12, 1920, 5 males.

Quite common in the oak dune forest and in fields of second growth scrub and the margins of woods in the inland region. Near the Warren Woods Preserve a male was taken stridulating in a shrub on the margin of a brushy ravine; it was resting on a twig about four feet from the ground. Another was several times seen in this same locality in a similar situation. Specimens were found to be common among the small trees of the oak dune forest near the lake, where the ground was open, with but little undergrowth. Here they were found

stridulating from the vantage points of low bushes, vines, and fallen branches. One of their favorite perching places seemed to be in a tangle of green brier, from the midst of which it was nearly impossible to secure them. One specimen was found on a vine at least six feet from the ground; when alarmed it leaped to the ground and attempted to hide under some dead leaves.

In these woods as many as six or eight could be heard stridulating at one time. Their song starts with a very faint, almost inaudible series of notes—*zree-zree-zree-zree*—which can only be heard if one is very close; after a long succession of these, gradually increasing in strength, it finally becomes loud and shrill. The song is maintained at this pitch for a variable length of time, after which it again drops to the faint buzz with which it started, or ceases altogether. There are usually long intervals of silence between periods of stridulation.

## RHAPHIDOPHORINAE

*Ceuthophilus latens* Scudder.<sup>26</sup>

Warren Woods, June 26 to July 4, 1919, 1 male, 2 females, 4 immature females; September 7, 1920, 1 male.

Sawyer Dunes, July 12 to 29, 1920, 14 males, 11 females, 25 immature specimens.

This species was found to be abundant in the dune forests, but not common in those on the Warren Woods Preserve. Nearly all the specimens were captured in molasses-fusel oil traps. Those not taken in this way were all found with a flashlight at night; one male in a trap baited with decaying meat in company with several species of *Necrophorus* and *Silpha*; several nymphs among dead leaves in the vicinity of the molasses traps; and one female in an open shed with bare

<sup>26</sup> Determined by J. A. G. Rehn.

sand floor near the edge of the oak dune forest. Mature specimens did not become common until the middle of July.

*Ceuthophilus nigricans* Scudder.

Warren Woods, June 26, 1919, 1 female; ? July 1, 1919, 1 immature female.

Sawyer Dunes, ? July 7 and 15, 1920, 2 immature males; July 19, 1920, 1 female.

Very much less common than *Ceuthophilus latens*, but occurring in the same situations. One nymph was taken under a rotten log in the oak dune forest; the rest from molasses traps.

The determination of this species is somewhat doubtful; Rehn did not care to express an opinion on the identity of these specimens. The two females agree well with the description given by Blatchley, except in regard to the teeth of the ovipositor, which are somewhat too aciculate to accord well with his description and figure.

GRYLLIDAE

GRYLLOTALPINAE

*Grylotalpa hexadactyla* Perty.

Warren Woods, June 29 to July 2, 1919, 5 immature specimens; September 1 to 3, 1919, 3 males, 3 immature specimens.

Stevensville, August 17, 1906, 1 female (collection Mich. Agr. Coll.).

Nymphs of this species were found to be quite numerous in the saturated sandy margins of a small pool on a springy hillside near the preserve. The sand down to at least six or eight inches beneath the surface was riddled with their burrows. The nymphs taken here in September are less than half the length of those taken in late June and early July, which were nearly mature.

Near the Warren Woods Preserve on September 1, while collecting in a low, moist meadow pasture, a chirping song was heard which was similar in cadence to that of *Gryllus assimilis*, but of different pitch and tone, being soft and low,

not hard and shrill as in *Gryllus*. Tracing this to its source, the point from which it originated was located within a few inches, though great care had to be exercised not to disturb the singer. It proved to be a male of this species, in a chamber about an inch below the surface of the ground which was merely a slight enlargement of its gallery. Others were traced down in the same way, and as a result of a number of attempts three adult males were secured. On September 5 males were heard chirping in a similar area on the other side of the preserve.

Hancock records taking long-winged specimens at light on August 1 at Lakeside.

#### TRIDACTYLINAE

##### *Tridactylus apicalis* Say.

Warren Woods, June 29 to September 3, 1919, 4 females, 4 immature specimens.

New Buffalo, September 2, 1919, 1 female.

This species was found in small numbers in company with the much more numerous *Ellipes minuta*, on moist sand and mud shores along the Galien River, on the sandy margins of spring pools on a marshy hillside near the Warren Woods Preserve, and on small exposed areas of moist sand among the *Equisetum* and *Carex* on the borders of Lake Pottawatamie at New Buffalo.

##### *Ellipes minuta* (Scudder).

Warren Woods, June 27 to September 3, 1919, 9 males, 12 females, 14 immature specimens.

These minute mole-crickets were found in moderate numbers in the same situations as *Tridactylus apicalis*. Along the Galien River they were fairly numerous on the moist sand and mud shores, but more common on the areas of bare, trampled mud about the watering places of the cattle. In the vicinity

of the Warren Woods Preserve specimens were also taken from the sandy shores of a small brook and from the wet, sandy margins of a spring-fed pool on a marshy hillside. In June the nymphs were far more numerous than the adults; September 3 they occurred in about equal numbers.

GRYLLINAE

*Nemobius fasciatus fasciatus* (DeGeer).

Warren Woods, August 30 to September 3, 1919, 5 males, 12 females;

September 5 to 7, 1920, 4 males, 5 females.

Sawyer Dunes, August 31, 1919, 1 male, 2 females.

New Buffalo, September 2, 1919, 8 males, 16 females; September 9, 1920, 2 males, 6 females.

Three Oaks, September 4, 1920, 6 males, 9 females.

This species is found in the latter part of the season in a great variety of habitats. It is abundant in dry, grassy fields and pastures, in cultivated fields and grassy orchards, in fields of second growth scrub, in the grassy margins of open woods, in roadside and forest margin thickets on low and high ground, in the drier portions of sedge and lizard's tail marshes, and in moist meadow pastures. Specimens were also taken in open oak forests, among the dead leaves and low undergrowth, among the moss and low herbage underneath the willow thicket surrounding one of the dune ponds, and in company with *Nemobius palustris*, among the bases of the grasses and sedges in the marshy borders of Klute's lakes.

Hancock has recorded taking the long-winged form at light at Lakeside.

*Nemobius palustris palustris* Blatchley.

Three Oaks (Klute's lakes), September 4, 1920, 3 males, 1 female.

Taken in the marsh surrounding Klute's lakes, on wet black muck, and climbing about on the vegetation, among the bases of the sedge and grass clumps; in company with *Nemobius fasciatus*, but much less numerous than that species.

*Nemobius carolinus carolinus* Scudder.

Warren Woods, September 1 to 3, 1919, 4 females.  
 Sawyer Dunes, August 31, 1919, 1 male, 1 female.  
 New Buffalo, September 2, 1919, 2 males, 2 females.

Taken in a moist meadow pasture and in a small marsh filled with sedges and iris near the Warren Woods Preserve; among the moss and low herbaceous vegetation under the willows around the margins of a dune pond; and from the lizard's tail marsh at New Buffalo, where they were moderately common in all except the wettest portions.

*Gryllus assimilis* Fabricius.

Warren Woods, June 19 to September 1, 1919, 20 males, 24 females;  
 July 3 to 16, 1920, 6 males, 15 females.  
 Sawyer Dunes, June 22 to August 31, 1919, 5 males, 9 females;  
 July 4 to 29, 1920, 7 males, 6 females.  
 Three Oaks, September 4, 1920, 2 males, 1 female.  
 Harbert, June 22, 1919, 1 female.  
 New Buffalo, September 2, 1919, 1 female; September 9, 1920, 2 males, 3 females.

The bulk of the specimens here recorded may be placed under the variants *pennsylvanicus* Burmeister and *luctuosus* Serville, the former being much more numerous; a few represent *neglectus* Scudder, and a single specimen agrees with the characters given for *scudderianus* Saussure, except that the ovipositor is too short. A considerable number of the specimens present combinations of characters which will not allow them to be placed under any of these standard or "typical" variants.

This species was common in a variety of habitats during the entire season from June 19 to September 9. Specimens were taken in the following situations: grassy fields and pastures throughout the region; cultivated fields and orchards; open, grassy woods and clearings; brushy fields; sand and mud-bar herbage; moist meadows; and beach grass and bunch



grass zones along the lake shore. Several specimens were collected in open oak woods at New Buffalo and in the Sawyer Dunes; one was taken in a molasses trap in thick forest, together with Blattids and Ceuthophilus. Several, both of the long- and short-winged types, were taken at light. This species is frequently found under boards, stones, and other objects in the fall, congregated together in colonies; on August 31 several hundred individuals were found under the loose bark of a single stump in the grassy margins of Warren Woods. A number of specimens were taken at night, in company with several species of *Melanoplus* and other forms, resting on tall mullein stalks and other plants, often three feet or more above the ground. Other specimens were found in cottages among the dunes and at the Warren Woods, where they had apparently taken up their residence, since they could be heard stridulating in the same corner night after night.

But little correlation of the various forms with specific habitats was noted. The typical *neglectus* variant was not taken in any of the drier habitats; it was commonest in the low, open, grassy woods found on some parts of the Galien River flood-plain, and among the low herbage around the shores of some of the dune ponds. The *pennsylvanicus* variant is the most widespread: this was the only one found in the beach grass and bunch grass zones of the dune region, and it occurs in all of the other situations enumerated above. The *luctuosus* variant is less common than *pennsylvanicus*, though found with it in the same habitats. The only specimen secured referable to *scudderianus* was taken on the lake strand. The proportion of macropterous individuals for the dune region is high, due largely to the fact that a considerable number of the specimens were taken in the beach drift; all of these are macropterous with the exception of one male. This was prob-

ably caught by the waves while feeding on dead fish or insects along the shore, as others were seen thus engaged on several occasions.

This species is reported from Lakeside by Hancock under the names of *abbreviatus* Serville and *pennsylvanicus* Burmeister.

## OECANTHINAE

*Oecanthus quadripunctatus* Beutemuller.

Warren Woods, August 30 to September 3, 1919, 6 males, 4 females;  
September 7, 1920, 1 male, 1 female.

Sawyer Dunes, August 31, 1919, 1 male, 1 female.

Three Oaks, September 4, 1920, 4 males, 5 females.

New Buffalo, September 2, 1919, 1 male; September 9, 1920, 1 male,  
2 females.

Common in the late summer and fall among tall herbaceous growths, roadside and forest margin thickets, in fields of second growth scrub, in sedge and lizard's tail marshes, and in dry, grassy fields. It was especially abundant in fields and pastures in small clumps and patches of ragweed; in September a dozen specimens might be taken with a few sweeps of the net across such a patch. In the dune region it was taken by sweeping among the grass and grapevines along the rim of a blowout, in company with the next species. Hancock found it at Lakeside in August.

*Oecanthus nigricornis* F. Walker.

Warren Woods, August 31 and September 1, 1919, 7 females; September 5, 1920, 1 male, 2 females.

Sawyer Dunes, September 6, 1920, 1 female.

Three Oaks, September 4, 1920, 9 males, 6 females.

New Buffalo, September 2, 1919, 2 males, 2 females.

Found in the same habitats as *Oecanthus quadripunctatus* and in some where that species was not taken. In the lowland thicket at Klute's lakes *nigricornis* was very common

among the rank growth of tall herbaceous plants, vines, and shrubbery, while no specimens of the other species were found; and it was more common than *quadripunctatus* in the roadside and forest margin thickets.

*Occanthus niveus* (DeGeer).

Benton Harbor, September 4, 1920 (Priscilla Butler), 1 female.

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THE AMPHIBIANS AND REPTILES OF WESTERN  
TENNESSEE

BY FRANK N. BLANCHARD

The following report is based upon collections made in western Tennessee, west of the Tennessee River, by Professor A. G. Ruthven, in August, and by the writer, in July, in the summer of 1919. To make the report more complete, all the specimens from Tennessee, west of the Tennessee River, in the collection of the U. S. National Museum have been included, as well as the records of Rhoades\* where they differ from those represented by these collections.

Ten salamanders, ten frogs and toads, four lizards, sixteen snakes, and ten turtles, or fifty forms in all, are represented. This is, of course, considerably less than the total number inhabiting the region, a good many of which could be predicted from our knowledge of general distribution. I have here included only definite records, a good many of which

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\* Rhoades, S. N., Contributions to the Zoology of Tennessee. *Proc. Acad. Nat. Sci., Philadelphia*, 1895, pp. 376-407.

are of forms not hitherto reported from this region. The value of these records is increased by the changes that are taking place in the fauna. There can be little question that the continued deforestation and denudation of the area is being accompanied by the widespread extermination of amphibians and reptiles. Furthermore, the additional material from this interesting section of the country will be useful in revisional and distributional studies.

No general description of the region can be given, as the writer spent his whole time (July 4 to 22, 1919) in the vicinity of Henry, in Henry County. This particular locality is about on the divide between the Mississippi and Tennessee drainage systems in the northeastern portion of this section of the state. It is mostly upland with numerous small permanent ponds or pools on clay soil, with some deciduous woods and much land under cultivation. "Bottom lands" are common, where slow streams meander along wooded flats, terminated usually abruptly on either side by the better drained upland.

The writer is pleased to acknowledge the kindness of Dr. Leonhard Stejneger in loaning the material in the collection of the United States National Museum, of Professor Alexander G. Ruthven for the privilege of reporting upon his collection and of making use of the facilities of the Museum of Zoology of the University of Michigan, and of Dr. Emmett R. Dunn, of Smith College, for identification of *Eurycea bislineata cirrigera* and other salamanders in the collection.

The common or English names that appear in the notes are those in use by the people in and near the town of Henry.



## LIST OF SPECIES

*Notophthalmus viridescens viridescens* (Rafinesque).—Rhoades referred fourteen newts secured at Samburg to *meridionalis*. These have been recently examined by Dr. E. R. Dunn (Proc. Acad. Nat. Sci., Philadelphia, 1917, p. 27) and identified as *viridescens*. I have, therefore, followed Dunn in referring a specimen (U. S. N. M. 28393) from Maxey to this form.

*Ambystoma microstomum* Cope.—Two specimens from Maxey, collected by George D. Morgan (28389-90), are in the National Museum collection.

*Ambystoma opacum* (Gravenhorst).—Twenty-three examples of this species have been examined, only a single one of which was taken near Henry. The latter was found under a small, loose board in an oak-hickory woods near an open field.

Localities and specimens are as follows: Camden, Benton County, and Reelfoot Lake, Obion County, University of Michigan; Maxey and Big Sandy, U. S. National Museum. Rhoades mentions a specimen from Raleigh.

*Ambystoma talpoideum* (Holbrook).—In the National Museum are two specimens (28391-92) of this salamander from Maxey, collected by George D. Morgan.

*Plethodon glutinosus* (Green).—Common near Henry, where 28 specimens were taken under rotten logs or loose bark of fallen trees in the woods. In addition, 33 specimens have been examined from Camden, Reelfoot Lake, and Jackson, Madison County (University of Michigan), and Maxey and Big Sandy (U. S. N. M.).

Rhoades regards this the "most abundant and uniformly

distributed salamander in 'Tennessee,' and records specimens from Samburg and Raleigh.

*Eurycea bislineata cirrigera* (Green).—One specimen, identified as this form by Dr. E. R. Dunn, was taken near Henry (University of Michigan, No. 53543). It was found in a soft rotted log in damp lowland woods along with a specimen of *Desmognathus fuscus fuscus*.

*Eurycea gutto-lineata* (Holbrook).—Nineteen specimens were taken near Henry in low woods under damp logs, and Professor Ruthven took six at Moscow, Fayette County.

*Eurycea longicauda* (Green).—A specimen in the National Museum (No. 45959) from Big Sandy is identified as this form by Dr. E. R. Dunn.

*Pseudotriton ruber ruber* (Sonnini).—One of the less common salamanders; found in the same situations as *Desmognathus fuscus fuscus*. Eight examples were taken at Henry and one at Como.

*Desmognathus fuscus fuscus* (Rafinesque).—This salamander was found to be abundant near Henry in woods at edges of springs, ponds, and swamps, under wet leaves or logs that rested partly in the water. It has apparently not hitherto been recorded from so far west. Fifty-four specimens of all sizes were secured.

*Bufo fowleri* Garman.—All of the toads examined from western Tennessee, fifteen in number, appear to belong to this species. They were found to be very common in the vicinity of Henry, and in view of the unsatisfactory state of our knowledge of the systematic status of the toads it is regretted that a larger series was not taken. They are called "toad-frogs" by the people near Henry.

Specimens and localities are as follows: Camden, Jackson, Henry, Como, Reelfoot Lake, and Somerville, Fayette County (University of Michigan), and Maxey and Memphis (U. S. National Museum).

*Acris gryllus* (Le Conte).—This form was found to be common near Henry along wet shores of ponds and marshes when not thickly wooded. Fifteen examples were taken. Ruthven took eleven specimens at Reelfoot Lake, Obion County. It is recorded by Rhoades from Samburg.

*Pseudacris triseriata* (Wied).—Identification provisional. Only a single specimen has been examined (U. S. National Museum, No. 28378, Maxey). The heel extended forward reaches the posterior border of the orbit.

*Hyla cinerea* (Schneider).—Two adults were taken by Professor Ruthven at Reelfoot Lake, Obion County. Rhoades records it from Samburg.

*Hyla versicolor versicolor* Le Conte.—This species was often heard calling, in the vicinity of Henry, and is undoubtedly common, although only four specimens were secured. Two in the National Museum represent Memphis and Maxey.

*Rana catesbeiana* Shaw.—The bullfrog is one of the commonest frogs in the vicinity of Henry. Twenty-four specimens were secured here. Ruthven took it at Moscow and Lane; two in the National Museum represent Maxey; and Rhoades records it from Samburg.

*Rana clamitans* Latreille.—Common near Henry in low, wooded situations, often under logs or near water. Twenty-one examples were secured, representing Como as well as Henry.

*Rana palustris* Le Conte.—Two isolated examples were found near Henry in woods near but not in water.

*Rana sphencephala* (Cope).—A very common frog in low woods near water, or even in fields and at a considerable distance from water. Commonly escapes by long leaps into bushes or grass. Specimens and localities are as follows: Moscow, Reelfoot Lake, Lane, and Henry (University of Michigan)) and Maxey (U. S. National Museum). Rhoades records it from Samburg and Raleigh.

*Gastrophryne carolinensis* (Holbrook).—Two adults were taken at Henry, one under a log in wet, open woods, and the other under a loose board near a very small pond in an open field.

Rhoades reports one adult from Raleigh.

*Sceloporus undulatus* (Latreille).—The black lizard was found to be very common near Henry on rail fences, trees, fallen logs, and stumps, in fields or openings in woods. In escaping a pursuer it was in no case seen to run on the ground. Twenty-seven specimens were taken. Professor Ruthven took three at Camden and one at Jackson. In the National Museum there is one specimen from Big Sandy, one from Maxey, and three from Memphis. Rhoades reports it from Samburg and Raleigh.

*Cnemidophorus sexlineatus* (Linné).—These lizards are called "sand scrapers" by the people near Henry. They are exceedingly common in sandy situations and are always found on the ground. They are very swift and escape by rushing into grass or brush. Over night some at least remain in holes dug in the sand, from which they may easily be taken early in the morning. The burrow is short and has two openings,

and when the lizard is inside one of these openings is partially filled with sand thrown out from within.

Twenty-eight specimens were taken near Henry and six at Somerville, Fayette County.

Strangely enough, Rhoades did not find this species in western Tennessee.

*Leiolopisma laterale* (Say).—The single specimen taken near Henry was found under a fence rail lying in an open field at the edge of a woods. Professor Ruthven took four specimens at Reelfoot Lake.

There is a single example in the National Museum from Maxey (No. 28410). Rhoades calls it "abundant," and records three adults from Raleigh.

*Plestiodon fasciatus* (Linné).—These lizards, locally known as "scorpions," were found commonly on trees and fences in wooded situations. They escape their pursuers by running around or up the tree, not by crossing the ground. An adult female with nine eggs was found, July 12, under the loose bark of a large fallen tree in the woods. The eggs appeared to be in no special cavity, but merely lay in the damp, rotted wood between the bark and the harder wood beneath. On July 15 two adult females and ten eggs (two eggs smaller and of different shape) were found in a hollow in a dead willow tree, about fifteen feet above the ground, buried in the loose, damp, rotted wood. One very small individual was found with the eggs, but escaped.

Twenty specimens were taken by Professor Ruthven and the writer from near Henry, near Como, Camden, Jackson, Reelfoot Lake, and Lane (Dyer County).

The following localities are represented by specimens in the National Museum: Maxey (28408-9), Clarksville (44932,

48200), Huntington (14113), Danville, Houston County (44770). Rhoades found it in the "western lowlands only," recording specifically Samburg and Raleigh.

*Carphophis amoena* (Say).—The single specimen examined (U. S. N. M., No. 44365, Danville, Houston County), a female, is typical in coloration. The scale rows are 13; upper labials, 5; lower labials, 6; post oculars, 1. There is only a single posterior temporal on each side. This specimen, as well as the one recorded by Rhoades from Raleigh, Shelby County, lacks the internasals. This is also true of a good many middle western specimens. It is not improbable that this character will prove of more geographic significance than hitherto supposed, and that a revision of the genus will assign these western Tennessee specimens to the western race, *C. vermis* (Kennicott). The ventrals are 128, the caudals 28, the length 253 mm., the tail 0.146 of the length.

*Diadophis punctatus strictogenys* Cope.—This name, given by Cope to a specimen with locality unknown, seems to belong to a race occupying the lower Mississippi Valley south from southern Illinois, the essential features of which are a low number of ventrals, 15 rows of dorsal scales, 7 upper labials, and more or less irregular or scattered black spots on the belly. In the first two characters it is identical with *punctatus* from the southeastern states, in the second it agrees with *edwardsii*, and in the third with *arnyi*. The ventral spots in *strictogenys* are not so neatly arranged in twos as they are in *arnyi*, nor are they in a single, well-defined row along the middle of the belly as in *punctatus*, but are irregularly arranged in the center, often partially fused into a single line.

The eastern ring-neck snakes may be provisionally defined as follows:

- A* Black spots on belly scattered or irregular; upper labials, 7 (only rarely 8).
- a* Ventrals more than 145; scale rows, 17-17, or 17-15 (occasionally only 15); belly spots scattered or in twos, generally clean-cut in appearance. *D. punctatus arnyi* (Kennicott) (Western Illinois, Iowa, Missouri, northwestern Arkansas, west to the Great Plains and south into Texas.)
- a*<sub>1</sub> Ventrals less than 145; scale rows 15 throughout; belly spots showing tendency to fuse into a single row, or irregularly massed. *D. punctatus strictogenys* Cope (Southern Illinois through the lower part of the Mississippi Valley to the Gulf.)
- A*<sub>2</sub> Black spots on belly in a single median row or absent (very rarely irregular); upper labials usually 8.
- b* Sum of ventrals and caudals usually less than 191; belly with a series of large half-circular black spots along the median line, neck ring usually partially or wholly interrupted on the mid-dorsal line. *D. punctatus punctatus* (Linné) (Eastern Alabama north to southern Virginia and south throughout Florida.)
- b*<sub>1</sub> Sum of ventrals and caudals usually more than 191; belly usually immaculate, but sometimes with a median series of small black spots, more or less imperfectly developed; neck ring only rarely interrupted on the mid-dorsal line. *D. punctatus edwardsii* (Merrem) (Wisconsin to the southern Appalachians and north into Canada.)

In the western Tennessee specimens the scale rows are only 15, the upper as well as the lower labials are seven, the neck ring is one-half to one scale in width, and the bellies are heavily spotted. The ventrals and caudals are as follows:

Locality	Ventrals	Caudals	Length	Tail divided by length	Sex
Camden . . . . .	148	37	332	0.160	Female
Henry . . . . .	143	44	276	0.178	Male

*Heterodon contortrix* (Linné).—The spreading adder is well known and rather common in fields and about dwellings. It is much feared as poisonous and is always killed. Of the numerous examples seen near Henry only two were captured. Rhoades records three from Samburg.

The characters of the specimens taken at Henry are:

Scale rows	Ventrals	Caudals	Labials	Oculars	Length	Tail divided by length	Sex
25-19	134	47	8 — 10-11	10 — 11	625	0.170	Male
25-19	144	44	8 — 11	11	745	0.161	Female

*Coluber constrictor constrictor* (Linné).—The black snake, or black racer, was seen frequently in fields and at the edges of woods. Three specimens were taken at Henry. These are all very dark in coloration, the scale rows on each are 17-15 and the oculars are 2-2. Rhoades records specimens from Samburg.

Ventrals	Caudals	Labials	Length	Tail divided by length	Sex
174	87	8-7 — 8-8	1170	0.248	Male
177		7 — 8			Adult female
181	98	7 — 8	1349	0.245	Male

*Elaphe obsoleta obsoleta* (Say).—This is a common and well-known snake, locally called "chicken snake." Near Henry a young adult was taken in an oak-hickory woods as it was going under a fallen log, and a cast skin was found in a school-house. The latter may have been carried in. This Henry specimen shows the dorsal spots clearly, but larger examples from Reelfoot Lake and Arlington (U. S. National Museum) more nearly approach the typical coloration. Rhoades reports it from Samburg and refers to it as the most abundant snake throughout the state.



Locality	Scale rows	Ventrals	Caudals	Labials	Length	Tail divided by length	Spots	Sex
Reelfoot Lake....	25-27-19	235	75	8 — 12	1280 mm.	.157	31	Female
Henry .....	23-25-17	244	81	8 — 11	1010 mm.	.173	31	Female
Arlington .....	25-19	231	85	8 — 11	1390 mm.	.180	29	Male

*Lampropeltis getulus holbrooki* (Stejneger).—The specimen collected by Rhoades at Samburg (Academy of Natural Sciences, No. 4451) has been examined by the writer and referred to this form. It has, however, a distinct leaning toward the next, *L. getulus niger*. The characters are: scale rows, 19-21-19-17; ventrals, 210; caudals, 54; upper labials, 7; lower labials, 9; cross bands, 70; male.

*Lampropeltis getulus niger* (Yarrow).—The king snake is known to most of the farmers, but is less often seen than *Coluber constrictor* and *Elaphe obsoleta*. One moderate-sized adult was found at the side of a road near Henry at dusk. This is close to, if not within, the region of intergradation between this form and the last, but the specimen found was more like *niger* than like *holbrooki*. The yellow spots were very small, although present for the most part midway between the cross bands. It was kept alive for two days, and then escaped.

*Natrix cyclopion* (Dumeril and Bibron).—Rhoades records four specimens from Samburg.

*Natrix erythrogaster* (Forster).—Two forms of harmless water snakes are recognized by the people near Henry. The one with the pattern of spots is called the "water moccasin," and the one that is very dark above with no dorsal markings and with pinkish belly is called the "copper belly." It seemed to the writer that these two forms were never found together, but more observation is needed on this point as well as on a number of others before the status of *erythrogaster* can be satisfactorily settled. It is surely not time to synonymize the name with *sipedon*. It is at least suggestive that all the Henry specimens separate into two clear-cut groups on the basis of belly pattern and ventrals, those with copper bellies having from 149 to 156 ventrals and those having spots below like *sipedon* possessing 136 to 144 ventrals. This was noted by Clark,\* and has recently been observed by the writer in the course of examination of large numbers of these types of water snakes. It appears that young examples of *erythrogaster* show the dorsal pattern of *sipedon* but not the ventral. It is particularly desirable that numerous entire broods of both these forms from the same region be obtained for examination.

The specimens described below are all from Henry, Tennessee, and are deposited in the University of Michigan Museum. The oculars and temporals are 1-3, the lower labials 10, in every specimen.

Scale rows	Ventrals	Caudals	Upper labials	Total length, millimeters	Tail divided by length	Spots	Sex
21-23-17	149	75	8	428	.245	36	Female
23-25-19	149	70	8	1004	.220	None	Female
21-23-17	156	67	9	1203	.195	None	Female
22-23-17	152	..	8	860 (incomplete)		None	Male
23-17	150	..	8	1030		None	Female

\* Clark, H. L. *Amer. Nat.*, vol. 37, 1903, pp. 1-23.

*Natrix rhombifera* (Hallowell).—A very large skin in the National Museum from Maxey, Dyer County, is identified as this species, probably correctly. The scale rows reach a maximum of 28; there are no suboculars; the pattern is obscure, but seems to be like that of *N. rhombifera*. A more certain record is that furnished by a small specimen collected by Ruthven at Reelfoot Lake.

Locality	Scale rows	Internals	Labials	Oculars	Temporals	Spots	Sex
Reelfoot Lake ..	27-21	146	9-10 —— 12-13	1-4, 2-3	1+3	30	Male
Maxey .....	27-28-21	142	8 —— 10	1, 3	——		

*Natrix sipedon sipedon* (Linné).—This snake was seen more often than any other. It was found along all the water courses, frequently lying in the bushes or on driftwood ready to drop off into the water at the first alarm, and was even common in the village of Henry by some of the numerous small ponds. All the specimens listed below are in the University of Michigan Museum and are from Henry, Tennessee. They show no evident approach to *N. fasciata*, even though in two specimens (53524, 53530) the dorsal saddles are complete throughout the body length, for they all show the half-circular belly spots, diagnostic of *sipedon*, and lack the postocular light line distinctive of *fasciata*.

The species recorded by Rhoades from Samburg was probably this form.

All of the specimens have 8 upper labials and 10 lower labials.

Scale rows	Ventrals	Caudals	Oculars	Temporals	Length in mm.	Tail divided by length	Spots	Sex
23-19	139	80	2-3	1-3	368	.272	22	Female
21-23-17	136	82	1-3	1-3	676	.280	31	Male
23-19	138	74	1-3	1-2	509	.250	25	Male
23-17	140	66	1-3	1-2	688	.240	23	Female
23-24-18	143	61	2-3	1-3	924	.215	27	Female
23-25-19	137	63	1-3	1-3	731	.235	27	Female
21-23-17	144	72	1-3	1-2	441	.250	23	Male

*Virginia valeriae elegans* (Kennicott).—A small specimen from Maxey, collected by G. D. Morgan, September 20, 1900, is typical of this form in most respects, but the first seven anterior caudals are entire and the last two lower labials on each side are united. Nearly all of the dorsal scales are keeled, but this is by no means atypical, as the series in the collection of the United States National Museum shows. The four longitudinal rows of black dots on the back show plainly, and a light median dorsal stripe is just discernible.

Its scalation is as follows: scale rows, 17 throughout; ventrals, 120; caudals, 45; upper labials, 6; lower labials, 5; loreal and prefrontal entering eye; temporals, 1+2; sex, male; total length, 101.5 mm.; tail length, 21 mm. (U. S. National Museum, No. 28412).

*Thannophis sauritus sauritus* (Linné).—Two specimens, both males, were obtained, representing Austin Lake, Obion County, and the township of Henry. Ribbon snakes from critical regions are not readily distinguishable, but the specimens secured may, on the basis of their seven supralabials and

high ventral and caudal counts, most readily be referred to this form. The Henry specimen was found under a piece of loose bark in a very small opening in a wet, grassy marsh or meadow. It escaped into the grass, but was taken on the next day beside a log within three or four feet of the same place.

Locality	Ventrals	Caudals	Labials	Length	Tail divided by length
Austin Lake..	175	116	7-8 — 10	280	.285
Henry .....	169	129	7 — 10	645	.353

*Tantilla coronata* Baird and Girard.—The scutellation of the two specimens found, one at Camden and one at Henry, seems to be typical: scale rows, 15; upper labials, 7; lower labials, 6; preoculars, 1; postoculars, 2. The coloration differs a little. The specimen from Henry has the light collar involving the tips of the parietals and half of the first dorsal scales; this is followed by a black half collar two scales wide and preceded by a mixture of black and brown becoming lighter on the snout. The Camden specimen has a narrower light collar, succeeded by a black band four scales wide, and the top of the head is entirely black.

The specimen from Henry was found under the boards of a small fallen shed in a small clearing on a wooded slope.

The characteristics not given above are as follows:

Locality	Ventrals	Caudals	Length	Tail divided by length	Sex
Camden .....	137	46	233	0.199	Male
Henry .....	143	44	324	0.185	Female

*Agkistrodon mokasen* Beauvois.—The highland moccasin, as it is called, seems to be well known to the farmers, but no specimens were seen either by Professor Ruthven or the writer. Rhoades, however, records two specimens from Samburg and one from Raleigh.

*Agkistrodon piscivorus* (Lacépède).—The cotton-mouth moccasin is common in the swamp lands everywhere, whether wooded or not. Five specimens were taken near Henry and many more were seen. There is a specimen in the National Museum from Arlington, and Rhoades records one from Reelfoot Lake.

Locality	Scale rows	Ventrals	Caudals	Labials	Length	Sex
Henry...	25-24-25-21	136	41	7-8 — 11	687	Female
" ...	23-25-21	136	44	7 — 10	720	Female
" ...	25-21	137	48	8 — 11	765	Male
" ...	25-21	136	46	7-8 — 10	953	Male
" ...	25-21	132	45	8-7 — 11	788	Male
Arlington	25-23-25-21	135	43	8-7 — 11	361	Female

*Kinosternon odoratum* (Latreille).—Evidently common. Nine specimens are at hand (University of Michigan collection), representing Henry and Reelfoot Lake.

*Kinosternon subrubrum subrubrum* (Lacépède).—A single small specimen identified as this form by Dr. Stejneger was taken near Henry in a small pool of water in a sunny road through moist woods. The carapace is 40 mm. in length, and the plastron is 37 mm. long.

Rhoades records one example of *Kinosternon pennsylvanicum* from Samburg.

*Chelydra serpentina* (Linné).—A single adult was seined from a small pond at Henry, but was accidentally destroyed after it reached Ann Arbor. Rhoades took six specimens at Samburg.

*Terrapene carolina carolina* (Linné).—An adult specimen each from Henry and Camden (University of Michigan, 53513, 53266) and from Clarksville and Danville (U. S. National Museum, 45304, 45307).

*Graptemys pseudogeographica pseudogeographica* (Gray).—Five specimens were secured by Professor Ruthven at Reelfoot Lake.

*Chrysemys marginata dorsalis* (Agassiz).—A single specimen was taken by Professor Ruthven at Reelfoot Lake.

*Pseudemys concinna* (Le Conte).—Recorded by Rhoades from Raleigh and Samburg.

*Pseudemys elegans* (Wied).—This turtle was very common in the pools and ponds near Henry, and it was also seen in the streams. Twenty-five specimens were secured, representing Henry and Reelfoot Lake (University of Michigan collection).

*Amyda mutica* (Le Sueur).—A single juvenile specimen of this species was taken by Professor Ruthven at Trotter's Landing, Benton County.

*Amyda spinifera* (Le Sueur).—One young example was secured by Professor Ruthven at Reelfoot Lake.

Rhoades refers to this species as "very abundant in west Tennessee," and records eleven specimens from Samburg.



OCCASIONAL PAPERS OF THE MUSEUM OF  
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HEMIPTERA FROM BERRIEN COUNTY, MICHIGAN<sup>1</sup>

BY ROLAND F. HUSSEY

The region about the southern end of Lake Michigan holds a peculiar interest for students of the distribution of animals and of plants. Zoologists and botanists alike find there a few forms which are characteristic of the southern states, or even of the coastal region of the Atlantic seaboard. The phytogeographic evidence indicates that the plants which fall in this class came in from the Atlantic coast during one of the later interglacial periods, and that the route which they followed led up the valleys of the Hudson and the Mohawk rivers to the forerunner of Lake Erie, around the southern shore of the lake and up the eastern side of Michigan to the "Thumb" region, and westward across the state through the valleys now occupied by the Saginaw and Grand rivers.<sup>2</sup> But when the ani-

<sup>1</sup> Contribution from the Entomological Laboratory of the Bussey Institution, Harvard University, No. 193.

<sup>2</sup> I am indebted to Mr. Donald C. Peattie, of Harvard University, for this information, which was given in an address before the New

mals are considered the case is much less simple. In certain cases we find a distribution which parallels that of the "coastal plain" plants, but often the forms in the Lake Michigan region have become sufficiently distinct from their relatives on the Atlantic coast to warrant their separation into geographical races: witness the Orthoperan species *Trimerotropis maritima* and *Paroxya clavuliger*, which are represented in the Lake Michigan region by *T. m. interior* and *P. c. hoosieri*, respectively. A large part of the southern element in the fauna of this region has undoubtedly followed up the Mississippi Valley.

Though botanical investigations have been carried on here for nearly half a century, faunistic work has largely been neglected. However, the Michigan Biological Survey has recently begun a study of the animals of Berrien County, which lies within this interesting region. In connection with this survey in Berrien County, I was asked to make collections of Hemiptera, and the present report is based on field work done during the summers of 1919 and 1920. The actual dates covered by my collections fall between June 19 and July 5, 1919, August 30 and September 3, 1919, and July 3 and July 28, 1920. The specimens secured are deposited in the Museum of Zoology of the University of Michigan.

Berrien County is located in the extreme southwestern part of the Southern Peninsula of Michigan, bordered on the west by Lake Michigan and on the south by Indiana. The region in which my collections were made comprises a strip about twenty miles long and three miles wide, extending parallel to the lake shore from New Buffalo, near the state line, north-east to a series of small, marshy lakes near Stevensville, which

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England Botanical Club, May 6, 1921. Mr. Peattie discusses the coastal plain element in the flora at the head of Lake Michigan in a paper which is appearing in *Rhodora*, Vol. xxiv, 1922.

are known locally as the Grand Marais. Most of my collecting was done in three localities: the marshy regions at New Buffalo; the region about the Warren Woods, near Three Oaks; and the dune region along Lake Michigan between Harbert and Bridgman, together with a narrow strip of the flat, sandy country immediately behind the dunes. I use the general term "Sawyer Dunes" for this dune region, since the little village of Sawyer lies about midway between Harbert and Bridgman.

Berrien County is characterized by level land with a rather sandy soil. Streams are few and sluggish, and the larger ones are heavily laden with silt. The whole region is shut off from Lake Michigan by a wall of sand dunes, which are best developed between Sawyer and Bridgman: here they reach a height of nearly four hundred feet above the level of the lake, in one or two cases, and extend back from the shore for a distance of a mile or more, forming two or three series of dune ridges with deep valleys between them. At intervals of three or four miles there are small creeks of clear water, which break through the dunes to the lake shore only to sink into the beach sands and disappear. All the streams which flow into Lake Michigan in this region broaden out just above their mouths to form small pools or extensive ponds, depending on the amount of water that they carry. Thus the Galien River widens out at New Buffalo to form a large marsh, which figures even on recent maps as Lake Pottawattamie; and the smaller creeks form quiet little backwaters in the fore-dunes or shallow pools on the beach itself, directly connected with the lake only for brief periods following heavy on-shore winds when the water driven across the beach by the waves unites with the water in the pools to cut temporary outlets across the sand.

Even on the highest dunes the soil a foot below the surface is always moist and the dune flora is surprisingly luxuriant. There is a splendid series of transition stages from the xerophytic habitats of the beach and the fore-dunes, where the evaporation is greatest, though subject to excessive variation, to the climax forest of beech and maple.<sup>3</sup> The first plants appear just above the line which is ordinarily reached by the waves during strong on-shore winds: these plants are principally the sea rocket (*Cakile edentula*), species of *Artemisia*, and *Potentilla anserina*. Close behind them follows the fore-dune association, where, in addition to the beach plants, are found the sand cherry (*Prunus pumila*), the beach pea (*Lathyrus maritima*), willows, milkweeds, and such grasses as *Calamovilfa longifolia* and *Ammophila breviligulata* Fernald (= *A. arenaria* of American authors). This is easily the best developed of the bare-sand associations on the Sawyer Dunes, and the plant associations found on the inland slopes of some of the traveling dunes show some resemblance to it, consisting chiefly of grasses and milkweeds, together with some creeping vines. The last of the associations characteristic of the bare sand is typified by the cottonwood (*Populus deltoides*), together with the puccoon (*Lithospermum gmelini*), various species of wild grapes, the poison ivy (*Rhus toxicodendron*), and the plants of the fore-dunes. And here is found the

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<sup>3</sup> The following papers dealing with the dune flora are of particular interest:

Fuller, G. D., 1917, The Vegetation of the Chicago Region, pp. 3-12. University of Chicago Bookstore.

Fuller, G. D., 1914, Evaporation and Soil Moisture in Relation to the Succession of Plant Associations. *Bot. Gaz.*, 58: 193-234.

Cowles, H. C., 1899, The Ecological Relations of the Vegetation of the Sand Dunes of Lake Michigan. *Bot. Gaz.*, 27: 117, 169-202, 281-308, 361-391.

flowering spurge (*Euphorbia corollata*), following the edges of the blow-outs from near the beach almost to the dune crests. The cottonwood association is typical of rapidly moving dunes.

The fourth association is characterized by the white pine (*Pinus strobus*); here, for the first time, we find undergrowth, chiefly dogwoods (*Cornus* spp.), the bearberry (*Arctostaphylos uva-ursi*), various species of wild roses, and a few sumacs (*Rhus* spp.). Poison ivy is abundant, and such climbing plants as the bitter sweet (*Celastrus scandens*), the Virginia creeper (*Psedera quinquefolia*), and various wild grapes occur here. Apart from the grasses, the most important herbaceous plants are the false Solomon's seals (*Smilacina stellata* and *S. racemosa*). The pine association is poorly developed on the Sawyer Dunes, and in fact a distinct pine-dune habitat was found in only one place within our limits. In some places the oak forest follows directly after the cottonwood association, but more commonly there is a thin strip of dogwood and sassafras between the two.

The fifth association, characterized by the black oak (*Quercus velutina*), is by far the most extensive of all the sand-dune habitats. The oak forest on the Sawyer Dunes has been almost entirely cut over, so that it is now represented largely by second growth; this is very dense in many places and is often thickly tangled with bitter-sweet and green brier (*Smilax* sp.). The choke cherry (*Prunus virginiana*) is abundant throughout the black-oak association, and in the deeper dune valleys there are numerous hemlocks. Small openings in the woods are not uncommon, and here there are abundant grasses and other herbaceous plants, together with sumacs and berry bushes (*Rubus* spp.). The undergrowth of the more open parts of the black oak forest is still suggestive of xerophytic conditions, consisting principally of sumacs,

blueberries (*Vaccinium* spp.), sassafras, the bush honeysuckle (*Diervilla lonicera*), and other plants of similar habits; the prickly pear (*Opuntia rafinesquei*) occurs on the dunes at New Buffalo, but does not appear to pass the Galien River.

The transition stages from the black oak to the beech-maple forest are more gradual than the stages which precede the oaks, and the associations are less clearly defined. At first the stand of black oak is almost pure, but farther from the lake other trees appear, such as the chestnut oak (*Quercus muhlenbergii*), the blue beech (*Carpinus caroliniana*), the basswood (*Tilia americana*), and the hop hornbeam (*Ostrya virginiana*). The white oak (*Quercus alba*) becomes more and more plentiful as the black oak disappears, until finally an association is formed in which the white oak is predominant. This is the last association which is found in a typical form on the Sawyer Dunes, but even here numerous maples (*Acer saccharum*) and occasional beeches (*Fagus grandifolia*) foreshadow the climax forest.

The climax forest is splendidly represented in the Warren Woods, about three miles north of Three Oaks and two or three miles back from the dunes. Mature beeches and maples form at least ninety per cent of the forest on the higher ground, and undergrowth is very scanty. The Galien River flows through the woods, and its flood plain supports a more varied flora: here, besides the beeches and maples, there are elms, butternuts, and sycamores; elders (*Sambucus* spp.) and dogwoods are numerous, and the herbaceous vegetation is plentiful. Occasional sandy beaches by the river are excellent habitats for *Gelastocoris* and the Saldids, and numerous shaded pools in the woods offer their attractions for some of

the aquatic bugs. The shady glens at the southern edge of the woods are splendid collecting localities: here there are quiet pools and intermittent streams, dense beds of lizard's tail (*Saururus cernuus*) and luxuriant grasses, shaded by sycamores, butternuts, elms, ash trees, and sour-gum (*Nyssa sylvatica*). In one of these glens nearly sixty species of Hemiptera were taken. Other types of habitats occur on the borders of the woods, such as upland pastures, meadows, orchards, cultivated fields, cat-tail marshes, and buttonbush swamps; and collecting conditions here were almost ideal.

*Acknowledgments:* An expression of sincere appreciation is due to several of my friends and co-workers on Hemiptera for their assistance in the determination of many of the species listed below: to Dr. H. H. Knight, who has examined all the Miridae of the 1919 collection and many of those taken in 1920; to Professor C. J. Drake, who has named several species of the Tingidae; to Mr. J. R. de la Torre Bueno, who has looked over the Saldid species of the collection; and to Dr. H. M. Parshley, who has kindly identified some of the other forms. Acknowledgments are also due to Messrs. M. H. Hatch, of Detroit, and Carrol Rawcliffe, of Cicero, Ill., who very generously gave me several Hemiptera taken from the June beach-drift at New Buffalo and at the Sawyer Dunes; to my co-worker in the field, Mr. T. H. Hubbell, who turned over to me many Hemiptera which he chanced upon while collecting Orthoptera; and to Mr. George R. Fox, of Three Oaks, whose intimate knowledge of the region and whose interest in our work greatly facilitated our field studies.

## REMARKS ON THE HEMIPTERA OF SOUTHERN MICHIGAN

The fauna of southern Michigan is in general similar to that of the other northeastern States, and this holds true for the Hemiptera as well as for other groups of animals. The great majority of the species are wide-ranging forms which are generally distributed throughout the northeast, but there are other elements which enter into the composition of the fauna. A few northern species, such as *Gerris rufoscutellatus* and *Notonecta insulata*, occur in all parts of Michigan; but other northern forms, though common near the tip of the Peninsula, do not range southward far enough to come within our limits: as examples we may cite *Homœmus aneifrons*, *Phytocoris lasiomerus*, and *Notonecta borealis*.

On the other hand, there are several species whose ranges barely enter Michigan from the south: such forms are *Thyanta custator*, *Lygæus turcicus*, *Sirthenea carinata*, *Atrachelus cinereus*, and *Tenagogonus hesione*. Enough is known of the distribution of these forms to make it clear that they have come into the State either directly from the south, through Ohio and Indiana, or through the Mississippi Valley. No Hemiptera were taken in Berrien County which can be definitely cited as examples of the "coastal plain" type of distribution discussed above.

## THE BEACH DRIFT

The shores of Lake Michigan have long been noted for the remarkable nature of their insect drift. Professor Needham, more than twenty years ago, called attention to the fact that occasionally one finds myriads of insects washed ashore, forming regular windrows which sometimes extend for miles along the beach. In a later paper<sup>1</sup> he gives a more extended account

<sup>1</sup> The Insect Drift of Lake Shores. *Can. Ent.*, 49: 129-137, 1917.



of the Lake Michigan beach drift as observed on the Illinois shore, together with a discussion of the factors which contribute to the phenomenon. Other contributions, dealing principally with the drift on the ocean beaches, have been made by Bueno<sup>5</sup> and by Parshley.<sup>6</sup>

My camp on the Sawyer Dunes was very favorably situated for observations on the beach drift, and I watched the beach daily during the three weeks of my stay there. Although a considerable number of insects were washed ashore at various times, I was not so fortunate as to witness any such remarkable drifts as have been reported by Needham.

The most extensive beach drift which occurred during the early summer in 1920 took place before my field work was begun, probably some time about June 20, and even on July 4, when I first visited the dune region, the remains were very evident. The insects were not piled up in masses, but merely formed uneven lines along the beach, from two to four inches wide, mixed with cinders and other flotsam from the lake steamers. Rhynchophora, Scarabaeidae, and Carabidae were predominant: in fact, none but hard-bodied forms had persisted until this date. Of the Hemiptera, *Podisus maculiventris* was easily the most abundant species, though other Pentatomidae were also common, and some forms belonging to other families were found.

During the first half of July insects were found on the beach in fair numbers, but later in the month the drift became negligible. Coleoptera continued to hold first place, with the Rhynchophora, Scarabaeidae, and the larger Carabidae espe-

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<sup>5</sup> Hemiptera in Beach Drift. *Ent. News*, 26: 274-279, 1915.

Remarks on Heteroptera in Beach Drift. *Bull. Brookl. Ent. Soc.*, 15: 142-145, 1920.

<sup>6</sup> Insects in Beach Drift. I—Hemiptera Heteroptera. *Can. Ent.*, 49: 45-48, 1917.

cially well represented: there were also numerous individuals of *Hydrophilus* and of the larger *Dytiscid* species. Soft-bodied forms were extremely rare, and small species were not numerous: they were found chiefly on the days when the lake was comparatively calm. Even the heavily chitinized forms were often badly mutilated by the pounding to which they had been subjected in the surf, which is very heavy here at times. The effect of tides is negligible in Lake Michigan, and there is a strong undertow when the waves are high, so that oftentimes the insects remain in the surf for a considerable time before they are finally washed up beyond the reach of the waves.

The great majority of the insects do not survive their immersion in the lake, and after they have been washed up on the sand and have dried they are at the mercy of the winds. Thus, following any considerable drift, insects may be found scattered over the sands in the blow-outs for a distance of half a mile or more from the lake. Mr. D. H. Peattie tells me that in August, 1920, he found several accumulations of insects and miscellaneous debris on the inland slope of a low dune (about 50 feet high) near Mineral Springs, Indiana, over a quarter of a mile from the shore.

Twenty-seven species of Hemiptera were taken from the beach drift during July, 1920. Eleven of these have not been reported by previous writers, and the total number of American Hemiptera now known from the drift line is raised to 118 species. The Berrien County list is given below, together with the number of days on which each species was found. An asterisk indicates a species not previously reported from beach drift.

<i>Chlorochroa uhleri</i> .....	1	<i>E. euschistoides</i> .....	3
<i>Euschistus variolarius</i> .....	11	* <i>Mencles incertus</i> .....	1

<i>Thyanta custator</i> .....	1	* <i>Stenopoda culiciformis</i> .....	1
<i>Acrosternum hilare</i> .....	5	* <i>Reduvius personatus</i> .....	1
* <i>Rhacognathus americanus</i> ...	1	<i>Nabis fesus</i> .....	1
* <i>Perillus bioculatus</i> .....	2	<i>Lygus pratensis oblineatus</i> ...	1
* <i>P. b. claudus</i> .....	1	* <i>Lopidea cæsar</i> .....	1
<i>Apateticus bracteatus</i> .....	3	<i>Gerris marginatus</i> .....	3
<i>A. cynicus</i> .....	11	<i>Gerris rufoscutellatus</i> .....	5
<i>Podisus maculiventris</i> .....	7	* <i>Notonecta irrorata</i> .....	2
* <i>Oncopeltus fasciatus</i> .....	3	<i>Ranatra americana</i> .....	1
* <i>Lygæus turcicus</i> .....	1	* <i>Benacus griseus</i> .....	7
<i>Lygæus kalmii angustomargi-</i>		<i>Lethocerus</i> sp. ....	2
natus .....	4	<i>Belostoma flumineum</i> .....	6
		* <i>Gelastocoris</i> sp. ....	1

After considering carefully the nature of the drift material, the physiography of the region, and the correlation between weather conditions and the extent of the drift, I came to the conclusions that most of the insects which were washed ashore near my camp, west of Bridgman, came from the region west of Stevensville, six or seven miles to the north; that the insects had flown far out over the lake, had fallen in, and had been slowly washed in onto our shore; and that only the larger, more heavily chitinized forms had endured their long immersion and the heavy pounding of the surf. The drift was negligible at the Sawyer Dunes when the wind was from the southwest, and reached its maximum when a bright, comparatively calm morning was followed by an afternoon with a strong northwest wind. The marshy lakes near Stevensville, which are known as the Grand Marais, are the only suitable habitats near the Sawyer Dunes for the Belostomatidae and the larger water beetles, and the only probable habitats for such Orthoptera as *Mecostethus lineatus*—all of which were found commonly on our beach. And the dunes are much lower and narrower in the Grand Marais region than they are farther south, and thus present less of a barrier to insects of the region behind the dunes. It is noteworthy that only two

of the twenty-seven beach-drift species, namely, *Chlorochroa uhleri* and *Lopidea caesar*, were found commonly on the dunes proper, the others occurring for the most part in the inland regions.

## LIST OF SPECIES

## SCUTELLERIDAE

*Eurygaster alternatus* (Say). Moderately common in marshy localities, where it occurs among the grasses and sedges. Specimens were taken at New Buffalo (June 30), near the Sawyer Dunes (July 21), and at the Grand Marais (July 22).

## CYDNIDAE

No species of the subfamily Cydninae were taken, though doubtless some occur here. Members of the Corimelæninæ<sup>7</sup> were taken only occasionally.

*Galgupha atra* A. & S. One specimen was swept from a tangle of grasses and vines on the flood plain of the Galien River, in the Warren Woods, September 7 (T. H. Hubbell).

*Galgupha aterrima* Malloch. One was swept from ground vegetation on the dunes near Harbert, June 22.

*Galgupha nitiduloides* (Wolff). One was taken from roadside grasses near Three Oaks, June 21, and another was beaten from vegetation in a clearing behind the Sawyer Dunes, July 26.

*Corimelæna pulicaria* (Germ.). Several specimens were taken from ragweed (*Ambrosia*) and a few were found in marsh grasses near the Warren Woods, July 5-6; several were collected from roadside grasses near Bridgman, July 20.

<sup>7</sup> If *Thyreocoris* and *Corimelæna* are to be regarded as distinct genera, the name of this subfamily reverts from *Thyreocorinae* (Van D. 1907) to *Corimelæninae* (Uhl. 1872). This point was overlooked by Malloch (*Bull. Ill. Nat. Hist. Surv.*, xiii, p. 206, 1919).

PENTATOMIDAE

*Podops cinctipes* (Say). Two specimens were taken from *Carex* and *Scirpus* in the marsh at New Buffalo, June 30.

*Peribalus limbolarius* Stål. Moderately common in the fields about the Warren Woods, July 4 to September 3.

*Trichopepla semivittata* (Say). Two adults were taken, from the same situation as the last species, June 21, and nymphs were fairly common, June 30 to July 5.

*Chlorochroa uhleri* Stål. A few adults and numerous nymphs were taken during July, on *Euphorbia corollata* on the Sawyer Dunes, and nymphs were moderately common on milkweeds, August 31. One specimen was taken from the June beach-drift.

*Mormidea lugens* (Fabr.). Moderately common throughout the summer, especially in grasses in shady localities, though specimens were also taken from raspberry, from *Saururus* beds, and from the sedge zones in the marshes. Specimens were secured in all of my collecting regions.

*Euschistus euschistoides* (Voll.). A moderately common Pentatomid in the grassy localities about the Warren Woods, especially in the hay fields and by the roadsides, where specimens were taken throughout the summer. This species was also secured at New Buffalo, at Bridgman, and, more rarely, in clearings on the dunes; it was fairly common in the beach drift.

*Euschistus variolarius* (P. B.). The most abundant Pentatomid in southern Michigan, and found everywhere in Berrien County, though less common on the dunes than in the other collecting localities. It occurred chiefly in the hayfields and on golden-rod, ragweed, and mullein; and during the second half of July it was the most abundant hemipteron found in the beach drift.

*Euschistus tristigmus* (Say). Fairly common about the Warren Woods, June 27 to September 3, especially in damp localities; specimens were taken from *Saururus cernuus*, from marsh grasses, and from *Benzoin aestivale*. This species was also collected at New Buffalo from wild rose and from the button-bush (*Cephalanthus occidentalis*). No specimens were taken in the dune region, nor were any found in the beach drift.

*Euschistus ictericus* (Linn.). This species was taken at New Buffalo, at the Warren Woods, and near Stevensville, June 29 to September 3. Most of the specimens were collected by sweeping sedges and grasses in more or less marshy localities, but a few were secured from *Saururus cernuus*.

*Cænus delius* (Say). Rather uncommon. Specimens were taken from grass by a creek near Harbert, June 20; from the Warren Woods, July 15 (Hubbell); at the edge of a cranberry bog near Livingston, July 22; and at Klute's Lake, near Three Oaks, September 4 (Hubbell).

*Hymenarcys nervosa* (Say). Three individuals were collected, one from a hayfield, June 27; one from fresh herbage by a spring near the Warren Woods, September 3; and one from under the bark of a beech stump at the edge of the woods, August 31.

*Neottiglossa undata* (Say). Surprisingly few individuals of this species were seen. Specimens were taken at Livingston, at Harbert, and at the Warren Woods, June 19 to September 3.

*Cosmopepla bimaculata* (Thomas). Somewhat more plentiful than the last species, but still surprisingly uncommon. Specimens were taken at the Warren Woods, June 26 to September 2, and also at Bridgman and at New Buffalo.

*Meneclis incertus* (Say). One specimen was found in the June beach drift at the Sawyer Dunes.

*Thyanta custator* (Fabr.). One, swept from ragweed at Bridgman, July 12. A second specimen was found in the June beach-drift (Carrol Rawcliffe).

*Acrosternum pennsylvanicum* (De Geer). A single individual of this species was swept from low vegetation at the base of a dune at New Buffalo, September 2, 1919. No other specimens have been taken in Michigan, as far as I am aware.

*Acrosternum hilare* (Say). Nymphs were fairly common in the Warren Woods during early July, and a number of adults were beaten from trees of various species, August 31 to September 3. This species occurred in the beach drift in fair numbers during the first half of July, but no individuals were taken after July 22.

*Banasa dimidiata* (Say). One specimen from the Warren Woods, July 15, 1920 (T. H. Hubbell).

*Perillus bioculatus* (Fabr.). Two specimens were taken from the beach-drift, July 1 (C. Rawcliffe) and July 4 (Hussey). One individual of the variety *P. b. claudus* (Say) was also taken on the beach, July 14.

*Rhacognathus americanus* Stål. One mutilated individual of this very rare species was found in old beach-drift near Sawyer, July 4, 1920. This is the easternmost record for the species.

*Apateticus cynicus* (Say). Nymphs which probably should be referred to this species were common on the maples in the Warren Woods during early July, and one adult female was beaten from a maple there on August 31. No other specimens were taken by ordinary collecting methods, yet this form was by far the most abundant of the beach-drift of early July: it was estimated that 80 per cent of the Hemiptera washed up between July 7 and July 15 were *A. cynicus*, and on some

days the number of individuals of this species on the beach was estimated at about 250 per mile.

*Apateticus bracteatus* (Fitch). This more northern species was much less common than the preceding, only three specimens being found in the beach drift, and none being taken elsewhere.

*Podisus maculiventris* (Say). Rather common on various bushes and in the grass about the Warren Woods, June 23 to September 3, and also found in the dune region. This was one of the most common species in the beach drift.

*Podisus modestus* (Dallas). Found in the same situations about the Warren Woods as was the preceding, but not found either in the dune region or in the beach drift. This species was much less common than *maculiventris*.

#### COREIDAE

*Acanthocephala terminalis* (Dallas). Adults were taken occasionally from dense tangles of herbage in damp localities, June 29 to September 1, and some were also found on the white ash (*Fraxinus americana*). Nymphs were beaten from a number of different trees, but were found in numbers only on the ash. I have not been able to find any description of these nymphs, which differ very strikingly in their early stages from the adults.

The first instar nymphs are metallic blue, shining, head and thorax with a pale median line above, the thorax terete, the pronotum with narrow, pale lateral lines. Thorax with eight spines above, which are directed forward: four of these are on the pronotum, two on the mesonotum, and two on the metanotum; abdomen scabrous above, its margin foliaceously lobed, especially on the posterior segments, and varied with yellow. Antennae one-half longer than the body, yellow, the



apical segment reddish, the distal half of the third and the base and apex of the fourth segments dark blue. Legs compressed, the tibiae of all three pairs similarly dilated, the outer dilatation broader than the inner, not scalloped; femora with broad basal and narrow median bands of yellow, the tarsi and the apical half of the tibiae also yellow. Length, 6 mm.

The second instar is much like the first in general appearance. The head and thorax are not shining and have scattered hairs. There is a slight indication of a vertical ridge on the frons; the thoracic spines are shorter; the fore tibiae are noticeably less dilated than the other pairs. Length,  $7\frac{1}{2}$  mm.

The third instar is much larger, the body being subequal in length to the antennae. General color dark brownish; thorax flattened and declivous before, noticeably more hairy than in the second instar; thoracic spines reduced to small tubercles; abdominal scallops much reduced. Antennae with only the base of the third and the middle of the fourth segments noticeably paler than the rest; femora with only the median pale band persisting. Length,  $10\frac{1}{2}$  mm.

Unfortunately, the fourth instar is missing from my material. In the fifth instar the form and aspect are essentially those of the adult, save for the undeveloped wings. There are still some traces of the nymphal coloring of the antennae and of the pale bands on the femora, and the abdominal margin is still very slightly scalloped. The frontal spine is smaller than in the adult. Length, 12 mm.

*Euthochtha galeator* (Fabr.). Two specimens were taken from ragweed in a pear orchard near the Warren Woods, September 3; and one was taken in flight at Harbert, July 13.

*Chariesterus antennator* (Fabr.). This is the most characteristic bug of the fore-dunes, where it appears to be restricted to a single food-plant, the flowering spurge (*Euphorbia corol-*

*lata*). Nymphs and adults are abundant here through the summer.

*Anasa tristis* (De Geer). Mr. Hubbell took one individual of this common species at Klute's Lake, near Three Oaks, September 4, and a number of specimens were taken at light in our camp on the lake shore early in July. A winter-killed individual of the preceding year was found under the bark of a dead pine on the fore-dune, July 7.

*Anasa armigera* (Say). Two specimens, from the grasses in an alder-buttonbush swamp at New Buffalo, September 2.

*Coriomerus humilis* Uhler. One, beaten from willow in a gravel pit at Harbert, July 13. I have compared this specimen with others from Wyoming (determined by Van Duzee) in the Museum of Comparative Zoology, and find no differences.

*Protenor belfragei* Haglund. A few individuals were taken from grasses in a marshy locality behind the Sawyer Dunes: others were taken at Stevensville and at Klute's Lake. The first adults were found July 21.

*Megalotomus quinquespinosus* (Say). One specimen, from roadside grasses in the Warren Woods, July 2, 1919.

*Coriscus*<sup>8</sup> *conspersus* Mont. Abundant in the fields and meadows about the Warren Woods during June and July, 1919. No individuals were taken here during the later part of the summer, nor was this species taken anywhere in Berrien County during the summer of 1920.

*Coriscus eurinus* (Say). From the same localities as the preceding, but much less numerous. One individual was taken in 1920, from a clump of beach grass on the fore-dune near Sawyer, September 6 (Hubbell).

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<sup>8</sup> Horváth has recently shown (*Ann. Mus. Nat. Hung.*, 15, p. 378) that *Alydus* Fabr. 1803 is a strict synonym of *Coriscus* Schrank 1796, since both were established for the same species. *Cimex calcaratus* Linn. = *Coriscus dauci* Schrank.

*Harmostes reflexulus* (Say). Two individuals were taken in the fields about the Warren Woods, June 23 and July 1; and one was swept from roadside grasses at Lakeside, July 13.

*Corizus bohemani* Sign. Two specimens were taken at Lakeside, July 13.

*Corizus lateralis* (Say). Very abundant in the grassy fields around the Warren Woods from late June to September, and in similar localities in the dune region during July. In several of the specimens the connexivum is nearly or quite as heavily spotted as in *C. bohemani*.

ARADIDAE

*Aradus robustus* Uhl. A single specimen was taken, from the bark of a large fallen beech in the flood-plain forest in the Warren Woods, July 5.

*Aradus implanus* Parsh. One, under the bark of a dead elm just within the Warren Woods, July 1.

*Aneurus fiskei* Heid. Rather common under the bark of the dead beeches in the Warren Woods, but found only on fallen trees. Specimens were taken late in June and early in July.

NEIDIDAE

*Jalysus spinosus* (Say). Fairly common among the *Juncus* and *Equisetum* near the edge of the New Buffalo Marsh, July 5. This species was also taken occasionally from the undergrowth in the dune forests, July 4 to 26.

LYGÆIDAE

*Oncopeltus fasciatus* (Dall.). Three specimens were taken in the beach-drift, July 2 (C. Rawcliffe), July 14, and July 19.

*Lygæus turcicus* Fabr. Two individuals, still alive, were washed up on the beach on the morning of July 26, 1920.

*Lygæus kalmii angustomarginatus* Parsh. Very common.

This species occurred in a number of situations in the Warren Woods area; it was taken at Lakeside, at Harbert, at Stevensville, and elsewhere; and it was frequently found on the dunes, especially on the milkweeds (*Asclepias syriaca*). A number of specimens were taken from the beach-drift.

*Lygæus bicrucis* Say. One specimen was taken at Three Oaks, September 4 (Hubbell).

*Ortholomus longiceps* Stål. Common in the fields about the Warren Woods during the summer of 1919. No specimens were taken in the dune area during 1920.

*Nysius ericæ* (Schill.). This species was common in the Warren Woods area, where it was taken from a number of species of Compositae, such as ragweed, dog-fennel, and *Rudbeckia hirta*. It was also abundant in the dune area, especially in the sandy fields immediately behind the dunes, where it was seen running about on the sand among the roots of the sparse grasses.

*Ischnorrhynchus geminatus* (Say). Several specimens were taken from ground vegetation in moist localities about the Warren Woods in June and September, and a few were beaten from red maple.

*Cymus luridus* Stål. All my Berrien County specimens came from the marshes at New Buffalo (June 30, September 2), where they were swept from sedges.

*Cymus angustatus* Stål. Common in the marshes about the Warren Woods throughout the summer, and also in the moist meadows behind the dunes.

*Cymus discors* Horv. More common than the preceding in one small marsh beside the Galien River at the edge of the Warren Woods. One specimen was taken in a moist meadow behind the Sawyer Dunes, July 17.

*Blissus leucopterus* (Say). One specimen only, from the

stem of a beach grass, *Calamovilfa longifolia*, on a fore-dune near Sawyer, July 3.

*Geocoris bullatus bullatus* (Say). Very common in the sand-dunes, where numbers of individuals were seen running about on the ground among the sparse grasses. I watched with interest the behavior of two of these bugs in a disused road at the back of the dunes: an adult was running about among the grasses, and in all its erratic course it was closely followed by a nymph of about the third instar.

*Geocoris uliginosus limbatus* Stål. One individual was swept from ragweed and *Polygonum* in a sandy field beside the Warren Woods, September 3; one was taken at Lakeside, July 13; one was swept from grasses in a moist meadow in the dune region, July 20; and several were taken from the ground in a small clearing on the dunes, July 16.

*Hypogeocoris piceus* (Say). A single specimen was taken in a sandy field behind the dunes, July 12.

*Phlegyas abbreviatus* (Uhl.). One of the most abundant Hemiptera in the grassy fields in all the collecting areas. Nymphs were very numerous in July, and adults were taken throughout the summer.

*Oedancata dorsalis* (Say). Common among the sedges and cat-tails in marshy localities about the Warren Woods, in moist meadows behind the dunes, and also in the marshes at New Buffalo and at Stevensville.

*Myodochus serripes* Oliv. One nymph which undoubtedly should be referred here was swept from luxuriant herbage near a spring in one of the dune valleys, July 27.

*Heraeus plebejus* Stål. One individual only, taken at light on the dunes near Bridgman, July 12, in the sassafras strip between the pine and the black oak associations.

*Ligyrocoris diffusus* Uhler. Abundant during the summer

of 1919, less common in 1920. A long series of individuals was taken in various fields about the Warren Woods, June 20 to September 3, especially from the goldenrods and ragweeds; and a few specimens were taken from similar situations in the Sawyer Dune area.

*Perigenes constrictus* (Say). One was found on the sand in a road near Harbert, June 22; two were taken from ragweed near the Warren Woods, September 3; and one was collected at Klute's Lake, September 4 (Hubbell).

*Orthæa basalis* (Dall.). One only, from the marsh near the Warren Woods, which has been mentioned in connection with *Cymus discors*. This specimen was taken on June 29.

*Sphragisticus nebulosus* (Fallén). Rather common near the sand dunes, and found in the same situations as *Geocoris bulbatus*. Two specimens were also taken on ragweed at Bridgman, July 12.

*Emblethis vicarius* Horv. Several specimens were secured in a sandy field behind the dunes, July 12 to 20.

#### PIESMIDAE

*Pisma cinerea* (Say). One, beaten from willow beside a small creek in the dunes near Bridgman, July 9.

#### TINGIDAE

*Gargaphia tilia* (Walsh). Abundant throughout the summer on the basswood, *Tilia americana*, both in the Warren Woods and on the Sawyer Dunes.

*Leptoypha mutica* (Say). Rather common on *Fraxinus americana* on the dunes, both adults and nymphs being found in fair numbers late in July. This species appeared to favor the seedlings of the ash, and, as far as I could observe, occurred only on the *upper* side of the leaves, near the mid-rib.

*Leptostyla clitoria* Heid. One specimen was swept from herbage at the foot of a low dune at New Buffalo, September 3. The occurrence of this "southern" species here is a matter of considerable interest.

*Corythucha marmorata* Uhler. By far the most abundant Tingid in Michigan. In some places in Berrien County this species occurred in almost unbelievable numbers on the golden-rods, but it was rarely taken on other plants.

*Corythucha arcuata* (Say). Common on the white oaks (*Quercus alba*) on the dunes, and found occasionally on the chestnut oak (*Q. muhlenbergii*).

*Corythucha ciliata* (Say). Common on the sycamores in the Warren Woods area, but rather scarce on this tree where it occurred beside the dune creeks. This Tingid was most abundant late in the summer: in early July, though nymphs were numerous, adults were rather scarce.

*Corythucha pruni* O. & D. A few individuals were taken from a *Prunus serotina* beside a dune creek west of Bridgman, July 25.

*Corythucha pergandei* Heid. Fairly common on *Alnus incana* beside the dune creek near Bridgman, July 25.

*Corythucha mollicula* O. & D. (= *C. salicis* O. & D.). Abundant on a single species of willow which grew rather commonly beside Bridgman Creek in the dune region. July 17 to 28.

*Corythucha* sp. Generally distributed over the dunes, occurring on the blue beech (*Carpinus caroliniana*). This species is much less gregarious than the other *Corythuchæ* found on the dunes: rarely are there more than half a dozen specimens found on a single branch, or more than one individual on a leaf.

*Corythucha* sp. A second species which cannot be named

at present. This form was by far the most abundant hemipteron on the Sawyer Dunes, where it occurred on *Prunus virginiana*, and also to some extent on *Amelanchier canadensis*. Scarcely a choke cherry was seen which did not show the effects of the ravages of this Tingid; but the Amelanchier was relatively free from infestation.

## PHYMATIDAE

*Phymata erosa wolfi* Stål. Moderately common. Adults were taken during the first week in September, at New Buffalo, at Three Oaks, and in the Warren Woods area. Nymphs were found as early as June 30.

*Phymata erosa fasciata* (Gray). Two specimens are at hand from New Buffalo, September 3.

## REDUVIIDAE

*Barce annulipes* (Say). One individual was taken June 30 at New Buffalo, where it was seen on the surface of the water among the bulrushes in the old outlet of the Galien River. It may be worth noting that all the specimens of this species that I have taken in Michigan were found in similar situations; Mr. Banks<sup>9</sup> states that "it is usually taken in dry meadows." *Stenopoda culiciformis* (Fab.). One individual was found in the remnants of an old beach-drift on the Sawyer Dunes, July 4.

*Reduvius personatus* (Linn.). At least one of these bugs came to light almost every evening at the Warren Woods, June 19 to July 5, and several specimens were taken at light on the dunes during July.

*Zelus exsanguis* Stål. This species was beaten from various trees and bushes during July, both in the Warren Woods and on the dunes.

<sup>9</sup> Notes on our Species of Emesidae. *Psyche*, 16: 43-48, 1909.



*Acholla multispinosa* (De Geer). Several specimens were beaten from a hickory at the edge of the Warren Woods, August 31.

*Sinea diadema* (Fabr.). The most abundant Reduviid in Michigan, found in all grassy localities from late July till October.

NABIDAE

*Nabis subcoleoptratus* (Kirby). Plentiful in the grass in moist situations about the Warren Woods, and in similar places in the dune region. This species was most abundant during the early summer; no specimens were taken after July 27.

*Nabis sordidus* Reut. Rather uncommon; taken sparingly from undergrowth in the woods and from woodland grasses, both in the Warren Woods and in the dune forests.

*Nabis annulatus* Reut. Two individuals, beaten from alder in a swamp at New Buffalo, September 3.

*Nabis propinquus* Reut. Moderately common on bulrushes and sedges in the marshes at New Buffalo and at Stevensville.

*Nabis ferus* (Linn.). One of the most abundant Hemiptera of the grasslands in Berrien County. The specimens taken late in June appear to average somewhat smaller than those taken later in the summer. This species was very active at night: several specimens came to light, and large numbers could be taken by sweeping the grasses after dark: many of these were feeding when taken.

*Nabis roseipennis* Reut. Fairly common. Specimens were secured at Bridgman and in the Warren Woods area, July 5 to September 1.

*Nabis rufusculus* Reut. A few were beaten from bushes at the edge of the Warren Woods, September 1.

## CIMICIDAE

*Cimex lectularius* Linn. I took one individual of this species in a shack on the shore of Lake Michigan, near Bridgman, July 22; and I have seen a second specimen from Berrien County, taken at St. Joseph in August, 1918 (C. Blashill).

## ANTHOCORIDAE

*Xylocoris ?cursitans* (Fall.). Common under the bark of dead trees in the Warren Woods, particularly on fallen beeches.

*Anthocoris* sp. One individual came to light near the Warren Woods, June 30.

*Triphleps insidiosus* (Say). Abundant on dog-fennel and other Compositæ about the edges of the Warren Woods, and also taken in the dune region. The dark variety *tricolor* was rarely taken.

## MIRIDAE

*Collaria meilleuri* Prov. Moderately common in the grasses in moist situations, both at the Warren Woods and in the dune region, June 23 to July 20; one specimen was taken from the margin of a cranberry bog near Livingston, July 22.

*Collaria oculata* (Reut.). This species was taken only in the dune region, where it was about as common as *C. meilleuri*.

*Miris dolobratus* (Linn.). Abundant everywhere in grassy situations during June and early July.

*Stenodema vicinum* (Prov.). A very common grass bug in all of the localities studied, occurring most abundantly in marshy places.

*Trigonotylus ruficornis* (Fall.). Another very common grass-dwelling Mirid in all my collecting localities, but, unlike the last, this form was found most commonly in dry fields and pastures, and in sandy uplands where the grasses were rather scanty.

*Teratocoris discolor* Uhl. Common in the Juncus-Equisetum zone at the edge of the New Buffalo marsh, July 5.

*Platytylellus* spp. One or two species of this genus were found sparingly in grasses in the more open parts of the Warren Woods, June 24 to July 3, especially in a bushy flat enclosed in an ox-bow of the Galien River.

*Neurocolpus nubilus* (Say). A common Mirid in marshes and swales; it was swept from grasses and herbage of various kinds, and in the Warren Woods region I found it especially numerous on buttonbush (*Cephalanthus occidentalis*).

*Phytocoris eximius* Reut. Three specimens were taken: one from roadside grasses in the Warren Woods, August 31; one from grasses near Bald Tom Pond in the dune region, July 26; and one from willow beside Bridgman Creek, July 17.

*Phytocoris neglectus* Knight. One, beaten from hazel (*Corylus americanus*) at New Buffalo, September 2.

*Phytocoris salicis* Knight. Several specimens were taken in various situations about the Warren Woods, June 20 to July 4, 1919.

*Phytocoris ?infuscatus* Reut. Two teneral individuals have been referred doubtfully to this species by Dr. Knight. They were taken on hickory at the Warren Woods, July 3.

*Phytocoris conspurcatus* Knight. One, beaten from hard maple in the dune forest by Bridgman Creek, July 18.

*Adelphocoris rapidus* (Say). Common everywhere and at all times during the summer.

*Stenotus binotatus* (Fabr.). A common grass dwelling form in the Warren Woods region during the early summer. No specimens were taken after June 28.

*Garganus fusiformis* (Say). This agile Mirid was common in the grass in damp localities about the Warren Woods, June 20 to September 1.

*Paracalocoris scrupus scrupus* (Say). A few specimens were taken at the Warren Woods, June 21, from grasses and from wild grape.

*Paracalocoris scrupus bidens* McAtee. One, beaten from sumac (*Rhus glabra*) at the edge of the Warren Woods, July 3.

*Paracalocoris adustus* McAtee. One was beaten from willow by Bridgman Creek, July 12, and a second specimen was taken from willow by a small pond behind the dunes, July 19.

*Pæciloscytus basalis* Reut. An abundant form on ragweed (*Ambrosia*) and also on dog-fennel (*Anthemis cotula*), and taken in all the localities where collecting was done.

*Pæciloscytus venaticus* Uhler. Common in the grass in moderately damp situations about the Warren Woods, June 20 to July 5; one specimen was taken on ragweed at Bridgman, July 12.

*Pæciloscytus* n. sp. Abundant in beds of *Saururus cernuus* in the shady glens at the southern edge of the Warren Woods, June 20 to September 3, and also found on the same plant in the marshes at New Buffalo.

*Horcias dislocatus* (Say). Common in shady localities about the Warren Woods, and along Bridgman Creek behind the dunes. The varieties *nigrita* Reut. and *goniphorus* (Say) were most numerous, and the variety *affinis* (Reut.) was also taken. Typical *dislocatus* was not found.

*Pæcilocapsus lineatus* (Fabr.). More abundant than the preceding, and found in similar situations everywhere that I collected.

*Capsus ater* (Linn.). A common bug in the hayfields and meadows during the early summer; specimens were taken until about July 10. All three of the color forms listed by Van Duzee were collected, the var. *tyrannus* (Fabr.) being the most abundant, while *semiflavus* (Linn.) was comparatively rare.

*Coccobaphes sanguinarius* Uhler. A common Mirid on the hard maples in the Warren Woods and in the dune forests. My specimens were collected between June 24 and July 28.

*Lygidea rubecula obscura* Reut. One from ragweed near the Warren Woods, July 5, and one from willow near the mouth of Bridgman Creek, July 9.

*Lygus pratensis oblineatus* (Say). Abundant in the grasses in dry situations in all parts of Berrien County, and occasionally taken on bushes.

*Lygus plagiatus* Uhler. A common species on ragweed and on dog-fennel. Specimens were taken at the Warren Woods, June 24 to July 5, and at Bridgman, July 12.

*Lygus rubicundus* (Fall.). A few specimens were taken on *Fraxinus* sp. and on willow near the Warren Woods early in July, and this species was found uncommonly on *Betula lutea* beside Bridgman Creek later in the month.

*Lygus campestris* (Linn.). One, from roadside grasses at the edge of the Warren Woods, July 5.

*Lygus pabulinus* (Linn.). Moderately common on the spotted touch-me-not (*Impatiens biflora*) in the Warren Woods, June 21 to July 3, and also taken at New Buffalo, July 5.

*Lygus invitus* (Say). A common form on the elms in the Warren Woods area, and also found occasionally on other trees, June 20 to July 3.

*Lygus inconspicuus* Knight. Two, beaten from elm at the Warren Woods, June 28.

*Lygus tiliæ* Knight. A single specimen was found dead at the base of a mullein stalk, in a small clearing in the white oak association on the Sawyer Dunes, July 16.

*Lygus caryæ* Knight. Common on hickory at the edge of the Warren Woods, June 21 to July 3.

*Lygus communis* Knight. This species was taken on elm

at the Warren Woods, June 28, and on herbaceous vegetation under elms at the edge of Bald Tom Pond in the Sawyer Dune area, July 11.

*Lygus quercalbe* Knight. Several specimens were beaten from white oak on the dunes, July 3 to 13.

*Lygus omnivagus* Knight. A common Mirid on the dunes during July; it was found on a number of plants, including white oak, hard maple, and green brier (*Smilax hispida*).

*Lygus hirticulus* Van D. Another common form on the dunes throughout the month of July, and specimens were also collected in the Warren Woods during the last week of June. This species was most abundant on hard maple.

*Tropidosteptes cardinalis* Uhl. Several individuals were taken on ash (*Fraxinus*) at the Warren Woods, June 28 to July 3.

*Neoborus palmeri* (Reut.). A common species on the ash trees at New Buffalo and in the Warren Woods region, June 28 to July 5.

*Neoborus canadensis* (Van D.). Much less common than the preceding. Taken on ash, and also on basswood and on button-bush, June 28 to July 3.

*Neoborus amænus* (Reut.). Taken from ash and from *Cornus* sp., June 21 to July 4.

*Neoborus amænus scutellaris* (Reut.). Somewhat more common than the typical *amænus*; commonly found on ash, but also taken on maple and wild grape.

*Neoborus pubescens* Knight. This was the only *Neoborus* which was common on the black ash (*Fraxinus niger*) on the dunes, where numerous specimens were secured, July 4 to 28. Other individuals were taken at the Warren Woods, June 21 to July 3, chiefly on ash.

*Xenoborus pettiti* (Reut.). A teneral individual was taken on ash at the Warren Woods, July 3.

*Deræocoris grandis* (Uhler). Common on elms in the Warren Woods, June 28 to July 3, 1919.

*Deræocoris fasciolus castus* Knight. Common on aphid-infested elms by Bridgman Creek in the dune region, July 23 and 25, 1920.

*Deræocoris aphidiphagus* Knight. A number of specimens were taken on elm at the Warren Woods, July 3, 1920.

*Deræocoris histrio* (Reut.). Several specimens were taken from the semi-aquatic vegetation about Bald Tom Pond in the Sawyer Dune region during July, and one specimen was beaten from willow at the mouth of Bridgman Creek, July 9.

*Fulvius imbecilis* (Say). Three individuals were taken from under the bark of a large fallen beech in the Warren Woods, July 5, and on the same date Mr. Hubbell secured two from a pile of cut wood nearby.

*Hyaliodes vitripennis* (Say). Moderately common on various trees, both in the Warren Woods and on the Sawyer Dunes, July 21 to August 31. Specimens were taken from yellow birch, beech, basswood, and hard maple, but the species was most commonly found on the maple.

*Dicyphus agilis* (Uhl.). Several specimens were taken from berry bushes (*Rubus* spp.), both in the Warren Woods and in the dune region, June 20 to July 27; and one individual was beaten from elm, June 28.

*Dicyphus famelicus* (Uhl.). One individual, on raspberry at the Warren Woods, July 3.

*Halticus citri* (Ashmead). Common in the grass in damp, shady localities in the Warren Woods, August 31 to September 3.

*Halticus intermedius* Uhler. Two specimens were swept

from grass beside Bridgman Creek, July 9. This species has apparently been known previously only from Pennsylvania and New Mexico.

*Strongylocoris stygicus* (Say). One of the most abundant grass bugs in damp, shady localities, both in the Warren Woods, and in the dune region, from June to September.

*Ceratopsus pumilus* (Uhler). Two specimens were taken, one from willow at Harbert, July 13, the other from wild rose under tall willows by Bald Tom Pond in the dune region, July 11.

*Ceratopsus modestus* (Uhler): Rather common on hickory at the edge of the Warren Woods, July 3.

*Lopidea casar* (Reut.). One of the characteristic Hemiptera of the black oak association on the dunes. Nymphs were numerous early in July, and the first adults were taken July 20.

*Lopidea media* (Say). Three specimens, taken at New Buffalo, June 30.

*Lopidea confluens* (Say). A few specimens were taken at the Warren Woods, June 26 and August 31.

*Lopidea staphyleæ* Knight. Very common on Staphylea and other bushes on the flood plain at the edge of the Warren Woods, June 28 to July 3. Two specimens were also taken on the hop tree (*Ptelea trifoliata*) near the crest of Bald Tom dune, July 26.

*Pseudoxenctus scutellatus* (Uhler). One, at light near the Warren Woods, June 21.

*Diaphnidia provancheri* (Burque). Found commonly on hickory at the edge of the Warren Woods early in July, and also taken on oaks on the dunes, July 12 and July 24.

*Diaphnidia pellucida* Uhler. A few were taken on maple on the dunes, July 4.



*Reuteria irrorata* (Say). One, from elm beside Bridgman Creek, July 24.

*Orthotylus viridis* Van D. Several specimens were taken from luxuriant vegetation in a small, marshy spot by the Warren Woods, July 5.

*Orthotylus flavosparsus* (Sahlb.). Swept from vegetation beside the railroad at New Buffalo, July 5.

*Orthotylus fumatus* Van D. One, at light in Three Oaks, July 5.

*Ilnacora malina* (Uhler). One, from grass in a ravine by the Warren Woods, June 25.

*Ilnacora stâli* Reuter. A number of specimens were swept from ragweed at Bridgman, July 12, and at Lakeside, July 13.

*Reuteroscopus ornatus* (Reuter). This agile species was taken several times on ragweed, at the Warren Woods and at Bridgman, July 5 to September 1.

*Plagiognathus albatrus* (Van D.). A fairly common species about the Warren Woods, where it occurred on butternut, sycamore, and sour-gum, June 28 to July 4, and at New Buffalo it was found on *Alnus*, July 5.

*Plagiognathus politus* Uhler. An abundant species everywhere that I collected.

*Chlamydatus associatus* (Uhler). Another very common species, especially in the late summer.

*Microsynamma bohemanni* (Fall.). Two specimens were beaten from willow beside Bridgman Creek, July 9.

Several other species of Miridæ, especially of the subfamily Phylinae, are represented in the Berrien County collections, but cannot be named definitely at present.

## HYDROMETRIDAE

*Hydrometra martini* Say. Several specimens were collected at a small pond at the base of Bald Tom dune, June 23 to July 26. Others were taken from the New Buffalo marsh (June 30) and from a small pond in the Warren Woods (July 4).

## GERRIDAE

*Gerris remigis* Say. Abundant on the Galien River in the Warren Woods, and on all the small creeks which flow through the dunes to Lake Michigan.

*Gerris marginatus* Say. Abundant and widespread in Berrien County. Specimens were collected at New Buffalo, the Warren Woods, Harbert, the dune region, Bridgman, and the Grand Marais.

*Gerris alacris* Hussey.<sup>10</sup> This species was taken in only one locality, a small pond at the east base of Bald Tom dune, near Sawyer, where specimens were taken July 19 and July 26, 1920. This pond is about sixty yards in length, comparatively narrow, roughly crescent-shaped, and has a maximum depth of five or six feet. On the west it is bordered by the steep slope of the bare dune; on the north it is fringed with willows growing on a narrow strip of damp sand; and on the east and south it is shut in by a small stand of elms and other trees. A small brook connects this pond with another larger one a short distance to the north. The water is turbid and supports an extensive growth of aquatic vegetation in which the cow-lily (*Nymphaea advena*) is conspicuous.

This *Gerris* was the most plentiful member of the genus here on these dates, and even at first glance it was recognized as distinct from its congeners. I have subsequently taken it at Ann Arbor.

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<sup>10</sup> *Psyche*, 28, p. 11, 1921.

*Gerris buenoi* Kirk. Apparently the least common *Gerris* in this region. Several specimens were taken from a pool in the Warren Woods, June 23, and a few were found at New Buffalo, June 30 and September 3.

*Gerris argenticollis* Parsh. The most abundant *Gerris* in the Warren Woods, with the possible exception of *G. remigis*. The present species occurred abundantly on all the woodland pools as well as on the quiet stretches of the Galien River in the woods.

*Gerris rufoscutellatus* Latr. Very common in several places in this region. Specimens were taken at New Buffalo, in the Warren Woods, and in the dune region; and this species occurred rather frequently in the beach drift.

*Metrobates hesperius* Uhler. Common in the Warren Woods, where it occurred on the Galien River, June 20 to August 31.

*Rheumatobates rileyi* Bergr. Common on the Galien River and also on the woodland pools in the Warren Woods. The specimens taken here were of the darker variety typical of more northern latitudes.

#### VELIADAE

*Microvelia americana* Uhler. Very common on the damp sand beside the Galien River, at the margins of the small brooks in the Warren Woods, and beside the creeks in the dune region.

*Microvelia borealis* Bueno. Rather uncommon among the bulrushes in the New Buffalo marsh in June, but exceedingly numerous there early in September. This species was not taken elsewhere in Berrien County.

*Microvelia fontinalis* Bueno. One specimen was taken at New Buffalo, June 30.

*Microvelia buenoi* Drake. Moderately common on one of the woodland pools in the Warren Woods, June 23 to July 4. One specimen was taken from a pasture pool, June 25.

*Rhagovelia obesa* Uhler. Common on moderately rapid portions of the Galien River in the Warren Woods.

## MESOVELIADAE

*Mesovelia mulsanti* White. This species was found commonly at New Buffalo, and other specimens were taken in the Warren Woods, at Harbert, and near the Sawyer Dunes.

## HEBRIDAE

*Hebrus burmeisteri* L. & S. Several specimens were taken at the Warren Woods, some from the margins of the Galien River and some from among the matted grasses in swamp meadows; and a few were taken at New Buffalo. About half the specimens secured were apterous!

*Merragata brunnea* Drake. One specimen was taken at New Buffalo, September 2.

## SALDIDAE

*Salda coriacea* Uhler. One specimen was taken at the Warren Woods, July 15 (Hubbell), and another was collected from the margin of Bald Tom Pond, June 24.

*Lampracanthia anthracina* (Uhler). One specimen was taken from the matted grasses in a pasture pond at the Warren Woods, June 25.

*Saldula major* (Prov.). Abundant on the margins of the Bald Tom Pond, where specimens were taken from June 24 to July 19.

*Saldula confluens* (Say). One specimen was taken at New Buffalo, June 30, and a second at Bald Tom Pond, July 3.

*Saldula orbiculata* (Uhler). Rather uncommon. This species was collected on the shore of the Galien River in the Warren Woods, June 25 to 29, and at New Buffalo, June 30.

*Saldula interstitialis* (Say). By far the most common and widespread Saldid found in Berrien County. This was the only member of the family that I found on the beach of Lake Michigan: and even in this case the bugs were confined to a narrow strip about the broad pool which Bridgman Creek formed on the lake beach.

*Saldula reperta* (Uhler). Moderately common on the sandy shores of the Galien River in the Warren Woods, June 20 to July 5.

*Micracanthia humilis* (Say). This species was also found in fair numbers beside the Galien River, but it was most abundant among the grasses and on the damp sand flat about the edges of the Bald Tom Pond, June 20 to July 11.

#### NOTONECTIDAE

*Notonecta undulata* Say. Abundant at New Buffalo, where it was found in the marsh and also in a large concrete tank at the edge of town. Other specimens were taken at Harbert and in the Galien River at the Warren Woods, but this species was not collected in the dune region.

*Notonecta irrorata* Uhler. Partial to the sluggish plant-free streams and pools in shady situations, and found both at the Warren Woods and in the dune region. This is the only *Notonecta* that I took from beach drift.

*Notonecta variabilis* Fieb. A few specimens were taken from a sluggish stream in one of the glens at the edge of the Warren Woods, and several others were taken from Bald Tom Pond.

*Buena margaritacea* Bueno. Abundant in the large concrete tank at New Buffalo, September 2.

*Buena elegans* (Fieb.). Very common in the same locality as the last, June 30 and September 2; a few specimens were also taken from the New Buffalo marsh on June 30.

*Plea striola* Fieb. This little species was abundant in the algal growths on the sides of the concrete tank at New Buffalo, both in June and September. Other specimens were taken from the Bald Tom Pond, July 19, and from a small woodland pool in the Warren Woods, July 4.

## NEPIDAE

*Nepa apiculata* Uhler. Two, from a cow-track pool in a marshy pasture at the edge of the Warren Woods, June 28.

*Ranatra americana* Mont. I took one individual of this species in the outlet of a creek at New Buffalo, June 30, and Mr. M. H. Hatch has given me one which he took from beach drift near the same place, June 22. Nymphs which probably were of this species were found on several dates during the early summer in the ponds about the Warren Woods.

*Ranatra kirkaldyi* Bueno. Mr. Hatch has kindly given me three specimens of this species which he took from a small creek flowing out of the Bald Tom Pond, June 16, 1920.

## BELOSTOMATIDAE

*Benacus griseus* (Say). My only Berrien County specimens, some thirty in number, were picked up on the beach of Lake Michigan during July, and Mr. Hatch has a good series which he obtained from beach drift at New Buffalo on June 22. The New Buffalo specimens probably came from the broad, marsh-like expanse of the lower portion of the Galien River, while those which came ashore in the Sawyer Dune region

probably came from the marshy lakes near Stevensville. The Berrien County specimens vary greatly in size, ranging from 45 to 63 mm. in length, and from 17 to 24 mm. in maximum width.

*Lethocerus* sp. Apparently much less abundant than *Benaucus*. One individual was found in a small pasture pool near the Warren Woods, July 3, and I took two specimens in the beach drift on the Sawyer Dunes in mid July. I prefer not to name this (or these?) species at present.

*Belostoma flumineum* Say. Numerous individuals were found on the beach, and a few were taken from the Bald Tom Pond and from various pools about the Warren Woods.

#### GELASTOCORIDAE

*Gelastocoris* n. sp. Abundant on the sandy margins of the New Buffalo marsh, on the banks of the Galien River in the Warren Woods, and about the Bald Tom Pond. Specimens were taken from June 20 to September 3; one individual was found in beach drift, July 19.

#### CORIXIDAE

*Palmacorixa gillettei* Abb. Abundant in the Galien River in June and in September, occurring in the shallow water, where they rested on the muddy bottom and darted quickly away if disturbed.

*Corixa verticalis* (Fieb.). Found with the preceding, in early September, and likewise very common. The superficial resemblance between these two forms is very striking.

Several other species of Corixidae were collected in Berrien County, which had best be left unnamed at present.





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OBSERVATIONS ON THE BIRDS OF BERRIEN  
COUNTY, MICHIGAN

BY NORMAN A. WOOD

The biological division of the Survey, in coöperation with the Museum of Zoology of the University of Michigan and the E. K. Warren Foundation, has since 1917 been engaged in a biological survey of the western part of Berrien County, particularly the parts of the general area included in the E. K. Warren Preserve. As elsewhere stated,<sup>1</sup> the preserve comprises two tracts "300 acres (150 or more of the original forest) situated two and a half miles north of Three Oaks, in Chickaming Township, Berrien County, and over 250 acres in the sand dune region on the shore of Lake Michigan, in Lake Township, two miles north of Sawyer, in Berrien County.

"The forest is a remnant of the original beech-maple forest

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<sup>1</sup> Ruthven, Alexander G. The Edward K. Warren Foundation and Two Wild Life Reservations in Michigan. *Science*, N. S. XLIV, 17-18.

of southern Michigan. It has never been cut or burned over and many of the trees are splendid specimens, fifty to seventy feet in height to the first limb, and from two to four feet in circumference. The Galien River flows through the forest for about one and one-half miles and there are numerous springs.

"The sand dune tract has a frontage on Lake Michigan of about 3,000 feet. It includes probably the highest dunes in the State of Michigan, the largest of which are from two hundred to three hundred feet in height. Much of the tract is wild, and with little doubt the original vegetation prevails in most places.

"The preserves have been established by Mr. and Mrs. E. K. Warren, of Three Oaks, Michigan, and are incorporated in the 'Edward K. Warren Foundation,' which also includes the Chamberlain Memorial Museum at Three Oaks, founded in 1915 and opened to the public in 1916."

The study of the avifauna was begun in 1917, when the writer investigated the conditions in the region about the village of Harbert and the resort of Birchwood Beach from July 6 to July 26, and, with Mr. H. B. Sherman, from August 26 to September 11. The total number of species observed during these periods was 135. Beginning April 7, and continuing for five weeks in 1918, the writer made a study of the spring migration in the Harbert region. In 1919 a camp was established at the Warren Woods and work was done in that region from May 4 to June 1. From April 29 to June 11, 1920, the fauna of that part of the dune region included in the Warren Preserve was studied.

#### GENERAL HABITATS

No attempt will be made to describe the habitats in detail as the survey of the plant life of the region has not been completed. The general habitats of birds are as follows:

1. The open beach.

2. The dunes. The vegetation of the dunes varies greatly. It is absent, or consists of a sparse growth of grasses and herbaceous plants or thickets of shrubs such as the low juniper and wafer ash, or there may be a rather dense cover of trees (white pine, beech, maple, and oak), all depending upon whether the dune is moving or not and the length of time it has been stationary. In the ravines which cut through the dunes or lie between them there is, at least in places (*c. g.*, at Birchwood Beach and at the Warren Reserve), a dense growth of deciduous trees. In the dune area are several ponds and streams which harbor the birds preferring these habitats. The birds of the dunes are not summarized by habitats for the reason that a more extended study must be made before the habitats can be accurately determined.

3. The cultivated lands.

4. E. K. Warren Woods. The area included in the E. K. Warren Woods comprises about 150 acres of forest and 150 acres of pasture land.

*Climax forest:* The forest is in the primitive condition, and the dominant trees on the high ground are beech and maple. Other trees are whitewood, sycamore, and black gum. In the eastern part of the woods there is little undergrowth, but over most of the western part there is a dense growth of beech and maple saplings and a few flowering dogwoods. A public road runs through the upper end of the forest, and a wood road from the entrance to the bend of the Galien River.

The birds of the forest were distributed as follows: In the tree tops were found the bay-breasted, black poll, Blackburnian, sycamore, and cerulean warblers, and the Baltimore oriole, and scarlet tanager. Lower down on the trees were observed the black-throated green, pine, Nashville, and orange-crowned

warblers, and the yellow-throated, blue-headed, Philadelphia, and red-eyed vireos. The lower branches of the trees were inhabited by the magnolia, chestnut-sided, and hooded warblers, the redstart, wood pewee, and green-crested and yellow-bellied flycatchers. The undergrowth was apparently the favorite habitat of the Wilson thrush, the Wilson, prairie, and golden-winged warblers, the chickadee, ruby-crowned and golden-crowned kinglets, the yellow-breasted chat, cardinal, brown thrasher, and house wren. On the ground were observed the palm, mourning, and Connecticut warblers, the oven bird, northern yellowthroat, the three water thrushes, woodcock, and whippoorwill. The four species of woodpeckers, of course, frequented the tree trunks.

*River, flood-plain, and swamps:* The river enters the north end of the woods and flows in a general southern direction to the edge of the clearing, where it turns abruptly to the west, forming a great bend before it leaves the western edge of the forest. At its low stage this river occupies a narrow channel from two to three rods wide and several feet below the top of its banks. In time of flood the water covers the banks and occupies quite an extensive plain, which is bordered by higher banks, in places thirty to fifty feet high. The flood-plain is mostly wooded, conspicuous trees being the black ash, elm, swamp oak, and soft maple, and there are several low areas, more or less open, but in general covered with a thick growth of willows and buttonbush, with a few trees. These swamps contain water during most of the year, but some of the smaller swamps are dry in midsummer.

The south swamp contains several acres and lies just south of the river where the latter leaves the reserve, and at flood time is connected with it. The swamp contains some water

at all seasons and is thickly covered with buttonbush, together with some willows and small trees at the edge.

A wooded ravine extends southeast from the great bend into the pasture, which is drained by a small stream that enters the river at this place. On both sides of the river the climax forest occupies the higher levels and comprises the major part of the wooded area. Beech and maple are the dominant trees, with some whitewood and sycamore at rare intervals. The black gum is also found here.

The river and swamp fauna was distributed as follows: In the aquatic and mud habitats were found but few species. Some ducks were reported during early and late migration, and the kingfisher, great blue heron, solitary and spotted sandpiper were observed.

In low, wet parts of the flood-plain were seen most of the birds observed in the forest, many of them in great numbers in the trees bordering the river. The low, wet ground was the place most favored by the Connecticut and mourning warblers and the three thrushes. About the edges of the buttonbush swamps or ponds the prothonotary warbler was the only characteristic species.

*The cleared pasture:* This was the favorite habitat of the bobolink, meadow-lark, killdeer, and the field and savanna sparrows; crows fed on the ground, and the song, white-crowned, and white-throated sparrows were seen about the edge of the woods.

*Aerial habitat:* Here the characteristic birds were the barn swallow, chimney swift, and night hawk, but the turkey vulture, rough-legged, red-tailed, and red-shouldered hawks were often seen circling about over the reserve.

## GENERAL REMARKS ON THE FAUNA

As was to be expected, several southern forms rare or restricted to the southern part of Michigan were observed. The cardinal, yellow-breasted chat, tufted titmouse, hooded and sycamore warbler were common. It may be mentioned in this connection that the summer tanager and Carolina wren were not seen.

Although the migrating birds received considerable attention, it is thought best not to attempt a summary of the observations. The results of several seasons' work must be at hand before even approximate dates of the arrival and departure of each species can be determined. It can be said, however, that the dune region is particularly favorable for work on migrations.

## ACKNOWLEDGMENTS

In the course of the field work the writer became deeply indebted to a number of residents for assistance and hospitality. Much of the success of the field studies is due to the coöperation of Mr. George Fox, Curator of the Chamberlain Memorial Museum at Three Oaks. Mr. and Mrs. Wells Sizer, of Birchwood Beach, rendered much assistance in the work in that region, and in 1920 Mr. and Mrs. Raymond Reymuth generously gave the use of their summer home as headquarters for the work in the dune region.

## LIST OF SPECIES

The writer realizes that this list is far from complete, as it is only the result of the work done in the three small areas mentioned above.

*Colymbus auritus*. Horned Grebe.—This species occurs only as a migrant. It was first observed at Birchwood Beach Sep-

tember 8, 1917. April 27, 1918, three were seen near the same beach catching small shore minnows. May 1, 1920, the writer noted six at the beach of the Warren Dunes.

*Podilymbus podiceps*. Pied-billed Grebe.—This species was noted as a migrant only, although it may breed on the inland waters of the county. One was seen near the shore at Birchwood Beach May 9, 1918.

*Gavia immer*. Loon.—A rather common migrant. July 20, 1917, two were seen on the Lake at Birchwood Beach, and May 15, 1918, one was noted at the same beach. The species was not noted at the Warren Dunes in 1920.

*Larus argentatus*. Herring Gull.—This is a very common migrant along the lake shore. It was first seen at Birchwood Beach July 20, and became common after September 1, 1917. In 1918, from April 27 to June 1, many were seen feeding on the beach and in high winds sailing against it over the dunes. April 30, 1920, the writer saw a hundred or more at the beach at Warren Dunes.

*Larus delawarensis*. Ring-billed Gull.—This species is a rare migrant. It was observed at Birchwood Beach from September 4 until September 10, 1917. At the Warren Dunes it was seen May 24, 1920.

*Larus philadelphia*. Bonaparte's Gull.—Doubtless a common migrant. A few were seen September 4, 1917, at Birchwood Beach, and at Warren Dunes May 1, 1920.

*Sterna caspia*. Caspian Tern.—Four specimens of this rare migrant were seen September 9, 1917, at Birchwood Beach, and two noted May 8, 1918. After these dates a few others were occasionally seen in company with herring gulls flying along the shore or resting on the sandy beach.

*Sterna hirundo*. Common Tern.—This common migrant was seen on July 24 and August 26, 1917. The species became

abundant at Birchwood Beach September 2, 1917, when hundreds were swimming off shore feeding on small minnows. In 1918 it was first seen May 14, when a flock of twelve were resting on the piles of an old pier, and by May 16 and 17 hundreds were migrating northward. None were seen in 1919 nor 1920.

*Chlidonias nigra surinamensis*. Black Tern.—No doubt a common migrant, although it was seen only in September, 1917. September 2 a large number were feeding with a flock of common terns mentioned above, and a few were seen by Sherman September 4.

*Phalacrocorax auritus auritus*. Double-crested Cormorant.—This rare migrant was seen only on May 4, 1918, when two were noted near Birchwood Beach.

*Mergus serrator*. Red-breasted Merganser.—Doubtless a common migrant, although it was noted but once, May 1, 1920, when the writer saw six at Warren Dunes.

*Anas rubripes*. Black Duck.—A common migrant and perhaps a summer resident. From July 19 to September 11, 1917, many were seen flying along the shore near Birchwood Beach, but none were noted in May and June, 1918.

*Querquedula discors*. Blue-winged Teal.—A common migrant. An adult was seen April 29, 1918, at Willow Brook Pond and four others at Sawyer Pond May 4.

*Spatula clypeata*. Shoveller.—A not common migrant. An adult male was resting on a low pile at Birchwood Beach May 9 and 10, 1918.

*Aix sponsa*. Wood Duck.—A rather rare migrant and summer resident. A pair was seen on a small pond at Warren Dunes May 1, 1920.

*Marila affinis*. Lesser Scaup Duck.—A common migrant as reported by hunters. May 5, 1918, a flock of twenty was seen



near Birchwood Beach. At Warren Dunes the writer saw a pair May 3, 1920.

*Branta canadensis canadensis*. Canada Goose.—A common migrant both spring and fall. Residents of this region see thousands during migrations. May 1, twenty-seven lighted on the beach at Birchwood Beach, and April 29, 1920, a flock passed over the Warren Dunes.

*Botaurus lentiginosus*. Bittern.—This is a common summer resident of the inland ponds, but it rarely visits the lake beaches. August 29, 1917, one was seen at Sawyer Pond and another May 8, 1918. A pair was seen at the south swamp, Warren Woods, from May 23 to May 30, and from April 29 to June 10, 1920, several were noted at the marshy ponds of Warren Dunes.

*Ardea herodias herodias*. Great Blue Heron.—A not rare summer resident. Recorded from July 7 to September 10, 1917, at Birchwood Beach, when they often visited the beaches to catch fish. After April 30, 1918, a pair were frequently seen standing knee-deep in the lake where Willow Brook entered it. They were catching and swallowing good-sized fish. In 1919 one was seen at Warren Woods at the big bend of the Galien River May 8, and at Warren Dunes several were on the lake beach and also about the north pond after May 2.

*Butorides virescens virescens*. Green Heron.—This is a common summer resident. It was recorded at Birchwood Beach from July 9 to August 29, 1917, and April 28, 1918. Several were seen along Willow Brook in May and June, 1919. At Warren Dunes it was common after May 1, 1920, about the north and middle ponds, where it nested.

*Rallus elegans*. King Rail.—No doubt a rare summer resident. One was found dead on the beach near Birchwood Beach July 11, 1918, by A. T. Wagner.

*Porzana carolina*. Sora.—Probably a common summer resident, although it was seen but a few times, as it lives about wet marshes and ponds. At Birchwood Beach it was seen August 27 and 29; and in 1918 there was one May 7 at Willow Brook. Only one was observed at Warren Dunes in 1920 (May 24).

*Coturnicops noveboracensis*. Yellow Rail.—A rare summer resident. One was noted near Lakeside in May, 1917, by Dr. J. L. Hancock, who said it stayed for a week about a bushy pond at his summer home. May 6, 1920, the writer found a dead male in perfect condition on top of the highest Warren Dune. It had evidently struck a limb while crossing the top of the dune, as it lay just beyond the sharp crest of a blowout.

*Gallinula galeata*. Florida Gallinule.—Not a common summer resident. May 8, 1918, two were on the middle pond back of the dunes, where one was also seen May 19, 1920.

*Philohela minor*. Woodcock.—A not rare summer resident. The writer saw one near Willow Brook August 27, 1917, and September 5 one was found dead at Birchwood Beach. In May, 1918, two were at Willow Brook. Single specimens were recorded at Warren Woods May 19 and May 26, 1919. May 13, 1920, a woodcock and her nest with four eggs was found in the thick second growth at the edge of the north pond at Warren Dunes. The eggs hatched May 15.

*Gallinago delicata*. Wilson's Snipe.—A common migrant first seen at the south pond September 10, 1917. May 10, 1918, it was noted at Birchwood Beach in a wet meadow, and four were seen at Warren Dunes May 10, 1920.

*Pisobia bairdi*. Baird's Sandpiper.—This species has been listed as a rare fall migrant in the Great Lakes region, but several were seen by Sherman and the writer, and specimens were taken August 31 and September 5, 1917.

*Pelidna alpina sakhalina*. Red-backed Sandpiper.—This migrant must be rare, as but one bird was seen at Birchwood Beach, May 18, 1919.

*Ereunetes pusillus*. Semipalmated Sandpiper.—This is a common fall migrant. We found them at Birchwood Beach August 27, 1917, and saw flocks each day until September 10.

*Calidris leucophæa*. Sanderling.—This abundant fall migrant was first seen at Birchwood Beach August 31, 1917. After that date it was the most common wader until August 10. They were in fall plumage.

*Totanus flavipes*. Yellow-legs.—Not a common migrant in this region. The only ones seen were two at south pond May 9, 1918.

*Tringa solitaria solitaria*. Solitary Sandpiper.—This is a rather rare migrant for which we have the following records: 1917, September 10, south pond; 1918, May 6, Willow Brook; 1920, May 8, Warren Woods; May 9, mud flats along Galien River.

*Bartramia longicauda*. Upland Plover.—A rare summer resident. The writer saw a pair in the meadow by the roadside north of Three Oaks, June 15, 1920.

*Actitis macularia*. Spotted Sandpiper.—A common summer resident which was seen daily on the Lake Michigan beaches in May and June, 1918. A few were noted along the Galien River in Warren Woods in May, 1919, and one was flying over north pond on Warren Dunes, May 3, 1920.

*Oxyechus vociferus*. Killdeer.—This is a common summer resident, and was often seen by us in the fields back of the dunes in 1917 and 1919, at Warren Woods in May, 1919, and at the Warren Dunes May 27, 1920.

*Charadrius semipalmatus*. Semipalmated Plover. A rare

migrant and seen but once, September 9, 1917, with several sanderling, near the resort at Birchwood Beach.

*Colinus virginianus virginianus*. Bob-white.—Not a common resident of the region. It was heard calling in July, 1917, and May, 1918. At Warren Dunes a male was seen May 19, 1920.

*Bonasa umbellus umbellus*. Ruffed Grouse.—This is a rather rare resident of the dunes and Warren Woods. Recorded July 23 and September 4, 1917, in thick woods on the eastern slope of the dunes a mile north of Birchwood Beach, and in May, 1920, on the dunes. In 1919 it was observed in Warren Woods May 15 by the writer, and October 12 by George Fox.

*Zenaidura macroura carolinensis*. Mourning Dove.—A common resident of the region, usually seen singly or in pairs. May 7, 1918, a flock of eight flew north over the dunes. May 10 a nest with two eggs was found on the ground under high huckleberry bushes near Birchwood Beach. A few were seen about Warren Woods and many at the Warren Dunes, where four nests were found in May, 1920, on the ground in the thick forest. This wholesale departure in nesting habits is noted here as it is unusual in a region where normal nesting sites are so plentiful.

*Cathartes aura septentrionalis*. Turkey Vulture.—This species occurs rarely as a straggler from the south. One was seen eating a chicken near Birchwood Beach by Dr. Hancock September 1, 1917. At Warren Woods two were circling over the forest in May, 1919, and one was seen May 12, 1920, at Warren Dunes.

*Circus hudsonius*. Marsh Hawk.—An occasional summer resident of the small marshes back of the dunes. A number of these hawks were migrating north over the dunes at Birchwood Beach the last three days of April, 1918. At Warren

Woods a pair were hunting over the big pasture after May 9, 1919. In May, 1920, two pairs nested at the eastern edge of Warren Dunes.

*Accipiter velox*. Sharp-shinned Hawk.—This species is a common migrant. A few were seen in August, 1917, at Birchwood Beach, and during a three days' migration the last of April, 1918, numbers of them were flying north over the dunes nearest the lake. At Warren Woods only one was seen in May, 1919, near the Galien River. At Warren Dunes there were a few about April 29, 1920.

*Accipiter cooperi*. Cooper's Hawk.—Not a common resident. Noted in July, 1917, and common during the hawk migration of April 27 to 30, 1918, at Birchwood Beach. A pair that apparently nested in the region were seen at Warren Woods after May 8, and two at Warren Dunes May 5, 1920.

*Buteo borealis borealis*. Red-tailed Hawk.—A rare summer resident. It was occasionally seen at Birchwood Beach in July, 1917, and during the migration in April, 1918. In 1919, at Warren Woods, a pair occasionally circled over the trees after May 5, 1919. At Warren Dunes it occurred rarely after April 29, 1920.

*Buteo lineatus lineatus*. Red-shouldered Hawk.—A common summer resident in the region. A pair were found at their nest, in a low beech-maple forest a mile north of Birchwood Beach, in July, 1917. A few were going north in April and May, 1918, at Birchwood Beach. In 1919, at Warren Woods, a nest was found May 18 in a big sycamore near the Galien River, and another with three eggs was found May 5 in a beech tree at the western edge of the reserve.

*Buteo platypterus*. Broad-winged Hawk.—This species was recorded only in 1918, from April 27 to 30, at Birchwood

Beach, during the hawk migration, and on May 9, when a few were flying north over the dunes.

*Archibuteo lagopus sancti-johannis*. Rough-legged Hawk.—The most common migrant hawk. It was recorded May 1 to 28, 1917, at Birchwood Beach, at Warren Woods on May 8, 1918, and at Warren Dunes after April 29, 1920.

*Haliaeetus leucocephalus leucocephalus*. Bald Eagle.—An occasional straggler over the dunes along the lake shore. The writer saw it September 3 and 10, 1917. June 8, 1918, Dr. Hancock noted one at Lakeside, three miles south of Birchwood Beach.

*Falco columbarius columbarius*. Pigeon Hawk.—A rare migrant. Only one was noted, April 29, 1918, when a male in beautiful adult plumage was secured. This bird was perched on a dead bush on top of the big blowout near Birchwood Beach.

*Falco sparverius sparverius*. Sparrow Hawk.—While this is a common summer resident over most of the state, the only record for this region was given us by George Fox, who saw one May 3, 1919, near Warren Woods. Smith,<sup>2</sup> on August 30, 1904, saw hundreds of this species migrating south in Allegan County.

*Pandion haliaëtus carolinensis*. Osprey.—A rare migrant, as the only record is for May 12, 1920, when the writer saw one perched in a dead tree on the Warren Dunes.

*Strix varia varia*. Barred Owl.—A rather rare resident. It was first noted May 9, 1919, at Warren Woods, where later it was heard hooting at night and on dark days.

*Otus asio asio*. Screech Owl.—A resident, but not very common. It was heard calling August 28, 1917, and a few times later near Birchwood Beach.

<sup>2</sup> Bull. Mich. Ornith. Club, V (1904), 77-78.

*Bubo virginianus virginianus*. Great Horned Owl.—Not a rare resident of the wooded dunes and Warren Woods. An adult male was taken near Birchwood Beach May 11, 1918, and young able to fly were found May 15, 1918, at Warren Woods. Several were seen after April 29, 1920, in the wooded ravines of Warren Dunes, where they nested.

*Coccyzus americanus americanus*. Yellow-billed Cuckoo.—A common summer resident of the woods and thickets along the dunes. It was seen at Birchwood Beach May 17, 1918; at Warren Woods May 22, 1919; and at Warren Dunes May 19, 1920. The cuckoos are more often heard than seen, due to their shyness as well as to the fact that they arrive when the trees are almost full of foliage.

*Coccyzus erythrophthalmus*. Black-billed Cuckoo.—This is also a common summer resident of the same habitat as the preceding species. It was noted May 19, 1918, at Birchwood Beach; at Warren Woods May 16, 1919; and May 19, 1920, at Warren Dunes.

*Ceryle alcyon alcyon*. Belted Kingfisher.—A rather common summer resident. After April 29, 1918, it fished at Birchwood Beach in Lake Michigan and in Willow Brook. At Warren Woods it was seen along the Galien River May 10 and later. It also occurred occasionally about the ponds at Warren Dunes and along the lake shore.

*Dryobates villosus villosus*. Hairy Woodpecker.—A rare resident of the dunes, but more common at Warren Woods, where it was first noted May 7, 1919. In 1920 a nest was found in a large sycamore at the edge of the Galien River May 19; and at Warren Dunes it was observed May 20, and occasionally after this.

*Dryobates pubescens medianus*. Downy Woodpecker.—This resident species is more common than the preceding one, and

it is frequently seen in the wooded dunes and orchards back of the dunes. May 10, 1919, a nest was found in a dead sycamore in Warren Woods.

*Sphyrapicus varius varius*. Yellow-bellied Sapsucker.—An abundant migrant and no doubt an occasional summer resident. First noted May 1, 1918, it soon became common on the dunes. At Warren Woods it was seen as late as May 20, 1918.

*Melanerpes erythrocephalus*. Red-headed Woodpecker.—This species was a rare summer resident of the dunes, but was common about the woods and orchards back of them. It was noted May 3, 1918, at Birchwood Beach, and at Warren Woods after May 5, 1919. It became quite common at Warren Dunes by May 10, but most passed on to the north after a day or so.

*Ceñurus carolinus*. Red-bellied Woodpecker.—This rare summer resident was seen only in Warren Woods, where a pair or two evidently nested.

*Colaptes auratus luteus*. Northern Flicker.—A rather common summer resident of all the region. We found it nesting everywhere.

*Antrostomus vociferus vociferus*. Whip-poor-will.—A very common summer resident of the thickets along the streams and among the sand dunes. The call was heard during July and August, 1917; in 1918 it was first noted on the evening of May 18; after April 20, 1920, it was abundant on the dunes.

*Chordeiles virginianus virginianus*. Nighthawk.—A common migrant and rare summer resident. First recorded at Birchwood Beach May 17, 1918. Flocks were seen flying over the dunes as late as May 31.

*Chætura pelagica*. Chimney Swift.—A common summer resident of the dunes, nesting in the buildings and feeding over the whole region. Noted May 3, 1918, at Birchwood



Beach; circling over Warren Woods May 12; and at Warren Dunes May 19, 1920.

*Archilochus colubris*. Ruby-throated Hummingbird.—This common summer resident was seen May 6, 1918, at Birchwood Beach, and a nest with one egg was found June 1. In 1919, at Warren Woods, it was noted May 12. On several later dates the species was seen at Warren Dunes, and was observed building a nest in a poplar at the foot of the dune near the north pond.

*Tyrannus tyrannus*. Kingbird.—This is a common summer resident of the dunes, where it was first noted May 6, 1918, and was frequently seen after this. In 1919 it appeared near Warren Woods on May 16 and a few times later. At Warren Dunes in 1920 it was seen daily from May 7 to June 14.

*Inxiarchus crinitus*. Crested Flycatcher.—Not a common summer resident, but well distributed over the whole region. It was noted at Birchwood Beach May 14, 1918; at Warren Woods May 8, 1919, and a few times later; and at Warren Dunes April 30, 1920, but rarely later.

*Sayornis phoebe*. Phoebe.—A common summer resident found about the cottages and farm buildings at Birchwood Beach. It was one of the few species recorded daily in 1918. At Warren Woods it was seen May 4 and a pair nested at a house near the woods. We noted it at Warren Dunes the day of our arrival, April 29, 1920, but it was scarce here, as nesting sites were few.

*Nuttallornis borealis*. Olive-sided Flycatcher.—This species occurs as a rare migrant only. It was seen at Birchwood Beach September 4, 1917, and two others appeared a few days later. In 1918 the writer collected one May 24 and saw two others May 25 on the dunes. At Warren Woods one called from

the top of a large dead sycamore near the Galien River May 30, 1920.

*Myiochanes virens*. Wood Pewee.—A common resident. Noted in July, 1917, and May 17, 1918, at Birchwood Beach; at Warren Woods May 7, 1919, and many times later; and May 9, 1920, at Warren Dunes. On June 11 a completed nest was found on a big butternut limb about twenty feet above the dune at the north pond.

*Empidonax flaviventris*. Yellow-bellied Flycatcher.—Barrows<sup>3</sup> says: "In Michigan this bird occurs sparingly during the migrations." This has also been the writer's experience until 1918, when for a few days after May 20 it was very common among the willow trees along the brook at Birchwood Beach. At Warren Woods in 1919 it was not so common, but after May 20 several were seen each day in the flood-plain, feeding in the lower tree levels about the button-bush ponds. In 1920 it was quite common at Warren Dunes about the edges of the north pond, where four were seen as late as June 1.

*Empidonax virescens*. Acadian Flycatcher.—This species is considered a rare summer resident at Ann Arbor, but we found it common in Berrien County in the thick forests along the streams. From July till September 10, 1917, we saw many at Birchwood Beach, where, in 1918, it was first noted May 7. At Warren Woods it was common from May 20 to June 1, 1919. Unlike the preceding species, it preferred the lower tree levels of the heavy climax forest. It was also abundant at Warren Woods about the north pond and wooded ravines after May 10, 1920.

*Empidonax minimus*. Least Flycatcher.—This is a rather rare summer resident of the region, but a few were noted in

<sup>3</sup> Michigan Bird Life, 1912, 402.

July and August, 1917, at Birchwood Beach, where the earliest record for 1918 was May 9. At Warren Woods it did not appear until May 15, 1919, and later a few were seen in the lower levels of the climax forest. In 1920 it was first seen May 12 at Warren Dunes, where it was quite rare.

*Otocoris alpestris praticola*. Prairie Horned Lark.—A rare summer resident. Recorded only May 17, 1918, in the road a mile south of Harbert, and May 27 near Warren Dunes.

*Cyanocitta cristata cristata*. Blue Jay.—This is a rare summer resident, but a common migrant along the dunes. In 1917 a small flock came around the resort at Birchwood Beach September 9. In 1918 it was noted April 29 and May 10; a flock of twenty was seen going north May 15; a flock of thirty and several smaller flocks went in the same direction as late as May 22. In 1919 at Warren Woods a few were seen May 7, and May 11 a flock of thirty flew north over the trees. At Warren Dunes many flocks, often up to thirty birds, were seen migrating north from May 8 to May 19.

*Corvus brachyrhynchos brachyrhynchos*. Crow.—A common summer resident of the region. They were found on top of the highest wooded dunes and in the wet, heavy woods back of them. At Birchwood Beach small flocks patrolled the beaches daily through July and August, 1917, and fed on the small fish cast on the shore. At Warren Woods from eight to ten were almost daily seen or heard mobbing the horned owls, and after May 15, 1919, a flock of about fifty were noted feeding on the ground of the pasture field or flying over the trees. At Warren Dunes, in 1920, we saw a few each day as they flew about the pines and lake.

*Dolichonyx oryzivorus*. Bobolink.—This common migrant is also a rare summer resident. A small flock was seen August 27 and September 8, 1917, in a small marsh just back of the

dune at Birchwood Beach. None were there in May or June, 1918, nor at Warren Woods in May, 1919, but several were noted in the meadows about Warren Dunes in May, 1920.

*Molothrus ater ater*. Cowbird.—A common summer resident of the region. It was seen singly and in flocks at Birchwood Beach after April 29, 1918. It was very common after May 5, 1919, at Warren Woods, and after April 30, 1920, at Warren Dunes, where it did much damage to the smaller birds.

*Agelaius phœniceus phœniceus*. Red-winged Blackbird.—A not very common summer resident. A few were seen at south pond in July and August in 1917. May 4, 1918, a flock of twenty flew north over the dunes at Birchwood Beach and about a hundred the next day. At Warren Woods a large flock was seen May 5, 1919, and a pair or two nested at the south marsh. In 1920 a few migrant flocks flew over the Warren Dunes in May, and a few pairs nested in the bushes about the north and middle ponds.

*Sturnella magna magna*. Meadowlark.—A not rare summer resident of the fields back of the dunes, where it nested. It was seen near Birchwood Beach May 5, 1918, at Warren Woods, in the big open pasture, May 5, 1919, and at Warren Dunes April 29, 1920, near the north pond.

*Icterus spurius*. Orchard Oriole.—This is a rare summer resident in the region. Two were observed in July and August, 1917, and one was reported near Lakeside by Mrs. E. K. Warren May 17, 1918.

*Icterus galbula*. Baltimore Oriole.—This summer resident is more common than the preceding. It was recorded in June and July, 1917, and after May 16, 1918, at Birchwood Beach; after May 8, 1919, at Warren Woods, and after May 10, 1920, at Warren Dunes.

*Quiscalus quiscula œneus*. Bronzed Grackle.—This common

migrant is a rather rare summer resident. Our earliest record for Birchwood Beach is May 3, 1918. At Warren Woods it was seen May 5, 1919, and not again until May 25. At Warren Dunes a small flock, evidently migrants, flew over on April 29, 1920.

*Carpodacus purpureus purpureus*. Purple Finch.—An abundant migrant. May 5, 1919, a large flock was noted in Warren Woods; small flocks were seen in this wood as late as May 21, generally in the tops of elm trees, feeding on the tender buds. In 1920 it was noted May 11 at Warren Dunes, but was very rare here.

*Astragalinus tristis tristis*. Goldfinch.—A common resident which fed singly and in flocks on the dunes and fields back of them. May 8, 1918, the writer saw 150 or more eating dandelion seeds. At Warren Woods, in 1919, it was common after May 5 at the edge of the forest. May 14, 1920, a flock of twenty were at Warren Dunes, and it was later seen along the beach.

*Poæcetes gramineus gramineus*. Vesper Sparrow.—This is a common summer resident of the region. Seen September 10, 1918, and May 3, 1918, at Birchwood Beach. At Warren Woods it was observed May 5, 1919, and at Warren Dunes at the edge of the north pond April 29, 1920.

*Passerculus savanna savanna*. Savanna Sparrow. —A very rare migrant in this region. Only one was seen at the roadside two miles southeast of Birchwood Beach May 17, 1918.

*Zonotrichia leucophrys leucophrys*. White-crowned Sparrow.—This migrant is not a common one in the region. At Birchwood Beach it was seen from May 6 to May 17, 1918. At Warren Woods it appeared May 14, 1919, and after May 16 no more were noted.

*Zonotrichia albicollis*. White-throated Sparrow.—An abun-

dant migrant, arriving earlier and staying later than the preceding species. At Birchwood Beach it was seen from April 27 to May 25, 1918; at Warren Woods, in 1919, from May 5 to May 26; and at Warren Dunes from April 30 to May 20, 1920.

*Spizella passerina passerina*. Chipping Sparrow.—A common summer resident of the region. Our earliest record is April 27, 1918, at Birchwood Beach. At Warren Woods it was seen after May 4, 1919, and at Warren Dunes along the eastern edge, and in the road at their base, April 29, 1920.

*Spizella pusilla pusilla*. Field Sparrow.—This summer resident is common in the cultivated region back of the dunes. It was noted April 29, 1918, at Birchwood Beach; at Warren Woods after May 4, 1919, in the clearings and open fields; in 1920 it was seen at Warren Dunes after April and was one of the species recorded daily.

*Junco hyemalis hyemalis*. Slate-colored Junco.—An abundant migrant seen in flocks from April 27 to May 20, 1918, at Birchwood Beach. At Warren Woods from May 7 to 30, 1919, it was common. In 1920 there were a few from April 29 to May 12 at Warren Dunes.

*Melospiza melodia melodia*. Song Sparrow.—A common summer resident of the region, where it prefers the vicinity of streams and ponds. Noted at Birchwood Beach after May 3, 1918; at Warren Woods every day after May 4, 1919; and at Warren Dunes after April 29, 1920.

*Melospiza lincolni lincolni*. Lincoln's Sparrow.—At Birchwood Beach this was a rare migrant, as only one was seen May 13, 1918. They were quite common at the edge of Warren Dunes about the north pond from May 10 to May 15, 1920.

*Melospiza georgiana*. Swamp Sparrow.—This is a not common migrant and summer resident. Noted at Birchwood

Beach from May 1 to May 8, 1918. It was more common at Warren Dunes, where it was seen about the marshy ponds from May 5 to May 15, 1920.

*Pipilo erythrophthalmus erythrophthalmus*. Towhee.—This common summer resident was noted from July to September, 1917, and after April 27, 1918, at Birchwood Beach. At Warren Woods it was common after May 5, 1919. It was one of the most common species at the Warren Dunes after April 29, 1920, and nested in all wooded areas.

*Cardinalis cardinalis cardinalis*. Cardinal.—A very common resident of the dunes and the region back of them. It was abundant from July to September, 1917, and again in May and June, 1918, at Birchwood Beach. Nests were found both years. At Warren Woods it was heard or seen every day after May 4, usually in thickets. In 1920 we found it common about the ponds and over the wooded dunes.

*Zamelodia ludoviciana*. Rose-breasted Grosbeak.—A common migrant, but rare summer resident. May 5, 1918, several were on the sand dunes near Birchwood Beach. At Warren Woods a few were noted after May 7, 1919, while at Warren Dunes it was not recorded until May 11, 1920, and rarely later.

*Passerina cyanea*. Indigo Bunting.—This is a common summer resident of the dunes and bushy pastures inland. It was noted from July to September, 1917, and after May 17, 1918, at Birchwood Beach. At Warren Woods it was seen daily after May 12, 1919, and it was very common on and about the Warren Dunes after May 10, 1920.

*Piranga erythromelas*. Scarlet Tanager.—A not very common summer resident of the sand dunes, but more abundant in the heavy forest at Warren Woods. Our earliest record at Birchwood Beach was May 15, 1918. It appeared May 10, 1919, at Warren Woods and numbers were seen May 14 and

later. At Warren Dunes it occurred May 6, 1920, and later.

*Progne subis subis*. Purple Martin.—A rare summer resident. A large colony occupied two houses at Mr. E. K. Warren's summer home near Lakeside in 1918, and a small colony lived in a bird house near the south pond. April 19, 1920, several flew over the Warren Dunes at the north pond.

*Petrochelidon lunifrons lunifrons*. Cliff Swallow.—This species was noted only as a spring migrant at Birchwood Beach April 29, 1918, where a few in company with other swallows were flying north over the dunes.

*Hirundo erythrogastra*. Barn Swallow.—A common summer resident noted daily after April 28, 1918, at Birchwood Beach. At Warren Woods it was not seen until May 16, 1919, and later a few others circled over the wood. April 29, 1920, a few appeared at Warren Dunes and later a pair nested in a barn near the north pond.

*Iridoprocne bicolor*. Tree Swallow.—This common summer resident was first seen April 28, 1918, flying over the dunes at Birchwood Beach. Later it was found breeding about the inland ponds and streams. It was common at Warren Dunes after April 30, 1920, breeding in the dead trees at the north pond.

*Riparia riparia*. Bank Swallow.—A summer resident, but not very common. After May 7, 1918, a few were seen over the dunes at Birchwood Beach, and later a small colony nested in a gravel pit near Harbert. After May 3, 1920, a few were noted at Warren Dunes. All of the swallows fed over the water as well as over the dunes and cultivated fields.

*Vireosylva gilva gilva*. Warbling Vireo.—This summer resident was rare in the region and was only recorded at Warren Woods May 22, 1918, and at Warren Dunes after May 26, 1920.

*Laniivireo flavifrons*. Yellow-throated Vireo.—This is a



rare migrant and possibly an occasional summer resident. It was noted only at Warren Woods from May 14 to 30, 1919.

*Lanivireo solitarius solitarius*. Blue-headed Vireo.—A rather rare migrant, as only one was seen at Birchwood Beach May 5, 1918. At Warren Woods a few were recorded from May 12 to 22, 1919, and three were noted in the thick woods on Warren Dunes after May 10, 1920.

*Mniotilta varia*. Black and White Warbler.—This common migrant was seen at Birchwood Beach August 25, 1917, and April 29, 1918. At Warren Woods it was common from May 5 to 22, 1919, in the flood-plain and forest. In 1920 it arrived at Warren Dunes May 4 in company with other warblers, and was very common May 12, when dozens were seen all over the wooded areas.

*Protonotaria citrea*. Prothonotary Warbler.—This rather rare summer resident was first seen at the edge of the Galien River at Warren Woods May 15, 1918. It was more common from May 8 to 22. It well deserves its reputation, as it was usually seen in the wet buttonbush swamp feeding low over the water. At Warren Dunes only one was noted, on the middle pond, May 13, 1920.

*Vermivora chrysoptera*. Golden-winged Warbler.—This species was not common as a migrant and was rare as a summer resident. The only one seen at Birchwood Beach was taken May 10, 1918, in a thick huckleberry swamp. At Warren Woods there were several about the wood ponds from May 7 to 20, 1919. After May 11, 1920, a few were seen about the north pond at Warren Dunes.

*Vermivora rubricapilla rubricapilla*. Nashville Warbler.—This species was noted as a rare fall migrant at Birchwood Beach from September 1 to 16, 1917, and was more common in May, 1918. It was abundant at Warren Woods from May 7

to 22, 1919, and a few were seen at Warren Dunes after May 10, 1920.

*Vermivora celata celata*. Orange-crowned Warbler.—This rare migrant was seen only at Warren Dunes. May 11, 1920, one was noted in a small apple tree at camp and others were seen as late as May 15.

*Vermivora peregrina*. Tennessee Warbler.—A rather common migrant, noted August 28 to September 15, 1917, and after May 16, 1918, at Birchwood Beach in both orchards and woods. In 1919 it was common from May 22 to 30 in tops of tall trees in Warren Woods. In 1920 it was first seen at Warren Dunes May 11 and was quite common about the orchards and the woods of the dunes until May 25.

*Compsothlypis americana pusilla*. Northern Parula Warbler.—This rare migrant was first noted at Birchwood Beach September 6, 1917, in an apple orchard at the foot of the dunes. One was seen at Warren Woods May 15, 1919; and at Warren Dunes one was taken in hemlocks May 12, 1920.

*Dendroica tigrina*. Cape May Warbler.—A rather common migrant at Birchwood Beach from August 29 to September 10, 1917, in low bushes at the top of a high dune. May 16, 1918, a small flock was seen in an orchard in full bloom. At Warren Woods only one bird was noted May 8, 1919, in a willow thicket at the edge of the flood-plain. In 1920 at Warren Dunes both adult and immature birds were quite common from May 18 to 25 in the blossoming fruit trees at the edge of the dunes.

*Dendroica caerulescens caerulescens*. Black-throated Blue Warbler.—A common migrant of the region, seen first at Birchwood Beach September 1, 1917, and after May 9, 1918. At Warren Woods it was common from May 5 to 22, 1919,

and at Warren Dunes from May 8 to 29, 1920. Dozens were in the wooded ravines on the dunes May 12.

*Dendroica coronata*. Myrtle Warbler.—An abundant spring migrant at Birchwood Beach from May 2 to 30, 1919. At Warren Woods it was common after May 5, 1919. At Warren Dunes it was occasionally noted from May 10 to 17, 1920.

*Dendroica magnolia*. Magnolia Warbler.—A common migrant in the region. It was seen at Birchwood Beach September 4, 1917, May 6 to 18, 1918, and at Warren Woods from May 10 to 28, 1919. It was first seen at Warren Dunes May 10, 1920, and a few lingered until May 29. It is usually found in the lower tree levels or in bushes near the ground.

*Dendroica cerulea*. Cerulean Warbler.—This rather rare summer resident was first recorded from one found dead at Vine Cottage Place in May, 1917, by Mrs. E. K. Warren. At Birchwood Beach the only one was seen May 29, 1918, in a tall maple on top of the first dune. At Warren Woods it was more common after May 12, 1919. It was rare at Warren Dunes, where it was first noted May 20, 1920. This species breeds in thick, heavy forests.

*Dendroica pensylvanica*. Chestnut-sided Warbler.—A common migrant in most of the region. It was seen at Birchwood Beach May 16, 1918, and at Warren Woods from May 10 to 27, 1919. In 1920 it occurred in some numbers at Warren Dunes from May 10 to 23. None were found breeding, although it may possibly do so in the county.

*Dendroica castanea*. Bay-breasted Warbler.—This rather common migrant was seen at Birchwood Beach September 6, 1917, and May 15, 1918. At Warren Woods it was quite common the third week of May, 1918, and from May 12 to 28, 1919, many were seen in the lower and middle levels of

the climax forest. A few were noted at Warren Dunes after May 11, 1920, among the hemlock and beech-maple woods.

*Dendroica striata*. Black-poll Warbler.—A common fall and spring migrant. At Birchwood Beach flocks of them were noted after May 16, 1918. At Warren Woods a few were seen from May 17 to 26, 1919. At Warren Dunes, where it was rare, it appeared May 19, 1920, and was again seen May 29.

*Dendroica fusca*. Blackburnian Warbler.—This species was a rare migrant on the dunes, but was more common in Warren Woods, where it was seen May 15, 1918, and from May 7 to 30, 1919. At Warren Dunes it was noted only May 11 and 12, 1920.

*Dendroica dominica albilora*. Sycamore Warbler.—This rare migrant is also, possibly, a rare summer resident of the county. April 28, 1918, one was feeding in the lower branches of a maple tree at Birchwood Beach.

*Dendroica virens*. Black-throated Green Warbler.—This common migrant was seen both spring and fall at Birchwood Beach September 6 to 10, 1917, and May 2, 1918. At Warren Woods many were noted from May 6 to 23, 1919, and at Warren Dunes from May 10 to 25, 1920. They were usually found feeding in the tops and middle levels of the trees, and on the dunes preferred the hemlocks.

*Dendroica palmarum palmarum*. Palm Warbler.—This common migrant is also one of the earliest; at Birchwood Beach the writer saw several September 24, 1919, and April 30, 1918. At Warren Woods it was abundant from May 8 to 16, 1919. In 1920 it was quite common at Warren Dunes from May 3 to 19. This warbler is usually found on the ground, walking and feeding among the bushes and more open woodland.

*Dendroica discolor*. Prairie Warbler.—This rather rare migrant and summer resident was first seen at Birchwood Beach September 1, 1917. Numbers were at Warren Dunes after May 12, 1920. June 5 a nest with five eggs was found in a juniper bush on the lake side of the first dune, and June 7 a second nest with five fresh eggs was found a few rods farther north, built in a small red cedar about four feet from the ground. These nesting records are the farthest south for the State, as the only previous report was in Ottawa County May 26, 1879, by Dr. Morris Gibbs.

*Seiurus aurocapillus*. Oven-bird.—This abundant summer resident was seen at Birchwood Beach in July, August and September, 1917, and after May 5, 1918. At Warren Woods it was found after May 6, 1919, and at Warren Dunes after May 11, 1920.

*Seiurus noveboracensis noveboracensis*. Water-Thrush.—This migrant was first noted at Birchwood Beach August 29, 1917, and May 7, 1918. At Warren Woods one was taken May 16, 1919. It was quite common at Warren Dunes from May 5 to May 20, 1920.

*Seiurus noveboracensis notabilis*. Grinnell's Water-Thrush.—This migrant was not as common as the preceding subspecies. One was taken May 7, 1918, at Birchwood Beach, and a few were seen at Warren Woods after May 7, 1919, and at Warren Dunes after May 5, 1920. Both of these thrushes were found in the same habitat, usually about the edges of streams and ponds.

*Seiurus motacilla*. Louisiana Water-Thrush.—A not rare summer resident of Warren Woods, where several were seen after May 9, 1919. This species was found in the same habitat as the other water-thrushes, and was paired and nesting the latter half of May.

*Oporornis agilis*. Connecticut Warbler.—This species is usually considered a rare migrant in Michigan. At Birchwood Beach it was noted from September 5 to 10, 1917; and May 30, 1918, one was taken in the junipers on top of the first dune. On three trips to Warren Woods, May 20, 22, and 27, 1918, the writer saw a dozen or more along the Galien River and its flood-plain, but in May, 1919, it was rare in the same woods. At Warren Dunes it was quite common about the middle and north ponds from May 20 to 30, 1920. This warbler usually feeds and nests on the ground, but when flushed will light in low bushes or trees.

*Oporornis philadelphia*. Mourning Warbler.—This rather rare migrant was first seen at Birchwood Beach September 6, 1917; and May 24, 1918, the writer saw five in a wet bog along Willow Brook. At Warren Woods a few were observed from May 19 to May 30, 1919, about the buttonbush ponds and flood-plain of the Galien River, and on May 20, 1920, a fine male was taken here. From May 13 to June 5, 1920, at Warren Dunes, this species was seen almost daily about the edge of the north pond, also in a small willow thicket which borders the small brook running into that pond.

*Geothlypis trichas trichas*. Maryland Yellow-throat.—A not very common summer resident of the region studied. It was recorded at Birchwood Beach September 10, 1917, and rarely after May 6, 1918. At Warren Woods a few were noted from May 7 to 30, 1919. At Warren Dunes they were first seen May 1, and soon became quite common, as their habitat was more extensive about the bushy ponds of the vicinity.

*Icteria virens virens*. Yellow-breasted Chat.—This rare summer resident was first seen near Birchwood Beach by Dr. Hancock, near whose residence a pair nested in June, 1917. May 19, 1918, a male was reported at the same place by Dr.

Hancock, and May 21 Mrs. E. K. Warren saw one at Vine Cottage Place and heard his wonderful vocal performance. This is only a short distance from Dr. Hancock's, and it may have been the same bird, as he was about all of June and July, 1918. At Warren Woods a pair were at the northwest edge of the big south swamp May 24 and 26, 1919, and Dr. Hancock again reported a pair nesting at his place in June, 1919.

*Wilsonia citrina*. Hooded Warbler.—This is a rare migrant and a possible summer resident, as Dr. Gibbs found it nesting in Kalamazoo County June 10, 1876, and in June, 1878. Barrows, 1910, records it from several southern counties and says "it undoubtedly breeds." At Birchwood Beach an immature bird was taken on the dunes August 31, 1917, and September 4 two others were seen, one of them an adult male.

*Wilsonia pusilla pusilla*. Wilson's Warbler.—This not rare migrant was first seen at Birchwood Beach September 5, 1917, and as late as September 10. It was noted May 15 and 24, 1918, but was more rare than in the preceding fall. At Warren Woods only three were noted from May 15 to 21, 1918. At Warren Dunes it was quite common from May 20 to 30, 1920, in the willows about the streams and ponds.

*Wilsonia canadensis*. Canada Warbler.—This was not a common migrant. In 1918 a few were noted from May 15 to 25, at Birchwood Beach. At Warren Woods a few were seen from May 9 to 22, 1919, and at Warren Dunes from May 18 to June 4, 1920. This species prefers the underbrush and thickets for its habitat.

*Setophaga ruticilla*. Redstart.—A common summer resident seen at Birchwood Beach in July, August, and September, 1917, and after May 6, 1918. At Warren Woods it appeared daily after May 7, 1919, and at Warren Dunes after May 8, 1920. It is usually found in the middle forest levels.

*Dumetella carolinensis*. Catbird.—This abundant summer resident was one of the species seen daily, both on the dunes and in the woods. At Birchwood Beach it was recorded in July, August, and September, 1917, and after May 3, 1918; at Warren Woods after May 7, 1919; and at Warren Dunes after May 1, 1920. The catbird is largely a ground species inhabiting hedge-rows and thickets. At the dunes the writer found them in May, 1920, feeding daily on the seeds of the sumach.

*Toxostoma rufum*. Brown Thrasher.—This common summer resident was seen at Birchwood Beach from July to September, 1917, and after April 29, 1918. At Warren Woods it was not so common, but there were a few after May 4, 1919, and at Warren Dunes after April 29, 1920. This also is a ground lover; it frequents brush piles and hedge-rows during the day, but sings from the tree tops at early morning and evening.

*Troglodytes aëdon aëdon*. House Wren.—A very abundant summer resident, especially about the resorts. A dozen pairs or more nested at Birchwood Beach in the cottages and nest boxes put up by Mr. Sizer, and although this colony was so closely associated, no trouble was noticed as the result. April 29, 1918, at Birchwood Beach, is our earliest record. In 1919, at Warren Woods it was not so common, but was noted each day after May 4 in the deep woods as well as about the buildings. At Warren Dunes many pairs were seen after April 2, 1920, often in the thick woods.

*Nannus hiemalis hiemalis*. Winter Wren—A rather rare migrant. Only two or three were seen at Birchwood Beach from April 29 to May 7, 1918. At Warren Woods only one was noted May 12, 1919, about an old wood-pile. At Warren Dunes it was rare, being recorded only on April 29, 1920.



*Telmatodytes palustris palustris*. Long-billed Marsh Wren.—A summer resident, but very rare in the region, as but one was seen June 2, 1920, at the edge of the north pond at Warren Dunes.

*Certhia familiaris americana*. Brown Creeper.—This migrant was not common at any station, but a few were seen at Birchwood Beach from April 29 to May 10, 1918, and at Warren Woods from May 9 to 12, 1919. It was noted but a few times at Warren Dunes from April 29 to May 5, 1920.

*Sitta carolinensis carolinensis*. White-breasted Nuthatch.—This resident was very rare at all the stations, and Mrs. E. K. Warren told the writer that she had seen none since the hard winter of 1917 and 1918, and she wondered if they were not almost exterminated locally at that time. At Birchwood Beach but one was seen May 22, 1918. At Warren Woods, in 1919, one was noted May 10 and on two later dates. On May 20, 1920, one was seen in these woods by the writer.

*Sitta canadensis*. Red-breasted Nuthatch.—A very rare migrant. In 1919 noted but once, at Warren Woods, May 13. At Warren Dunes, in 1920, it was seen May 7 and again on May 29.

*Bæolophus bicolor*. Tufted Titmouse.—This is a resident but is not common. There were a few at Birchwood Beach July to September, 1917, and after May 4, 1918. At Warren Woods it was often seen after May 8, 1919, and was noted again on May 20, 1920.

*Penthestes atricapillus atricapillus*. Chickadee.—A resident but rather rare in the region. At Birchwood Beach a few were seen July to September 10, 1917, and in 1918 from April 29 to June 1. At Warren Woods a few were noted after May 7, 1919. In 1920 it was more common at Warren

Dunes after May 1. Residents here thought many were killed during the winter of 1917.

*Regulus satrapa satrapa*. Golden-crowned Kinglet.—This migrant was not very common in the region. It was seen at Birchwood Beach but a few times in May, 1918, and at Warren Dunes April 29 and 30, 1920.

*Regulus calendula calendula*. Ruby-crowned Kinglet.—An abundant migrant. At Birchwood Beach dozens were seen daily from April 29 to May 15, 1918. At Warren Woods it was common from May 7 to 22, 1919, and at Warren Dunes from April 29 to May 17, 1920. The kinglets prefer the tops of the trees, but sometimes feed in low bushes.

*Polioptila cærulea cærulea*. Blue-gray Gnatcatcher.—A rather rare and local summer resident, as it was found only in Warren Woods. Several were noted May 15 and 20, 1918; and May 6 to 27, 1919, it was seen almost daily, and was noted again on May 20, 1920. This species prefers the middle tree levels and nests in the tops of the lower trees.

*Hylocichla mustelina*. Wood Thrush.—A common summer resident. It was noted at Birchwood Beach July to September, 1917, and May 17 to 20, 1918. After May 5, 1919, it was seen at Warren Woods. A nest with three eggs was found May 26, 1919, four feet from the ground. At Warren Dunes it was seen after May 5, 1920. Its habitat is the ground and underbrush of the heavy forest.

*Hylocichla fuscescens fuscescens*. Veery.—A common migrant and occasional summer resident. At Birchwood Beach it was seen August 30, 1917, and after May 11, 1918. At Warren Woods it was abundant after May 7, 1919, and a nest was found May 25 built twenty feet from the ground in a small maple.

*Hylocichla aliciae aliciae*. Gray-cheeked Thrush.—A rare

migrant in the region. At Warren Woods it was noted but three times after May 16, 1919. At Warren Dunes a few were seen after May 3, 1920, usually on the ground or low bushes.

*Hylocichla ustulata swainsoni*. Olive-backed Thrush.—A very common migrant at Birchwood Beach after August 29, 1917, and after May 15, 1918. At Warren Woods it was abundant from May 6 to 12, 1919. This species was usually seen on the ground about wet places in the heavy forest.

*Hylocichla guttata pallasi*. Hermit Thrush.—This common migrant is also the earliest of all the thrushes. It was noted April 28, 1918, at Birchwood Beach and at Warren Woods May 5 to May 10, 1919. At Warren Woods it was noted on our arrival April 30, 1920, but was gone by May 11. Like all the thrushes, this was usually seen on or near the ground.

*Planesticus migratorius migratorius*. Robin.—This summer resident was not very common about the dunes, but was more common on the farms back of them, and during migration it became abundant. At Warren Woods in 1919 a few were seen about the edge of the woods, but seldom in the heavy forest. At Warren Dunes it was noted on our arrival, April 29, 1920, but was a rare breeder in the region. One nest was found in a small fruit tree near our camp. The region is sandy and the scarcity of worms may be the cause of the rareness of this species.

*Sialia sialis sialis*. Bluebird.—This is a summer resident, but is common only during migration. At Birchwood Beach very few were found nesting in 1917-18. At Warren Woods in 1920 only three pairs nested in the orchards near the edge of the woods. At Warren Dunes it was noted on our arrival, April 30, 1920, but very few nested here. This species prefers cultivated areas and the vicinity of orchards for its habitat.



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## A REVISION OF THE HOLARCTIC LAMPREYS

BY CHARLES W. CREASER AND CARL L. HUBBS

## INTRODUCTION

Regan's synopsis of the marsipobranchs of the order *Hyperoartii*, published in 1911,<sup>1</sup> placed the taxonomy of the lampreys on a fairly sound basis. Although we adopt this classification as a whole, we find it necessary to propose certain refinements, both of taxonomic and nomenclatural character.

In the present revision we deal with all the known Holarctic lampreys, but do not consider the Antarctic types. We have examined the collections of the following museums: United States National Museum, Stanford University collections, American Museum of Natural History, Field Museum of Natural History, and the Museum of Zoology of the University of Michigan. We wish to thank the officials of these institutions for the use of their lamprey material.

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<sup>1</sup> Ann. Mag. Nat. Hist., Ser. 8, Vol. 7, pp. 193-204.

This report is only a systematic outline of the northern lampreys. We hope to obtain much additional material, and if possible to find characters by which ammocoete material can be more certainly identified. Until such additional information is at hand, we consider it premature to enter into a discussion of the geographical distribution and evolution of the North American lampreys. The ranges of the various forms, as given in the following key, are completely verified by material examined.

In the classification of the lampreys a comparison of dentition is indispensable. In order to render them clearer, the descriptions of the teeth in the following key should be supplemented by figures, to which we here append references in the following list.

LIST OF THE HOLARCTIC LAMPREYS, WITH REFERENCES TO  
FIGURES OF DENTITION

Genus *Ichthyomyzon* Girard.

Subgenus *Ichthyomyzon* Girard.

*Ichthyomyzon concolor* Kirtland: Bensley, Contr. Can. Biol., 1911-1914 (1915), pl. 1, fig. 5.

Subgenus *Reighardina* (new).

*Ichthyomyzon unicolor* DeKay: Reighard and Cummins, Occ. Pap. Mus. Zool., Univ. Mich., No. 31, 1916, pl. 2, fig. 1.

Genus *Petromyzon* Linnaeus.

Subgenus *Petromyzon* Linnaeus.

*Petromyzon marinus* Linnaeus: Gage, The Wilder Quarter-Century Book, 1893, pl. 6, figs. 19, 20; Smitt, Hist. Scand. Fishes, pt. 2, 1895, p. 1184, fig. 352; Bade, Die mitteleuropäischen Süßwasserfische, 2, 1902, p. 111, fig. 85; Fowler, Proc. Acad. Nat. Sci. Phila., 1907, p. 462, fig. 1.

Subgenus *Caspiomyzon* Berg.

*Petromyzon wagneri* Kessler, "Trud. St. Petersburg. Obshch. Estestv., 1, 1870, pp. 270, 302, pl. 3, figs. 4, 5."

Subgenus *Eudontomyzon* Regan.

*Petromyzon danfordi* Regan: Wajgel, Verh. zool.-bot. Ges. Wien, 33, 1883 (1884), pl. 17, fig. 3 (as *Petromyzon planeri*; details inaccurate).

Genus *Entosphenus* Gill.Subgenus *Tetrapleurodon* (new).

*Entosphenus spadiceus* Bean (no figure).

Subgenus *Entosphenus* Gill.

*Entosphenus tridentatus tridentatus* Gairdner: Lucas, Rept. Fur-Seal Invest., pt. 3, 1896-1897 (1899), pl. 15.

*Entosphenus tridentatus ciliatus* Ayres (no figure, but dentition as in typical *tridentatus*).

Subgenus *Lethenteron* (new).

*Entosphenus japonicus* Martens: Smitt, Hist. Scand. Fishes, pt. 2, 1895, p. 1191, fig. 353 (as "*P. fluviatilis* Var.").

*Entosphenus appendix* DeKay: Gage, The Wilder Quarter-Century Book, 1893, pl. 6, fig. 21; Forbes and Richardson, The Fishes of Illinois (Nat. Hist. Surv. Ill., Vol. 3, Ed. 1, 1908, and Ed. 2, 1920, p. 11, fig. 10).

Genus *Lampetra* Gray.Subgenus *Lampetra* Gray.

*Lampetra fluviatilis* Linnaeus: Günther, An Introduction to the Study of Fishes, 1880, p. 692, fig. 316; Bade, Die mitteleuropäischen Süßwasserfische, 2, 1902, p. 106, figs. 77, 78.

*Lampetra planeri* Bloch: Bade, Die mitteleuropäischen Süßwasserfische, 2, 1902, p. 109, fig. 82.

Subgenus *Okkelbergia* (new).

*Lampetra lamottenii* Le Sueur: Creaser and Hubbs, pl. 1 (present work).

## A DIAGNOSTIC KEY TO THE HOLARCTIC LAMPREYS

In the construction of this key an attempt is made to express the probable relationships of the Holarctic lampreys, and to make the diagnosis of any subdivision sufficiently complete to serve as its definition.

Family *Petromyzonidae*

a<sup>1</sup>. Buccal funnel with series of teeth radiating in all directions from the mouth, deflected backward toward the margin of the disc.

b<sup>1</sup>. A single more or less deeply emarginate dorsal fin; dorsal fin not separated from the caudal by a sharp notch; caudal a broadly oval lobe; innermost lateral disc teeth usually unicuspid; base of teeth poorly developed; myotomes between last gill opening and the vent fewer than 60 (49 to 57).

Genus *Ichthyomyzon*

- c<sup>1</sup>. Buccal funnel when expanded much greater in diameter than the width of the body; supraoral lamina greatly constricted, with one to four (usually two) approximated cusps; anterior lingual lamina with anterior and posterior transverse elements each provided with sharp denticles; all disc teeth sharp and large; oral fimbriae arranged in a double row; a high marginal membrane inside with weakly ciliate border; intestine well developed and functional in adults; larvae probably transforming at a size of less than 120 mm. *Basins of Hudson Bay, Great Lakes, and Mississippi River.*

*Ichthyomyzon (Ichthyomyzon) concolor.*

- c<sup>2</sup>. Buccal funnel constricted, when fully expanded not greater in diameter than the width of the body; supraoral lamina with two small, blunt, well-separated cusps; anterior lingual lamina with a single transverse element with minute rounded denticles; all disc teeth weak and blunt, mostly obsolescent; oral fimbriae presenting a matted appearance; intestine degenerate and non-functional in adults; larvae transforming at a size of more than 120 mm. *Great Lakes basin.*

*Ichthyomyzon (Reighardina)<sup>2</sup> unicolor.*

- b<sup>2</sup>. Two distinct, more or less widely separated dorsal fins; dorsal fin separated from the caudal by a sharp notch; caudal a rather angular lobe; innermost lateral disc teeth enlarged, one or more multicuspoid.

Genus *Petromyzon*

- d<sup>1</sup>. Anterior lingual lamina so sharply curved as to appear as two sharply denticulated ridges, without a differentiated median cusp; supraoral lamina expanded behind the two heavy divergent anterolateral cusps, which rarely are imperfectly separated; infraoral lamina with 7 to 9 strong cusps; all teeth well developed and pointed; four innermost laterals always bicuspid; buccal funnel wide; oral fimbriae appearing to be arranged in several series, each lateral and posterior fimbria being cleft two or three times nearly to the base, each of the two or three lobes thus formed again cleft and each of the minor lobes minutely cleft; membrane forming edge of oral disc high, with sharply ciliate border and with numerous well-developed papillae along the inner base; myotomes between the last

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<sup>2</sup> *Reighardina* Creaser and Hubbs, new subgenus; orthotype, *Ichthyomyzon fossor* Reighard and Cummins (= *Ichthyomyzon unicolor*).



gill opening and the vent about 70 in number. *North Atlantic Ocean and coastwise streams.*

*Petromyzon (Petromyzon) marinus.*

- d<sup>2</sup>. Anterior lingual lamina little bent inward medially, its edge crenulate, without a differentiated median cusp; supraoral lamina narrow, with one (usually) or two lobe-like cusps; infraoral lamina with five blunt cusps or crenulations; all teeth very blunt and greatly reduced in size, particularly on the posterior field;<sup>3</sup> lateral disc teeth about as in *Petromyzon marinus*, but much weaker; the innermost (enlarged) teeth grading outward into minute teeth aligned in rows deflected backward much more sharply than in *Petromyzon marinus*; buccal funnel reduced in size; oral fimbriae smaller than in *Petromyzon marinus* and less divided; marginal oral membrane scarcely developed. *Caspian Sea and tributaries.*

*Petromyzon (Caspionomyzon) wagneri.*<sup>4</sup>

- d<sup>3</sup>. Anterior lingual lamina little bent inward medially, usually with an enlarged median cusp; supraoral lamina broad and bicuspid; infraoral lamina with 9 to 11 cusps; innermost lateral disc teeth of each side enlarged, the first and third unicuspid or bicuspid, the middle one bicuspid or tricuspid. *Transylvania [from Regan].*

*Petromyzon (Eudontomyzon) danfordi.*<sup>5</sup>

- a<sup>2</sup>. Teeth of the buccal funnel not in distinct radiating series, but in several groups: several enlarged lateral teeth, usually multicuspid, at the edge of the oral opening; a marginal series around edge of disc; few to many teeth on the anterior part of the disc; supraoral broad, the main cusps being separated by a bridge; fins about as in *Petromyzon*.

- e<sup>1</sup>. A posterior series of small teeth developed, parallel to the marginal series and connecting the last pair of enlarged laterals.

Genus *Entosphenus*

<sup>3</sup> The posterior disc teeth in *Petromyzon wagneri* are least obsolete in a single series corresponding to that diagnostically retained in *Entosphenus*.

<sup>4</sup> *Petromyzon wagneri* Kessler, "Trud. St. Petersburg. Obshch. Estestv., 1, 1870, pp. 207, 302, pl. 3, figs. 4, 5"; *Caspionomyzon wagneri*, Regan, Ann. Mag. Nat. Hist., (8), 7, 1911, p. 200. The diagnosis here given by us is based upon a series of specimens from Astrachan, Russia (No. 37293, United States National Museum).

<sup>5</sup> *Eudontomyzon danfordi* Regan, Ann. Mag. Nat. Hist., (8), 7, 1911, p. 200.

- f<sup>1</sup>. Anterior disc teeth very numerous and crowded, in about six rows medially; enlarged laterals four on each side, the first and last bicuspid, the median two either bicuspid or tricuspid; anterior lingual lamina not at all bent inward medially, the edge comb-like with long, pointed serrations; supraoral often with one or two small denticles located laterally on the bridge between the main cusps; infraoral with nine teeth, alternately larger and smaller. *Rio Lerma basin, Mexico. Entosphenus (Tetrapleurodon)*<sup>6</sup> *spadiceus*.
- f<sup>2</sup>. Anterior disc teeth not very numerous or crowded; enlarged laterals normally four in number, the first and last bicuspid, the median two tricuspid (one of the median two rarely lacking, a fifth occasionally added by the doubling of the first tooth of the posterior series); anterior lingual lamina slightly bent inward medially, the edge dentate, the median cusp little enlarged; supraoral always tricuspid, the third cusp median; infraoral cusps 4 to 6, uniform in size, the outermost not doubled.

Subgenus *Entosphenus*

- g<sup>1</sup>. Myotomes between the last gill opening and vent 68 to 74. *Pacific Ocean and coastal streams from Unalaska to the Columbia River System.*

*Entosphenus tridentatus tridentatus.*

- g<sup>2</sup>. Myotomes between the last gill opening and the vent 57 to 67. *Pacific Ocean and coastal streams from southern Oregon to southern California.*

*Entosphenus tridentatus ciliatus.*

- f<sup>3</sup>. Anterior disc teeth not very numerous or crowded; enlarged laterals always three in number, all bicuspid; anterior lingual lamina not at all bent inward medially, the edge dentate or crenulate, with the median teeth notably enlarged; supraoral rarely with a median or submedian denticle, at most weakly developed; infraoral cusps 8 to 11, the outermost two of each side imperfectly separated.

Subgenus *Lethenteron*<sup>7</sup>

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<sup>6</sup> *Tetrapleurodon* Creaser and Hubbs, new subgenus; orthotype, *Lampetra spadicea* Bean.

<sup>7</sup> *Lethenteron* Creaser and Hubbs, new subgenus; orthotype, *Lampetra wilderi* Gage (= *Petromyzon appendix* DeKay).

h<sup>1</sup>. Dorsal fins well separated by an interspace, except in breeding specimens; oral fimbriae relatively slender, with few marginal incisions; all teeth sharp and strong (becoming blunt by wear in breeding individuals); intestine of adults well developed and functional; larvae at transformation much smaller than the larger adults; not breeding at a size of less than 30 cm. *Coasts and streams from Bering Sea west to the White Sea and south to the Sea of Japan.*

*Entosphenus japonicus.*

h<sup>2</sup>. Dorsal fins separated only by a notch to base; oral fimbriae palmate; all teeth blunt and weak; intestine of adults degenerate and non-functional; larvae at transformation attaining the adult size (21 cm. or less). *Streams of North America and eastern Asia.*

*Entosphenus appendix.*

e<sup>2</sup>. No teeth other than the marginals on the posterior field of the disc; three enlarged laterals.

Genus *Lampetra*

i<sup>1</sup>. Cusps of supraoral always simple, stronger, well separated by a broad bridge; infraoral lamina with 6 to 9 distinct cusps; a series of teeth extending across the entire anterior part of the buccal disc within the marginal series; cusps of lateral teeth with a common well-marked base; myotomes between the last gill opening and the vent 58 to 70.

Subgenus *Lampetra*

j<sup>1</sup>. Dorsal fins usually well separated by an interspace; myotomes between the last gill opening and the vent 63 to 70; all teeth sharp and strong; intestine of adults well developed and functional; larvae at transformation much smaller than the larger adults. *Coasts and streams of northern Eurasia and western North America.*

*Lampetra fluviatilis.*

j<sup>2</sup>. Dorsal fins separated only by a notch to base; myotomes between the last gill opening and vent 57 to 66; all teeth weak and blunt; intestine of adults degenerate and non-functional; larvae at transformation attaining the adult size. *Streams of Eurasia and western North America.*

*Lampetra planeri.*

- i<sup>2</sup>. Cusps of supraoral usually bitubercular, always weak and rounded, separated by a short, narrow isthmus, the base of the cusps poorly developed; infraoral lamina without distinct denticles, the crest crenulated or even nearly entire; all teeth greatly reduced; the anterior field of the disc with but few (about four) denticles, placed laterally and separated by a broad toothless median area; the three laterals of each side obsolescent, with scarcely developed bases, sometimes unicuspid or with the two or three cusps isolated as more or less widely separated denticles; myotomes fewer, 54 to 60 between the last gill opening and vent. *Ohio and Potomac River basins.*

*Lampetra (Okkelbergia)*<sup>8</sup> *lamotteni*.

#### NOTES ON THE NORTH AMERICAN SPECIES

##### 1. *Ichthyomyzon concolor* Kirtland

*Ammocoetes concolor* Kirtland appears to have been based on the larva of the present species. It is certainly a species of *Ichthyomyzon*, and "the irregular series of dark brown dots" mentioned by Kirtland are not developed in the other species of the genus. Furthermore, *I. unicolor* is not known to occur in the Ohio drainage, where the type of *concolor* was obtained.

Forbes and Richardson<sup>9</sup> have demonstrated the specific identity of *Ichthyomyzon castaneus* with *I. concolor*. In our own study we have found abundant confirmation of this view.

##### 2. *Ichthyomyzon unicolor* DeKay

The degenerate relative of *Ichthyomyzon concolor*, lately described by Reighard and Cummins,<sup>10</sup> is so distinct that we regard it as the type of a new subgenus, *Reighardina* (defined on p. 4). It has subsequently been referred to as "*Ichthy-*

<sup>8</sup> *Okkelbergia* Creaser and Hubbs, new subgenus; orthotype, *Ammocoetes aepyptera* Abbott (= *Lampetra lamotteni*).

<sup>9</sup> The Fishes of Illinois, Nat. Hist. Surv. Ill., Vol. 3, 1908 (Ed. 2, 1920), p. 10.

<sup>10</sup> Occ. Pap. Mus. Zool., Univ. Mich., No. 31, 1916, pp. 1-12, pls. 1, 2.

omyzon sp." by Hankinson,<sup>11</sup> and we have found it common throughout Michigan. An ammocoete from the St. Lawrence drainage at Madrid, New York, seems to belong to the same species.

Although not absolutely certain, it is highly probable that the specimens named *Ammocoetes unicolor* by DeKay,<sup>12</sup> from a tributary to Lake Champlain, and *Ammocoetes borealis* by Agassiz,<sup>13</sup> from a stream flowing into Lake Superior, were larvae of this species. It is certain that both names were based on a species of *Ichthyomyzon*, and the large size and the shape of the types suggest that they belonged to this species rather than to *concolor*.

### 3. *Petromyzon marinus* Linnaeus

We concur in the prevalent view that *Petromyzon americanus* Le Sueur<sup>14</sup> is identical with *P. marinus* of Europe. *Petromyzon nigricans* DeKay<sup>15</sup> merely represents the uniformly colored young, *Ammocoetes bicolor* DeKay<sup>16</sup> the larva, of the sea lamprey. The dwarfed race (*P. marinus dorsatus* Wilder),<sup>17</sup> land-locked in the New York lakes, of which we have examined material, does not appear to use worthy of even subspecific recognition.<sup>18</sup> *Bathymyzon bairdii* Gill<sup>19</sup> and *Oceanomyzon wilsoni* Fowler<sup>20</sup> we hold to be strict synonyms of *P. marinus*, each having been based on marine specimens

<sup>11</sup> Occ. Pap. Mus. Zool., Univ. Mich., No. 89, 1920, p. 5.

<sup>12</sup> New York Fauna, Fishes, 1842, p. 383, pl. 79, fig. 250.

<sup>13</sup> Lake Superior, 1850, p. 252.

<sup>14</sup> Trans. Am. Phil. Soc., 1, 1818, p. 383.

<sup>15</sup> New York Fauna, Fishes, 1842, p. 381, pl. 79, fig. 247.

<sup>16</sup> *Ibid.*, p. 383, pl. 79, fig. 248.

<sup>17</sup> In Jordan and Gilbert, Bull. U. S. Nat. Mus., 16, 1883, p. 869.

<sup>18</sup> See also Meek, Ann. N. Y. Acad. Sci., 3, 1886, pp. 285-289.

<sup>19</sup> Proc. U. S. Nat. Mus., 5, 1883, p. 254.

<sup>20</sup> Proc. Acad. Nat. Sci. Phila., 59, 1907 (1908), p. 462.

with aberrant dentition; we have examined numerous typical specimens from rather deep water in the North Atlantic.

Regan's record<sup>21</sup> of this species from Muscatine, Iowa, is probably erroneous, although based on specimens of *P. marinus* so labelled by Meek (some of which we have re-examined). It seems more likely that labels were transposed than that *marinus* should have been taken in the Mississippi basin.

#### 4. *Entosphenus spadiceus* Bean

This species is sharply differentiated by its dentition, which seems to be more generalized than that of other members of the *Entosphenus-Lampetra* series. We make it the type of a new subgenus, *Tetrapleurodon* (defined on p. 6). In addition to the types, we have examined specimens taken by Dugés at Tanganzicuaró, Mexico, and by Nelson in Lago de Chapala.

#### 5. *Entosphenus tridentatus tridentatus* Richardson

We find it necessary to divide this West American species into a northern and a southern subspecies, as in the specimens examined from the Columbia River system and northward the myotomes between gill slits and anus vary from 68 to 74, whereas in those from the Klamath basin and southward the myotomes number 57 to 67.

*Petromyzon lividus* Girard<sup>22</sup> and *P. astori* Girard<sup>23</sup> fall into the synonymy of the typical subspecies of *Entosphenus tridentatus* as thus restricted.

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<sup>21</sup> Ann. Mag. Nat. Hist., Ser. 8, Vol. 7, 1911, p. 198.

<sup>22</sup> Pac. R. R. Exp., Fish., 1858, p. 379.

<sup>23</sup> Pac. R. R. Exp., Fish., 1858, p. 380.

6. *Entosphenus tridentatus ciliatus* Ayres

Two names, *Petromyzon ciliatus* Ayres<sup>24</sup> and *Petromyzon cpiherodon* Gill<sup>25</sup> have been based on this southern form of *Entosphenus tridentatus*, which is characterized by the reduced number of segments.

7. *Entosphenus japonicus* Martens

The large lamprey of Japan is an *Entosphenus*, as Regan<sup>26</sup> has shown. The species is of wide distribution, occurring also in the White Sea, as Regan suggested. We are now able to state that the lamprey of the Yukon, described as *Ammonoetes aureus* by Bean,<sup>27</sup> is also conspecific with *japonicus*.

In our opinion, *Lampetra mitsukurii major* Hatta,<sup>28</sup> of which we have examined topotypic material,<sup>29</sup> is based on breeding individuals of *Entosphenus japonicus*. The distinctive features of this nominal form, as pointed out by the describer, are just those which, as Gage<sup>30</sup> has shown, distinguish breeding from non-breeding adults of *Petromyzon marinus*; the bluntness of the teeth is due to wear. We find that like changes take place in *Entosphenus tridentatus* and in *Lampetra fluviatilis* (q. v.).

8. *Entosphenus appendix* DeKay

*Petromyzon appendix* DeKay<sup>31</sup> we regard as assuredly based on the species currently known as *Lampetra* or *Entosphenus*

<sup>24</sup> Proc. Cal. Acad. Nat. Sci., 1855, p. 44.

<sup>25</sup> Proc. Acad. Nat. Sci. Phila., 1862, p. 331.

<sup>26</sup> Ann. Mag. Nat. Hist., Ser. 8, Vol. 7, 1911, p. 202.

<sup>27</sup> Proc. U. S. Nat. Mus., 4, 1881, p. 159.

<sup>28</sup> Annot. Zool. Jap., 7, 1911, p. 268, pl. 9.

<sup>29</sup> Recorded by Jordan and Snyder (Proc. U. S. Nat. Mus., 23, 1901, p. 734), as *Lampetra mitsukurii*.

<sup>30</sup> Wilder Quarter-Century Book, 1893, p. 439, pl. 3.

<sup>31</sup> New York Fauna, Fishes, 1842, p. 381, pl. 64, fig. 211.

*wilderi*. We find the range of this form to extend from southern New England and northern New York south to Maryland (specimens in National Museum), and west to Wisconsin and Iowa, in North America.

Furthermore, we are wholly unable to distinguish from this form, a nominal species, *Lampetra mitsukurii*, described by Hatta<sup>32</sup> from Japan, and also recorded by him from eastern Siberia (the species will probably be found to occur also in intervening localities). Regan<sup>33</sup> has erroneously referred *mitsukurii* to the synonymy of *Lampetra planeri*, despite the fact that Hatta described its generic characters. It is possible, however, that Hatta did include specimens of *L. planeri*, which also occurs in Japan, in his material, particularly that of *Lampetra mitsukurii minor*. Under this name he redescribed the same form in 1911,<sup>34</sup> without, however, indicating a definite type-locality; this we here designate as Sapparo, Hokkaido.

#### 9. *Lampetra fluviatilis* Linnaeus

A race of lampreys inhabiting San Francisco Bay and Puget Sound, and doubtless ascending West Coast streams to spawn, we identify after careful examination with this species. On examples of this race the names *Petromyzon plumbeus* Ayres<sup>35</sup> and *Petromyzon ayresii* Gunther<sup>36</sup> have been based.

Lönnberg<sup>37</sup> and Smitt<sup>38</sup> have both claimed that *Lampetra fluviatilis* and *L. planeri* intergrade and are inseparable specifically. While we expect to return to this problem at a later time, and do consider the intergradation as not improbable,

<sup>32</sup> Annot. Zool. Jap., 4, 1901, p. 24.

<sup>33</sup> Ann. Mag. Nat. Hist., Ser. 8, Vol. 7, 1911, p. 203.

<sup>34</sup> Annot. Zool. Jap., 7, 1911, p. 268, pl. 9.

<sup>35</sup> Proc. Calif. Acad. Sci., 1854, p. 28.

<sup>36</sup> Cat. Fishes Brit. Mus., 8, 1870, p. 505.

<sup>37</sup> Bih. Sv. Vet-Akad. Handl., 1893, 18, Afd. 4, No. 2, pp. 1-13.

<sup>38</sup> Hist. Scand. Fishes, pt. 2, 1895, p. 1188.



we may state here that the authors quoted apparently arrived at their conclusion from erroneous data. They seem to have compared only non-breeding with breeding specimens of *fluviatilis*, believing the latter to represent *L. planeri*. Wajgel<sup>39</sup> also concluded that *fluviatilis* and *planeri* intergrade, but he confused *Eudontomyzon danfordi* with *Lampetra planeri*. Other authors have expressed like views, but so far as we know, no one has presented any conclusively supporting evidence.

#### 10. *Lampetra planeri* Bloch

We refer to this form many specimens examined from Europe, Japan, and from Western North America (from Alaska to central California). The material represents numerous races, without geographical significance, and apparently not recognizable nomenclaturally. Indeed, as suggested above, *planeri* may even intergrade with *fluviatilis*.

The brook lampreys of California have passed under the name *Lampetra cibaria*, but *Ammocoetes cibarius* Girard<sup>40</sup> was described as having the dorsal fins separated, and hence was probably based on either *Entosphenus t. tridentatus* or *Lampetra fluviatilis*.

<sup>39</sup> Verh. zool.-bot. Ges. Wien, 33, 1883 (1884), pp. 311-320, pl. 17.

<sup>40</sup> Pac. R. R. Exp. Fish., 1858, p. 383.

II. *Lampetra lamottenii* Le Sueur (Plate I)

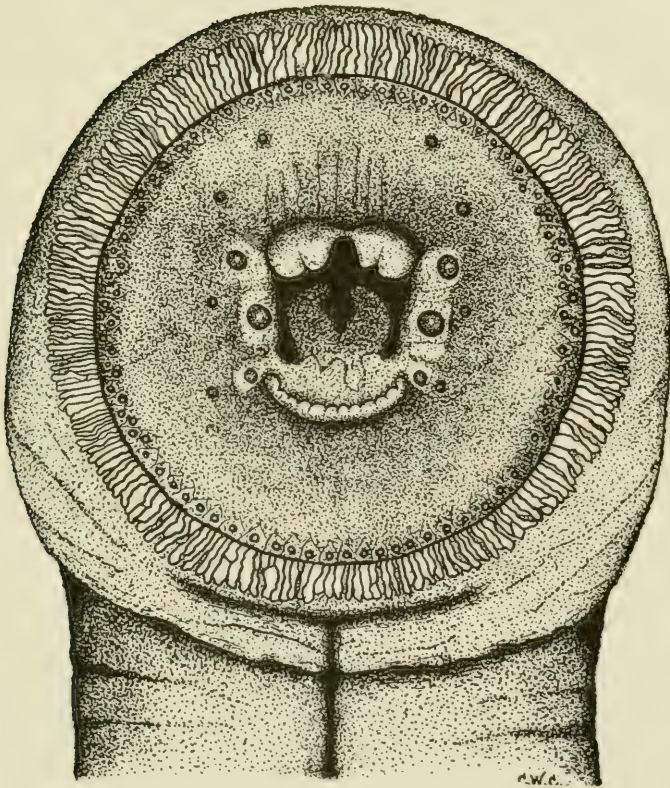
The name *lamottenii* Le Sueur<sup>41</sup> is revived for this aberrant brook lamprey, as the obsolescent dentition, partial union of the dorsal fins, and the coloration as shown in the type figure indicate that Le Sueur had the present species. It is the only representative of the genus *Lampetra*, as now restricted, which occurs in eastern North America. *Ammocoetes aepyptera* Abbott<sup>42</sup> is its only synonym. It is the most degenerate of all the known lampreys.

We base on this species a new subgenus, *Okkelbergia*, named in honor of Dr. Peter Okkelberg, of the University of Michigan, in recognition of his careful studies on the history of the germ cells in lampreys. The subgeneric and specific characters are both indicated in the diagnostic key (see p. 8).

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<sup>41</sup> In DeKay, New York Fauna, Fishes, 1842, p. 382, pl. 79, fig. 249.

<sup>42</sup> Proc. Acad. Nat. Sci. Phila., 1860 (1861), p. 327; type redescribed by Fowler, *ibid.*, 1901, p. 328; and *ibid.*, 1907, p. 466.



Dentition of *Lampetra (Okkelbergia) lamottenii*



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SOME ROBBERFLIES IN THE UNIVERSITY OF  
MICHIGAN MUSEUM OF ZOOLOGY, AND THE  
DESCRIPTION OF A NEW SPECIES

BY JAMES S. HINE

In a collection of Asilidae sent from the University of Michigan Museum of Zoology are a number of species of more than usual interest. I have used my specimens of some of the species also because by a combination of specimens from the two collections it is possible to form a better series of each species from which to draw conclusions.

*Stichopogon argentius* Say.—Numerous specimens taken at Sawyer Dunes, Berrien County, Michigan, also one from Seward County, Kansas. The species is known to be partial to sand areas and has a wide distribution, having been taken on the Pacific as well as the Atlantic coast of North America. These records add two more states to its known range.

*Proctacanthus rufus* Williston.—This fine, large insect was described by Williston in Volume 12, Transactions of the American Entomological Society, and reported by him as

occurring in North Carolina and Massachusetts. It has been collected in several states since and the records show that it is partial to bare, sandy areas such as are present along lakes, seas, and rivers and in semi-arid regions. I have collected numerous specimens at Cedar Point, Sandusky, Ohio, on the sandy shores of Lake Erie, and have observed it issuing from the pupa-case which was left partially protruding from the sand. Its larva, no doubt, is predaceous on subterranean animal life of its chosen habitat. Nearly a score of specimens were taken along the shore of Lake Michigan, in Berrien County, which is the first record of its occurrence in Michigan known to me.

Pupa. Three cast pupa skins of *Promachus rufus* were received with the adults. The pupae of different species of Asilidae are much alike except they vary strikingly in size, as is to be expected. The division into head, thorax, and abdomen is plainly apparent and the segmentation is clearly evident. The middle of each abdominal segment is expanded into a ridge which entirely encircles its segment and bears a row of spines which are stoutest dorsally. These rows of spines dorsally near the middle of the length of the abdomen are composed of slender, hair-like spines and short, heavy, two-pointed spines alternating with one another. The location of the eyes is easy to see. Just beneath each eye is a very prominent complex spine with three long points, and between these, but somewhat higher up, are two prominent spines with enlarged bases, while behind each eye, near the middle of the thorax, are two less prominent spines. Immediately behind each eye is a thoracic spiracle. Total length 28 to 32 millimeters. This pupa differs from those of *Asilus sericeus* and *Erax interruptus* in not having distinct spines protruding from its posterior end.

*Dizonias tristis* Walker.—The extreme variation in color of the members of this genus has been considered by several authors, but none of them have come to a conclusion as to the limits of the species.

In a collection of twenty specimens, twelve males and eight females, from Louisiana, Texas, Georgia, Alabama, and Florida there is much variation and the characters given for separation of the four recognized North American species do not appear to be altogether reliable. One could easily find color characters for the separation of several types that might be called species among this material, but on account of the gradual variations in the series and the results of studies that others have made, the better disposition of the problem presented seems to be to consider all these specimens as belonging to a single species.

There is general agreement in the series in that all males are predominantly black and all females are predominantly brown. The white bands or zones on the second and third segments which suggest the generic name are extremely variable, being distinctly apparent in some specimens and entirely absent in others, with various gradations, although it may be said that when specimens become old and greased, as they often do, the white color producing the zones is of such a nature that it often becomes nearly obsolete. Aside from these white zones, five males have the abdomen all black and seven have the abdomen part brown; of the latter, two have the last three segments brown and one has the abdomen all brown beyond the middle of the second segment, while the remaining four intergrade. In all males the extreme tip of the abdomen is white-haired; in nine males the hypopygium is black, in three it is brown. In total length the smallest male is 15 mm., the largest male is 22 mm.

All of the eight females have the dorsum of the mesothorax brown, the mystax bright yellowish brown, and the legs and antennae brown, but in two specimens the femora are partly fuscus and in most cases the third antennal segment is darkened somewhat apically. In all these females the wings are dark fuscus and quite uniform through the series. The abdomen is extremely variable both in coloration and markings. Two specimens have the light zones on segments two and three; two other specimens have these zones on segments two and three and an additional zone on five; one specimen has only one zone, and that on segment three; two specimens have the abdomen black without zones, but with suggestions of brown on segments two and three; and one specimen has no light zones, but the abdomen is black and brown banded, with most of the anterior part of each segment brown and the posterior part black, although the last three segments are nearly all brown. This last specimen I collected in Louisiana pairing with a male which is black with the last four abdominal segments brown. In one female with three zones the abdomen is entirely black otherwise, while in the light-zoned females with more or less brown on the abdomen black is present in variable combinations.

A male specimen of *Dizonias* from Arizona, which I have labelled *D. lucasi* Bellardi, differs from the males considered above in the appearance of the hypopygium. The superior appendages are longer and slenderer than in *tristis* and near the middle of their length on the inner dorsal border each bears a tuft of elongate, coarse, upright hairs which are bright yellow in color, as is the tip of the abdomen beyond the apex of the third segment. In *tristis* these appendages are short and conical, with quite a different arrangement of white, bristly hairs. It would seem, therefore, that the basis of sep-



aration of the species of *Dizonias* will be found in the structure of the genitalia rather than in the color of the body, which has been used by previous authors.

*Townsendia niger* Back.—The genus *Townsendia*, erected by Williston for a species from Tabasco, Mexico, is peculiar among North American Asilidae in having only four posterior cells. So far as I find, five specimens of the genus are mentioned in entomological literature, and these have been placed as four species. Two specimens in the collection under consideration and three specimens in my collection appear to agree best with *T. niger*, although, as Back states, the differences between *minuta* and *niger* are not pronounced. The five specimens before me extend the range of the genus and indicate a rather wide distribution, as they come from Winfield, Louisiana, Decatur County, Georgia, and Dayton, Kentucky. Williston described *minuta* from two specimens, one from Tabasco and one from New Mexico. Back described *pulcherrima* from Travis County, Texas, and *niger* from South Amboy, New Jersey, each from a single specimen. And Bezzi has described *febrigii* from one specimen from Paraguay in *Annals of the Hungarian National Museum*, 1909.

*Proctacanthus mystaceus* Macquart.—Several specimens of this South American species from Riohacha, Magdalena, Colombia, were collected by F. M. Gage. They correspond closely in size and somewhat in appearance to specimens of *Proctacanthus brevipennis* Wiedemann, but are easily known by the elongate second submarginal cell with its base plainly before the base of the second posterior cell or nearly opposite the middle of the length of the section of the fourth vein, which reaches from the anterior cross-vein to the base of the second posterior cell. None of the North American species

known to me have the second submarginal cell so long as in *mystaceus*. Usually this cell has its base almost exactly opposite the base of the second posterior cell. Total length 25 to 27 millimeters. Macquart figures a wing of *mystaceus* in *Dipteres Exotiques*, Supplement 1, Plate 8, figure 10.

#### GENUS ASILUS

*Asilus* may be divided into two groups by the presence or absence of a transverse row of bristles just before the apex of each abdominal segment, clearly larger than the hairs commonly present on the abdomen. The group characterized by the absence of these bristles is smaller than the other and the species included from North America hardly can be said to fall together naturally. Loew and others used this means of grouping old world species and American students have adopted it in this country, presumably because nothing better has been suggested. Six North American species have been included in the group and an undescribed species collected by F. M. Gaige at Lake Cushman, Washington, is before me. The following key is offered for separating these seven species:

1. Large, bright-colored species, wings distinctly colored all over.. 2  
    Smaller, modest-colored species, wings nearly hyaline..... 3
2. Body and legs black, wings uniformly rich yellow....*midas* Brauer  
    Body brown, legs pale brown, wings brown with the veins  
    margined with paler.....*sericeus* Say
3. Scutellum with numerous upright, mostly white bristles on  
    its posterior part, female genitalia with a cirlet of strong  
    spines at the tip..... 4  
    Scutellum with a row of black bristles on its margin, female  
    genitalia without a cirlet of spines at the tip..... 5
4. Upper forceps of the male genitalia protruding half their  
    length beyond the other parts.....*leucopogon* Williston  
    Upper forceps of the male genitalia not protruding beyond  
    the other parts.....*cacopilogus* Hine
5. Third antennal segments wide, widest at middle of its  
    length, body with abundance of fine pile.....*platycras* Hine  
    Third antennal segments slender, nearly the same width  
    throughout, body with normal amount of pile..... 6

6. Body black, face just beneath the antennae shining black.  
*nitidifacies* Hine  
Body pale, face entirely yellowish pollinose.....*astutus* Williston

***Asilus platyceras* n. sp.**

Total length 14 to 16 millimeters. Dark-colored all over without color markings. Mystax black above, pale straw-color beneath. Bristles of the mesothoracic dorsum and the scutellum black.

Antenna black, third segment rather short, widest at middle of its length, arista shorter than its segment, beard white, occipito-orbital bristles black; mesothoracic dorsum black-haired, posteriorly with numerous long, black hairs and bristles; scutellum with numerous short, black hairs on its disc and a row of long, black bristles and hairs on its margin; wings gray-hyaline, extreme base and region of the basal cells nearly transparent; legs black with gray pilosity and black bristles; inner sides of the tibiae and tarsi furnished in most specimens with glistening reddish pile, more evident from some views than others. Abdomen dark, nearly uniformly gray pollinose and quite thickly gray pilose. Male genitalia shining black from side view, superior appendages slightly longer than abdominal segments six and seven, slender, of uniform width and directed nearly straight backward. From dorsal view, slightly narrowed to apical third and from thence more rapidly narrowed to apex. Ovipositor shining black, conical and about equal in length to abdominal segments six and seven.

Male type and allotype collected at Lake Cushman, Mason County, Washington, August 6, 1919, by F. M. Gaige. In the University of Michigan Museum of Zoology. Four paratypes in the same museum were collected at the same place between July 4 and August 6, 1919. Two paratypes in my collection from the same locality were taken August 8, 1919.



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A NEW SPECIES OF AMPHISBAENA FROM  
BRITISH GUIANA

BY ALEXANDER G. RUTHVEN

The collections of reptiles and amphibians made in British Guiana by the Museum of Zoology, University of Michigan, contain several specimens of the genus *Amphisbaena*, one of which apparently represents an undescribed species.

***Amphisbaena stejnegeri***, new species

*Diagnosis:* Nasals forming a suture on the snout; nasal suture shorter than praefrontal suture; no infraocular; no praeocular; no occipitals. Annuli on the middle of the body composed of 34 segments, the dorsals longer than broad, the median ventrals broader than long. Six præanal pores.

*Type Specimen:* Cat. No. 55858, Museum of Zoology, University of Michigan; sand reef at Vreeden Rust, Demerara River, British Guiana; January 1, 1921; E. N. Clarke, collector.

*Description of Type Specimen:* Snout rounded, prominent. Rostral rather small, triangular, just visible from above; nasals forming a suture on the snout, the suture about three-fourths the length of the praefrontal suture; praefrontals the largest head-shields, the suture shorter than that between the frontals; frontals twice as long as broad; occipitals, praecoculars and infraoculars absent; eye distinguishable under the ocular which is situated between the praefrontal, second and third labials and a single postocular; four upper labials, the fourth very small and bordered above by a large shield which lies below the postocular and is separated from the ocular by the postocular and third upper labial. Symphysial linguiform pointed behind, followed by a pair of chin-shields; two lower labials, the first very large, two large sublabials. Two hundred and forty-eight annuli on the body, one in the middle of the body containing 34 segments; dorsal segments longer than broad, the median ventral segments broader than long; 13 annuli on the tail, the last one composed of elongate segments, the end of the tail blunt and covered with irregular segments. Lateral line distinct. Six præanal pores. Six præanal segments. Above whitish, except that some of the dorsal segments are dark brown; below whitish, except for some pale brown spots on the subcaudal segments.

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THE MAMMALS OF WASHTENAW COUNTY,  
MICHIGAN

BY NORMAN A. WOOD

Three natural physiographic divisions cross Washtenaw County from northwest to southeast. The northwestern part of the county is occupied by the rough interlobate moraine of loose-textured soil, the Interlobate Lake District; a broad Clay Morainic Belt occupies most of the central part of the county; and in the southeastern corner of the county is found a low Lake Plain, once the bed of glacial Lake Maumee.

The Interlobate Lake District has a conspicuous system of moraines, making up a most irregular land surface. Steep knolls 100 to 200 feet in height are closely associated with basins, which are often deep, and some of which are occupied by lakes. Small, undrained depressions occur everywhere, producing thousands of acres of swamp and marsh land.

The Clay Morainic Belt occupies the region from just below Portage Lake to Ypsilanti. It is composed of glacial till plains.

and clay moraines extending from northeast to southwest. This area includes the highest land in the county, one hill exceeding and several approaching 1100 feet in altitude. Most of the area is high and rolling.

The old beach, marking the limits of the Lake Plain District, runs northeast from Ypsilanti to the county line above Cherry Hill, and southwest through Stony Creek to a point on the county line about eight miles west of Milan.

The native upland forests of the Interlobate Moraine District were composed chiefly of red, yellow, and white oak, with some smooth-bark hickory and sugar maple and a few shag-bark hickories. Here were also large areas of creeping juniper and a few small patches of ground hemlock (yew). On the flood-plains of the rivers and lakes were quite extensive swampy forests of soft maple, black ash, and white elm. Swamp oak and whitewood grew commonly in the drier situations toward the edge of the swamp conditions. The red-bud and red cedar were characteristic of the river banks. White pine probably never grew in the county, although a few trees occur on the south bank of the Huron River near Hamburg, a few miles north of the county line.

Tamarack bogs, some of large size, are abundant in the Interlobate Moraine District and occur commonly also in the Clay Morainic District, but are practically wanting in the Lake Plain District.

The Clay Morainic District was originally dominated by forests of oak and hickory. Several kinds of oaks, white ash, and several species of hickories, with shagbark most characteristic, were most abundant. Mixed with these were elm, beech, sugar maple, black walnut, and butternut. On the higher ground many stands of quaking aspen were found. The forest was quite dense and little underbrush normally



occurred. Tamarack bogs were common, and a small stand of black spruce occurred at the edge of Independence Lake. There are few flood-plains along the Huron River in this district, but along the river's edge were a few cottonwoods and sycamores, and many willows, some of large size. On the steep bluffs along the river was often a heavy growth of red cedar; and some large areas of procumbent juniper occurred. In this district were several open, level, sandy plains covered with a scattered growth of white and bur oaks and an undergrowth of hazel brush. These were known to the pioneers as "oak openings" or "plains." Lodi Plains in Lodi Township, Bur Oak Plains in Manchester Township, Sharon Plains in Sharon Township, and Boyden's Plains in Webster Township were the largest of these natural openings in Washtenaw County.

On the low lands of the Lake Plain District great forests of black ash, elm, whitewood, soft maple, red-bud, swamp oak, and bur oak were found by the early settlers. Large sycamore trees were found along the river banks, these following the Huron River up a short distance beyond Ann Arbor and occurring all along the Raisin and Saline rivers. The paw paw and pin oak were found rarely in the southeastern part of the county. Along the small streams in this district were extensive marshes which were evidently old beaver meadows. About the edges of the marshes were fringes of tamaracks.

At the beginning of the nineteenth century Washtenaw County was an unbroken wilderness, and deer, wolves, bear, and other large and small fur-bearing animals were abundant. A few white trappers were in the region, and the Indians frequently passed through on the old Tecumseh Trail to Detroit, where they went to trade.

In 1809 three Frenchmen established a trading-post at

Ypsilanti, where the Tecumseh Trail crossed the Huron River, and for several years they traded here with the Indians. In 1823 the first permanent settlement in the county was made by Benjamin Woodruff and two others at Woodruff's Grove, not far from the present site of Ypsilanti. A settlement was made at Ann Arbor in 1824, and many pioneers arrived in the county during the next few years.

With the coming of the settlers and the clearing of the forests the natural mammal habitats were greatly altered or destroyed. This, together with the hunting by the settlers, caused the gradual disappearance of the larger mammals, such as the cougar, bear, wolf, lynx, and deer. The clearings of the settlers created new habitats which were gradually occupied by species better adapted to civilization, such as the mole, woodchuck, ground squirrel, fox squirrel, and skunk, and also the house mouse and Norway rat, which were brought in unintentionally by the settlers.

For sixty-five years I have lived almost constantly in Washtenaw County and I have seen the latter part of the exploitation of the forests of the county and the extermination of most of the larger mammals. From my father, who settled in the county in 1836, and other old pioneers I have drawn extensively for information about the early mammals of the county. Much use has also been made of information contained in the Michigan Historical Collections. The specimens on which the records here are based are mostly preserved in the Museum of Zoology.

For considerable assistance in the preparation of the manuscript of this paper I am indebted to L. R. Dice, Curator of Mammals in the Museum of Zoology, University of Michigan.

## LIST OF SPECIES

*Didelphis virginiana virginiana*. Virginia Opossum.—This species is rare in the county. One was taken by my father, Jessup S. Wood, in 1845, in Lodi Township. We have later records for Ann Arbor, Dexter, Manchester, Saline, and Scio Township. The last recorded specimen was taken by some boys in November, 1921, just south of the Oakland County line.

February 5, 1912, a trapper took a specimen near Ann Arbor on a night when the temperature was about 10° F. below zero.

*Scalopus aquaticus machrinus*. Prairie Mole.—The mole was rare or absent from the county when first settled, but it has gradually increased and has spread over most of the cultivated lands. It is most common in sandy or gravelly loams, and is absent from the hard clay soils. I remember the first appearance of the species on the old Wood homestead in Lodi Township about 1870. It soon became common.

*Condylura cristata*. Star-nosed Mole.—Although not very rare in this county, it is seldom seen. We have records for Lodi Township, Ann Arbor, Webster Township, Ypsilanti, and Chelsea. It prefers low, marshy land near the water, and much of its food consists of aquatic insects, which it secures by swimming. It is not as well adapted for burrowing as the preceding species, so it lives in softer soil.

May 8, 1913, a nest containing six half-grown young was found by Kitt Cobb in marshy ground beside the Huron River at Portage Lake. The nest was in a good-sized cavity near the surface of the ground and was lined with dried grass. This species sometimes comes out on the surface of the ground, where I have found several individuals in early spring, most of them dead. February 10, 1907, near Ann Arbor, A. D. Tinker heard one tunneling in the snow and dug it out.

*Sorex personatus*. Masked Shrew.—In this county the masked shrew is usually found in sphagnum and tamarack bogs. There are records for a tamarack bog, three miles south of Ann Arbor, and for Honey Creek, three miles west of Ann Arbor. I have found it mostly under old logs and in stumps in rather moist situations.

*Blarina brevicauda talpoides*. Short-tailed Shrew.—Common in swamps, woodlands, and even in meadows, where it has its own runways and also uses those of the meadow mouse, on which it largely feeds.

This shrew is diurnal as well as nocturnal, and I have often seen it in its runways. It is active all winter, and its tunnels may often be seen in the snow. While trapping in Steere's Swamp, south of Ann Arbor, a *Synaptomys cooperi* in a trap was eaten by one of these shrews, which was later caught in the same trap.

*Cryptotis parva*. Small Shrew.—The first record for the county was obtained in 1902 at Ann Arbor. In February, 1904, one was found in a barn three miles east of Ann Arbor. At Portage Lake, in 1916, a house cat brought two individuals to her kittens on October 29 and 31, respectively. The specimens taken by me were found in grassy places, usually where briars and shrubs were intermingled with the grass, but not in the woods.

*Myotis lucifugus lucifugus*. Little Brown Bat.—Almost every winter individuals have been found in the building of the Museum of Zoology, at Ann Arbor, where they have been awakened by the heat long before insects were flying about. Max Peet took one at Ypsilanti June 6, 1904.

*Myotis subulatus subulatus*. Say Bat.—In 1902 one was found alive in one of the buildings of the University of Mich-

igan at Ann Arbor and was kept in a cage from February 26 to March 6, when it died.

*Lasionycteris noctivagans*. Silver-haired Bat.—A female which seemed to have an injured wing was picked up at Ann Arbor by A. G. Ruthven, June 13, 1910. It contained two large embryos. This species is rare in this county.

*Eptesicus fuscus fuscus*. Large Brown Bat.—Common at Ann Arbor and Ypsilanti. It is often found in buildings in winter. We have records for Ann Arbor every month except September, October, and November. Of all the bats this one is the most common about dwellings, and it is the one that most often enters houses at night in search of insects. Perhaps it is attracted by the light, as I have often seen it feeding about the street lights.

*Nycteris borealis borealis*. Red Bat.—Common at Ann Arbor, and there is one record for Ypsilanti. At Ann Arbor there are records from April 30, in 1919, to July 4, in 1921. Also one was taken in November, 1917. On June 12, 1903, a female with two young attached to the underside was found hanging in a tree in Ann Arbor. The young were naked and blind and quite small. June 10, 1908, another female was found in a similar situation with three half-grown young attached.

*Nycteris cinerea*. Hoary Bat.—We have records for Ann Arbor, Bridgewater Township, Manchester, and Portage Lake. Our dates run from September 5 to October 15; but in December, 1891, one was found in a barn and was kept alive for several weeks.

*Ursus americanus*. Black Bear.—Formerly common, and one of the last of the larger animals of the county to be exterminated. The last one known to be in the county was

killed in October, 1875, in the big marsh west of Saline. Mr. George Inman, one of the pioneers of Lodi Township, told me that he had seen one just killed a few miles west of Ypsilanti in 1852. One was killed in Pittsfield Township in 1835. Black or brown is the normal color in this state, but I have heard of one albino which was taken in Bay County not many years ago.

*Canis lycaon.* Timber Wolf.—When the county was first settled the wolves were so destructive that it was difficult to keep any domestic animals. As late as 1840, 30 sheep were killed for a neighbor of my father's in Lodi Township; and another neighbor was himself chased by a pack in the winter of 1836. In October, 1834, a large wolf was seen by Mr. S. P. Allen near Ypsilanti. In looking over the county records I find that in 1837 a bounty of five dollars each was paid to four residents for eight wolf scalps; in 1838 eight more bounties of eight dollars each were paid; and up to 1839 bounties to a total amount of \$178 had been paid. The records for the next twelve years are not available, but as late as 1853 two wolf bounties of eight dollars each were paid to residents of the county. Some of these probably refer to coyotes. We have one record of a black wolf for the county.

*Canis latrans.* Brush Wolf, Coyote.—In the History of Washtenaw County<sup>1</sup> there is a full-page picture of hunting the prairie wolves in an early day, which shows men on horseback in oak openings, rounding up the wolves. In the same volume is an account by Mrs. H. L. Noble, saying that the wolves would "come at evening and stay about the cabin all night, keeping up a serenade that would almost chill the blood in my veins." These were no doubt coyotes. In 1905 I

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<sup>1</sup>History of Washtenaw County, Michigan, p. 67, 1881.

mounted a large male, weighing 45 pounds, which had been shot in Sharon Township, March 10, by Mr. Keeler. Another is reported to have been seen in the same township in 1910.

*Vulpes fulva*. Red Fox.—The early settlers report the red fox as being quite common and destructive to small lambs, poultry, and game. Owing to its cunning this species has been able to live and increase in spite of much hunting and trapping. It is nocturnal as a rule, though I have seen them often in the daytime catching mice on the marshes. In April, 1883, a den was found in Lodi Township, and by careful watching the young could be seen playing about the entrance to the den while waiting for their mother to bring them food. The young in this den were moved to other dens every week or so, and to my certain knowledge were moved three times before they were dug out by a friend and myself. One transfer was for more than one-third of a mile. There were six of them about the size of small cats. These dens seem to have been woodchuck holes dug out and enlarged. Some were in hillsides, but some were on level ground. The den dug out was an old woodchuck hole. It extended about 25 feet into a bank, with a large nest chamber at the end about six feet from the top of the ground. A second entrance to the tunnel led down from the top of the bank and joined the tunnel about 12 feet from the nest. Some dried grass was noted in the nest chamber. A black fox was taken in Pittsfield Township in 1878, and I have heard of another being seen at a later date.

*Urocyon cinereoargenteus cinereoargenteus*. Gray Fox.—This small fox persisted in this county for many years. I saw one in Lodi Township in 1866 which had been treed by a dog. In October, 1866, two were shot near Saline by J. H. Bortle. The last one known to me in the county was taken

in Steere's Swamp, near Ann Arbor, in the winter of 1882. The species is very local, living in swamps and woods, which it rarely leaves. It has a sharp bark which is heavier than that of the red fox.

*Procyon lotor lotor*. Raccoon.—In this county the raccoon was formerly very common, according to the early settlers, and did much damage to poultry and to the corn when in the milk. In return it served as food and its skin was both an article of dress and a medium of exchange, a coon-skin being valued at 25 cents. It was still very common in Lodi Township in 1870-80 and furnished the sport of "coon-ing," when it often led both dogs and men a tiresome chase through woods and swamps and often escaped to its den in some big hollow tree.

When taken young it makes an interesting but very mischievous pet, and cannot be allowed loose in the house. I once had three as pets, and nearly all kinds of food given them were treated to a bath before eaten. It is omnivorous in its food habits and eats all kinds of fish, flesh, eggs, apples, berries, and is especially fond of green corn. On this food the coon grows fat, and when winter comes curls up in some den tree and sleeps through the winter, sometimes alone, and sometimes with several others. I have known of seven being found in a big hollow tree in Lodi Township. The latter part of the winter, during the warm spells; I have found tracks in the snow and have followed the tracks for miles as they visited other dens. The species is not strictly nocturnal, and I have often seen coons sunning themselves on limbs and have also found them on the ground feeding in the daytime. I once found a small one in the water of a little brook, where it was nearly drowned and was uttering a shrill, piteous cry. It had probably fallen from a log into the stream.



The young grow slowly and generally stay with the parents until a year old. They do not obtain their full growth until about the third year. They vary much in size, weighing from 15 to 40 pounds. One caught near Ann Arbor in November, 1905, weighed 30 pounds, and the blanket of fat under the skin weighed five pounds. The heaviest Michigan raccoon known to me was taken near Edmore, Montcalm County, May 10, 1904, and weighed 56 pounds.

The call is a shrill tremulo cry, almost like a whistle, and on a still night may be heard for a long distance. When caught by a dog it sometimes utters a snarling cry, from rage or pain. The color varies in shades of gray and black, and we have a dozen records of white or albino raccoons from this county, and half that number of black or melanistic ones.

*Mustela pennantii pennantii*. Fisher.—Henry Wilson, an old pioneer of Dexter, told me that he killed a large male in February, 1862, near Independence Lake, Webster Township. Other old trappers report that it has been taken in the county, but are not able to give exact data.

*Mustela noveboracensis noveboracensis*. New York Weasel.—This species is quite commonly distributed over the county even now. One summer day in Lodi Township I heard the excited squawking of a setting hen that was confined in a box coop; on raising the cover the hen was seen to have a weasel attached to her leg. With a stick I attempted to hit the weasel, which was dragged about by the hen, but only succeeded in causing it to run under a shed, from which place it soon stuck its head out of a hole. I again tried to hit it with a stick, but it always dodged the blow. Finally I went to the house for the gun, and when I returned found the weasel out chasing the hen again. A shot soon finished it.

In this county only about 75 per cent of the weasels change to the white coat in winter.

*Mustela vison mink.* Northeastern Mink.—In this county the mink has been so closely trapped that it is almost, if not quite, exterminated in some townships where it was formerly common. The mink is not so perfectly aquatic as the otter, but it also travels on land quite fast and far. I have found them a half-mile from water hunting for mice, birds, and even cottontails. I once shot one in Lodi Township that came to the chicken house and killed a fully grown hen, which it dragged a rod or so away, where it ate all it wanted. Another time I followed on the snow one that had run five miles in a night, and finally found it only a short distance from the place it started from. The mink is generally nocturnal, but I have often found it out on dark days. Once while fishing I saw one catch and carry away a good-sized trout. It is a poor climber, but once while hunting raccoons a dog chased one up a tree, where it was shot from a limb 20 feet above the ground. Albinos are rare, but we have in the Museum collections a mounted specimen which was taken at Ann Arbor. Melanistic specimens are rarer still, and I have seen but one, which was caught in Lodi Township in 1875.

*Mephitis nigra.* Eastern Skunk.—The skunk was common when the first settlers arrived in this county. With the clearing of the forests it became abundant. Altogether I have seen hundreds about my old home in Lodi Township. Here in one winter, about 1870, more than 30 were taken in one trap under an old barn.

Although it usually passes most of the winter months in a state of hibernation, it occasionally comes out during warm spells and wanders from one den to another. I have seen its

tracks every winter month. It is mainly nocturnal, but it also travels in the early evening and later morning, and I once saw a mother and six young pass through the dooryard just at dusk. The skunk is not a climber, as a rule, but I have found it a few feet up the inside of small hollow trees. Once I saw one enter a small stream and swim across; it was not forced, but went into the water of its own volition.

*Taxidea taxus taxus*. Badger.—The early settlers state that the badger was found in this county, but was not common. We have records from 1883 to 1919, including Saline Township, Superior Township, Lyndon Township, Ann Arbor, Chelsea, and Bass Lake. The species hibernates, but I have known it to come out on the snow, and I have records for every winter month.

*Lutra canadensis canadensis*. Canada Otter.—Formerly the otter was not rare in all the river systems of the county, and we know of a number being taken on the Huron, Raisin, and Saline rivers from 1856 to 1910, but none have been reported since that date. Three were seen and one shot by Edwin Hawley near Munith, Jackson County, not far from the county line, March 25, 1909. One was reported seen in a small mud lake in Lodi Township in 1910. At this same lake in 1886 two were taken by J. H. Bortle, of Saline. In May, 1908, John Staebler, a farmer, saw one at close range near Fleming Creek, two miles east of Ann Arbor, and in the spring of 1900 he saw another near the same place.

*Felis cougar*.—L. D. Watkins, of Manchester, records this animal as often passing through Manchester, about 1835, generally going southwest; the last one was seen in 1870. Hon. Henry S. Dean, of Ann Arbor, stated that one was reported in the county by hunters in 1838. Miss Julia Dexter Stan-

nard<sup>2</sup> tells of a panther that in 1830 chased her mother at dusk one evening while she was returning home, to Webster Township, from Ann Arbor on horseback. The panther followed almost to the house, when the lights in the window scared it off.

*Lynx canadensis*. Canada Lynx.—L. D. Watkins reports that he killed one in this county in 1842, and Hon. Henry S. Dean, of Ann Arbor, told me that old hunters reported it in the county in 1838.

*Lynx ruffus ruffus*. Bob-cat, Bay Lynx.—This species was always more common in the county than the Canada lynx, but it has been extinct here for fifty years. The early settlers often recorded it as common. In 1850 J. S. Wood, of Lodi Township, treed one with a dog. In 1870 Henry Wilson, of Dexter, saw one near Independence Lake.

*Peromyscus maniculatus bairdii*. Prairie Deer Mouse.—Specimens were taken September 28, 1909, in open fields near Manchester by F. M. Gaige. In the fall of the same year Dr. J. B. Steere took it on the big marsh four miles south of Ann Arbor; this, he states, is his first record for the species. In 1920 it was taken near Cavanaugh Lake, and is numerous near Ann Arbor and Portage Lake. It probably formerly occurred on the open prairies and oak openings, but now it is found in open fields and in grassy meadows.

*Peromyscus leucopus noveboracensis*. Northern Deer Mouse.—This mouse is abundant in forests over the county, and is found in adjoining fields, especially in those containing corn.

*Synaptomys cooperi cooperi*. Cooper Lemming-vole.—In October, 1883, George B. Sudworth took one near Ann Arbor.

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<sup>2</sup> *Mich. Pioneer Coll.*, v. 28, p. 565.

February 13, 1903, E. H. Frothingham found one under a corn shock about four miles south of Ann Arbor. In a run-way in a small tamarack stand in Steere's Swamp, near the same place, I trapped an adult female and four nearly grown young, October 8 and 9, 1903. In February, March, and April, 1921, H. B. Sherman trapped six in a field containing a little brush, a short distance south of Ann Arbor. A number of their remains were found by J. Van Tyne in the winters of 1921 and 1922 near Ann Arbor, in pellets of the long-eared owl.

*Microtus pennsylvanicus pennsylvanicus*. Pennsylvania Vole.—Was formerly found in beaver meadows, but with the clearing of the forests it has extended its range to the fields of grass and grain, and has become the most numerous of all the mammals of the county. Records are at hand for Ann Arbor, Pittsfield Township, and Portage Lake.

*Microtus pinetorum scalopsoides*. Pine Vole.—July 15, 1921, A. G. Ruthven found an adult male in the oak-hickory woods on his grounds near the outskirts of Ann Arbor.

*Fiber zibethicus zibethicus*. Muskrat.—In spite of persistent trapping, muskrats are still numerous in the county. Records are at hand for Ann Arbor, Pittsfield Township, Portage Lake, Saline, and Ypsilanti.

*Rattus norvegicus*. Norway Rat.—This injurious rodent became common soon after the settlement of the county. Its omnivorous food habits and adaptability have enabled it to increase greatly.

*Mus musculus musculus*. House Mouse.—The house mouse did not reach Washtenaw County until several years after the settlement of the district. It has become a serious pest, not only to household effects and stored food, but it has taken to

the grassy fields and the woods bordering grain fields, and is commonly found in shocks of corn. The amount of damage done by it in this county must be very great.

*Zapus hudsonius hudsonius*. Jumping Mouse.—A few occur in the county. We have records for Ann Arbor, Portage Lake, and Whitmore Lake. In October, about 1880, in Lodi Township, a female jumped from a shock of corn that was pulled over, and when caught, after several jumps of two feet or more, was found to have three small young attached to her teats.

*Erethizon dorsatum dorsatum*. Canada Porcupine.—The first settlers found porcupines were common in the county. My father killed one in 1855 in Lodi Township, and the last one known in the county was killed near Saline in October, 1868, by John H. Bortle.

The porcupine lives on the buds and bark of several species of trees, and also eats the stems and leaves of water lilies. It is a clumsy and stupid animal, knowing under natural conditions neither fear nor haste. Its coat of sharp-barbed quills affords almost complete protection from nearly all enemies except man, who alone is responsible for its extinction in the county. Although large and clumsy, it climbs readily, and often lives in the same tree for days. It also swims quite readily, sometimes entering the water voluntarily. It makes a number of noises; it sniffs, grunts, whines, chatters, and sometimes shrieks and cries like a child.

*Marmota monax rufescens*. Woodchuck.—Before the settlement of the county woodchucks were not very common, a few living on the prairies as well as in the woods. With the clearing of the forests it found a congenial habitat about the fields and gardens of the settlers, and there found also choice

food easily gathered. With these conditions it has greatly increased and has become a pest, so that many townships in southern Michigan pay a bounty of 25 to 50 cents each for woodchucks.

On the Wood homestead of 400 acres in Lodi Township this animal was rarely seen in 1865, but in the next twenty years it became so common that in the years 1881-82 I killed more than 100 and my brother and his helper 125 more, all of them on this one small tract, and even then some were left.

Its flesh is good when properly prepared, but most people are so prejudiced that they will not eat it.

Albinos are not rare; I know of one taken near Saline about 1885.

When alarmed it utters a shrill whistle; and when angry it chatters its teeth. I have often seen it climb trees, and have shot it from heights of 10 to 30 feet. It climbs when chased by dogs and also of its own free will.

*Citellus tridecemlineatus tridecemlineatus*. Striped Ground-squirrel.—This animal (erroneously called "gopher" by many people) was formerly common only in the southern part of the Lower Peninsula, where its natural habitat was the prairies or oak openings. Here it occurred in great numbers, as stated by the first settlers. As the state became settled and the timber cut off it gradually extended its range until at present it occurs in most of the cultivated areas of the Lower Peninsula.

This squirrel rarely climbs in bushes or small trees. It has a sharp whistle of alarm and a lower chirping call while feeding in company.

*Tamias striatus lysteri*. Northeastern Chipmunk.—Formerly abundant in the county, living in the forests. With the cutting of the forests it has become scarce, but is now sometimes found along brushy roadsides as well as in woods.

It occasionally climbs trees, but usually lives under stumps or logs in or at the edge of woods. It stores up quantities of food, and is seldom seen in the winter months.

We have an albino at the Museum of Zoology which was caught near Ann Arbor by a cat, and I know of one other seen near the city.

The call of the chipmunk is a loud chirp or chuck, regularly repeated and audible for a half-mile on still, frosty mornings. It also has a bird-like chirp or rapid call.

*Sciurus hudsonicus loquax*. Southeastern Red-squirrel.—This is the most abundant squirrel in the county. Owing to its small size it was formerly not hunted; it also easily adapted itself to civilization and increased so rapidly that in places it became a nuisance. It has been accused of driving off the fox and gray squirrels, for which reason it was exterminated from the University campus, where it formerly occurred.

The red-squirrel is very noisy and has a number of calls, chatters, and a whining cough which easily distinguishes it from other squirrels.

Several albinos have been taken in Washtenaw County, one pure albino in Dexter Township in 1908, and one nearly pure white, but with brownish dorsal stripe and tail, near Ann Arbor in 1912.

*Sciurus carolinensis leucotis*. Northern Gray Squirrel.—Abundant in the county for many years after its settlement. To the early settlers it was an injurious species, as it destroyed much of their scanty corn crop; but in later years it furnished much sport as well as a choice food for the table. Its chosen habitat was the heavy forest of beech and sugar maples, and with the cutting of these woods the gray squirrel has gradually become rare, only a few now being found in the county.



As late as 1875 I saw many of the species, about one-half of the black phase.

Its call is a high, shrill chatter, which may be heard quite a distance, and which is distinguished by hunters from the call of the red squirrel or fox squirrel. J. Austin Scott witnessed a migration in the fall of 1840, when hundreds of gray and black squirrels crossed the Raisin River near Adrian. They came from the south and were so exhausted from swimming across the river that the boys killed many with clubs. He counted 30 in one small tree near the water's edge.

*Sciurus niger rufiventer*. Western Fox Squirrel.—When Michigan was first settled the species was rare and was confined chiefly to the southern part of the state, where it occurred in the oak openings, which seem to be its favorite habitat.<sup>3</sup> With the cutting of the heavy timber it has gradually extended its range, occupying all of the more open forests, and it has become very common, even entering the cities, where it has become semi-domesticated.

W. J. Beal<sup>4</sup> states that in Lenawee County there were no fox squirrels in the early days, but later they came in from the south. At my home in Lodi Township I never saw one until about 1875, and they were rare for several years after that.

This is our largest squirrel, furnishing sport and food for hunters. One albino taken in the county is in the collection of the Museum of Zoology; and one partly melanistic individual, taken near Ann Arbor, November 12, 1910, has the whole underside jet black.

The call is hoarser than that of the gray squirrel, but although not so high in pitch may be heard for some distance.

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<sup>3</sup> Robert Kennicott, *U. S. Patent Office Report*, p. 56, 1856.

<sup>4</sup> *Mich. Pioneer Coll.*

It occasionally swims; I know of one which swam across a part of Portage Lake, one-half mile, on a hot summer day, about 1910.

*Glaucomys volans volans*. Southern Flying Squirrel.—This species may still be found in some numbers in suitable habitats in the county. They are usually found in woods, although I have found them in houses both in Ann Arbor and at Portage Lake. They nest and live in tree cavities, and in winter are gregarious. In late December, about 1890, in Lodi Township I found 20 or more in a hollow butternut stub. The call is a high, bird-like chirp or long squeak, which I have often heard from the tree tops while in the woods on moonlight nights.

*Castor canadensis michiganensis*. Woods Beaver.—The first settlers of this county found this species to be nearly extinct, although dams and old beaver meadows were very common. It probably became scarce about 1800. Hon. Henry S. Dean, of Ann Arbor, told me that in 1837 at "Gravel Run," a few miles north of Ann Arbor, he saw a dam in good shape, although not used at that time. Remains of other dams still exist. S. D. Allen, of Ann Arbor, told me that in 1835 he saw a live beaver in the Huron River near Ypsilanti. This is the last record for the county.

*Lepus americanus americanus*. Snowshoe Hare.—This hare was formerly common over all the southern peninsula of Michigan. In Washtenaw County it persisted for a long time in the tamarack bogs, but when these were mostly drained or destroyed the hares became extinct. It was last taken in Steere's Swamp, four miles south of Ann Arbor, in 1875. One was taken in a swamp near Whitmore Lake in 1890. L. D.

Watkins, of Manchester, reports shooting one in a large swamp near Pleasant Lake in the fall of 1907.

*Sylvilagus floridanus mearnsii*. Mearns Cottontail.—The cottontail was formerly common only in the southern part of Michigan, but it now occurs over all the cultivated area of the Lower Peninsula. It has increased with and followed the civilization that furnished an abundance of food and destroyed many of its enemies.

I have several times found nests in meadows and cultivated fields. The nest is built in a deep form and is lined with fur from the mother's body and fine grass. The young are completely hidden when left by the mother. April 16, 1920, I found a nest containing five young in a stubblefield at Portage Lake. The young were well covered with hair, but the eyes were not open. April 20, 1920, I found another nest containing young on the lawn of an unoccupied house near the shore of Portage Lake. The number of young was not determined. May 5 the young were gone and the nest was deserted. May 16, 1920, L. R. Dice saw four young cottontails with their eyes open in the possession of a boy. They were taken from a nest near Ann Arbor.

About May 10, some years ago, I saw a cottontail jump into and swim across Mill Creek in this county. The animal was not pursued nor driven in any way into the water. Sometimes when caught alive the cottontail utters a loud, shrill cry.

*Bison bison bison*. American Bison.—According to the reports of the early explorers, this large mammal, in the eighteenth century, occupied, or at least visited, the southern border of the state of Michigan. Although we have no record of its occurrence in this county, its remains have been found just over the western border of the county by L. D. Watkins, who

in 1835 picked up three skulls near Norvell, Jackson County (Township 4 south, Range 2 east, Section 22). Two of these skulls were sent to Hillsdale College, where one still remains, though the data with it were lost during a fire; the other skull was sent to Albion College, but cannot now be found. At the time these specimens were collected other bones were plentiful on the surface of the ground.

*Cervus canadensis canadensis*. Eastern American Elk.—Probably common over most of the Southern Peninsula of Michigan up until the time of the settlements. I have found no record of live elk seen in the county, and the species probably was extinct in the district before 1800. Bones and antlers are common in the marshes and swamps of the county.

*Odocoileus virginianus borealis*. Northern White-tailed Deer.—Abundant in the county when the first settlers arrived, and continued common for many years. It quickly learned to adapt itself to civilization, feeding by night where it formerly fed by day. Some early settlers report much damage done to gardens and crops, of which the deer soon learned the location. The last deer known to me in the county was seen in Saline Township in 1875 by William Gordon, who reported it to me at the time. Covert<sup>5</sup> records one seen in the county in 1879.

#### *Hypothetical List*

The mammals included in this list have been reported as occurring in Washtenaw County, but I can find no specimens with authentic data nor descriptions satisfactory for identification, and consider the records doubtful.

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<sup>5</sup> Covert, A. B., in *History of Washtenaw County*, p. 194, 1881.

*Rattus rattus rattus*. Black Rat.—Covert<sup>6</sup> states that the species is “very rare. I have but one specimen, which was caught at the Michigan Central R. R. Depot.”

*Mustela allegheniensis*. Least Weasel.—Covert says, “The only specimens of this mammal I have had were brought in this winter” (1881). I have not been able to find these specimens, which were doubtless small females of *Mustela noveboracensis*.

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<sup>6</sup> Covert, A. B., in History of Washtenaw County, pp. 193-194, 1881.



OCCASIONAL PAPERS OF THE MUSEUM OF  
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UNIVERSITY OF MICHIGAN

ANN ARBOR, MICHIGAN PUBLISHED BY THE UNIVERSITY

NOTES ON THE MAMMALS OF BERRIEN COUNTY,  
MICHIGAN

BY NORMAN A. WOOD

The data on the mammals of Berrien County given below were obtained more or less incidentally by the writer, while engaged in a study of the birds of the region in 1917, 1918, 1919, and 1920. A few traps were set in the region about Harbert in 1917 and 1918, but in the work in the E. K. Warren Preserve, in 1919 and 1920, no trapping was done since the mammals of the woods and dunes were being studied by Lee R. Dice.<sup>1</sup>

## LIST OF SPECIES

*Bison bison bison*. American Bison.—The basal portion of a small skull with horn cores attached was dug up at Birchwood Beach by Wells Sizer about 1897. At present these are the only remains of the species in Michigan known to me. Three skulls, which were found by L. D. Watkins near Man-

<sup>1</sup> *Occ. Pap. Museum of Zoology*, No. 86, June 24, 1920.

chester, Washtenaw County, in the early thirties, have been destroyed by fire.

*Sciurus niger rufiventer*. Fox Squirrel.—Not a common species in the dune region. Specimens were seen at Harbert by Ruthven in July, 1917, and by the writer in May, 1918. One or two were noted at Warren Woods in May, 1919, and several at Warren Dunes in May and June, 1920.

*Sciurus carolinensis leucotis*. Northeastern Gray Squirrel.—This is more abundant than the preceding species, especially in the beech trees of the wooded dunes. The writer saw a black one at Birchwood Beach in May, 1919.

*Sciurus hudsonicus loquax*. Southeastern Red Squirrel.—The most common species on the wooded dunes and in Warren Woods. It is a pest about the resorts.

*Tamias striatus lysteri*. Northeastern Chipmunk.—Rare. One was seen a mile north of Birchwood Beach, May 20, 1918. In Warren Woods one was taken May 15, 1918, and another noted in May, 1919.

*Citellus tridecemlineatus tridecemlineatus*. Striped Spermophile.—A common species at Birchwood Beach, where specimens were taken in July, 1917, and May, 1918. It was only occasionally seen at Warren Woods and Warren Dunes in 1919 and 1920.

*Marmota monax monax*. Southern Woodchuck.—Common about the dunes and the farms behind them. An adult male, light gray, was shot in a small tree near Willow Brook in May, 1918. At Warren Woods several (one very dark in color) were noted in 1919, and at Warren Dunes in 1920.

*Glaucomys volans volans*. Eastern Flying Squirrel.—A specimen was taken in a cottage a half-mile north of Birch-



wood Beach in October, 1917, and was presented to the Museum by Preston Sweet. The species was not noted by the Museum collectors.

*Mus musculus musculus*. House Mouse.—So common that it is a nuisance.

*Peromyscus leucopus noveboracensis*. Northern White-footed Deer Mouse.—A nuisance about the resorts, where it does much damage.

*Peromyscus maniculatus bairdii*. Prairie White-footed Mouse.—A pair was found in July, 1917, at Birchwood Beach under a pile of driftwood, where they had built a nest of fine grass.

*Microtus ochrogaster*. Prairie Vole.—Rare. So far as known the first specimen to be taken in the State was captured by the writer in May, 1918, in a small meadow near Birchwood Beach. The species was taken at Warren Woods by Dice in 1919.

*Fiber zibethicus zibethicus*. Muskrat.—Only occurs occasionally on the lake beaches, but it is more common on the ponds and streams back of the dunes. At the south pond it was observed in May, 1918, and numbers had been trapped there the winter before. There were a few about the north pond in 1920.

*Sylvilagus floridanus mearnsii*. Mearns' Cottontail.—A common species at Birchwood Beach. Several young were seen after May 15, 1918, and a few were noted at Warren Woods in 1919 and at Warren Dunes in 1920.

*Procyon lotor lotor*. Raccoon.—Occurs only in the heavy forests. Tracks were noted along the Galien River in May,

1918 and 1919, and along the edge of the north pond at Warren Dunes in May, 1920.

*Taxidea taxus taxus*. American Badger.—One was trapped by John Eardman in November, 1917.

*Mustela noveboracensis noveboracensis*. New York Weasel.—July 21, 1917, a large male of this species was shot at the edge of Willow Brook near Birchwood Beach. Tracks were occasionally seen on the dunes in 1918 and 1920.

*Scalops aquaticus machrinus*. Prairie Mole.—Very common on the dunes, where its runways almost reached the lake, and in fields. Several were caught at Birchwood Beach, and the runways were noted at Warren Dunes in May and June, 1920.

*Nycteris cinerea*. Hoary Bat.—An adult female containing two large embryos was taken by Dr. J. Hancock at his cottage near Lakeside, June 10, 1917. This is the only breeding record known to me for the State.

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NOTES ON THE LIFE-HISTORY OF THE BROOK  
LAMPREY, *ICHTHYOMYZON UNICOLOR*<sup>1</sup>

BY PETER OKKELBERG

The brook lampreys live the greater part of their lives in a larval state, the period of adult existence being less than a year. As far as known, metamorphosis usually takes place in late summer or in the fall. At the time of metamorphosis the larvae have reached the adult size and no food is taken subsequent to transformation. After the spawning season, which is usually in April or in May, all the adults die, and consequently only larvae are found during the early summer months.

Due possibly to the difficulty of obtaining large collections of larvae from one locality at any one time, no one has yet tried to determine the rate of growth in the brook lampreys. Several attempts have been made, however, to determine the duration of the larval period, but so far no uniformity of results have been obtained. This may be due to the small number of specimens often used in making the calculations,

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<sup>1</sup> Mr. Carl L. Hubbs has kindly read and criticised the manuscript for this paper.

but it is also likely that different species vary with respect to the length of the life cycle and that the same species may vary in different localities.

Müller (1856), who is usually credited with the discovery that the ammocoetes are the larval forms of the lampreys, measured six larvae of the European brook lamprey, presumably *Lampetra planeri*, and found their lengths to be 5.8, 6.3, 6, 15.3, 15.4, and 14 centimeters, respectively. The first three he judged to be a little over a year old and the last three about two years. Two metamorphosed individuals measured 16.2 and 19.3 centimeters each, and he concluded that these must be at least over two years old and would be three years at the time of spawning.

In the same species, Lubosch (1903) found larvae of three different sizes. Those of the first few months measured from one to two centimeters in length. The average size of larvae of the first year was five centimeters, that of the second year larvae ten centimeters, and that of the third year larvae, or just before metamorphosis, fifteen to eighteen centimeters. He thus agrees with Müller regarding the length of the life cycle in this species.

Loman (1912), on the other hand, found larvae of four different sizes in single collections of this species, and he believed that these represented four different generations. No mention is made of the season when such collections were made, so it is not possible to tell whether he meant to imply that the life cycle is four or five years.

Larvae of the American brook lamprey, *Entosphenus appendix*,<sup>2</sup> collected near Ann Arbor, Michigan, were found by Schaffner (1902) to be of three different sizes just before the

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<sup>2</sup> The species commonly known as *Lampetra* or *Entosphenus wilderi*. See Creaser and Hubbs (1922).

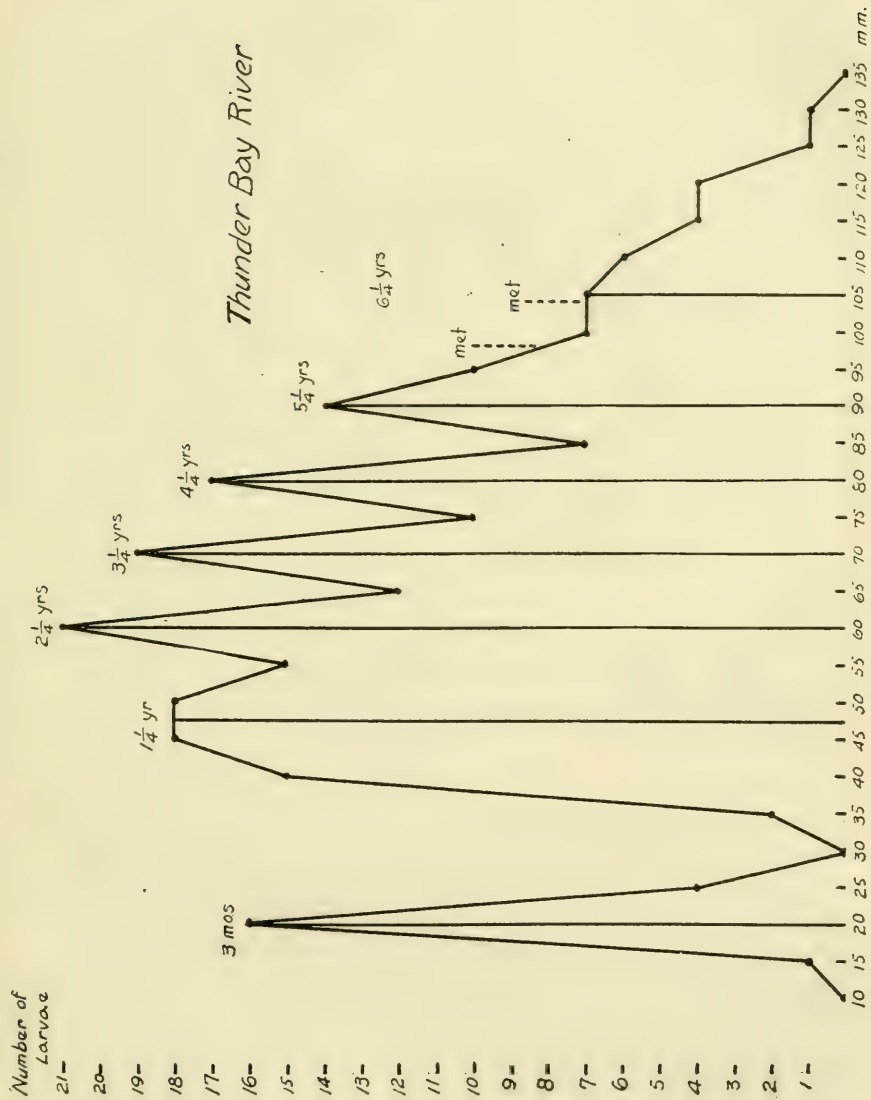


Fig. 1. Graph showing year groups of 229 larvae of *Ichthyomyzon unicolor* collected August 25, 1921, in Thunder Bay River, near Atlanta, Michigan

Gilchrist Creek.

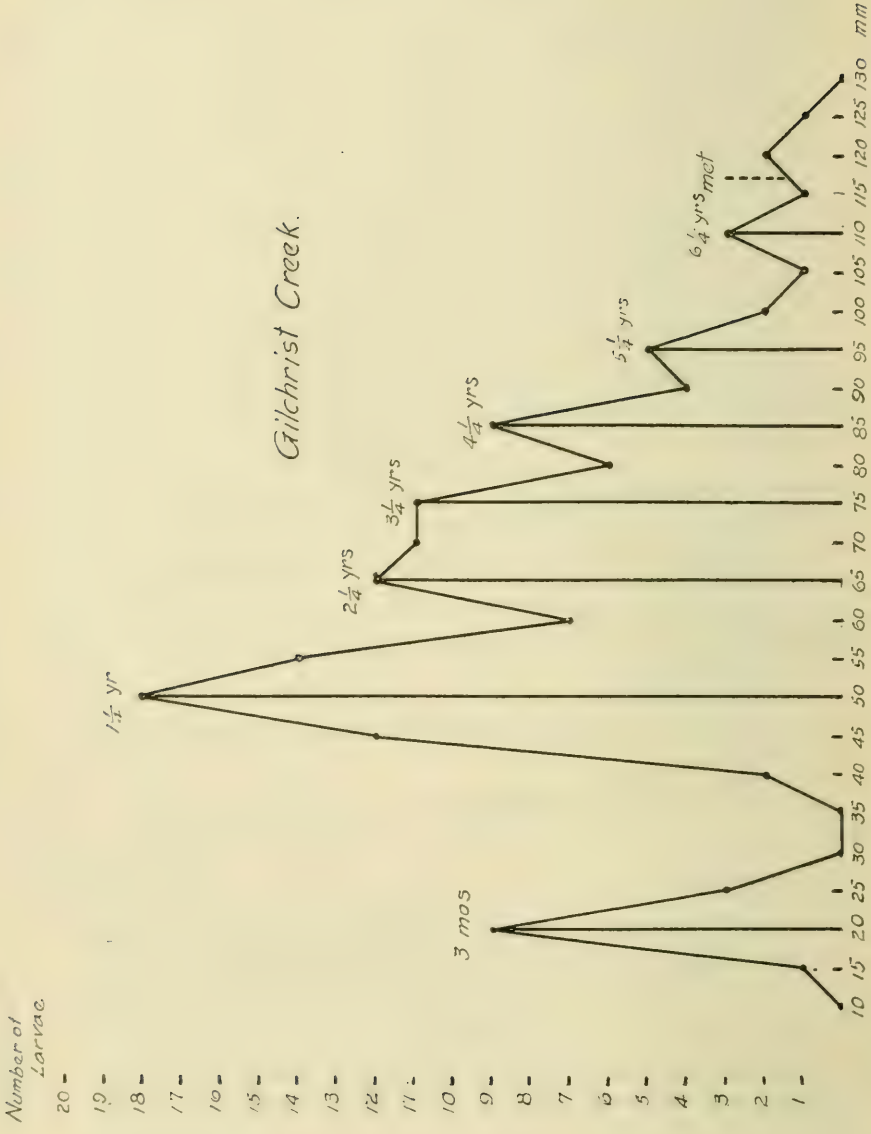


Fig. 2. Graph showing year groups of 134 larvae of *Ichthyomyzon micolor* collected August 26, 1921, in Gilchrist Creek, a tributary of the Thunder Bay River.

spawning season in the spring, and he took this to mean that it required four years for the whole life cycle. The three groups were arranged by him as follows: larvae of the third year, 17 to 20 centimeters; those of the second year, 9 to 11 centimeters, and those of the first year, 3 to 6 centimeters.

In the same form and from the same locality, the writer (1921) found larvae of five different sizes during the month of August, indicating a life cycle of at least five years. This conclusion was based on measurements of 167 larvae. Similar results were obtained from collections made in February and during the months of April, May, and June.

*Nature of Material.*—In 1921 two collections of another species of brook lamprey, *Ichthyomyzon unicolor* (see Creaser and Hubbs, 1922), were obtained by Messrs. Carl L. Hubbs and Charles W. Creaser, one on August 25 in Thunder Bay River southeast of Atlanta, Michigan, consisting of 229 specimens, and another on August 26 in Gilchrist Creek, a tributary to Thunder Bay River, of 134 specimens. In the former collection there were two metamorphosing individuals and in the latter another one. These collections were kindly turned over to the writer for a determination of the rate of growth and of the length of the life cycle.

*Ichthyomyzon fossor*, a synonym of this species, was described by Professor Jacob E. Reighard and Mr. Harold Cummins in 1916 from specimens obtained in Mill Creek, near Dexter, Michigan. The adults which formed the basis for the description ranged in size from 112 to 149 millimeters and the larvae from 80 to 158 millimeters. The time of metamorphosis and the duration of the larval period were not determined.

*Length of the Life Cycle.*—The specimens of both collections were carefully measured and the measurements were

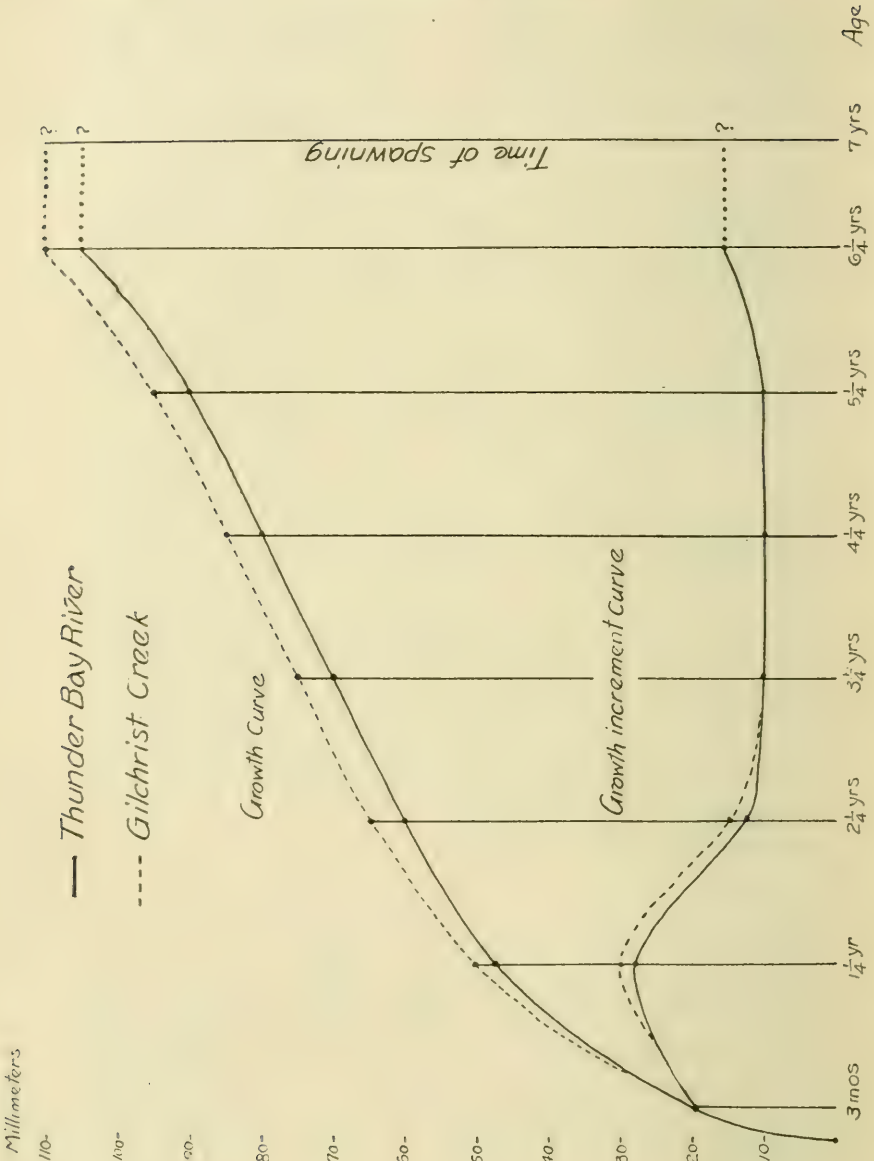


Fig. 3. Growth and growth increment curves of *Ichthyomyzon unicolor* collected in Thunder Bay River and Gilchrist Creek.



recorded separately. The larvae of the first collection were found to range from 16 to 128 millimeters in length and those of the latter from 17 to 126 millimeters. The measurements were plotted and used as the basis for the life cycle curves shown in Figs. 1 and 2, for the two collections respectively. The ordinates in the curves represent the number of individuals and the abscissae their lengths in millimeters.

A study of these graphs reveals the fact that they are made up of several distinct modes around which the larvae seem to be grouped. This can scarcely be a matter of chance, since both of the collections exhibit the same groups. The groups undoubtedly represent different generations of larvae, and the conclusion is reached that the length of the life cycle in this form and in this particular locality is seven years. This does not preclude the possibility, however, that some precocious individuals may metamorphose at an earlier stage than others and that some retarded individuals may even take more than seven years for their full development. The great amount of variation in the size of the larvae due to inequality of growth makes it impossible to determine with any degree of exactness the age of any single individual. The only part of the curve that stands out definitely in each case is that part which represents the youngest larvae in the collection, namely, those three months old. From this time on the year-group curves merge more or less with one another and it is only possible to arrange the larvae according to age around certain average sizes. The full-grown larvae are grouped around the last mode, which is at 105 millimeters, and although two transformed individuals were found to be shorter than this, it is likely that the adults would on the average be about 105 millimeters or more. Most of the larvae grouped around the last

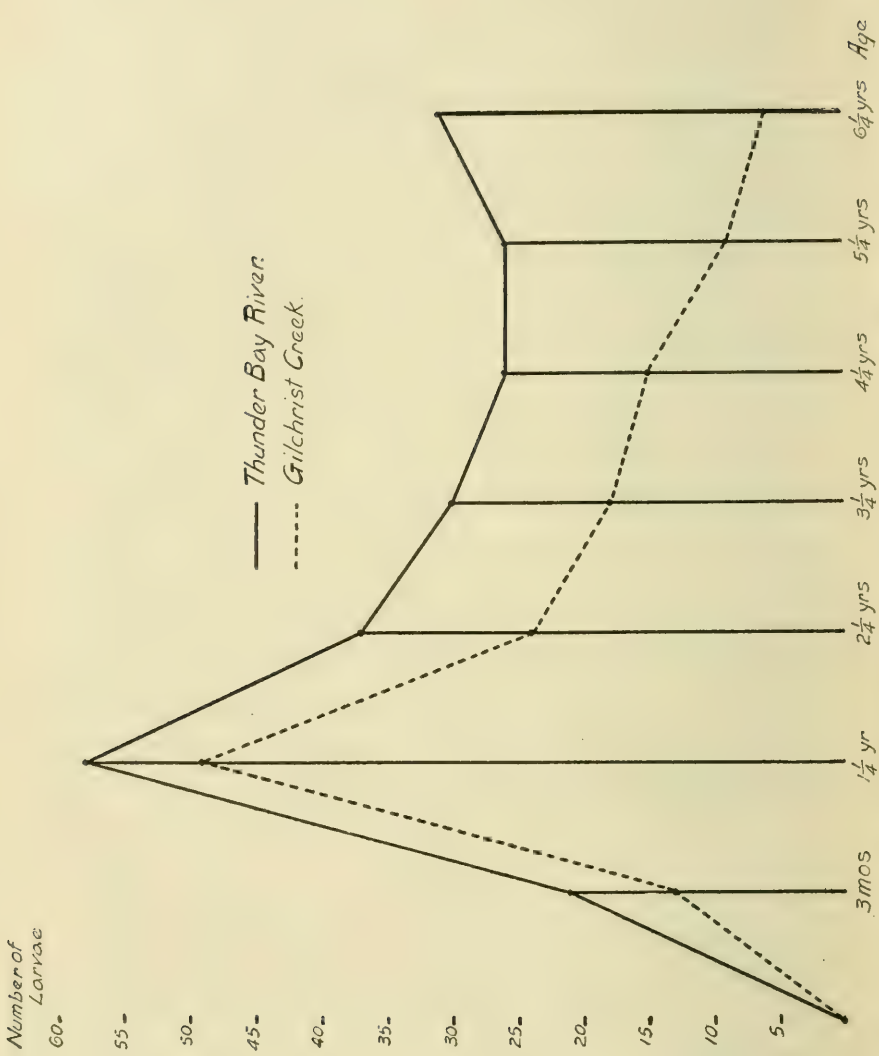


Fig. 4. Survival curves of *Ichthyomyzon unicolor* collected in Thunder Bay River and Gilchrist Creek.

mode would presumably transform before the next spawning season.

Summarizing the data contained in the curve, it is found that the annual groups may be arranged around the modes as follows:

<i>Age</i>	<i>Thunder Bay River</i>	<i>Gilchrist Creek</i>
3 months .....	20 millimeters	20 millimeters
1 $\frac{1}{4}$ years .....	47.5 "	50 "
2 $\frac{1}{4}$ " .....	60 "	65 "
3 $\frac{1}{4}$ " .....	70 "	75 "
4 $\frac{1}{4}$ " .....	80 "	85 "
5 $\frac{1}{4}$ " .....	90 "	95 "
6 $\frac{1}{4}$ " .....	105 "	110 "

At present there is not a sufficiently large collection of larvae from the type locality (Mill Creek, near Dexter, Michigan) on hand for the study of the life cycle. It is hoped that such a collection may be obtained so that a comparison may be made with the above more northern series. It is possible that temperature may have some influence on the length of the life cycle and that the northern form may pass through its development more slowly than the more southern forms. The difference in latitude between the two points is only about 185 miles, but the difference in the temperature of the water is greater than indicated by the difference in latitude.

*Rate of Growth.*—Taking the average size of the larvae of each year to be represented by the modes of the graphs 1 and 2, growth and growth increment curves may be constructed which will throw interesting light upon the rate of growth in the larvae during the successive years of their life cycle. Such curves are shown in Fig. 3.

It will be seen that the greatest increase in length takes place during the first year and a quarter of the animal's life. In fact, the larvae have attained to about half the adult length

at the end of this period. From this time on there is a sudden decrease in the growth rate up to the third year, when the rate becomes constant until between the fifth and sixth years, when there seems to be a slight increase again. This may accompany changes that eventually lead to metamorphosis. No data are available for a comparison of the size of the full-grown larva with that of the adult. Since the animal does not feed after metamorphosis, it is likely that there is no increase subsequent to this period. Neither is it likely that there is any decrease in size during or after metamorphosis, as Meek (1916) has suggested.

Reduced to percentages, the growth increments for the successive years of larval life are found to be as follows:

<i>Age</i>	<i>Thunder Bay River</i>	<i>Gilchrist Creek</i>
0 to 3 months.....	19.0%	18.1%
3 months to 1¼ years.....	26.1%	27.2%
1¼ years " 2¼ " .....	11.9%	13.6%
2¼ " " 3¼ " .....	9.5%	9.0%
3¼ " " 4¼ " .....	9.5%	9.0%
4¼ " " 5¼ " .....	9.5%	9.0%
5¼ " " 6¼ " .....	14.2%	13.6%

From the above table and from the graphs it will be seen that the rate of growth differs somewhat in the two collections. The rate is a little higher in the brook collection during the first and second years. This variation may, of course, be within the limits of error due to the small size of the series, but if any meaning can be attached to it, one might suggest the cause to lie in differences in food conditions, differences in temperature, or some other factor which might favor the brook-living individuals.

*Mortality Rate.*—By grouping the larvae that approximately belong to each year in the life cycle of the animal, it is possible to obtain some idea of the annual death rate. One can-

not be absolutely certain of the year to which a certain larva belongs, since there is a great deal of intergradation due to inequality of growth, but one should be quite nearly right by taking the larvae represented in each hump of the curve as the number of each year. These numbers and their equivalents in percentages are as follows:

<i>Age</i>	<i>Thunder Bay River</i>	<i>Gilchrist Creek</i>
3 months .....	21 indiv. or 9.1%	13 indiv. or 9.7%
1¼ years .....	58 " " 25.3%	49 " " 36.5%
2¼ " .....	37 " " 16.1%	24 " " 17.9%
3¼ " .....	30 " " 13.1%	18 " " 13.4%
4¼ " .....	26 " " 11.3%	15 " " 11.1%
5¼ " .....	26 " " 11.3%	9 " " 6.7%
6¼ " .....	31 " " 13.5%	6 " " 4.4%

On plotting these figures the curves represented in Fig. 4 are obtained. Theoretically, the largest number of individuals should have been obtained of larvae three months old, and yet the graphs show that relatively few were obtained of this age as compared with some of the older stages. There may be several reasons for this. For one thing, the young larvae are very small and some of those landed may have escaped observation. It may be also that the young larvae remain nearer the spawning grounds, among rocks and higher up the streams, during the first summer, due to the absence of conditions, such as floods, etc., which later would be operative in carrying them down stream and into more favorable collecting places.

The largest year-group of larvae obtained comprised those one year old. There is a sudden drop in number during the second year, and this is correlated with a sudden drop in the growth increment curve during the same period. This might indicate that this is a critical period in the life of the larvae, when vitality, perhaps, is low on account of some internal change of great importance. In another species of lamprey, *Entos-*

*phenus appendix*, this is the period when sex is being established in the larvae (see Okkelberg, 1921), and during which profound changes are taking place in the gonads. Since the germ cell history in *Ichthyomyzon unicolor* has not been studied, only the suggestion can be offered of correlation between the apparent low vitality of this period and the changes connected with the establishment of sex.

Another explanation of the sudden drop in the curve between the first and second years may be that the smaller larvae are more subject than the older ones to destruction by fish, for which they undoubtedly serve as food.

There is a gradual decrease in the number of larvae during the third and fourth years. After this there is no decrease in the series from Thunder Bay River and the curve even indicates an increase during the sixth year. In the tributary to the river, however, the decrease is quite gradual up to the last year. This discrepancy in the two curves may be correlated with a passive migration of the larvae down stream during heavy rains and spring thaws. Such transportation of larvae down stream has been suggested for *Entosphenus appendix* (Okkelberg, 1921). The larvae which during their early life period were found in the smaller streams might well have been carried into the river by the time of their fifth and sixth years, and thus there should be an increase of larger larvae in the collection from the river.

In the above discussion it has been assumed that spawning took place under identical conditions each year. It is conceivable that the crop of larvae of one year might be greatly reduced during or directly after the spawning season, through the agency of floods or other circumstances appearing at a time when the embryos or young larvae are least able to sur-

vive unusual conditions. Such catastrophes would, of course, influence the shape of the graphs.

#### SUMMARY

The length of the life cycle in *Ichthyomyzon unicolor* in the region of the Thunder Bay River, Michigan, appears to be seven years. This is a longer life cycle than has been recorded for any other lamprey.

The greatest increase in length takes place during the first year. At the end of the first year and a quarter the larvae have attained to about one-half their full-grown lengths. From this time on the increase is uniform from year to year except the last, when there is a slight increase over the normal. This may be correlated with changes leading to metamorphosis.

The mortality rate is greatest between the first and second years. A suggestion is made that this may be a period of low mortality correlated with internal changes leading to the establishment of sex.

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OCCASIONAL PAPERS OF THE MUSEUM OF  
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DISCOVERY OF THE EGGS OF THE FOUR-TOED  
SALAMANDER IN MICHIGAN

BY FRANK N. BLANCHARD

Even before the publication of Mr. S. C. Bishop's excellent paper on the habits and development of *Hemidactylum scutatum* (Schlegel),<sup>1</sup> it had been the present author's hope to find the eggs of this "rare" salamander in Michigan. Adults and immature individuals had been found in several localities, chiefly in the autumn, however, on account of lack of time and facilities for spring collecting and because the salamanders are easier to find at the former season in the situations most hunted, *i. e.*, beneath old logs and wood in terrestrial habitats adjacent to swampy areas.

In one such place, in Lima Township, Washtenaw County, adults and half-grown individuals had been taken under logs on several occasions in the autumn. Here a small piece of oak woods occupies an uneven ground adjacent to a wet grass-

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<sup>1</sup>*New York State Mus. Bull.*, Nos. 219, 220, 15th Rep. of the Director for 1918, 1920, pp. 251-282.

land that borders a moderate-sized stream. Partly in and partly outside of the woods lies a small, irregular pond, roughly 300 feet by 30 feet, with low grasses, sedges, and mosses at its edges, and numerous grassy and shrubby clumps forming little islets out from shore. Duckweed, crossed by numerous muskrat swimways, almost entirely covers its surface, beneath which may be seen a plentiful aquatic vegetation with sphagnum in places abundant. At the first step from shore one sinks knee-deep or more in a vile-smelling muck of decayed leaves and aquatic vegetation. Good-sized oaks nearby admit only an intermittent light during most of the day. Here wood frogs, green frogs, cricket frogs, and newts are abundant. And here in the rhizoids and roots of moss and grass the eggs of *Hemidactylium scutatum* were first found this spring on May 13. About eight bunches of eggs were discovered on this date with larvae bearing gills and fore limbs as buds or only slightly developed, representing Bishop's figures 2 and 3, plate 7. Subsequent visits to the same place revealed about thirty more masses of eggs. In every case the eggs were found within from three to six and a half inches of the water's surface, either just under the moss covering of an old stump or root or entangled in moss rhizoids and grass roots, not in the earth below the roots nor in the moss and grass above the roots. In the great majority of instances the eggs were almost or quite directly above the water, but occasional masses were located as much as three inches from the water horizontally. Although most of the clusters were confined to the shore line, a few were discovered in the grassy islets several feet from shore.

The process of hatching was observed in three egg masses in the field on May 27, and numerous larvae were taken from the water with a dip net. The larvae in all the other egg masses examined on this date were in an advanced state of

development. On June 4 no eggs were to be found, but about eighteen larvae were taken near shore with a dip net. These had fully developed gills, and the hind limbs showed from two to four toes. Although somewhat less advanced than examples reared in the laboratory, they were plumper and lacked the frequent mutilations of gills and limbs observed in the indoor specimens.

Eggs were found also in two similar localities in Iosco Township, Livingston County, on May 21, and in Whiteoak Township, Ingham County, May 28. At the latter place fifty-two masses of eggs were found in one section of a single small pond in a shady, wet woods of ash, linden, oak, maples, and elms. Not only was advantage taken of the mossy situations, but very many masses of eggs were attached to the sides of crevices and hollows in the soft, rotted wood of a large water-soaked log that projected thirty feet or so out into the pond, and in one instance eggs were found under the loose bark of an old stump that stood at the edge of the water. In one egg cluster the larvae were hatching; in the others they were well advanced and those brought to the laboratory nearly all hatched in a day or two. Here, as in previous instances, with nearly every egg mass an adult salamander was found, which proved in every one of about forty dissections to be a female. Varied as were the places for deposit of the eggs, every cluster fulfilled the essential conditions of proximity to water, both horizontal and vertical, that were found in the Lima pond, and that Bishop observed in New York state. Doubtless it will be found that the eggs occur in this state, too, in sphagnum at the bases of shrubby clumps in bogs or swamps, as Bishop reported, but at any rate "feather-bed" swamps do not present the only acceptable conditions for the breeding of the four-toed salamander.



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NEW SPECIES OF CRANE-FLIES FROM SOUTHERN  
INDIANA

BY CHARLES P. ALEXANDER

During June, 1921, J. Speed Rogers and the writer spent two weeks in making a survey of the Tipulid fauna of southern Indiana, devoting especial attention to the remarkable fauna of Jefferson County in the vicinity of Hanover. The complete list of crane-flies secured upon this trip will be recorded in another paper. The types of the new species described herein are preserved in the writer's collection, allotypes and paratypes in the collections of the Museum of Zoology of the University of Michigan.

*Erioptera (Acyphona) indianensis*, sp.n.

Mesonotal praescutum obscure yellow with four brown stripes; pleura silvery gray, delimited by narrow, dark brown, longitudinal stripes; each femur yellow with a single, sub-terminal, dark brown ring; wings yellow, the brown pattern very restricted; abdomen dark brown; hypopygium with the gonapophyses very slender, curved to the acute tips.

*Male*.—Length, 3.8 mm.; wing, 4.8 mm.

*Female*.—Length, 4.5 mm.; wing, 5.3 mm.

Rostrum and palpi dark brown. Antennae light yellow, the terminal half of the segments infuscated. Head obscure yellow, the center of the vertex darkened.

Mesonotal praescutum obscure yellow with four brown stripes, the intermediate pair narrowly separated anteriorly, confluent near the suture; tuberculate pits situated one on either side of this pale median vitta; scutum pale, the lobes darker; scutellum testaceous. Pleura silvery gray with a narrow, brown, dorsal, longitudinal stripe; mesosternum brown, these two brown lines thus appearing to enclose a broad silvery gray stripe; dorso-pleural membrane gray. Halteres pale yellow. Legs yellow; femora with a single, dark brown, subterminal ring of moderate width; tips of tibiae and metatarsi very narrowly darkened; terminal tarsal segments darkened. Wings light yellow with a restricted brown pattern, this including a narrow band along the cord; small but conspicuous spots near the wing-root, at origin of *Rs*, at *Sc2* and at the tips of the longitudinal veins. Venation: *m* at or beyond midlength of *M3*.

Abdomen dark brown, the hypopygium obscure yellow. Male hypopygium as in *E. armillaris* and *E. graphica*, but the gonapophyses much longer, more slender and pointed, and with the apices very strongly arcuated and recurved.

*Holotype*, male, Corydon, Harrison County, Indiana, June 18, 1921 (Alexander).

*Allotopotype*, female (Rogers).

*Paratopotypes*, 3 males (Alexander and Rogers).

The types were swept from beds of *Dianthera* in Little Indian Creek. *E. indianensis* is allied to the larger *E. sparsa* Alex. (California).

**Gonomyia (Gonomyia) bidentata**, sp.n.

Allied to *G. subcinerea* Osten Sacken; rostrum orange; thoracic pleura with a brown spot on the mesepisternum; halteres elongate; wings long and narrow, cell *2nd A* narrow; male hypopygium with the dorsal pleural appendage terminating in a chitinized blade that is bidentate apically; gonapophyses slender, straight.

*Male*.—Length, 4.2 to 4.5 mm.; wing, 5.5 to 5.6 mm.

*Female*.—Length, 4.8 to 5 mm.; wing, 5.4 to 5.6 mm.

Rostrum orange; palpi dark brown. Antennae dark brown throughout. Head gray, the occiput paler.

Pronotum obscure yellow, the scutellum brownish medially. Mesonotal praescutum obscure yellow with three nearly confluent dark brown stripes; pseudosutural foveae conspicuous; scutum brown, obscure yellow medially and laterally; scutellum brown, the posterior margin obscure yellow; postnotum brown medially, the lateral sclerites yellowish. Pleura yellow, whitish pollinose; propleura darkened; an incomplete, dorsal, longitudinal brown stripe indicated as a more or less conspicuous spot on the mesepisternum; a less distinct darkening on the mesosternum, the pale area between these two latter appearing as a white stripe. Halteres very elongate, dark brown, the extreme bases pale. Legs with the coxae whitish yellow; trochanters yellow; remainder of the legs brown. Wings grayish subhyaline, highly iridescent; stigma pale brown; veins dark brown. Wings long, strongly narrowed basally. Venation: *Sc1* ending about opposite or just beyond the origin of *Rs*, *Sc2* close to the tip of *Sc1*, its position slightly variable; basal deflection of *R4+5* very short to entirely obliterated; cell *1st M2* closed; basal deflection of

*CuI* close to the fork of *M*, in most cases at or immediately beyond this fork.

Abdominal tergites dark brown; sternites yellow or brownish yellow, the subterminal segments especially darkened. Male hypopygium with the pleurites moderately stout, the outer caudal angle produced caudad into a short, cylindrical lobe; two pleural appendages, the ventral appendage elongate, fleshy, with the long apex obliquely truncated, the proximal face not setigerous; dorsal pleural appendage a triangular fleshy lobe, the cephalic portion produced proximad into setigerous beak, the caudal angle produced into a conspicuous blackened blade that is directed dorsad, the apex shallowly two-toothed. Penis-guard straight, comparatively slender, the apex truncated; before the apex on the ventral face with a conspicuous subapical spine. Gonapophyses straight, slender, broad at the base, the extreme tip of each produced into a small, pale spine.

*Holotype*, male, Clifty Ravine, near Hanover, Jefferson County, Indiana, June 15, 1921 (Alexander).

*Allotopotype*, female, .....

*Paratopotypes*, 40 males and females (Alexander and Rogers).

#### ***Gonomyia (Gonomyia) armigera*, sp.n.**

*Male*.—Length, about 4.8 mm.; wing, 5.5 mm.

Closely related to *G. florens* Alexander, differing as follows:

Longitudinal pleural pale stripe slightly wider and less tinged with yellow.

Male hypopygium with the dorsal pleural appendage not conspicuously dilated basally, gradually narrowed into the comparatively short but stout stem, this provided with from



eight to ten setigerous punctures; the head of this appendage is dilated into a roughly semicircular blade, the proximal angle or "toe" of which bears two strong setae, the apex one large and one small seta, the lateral angle or "heel" of the blade a single powerful seta. At the base of this appendage at the caudal lateral angle of the pleurite is a small, cylindrical, setiferous lobe and a short chitinized horn. The third appendage is the longest and is fused basally with the dorsal appendage, deeply constricted beyond the base, more slender than in *florens*, gradually narrowed to the short but powerful apical spine. The second appendage appears as an elongate, sinuous, chitinized blade that is constricted at near two-thirds to three-fourths its length, beyond this point tapering into a long, sickle-shaped blade; in *florens* this appendage is stouter, not sinuous, the apex not produced into a blade. Gonapophyses appearing as two long, chitinized spikes, directed dorsad, these much larger and more powerful than in *florens*.

*Holotype*, male, swept from beds of *Dianthera* in Little Indian Creek, Corydon, Harrison County, Indiana, June 18, 1921 (Alexander).

*Paratopotypes*, 3 males (Alexander and Rogers).

***Teucholabis complexa immaculata*, subsp. n.**

Very similar in all respects to *T. complexa* O. S., differing as follows:

Mesonotum shiny reddish, unmarked with darker. Pleura obscure yellow, the dorsal brown stripe in *complexa* represented only by a large rounded spot cephalad of the wing-root. Brown femoral tips broader and more gradually darkened.

Abdomen lighter colored; sixth sternite with a large rounded black spot; seventh sternite with two smaller black spots.

*Holotype*, male, Hensler's Woods, near Hanover, Indiana, June 14, 1921 (Alexander).

*Allotopotype*, female (Rogers).

*Paratopotypes*, 5 males (Alexander and Rogers); *paratype*, 1 male, at mouth of Wyandotte Cave, Crawford County, June 19, 1921 (Alexander).

Further studies may show this race to represent a distinct but closely allied species.

#### **Oropeza rogersi**, sp.n.

Size small (length of male under 8.5 mm.); praescutal stripes reddish brown, the median stripe split by a darker brown line; pleura yellow; legs brown; abdominal segments yellowish brown, the subterminal segments darkened, the posterior margins of the tergites narrowly dark brown.

*Male*.—Length, 7.5 to 8.3 mm.; wing, 8.5 to 9 mm.

*Female*.—Length, 10 mm.; wing, 9 mm.

Frontal prolongation of head testaceous, darker above; palpi brown. Antennal scape and first flagellar segment yellowish testaceous; remainder of flagellum brown. Front pale, the vertex brown.

Mesonotal praescutum obscure yellow with three reddish brown stripes, the median stripe more or less distinctly split by a capillary dark brown line; scutal lobes brown; scutellum and postnotum brownish testaceous. Pleura yellow, unmarked. Halteres brown. Legs with the coxae yellow; trochanters testaceous; remainder of the legs brown, the tarsi not brightened. Wings with a brown tinge, the stigma darker brown; a conspicuous obliterative area before the stigma, extending into cell *1st M2*; veins brown. Venation: *Rs* longer than the petiole of cell *M1*.

Abdominal tergites light yellowish brown, the posterior margins of the segments very narrowly ringed with dark brown; segments four to eight, indistinctly darkened; sternites more uniformly yellowish. Male hypopygium with the pleural appendages black.

*Holotype*, male, Hensler's Woods, near Hanover, Indiana, June 16, 1921 (Alexander).

*Allotopotype*, female, June 14, 1921 (Alexander).

*Paratopotypes*, 8 males (Alexander and Rogers).

*Oropeza rogersi* is the smallest species of the genus so far discovered. It is allied to *O. dorsalis* Johnson. It is with great pleasure that this interesting fly is dedicated to my friend, J. Speed Rogers, who has done so much to make known the Tipulid fauna of Indiana, Iowa, and Michigan.



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NOTES ON THE INTERNAL LAMELLAE OF  
CARYCHIUM

BY MINA L. WINSLOW

It became evident during systematic work on some of the smaller land snails of Michigan that the two common forms of Carychium, *C. exiguum* and *C. exile*, approached each other so closely in some cases that characters other than those already used were desirable in order to separate the two species more conclusively. It was suggested by Dr. George H. Clapp and Dr. Bryant Walker that the internal lamellae might be investigated, and accordingly shells of both species were opened, with the results stated below. The difference in the size and shape of the lamellae of *exile* and *exiguum* seemed so marked that other forms were opened to see whether the folds bore out the external differences of the shell upon which the species have hitherto been differentiated. Some doubtful forms were discovered, and some peculiarities, all of which are noted in the descriptions below. All figures were drawn

with the aid of a camera lucida, and all are magnified approximately thirty-three diameters, except figure 8, which is magnified 16 times.

It would be interesting to make an opening in each whorl of the shell and trace the lamellae to the apex, but the delicacy of the operation and the small number of specimens available, except in the case of *C. exiguum*, have made it inadvisable to attempt this at present.

I wish to express appreciation of the interest of Dr. Clapp and Dr. Walker, who have loaned and given specimens and offered helpful advice and criticism.

It may be stated in general that the lamellae of *Carychium* are two in number, the lower one arising as a tubercle on the columellar margin of the aperture, the upper appearing as a more conspicuous projection upon the parietal wall. The lower fold is the smaller and revolves about the columella beneath the upper lamella, which attains its greatest development within the body whorl of the shell. The edge of each lamella is thickened, cord-like. The degree of development of the lamellae is undoubtedly correlated with the age of the shell. In fresh young specimens they are well developed but not so heavily corded; in old shells they seem to be smaller, probably somewhat worn. There is also considerable variation in the degree of sinuosity of the lamellae, although within such limits that they remain specifically distinct. Clapp has pointed out (*Nautilus*, XIX, p. 138, 1906) that the shells of each species vary considerably in size, and it is to be expected that the lamellae will also vary accordingly, although it will be seen from the following notes that there are differences between species so marked as to be of importance.

*Carychium exiguum* Say.

In the examination of large series of this species two rather distinct forms were noted. The smaller is narrow, glistening, and is probably often mistaken for *exile* because of its small size, and because of the striations which often become quite regular just back of the aperture. Clapp writes that "there is one character which at once distinguishes *exiguum* from *exile*—that is, the swollen body whorl, giving to *exiguum* a 'bellied' appearance when viewed from the side." Besides this, however, the lamellae as seen through the shell of fresh specimens will conclusively distinguish it from *exile*. The lamellae may be described as follows: upper fold small in proportion to the diameter of the last whorl, somewhat sinuate, but never deflected sharply downward. Lower fold evenly sinuate, in well-developed specimens shelf-like for a short distance beneath the upper fold in the last whorl of the shell. The larger form of *exiguum* is more distinctly "bellied" and the striation, when it occurs, is very indistinct and irregular.

*Carychium exile* H. C. Lea.

The upper columellar fold is very large in proportion to the diameter of the last whorl, almost touching the wall of the whorl at the upper angle of the aperture. Typically it is bent sharply downward at its widest part, the edge turning toward the columella. The lower fold is leaf-like, curling at its edge, wider than in *exiguum* and conspicuously projecting from the columella beneath the upper fold. Both lamellae are more persistent in the penultimate whorl than is the case in *exiguum*, becoming wider in that whorl before disappearing in the upper whorls.

The distinct differences in shape and size that these lamellae show should serve to distinguish *exile* from *exiguum*, in case

the *very regular* sculpture and flat-sidedness of the body whorl are not sufficient to do so. The deflection downward of the upper fold is a very marked characteristic, and if it cannot be seen through the shell the last whorl may be opened with a needle, from the left side, from which a good profile view may be obtained. A specimen from Kent, Ohio, opened by Mr. Clapp, is figured in a view from the back.

*Carychium exile canadense* Clapp.

Folds similar to those of *exile*, but the downward bend occurs farther from the aperture—*i. e.*, after about one and one-quarter turns of the lamella around the columella. In the figure the bend is too far dorsad to be shown in the front view.

*Carychium occidentalis* Pilsbry.

Upper fold evenly curved, small in proportion to the diameter of the last whorl. Lower fold small, about half as wide as the upper, projecting, evenly curved. Both are remarkably small for so large a shell, especially when compared with the lamellae of *exile*.

*Carychium nannodes* Clapp.

Upper fold small in proportion to the size of the last whorl, evenly sinuate. Lower fold scarcely more than a cord, becoming somewhat flattened and slightly projecting during the course of the first turn. Only one cotype was opened, but lamellae of others were examined through the shell.

*Carychium minimum* Müller.

Upper fold large, widest and deflected rather sharply upward after about a half turn. Lower fold sinuate, projecting most prominently after a half turn, under the widest part of the upper lamella.



Both folds are more strongly indicated in the aperture than in the case of the United States species, and they reach their greatest development correspondingly earlier in the course of the turn about the columella.

*Carychium exiguum* var.?

The six shells figured under this name were collected near Harbert, Berrien County, Michigan, on the moist ground and debris of a wooded ravine between sand dunes, near the Lake Michigan beach. In size and smoothness they closely resemble *C. nannodes*, and the internal lamellae in shape and size seem to bear out the similarity. They were submitted to Dr. Clapp, who writes that he thinks the "aperture is proportionately narrower" in *nannodes* than in the Michigan shells, and that the latter should be considered a "dwarfed, narrow form of *exiguum*." The difference in aperture is not evident upon comparison of the six shells with cotypes of *nannodes* (loaned by Dr. Walker) and the flatness of the body whorl is not like the obeseness of *exiguum*, though this may be one evidence of dwarfedness. It seems fairly possible that both *nannodes* and the Michigan shells are depauperate forms, arising from the same stock or converging from different stocks, the southern form having become stabilized, while the northern one still appears only sporadically. *Nannodes* was found in numbers in company with "a coarsely ribbed *exile*," while the *exiguum* var.? was collected with *exiguum*, and a few *exile* and *exile canadense*, seeming to make the probability greater that the Michigan shells are depauperate individuals of the common form (*exiguum*) rather than an apparently distinct race like *nannodes*.

The lamellae are almost identical in the two forms, as may

be seen in the figures (22 and 23); in fact, they do not vary as much as in different individuals of *exiguum*.

The discovery of other individuals as small and distinctive in characteristics will be awaited before naming this peculiar form.

#### *Carychium exile?*

A single specimen collected by the writer at Harriman, Tennessee, in wet grass at the foot of Walden Ridge, combined characters of *exile* and *exiguum* in a striking way. It is a very coarsely ribbed, small shell, having, however, the obese body whorl, and relatively small lamellae of *exiguum*. It is figured before and after opening, in order to show the profile contour. Clapp, in his description of *C. nannodes*, mentions a coarsely ribbed *exile* found with that species, and it seems possible that this is that form, but the internal lamellae are so distinctly those of *exiguum* that it is placed with *exile* only tentatively. Further southern material should be examined in order to clear up this apparently anomalous combination of characters.

It would probably be interesting to examine the lamellae of the remaining United States species of *Carychium*, and determine whether varietal differences are borne out in other cases as they seem to be in the case of *exile* and *exile canadense*. The varieties *jamaicensis*, *floridanum* and *mexicanum* of *exiguum* and the Kentucky *C. stygium* might be examined with profit.

The following short list is published as an aid in finding the original descriptions and figures of the species discussed in the above paper:

PILSBRY, H. A. Forms of American *Carychium*. *Nautilus*, IV, pp. 109-110. 1891.

PILSBRY, H. A. The American Species of *Carychium*. Nautilus, VIII, pp. 61-63. 1894. (Contains short descriptions and figures of *C. exiguum*, *exiguum mexicanum*, *occidentalis*, *exile*, *exile jamaicensis*.)

CALL, R. E. Some Notes on the Flora and Fauna of Mammoth Cave, Ky. American Naturalist, XXXI, p. 387, fig. 1897. (*C. stygium*.)

CLAPP, GEO. H. *Carychium nannodes*, n.sp. Nautilus, XIX, p. 91, Pl. III, figs. 7-9. 1905.

CLAPP, GEO. H. Notes on *Carychium* and Description of a New Variety. Nautilus, XIX, pp. 138-140, Pl. VIII. 1906. (*C. exile canadense*, and notes on variation in size of *exiguum* and *exile*. A number of figures of *exile*, *e. canadense*, and *exiguum* are given, and one of a cotype of *C. stygium*.)

CLAPP, GEO. H. New Southern Forms of *Carychium* and Thysanophora. Nautilus, XXXI, pp. 73-76, Pl. VIII, figs. 1, 2, 6, 7. 1918. (*C. exiguum floridanum*.)

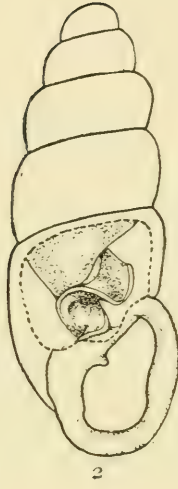
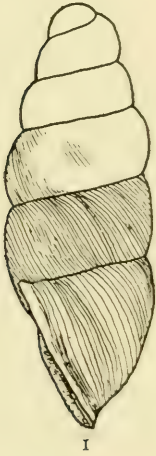
## PLATE I

Carychium.

Figure 1. *C. exile* H. C. Lea. Side view.

Figures 2 and 3. *C. exile*. Hudson County, Ohio. G. H. Clapp.

Figures 4 and 5. *C. exile*. Forest Hill, Gratiot County, Michigan.  
B. Walker Collection No. 24193.



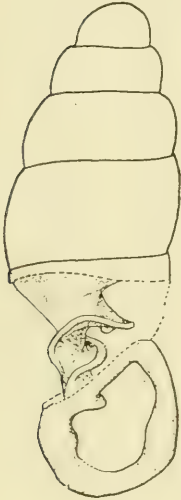
## PLATE II

Figures 6 and 7. *C. exile canadense* Clapp. From type lot. G. H. Clapp.

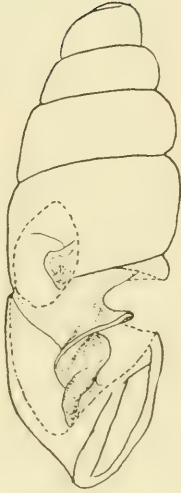
Figure 8. *C. exiguum* Say. Side view.

Figure 9. *C. exiguum*. Edgeworth, Pennsylvania. G. H. Clapp.

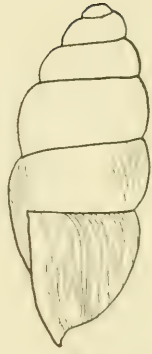
Figures 10 and 11. *C. exiguum*. Edgeworth, Pennsylvania. G. H. Clapp.



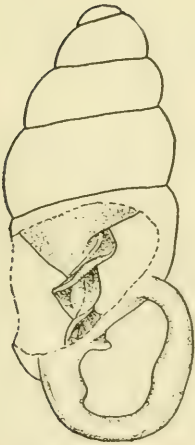
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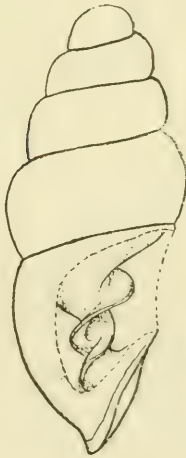
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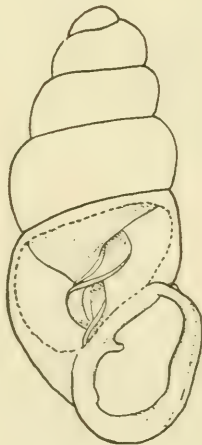
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## PLATE III

Figure 12. *C. exiguum*. Independence Lake, Washtenaw County, Michigan.

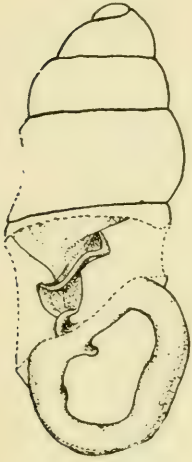
Figure 13. *C. exiguum*. Ann Arbor, Michigan. Very sinuate lamellae.

Figure 14. *C. exiguum*. Ann Arbor, Michigan.

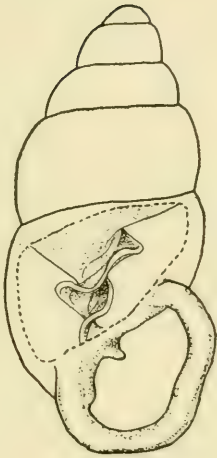
Figures 14 and 15. *C. exiguum*. Edgeworth, Pennsylvania. G. H. Clapp. Very short, stumpy shell.

Figures 16 and 17. *C. occidentalis* Pils. Seattle, Washington. G. H. Clapp.

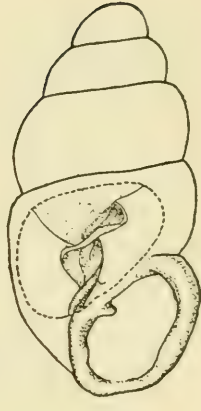




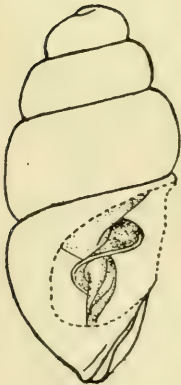
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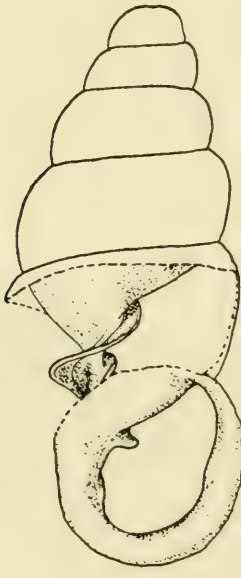
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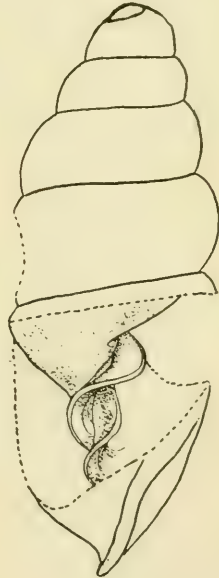
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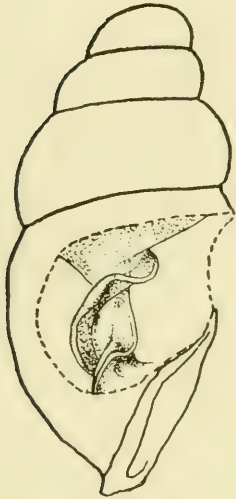
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## PLATE IV

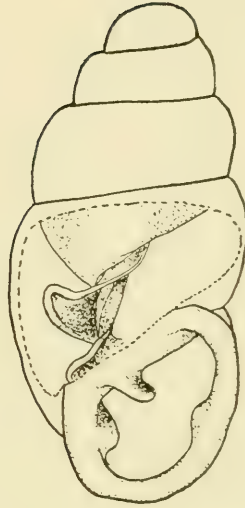
Figures 18 and 19. *C. minimum* Müller. Greenhouse at Norfolk Downs, Massachusetts. G. H. Clapp.

Figures 20 and 21. *C. exiguum* var.? Harbert, Berrien County, Michigan. Museum of Zoology No. 13326.

Figure 22. *C. exiguum* var.? Harbert, Berrien County, Michigan. Museum of Zoology No. 13331.



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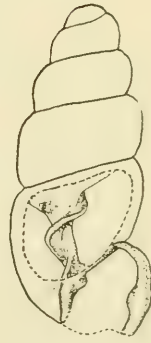
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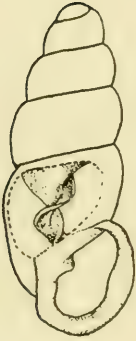


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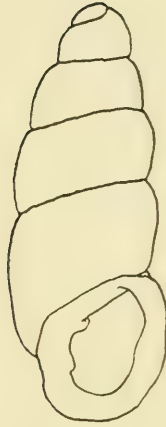
## PLATE V

Figure 23. *C. nannodes* Clapp. Cotype. From B. Walker Collection, No. 24907.

Figures 24, 25, and 26. *C. exile?* Harriman, Tennessee.



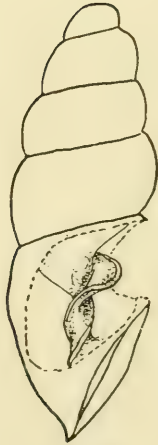
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