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THE DERMAPTERA AND ORTHOPTERA OF
BERRIEN COUNTY, MICHIGAN

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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.¹ 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,² 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.

¹For a list of these see the bibliography at the end of the paper.

²*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 Fox³ 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.

³ 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 Sherman⁴ 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†

⁴Dice, 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 wyomingia-</i> <i>num</i> *
<i>Tettigidea lateralis parvipennis</i>	
<i>Chloea 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 wyomingia-</i> <i>num</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-</i> <i>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 collare wyomingianum</i> *	<i>Scudderia texensis</i> †
<i>Psiniidia 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>Eucoptolophus 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 wyomingianum</i> *	<i>Gryllus assimilis</i> *
<i>Melanoplus mexicanus atlantis</i> *	<i>Oecanthus quadripunctatus</i>
<i>Melanoplus femur-rubrum femur-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:

Parcoblatta virginica

Parcoblatta pennsylvanica

Melanoplus viridipes

Melanoplus mexicanus atlanis

Melanoplus angustipennis

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 atlanis</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 binittatus</i> *
<i>Tettigidea lateralis parvipennis</i>	<i>Scudderia pistillata</i> *
<i>Tryxalis brevicornis</i>	<i>Amblycorypha oblongifolia</i>
<i>Chloeahtis 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 Shelford⁵ 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

⁵ 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 allanisi</i>	<i>Neoconocephalus ensiger</i>
<i>Melanoplus femur-rubrum femur-rubrum</i> *	<i>Orchelimum vulgare</i> *
	<i>Orchelimum gladiator</i> *
<i>Melanoplus differentialis</i>	<i>Conocephalus brevipennis</i> *
<i>Melanoplus bivittatus</i> *	<i>Nemobius fasciatus fasciatus</i>
<i>Scudderia texensis</i> *	<i>Oecanthus quadripunctatus</i>
<i>Scudderia pistillata</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>Chloecaltis 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>Cammula pellucida</i>	<i>Melanoplus bivittatus</i>
<i>Dissosteira carolina</i>	<i>Scuddería texensis</i> *
<i>Spharagemon bolli</i> *	<i>Scuddería pistillata</i>
<i>Spharagemon collare wyomingia-</i> <i>num</i>	<i>Scuddería 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>Chloealtis conspersa*</i>	<i>Melanoplus bivittatus</i>
<i>Arphia sulphurea</i>	<i>Scudderia furcata furcata</i>
<i>Cammla pellucida</i>	<i>Neoconocephalus robustus crepitans†</i>
<i>Spharagemon bolli*</i>	<i>Orchelimum vulgare</i>
<i>Spharagemon collare wyomingianum</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>Chloealtis conspersa</i>	<i>Melanoplus fasciatus†</i>
<i>Spharagemon bolli*</i>	<i>Melanoplus keeleri luridus*</i>
<i>Spharagemon collare wyomingianum</i>	<i>Nemobius fasciatus fasciatus*</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 atlanis*</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 atlantis</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 minima</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 atlanis</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>Chloeaalis 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 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 atlantis (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 SPECIES⁶

FORFICULIDAE

Doru aculeatum (Scudder).⁷

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

⁶ 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.

⁷ 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).⁸

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.

⁸ Determined by J. A. G. Rehn.

ACRYDIDAE

ACRYDIINAE

Nomotettix cristatus, probably subspecies *cristatus* (Scudder).⁹

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

⁹ 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.¹⁰

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.

¹⁰ 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).¹¹

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

¹¹ 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.

Chloealtis 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.¹²

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.

¹² 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.

Cammula 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.

Psimidia 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).¹³

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

¹³ 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).¹⁴

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.

¹⁴ 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,¹⁵ 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.¹⁶

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

¹⁵ Pettit, R. H., 1899. *Mich. State Agr. Exp. Sta. Bull.* No. 175, p. 343.

¹⁶ 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.

Melanoplus 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).¹⁷

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.

¹⁷ 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 atlanis (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.¹⁸

New Buffalo, September 2, 1919, 1 male; September 9, 1920, 2 females.

¹⁸ 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 *Psiniidia 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 atlanis*; 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 *atlanis*, 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 *Spharagemon 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.

Melanoplus 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.¹⁹ 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.

¹⁹ 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.

TETTIGONIDAE

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.

Hancock²⁰ 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

²⁰ 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).²¹

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

²¹ 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).²²

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

²² 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.

Blatchley²³ 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

²³ 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).²⁴

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-

²⁴ 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).²⁵

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.

²⁵ 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—*gree-gree-gree-gree*—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.²⁶

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

²⁶ 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

Gryllotalpa 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.

Oecanthus niveus (DeGeer).

Benton Harbor, September 4, 1920 (Priscilla Butler), 1 female.

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