SIXTEENTH REPORT

OF

THE MICHIGAN ACADEMY OF SCIENCE

PREPARED UNDER THE DIRECTION OF THE COUNCIL

BY

RICHARD DEZEEUW

SECRETARY

BY AUTHORITY

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LETTER OF TRANSMITTAL.

To Hon. Woodbridge N. Ferris, *Governor of the State of Michigan:*

Sir—I have the honor to submit herewith the XVIth Annual Report of the Michigan Academy of Science for publication, in accordance with Section 14 of Act No. 44 of the Public Acts of the Legislature of 1899.

Respectfully,

RICHARD de ZEEUW,

Secretary.

East Lansing, Michigan, November, 1914.

FOREWORD.

At the general session of the Michigan Academy of Science held in April, 1913, the members, acting upon the recommendation of the Council, voted to change the time of the annual meeting from the spring to the Friday and Saturday following the last Thurdsay in November. After the general session at which this action was taken, several objections to the fall meeting were brought to the attention of the Council, which met on October 17, 1914, to arrange for the annual session. After considering the objections, the Council voted that it was inexpedient to change the time of meeting, that the next session should be held in the spring of 1915, and that the President and Secretary should canvass the membership for papers and publish a report for 1914 in order that the publication of the annual reports should not be interrupted.

The President and Secretary have followed the instructions of the Council and have arranged in this volume the papers received from the members. The minutes of the meetings, reports of officers, and other business matters usually published in the annual report have been omitted, since the terms of office will be automatically extended to the spring meeting, and the reports cannot properly be published until accepted by the Academy.

Signed,

ALEXANDER G. RUTHVEN,

President.

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The Council consists of the above-named officers and all Resident Past-Presidents.

A NEW CESTODE, OPHIOTAENIA CRYPTOBRANCHI NOV. SPEC., FROM CRYPTOBRANCHUS ALLEGHENIENSIS (DAUDIN).*

GEORGE R. LA RUE, UNIVERSITY OF MICHIGAN.

Up to the present time but two species of *Ophiotaenia*, *O. lonnbergii* (Fuhrmann) and *O. filaroides* La Rue are known from the amphibia of North America. The species about to be described under the name *Ophiotaenia cryptobranchi* nov. spec. adds the third to the list. The specific name is derived from the name of the host inhabited by this form.

Diagnosis. Length, as much as 30 cm. Maximum width, about 2 mm. Head, globose, 0.342 mm. broad, 0.324 mm. long. Suckers, four, 0.18 mm. long by 0.11 mm. broad. Neck, 3.2 mm. long. Youngest proglottids, much broader than long. Nearly mature proglottids, 0.4–0.77 mm. long by 1.44-1.36 mm. broad. Ripe proglottids, 1.16–2.68 mm. long by 1.94-1.32 mm. broad. Genital pore, marginal, irregularly alternating, situate at end of first ninth, eighth, sixth, or fourth of proglottid length. Cirrus-pouch, about 0.31 by 0.088 mm. in nearly mature proglottids, 0.335 by 0.124 mm. (cirrus unprotruded) in ripe proglottids, reaching 1/6–1/4 across breadth of the proglottid. Protruded cirrus, slender, long. Cirrus and ductus ejaculatorius form 4 or 5 coils in cirrus-pouch. Testes, 107–160, in two fields. Vagina, usually posterior to cirrus-pouch, sinuous in mid-field of proglottid. No sphincter vaginae. Uterus, with 15–20 lateral pouches on either side. Eggs, spheroidal, yolk mass about 0.02 mm. in diameter.

Material. The description is based on a single worm taken, May 21, 1913, from the small intestine of *Cryptobranchus allegheniensis* (Daudin) (type host) purchased for laboratory purposes at Meadville, Pa. (type locality). The material consisted of five pieces of which the piece with the head measured 14.5 cm. A piece made up of ripe proglottids was 10 cm. long and there were 3 pieces each about 1.5 cm. long containing mature or nearly ripe proglottids. Since only one head and anterior region was found it is assumed that all these pieces belong to one specimen. The type specimen (microscopic slides and alcoholics) bear the serial number 391 in the collection of the author.

EXTERNAL CHARACTERS

The length of the entire animal after preservation is 30 cm. In width the strobila varies considerably. A minimum width of 0.23 mm. occurs at a point 1.26 mm. posterior to the tip of the head. From this point follows a gradual increase in width to the end of the fifth cm. where the width is about 1.5 mm. From this point to the 13th cm. the increase in width is more gradual than before. At the 13th cm. the width is about 2 mm. Thereafter the width decreases irregularly. The 10 cm. piece, noted in the state-

* Studies from the Zoölogical Laboratory, The University of Michigan, No. 142.

ment of materials, measures 1.5–1.6 mm. wide and the three small pieces about 1.75 mm. wide.

Head. The head (Pl. 1, fig. 2) which was somewhat twisted is globose with a rounded apex. It is flattened dorsoventrally, 0.342 mm. broad, slightly broader than the neck. Its length to the posterior margin of the suckers is 0.252 mm. and to the constriction of the bulbous end 0.324 mm. There are no furrows nor rostellum present, nor are there any hooklets or spinelets of any kind.

Suckers. The four suckers borne on the broadest part of the head are shallow, oval in outline, prominent and of large size. A functional fifth sucker is lacking and on account of the scarcity of material the head could not be sectioned and examined for the presence of a vestigial fifth sucker. The four suckers measure over all 0.18 mm. long by 0.126 mm. broad, 0.18 by 0.108, 0.198 by 0.126, 0.162 by 0.09 mm. average 0.18 by 0.11 mm. The measurement of breadth of the last sucker is probably too little on account of foreshortening.

Neck. The neck is thin, flattened and slightly narrower than the head, is somewhat swollen for a short distance, then is sharply contracted. Its maximum breadth, 0.324 mm., is found 0.9 mm. posterior to the tip of the head and its minimum breadth of 0.231 mm. about 1.26 mm. from the tip of the head. Its length to the first visible signs of internal segmentation (stained slide) is 3.2 mm. The first outward signs of segmentation appear 4 mm. from the tip of the head.

Segmentation. Segmentation is not evident in young or in nearly mature proglottids but is more evident in fully mature proglottids and is readily seen in fully ripe proglottids. For the most part the margins of the strobila are smooth. The limits of the individual ripe proglottids are marked by slight indentations at the corners and these indentations are connected by minute transverse furrows. The surface of the worm is more or less wrinkled. The color in the preserved worm is white. The cuticula is smooth, there being no spines or hooklets of any kind.

Proglottids. All proglottids are thin and flat. The youngest proglottids, 4.0 mm. posterior to the head, are much broader than long, measuring 0.054–0.09 mm. long by 0.43–0.5 mm. broad.

Nearly mature proglottids, about 32-36 mm. posterior to the head are considerably broader than long. They measure 0.4–0.77 mm. long by 1.44–1.36 mm. broad. In these proglottids spermatozoa are just beginning to collect in the vas deferens and the outpocketings of the uterus are taking form. Ripe or nearly ripe proglottids are usually longer than broad but may be quadrate or broader than long. In the following measurements (in millimeters) length is stated first: 1.83 by 1.9, 1.16 by 1.79, 1.55 by 1.4, 1.94 by 1.36, 1.75 by 1.59, 2.32 by 1.55, 2.68 by 1.32.

INTERNAL CHARACTERS

Parenchyma. The parenchyma may be readily differentiated into cortical and medullary portions which in structure and in relations to the various organs are similar to the same portions in other species of *Ophiotaenia.* As in other species of the group the parenchyma is characterized by large spaces from which lipoid substances have been dissolved. These spaces are smaller than in *O. filaroides.*

Musculature. The musculature of the head and neck have not been worked out owing to lack of sufficient material. In the proglottids muscles are in general arranged as in *O. filaroides.* Muscles are weakly developed.

Nervous system. In the proglottids a single pair of lateral nerve trunks were found. No study of the nerves in head and neck could be made.

Excretory system. The main excretory vessels of the proglottids alone have been worked out. There are two pairs of main lateral excretory vessels (Pl. 1, fig. 4), dorsal and ventral respectively. Of these the ventral vessels are marked by their large size. Both dorsal and ventral vessels are more or less sinuous, approaching the condition seen in *O. lonnbergii* (Fuhrmann). In well extended proglottids the excretory vessels are almost straight. Both pairs lie mesad to the lateral nerve trunks and to the vitellaria. A commissure connects the ventral vessels in the posterior part of the proglottid, but the presence of a dorsal commissure could not be ascertained. There may be (Pl. 1, fig. 4) a more or less intricate plexus of smaller vessels in the posterior regions of the proglottids. The presence of secondary excretory openings, foramina secundaria, could not be determined even in transverse or frontal sections. In most of the proteocephalid species examined for this character these openings are readily found.

Sexual organs. The earliest traces of sexual organs (in 'in toto' mounts) appear as darkly staining lines of cells in the median logitudinal region about 6 mm. from the tip of the head. The proglottids measure about 0.11 mm. long by 0.54 mm. broad. Riggenbach (1896) has described the development of the organs. The adult sexual organs are arranged as usual in species of the group.

Genital pore. The genital pore is marginal, irregularly alternating, frequently with several successive pores on the same side. There is no genital papilla, nor is the pore situated in a depression. In nearly mature, in quadrate or sub-quadrate and in elongated ripe proglottids small variations may be found in the position of the genital pore. In a few cases the pore was located at the end of the first fourth of the proglottid's length but in no case was it found posterior to this point. It was sometimes found as far forward as the end of the first ninth, eighth or sixth. Among long ripe proglottids it occurred most frequently at the end of the first sixth. In this extreme forward position of the genital pore this species agrees with the other North American species of *Ophiotaenia* infesting amphibians. Johnston (1912) found a species of *Ophiotaenia* in *Hyla aurea* of New South Wales which he described as *O. hylae* in which the genital pore was located at or very near the middle of the margin of the proglottid. His species forms the only known exception to the usual anterior location of the genital pore in the amphibian *Ophiotaenia*.

Male organs. The muscular cirrus-pouch (Pl. 1, fig. 3) is pyri-form, the inner end usually somewhat broader than the outer. The position of the pouch is usually at right angles to the margin of the segment but sometimes its inner end is bent posteriad. Measurements of cirrus-pouches from different regions of the strobila show that there is some variation in the size of this organ. In nearly mature proglottids two cirrus-pouches measure 0.29 by 0.084 mm. and 0.333 by 0.092 mm. respectively. In six ripe proglottids, the cirri being unprotruded, the cirrus-pouches measure 0.33 by 0.116, 0.33 by 0.116, 0.32 by 0.116, 0.4 by 0.133, 0.3 by 0.133, 0.333 by 0.133 mm., average dimensions 0.335 by 0.124 mm. These measurements of length are taken from the inner end of the pouch to the margin of the proglottid. These cirrus-pouches reach 1/6–1/4 across the proglottid's breadth. Seven cirrus-pouches selected because of protruded cirri were measured. In each of these cases the proglottid to which the cirrus-pouch belonged was ripe. Casual examination of these pouches before measurement showed

that the pouches were shorter but thicker than those in which protrusion of the cirrus had not taken place. Moreover in some cases the pouch was greatly twisted in such a manner that its length was considerably reduced. In the first group the cirri were well protruded. These pouches measure 0.216 by 0.12, 0.265 by 0.117, 0.265 by 0.093 mm., average dimensions 0.248 by 0.106 mm. In the second group of pouches the cirri were only partly protruded. These pouches measure 0.283 by 0.11, 0.25 by 0.126, 0.20 by 0.146, 0.20 by 0.133 mm., average dimensions 0.233 by 0.128 mm. The average of the seven pouches with protruded cirri is 0.239 by 0.119 mm.

Comparison of the above data shows that while the cirrus-pouches of nearly mature proglottids are only slightly shorter than the cirrus-pouches of ripe proglottids with unprotruded cirri they are considerably more slender. Comparison of the dimensions of the two classes of cirrus-pouches of ripe proglottids, those with cirrus unprotruded and with this organ protruded, shows that in the act of protruding the cirrus the cirrus-pouch is considerably shortened, but its diameter may be slightly increased. The above data are altogether too meager to permit the formulation of a general statement that the act of protrusion of the cirrus is due to contraction of the walls of the cirrus-pouch but this idea is strongly suggested.

The unprotruded cirrus and the ductus ejaculatorius describe four or five coils in the cirrus-pouch. When the cirrus is protruded this number is reduced. Protruded cirri are first seen at the sixth centimeter. These are readily visible to the naked eye. In all 26 such cirri were counted with the aid of a hand-lens. In form the protruded cirrus (Pl. 2 fig. 3) is somewhat cylindrical, slightly tapering from its base to its tip. Its length is about 0.34 mm. and its breadth at the broadest part about 0.08 mm. No coils of the ductus ejaculatorius are pushed out into the base of the cirrus.

The vas deferens extends from the cirrus-pouch toward the median part of the proglottid as a mass of coils which in nearly mature proglottids are small and close. As the vas deferens becomes filled with spermatozoa its walls are enormously dilated and the coils make a broad mass.

Testes in nearly mature proglottids occupy two broad lateral fields (Pl. 2 fig. 5) which extend latera almost to the vitellaria and mesad well toward the median line but leaving between the two fields a free median zone. In transections of the mature proglottid the testes are seen to lie in a single layer in the medullary parenchyma. Testes number, in nearly mature proglottids, from 107 to 160. These testes, which probably are not fully mature, measure about 0.066 mm. in diameter. They are spheroidal or slightly irregular due probably to the juxtaposition of neighboring testes. Four testes which were teased out of an unstained ripe proglottid measured 0.077 by 0.06, 0.083 by 0.077, 0.063 by 0.05, 0.067 by 0.057 mm., average 0.0725 by 0.061 mm. It was impossible to measure testes from fully mature proglottids.

In ripe proglottids (Pl. 2 fig. 1) full of eggs only about 60 testes are visible, lying laterad to the uterine pouches. In some ripe proglottids not more than 50 testes may be seen. This is an apparent, rather than a real, diminution in the number of testes. For in an examination of the ripe proglottids with a lens magnification of about 465 many of the testes are found to be reduced to one or two large spherical cells. Such remnants are too small to be seen when making the camera drawings with low magnifications. It is moreover probable that a considerable number of the testes are covered up by the great mass of eggs in the uterus. It is evident that the testicular

count in this species should be made from mature rather than ripe proglottids.

Female organs. The vagina lies anterior or posterior to the cirrus-pouch but most frequently posterior. Its opening into the common genital atrium is likewise anterior or posterior but never dorsal as in some proteocephalids. In one proglottid out of forty examined the vagina crossed the cirrus-pouch. In this instance the vagina lay posterior to the cirrus-pouch, then was bent anteriad across the inner end of the pouch and then passed to the mid-field of the proglottid. That portion of the vagina lying in the mid-field of the proglottid is usually thrown into sinuous curves which are more pronounced near the ovarian region. These curves are also more pronounced in strongly contracted than in extended proglottids. A sphincter vaginae is not visible in 'in toto' preparations. Even in transections no definite sphincter vaginae can be distinguished. There are a few scattering muscle fibers in the region about the initial part of the vagina which perhaps may belong to an inefficient sphincter muscle, but it is by no means certain that these fibers form a part of the musculature of the vaginal wall. A receptaculum seminis of the kind figured for *O. filaroides* is found at or posterior to the mid-piece of the ovary.

The vitellaria are lateral, made up of small acini which are more numerous toward the posterior end of the segment. On the porose side the vitelline field is divided into two areas, the anterior area containing from one to ten follicles. The bilobed ovary (Pl. 1 figs, 1 and 5) occupies the usual posterior position. The lobes are long, straight and heavy, and are made up of anastomosing tubules and many small acini. The organs of the interovarial space are arranged in the manner common to the group. The ducts (oviduct, vagina, and uterine passage) lie in numerous coils. The oöcapt is muscular and is surrounded by numerous gland cells. It measures from 0.053 to 0.063 mm. in diameter. The oötype with the so-called shell-gland has a maximum traverse dimension of about 0.10 mm.

The ripe uterus is made up of a median stem and 15, 18, 19, or 20 long lateral outpocketings on either side. These pouches occupy the larger part of the area between the vitellaria thus covering up the greater number of the testes. Examination of transverse sections of ripe proglottids shows that the uterus with its pouches has replaced almost the entire medullary parenchyma and even the thickness of the cortical parenchyma dorsal and ventral to the uterus is reduced. No uterine pores were observed.

The development of the lateral uterine pouches agrees with the descriptions of their development by Schneider (1904) for *Proteocephalus esocis* and by La Rue (1910) for *O. filaroides*. An early stage in development is shown (Pl. 1 fig. 5) which represents a proglottid measuring about 0.9 mm. long by 1.15 mm. broad, and occurring .29 mm. posterior to the head. Here the lateral pouches are made up of strong solid strands of cells. At this stage the testes and ovary though still immature are rapidly approaching maturity. The cirrus-pouch and vagina are slender and immature. The anlage of the uterine pouches can be traced forward to a point 22 mm. from the head where proglottids measure about 0.48 mm. long by 0.9 mm. broad. Here the anlage are composed of short slender strands of cells. At this point ovary, testes and vitellaria are evidently far from mature. The cirrus-pouch and vagina are slender. Neither cirrus-pouch, vas deferens, vagina nor median stem of the uterus shows a lumen.

Eggs. Uterine eggs only were studied. Eggs are spheroidal, surrounded by two membranes which probably represent the two outermost of the three

membranes usually found covering eggs of this group. The third membrane, if present, covered the yolk mass so closely that it could not be distinguished. Hooks were not seen on any of the eggs examined hence it is probable that the oncospheres were not fully formed. Measurements of the envelopes and the yolk masses of six eggs are given in the following table:

Outer membrane	Second membrane	Yolk mass
0.057 mm.	0.033 mm.	0.023 mm.
0.060 mm.	0.035 mm.	0.033 mm.
0.067 mm.	0.033 mm.	0.030 mm.
0.057 mm.	0.033 mm.	0.030 mm.
0.057 mm.	0.027 mm.	0.025 mm.
0.067 mm.	0.037 mm.	0.033 mm.
0.0608 mm average.	0.033 mm. average.	0.029 mm. average.

In securing the above eggs for measurement a few yolk masses were teased out of the egg-membranes. These measured 0.20, 0.023, 0.02, 0.017, 0.02, 0.02, 0.023 mm., average 0.020 mm. On account of the fact that the egg-membranes make it difficult to determine the limits of the yolk mass it is probable that the measurements of the membraneless yolk masses are more accurate than those given in the third column of the table.

RELATIONSHIPS

This species is clearly a member of the genus Ophiotaenia. Its nearest congeners are the two species of Ophiotaenia already known to inhabit certain tailed amphibians of North America, viz. *O. filaroides* La Rue from *Ambystoma tigrinum* (green) and *O. lonnbergii* (Fuhrmann) from *Necturus maculosus* Raf. With these two species it forms a well graded series in size, this species being the larger (as is also its host). In respect to size and to the relative position of the vagina and cirrus-pouch, and also in respect to the sinuous vagina and the long slender protruded cirrus this species resembles *O. lonnbergii* more closely than *O. filaroides*.

It differs considerably from *O. hylae* Johnston which is found in *Hyla aurea*, New South Wales in size, position of the genital pore and the usual relations of vagina and cirrus-pouch. The latter species more closely resembles some of the reptilian Ophiotaeniae.

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EXPLANATION OF PLATE

All drawings were made from 'in toto' preparations with the aid of the camera lucida. The abbreviations used are: *ci*, Cirrus; *de*, Ductus ejaculatorius; *ov*, Ovary; *t*, Testes; *ua*, Anlage of uterine pouches; *up*, Uterine pouches; *va*, Vagina; *vd*, Vas deferens; *vi*, Vitellaria.

Fig. 1.—Ripe proglottid in outline.
Fig. 2.—Head and neck.
Fig. 3.—Protruded cirrus, detailed drawing of cirrus shown in figure 1.
Fig. 4.—Main excretory vessels in nearly mature proglottid.
Fig. 5.—Nearly mature proglottid, 29 mm. posterior to head. Figures 4 and 5 represent the same proglottid.

PHYSIOGRAPHIC AND MOLLUSCAN SUCCESSION IN LAKE POOLS.

BY H. BURRINGTON BAKER.

CONTENTS.

INTRODUCTION.

The problem under consideration is the physiographic succession in beach pools, which are formed along the shores of larger lakes by wind and current action, and the corresponding ecological succession in the molluscs they contain. Douglas Lake, in Cheboygan County near the northern end of the Southern Peninsula of Michigan, has a number of pools in different stages of formation, and the data given here was mostly collected in that region during the summers of 1911, 1912, and 1913. Less complete studies were also made in Saginaw Bay, off Lake Huron, during the summer of 1908(5), and some mention of these pools will also be made in this paper.

Map 1 is a map of the northern end of the Southern Peninsula of Michigan, showing the situation and the shape of Douglas Lake. The lake was part of the Great Lakes at one of the former glacial lake levels, and has a fauna closely related to the present Lakes Michigan and Huron (6).[1]

[1] The numbers in parentheses refer to the bibliography at the end of the paper.

PHYSIOGRAPHIC SUCCESSION.

A. Types of Lakes.

Chart I. Classification of Lakes of Temperate Regions.

	SMALL LAKES.	LARGER LAKES.	VERY LARGE LAKES.
Shallow lakes.	*Type I.* Small lakes, too shallow for thermocline. Stagnant when frozen; good circulation when not. No abyssal depths. Shores all of protected type.	*Type II.* Larger lakes, too shallow for thermocline. Stagnant when frozen; good circulation when not. No abyssal depths. Shores of both protected and unprotected types; mostly the former. Rarely beach pool formation.	*Type III.* Very large lakes, too shallow for thermocline. Stagnant when frozen; good circulation when not. No abyssal depths. Shores of both protected and unprotected types; mostly the latter. Considerable beach pool formation.
Deep lakes.	*Type IV.* Small lakes deep enough for thermocline. Stagnant when frozen, thermocline when not, except spring and fall overturnings. Abyssal depths with periodic warming and aeration. All shores of protected type.	*Type V.* Larger lakes, deep enough for thermocline, which, however, is usually not very sharp (14). Stagnant when frozen, thermocline when not, except spring and fall overturnings. Abyssal depths with periodic warming and aeration. Shores of both protected and unprotected types. Beach pool formation on a small scale.	*Type VI.* Very large lakes, too large for thermocline. Rarely completely frozen; slow circulation. Abyssal depths with slow, but quite constant, warming and aeration. All shores of unprotected types, except in bays, behind spits, etc. Lakes and large pools formed by current and wave action.

Lakes belong to the general series of physiographic successions known as the lake-pond-swamp series. They tend to form ponds, by being filled in with stream and wave sedimentation and by plant encroachment, while ponds, in turn, become temporary swamps thru the action of similar agencies.

Lakes have often been divided into three main groups based on their adaptation for plankton life (See 8 and 9). These would be: (1 usually small lakes too shallow to have a thermocline; (2) small or larger lakes, deep enough to develop a thermocline; and (3) very large lakes, too large to allow a thermocline. A classification based on the nature of the shores, and consequently on their adaptability for shallow littoral forms would, on the other hand, require a division into two different classes: (1) lakes too small to develop wave and current action to the extent of building sandy, more or less shifting shores; and (2) lakes large enough to prevent, by such action, the fixation of the entire shore by vegetation. The second class would, of course, include all of the lakes that would be able to develop pools to any marked degree.

The relationships of all of the different kinds, for temperate regions, might be expressed about as shown in the accompanying chart (Chart I). Types II, III, V, and VI, as shown in the chart, would be the only ones to develop beach pools to any extent. Rush Lake in Huron County, Michigan, (5), approaches the second type, while Lake St. Clair, between Lakes Huron and Erie, is probably an example of the third. Types V and VI, however, are the ones with which this paper especially deals; Douglas Lake is an example of the former, while the head of Saginaw Bay, off Lake Huron (5), is an example of the latter.

B. TYPES OF LAKE POOLS.

In these types of lakes, with a portion of the shore-lines shifting and sandy, another form, of the same series of physiographic succession as already

mentioned, is illustrated; the ponds, instead of being formed from the entire lake by sedimentation, are cut off from the parent body by sand and gravel barriers, built up by the action of the waves and currents and often also of the ice. There are two types of these pools: those separated mainly by barrier beaches, and those bounded by true bars (10), and it may not be out of place here to include a slight digression into the dynamics of these two classes.

I. Barrier Beach Types. Barrier beaches are embankments of sand, etc., thrown up at right angles to the direction of the prevailing strongest winds and usually more or less parallel to the shore. They are built up by the direct action of the waves, combined with the shifting action of the inshore currents; when they connect with the shore at the ends, they enclose small beach pools. On account of this method of formation, they can be raised, by the action of the water alone, only as high as the limit of action of the largest waves, and from depths no greater than this same limit of action; their height and depth are thus proportionate to the size of the waves, and consequently to the size of the lake in which they are formed. Secondarily wind action may raise the barrier beaches even higher, even building large sand dunes in front of the pools, altho this usually only happens where the surface level of the lake is falling, because only in such cases is enough dry sand exposed. The ice also often helps in building these barrier beaches, and the freezing of the water in the sand allows greater movement of the sand by the wind.

It has sometimes been stated that barrier beaches could only be formed along retreating shore-lines, that is, in lakes, the surface level of which was falling. The maps (maps 3, 4, 5 and 6) show an example of the formation of a beach pool while the surface of the lake was actually rising. It was very evident, to an observer, that this barrier beach was actually pounded up above the surface of the water by the direct action of the waves; in fact, during a heavy storm the barrier beach would actually increase in height while it was being watched. There could be no doubt that the beach could be easily built up while the water remained at the same level. In addition, during the next summer a continued study of the same region was made, and it was found that the formation of the barrier beach was effectually prevented when the surface of the lake fell rapidly, because the line where the waves broke, and where the action was most severe, did not remain long enough in the same place to completely effect its construction. Time and time again during the summer, barrier beaches were started and then abandoned for a line farther out, after which the outwash, that takes place in shallow water between waves, scoured away the partially developed ridge.

A similar abandonment might occur at the time of a rise in surface level, as is shown by the series of maps. Map 4 shows the beginning of a barrier beach, which was later abandoned, and finally destroyed when the rising water caused the line of greatest wave action to move farther inshore. In conclusion, it might be stated that the best conditions for the formation of barrier beach pools appeared to be a fairly constant water level, in very shallow water which deepened very gradually out from the shore, in a lake where large waves were produced during storms.

Along Saginaw Bay (5), this method, combined with wind action, separated long-lived, sand dune pools, which attained a length of nine hundred meters, a width of from fifty to sixty meters, and a depth of not much over a meter; Long Lake on Sand Point was such an example. At Douglas Lake, however, as may partially be seen from the maps, they were usually not more than

fifty meters long and twenty centimeters deep; they were too small to be permanent as their depth was less than the annual variation in the level of the lake. In both cases, on account of the method of formation, they were usually long, narrow and shallow, with their long axes parallel to the shore, and at right angles to the wave action.

II. Sand Spit Types. The sand spit or hook, on the other hand, was usually built up more or less parallel to the direction of the currents, which in our small, fresh-water lakes is largely dependent on the direction of the prevailing strongest winds. They were produced by sand being carried out around some point that crossed the path of the current, and then deposited in deeper water; this process was carried on until the spit again connected with the shore and produced a bar. Their size, and the size of the pools and lakes behind them, was not so completely dependent on the size and strength of the waves and currents, and consequently on the size of the lake in which they were produced, as were the barrier beach pools; they could be started in shallow water along the shore and then be built out gradually into deeper water. The time required for their building, however, was directly so dependent. As a result, the sand bar pools were much larger features than the barrier beach pools, it is true that they were much larger in the Great Lakes than in the smaller, inland ones, but this was largely due to the fact that the few thousand years that have elapsed since the glacial retreat from Michigan was far to short a time for the puny currents of these smaller lakes to construct such large bars, as have been produced, for instance, along Lake Michigan, where many of the lakes so separated are larger than Douglas Lake itself. Off several of the points in Douglas Lake were found very evident signs of large bars, which will, in time, separate off lakes of considerable size from the parent body.

MOLLUSCAN SUCCESSION.

A. MOLLUSCS OF DOUGLAS LAKE.

The molluscs of Douglas Lake, at least of the southwestern portion where the pools were being formed, entirely consisted of gill-breathing species, or of pulmonates which had become adapted to take water into their lungs and breathe in that way. Even the young of *Physa ancillaria parkeri* (Currier), which lived in water but a few centimeters deep, normally breathed in this way, while the older shells, such as the adults of this same species, were so completely habituated to breathing water that, when placed in small aquaria, they died soon after exhausting the air in the water, without even attempting to come to the surface to breathe; altho when once taught to breathe air, by the simple method of exposing them out of water until the water in their lungs partially evaporated or was otherwise replaced by air, they could be kept in a small dish for several months and would come to the surface regularly like any ordinary, air-breathing form.

The shallow littoral fauna, which was the only portion that directly affected the beach pools, could be divided into five groups according to habitat: (1) the shells of unprotected, sandy shores; (2) the shells of more or less protected, sandy to marly shores; (3) the shells of well-protected, mucky shores; (4) the deep littoral shells that came up into shallow water to breed; and (5) the shells of the submerged vegetation zones.

There follows lists with brief notes of the molluscs in the various groups. In these lists the species are divided into three classes according to size: clams, primary species, and secondary species. The notes on abundance refer to the comparative abundance in the groups; this is done in an attempt to more or less equalize the effect of the size in an attempt to prevent the direct comparison of the abundance of a large form, like a clam, with that of a small form such as, for instance, *Planorbis parvus* Say. A small form, altho very abundant, may not be such a powerful factor in the association as a species less numerous in individuals but of much larger size; it must be, understood, however, that these groups are not meant to express comparative dominance, in the sense that this is used in plant ecology.

The remarks on abundance are purely comparative; figures, however, were obtained for many of the forms by means of a quadrat study, and these will be published in a future report. The following designations are used to express this abundance: very abundant, abundant, quite abundant, very common, common, quite common, frequent, quite infrequent, infrequent, very infrequent, quite rare, rare, very rare.

1. Shells of the unprotected, sandy shores. In most places around the south-west end of Douglas Lake, the bottom sloped out gradually to a depth of about a meter, and dropped off more or less suddenly to deep water; along the unprotected, sandy shores, this "step-off" was particularly steep, and sometimes even attained an angle of forty-five degrees. In these places exposed to the more or less direct action of the waves and currents, the sand was constantly shifting under the action of these agents, and all of the shells were quite large burrowing forms; higher plant life was entirely absent.

Clams. (All of the clams of the lake were small, approaching the dwarfed, Great Lakes forms.)

Lampsilis luteola (Lam.). Abundant; from about 20 cm. of water out, mainly in about 1 m. of water near the edge of the shelf.

Anodonta grandis footiana (Lea). Quite abundant; distribution similar to the preceding species.

Lampsilis nasuta (Say). Quite common; distribution similar to the preceding.

Primary species.

Campeloma decisum (Say). Abundant close to shore in about 15 to 20 cm. of water, quite abundant at a depth of a meter, and considerably less numerous between these depths.

Sphaerium acuminatum (Prime). Infrequent; mostly at a depth of a meter or a little less.

2. Shells of the more or less protected, sandy to marly shores. On the north-eastern shores of the bays and behind spits, etc., the shores were more protected, especially in the shallower waters. The bottom usually contained more or less marl, which often cemented the sand so as to form a rather firm, superficial layer in shallow water, while it was apt to be considerably softer in deeper water. *Scirpus americanus* usually grew along these shores, with *Scirpus validus* near the edge of the shelf. There was often a zone of *Potamogeton*, etc., along the edge of the shelf, while bunches of *Chara*, etc., were not infrequent in the shallow water of the shelf itself, and *Utricularia cornuta* often formed a sort of a sod in the places where the marl helped to form a firm superficial layer.

Clams.

Anodonta grandis footiana (Lea). Common; distribution similar to that along the unprotected shores.

Lampsilis luteola (Lam). Frequent; distribution similar to preceding species.

Anodonta marginata (Say). Infrequent; found mainly in deep littoral zones; found in shallow water and in more protected situations than the preceding forms.

Lampsilis nasuta (Say). Very infrequent; distribution similar to the first two species.

Primary species.

Campeloma decisum (Say). Very abundant; distribution similar to that on unprotected shelves, only more abundant thruout.

Planorbis bicarinatus, var approaching *portagensis* Baker. Shelf form. Abundant; from a depth of about 15 cm. to near the edge of the shelf. Most abundant in soft bottomed places at a depth of 65 cm., or in places protected by outer bars.

Sphaerium acuminatum (Prime). Frequent; thruout the deeper portions of the shelf.

Planorbis campanulatus smithii Baker. Infrequent; most numerous in about 40 cm. of water, in places where bottom was soft.

Lymnaea emarginata, var. approaching *angulata* (Sowerby). Shelf form. Infrequent; most numerous in about 40 cm. of water in places where there was a superficial crust.

Secondary species.

Planorbis bicarinatus, var., juvenile. Juvenile specimens, which were probably both the offspring of the shore form and of the deep littoral varieties, were abundant in similar situations to the adult shore form, altho usually in somewhat shallower water.

Physa ancillaria parkeri (Currier), juvenile. Quite abundant; mainly in 5 to 15 cm. of water on pebbles, etc., and on the firmly cemented bottom.

Lymnaea emarginata angulata (Sowerby), juvenile. Common in similar situations to the shelf form.

Planorbis parvus Say. Common; mostly in protected places in water from 10 to 35 cm. in depth. Most abundant at about 20 cm.

Valvata tricarinata (Say), and var. *confusa* Walker. Quite common; in similar situations to the preceding. Most numerous in about 30 cm. of water.

Amnicola limosa (Say). Quite infrequent; in similar situations to the preceding.

Planorbis campanulatus smithii Baker, juvenile. Infrequent; along with the adults.

Physa ancillaria, var. approaching *magnalacustris* Walker. Very infrequent; mostly in about 20 cm. of water. It appeared that some of the offspring of the deep littoral *Physa ancillaria parkeri* remained on the shelf and became this form, as has been mentioned in a former paper in regard to the forms in the outlet of Maple River (6). Air-breathing, juvenile specimens in the laboratory developed into the same form.

Physa gyrina Say. Very rare; a single specimen was obtained in 25 cm. of water off Pine Point.[1]

[1] This species, *Planorbis deflectus*, and *Ancylus parallelus* were not examined for the purpose of determining whether they breathed water or air, but it seemed probable that they did the latter, as all of the other pulmonates, including *Planorbis parvus*, appeared to do so.

Pisidium sp. Several species of *Pisidia* were obtained in this habitat, but the specimens and records were lost by fire.

3. *Shells of mucky shores.* In the most protected places, the water plants, such as white and yellow water-lilies, potamogetons, wild celery, etc., were much more abundant on the shelf and at the edge of the step-off. In consequence, there was often a considerable deposit of fine muck, and the bottom conditions of these places more closely approached the pools, than did those of the other portions of the shelf. The step-off was much more gradual in these places; often it was hardly noticeable.

Clams.

Anodonta grandis footiana (Lea). Frequent; depth distribution similar to that in preceding habitat.

Lampsilis luteola (Lam.). Infrequent; ditto preceding.

Lampsilis nasuta (Say). Rare; ditto preceding species.

Strophitus edentulus (Say). Very rare; one specimen obtained from about 35 cm. of water.

Primary species.

Campeloma decisum (Say). Very common; distribution similar to that in preceding habitats.

Planorbis bicarinatus, var. approaching *portagensis* Baker. Shelf form. Common; similar in distribution to that in preceding habitat.

Planorbis campanulatus smithii Baker. Quite common; distribution similar to that in preceding habitat. More numerous than the preceding species in the most mucky places.

Lymnaea stagnalis perampla Walker, young specimens. Frequent; mostly in water about 55 cm. in depth, and in the most mucky places.

Sphaerium sulcatum (Lam.). Infrequent; mostly in water about a meter in depth.

Secondary species.

Planorbis bicarinatus, var., juvenile. Common; similar in distribution to that in preceding habitat.

Planorbis campanulatus smithii Baker, juvenile. Common; in similar places to adults.

Amnicola limosa (Say). Frequent; similar in distribution to those of marly shores; especially numerous on sticks and debris.

Valvata tricarinata (Say), and var. *confusa* Walker. Quite infrequent; similar in distribution to preceding species.

Planorbis parvus Say. Infrequent; similar in distribution to preceding; altho usually in shallower water along with the next form.

Physa ancillaria parkeri (Currier), juvenile. Quite rare; similar in distribution to those on marly shores.

Planorbis deflectus Say. Very rare; similar in distribution to *Planorbis parvus.*

4. *Deep littoral shells, which came up into shallow water to breed.* As has already been mentioned in a former paper (6), there were six primary forms which lived in the deep littoral zones of Douglas Lake, but came up on the shelf to breed. These apparently came up in a regular order during the summer and at quite separate times, except in colder summers, like that of 1912, when they came up crowded together in the early part of September, altho apparently in the same order as before.

Planorbis bicarinatus portagensis Baker. Bred in great abundance, in similar situations to habitat of shelf form; came up usually in midsummer.

Lymnaea emarginata angulata (Sowerby). Bred in abundance, in similar situations to the habitat of the juvenile specimens in group 2; came up in latter part of July, slightly later than the preceding species.

Physa ancillaria parkeri (Currier). Appeared common; in water from 10 to 35 cm. in depth, especially in places where there was a firm, marly crust. Most numerous at about 20 cm. Apparently came up in the early part of June.

Planorbis bicarinatus percarinatus Walker. Frequent; in similar places and at a similar time to the other variety of *P. bicarinatus*.

Lymnaea stagnalis perampla Walker. Frequent; bred in mucky-bottomed and weedy situations. Found in great abundance near the middle of July in the mouth of Bessey Creek in the summer of 1911.

Planorbis campanulatus smithii Baker. Quite infrequent; bred mainly along mucky-bottomed shores with the shelf form. The time was difficult to determine as the deep littoral immigrants are difficult to distinguish from the form which inhabited the shelf; apparently it was nearly coincident with that of the varieties of *P. bicarinatus*. This variety was less completely a deep littoral form than were the others; the shelf form was not so noticeably increased in numbers during the immigration.

5. *Shells of the vegetation zones.* As has already been mentioned, there were considerable areas at the edge of the shelf, especially along the mucky shores, which were taken up by various aquatic plants. These zones only occurred in the protected places.

Primary species.

Lymnaea stagnalis perampla Walker, young shells. Quite infrequent.

Secondary species.

Amnicola limosa (Say). Very abundant.

Valvata tricarinata (Say), and var. *confusa* Walker. Quite common.

Planorbis parvus Say. Quite common.

Ancylus parallelus Haldeman. Frequent; especially on lily pads.

Planorbis deflectus Say. Quite rare.

B. MOLLUSCS OF LAKE LAGOONS AND POOLS.

I. BARRIER BEACH TYPES.

a. Barrier Beach Pools on South Point. (Map 2, a; maps 3, 4, 5, and 6.) The barrier beach pools of Douglas Lake, as has already been mentioned, were so small that their depth was less than the annual range of the surface level of the lake itself, and so they were built and destroyed each year. On this account, the shells of these pools were simply landlocked forms from the lake itself, and showed no ecological succession of pool forms.

These pools were mainly formed on South Point, on the northeast side of the lake about midway between North and South Fish Tail Bays. They were situated in a place that would have been open to the action of the strongest waves, except for the presence of a large triangular bar of peculiar formation (map 2, 0), which caused the water to be not much more than a meter deep for nearly a mile off shore. For these reasons, there were apparently almost no shelf forms except the clams and *Campeloma decisum*. These lagoons and pools were, however, favorite breeding places for *Lymnaea emarginata angulata*, *Planorbis bicarinatus portagensis* and *P. bicarinatus percarinatus*,

and large numbers of these species were landlocked, and subsequently many of them killed, during the summer of 1911. *Physa ancillaria parkeri* must have bred here also, as the juvenile specimens were found, in considerable numbers, during the summers of 1911, and 1913, and to some extent in 1912. Small specimens approaching *Physa ancillaria magnalacustris* were also obtained.

II. SAND SPIT TYPES.

On the other hand, the sand spit pools of Douglas Lake, like the barrier beach pools of Saginaw Bay, were major features and often predicated a long life history. Four lagoons and pools, in different stages of completion, were studied; these were, in order of their apparent age: the Pine Point Lagoon, the Hook Point Lagoon, the Swamp Point Lagoon, and the Sedge Point Pool. The situations of these four were more or less similar, in that they all were produced along the north-east side of the lake, the first two and the last along the shore north of North Fish Tail Bay, the last on its south shore. They apparently were produced by the currents that were diverted along the shore of the lake to the east of the triangluar bar already mentioned.

a. Description of Different Examples.

1. The Pine Point Lagoon. (Map 2, b; map 7). During the summer of 1912, a spit was initiated to the south-east of Pine Point by a heavy storm from the west and south-west; in the summer of 1913, this had developed far enough to partially enclose a small lagoon. This was choked with *Scirpus americanus*, and also contained a few scattered potamogetons, *Eleocharis*, bunches of *Chara*, etc. The bottom was at first of sandy marl, similar to the bottom of the shelf in that portion, but soon accumulated considerable quantities of debris, muck, etc.

Clams.

Anodonta grandis footiana (Lea). Infrequent; a few stray specimens were noticed.

Primary species.

Campeloma decisum (Say). Abundant.

Planorbis bicarinatus, var. approaching *portagensis* Baker, shelf form. Abundant.

Physa ancillaria parkeri (Currier). Common, during breeding period.

Lymnaea emarginata angulata (Sowerby). Frequent; during breeding period.

Planorbis campanulatus smithii Baker. Infrequent.

Lymnaea stagnalis perampla Walker. Very infrequent; during breeding periods.

Secondary species.

Planorobis bicarinatus, var. juvenile. Abundant.

Physa ancillaria parkeri (Currier); juvenile. Very common.

Planorbis parvus Say. Frequent.

Lymnaea emarginata angulata (Sowerby); juvenile. Frequent.

Amnicola limosa (Say). Frequent.

Valvata tricarinata (Say), and var. *confusa* Walker. Infrequent.

2. The Hook Point Lagoon. (Map 2, c; map 8). Inside the inner curve of the sand spit, at the end of Hook Point, was a marshy lagoon in which the water was quite shallow, reaching a depth of 30 cm. The shelf adjacent

was mucky bottomed and was covered with patches of white and yellow water-lillies; the lagoon itself was choked with such plants as *Scirpus americanus, Hypericum virginicum, Dulichium arundinaceum, Lobelia cardinalis, Eupatorium perfoliatum,* and a few, short-stemmed plants of *Castalia odorata,* while at one end there was a considerable growth of *Myrica gale.*

Primary species.

Planorbis bicarinatus, var. approaching *portagensis* Baker; shelf form. Infrequent.

Campeloma decisum (Say). Infrequent; young.

Lymnaea stagnalis perampla Walker. Very rare; young specimens.

Secondary species.

Amnicola limosa (Say). Abundant.

Planorbis bicarinatus, var.; juvenile. Quite common.

"*Pisidium,* juvenile, apparently *regulare* Prime."[1] Quite common.

Planorbis hirsutus Gould. Quite common.

Planorbis deflectus Say. Infrequent; dead shells.

Musculium securis (Prime). Infrequent.

Physa ancillaria parkeri (Currier); juvenile. Very infrequent.

Pisidium sargenti Sterki. One specimen; "not typical."

3. Swamp Point Lagoon. (Map 2, d; no separate map). On Swamp Point, the sand spit had surrounded the lagoon to a greater extent than at Hook Point; there was only a channel, a few centimeters deep, connecting it with the main lake in 1911; and this was also filled in by the growing spit during the summer of 1913, so that it was only open during very high water. The bottom of the shelf nearby was more or less mucky and there was a considerable development of the weed zones, which reached very close to shore on account of the exceptional narrowness of the shelf in this portion of the lake. The bottom of the lagoon was also covered with marly muck, but this deposit was thicker and was also mixed with decayed and matted rushes and other plant remains. This lagoon closely approximated a pond, both in fauna and flora. Some of the prominent plants were *Spartina michauxiana, Scirpus validus, Phragmites communis, Scirpus americanus, Potentilla palustris, Lobelia kalmii,* and *Rosa carolina.*

Primary species.

Campeloma decisum (Say). Infrequent; young specimens.

Secondary species.

Musculium securis (Prime). Quite common.

Segmentina crassilabris Walker. Quite common.

Lymnaea obrussa Say. Infrequent; young specimens.

Pisidium sargenti Sterki. A few young specimens, "small and slight."

Planorbis bicarinatus, var.; juvenile. Rare.

Planorbis sp. Rare; juvenile, too young to be identified.

Physa ancillaria parkeri (Currier), juvenile. Rare.

4. Sedge Point Pool. (Map 2, e; map 9). At Stony Point, somewhat over a hundred yards west of Sedge Point, a steep, stony bank sloped up directly from the waters edge to a height of from fifteen to twenty feet. This "sea-cliff" showed signs of considerable, recent erosion at the base, while to the east of it a long ridge became apparent; the whole of the latter had apparently been formed as a sand spit from the sand worn away from

[1]The pisidia were indentified by Dr. V. Sterki, and the notes in quotation marks were made by him.

Stony Point and other places along the shore. Ice had apparently assisted in building this spit.

Behind this ridge were a series of swamps and ponds, beginning with areas of damp, low ground near Stony Point, and terminating in the large pond shown on the map of Sedge Point (Map 9). Beyond Sedge Point, as can be seen from the map, a submerged continuation of the spit extended out towards Pine Point, and this was apparently separating a new pool. The bottom of the shelf on the outer side of this latter portion of the spit was quite sandy and unprotected, but the bottom behind it was covered with a considerable deposit of marl.

The Sedge Point Pool was mucky-bottomed and the water had a reddish tinge, probably due to iron. The center of the pond was free from vegetation, except for a gew scattering potamogetons, but around the dege was a more or less complete zone of water plants. This was dominated by *Scirpus validus*, intermixed with water-lilies, along the inner shores, and by *Scirpus americanus* along the outer and eastern edges. In the shallow water, especially along these latter shores, was a thick growth of such plants as *Hypericum virginicum*, *Dulichium arundinaceum*, *Proserpinacea palustris*, *Lobelia cardinalis*, *Eupatorium perfoliatum*, and *Sium cicutaefolium*. At the western end the bottom was very mucky and was dominated by such plants as *Phragmites communis* and *Typha latifolia*. It was in the shallow water around the eastern end, where the mucky layer was least prominent, that most of the shells were found.

Clams.

Anodonta grandis footiana (Lea). Very rare; in the central, weedless area.

Lampsilis nasuta (Say). Very rare; ditto preceding.

Primary species.

Lymnaea stagnalis appressa (Say), rarely somewhat approaching *perampla* Walker. Very abundant, but usually not very large. One of the largest measured: altitude 41.9 mm., diameter 21.2 mm., aperture length 23.1 mm.

Planorbis trivolvis Say. Infrequent; shells quite small and flat. The largest specimen measured: greater diameter 18.6 mm., lesser diameter 15.5 mm., altitude of aperture 7.1 mm.

Lymnaea exilis Lea. Apparently infrequent. The largest specimen obtained measured: altitude 36.7 mm, diameter 11.7 mm., length of aperture 16.7 mm.

Planorbis campanulatus smithii Baker. Only dead shells obtained.

CHART II.—COMPARISON OF BEACH POOLS OF DOUGLAS LAKE.

	Pine Point L.	Hook Point L.	Swamp Point L.	Sedge Point P.	Temporary swamps.
Clams.					
Anodonta grandis footiana (Lea)	I			vR	
Lampsilis nasuta (Say)				vR	
Primary species.					
Planorbis campanulatus smithii Baker	I				
Lymnaea emarginata angulata (Sowerby)	Fb				
Physa ancillaria parkeri (Currier)	Cb				
Lymnaea stagnalis perampla Walker	vIb	vRy			
Planorbis bicarinatus, shelf form	A	I			
Campeloma decisum (Say)	A	Iy	Iy		
Physa ancillaria Say, var				vR	
Lymnaea stagnalis appressa (Say)				vA	
Lymnaea exilis Lea				I	
Planorbis trivolvis Say				I	
Aplexa hypnorum (L.)					qA
Lymnaea palustris (Mueller)					Cl
Secondary species.					
Valvata tricarinata (Say) and *canfusa* Walker	I				
Lymnaea emarginata angulata (Sowerby), juven.	F				
Planorbis parvus Say	F				
Amnicola limosa (Say)	F	A			
Physa ancillaria parkeri (Currier), juvenile	vC	vI	R		
Planorbis bicarinatus, var., juvenile	A	qC	R		
Pisidium regulare Prime?		qC			
Planorbis hirsutus Gould		qC		I	
Planorbis sp?			Rj		
Pisidium sargenti Sterki		vR	vIy		
Musculium securis (Prime)		I	qC	A	
Segmentina crassilabris Walker			qC	vA	
Lymnaea obrussa Say			Iy	vR	
Pisidium variabile Prime				R	
Sphaerium occidentale Prime					vC
Planorbis umbilicatellus Cockrell					I

CHART III.—COMPARISON OF POOLS OF DIFFERENT REGIONS.

	Sand Point (19).	Stony Island (19).	Near Rush Lake (19).	"Long Lake" (9).	Sedge Pool (13).	Sedge Point Pool.
Clams.						
Anodonta grandis footiana (Lea)						vR
Lampsilis nasuta (Say)						vR
Primary species.						
Planorbis trivolvis Say	A	A	A	A	A	I
Lymnaea lanceata (Gould)[1]	C	C				
Lymnaea kirtlandiana (Lea)					R	
Lymnaea palustris (Mueller)	R		I			
Lymnaea exilis Lea						I
Lymnaea stagnalis appressa (Say)					A	vA
Physa gyrina Say			C		I	
Physa elliptica Lea	I					
Physa ancillaria Say, var						R
Aplexa hypnorum (L.)	I		I			
Secondary species.						
Musculium securis (Prime)	A	A	A	A	?	A
Musculium ryckhaltii (Norman)		R				
Musculium truncatum (Linsley)	I					
Sphaerium occidentale Prime	I		I			
Pisidium variabile Prime						I
Segmentina crassilabris Walker			C			vA
Segmentina armigera (Say)	C		C			
Planorbis parrus Say	I					
Planorbis deflectus Say		I				
Planorbis exacuous Say	I			I		
Planorbis hirsutus Gould		C				I
Planorbis umbilicatellus Cockerell					R	
Planorbis crista (L.)		R				
Amnicola walkeri Pilsbry	R					
Lymnaea obrussa Say	I					R

[1]This was published as *Lymnaea reflexa* Say, and var., in previous papers (4 and 5), but the writer has since come to the conclusion that it was the *Lymnaea lanceata* (Gould) of F. C. Baker (2).

Physa ancillaria Say, var. Two specimens were obtained which appeared to be close to this species. They were quite dark brownish horn in color, with a purplish brown callus. The largest example measured: altitude 11.7 mm., diameter 7.3 mm., aperture length 9.3 mm., while a specimen of *Physa ancillaria parkeri*, from the shore of the lake, measured: 12.3 mm., 9.2 mm., 10.5 mm.

Secondary species.

Segmentina crassilabris Walker. Extremely abundant.
Musculium securis (Prime). Abundant.
Planorbis hirsutus Gould.
Pisidium variabile Prime. Rare.
Lymnaea obrussa Say. Very rare.

b. Comparison of Different Pools.

To bring out more clearly the relationships of these different pools, two charts were prepared: one, (chart 2), comparing the four lagoons and pools of Douglas Lake, while the other (chart 3), the pools of three different regions in northern Michigan. Six pools were shown in this last chart; the first four from Huron County (5), the fifth from Dickinson County (7), and the sixth the Sedge Point Pool of Douglas Lake.

The pools in the first class were the remnants of small, sand-spit lakes on the south side of Sand Point; the fourth was "Long Lake," a barrier beach pool on the north side. The pools on Stony Island were formed on a large sand spit which, in fact, constituted most of the island, but were separated from Saginaw Bay by what appeared to be a barrier beach; they were on the less protected side of the island. On the other hand, the pools near Rush Lake in Huron County, and the sedge pool of Dickinson County, were formed in connection with streams. The first were apparently creek-flat pools; the second was a glacial depression which was close to the Sturgeon River, and certainly drained into the latter, during high water, if it was not flooded by it.

From chart 3, it will be seen that the characteristic pool molluscs of these portions of northern Michigan were: *Planorbis trivolvis* among the larger species, and *Musculium securis* among the smaller ones. The presence of some medium-sized *Lymnaea* was also quite typical; in the Sand Point and Stony Island pools, *Lymnaea lanceata*, derived from the lagoon formations of Saginaw Bay, was quite common, while in the pools near Rush Lake and in Dickinson County, *Lymnaea palustris*, with varieties, and *Lymnaea kirtlandiana*, respectively, appeared to be the pioneers of the temporary swamp conditions (see chart 4). *Lymnaea exilis* seemed to be the example of this type in the Sedge Point Pool, while both in it and in the sedge pool of Dickinson County, *Lymnaea stagnalis appressa*, a shell more characteristic of larger bodies of water, was very numerous. Another characteristic genus was *Segmentina*, one or the other of the two species being usually present.

It will be noticed that, in this paper and in former papers by the writer, the line between lakes and pools was apparently drawn farther along than by Shelford (13), or by F. C. Baker (1); in fact, the pools of the writer appear to correspond to the senescent stages, at least in the molluscan fauna, of those described by Shelford. The writer did not find, in any of the three regions mentioned, *Planorbis campanulatus* or *Amnicola limosa* in any pool closed off from the parent lake or stream, and the Sedge Point Pool was the

only one where clams were found. This partly might have been due to the differences in location; the three regions, described by the present writer, were all considerably north of Chicago, and the colder winters, on account of the greater amount of ice and the resultant stagnancy, might have prevented the life of such forms in the shallow waters of the pool formation. It also might have depended partly on the point of view of the writer; I would have called the senescent pools of Shelford the typical pools, perhaps because, in the more northern regions, the transition stages between the lake and pool, which were most prominent in the latter writer's descriptions, appeared to be passed thru more quickly. Also, the molluscs present in the "senescent" stages were the only ones common to all pools, no matter what their method of formation. The pools of the writer appeared to resemble more closely the prairie pools of Shelford, perhaps because these apparently did not show transition stages connecting them with the larger lakes, and so lacked relict species from those formations.

To return to Douglas Lake, the Pine Point Lagoon had about the same shells as the adjoining, marly bottomed shelf (groups 2 and 4), only, as the bottom was more mucky, a few of the mucky bottomed shelf forms were more numerous (Groups 3 and 4). This was what might have been expected from the youngest lagoon of the series; a year or two was not enough time to develop a divergent fauna or to cause a disappearance of the old one.

The second of the series, in completeness of separation and in age, was the Hook Point Lagoon. Here was found a considerable reduction in the lake forms; the single clam, four of the primary species, and three of the smaller forms had disappeared, while of the remaining ones were less numerous, with the single exception of *Amnicola limosa*, which increased greatly in numbers. This exception may have been due to the fact that the present lagoon was more closely connected with a mucky-bottomed shelf and with the weed zones, while the preceding one was adjacent to a marly-bottomed portion. Two new forms, not including the pisidia on account of the loss of the records of the shelf forms, had appeared in the Hook Point Lagoon, one being common, the other infrequent. The latter of these, *Musculium securis* has already been mentioned as one of the most characteristic pond forms.

In the Swamp Point Lagoon was found a still greater reduction of the lake forms. All of the primary species had disappeared as such, with the exception of *Campeloma decisum*, while two others were sparsely present as juveniles. *Planorbis hirsutus* was not found, but juvenile specimens of a *Planorbis*, too young to be identified, appeared partly to take its place. On the other hand, *Segmentina crassilabris*, another pond species, had appeared.

The Sedge Point Lagoon differed somewhat from the others; judging from its greater size and probably far greater age, it must have been separated from the main lake much more slowly. All of the lake forms had disappeared, with the exception of the two clams, which were rare and had probably persisted on account of the large size of the pond.[1] However, two of the lake shells, *Physa ancillaria parkeri* and *Lymnaea stagnalis perampla* (group 4), were represented by changed varieties, *Physa ancillaria*, var., and *Lymnaea stagnalis appressa*, respectively. In addition, two new, primary species had appeared, both of them more or less characteristic of ponds; in fact, the first, *Planorbis trivolvis*, already has been cited as the

[1] It is well within the limits of possibility that these were introduced artificially, by students or by fishermen.

most typical, large form of the ponds of northern Michigan. Among the secondary species, not counting the pisidia, all of the forms that appeared in the other lagoons were present; they were also in greater numbers than in the smaller lagoons, with the single exception of *Lymnaea obrussa* which had fallen off in abundance.

CHART IV.—COMPARISON OF TEMPORARY SWAMPS OF DIFFERENT REGIONS.

	Sand dune swamps (18).	Rich, clay swamps (18).	Burnt, tamarack S. (14).	McKinnon Brook Flats (15).	Douglas Lake Region.
Primary species.					
Lymnaea palustris (Mueller)	vA	vA	.....	.....	Cl
Lymnaea kirtlandiana (Lea), var	.....	.....	.....	vA	.....
Aplexa hypnorum (L.)	A	A	qAd	qC	qA
Physa gyrina Say	.....	qC	.....	qC	.....
Pgyrina, var. hildrethiana (Lea)	.....	I	.....	.....	.....
Physa elliptica Lea	I	.....	.....	.....	.....
Physa heterostropha Say	.....	.....	.....	Rj	.....
Secondary species.					
Sphaerium occidentale Prime	A	A	.....	A	A
Musculium truncatum (Lindsley)	qA	qA	.....	.....	.....
Musculium partumeium (Say)	I	I	.....	.....	.....
Pisidium roperi Sterki	.....	.....	vAd	I	.....
Planorbis parvus Say	C	C	Ad	C	.....
Planorbis parvus walkeri Vanatta	.....	R	.....	.....	.....
Planorbis umbilicatellus Gould	R	R	.....	.....	I
Planorbis exacuous Say	.....	.....	.....	A	.....
Segmentina crassilabris Walker	.....	C	.....	.....	.....
Lymnaea obrussa peninsulae (Walker)	.....	.....	Id	.....	.....
Lymnaea sp?	.....	Rj	.....	.....	.....

III. TEMPORARY SWAMPS.

a. Description of Swamps.

On Grapevine and Hook Points were found remnants of old ponds which had become temporary swamps, mainly thru the deposit of humus by the water plants and the surrounding forest trees. These were mostly small and rather barren, and were dry during a large proportion of the summer. Another swamp was reported from near the north shore of North Fish Tail Bay, which appeared from the description to be richer; here *Lymnaea palustris* was said to be quite abundant, but the writer was never able to find the place. There were also some larger swamps along the flats of Bessey Creek, at the other end of the lake, but these appeared very similar to those first mentioned. *Lymnaea palustris* was also found along the Maple River, the outlet of Douglas Lake.

There were also many other small hollows thruout the burnt-over, poplar and second growth regions around Douglas Lake, most notably behind the first sand ridge along the south-east shore; this latter might be regarded as a barrier beach formation secondarily increased by wind blown sand. These were similar to the hollows in the sand dunes of Huron County (5), which almost always contained little temporary swamps. These places around Douglas Lake may have contained similar swamps before the fires; in fact, *Nemopanthus mucronata*, a bog plant, was found growing in one of these dry hollows, and a burnt, bleached specimen of *Succinea retusa* was picked up in another. However, the fire had burnt out the mosses, leaves and humus and had destroyed the shading shrubs and trees, all of which formerly pre-

vented rapid absorption and evaporation of the water, so that finally the pervious, sandy soil sucked up the rain almost as fast as it fell. A similar destruction was more apparent in Dickinson County, Michigan, on similar soil (7); hollows, which contained no water in the summer after the disastrous fires of 1908, were still choked with the scorched trunks of the dead tamaracks, etc., and still contained large numbers of dead and partially burnt, aquatic shells.

Primary species.
Aplexa hypnorum (L). Quite abundant.
Succinea retusa Lea. Quite abundant; semi-amphibious.
Lymnaea palustris (Mueller). Common; local.

Secondary species.
Sphaerium occidentale Prime. Very common.
Zonitoides nitida (Mueller). Frequent; semi-amphibious.
Planorbis umbilicatellus Cockerell. Infrequent.

b. Discussion of Swamp Forms.

In Chart IV, the temporary swamps of the same three regions in northern Michigan have been listed, and their molluscan faunas tabulated, after the manner of those of the permanent ponds. The first two pools were in Huron County, the second two in Dickinson County, the fifth in the present region. The first were temporary swamps formed between the sand dunes of Sand Point, the second the richer, forest swamps of the flat, clay-soiled regions around Rush Lake (5). The third was a burnt-over tamarack swamp, which differed considerably from the other swamps, and was listed, in this connection, to call further attention to the destruction of temporary swamps by fire, a matter which has already been discussed. The characteristic shell of such tamarack swamps appeared to be *Pisidium roperi*. The fourth series of swamps were those formed on the mud flats of McKinnon Brook, a small stream, which flowed out of the clay moraines thru the sandy, outwash regions.

It will be seen from this chart that *Aplexa hypnorum* was the most characteristic of the large molluscs, as *Sphaerium occidentale* was of the smaller. Two medium-sized species of *Lymnaea* also appeared to be connected with this habitat: *Lymnaea palustris* in Huron County and around Douglas Lake, and *Lymnaea kirtlandiana*, var., in Dickinson County. In addition, small planorbices seemed to be present quite universally, while *Musculium truncatum* and, to a lesser degree, *Musculium partumeium* were important swamp forms in Huron County. (Compare 3, Station XXI).

The temporary swamps around Douglas Lake seemed to be quite typical in regard to their molluscan fauna; two of the most typical forms were quite numerous, while a third appeared to be common locally, and the small planorbices were represented by *Planorbis umbilicatellus*. They were quite barren, however, and only contained these widely distributed forms, while the other swamps listed contained some accessory species; this was most noticeable in the rich, hardwood swamps around Rush Lake.

SUMMARY.

a. Environmental Differences Between Lakes, Pools and Swamps.

There seemed to be seven main factors that differentiated the various stages of this form of the lake-pond-swamp series, and these were all largely dependent on the size, depth and amount of protection of these bodies of water. The seven factors were: (1) the amount of wave action, and the "roughness" of the water, (2) the comparative extent of the shallow littoral conditions, as compared to the remainder of the body of water, (3) the constancy in amount of water, (4) the isolation, (5) the amount and character of the vegetation, (6) the temperature, and (7) the proportion between the surface and the entire volume of the body of water. Some of these factors were reflected by marked adaptations in the molluscs; the effects of others would have to be determined by closer observation and experiment.

I. The Amount of Wave Action. The lakes naturally developed much larger waves than did the ponds and swamps; Douglas Lake sometimes was disturbed by waves six feet in height between trough and crest, while the pools and swamps were mostly smooth or were affected by small ripples. The lagoons, however, altho much less disturbed than the open lake or the unprotected shores, were much more open to wave action than were the enclosed pools.

In this connection, two adaptations were noticeable among the molluscan forms of the lake, in contrast to the pools and swamps: (1) the prominence of burrowing forms in the lake, and (2) the adaptations of the lake molluscs for breathing water. Group 1, of the lake, has already been described as consisting entirely of rather large burrowing forms, and, while their relative prominence fell off with increasing protection, they were present in Groups 2 and 3 at certain depths. The varieties of *Planorbis bicarinatus* and *Planorbis campanulatus smithii* were also semi-burrowing in habit. This fauna became inconspicuous in the lagoons and usually disappeared in the pools, altho the Sedge Point Pool contained two clams; it was entirely absent in the temporary swamps.

The second of these factors was even more prominent. All of the shells of Douglas Lake breathed water (with the possible exceptions already noted), while all of the forms of the Sedge Point Pools, with the exception of the *Sphaeridae* and the two, rare clams were air breathers, as were also the forms of the temporary swamps with the exception of *Sphaerium occidentale*. The pulmonates of the Pine Point and Hook Point Lagoons appeared to breathe water like those of the lake, but those of the Swamp Point Lagoon were air-breathers as far as could be examined. The comparative infrequency of the gill-breathing forms in the pools might have been partly due to the next factor to be taken up, but it certainly seemed probable that the water-breathing adaptations of the larger pulmonates in the lake was forced on them by their inability to take air unless the surface of the water was comparatively smooth. The six, deep littoral forms of group 4 were all peculiar varieties, as has been mentioned in a previous paper (6), with their basal whorls considerably enlarged, apparently to allow for the increased capacity of their lungs which was correlated with this habit of filling them with water. Two of them, *Physa ancillaria parkeri* and *Lymnaea stagnalis perampla*, as has already been mentioned, had changed in Sedge Point Pool to the more slender, air-breathing forms, *Physa ancillaria*, var., and *Lymnaea stagnalis appressa*, respectively.

II. Comparative Extent of Shallow Littoral Conditions. In most places in Douglas Lake, the shallow littoral zone formed only a narrow shelf fringing the shore, while in the pools and swamps there were no other conditions present. This resulted in two important differential effects on the lake fauna: (1) the free immigration of the deep water forms of the lake, and (2) the fact that the shallow littoral forms were not completely dependent on the water above them for food and air.

The shelf of the lake was open to the immigration of the deep water forms, and the opposite was also true, and the migrations of the deep littoral forms of group 4 certainly showed to what extent competition between the inhabitants of the different zones was possible. On the other hand, the food and air supply of the shelf was added to constantly by the contributions of the wind-developed currents which brought the plankton and air in from the entire surface of the lake, while the pool and swamps forms were completely dependent on the water above them for these necessities. This lack of aeration by change in the water might have been one of the factors that caused the predominance of air-breathing forms in the pools altho its influences must have been largely counterbalanced by other methods of aeration. It certainly seemed as if the food supply must have had a strong effect in the elimination of the larger species from the latter habitats. It would take a rather large pool, for instance, to supply enough food for a self-reproducing body of clams, and they certainly would not be anywhere near so abundant as in the same area on the shelf.

III. Constancy in Amount of Water. The lake had practically a constant water supply, but in the pools the amount of water was subject to great variation, while in the swamps comparative dessication was the dominant feature during much of the time. As a result, the pool forms had to be more able to resist change in the amount of water with its attendant dilution and concentration of the mineral content and other substances. In addition, the shells of the swamps needed adaptations for the resistance of drought, and these were found to be present. All of the shells of the swamps were able to live for some time out of water, either burrowed in the mud or up on the water plants, with an epiphragm closing the aperture.

In the cases of *Lymnaea palustris* and *Aplexa hypnorum*, the egg-masses must have been able to resist even greater dessication, as the bottoms of pools, which had been dry for some time, were dug up without the discovery of any living shells, and yet the juvenile shells appeared in great numbers during the next rainy season. Specimens of the *Sphaerium occidentale* were also found, in which the animals were all dead, but the damp decaying bodies contained numbers of living, juvenile specimens, protected within the shells of the viviparous parents. Experimental data, on the abilities of different molluscs and their eggs to resist dessication and stagnancy of the water, would be very interesting and important in this connection.

IV. Isolation. Lakes are usually connected with other lakes and with large streams by at least temporary streams, and can receive their fauna in this way; Douglas Lake was no exception in this regard (6). The pools and swamps, on the other hand, were usually more completely isolated from other similar habitats. The ponds, it is true, could receive some of their fauna from or thru the parent lake before complete separation from it, but it was often very difficult to find signs of how this would be accomplished; the nearest specimens of *Planorbis trivolvis* to those of the Sedge Point Pool were found in the mouth of a brook three miles away, and these latter were totally different in form and appearance. A single specimen of *Physa*

gyrina in group 2, and another of *Strophitus edentulus* in group 3, showed how stray specimens might often be found at a considerable distance from their associates of the same species, and the pools might have been largely populated by similar wandering migrants.

The temporary swamps present a still more difficult problem. The shells in them were found nowhere else around the lake, and they were not connected with each other or with the lake even by temporary streams. It must have been that their comparative tolerance of dessication enabled them, or their eggs, to be carried easily, by birds, etc., from pool to pool.

V. The Vegetation. The swamps and pools usually contained a greater amount of vegetation than did any portion of the lakes with the exception of the weed zones, and it was also of a different character. This, of course, had a marked effect or the deposition of humus and on the amount of humic acids in the water. However, the effects of this were not especially brought out.

VI. The Temperature. During the summer, the temperature of the pool was considerably higher than those of the littoral zones of the lake, and must have been lower in winter. This was especially true of the beach pools, exposed to the direct sun on the treeless, sandy beaches. This must have had a considerable effect on the shells themselves, and on their food supply.

VII. Proportion between Area of Surface and Total Volume. The larger area of the surface of the pools, in proportion to the total amount of water, was in very marked contrast to that of the lake; this strongly effected the preceding factor, and also allowed greater aeration and also greater evaporation in the former habitats. The greater evaporation apparently resulted in high mineral content; the iron deposits of beach pools were apt to be quite prominent and must have been attended by higher concentration of other materials, altho this was not especially tested.

b. Conclusion.

In conclusion, it might be remarked that the beach pools of Douglas Lake gave a marked example of animal succession. As the waves and currents built up the spits and bars, the environment changed, and along this differentiation came changes in the molluscan fauna. The fauna, however, had little effect on these initial metamorphoses, but after the separation, and during it, there must have been considerable competition between the old and the new forms. In addition, they must have become considerable factors in the small pools, by changing the gaseous and organic content, etc. In this succession, the larger species of the lake habitats appeared to be the first to go, while the secondary forms appeared to be the pioneers. Part of this latter, apparent succession may have been due, however, to the large size of the climax pool as compared with the lagoons.

Despite the considerable effects of the animals on their environment, the physical factors were the main causes of the change from lake to pool, while the vegetation appeared to be the main factor in the change from pool to temporary swamp. Animal ecology, even as compared to plant ecology, seemed to be much more the study of habitats than of associations.

Colorado College, Nov., 1914.

KEY TO MAPS AND CHARTS.

Chart. I. Classification of Lakes of Temperate Regions.
Chart II. Comparison of Beach Pools of Douglas Lake.
Chart III. Comparison of Pools of Different Regions.
Chart IV. Comparison of Temporary Swamps of Different Regions.

ABREVIATIONS USED IN CHARTS.

A.....abundant.
b.....breeding, only.
C.....common.
d.....dead.
F.....frequent.
I.....infrequent.
j.....juvenile.
l.....local.
q.....quite.
R.....rare.
v.....very.
y.....young.

The numbers refer to the numbers of the habitats given in former papers (5, 7).

Map 1. Map of the Northern End of the Southern Peninsula of Michigan, showing Beaches of Glacial Lakes Algonquin and Nipissing.[1]

The cross-hatched portions show what was land during the time of the Algonquin highest beach level; the highest Nipissing beach is represented by the line just inside the present lake shore and surrounding Mullet, Burt and Crooked Lakes. The figures in the different lakes are their approximate heights above sea-level. The large squares represent the townships, or areas six miles square. (Reproduced from 6).

Map 2. Douglas Lake.

a.....barrier beach pools.
b.....Pine Point.
c.....Hook Point.
d.....Swamp Point.
e.....Sedge Point.
f.....South Point.
g.....Stony Point.
h.....North Fish Tail Bay.
j.....South Fish Tail Bay.
k.....Grapevine Point.
l.....head of Carp Creek.
m.....Maple River.
n.....Bessey Creek.
o.....outer edge of triangular bar.

Maps 3, 4, 5 and 6. Barrier Beach Formation.

Four successive maps made of the same region in the summer of 1912, surveyed on July 22, July 30, August 16, and September 5, respectively. All four maps made on the scale; the oblong area inside of the two cross-lines in maps 5 and 6 represent the entire area of maps 3 and 4. (Size 25 by 30 m.) Cross-hatched areas represent land. Contour interval, showing depths of water, 5 cm. *st* and dotted lines represent stony-bottomed areas; *r*, a rock; the remainder of the bottom was sandy. Numbers represent depths in cm.

Map 7. Pine Point Lagoon; made July 29, 1912.

Contour interval, showing depths of water, 5 cm. Squares, shown only on land, 5 m. each way. This map shows the lagoon just after it was formed; in 1913 the spit was one-third longer and more completely surrounded the pond.

Map. 8. Hook Point; made August 20, 1912.

Contour interval, showing depths of water, 20 cm., out to 1 m. in depth,

[1]The data for this map were taken from the large map accompanying (11), from (12), and from corrections kindly made by Mr. Leverett from his field notes.

beyond which it is 1 m.; the latter only shown in depression behind outer spit, in the upper, left hand corner of the map. Squares, shown only on land, 25 m. each way. *H. P. L.*, Hook Point Lagoon. Dashes indicate distribution of *Scirpus americanus.*

Map 9. Sedge Point and Sedge Point Pool; made August 1, 1912.

Contour interval, showing depths of water, 10 cm., out to depth of 1 m.; no contours shown beyond that depth; 10 cm. contour omitted, except in pool. Squares, shown only on land, 25 m. each way. Dashes indicated distribution of *Scirpus americanus;* dots of *Scirpus validus.* Broken line indicates margin of trees. The line inside the shore-line represents the high water mark for that year, about 20 cm. above level when map was drawn. *S. P. P.;* Sedge Point Pool.

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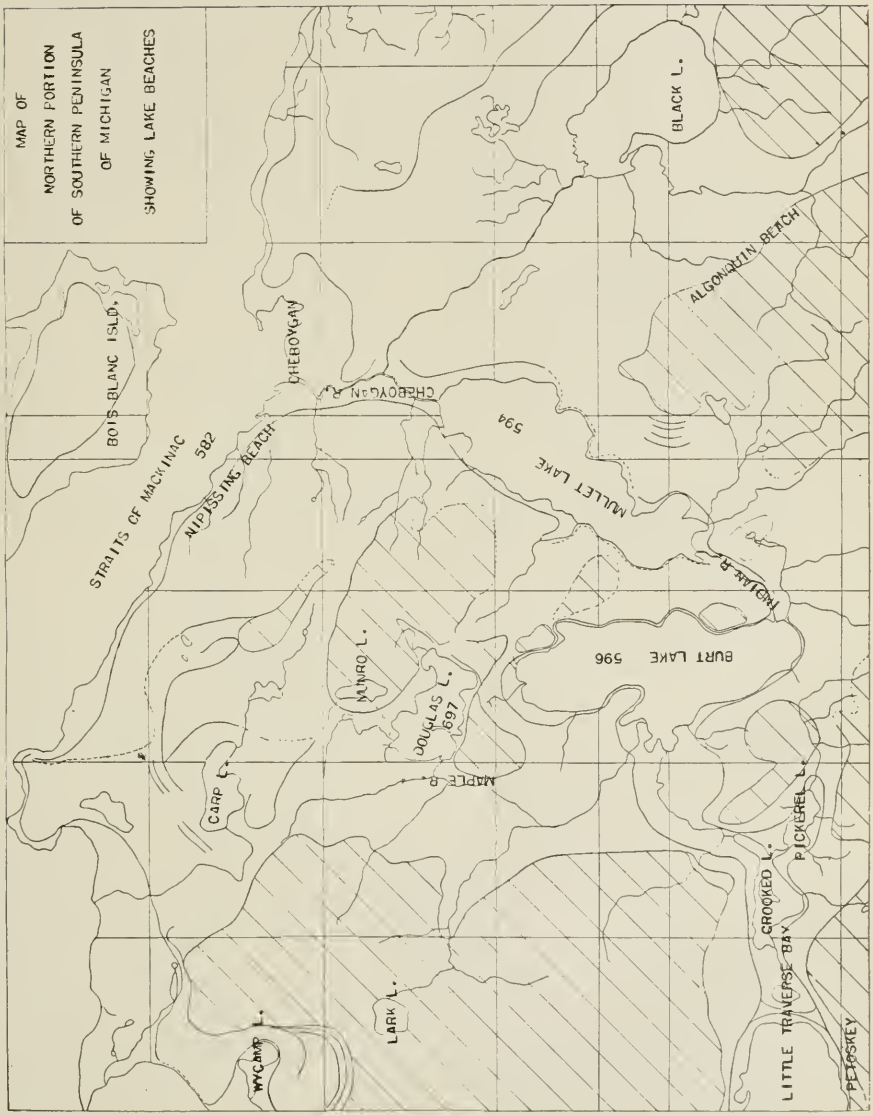
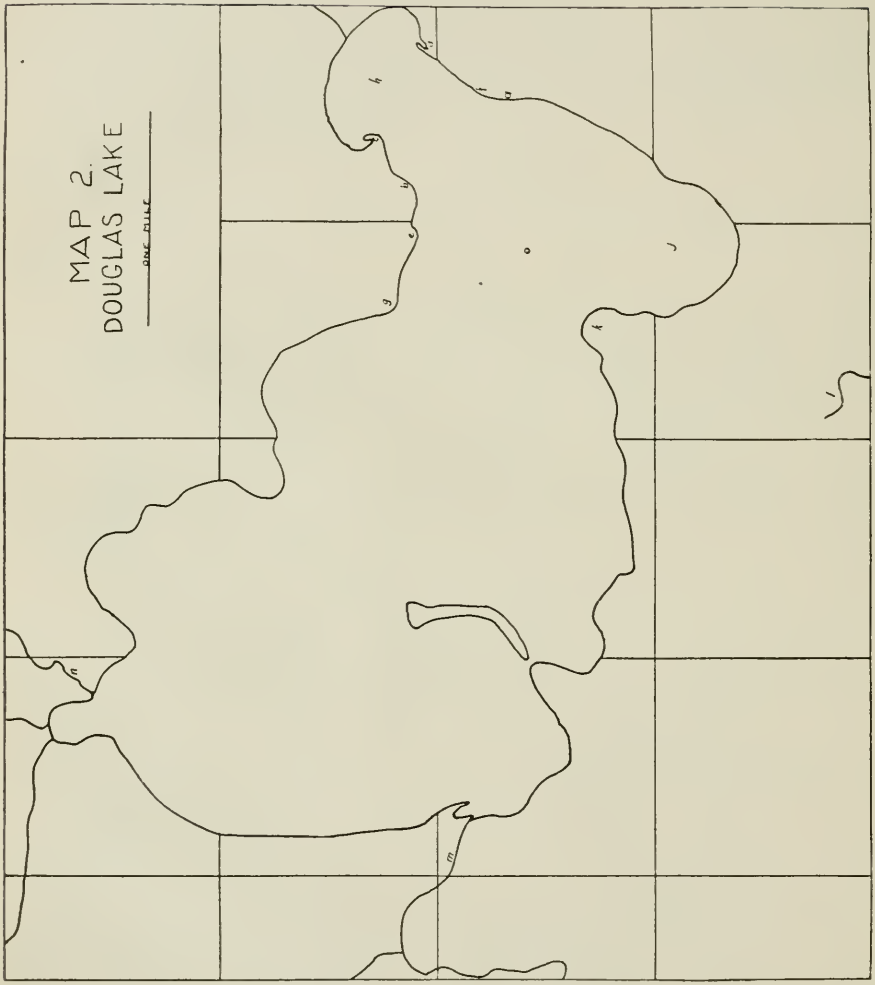
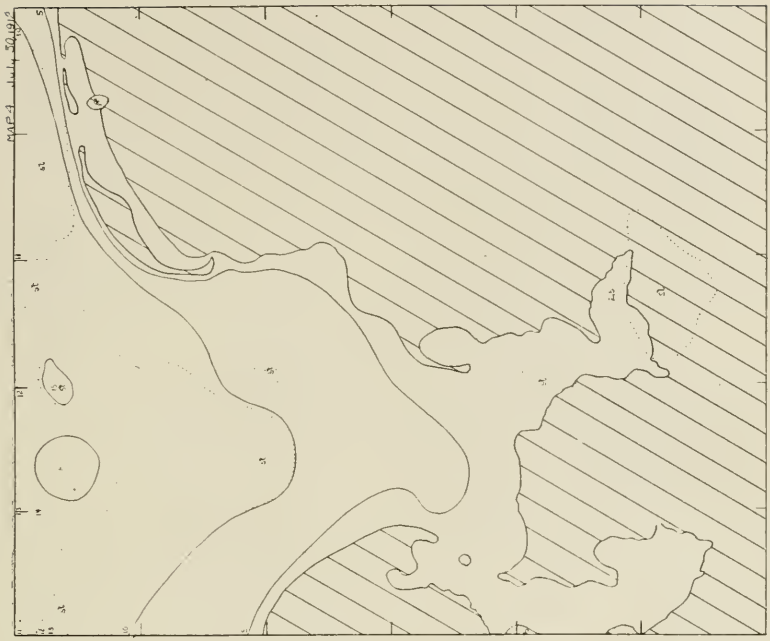
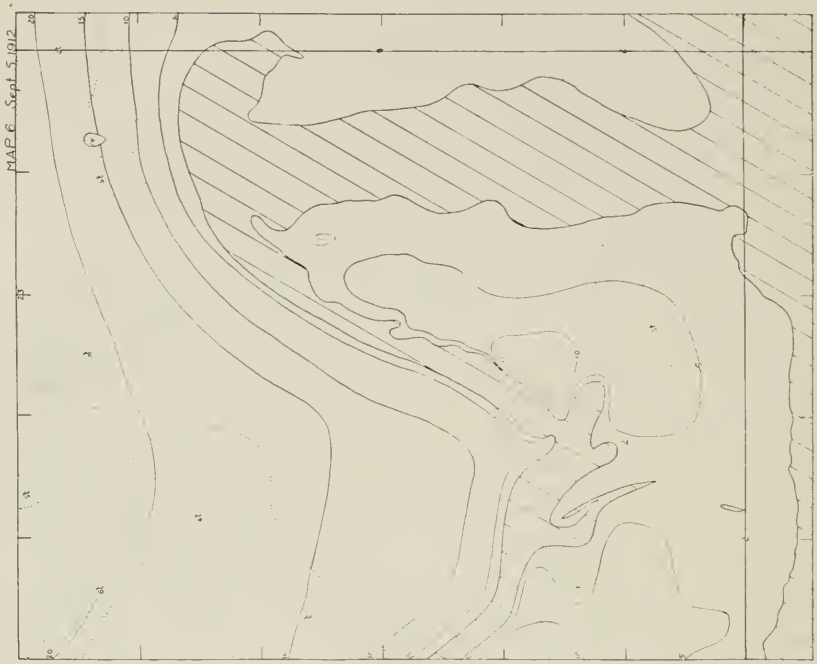

MAP OF
NORTHERN PORTION
OF SOUTHERN PENINSULA
OF MICHIGAN
SHOWING LAKE BEACHES
BOIS BLANC ISLD.
STRAITS OF MACKINAC
582
NIPISSING BEACH
CHEBOYGAN
CHEBOYGAN R.
MULLET LAKE 594
ALGONQUIN BEACH
BLACK L.
INDIAN R.
BURT LAKE 596
MUNRO L.
DOUGLAS L. 697
MAPLE R.
CARP L.
LARK L.
WYCAMP L.
CROOKED L.
PICKEREL L.
LITTLE TRAVERSE BAY
PETOSKEY

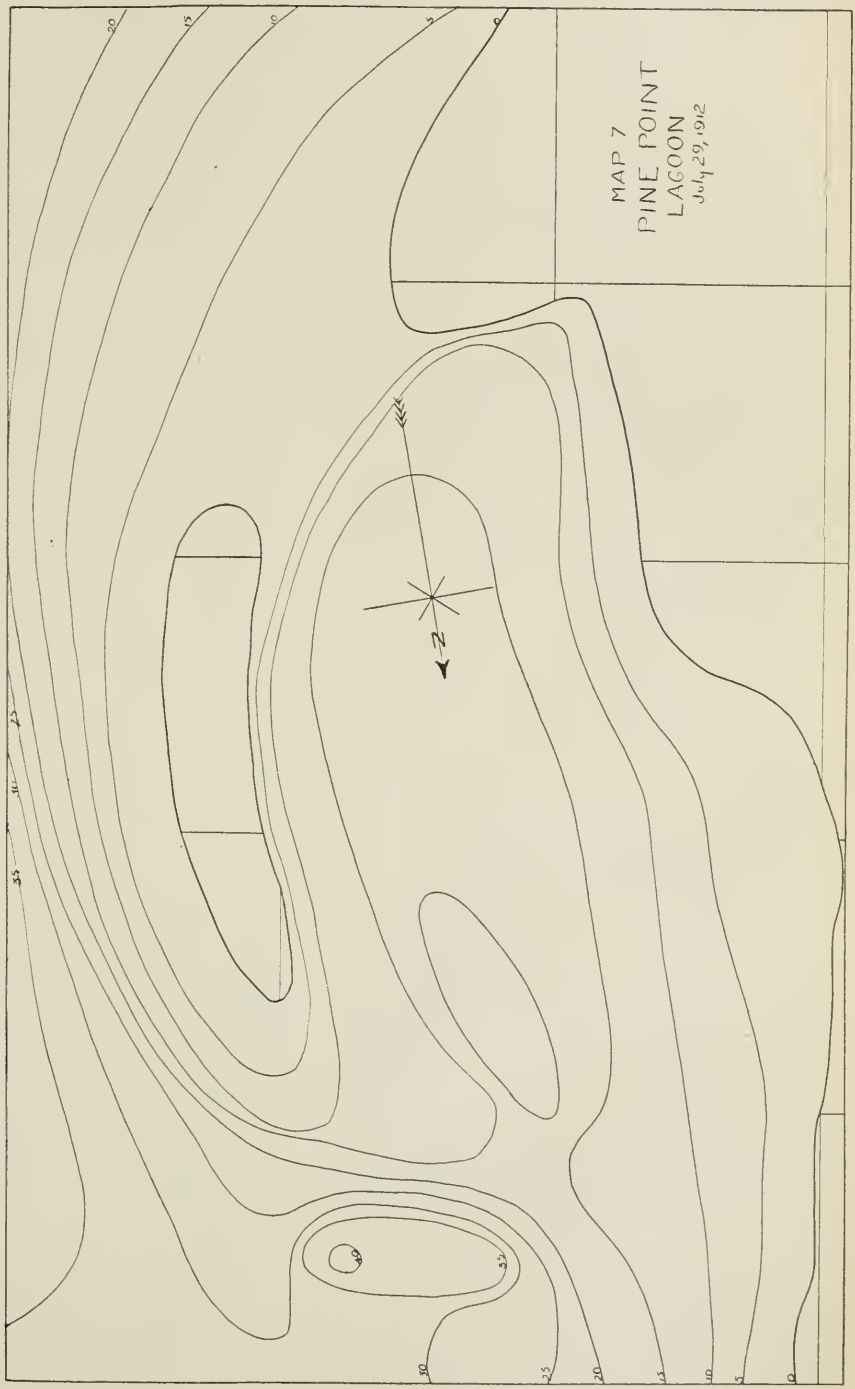

MAP 2.
DOUGLAS LAKE
ONE MILE

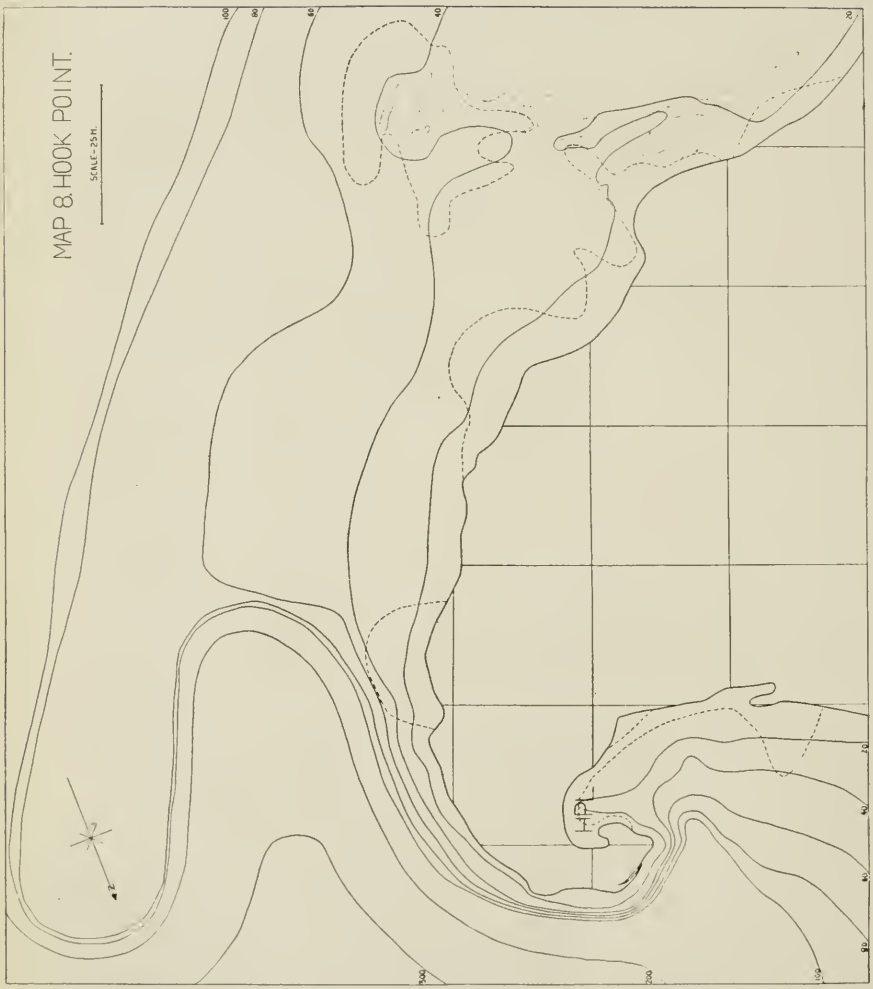

MAP 4 July 30, 1912


MAP 5 July 22, 1912


MAP 6 Sept 5, 1912


MAP 5 Aug 16, 1912


MAP 7
PINE POINT
LAGOON
July 29, 1912
N
20
15
10
5
0
25
30
35
40
50
30
25
20
15
10
5
0


MAP 8. HOOK POINT.
SCALE - 25M
100
80
60
40
20
300
200
150
70
60
50
40
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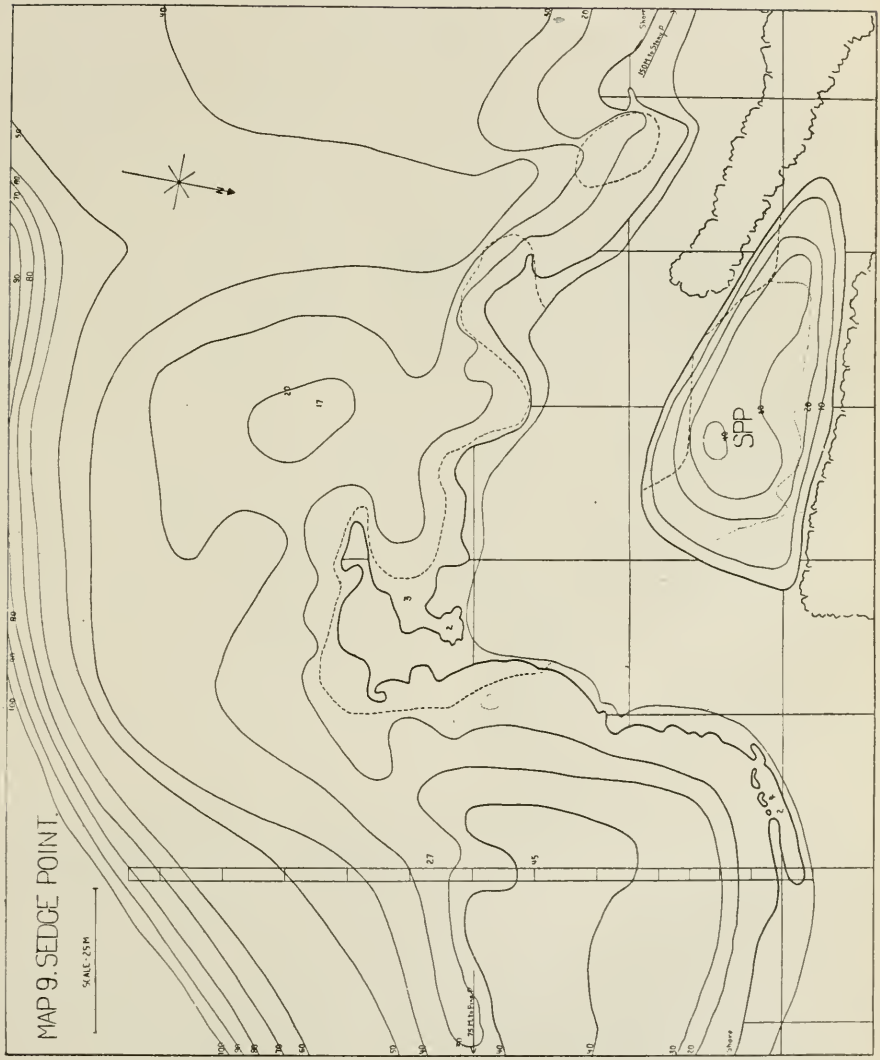
MAP 9. SEDGE POINT.
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PARTHENOGENESIS IN *ANTHOTHRIPS VERBASCI.*

BY A. FRANKLIN SHULL.

The mode of reproduction in Thysanoptera has been accurately determined in only a few species, especially in those of economic importance. Parthenogenesis has been shown to occur in certain species by rearing them in guarded cultures; but *proof* of sexual reproduction has not, so far as I can find, been advanced for any species. The mode of reproduction has been, as a rule, inferred from the relative frequency of males, and from the occurrence of copulation in nature. Owing to the peculiar sex ratios found (Shull, 1914, p. 239), this rule is difficult to apply. In some species, males are unknown (*Anthothrips niger*). In others, they are uncommon (*Thrips tabaci*). In *Anaphothrips striatus*, males are unknown in some regions (Massachusetts), rare in others (Huron County, Mich., Shull, 1909, p. 224), and fairly common in others (25 per cent of males at Douglas Lake, Mich.) In *Euthrips tritici*, males are always abundant, though less numerous than the females. In *Anthothrips verbasci*, there are about 24 per cent of males.

In this series of species exhibiting increasing abundance of males, where does parthenogenesis end and sexual reproduction begin? For the purpose of answering this question, an extensive series of experiments was started in the summer of 1914. The method of conducting these experiments was to rear the food plant under cover from seed on sterilized soil, and at the proper time transfer to it a single larva or pupa of some species. After allowing sufficient time for the larva to emerge as an adult, and produce offspring of its own, the food plant was examined carefully for thrips.

In this way I have been able to demonstrate parthenogenesis in a few species, mostly those in which it has been inferred before. In one species (*Anthothrips verbasci*), however, parthenogenesis occurred wholly unexpectedly. Only the experiments with this last-named species will be described here.

In the cultures of Anthothrips, the host plants (common mullein, *Verbascum thapsus*) were not reared from seed, but were transplanted from a spot in a field where a colony of very young plants had started near an ash heap. No other mullein plants could be discovered within about 20 rods. Since *A. verbasci* lives on no other plant, and does not migrate readily, this distance made infection of such young plants quite unlikely. Moreover, no thrips were on the plants at the time, this species of thrips being quite large, hence easily seen, and not at all inclined to hide in crevices on young plants. I conclude that the young mulleins grew from seeds brought in with rubbish, and there had been as yet no opportunity for infection.

To determine whether any eggs might be on the plants, the latter were reared in the greenhouse for a month (about July 23 to August 28), before being used in experiments. In that time no larvae appeared on them. All of the original leaves had by that time been removed, so that any eggs that might have remained unhatched longer than usual would have been removed with them. Ten of the plants were kept nearly three months without the appearance of any larvae. Three of these ten are still being used as controls

at the time of writing, and are entirely free from larvae. Further evidence that the larvae subsequently found upon these plants were not in the egg stage when the plants were brought in, is found in the fact that the larvae on plants on which females were first placed on September 16 were noticeably smaller on a given date than those on plants on which females were placed on September 5. Had they been in the egg stage at the same time, that is, when the plants were introduced from outside, these larvae should have been of equal size. I think it safe to conclude, therefore, that the imported plants bore no thrips in any stage.

Virgin females for the experiments were obtained by rearing large larvae or pupae in isolation. When the adult emerged from the pupa, it was placed, under cover, on one of the thrips-free mullein plants. In some cases, only one individual was placed on a plant, and in these cases the sex of the thrips was not determined. In other cases, the sex was determined by mounting the live insect in a drop of water under a supported cover-glass, and examining it with a microscope. The males possess, on next to the last abdominal segment, a pair of stout, dull spines, which are wanting in the females. When the sex was determined in this way, several females were put together on one plant.

In at least six of these experiments larvae have appeared. The data from these six experiments are given in Table 1.

TABLE 1.

Showing details of experiments to test parthenogenesis of *Anthothrips verbasci*.

No. of experiment.	Date of transplanting virgin females.	No. of females.	Date of discovery of larvae.	No. of larvae.
93	August 28	1	October 15 (?)	1
98	September 5	1	October 22	4
			November 2	8
99	September 11	5	October 22	19
100	September 14	7	October 29	13
101	September 16	7	November 2	2
102	September 16	9	October 22	11

There can be no doubt, I believe, that the larvae appearing in these experiments were produced parthenogenetically. *Anthothrips verbasci*, however, gives more evidence of sexual reproduction in nature than almost any other species in the region around Ann Arbor. There are always numerous males. Large numbers of spermatozoa are produced, as shown by sections of full grown larvae. There appears to be a lagging chromosome, suggesting a dependence of sex upon fertilization. Furthermore, copulation occurs frequently. In fact, it is usually necessary only to drive a male and a female toward one another to induce mating.

The discovery of parthenogensis in such a species greatly reduces the probability that sexual reproduction is of common occurrence in the Thysanoptera as a group. If *Anthothrips verbasci* is parthenogenetic, it is not safe to conclude, without much better evidence than the abundance of males and the occurrence of copulation, that any species is sexual. Whether sexual reproduction may occur only at certain seasons, or simultaneously with parthenogenesis, is a question upon which the experiments here reported have no bearing.

It is unfortunately too early at the time of writing to determine the sex of the parthenogenetically produced larvae of these experiments.

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EXPERIMENTAL STUDIES ON THE RELATION BETWEEN THE STRUCTURE AND DEVELOPMENT OF THE EGGS OF CHRYSOMELID BEETLES.[1]

ROBERT W. HEGNER.

The structure and development of the insect egg differ widely from that of the eggs of most other animals. Two of these differences are (1) the fact that most insect eggs are laid and develop in the air instead of in the water, and (2) because of the comparatively immense amount of yolk, early cleavage is superficial instead of complete, partial or discoidal. In a report published five years ago (Hegner, 1909b) some of the effects of centrifugal force upon the structure and development of certain chrysomelid beetles were described. Since that time the same method of experimentation has been employed by the writer for the purpose of determining (1) the relation between the structure and polarity of the egg, and (2) the comparative importance of the nuclei and other constituents of the egg in development.

The eggs of the willow beetles, *Calligrapha multipunctata* and *C. bigsbyana*, and of the potato beetle, *Leptinotarsa decemlineata*, have been used exclusively in the experiments here to be described. They have proved to be favorable for this work because these beetles are easily reared in the laboratory and their eggs are thus available in great numbers. Besides this the normal embryology of these beetles is well known.

In nature the eggs are laid in batches of from twenty to seventy-five and fastened to the under surface of the leaves of the willow or potato plant, at right angles to their longitudinal axis. Shortly before the eggs hatch the markings of the larva within can be seen through the chorion, and without exception the posterior end of the embryo coincides with the fixed end of the egg and the anterior end with the free end of the egg. By marking the free end with India ink it has been possible to maintain an accurate orientation of the egg throughout its entire developmental period. It has been shown in a previous communication (Hegner, 1909b) that the surfaces of the egg corresponding to the right and left sides and dorsal and ventral surfaces of the future embryo can also be determined as soon as the eggs are laid.

Because of the definite orientation of the egg it is possible to perform experiments upon certain regions whose history under normal conditions is known. Thus with a hot needle any portion of the cytoplasm of a freshly laid egg or of the blastoderm of an egg twenty-four hours old can be killed and the part of the embryo to which that particular mass of cytoplasm or group of cells would have given rise is prevented from taking part in further development (Hegner, 1911).

Centrifugal force has been employed as a method in experimental embryology with the principal objects of studying the weights, distribution and chemical constitution of the egg substances, the initial structure and

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polarity of the egg, the constitution of the mitotic figure, the significance of organ-forming substances, and as a general substitute for the force of gravity.

In my earlier report I pointed out the fact that the development of the insect egg is not only uninfluenced by gravity but is not even altered by a centrifugal force many times stronger than the force of gravity. The larvae that hatched from eggs that had been subjected to a moderate centrifugal force appeared to be perfectly normal, and many of them were reared in the laboratory until they pupated. Normal adults emerged from the pupae. There can be no question therefore regarding the ability of the beetle's egg to develop normally after centrifuging. In most cases where centrifugal force has been used in experimental embryology the late embryonic and post-embryonic stages have not been studied and hence whether they were normal or not remained undetermined.

A very strong centrifugal force for a short period or a weaker force for a longer period affect the beetle's egg quite differently. As has been recorded for many kinds of eggs, both of vertebrates and invertebrates, the egg substances were found to be distributed by a strong centrifugal force in three distinct strata according to their specific gravities. The beetles' eggs were placed in cavities in a paraffin block so that a longitudinal position while in the centrifuge was maintained. Eggs centrifuged with either the posterior or anterior end toward the center of rotation exhibited three zones: (1) a bright-orange light zone at the inner end which I have called the vesicular zone (Fig. 2, v. z.), (2) a comparatively large central mass composed of yolk globules which are largest at the outer heavy end, gradually becoming smaller until almost indistinguishable from cytoplasm at the inner end (Fig. 2, y), and (3) a colorless layer, which I have called the gray cap, at the extreme heavy end (Fig. 2, g. l).

Experiments to determine whether the material of the gray cap is necessary for normal development.

The material of the gray cap is the heaviest of the egg contents. It is composed of very fine colorless granules whose positions before being driven to the heavy end of the egg could not be determined. Sections through eggs that were allowed to develop after being centrifuged showed the gray cap still at the heavy end. This led to the conclusion that the substance of the gray cap is not necessary for the normal development of the embryo.

TABLE I.

Eggs of Leptinotarsa decemlineata, laid at 4 P. M., June 11; centrifuged for one hour when 18 hours old.

A. Control No. 1	6 eggs not centrifuged	Hatched June 16.
B. Control No. 2	6 eggs centrifuged	Hatched June 16.
C.	9 eggs centrifuged, gray cap at posterior end killed	One hatched June 16; eight developed but did not hatch.
D.	8 eggs centrifuged, gray cap at anterior end killed	One developed to hatching stage; seven abnormal.

To test this conclusion the following series of experiments were performed (Table I). Eggs that had been allowed to develop for eighteen hours were centrifuged for one hour, some with the anterior end and others with the posterior end toward the center of rotation. When these eggs were taken from the centrifuge they were placed in watch glasses and the gray-cap

end (the heavy end) of each was touched with a hot needle. In this way the gray-cap material was coagulated and hence prevented from taking part in further development.

All of the control eggs, that is the eggs that were centrifuged but were not operated upon with the hot needle, hatched at the same time as those that had not been centrifuged. In the eggs centrifuged with the anterior end toward the center of rotation, the gray cap was thrown toward the posterior end. Nine of these eggs were operated upon with the hot needle. One of them hatched at the same time as did the control eggs; the other eight developed up to the hatching stage but the larvae failed to emerge.

In the eggs centrifuged with the posterior end toward the center of rotation, the gray cap was thrown to the anterior end. Eight of these eggs were operated upon with the hot needle. On the sixth day one of these contained a larva ready to hatch but the other seven were apparently undeveloped. After these were prepared for microscopical examination each egg exhibited a shapeless mass of tissue near the center, occupying about one third of the total mass, whereas the rest of the egg substance consisted of homogeneous yolk material. This result may have been due and probably was due to the effects of the centrifugal force rather than to the destruction of the gray-cap material.

Conclusion. The results of these experiments lead to the conclusion that the gray-cap material is not necessary for normal development and should therefore not be regarded as an organ-forming substance except in so far as it may furnish nutriment for the developing embryo.

Experiments to determine whether the changes in the position of the egg substances affect the polarity of the egg.

Experiment A. Sixteen eggs were placed in the centrifuge 18 hours after their deposition and rotated for 20 hours. Eight of them were placed with the anterior end and eight with the posterior end toward the center of rotation. They were allowed to develop after their removal from the centrifuge. Shortly before hatching the orientation of the embryos was determined and in every case it had *not* been influenced by the centrifugal force. All of the eggs hatched and apparently normal larvae emerged.

Experiment B. This experiment was similar to *Experiment A* except that the eggs were only one hour old instead of 18 hours old and they were rotated for twenty-two hours instead of twenty hours. Only four of the eight eggs that were centrifuged with the posterior end toward the center of rotation hatched. The orientation of these was *not* influenced by the centrifugal force. Seven of the eight eggs that were centrifuged with the anterior end toward the center of rotation developed normally and hatched. The orientation of these was likewise uninfluenced by the centrifugal force. In both sets of eggs hatching was slightly delayed.

Experiment C. Twenty eggs 19 hours old were centrifuged in various positions for one and one-half hours. The orientation of the embryos was *not* disturbed and all of them hatched in the normal period.

Experiment D. Sixteen eggs four hours old were centrifuged slowly until they hatched, at the end of six days. Eight were placed with the anterior end and eight with the posterior end toward the center of rotation. The embryos all exhibited a normal orientation.

Experiment E. This experiment was similar to *Experiment D* except that the eggs were twenty-two hours old when rotation was begun and were rotated much more rapidly. No larvae hatched from these eggs and the embryos which developed in them differ from normal embryos in several

respects, the principal difference being due to the fact that the yolk and gray-cap substances were practically all thrown to the centrifugal end, whereas the lighter oil globules gathered at the centripetal pole, and the embryo developed between these two masses.

Superficial views of three of these embryos are represented in Figs. 2, 3, and 4. In normally developed eggs the embryo develops around the yolk and at the expense of this nutritive substance (Fig. 5). In these centrifuged eggs, however, the yolk has been thrown away from the cytoplasm and a dwarf embryo has resulted in every case. These dwarfs resemble in general the normal embryos in appearance but present many minor abnormalities. The head and thorax seem to have been less affected than the abdomen, probably because in normal development the tail-fold is pushed around on the dorsal surface of the yolk (Fig. 6) and later contracts until its posterior end coincides with the posterior end of the egg (Fig. 5). The shifting of the yolk would therefore seriously affect the growth of the tail-fold.

Perhaps the most interesting feature of these dwarf embryos is the fact that their orientation is as nearly like that of the normally developed embryo as the mechanical conditions would allow. Thus while they lie more or less transversely in the egg the head end is directed toward the anterior pole of the egg.

Conclusion. The original polarity of the beetle's egg is retained in the cytoplasm in spite of the shifting of the yolk, gray-cap material, and cytoplasm by centrifugal force.

Discussion. The roles played by the nucleus and cytoplasm in heredity has for many years furnished interesting problems which have been attacked by both morphological and experimental investigations. The literature of the subject is extensive and no attempt will be made to review it here, but the relation of the results of the experiments described in the preceding pages to the ideas that are now prevalent may be discussed to advantage.

Studies on the organization of animal eggs have shown that the cytoplasm of the egg is not a homogeneous substance, but is heterogeneous. The chromatin has for many years been considered the special substance containing the determiners of hereditary characteristics. Experiments, such as the fertilization of the egg of one species of animal by the spermatozoon of another species, have shown that the large features in development, that is, the features of the phylum, class, or order, are controlled by the cytoplasm since they appear before the male and female nuclei exert any influence on embryonic growth. These characters must therefore be transmitted by the cytoplasm of the egg and more is therefore inherited from the egg than from the spermatozoon, and hence more from the mother than from the father. The smaller characteristics, that is, those of a generic, specific, varietal, or individual nature, appear later and are influenced by both the male and female cells, presumably being largely under the control of the nuclear substance, chromatin. The differentiations leading to the modification of the larger characters by the chromatin must take place in the cytoplasm, and since the cytoplasm is known to be heterogenous the object of many investigations has been to discover the factors of differentiation that exist in the egg substance.

The beetle's egg consists of a large central mass of yolk surrounded by a thin superficial layer of cytoplasm (Fig. 7). The maturation divisions of the egg nucleus take place in the cytoplasm near one side of the egg. The

female pronucleus, surrounded by a small amount of cytoplasm, then moves toward the center of the yolk mass forming a sort of minute island. Here the male pronucleus unites with it and the first cleavage divisions occur. The cleavage nuclei migrate toward the periphery as they increase in number (Fig. 8), finally fusing with the superficial layer of cytoplasm. The blastoderm of a single layer of cells is thus formed (Fig. 9).

The visible substances within the freshly laid egg are (1) the superficial layer of cytoplasm, (2) yolk globules of various sizes, (3) the male and female pronuclei, and (4) a mass of granules near the posterior end which take part in the formation of the primordial germ cells and which I have for this reason called "germ-track-determinants."

The gray-cap which appears at the heavy end of the egg after centrifuging must have been distributed throughout the yolk mass of the normal egg, and is probably nutritive material of some kind since the experiments show that it is not necessary for the normal development of the egg.

When the position of the fundamental egg substance, that is, the superficial layer of cytoplasm, is not changed by the centrifugal force, development proceeds in the normal fashion. This proves that the shifting of the yolk and the gray-cap material does not have any decided influence upon the regular growth processes. When this cytoplasm is displaced by a stronger force and the yolk is driven entirely to one end, the embryo develops near the opposite, lighter end independently of the yolk. That no conspicuous changes occur in the formation of such an embryo indicates that the cytoplasm in its new position retains the potentialities it possessed in its normal environment.

A morphological study of the embryology of chrysomelid beetles led the writer some years ago (Hegner, 1909a) to the conclusion that the nuclei that enter the superficial layer of cytoplasm just before the blastoderm is formed are all alike potentially but that the cytoplasm is heterogeneous and controls the future history of any particular blastodermic area. Later (Hegner, 1911) by the experimental method of killing parts of the egg with a hot needle it was found that the killing of a portion of the cytoplasm of the fresh egg resulted in the absence of the part of the embryo to which this cytoplasm would otherwise have given rise, although no nuclei were destroyed.

Conclusion. Three lines of evidence lead to the conclusion that in the early development of chrysomelid eggs the superficial layer of cytoplasm, the "Keimhautblastem" of Weismann, is the controlling substance and that this cytoplasm is heterogeneous. These lines of evidence are (1) the morphological evidence derived from the study of the normal embryology, (2) the experimental evidence obtained by killing parts of the egg, and (3) the experimental evidence procured by shifting the egg substances with centrifugal force. Thus far, however, no visible differentiations have been observed in the cytoplasm except at the posterior end where the germ-track-determinants are in some way concerned in the production of the primordial germ cells.

Ann Arbor, Michigan,
November 12, 1914.

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EXPLANATIONS OF FIGURES.

Fig. 1. Longitudinal section through an egg of *Calligrapha multipunctata* which was placed in the centrifuge when fresh, rotated for 16 hours and then killed. Three zones are visible. *bl.*=blastoderm; *g. c.*=gray cap; *p*=posterior end; *vt*=vitellophag; v. z.=vesicular zone; *y*=yolk.

Fig. 2. Superficial view of an egg of *Leptinotarsa decemlineata* centrifuged for seven days with the anterior end toward the center of rotation. *a*=anterior; *ab*=abdomen; *p*=posterior; *t*=thorax.

Fig. 3. Another egg from same lot as that shown in Fig 2.

Fig. 4. As in Fig. 2 except centrifuged with the posterior end toward the center of rotation.

Fig. 5. Ventral view of an embryo of *Leptinotarsa decemlineata* 72 hours old. *ab*=abdomen; *h*=head; *t*=thorax.

Fig. 6. Right side of an embryo of *Leptinotarsa decemlineata* 48 hours old, showing tail-fold on dorsal surface. *a*=antenna; *m*=mandible; m^1= first maxilla; m^2=second maxilla; t^1-t^3=thoracic appendages; *tf*= tail-fold.

Fig. 7. Longitudinal section through fresh egg of *Calligrapha bigsbyana*. *gcd*=germ-track-determinants; *gn*=germ nuclei fusing; *khbl*=Keimhaut-blastem; *p*=posterior; *vm*=vitelline membrane; *y*=yolk.

Fig. 8. As in Fig. 7 except egg 14 hours old. Pbln=preblastodermic nuclei; *vt*=vitellophag. Other lettering as in Fig. 7.

Fig. 9. Longitudinal section through egg of *Leptinotarsa decemlineata* 24 hours old showing fully formed blastoderm (*bl*) and primordial germ cells (*pgc*).

RESULTS OF THE SHIRAS EXPEDITIONS TO WHITEFISH POINT, MICHIGAN.—BIRDS.

NORMAN A. WOOD.

The biological survey of the Whitefish Point Region which has been carried on for three years by the Museum of Zoology, University of Michigan, and the Michigan Geological and Biological Survey was begun in 1912 by the Museum of Zoology with the assistance of Hon. George Shiras 3d. The work of the first year consisted of a preliminary study of the vertebrates other than fishes and was assigned to the writer, who was in the field for nearly six weeks, from July 6 to August 14, all but nine days of which (July 28-August 6) were spent near the end of the point, the remainder of the time at Vermilion. The birds and mammals received most attention, but no opportunity of obtaining reptiles and amphibians was neglected.

In 1914, the writer was again sent to the region to supplement the work of 1912 by an investigation of the late spring migrant birds and a further study of the mammals and breeding birds. The field work was begun on May 11 and continued to August 19, the first three weeks being spent at the end of the point, the remainder of the time at Vermilion. For eight weeks, beginning June 24, Frank Novy, University of Michigan, acted as assistant, and after July 1 Otto McCreary joined the party, devoted his time entirely to the study of the birds, and very generously presented his notes and specimens to the survey.

Few naturalists appear to have visited this point. It is briefly described by several geologists and explorers, but the writer has been unable to find in the literature any reference to the birds. It should be mentioned, however, that the late John Clarke, of Vermilion, resided at the Whitefish Point postoffice for thirty years, and during that time studied the birds and mammals and fortunately mounted many specimens. The writer examined this collection, which is now in part in the Sault Ste. Marie high school and in part in the store of A. H. Eddy at Sault Ste. Marie, and has included the records in this paper with those observations of Clarke about which there can be little question.

LOCATION.

Whitefish Point is in Chippewa County, in the northern peninsula of Michigan. It extends northeastward into Lake Superior and forms the northern end of Whitefish Bay. For the purpose of this study, the base of the point is arbitrarily fixed at a line extending from the county line of Chippewa and Luce at Lake Superior to the Shelldrake River, and down this river to the town of Shelldrake.

Near the end of the point is the Whitefish Point lighthouse, and the buildings and dock of a fishing company. On the west side of the point and about three miles from the lighthouse is the Whitefish Point postoffice, and about seven miles farther west is the life saving station and postoffice known as Vermilion. On the south side of the point, at the mouth of the Shelldrake River, is the little town of Shelldrake.

TOPOGRAPHY.

The topography of the point is simple. It may be described as sand and shingle ridges varying from a few feet to about sixty feet in height, having in general a trend parallel with the present shore line, and separated by swales, ponds or swamps of various sizes. The soil of the point is thus principally sand, and, owing to the fact that the ridges are mostly covered with coniferous trees, it is only in the swamps and ponds and on the old ridges at the base of the point that a layer of humus of any depth has accumulated. West of Vermilion there is a moraine of sandy till that extends away to the southward, the northern end of which has been included in the region studied.

HABITATS AND VEGETATION.

As shown by the vegetation, there is but a small number of major habitats in the region. The following may be recognized:

Terrestrial.

Beach of Lake Superior.
Sand ridges.
  Open areas.
  Jack pine forest.
  Birch-white pine forest.
  Pine forest.

Low ground.
  Alder and willow thickets.
  Grass and sedge swamps.
  Tamarack and cedar bogs.
  Balsam-spruce forest.
Moraine (Hemlock-birch-maple forest).

Aquatic.

Lake Superior.
Transient ponds.
Permanent ponds.
Streams and ditches.

Beach of Lake Superior.—The Lake Superior beach everywhere consists of sand or pebbles. The beach proper varies in width from a few feet to several rods, and is without vegetation. Where the first dune is some distance from the water's edge the face of the dune and more or less of the flat is covered with grasses, but where the lake is cutting into the dune this zone is lacking. The vertical face of the outer dune was used as a nesting site by the Kingfishers and colonies of the Bank Swallows.

As is well known, there is little food for birds on such beaches in this region. A few insects, such as flies, ants, dragon flies and butterflies are seen, but these mostly prefer the more protected habitats and are seldom abundant. A few dead fish and a small amount of invertebrate remains are cast up, but this food supply also is sporadic and scanty.

The scavenger birds, such as the Herring Gull, Crow, Raven and Bald Eagle, were most regularly seen. The waders observed were a few Spotted Sand Pipers, a family of Killdeer, and, during the migration season, Black-bellied Plover, Least Sandpiper, Semipalmated Sandpiper, Semipalmated Plover, Turnstone and Solitary Sandpiper. An adult Merganser and young were seen on the south beach on one occasion, and a Sora at another time, and flocks of the Bank Swallow and Barn Swallow sometimes flew along this habitat.

Sand ridges.—The sand ridges constitute the most important habitat on the point. The flora indicates four important divisions. At the end of the

point and on the lake side of the first sand dunes, except where the lake is cutting away the latter, there are extensive areas covered with coarse grasses, wild pea, a low beach heather, scattered junipers, and in places scrubby oaks.

Over the greater part of the point, the vegetation of the ridges may be described as jack pine, associated with small red oak, poplar, white birch, a few Norway and white pine, scarlet maple and mountain ash, and with a ground cover of ferns, wintergreen, dwarf blueberry, arbutus, club moss, and huckleberry. Toward the base of the point, the jack pine forest is replaced on the higher ridges by a deciduous forest dominated by the yellow birch and white pine, and on the lower (not swampy) ground by a balsam and spruce forest.

The characteristic birds in these habitats are apparently as follows:

Non-wooded areas near the end of the point (natural or due to burnings and clearings), Killdeer, Goldfinch, Nighthawk.

Jack pine forest, Ruffed Grouse, Canada Spruce Partridge, Sharp-shinned Hawk, Downy Woodpecker, Arctic three-toed Woodpecker, Flicker, Nighthawk, Hummingbird, Vesper Sparrow, Chipping Sparrow, Junco, Song Sparrow, Cedar Bird, Myrtle Warbler, Magnolia Warbler, Black-throated Green Warbler, Brown Creeper, Red-breasted Nuthatch, Chickadee.

Birch-pine forest, Ruffed Grouse, Black-billed Cuckoo, Flicker, Red-eyed Vireo, Black-throated Green Warbler, Redstart, Olive-backed Thrush, Bluebird.

Pine forest.—Large areas of pine forest exist along the north side of the Shelldrake River from its mouth to Shelldrake Lake. This forest is made up of Norway and white pines and is mostly free from undergrowth, except for the low bush blueberry which is found almost everywhere in it.

The birds noted in this habitat were as follows: Pine Warbler, Blue-headed Vireo, Oven-bird, Hermit Thrush, Hairy Woodpecker, Downy Woodpecker, Red-headed Woodpecker, Flicker, Red-breasted Nuthatch, Chickadee, American Crossbill, White-winged Crossbill, Nighthawk, Robin, Nashville Warbler, White-throated Sparrow, Brown Creeper, Chipping Sparrow, Least Flycatcher, Junco and Black-throated Green Warbler.

Low ground.—The vegetation of the low ground, like that of the ridges, is different on the older and younger parts of the point. At the end of the point, the hollows too wet for the jack pine are filled with willows, alder, etc. Farther south, there are tamarack and cedar swamps, and grass and sedge marshes, the latter surrounded by a growth of poplar, birch and alder, which also surrounds the lakes and ponds. The dryer swales on the older part of the point have a balsam-spruce forest.

The birds that frequent these habitats may be classified as follows:

Alder and willow thickets, Marsh Hawk, Downy Woodpecker, Kingbird, Flicker, Red-winged Blackbird, Song Sparrow, Swamp Sparrow, Northern Yellow-throat, Alder Flycatcher.

Grass and sedge swamps, Marsh Hawk, Vesper Sparrow, Song Sparrow, Savannah Sparrow, Short-billed Marsh Wren, Bobolink, Northern Yellow-throat.

Tamarack and cedar bogs, Winter Wren, Olive-sided Fly-catcher, Northern Yellow-throat, Redstart, Black-throated Green Warbler, Nashville Warbler, Blackburnian Warbler, Winter Wren, Canada Spruce Partridge.

Balsam-spruce forest, Ruffed Grouse, Western Horned Owl, White-throated Sparrow, Canada Jay, Black and White Warbler, Magnolia Warbler,

Redstart, Olive-backed Thrush, Red-tailed Hawk, Broad-winged Hawk, Black-throated Green Warbler.

Moraine.—West of Vermilion, on the Luce-Chippewa county line, there is a morainic area, the soil of which is a sandy till. The northern end of this ridge was included in the region studied. The moraine is much cut up with deep ravines and low swampy areas. The higher areas are covered with a dense forest of birch, maple and hemlock, with some white pine, beech, and red oak. Some of the swamps are tamarack bogs and others are filled with small trees and bushes.

The Pileated Woodpecker is chiefly confined to this habitat (birch-maple forest) and evidently occurs in some numbers. The Hairy Woodpecker is also quite abundant, and the Western Horned Owl and Olive-backed Thrush breed, as probably do the Sapsucker, Ruffed Grouse, Flicker, White-throated Sparrow, Mourning Warbler, Canadian Warbler, Blackburnian Warbler, Parula Warbler, Black-throated Blue Warbler and Golden-crowned Kinglet, which were observed.

Lake Superior.—This habitat needs little description. Only the water within a half mile of the beach is included. The water is shallow or deep, and cold, and the bottom is uniformly of sand.

There is, of course, in this habitat abundant food for fish-eating birds, which predominate. The Herring Gull is the characteristic species, and the Loon, Merganser, Eagle, Black Duck, and Osprey occur. In the fall and early winter until the lake is frozen over far from shore, and in the early spring the Old Squaw Duck and White-winged Scoter are apparently common.

Permanent Ponds.—There are a number of long, narrow ponds of different sizes in the depressions between the sand ridges. As a rule, the bottom of these ponds is sand with little or no covering of debris, but in a few there are areas covered with a shallow deposit of muck, and in a few places there are small floating bogs about the shores. Many of the ponds are connected only in periods of high water, but the largest ones have an open outlet except for a longer or shorter period after storms, when the outlet is dammed with sand. The largest pond, Little Lake, is near the Whitefish Point postoffice. It is about a mile long and a quarter of a mile wide, and from a few inches to four or five feet in depth. The second largest is Beaver Lake, about a mile east of Vermilion. The vegetation in these ponds is, as a rule, very scanty. There is frequently a sparse growth of rushes and water lilies, associated with some other forms. Animal food for birds is abundant in proportion to the size and depth of the pond, fish, frogs, and crawfish, leeches, clams, snails and doubtless many other invertebrates being present in those of sufficient depth.

The Red-breasted Merganser, Hooded Merganser, Kingfisher, Mallard, Black Duck, Bittern, Great Blue Heron, Sandhill Crane and Spotted Sandpiper were observed feeding in or about Little Lake, and it is certain that geese, swans, and several other ducks stop here on their migrations.

Transient ponds.—The depressions between the dunes that contain water for only a part of each year are numerous. They are, of course, shallow, and support but little plant or animal life. The flora consists principally of sparse growths of rushes and sedges. The only animals observed were occasional clams and crawfish and a few leopard frogs.

The American Bittern and Sandhill Crane visit these ponds and the sandpipers and crows are occasionally seen about the shores.

Streams and ditches.—As the conditions in the running water habitats were

not studied in detail, a general description must suffice. The Shelldrake River is the only large stream in the region. It is perhaps one hundred feet wide at Shelldrake and has a little current. On the north side of the point, there is a small stream that forms the outlet of Little Lake and flows only a part of the summer; another, the outlet of East Vermilion Lake, near Vermilion, is about one-fourth of a mile in length, swiftly flowing, and clear and cold; east of Vermilion, there are two ditches that drain a system of ponds into Lake Superior, and emptying into these ponds there is a small stream that emerges from a cedar swamp. On the east side of the point there are numerous small sluggish streams.

The animals observed in the streams that serve as bird food are mink frog, leopard frog and green frog, water snake, many kinds of small fish, crawfish, snails and clams, but the faunas of the different streams vary greatly. Practically no animals were found in the streams on the east side, and many of those of the west side have a very meager fauna.

The birds observed in this habitat are as follows: Merganser, Hooded Merganser, Black Duck, Great Blue Heron, Sandhill Crane, Osprey and Kingfisher.

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It is my pleasant duty to acknowledge the assistance of the late Mr. John Clarke, of Vermilion, Mr. Robert Carlson and son, of the Whitefish Point Lighthouse, Captain James Carpenter and Mr. Palmer Burrows of the Life Saving Station, Mr. Frank Weatherhog and Mr. Benjamin Butler, mail carriers on the point, and Mr. Frank House, Mr. Alexander Barclay, and Mr. William Hawkins, for notes, specimens and assistance in the field. I must also acknowledge the very material assistance of my wife and daughter, who accompanied me in 1912, in cataloging and labeling specimens.

LIST OF SPECIES.

1. **Colymbus auritus.** Horned Grebe.—This bird was not noted in 1912, but in 1914 two were seen by the writer near the beach at the end of the point on May 23, and two again on May 27.

2. **Gavia immer.** Loon.—While not abundant, this species was nearly always to be seen on Lake Superior, generally about the fish nets. Pairs were occasionally seen flying inland. It bred at Vermilion in 1914.

3. **Larus argentatus.** Herring Gull.—This is one of the most abundant species in the region. The birds seemed to make their headquarters at the end of the point near the lighthouse, where hundreds came for the refuse from the fishery, which was dumped on a vacant lot a quarter of a mile inland. Residents said that a colony nested on some rocky islands in Whitefish Bay, a few miles south of the point.

4. **Larus philadelphia.** Bonaparte's Gull.—This gull was seen but twice, both times in 1914. On May 22 the writer found an adult male wounded on the beach near the postoffice, and was told later that a flock had been seen near Vermilion on the previous day by a member of the life saving crew. On August 18 one was seen west of Vermilion.

5. **Sterna caspia.** Caspian Tern.—On July 16, 1914, a caspian tern was seen on the beach at Vermilion by McCreary. It had been reported by members of the life saving crew for two or three days previous to this date, but was only seen once by members of the field party.

6. **Mergus americanus.** Merganser.—This merganser is a summer resident

and no doubt breeds along the shores of the rocky islands of Whitefish Bay. It was observed on the beach and on the Shelldrake River. On July 25, 1912, an adult female and ten young in the down were seen sunning themselves on a drift log on the east beach not far from the mill town of Shelldrake, at the mouth of the Shelldrake River. According to residents this river receives its name from the large numbers of mergansers, here called shelldrakes or fish ducks. On June 25, 1914, a female with young was observed on the north beach.

7. **Mergus serrator.** Red-breasted Merganser.—This species was seen but twice. On July 26, 1912, three were seen at a beaver pond not far from Little Lake, and on August 3, of the same year, it was observed again on a small inland lake near Vermilion.

8. **Lophodytes cucullatus.** Hooded Merganser.—The hooded merganser was the most common merganser on the point. It was often seen on the small ponds and lakes, was observed in numbers on the Shelldrake River, and a few were seen at Vermilion. The birds were very tame and often came within a few rods of the observer.

9. **Anas platyrhynchos.** Mallard.—This duck occasionally nests in the wet marshes about the ponds and lakes, but it was rarely seen as these marshes were too wet and soft to enter. On August 1, 1912, a fine pair was seen on a small lake near Vermilion. The hunters stated that it is very common during the migrations, when many are shot for food.

10. **Anas rubripes.** Black Duck.—The black duck is a rather common breeder in the marshes about the ponds and lakes. A female and a brood of halfgrown young were seen on the Shelldrake River about two miles south of Vermilion on August 2, 1912, and a female with six half-grown young was found, July 12, 1914, in a beach pond. Like the mallard, this duck is also said to be common in the migrations. May 19, 1914, hundreds of ducks, many of this species, passed the point going north very early in the morning.

11. **Querquedula discors.** Blue-winged Teal.—Only seen once, August 3, 1914, when Novy found it on the Shelldrake River just south of Vermilion.

12. **Aix sponsa.** Wood Duck.— This species was not seen in 1912, but in the Clarke collection there is a specimen taken on the point, and Clarke stated that it often nests along the Shelldrake River. In 1914 a female was seen on July 7, and a pair on August 8, both at Vermilion.

13. **Marila americana.** Redhead.—There is in the collection of Mr. Clarke a mounted bird that was taken on the point. It is said to be common during migration.

14. **Marila marila.** Greater Bluebill.—This species was observed once, May 16, 1914, when a pair was seen on Little Lake by the writer. It is doubtless a regular migrant through the region.

15. **Marila affinis.** Lesser Bluebill.—There is a mounted specimen in the Clarke collection. Said to be common in spring and fall.

16. **Clangula clangula americana.** Golden-eye.—In 1914, the writer saw three adult birds on Lake Superior, near the end of the point. These were the only ones seen, but there is a pair of birds in the Clarke collection, and it is said to be common in the late fall and early spring.

17. **Charitonetta albeola.** Buffle-head.—There is a fine male in the Clark collection. The species is said to be common during migration.

18. **Harelda hyemalis.** Old-squaw.—In 1912, the remains of several old-squaw ducks were seen on the Lake Superior beach, and there is a mounted bird in the Clarke collection. Clarke informed the writer that the species is

often common and is locally called the winter duck on account of its habit of staying until the lake is frozen out from shore, sometimes so far that the birds cannot find food and starve to death. He has, he said, seen the birds so weak that they could not fly.

19. **Oidemia deglandi.** White-winged Scoter.—There is a mounted specimen of this duck in the Clarke collection, that was taken on Lake Superior, near the postoffice. According to residents it is not rare in spring and fall.

20. **Erismatura jamaicensis.** Ruddy Duck.—A mounted specimen in the Clarke collection establishes the fact that the ruddy duck occurs in this region. Clarke stated that it is common about the ponds and lakes during migration.

21. **Chen hyperboreus.** Snow Goose.—According to Clarke this species is often seen on the lakes and ponds during the migrations, a few having been seen by him in October, 1911.

22. **Branta canadensis canadensis.** Canada Goose.—This species may, Clarke informed the writer, be considered a rather common migrant in the region, where it often stops on the ponds and marshes. There is a mounted specimen in his collection, that was taken on the point, and he observed it nesting in the marsh at the edge of Little Lake about 1875.

23. **Olor columbianus.** Whistling Swan.—According to Clarke, flocks of swans are often seen early in spring and late in the fall, but they rarely stop on the point.

24. **Botaurus lentiginosus.** Bittern.—This bittern is a common summer resident, and was found in the marshes and about the ponds and lakes. On May 27, 1914, a nest was found at the edge of a small marsh near the end of the point. It nested also at Vermilion Lake.

25. **Ixobrychus exilis.** Least Bittern.—The writer did not see this species alive, but Clarke had a mounted specimen which was taken at Vermilion. He stated that the bird is very rare in the region.

26. **Ardea herodias herodias.** Great Blue Heron.—Several great blue herons were seen about the marshes and ponds. According to Clarke, some of these birds nested in the swamp near the Shelldrake River.

27. **Grus mexicana.** Sandhill Crane.—This species is not rare in the region studied. It visits the small ponds and marshes about the point and breeds in the marshes south of the Shelldrake River. On August 1, 1912, House heard it calling in the marshes mentioned, and three were seen flying high overhead. We were told by Butler that in the spring of 1912 three cranes were seen in a small marsh near the house and that one was white. The latter bird may have been a whooping crane. In 1914 the writer saw two, on May 18, near the end of the point, and two on May 24, and three on June 1 flying inland from the point.

28. **Porzana carolina.** Sora.—Altho reported by residents, the sora was not seen in 1912, but in 1914 one was observed at a pond east of Vermilion, August 14, and another was found dead on the beach of Lake Superior, August 7. It is no doubt a resident species.

29. **Fulica americana.** Coot.—According to the hunters this bird is a rather common migrant. The writer did not find it, but there is a bird in the Clarke collection, which establishes the occurrence of the species.

30. **Philihela minor.** Woodcock.—No woodcock were found, but Clarke stated that it is occasionally observed.

31. **Galinago delicata.** Wilson's Snipe.—According to Clarke, this bird is rather common in the spring. The writer saw but four birds, one on June

30, two on July 1, and one on July 3. The bird taken on the last date was a female, and contained an egg about two-thirds developed.

32. **Pisobia minutilla.** Least Sandpiper.—The least sandpiper was found on the beach of Lake Superior during the migrations in 1914. The first spring record was May 21, the fall records August 10 and August 19.

33. **Ereunetes pusillus.** Semipalmated Sandpiper.—A small flock of this sandpiper was seen on May 29 and May 30, 1914, and a single bird was seen on the beach west of Vermilion on August 18. These were the only records secured.

34. **Totanus melanoleucus.** Greater Yellow-legs.—"Found during migrations on the marshes about the ponds; common at times at Little Lake."—(Clarke).

35. **Helodromas solitarius solitarius.** Solitary Sandpiper.—This species was not seen in 1912, and in 1914 was first noted on August 13 at a small mud pond near Vermilion. Another was seen here on August 14.

36. **Actitis macularia.** Spotted Sandpiper.—The spotted sandpiper is not common on the point. Only a few pairs were seen, and usually along the beach of Lake Superior and the outer sand dunes, although a few were seen on the inland ponds and lakes. No nests were found but the birds evidently bred. On June 27, 1914, a female and young were found in a wet meadow near Vermilion, and another family on July 10 about two miles west of Vermilion. The young in these families were about one week old and could just fly.

37. **Numenius hudsonicus.** Hudsonian Curlew.—On May 22 the writer saw a flock of about twenty-five curlew flying along the north beach at the end of the point and at Vermilion this or another flock lit very close to one of the life saving crew who reported them. Residents said they were a rare migrant.

38. **Squatarola squatarola.** Black-bellied Plover.—This plover is common at times during the migration season. Single adult birds in the breeding plumage were seen on May 24, 26, and 28, 1914.

39. **Charadrius dominicus dominicus.** Golden Plover.—This bird is included on the authority of Clarke, who claimed to have taken it at this place, and that it was more common formerly.

40. **Oxyechus vociferus.** Killdeer.—The killdeer is rather uncommon. Only two pairs were seen in 1912 and two pairs in 1914. The birds were present throughout the summer.

41. **Aegialitis semipalmata.** Semipalmated Plover.—This bird was found on the Lake Superior beach, and at a small pond near Vermilion in 1914. It was first noted in the spring on May 23, and in the fall on August 14.

42. **Arenaria interpres morinella.** Ruddy Turnstone.—The turnstone was only observed at the end of the point and in late spring, 1914. It was first noted on May 29, when two were seen. On May 30, two were also seen, and a flock of seven was noted on June 1. All of these birds were in breeding plumage. The end of the point was not worked again during June, and the species was not found at Vermilion.

43. **Canachites canadensis canace.** Canada Spruce Partridge.—This bird was noted between Vermilion and the postoffice and in the cedar swamps along the Shelldrake River on July 15 and August 1, 7 and 10, 1912, and August 21, 1914. On July 15, 1912, a female with a brood of young was seen near the road between the postoffice and Vermilion.

44. **Bonasa umbellus togata.** Canada Ruffed Grouse.—The grouse is very common on the point and was seen on the sand ridges, in the birch-maple

forests and in the spruce-balsam forests. On the sand ridges and burnings it seemed to be feeding on the blueberry. On June 14, 1914, a nest with eleven eggs was found, and the latter were all hatched the next day. Another nest with ten eggs was found, June 7, at the edge of the road east of Vermilion. These eggs did not hatch. Several broods of well-grown young were observed during the first week in August, 1912.

45. **Circus hudsonius.** Marsh Hawk.—This was the most common hawk observed on the point. It was usually seen near marshes at the edges of ponds and lakes. It was noted about the postoffice at Little Lake, and was very common about Vermilion, where it was observed in the wet marshes near the beaver pond, or flying about over the cranberry marshes. Most of the birds seen were young in the reddish brown plumage.

46. **Accipiter velox.** Sharp-shinned Hawk.—The sharp-shinned hawk is not common in the region except during migration, but apparently a few breed on the point as birds were seen at various times during July and August. In the spring the birds pass up the point and across the lake in large numbers. In 1912, the remains of very many were found along the shore near the end of the point, where hunters had left them. In 1914, hundreds of birds were seen between May 13 and June 3.

47. **Accipiter cooperi.** Cooper's Hawk.—This hawk is also common during the spring migration. In 1914 a resident described a flight of hawks which took place on the first, second and third of May, and among the remains of the birds shot during this flight were many of this species. In fact, both in 1912 and 1914, many dead Cooper's Hawks were noted along the beaches. Only a few individuals were seen after May 12.

48. **Astur atricapillus atricapillus.** Goshawk.—On July 31, 1912, an immature goshawk in fine striped and spotted plumage was shot as it flew over the beaver pond just back of the lake beach at Vermilion, and immature birds were recorded on July 9 and August 5 and 12, 1914. Among the remains of hawks shot during the flight of May 1–3. 1914, the writer found those of several goshawks.

49. **Buteo borealis borealis.** Red-tailed Hawk.—Only one living bird of this species was seen, on August 9, 1912, but many were found dead among those shot by residents during the flight of hawks on May 1–3, 1914.

50. **Archibuteo lagopus sancti-johannis.** Rough-legged Hawk.—During May, 1914, this hawk was common all over the point, and numbers were seen about the postoffice as late as June 3. Sing e birds were observed near Shelldrake Lake on June 13, 18, 30 and on July 6.

51. **Buteo platypterus.** Broad-winged Hawk.—This hawk was only observed in 1914. On May 15, the writer secured a specimen near the end of the point, and single birds were seen in the forest southwest of Vermilion on July 4 and August 7.

52. **Haliæetus leucocephalus leucocephalus.** Bald Eagle.—The eagle is not common and was usually noted along the beach. It was said to nest near the Shelldrake River.

53. **Falco columbarius columbarius.** Pigeon Hawk.—The only birds of this species seen were the remains of two found in 1912 on the beach and sand dunes with those of other hawks.

54. **Falco sparverius sparverius.** Sparrow Hawk.—The sparrow hawk is not rare on the point. It was generally seen about the burnings and clearings. All of those seen were evidently local birds, no migrants being noted during the field work. One adult male, shot in 1912, contained a red-bellied snake, *Storeria occipitomaculata*, which it had swallowed entire. A nest

which contained four young birds was found, July 17, in a dead pine near the Shelldrake River.

55. **Pandion haliaetus carolinensis.** Osprey.—The osprey was seen occasionally on Lake Superior and on the Shelldrake River both in 1912 and 1914. In 1912, there was a nest near the Shelldrake River about two miles south of Vermilion.

56. **Asio wilsonianus.** Long-eared Owl.—On May 18, 1914, the writer found four birds of this species among low jack pines at the end of the point, and one specimen was secured for the collection. This is the second record of the occurrence of the species in the upper peninsula.[1]

57. **Asio flammeus.** Short-eared Owl—Only two birds of this species were seen. On May 18, 1914, one was discovered in a low jack pine tree at the end of the point, and a dead bird was found near Vermilion on June 10, 1914.

58. **Strix varia varia.** Barred Owl.—This owl was not seen, but mounted specimens were found in the collection of Philip Eby at No. 10 Life Saving Station, six miles west of Vermilion. It was claimed that the bird had been taken near that place.

59. **Cryptoglaux funerea richardsoni.** Richardson's Owl.—A specimen of this owl, which is rare in Michigan, was found among a pile of dead hawks shot at the lighthouse about the first of May, 1914. The only other authentic Michigan record for the species is that of Barrows (Michigan Bird Life, p. 314) which is based on two specimens in the high school at Sault Ste. Marie.

60. **Cryptoglaux acadica acadica.** Saw-whet Owl.—One of these owls was caught alive by one of the men at the lighthouse on August 6, 1912. According to Clarke, it is to be found throughout the summer, but we were unable to find other specimens.

61. **Bubo virginianus pallescens.** Western Horned Owl.—Only three horned owls were recorded. On August 1, 1912, two young birds, mostly covered with down but able to fly, were noted on a fallen tree, several feet from the ground, one was discovered in a growth of low jack pines at the end of the point on May 23, 1914, and another was heard near Vermilion Lake on June 26, 1914.

62. **Nyctea nyctea.** Snowy Owl.—There is a mounted snowy owl in the Clarke collection. The species is said to be rather common in fall and winter.

63. **Coccyzus erythrophthalmus.** Black-billed Cuckoo.—This cuckoo is not very common on the point. It was found throughout the summer, both in 1912 and 1914, in the jack pine and hardwood forests, but was more often heard in the latter.

64. **Ceryle alycon.** Belted Kingfisher.—Only a few kingfishers were noted. It was seen at Little Lake, and in 1914 a pair nested in a steep sand bank at the edge of Lake Superior. The seven young left this nest on July 8.

65. **Dryobates villosus villosus.** Hairy Woodpecker.—This species is rather rare, except in the hemlock-spruce and beech-maple forest. It was seen at different times during the summer and at various places. Barrows[2] says that it is not impossible that the northern form may breed occasionally in favorable localities in the upper peninsula, but our specimens are ap-

[1]Barrows (Michigan Bird Life, p. 300) records a specimen taken in Alger County in June, 1906.

[2]Michigan Bird Life, p. 347.

parently true *D. v. villosus*. A family of five was seen, July 8, in the pine forest near the Shelldrake River.

66. **Dryobates pubescens medianus.** Downy Woodpecker.—This woodpecker is rare on the point. Only seven birds were seen, the first on July 20, 1912, on a white pine on the first sand dune near the beach. On August 1, 1912, a pair was discovered near the edge of a small pond, feeding on some small dead willows, and in 1914 two pair were found near Vermilion.

67. **Picoides arcticus.** Arctic Three-toed Woodpecker.—Only a few woodpeckers of this species were seen, but it breeds on the point. On July 26, 1912, in an extensive area of burned over ridges and plains, a family was found, and an adult male and one juvenile male were taken. The young bird was still in the downy plumage. On July 27, 1912, two more were seen in another place, and on July 29, 1914, a single bird was noted in a pine forest near Vermilion. An adult male taken near Vermilion in February, 1915, is in the University of Michigan museum.

68. **Sphyrapicus varius varius.** Yellow-bellied Sapsucker.—On July 15, 1914, a male was seen near Vermilion in the birch-pine forest, and a juvenile bird was taken on July 25. These were the only ones seen, but its punctures were observed on numbers of trees, and some quite fresh ones were noted on jack pine trees on the point.

69. **Phloeotomus pileatus abieticola.** Northern Pileated Woodpecker.—This bird was found only in the beech-maple forest, west of Vermilion. On July 11, 1914, Novy found a nest forty feet from the ground in a tall dead white pine. The young were nearly grown and left the nest before July 17. Another nest was discovered about six miles west of Vermilion.

70. **Tyrannus tyrannus.** Kingbird.—The kingbird is apparently a rather rare bird on the point and was seen only at Vermilion. In 1912, two pairs lived about the beaver ponds, where they could usually be seen perched on the dead tamarack trees or making short flights for insects. In 1914 the writer found a nest on top of a low stump, in the edge of Vermilion Lake, which contained two eggs on July 7; another nest was discovered on the jack pine plains, June 30, which contained two eggs.

71. **Melanerpes erythrocephalus.** Red-headed Woodpecker.—In 1914, the writer saw three red-headed woodpeckers at the end of the point, on May 18, and during the summer it was occasionally observed about burnings and clearings near Vermilion.

72. **Colaptes auratus luteus.** Northern Flicker.—The flicker is a common breeder and was seen almost daily in all of the wooded habitats and in the clearings, burnings and drier marshes everywhere on the point.

73. **Antrostomus vociferus vociferus.** Whip-poor-will.—This species was not seen in the region, but its call was heard twice, on May 20 and 29, both times near the postoffice.

74. **Chordeiles virginianus virginianus.** Nighthawk.—The nighthawk is a common breeder on the point. One nest with young was found in a clearing, July 15, 1912, and on July 8, 1914, a nest with young was discovered in the pine forest at Vermilion. On August 1, 1912, a cool, clear day, numbers were observed flying all day over a small pond near a meadow at Vermilion.

75. **Chaetura pelagica.** Chimney Swift.—Very few swifts were seen, although a few nested in the buildings at the end of the point. A nest was found at Vermilion on the inside of the gable end of a barn. This nest was fastened against the boards, as is usual in such situations, and contained

several young birds. On August 2, 1912, the young were nearly ready to leave the nest. On June 24, 1914, this same nest contained six eggs, and the young were able to fly on August 8. Another nest was found in the gable of an old house, which contained three young and one egg.

76. **Archilochus colubris.** Ruby-throated Hummingbird.—The hummingbird is not rare on the point during the summer.

77. **Sayornis phoebe.** Phoebe.—The phoebe is apparently a rare species on the point. One was seen on May 31, 1914, at the end of the point, and a pair nested at a vacant house near Vermilion in 1912 and 1914, but no others were seen. In 1914, the pair mentioned had a nest and five eggs on July 31.

78. **Nuttallornis borealis.** Olive-sided Flycatcher.—This flycatcher is a rather common summer resident. It was nearly always found in or near the cedar and tamarack swamps. No nests were found but an immature bird was seen in 1912.

79. **Myiochanes virens.** Wood Pewee.—The pewee is a rather common summer resident on the point. It was observed both in the pine and hardwood forests. No nests were observed, but young birds just able to fly were seen on several occasions. In 1914, it was first seen on May 31.

80. **Empidonax flaviventris.** Yellow-bellied Flycatcher.—This species was not uncommon as a migrant in 1914. Several were seen by the writer in low willow thickets at the end of the point on May 26 and June 3. It may also breed in the region as one was taken in a tamarack swamp near Vermilion on June 10, 1914.

81. **Empidonax trailli alnorum.** Alder Flycatcher.—The alder flycatcher was only found about Vermilion, where it was common in June, July and August, 1914. It frequented the alder thickets about the shores of ponds, lakes and the Shelldrake River.

82. **Empidonax minimus.** Least Flycatcher.—This flycatcher was not noted in 1912 but was a common species in 1914. It was first seen at the end of the point on May 22 and May 26, and was quite common about Vermilion after June 30. It seemed to prefer the more open pine woods, but was also found at the edge of the birch-maple and spruce-pine forests.

83. **Octocoris alpestris alpestris.** Horned Lark.—The writer found a fine adult bird on the stony beach near the postoffice on May 30, 1914. This bird was not certainly a spring migrant, however, since it could not fly, and a resident stated that he had seen a single bird about the beaches throughout the winter. The writer was told that large flocks pass across the region in the fall, but could get no spring records.

84. **Cyanocitta cristata cristata.** Blue Jay.—The blue jay is common during migration, but in 1912 and 1914 there were few resident pairs. In 1914, a few were noticed before May 16, but after that date large flocks were noted during the first four days of June. The migrating birds seemed to furnish much of the food of the sharp-shinned hawk, which migrated at the same time. The writer saw literally hundreds of blue jays killed and eaten by the hawks.

85. **Perisoreus canadensis canadensis.** Canada Jay.—The Canada jay is apparently a rare breeding bird on the point. On May 22, 1914, these birds were noted with a flock of blue jays, and a resident asserted that large flocks are occasionally seen in the spring. It was observed near Vermilion, on July 6 and July 10, 1914, and Hawkins stated that he has observed it at various times throughout the year.

86. **Corvus corax principalis.** Northern Raven.—While not abundant, the

raven was frequently seen at the end of the point in 1912. During July, 1912, on several trips to the end of the point, from two to five birds were observed, generally in the field where the refuse from the fishery was deposited. On August 7, a dozen or more were seen at the latter place, some of which were young birds. The birds were fairly tame, allowing one to approach them quite closely. The residents claimed that it nested in the heavy forests south of the Shelldrake River, and that the birds are sometimes caught in traps set for wolves and foxes and poisoned by bait set out for these animals. In 1914, not one was seen although a much larger region was worked than in 1912, and three weeks were spent at the end of the point.

87. **Corvus brachrhynchos branchrhynchos.** Crow.—The crow is rather uncommon in the region, but was noted throughout the summer. In 1912, it was frequently found with the ravens at the end of the point, where the refuse from the fishery was deposited. A nest was found in June, 1914, near Vermilion.

88. **Dolichonyx oryzivorus.** Bobolink.—On June 10, 1914, one bobolink was seen at Vermilion, and later two pairs nested in the cranberry marsh at the same place. The young birds were able to fly the last week of July.

89. **Molothrus ater ater.** Cowbird.—This species was not seen in 1912 and only twice in 1914. It was first observed on May 13 at the end of the point, and a single bird was seen at the postoffice on May 17.

90. **Agelaius phoeniceus phoeniceus.** Red-winged Blackbird.—This species is a rare summer resident, and, although there are many apparently suitable habitats, it was found only about the beaver ponds at Vermilion and at Vermilion Lake. Three pairs were found at the ponds in 1912, and one pair at Vermilion Lake in 1914.

91. **Sturnella magna magna.** Meadowlark.—The meadowlark was not seen in 1912, but in 1914, a pair nested in the cranberry marsh at Vermilion, and residents stated that it occurred in some numbers at the postoffice about May 1.

92. **Icterus galbula.** Baltimore Oriole.—Occasionally seen on the point (Clarke).

93. **Quiscalus quiscula aeneus.** Bronzed Grackle.—This species was not noted in 1912, but in 1914 it was found to be a rare breeder on the point. The first bird was seen on June 2 at the postoffice. One nest was found and the young birds were able to fly on July 7.

94. **Hesperiphona vespertina vespertina.** Evening Grosbeak.—Occasionally visits the point in winter (Clarke). Two specimens taken from a flock at Vermilion, in February, 1915, are in the Museum of Zoology, University of Michigan.

95. **Pinicola enucleator leucura.** Pine Grosbeak.—A common winter visitant at the point (Clarke).

96. **Carpodacus purpureus purpureus.** Purple Finch.—The purple finch is a rather common summer resident on the point and was usually seen about the clearings and in the open woods. In August, 1914, small flocks were seen daily, feeding on the ripe June berries.

97. **Loxia curvirostra minor.** Crossbill.—Common on the point during the winter (Clarke). Near Vermilion, in 1914, this species was found in small flocks throughout the summer. On July 6 and 8, flocks of twenty or more were seen feeding in the pine woods.

98. **Loxia leucoptera.** White-winged Crossbill.—Frequently seen on the point during the winter months (Clarke). In 1914, a single flock was observed near Vermilion on July 14.

99. **Acanthis linaria linaria.** Redpoll.—Very common on the point in the winter (Clarke).

100. **Astragalinus tristis tristis.** Goldfinch.—The only bird of this species seen in 1912 was an adult male taken on the first dune near the beach at Vermilion on July 30. In 1914, it was only occasionally seen throughout the summer.

101. **Spinus pinus.** Pine Siskin.—The pine siskin was seen at the end of the point with other species of migrating warblers on June 2, 1914. At Vermilion during the same year it was seen almost daily from July 1—often two or three at a time and occasionally in flocks of from fifty to a hundred.

102. **Passer domesticus.** English Sparrow.—As yet the English sparrow is not common on the point, and only a few pairs nested about the buildings at Vermilion and at the end of the point.

103. **Plectrophenax nivalis nivalis.** Snow Bunting.—Very common during the winter months (Clarke). The remains of a bird were found on the beach near camp.

104. **Poœcetes gramineus gramineus.** Vesper Sparrow.—This was one of the most common birds on the point. It frequents the jack pine forests as well as the drier marshes, clearings and burnings. In 1914, a nest was found on July 8. On August 15, flocks were seen on the jack pine plains.

105. **Passerculus sandwichensis savanna.** Savannah Sparrow.—The savannah sparrow is less common than the vesper sparrow. It was found breeding in meadows and dry marshes. A nest with three eggs was found in a bog at the foot of Little Lake in July, 1912. In 1914, several pair nested in the meadows and cranberry marsh at Vermilion, where young able to fly were seen on August 1. In 1914, it was first observed on May 18.

106. **Zonotrichia leucophrys leucophrys.** White-crowned Sparrow.—On May 19, 1914, a single white-crowned sparrow was seen at the edge of the lighthouse clearing at the end of the point. This was the only bird noted.

107. **Zonotrichia albicollis.** White-throated Sparrow.—This species is also a common breeding bird on the point and was seen in nearly every wooded habitat throughout the summer.

108. **Spizella passerina passerina.** Chipping Sparrow.—This is probably the most common bird on the point. It was found nearly everywhere, except in the very dense forests. It was very common among the jack pines all over the point, where it seemed to feed on the ground as well as in the trees.

109. **Spizella pallida.** Clay-colored Sparrow.—On May 22, 1914, at the end of the point, the writer was fortunate enough to secure the third specimen of this species to be taken in the state. It was feeding with a junco on the ground under low jack pines. The other locality records are Port Huron, May 2, 1901, by P. A. Traverner, and Isle Royale, August 25, 1904, by the Museum Expedition. (cf. Barrows, W. B., Michigan Bird Life, p. 510).

110. **Junco hyemalis hyemalis.** Slate-colored Junco.—The junco is a rather common summer resident on the point. It was most often seen at the edge of the clearings and burnings and in second growth, where it no doubt nested. In August, 1912, it was also seen in flocks on the sand dunes and plains, which were covered at this time with blueberries and in places with tall weeds and grasses. The young were able to fly on July 8, 1914.

111. **Melospiza melodia melodia.** Song Sparrow.—This species is a very

common summer resident, and was seen every day and in nearly all habitats except in the jack pine and pine forests.

112. **Melospiza lincolni lincolni.** Lincoln's Sparrow.—This species was only recorded on May 20, 1914, when one was picked up dead at the lighthouse.

113. **Melospiza georgiana.** Swamp Sparrow.—Only two swamp sparrows were seen in 1912 and on but one occasion, at the edge of a beaver pond near Vermilion, but in 1914 it was a common breeder in all favorable locations about Vermilion. The young were able to fly on July 16.

114. **Zamelodia ludoviciana.** Rose-breasted Grosbeak.—This species was not seen on the point either in 1912 or 1914. Clarke said that he had observed it, and it is reported as not uncommon at Sault Ste. Marie.[1]

115. **Piranga erythromelas.** Scarlet Tanager.—Seen occasionally in spring and fall (Clarke). In 1914, a bird was seen on the east beach, May 26, near Shelldrake on May 29, one bird at Vermilion on July 4, and another at the last place on August 6.

116. **Petrochelidon lunifrons lunifrons.** Cliff Swallow.—This species was only noted as a migrant. The writer saw a few on July 30 and 31 with a flock of barn and tree swallows just west of Vermilion.

117. **Hirundo erythrogastra.** Barn Swallow.—This swallow is common at the end of the point and at Vermilion, where there are a number of old buildings in which they nest. On several occasions they were seen flying along the Lake Superior beaches on both sides of the point, several miles from any buildings. On August 7, 1912, there was a large flock on the beach near our camp, that may have been migrating.

118. **Iridoprocne bicolor.** Tree Swallow.—This species was not seen toward the end of the point but after June 4, 1914, it was found to be a rather common breeder about Vermilion, where it nested in dead stubs about the ponds and lakes. A nest was found by the writer on June 18, in a small dead birch near the edge of Vermilion Lake. The nest was about eight feet from the ground in a cavity made by woodpeckers. On July 19, flocks —nearly all young of the year—were seen flying and feeding over the wet marsh near Vermilion Lake. It was not seen after August 19.

119. **Riparia riparia.** Bank Swallow.—The bank swallow is not common in this region. In 1912, a small colony was found nesting in the high dunes on the north shore of the point, and in 1914, this colony had increased to about thirty nests. In 1914, the writer found another small colony, in June, in a deep bank on the shore of Lake Superior, a mile east of Vermilion.

120. **Bombycilla cedrorum.** Cedar Waxwing.—This species is a common summer resident on the point and both in 1912 and 1914 was seen almost daily between July 6 and August 10. It was not often observed in large flocks, and did not seem to damage the strawberries, but it was stated that in 1911 enormous flocks came to the point and did much damage to the berry crop. A nest was found with four eggs, on July 8, 1914, in low jack pines.

121. **Lanius borealis.** Northern Shrike.—This species is included on the authority of Clarke, who told us it was not rare during the winter. The writer saw several in the highschool collection at Sault Ste. Marie.

122. **Vireosylva olivacea.** Red-eyed vireo.—The red-eyed vireo is apparently rather rare. It was seen but a few times and only in the deciduous forests and in spruce, cedar and tamarack swamps. In 1914 it was first noted on June 5.

[1]Michigan Bird Life, p. 532.

123. **Vireosylva philadelphica.** Philadelphia Vireo.—On May 27, 1914, the writer secured an adult male of this species at the end of the point. No others were seen.

124. **Lanivireo solitarius solitarius.** Blue-headed Vireo.—Individual birds of this species were found in the pine forests on May 25 and July 8, 1914, and in a burning near the birch-maple forest on July 4, 1914.

125. **Mniotilta varia.** Black and White Warbler.—This warbler can only be considered a rare summer resident in the region. One bird was seen with a small flock of other warblers at the edge of an open growth of birch and balsam near Vermilion on July 31, 1912, a few were noted during migration on May 22, 1914, and at Vermilion a few bred in the mixed forest in 1914. It is probably more common in the dense hardwoods.

126. **Vermivora rubricapilla rubricapilla.** Nashville Warbler.—This species was first seen on May 22, 1914, at the end of the point. After June 4, it was observed about Vermilion all summer and nested in some numbers about the low sand ridges, which had a vegetation of low trees and shrubs, and about the swamps in the pine and hardwood forests.

127. **Vermivora celata celata.** Orange-crowned Warbler.—This warbler was observed on two occasions in 1914. A single bird was killed at the lighthouse on May 19, and a small flock was found near the postoffice on May 23.

128. **Vermivora peregrina.** Tennessee Warbler.—Two birds of this species were found dead at the lighthouse on May 19.

129. **Compsothlypis americana usneæ.** Northern Parula Warbler.—This species was seen only about Vermilion, where it was found in the heavy forest. A few birds no doubt breed in the region studied, as they were heard singing on July 15, 1914, and an adult male was taken on July 19, 1914.

130. **Dendroica tigrina.** Cape May Warbler.—The Cape May warbler was a common migrant at the end of the point in 1914. Two were found dead at the lighthouse on May 19, and others were seen there until May 23. No others were noted until August 5, when one was observed in the low jack pines on the first sand dune at Vermilion. Other birds were seen on August 6 and 13.

131. **Dendroica æstiva æstiva.** Yellow Warbler.—This warbler is not common. It was found in the willows along the Shelldrake River and about Vermilion Lake in 1914. Young were observed for the first time on August 8.

132. **Dendroica cærulescens cærulescens.** Black-throated Blue Warbler.—This species was first seen on May 23, 1914, at the end of the point, and for a few days after this date was a rather common migrant. It was found as a resident near Vermilion, where it nested in the dense birch-beech-maple forest.

133. **Dendroica coronata.** myrtle warbler.—The myrtle warbler is one of the most common warblers in the region. In 1914, some of the young left the nest before July 9.

134. **Dendroica magnolia.** Magnolia Warbler.—This is a rather common resident species throughout the region. In 1914, it was first seen on May 16, and during the night of May 18, when a large migration of warblers took place, more birds of this species were killed at the lighthouse than of any other. A nest containing two eggs was found in July, 1914.

135. **Dendroica pensylvanica.** Chestnut-sided Warbler.—This warbler was first seen on May 22, 1914, at the end of the point with other migrants.

Other birds were recorded from the same place on May 23 and 26. A few nested near Vermilion in the burnings near the birch-maple forest, where they were heard and noted at various times in June and July.

136. **Dendroica castanea.** Bay-breasted Warbler.—A few migrating birds were seen between May 19 and May 25, 1914.

137. **Dendroica striata.** Black-poll Warbler.—This bird was seen only twice, on May 22 and 23, 1914, at the lighthouse.

138. **Dendroica fusca.** Blackburnian Warbler.—During the migration of warblers on the night of May 18, four blackburnian warblers were killed and many others injured at the lighthouse. The species was next observed on May 23. It nested in the hardwood forest near Vermilion.

139. **Dendroica virens.** Black-throated Green Warbler.—This is one of the most common warblers in the region. It was quite generally distributed over the open jack pine plains, and was also found at the edge of the forests about Vermilion. A female was seen feeding a brood of young, on July 8, 1912, in the jack pine forest, and at Vermilion it nested generally in the tops of coniferous trees. On May 19, 1914, one was found dead at the lighthouse.

140. **Dendroica vigorsi.** Pine Warbler.—In 1914, the Pine Warbler was common throughout the summer in the pine forest southeast of Vermilion.

141. **Dendroica palmarum palmarum.** Palm Warbler.—This was the first warbler noted during the spring migration in 1914. Three were seen on May 13 and others on May 16, at the lighthouse. No others were observed.

142. **Seiurus aurocapillus.** Oven-bird.—This species was not rare as a summer resident about Vermilion in 1914, where it nested in the birch-maple forests. It was first seen on May 27.

143. **Seiurus noveboracensis notabilis.** Grinnell's Water Thrush.—A bird of this species was found dead at the lighthouse on May 20, 1914. The species was not noted again until July 15, when one was seen at the edge of a cedar swamp near Vermilion.

144. **Oporornis philadelphia.** Mourning Warbler.—This warbler was first seen near Vermilion on June 27, 1914. It was rather common in the burnings and clearings in the birch-maple forest thruout the summer, where it was noted as late as August 7. On July 11, several young birds just from the nest were observed.

145. **Geothlypis trichas trichas.** Northern Yellow-throat.—The yellow-throat is not uncommon on the point and was seen at various places after June 5, 1914. In harmony with the habits of the species, the birds observed were always at the edges of the swamps and ponds. An adult with young too small to fly was seen at the edge of Vermilion Lake, July 11, 1912. It was observed as late as August 13, 1914.

146. **Wilsonia pusilla pusilla.** Wilson's Warbler.—In 1914, this species was first seen near the end of the point on May 23, in company with other migrating Cape May, magnolia, bay-breasted, black-poll and Canada war-warblers. It was not seen after May 27.

147. **Wilsonia canadensis.** Canada Warbler.—On May 22, 1914, this species was found with a number of other migrating warblers at the end of the point. After that date it was observed to be a rather common resident about Vermilion, where it frequented the edge of swamps and mixed woods of spruce, balsam, tamarack and cedar.

148. **Setophaga ruticilla.** Redstart.—This bird was found in the birch and balsam forests on the point and in the dense woods near Vermilion, but it was not observed in the jack pine habitat, except that in migra-

tion (1914) it was noted at the lighthouse on May 19. It was not seen after August 7.

149. **Anthus rubescens.** Pipit.—On May 21, 1914, a flock of about twenty pipits was seen on the gravelly beach near the end of the point, and on June 3, 1914, a single bird was found in the same habitat.

150. **Toxostoma rufum.** Brown Thrasher.—On August 6, 1914, the writer saw a single brown thrasher in a thicket of spruce and maple near Vermilion.

151. **Troglodytes ædon ædon.** House Wren.—In 1914, a few pairs of house wrens were observed about Vermilion, and on July 18 a nest was found in a birch stub.

152. **Nannus hiemalis hiemalis.** Winter Wren.—The winter wren is apparently a common resident in the dense forests at the base of the point. In 1912 and 1914, it was noted throughout the summer both in the swamps and drier forests. The first bird noted in 1914 was seen on May 27.

153. **Cistothorus stellaris.** Short-billed Marsh Wren.—This wren is, at least locally, a common nesting species in the wet marshes of the region. It was first heard singing the last week in June and the first week in July, 1914. On July 7, more than a dozen were singing among the low bushes and tall grass in the marshes at Vermilion. No nests were found, but the birds were undoubtedly breeding, for on July 7 a female was shot which contained a nearly formed egg. The birds were seen as late as August 1. This is the first authentic record for the upper peninsula, although Bois[1] says "Sometimes seen on the lowlands on the east side of Neebish Island, St. Mary's River." Barrows (Michigan Bird Life, p. 679) says in regard to the above record, "It seems probable that the long-billed marsh wren was the species found there."

154. **Certhia familiaris americana.** Brown Creeper.—The brown creeper is not rare in the region worked, and was observed throughout the summer both in 1912 and 1914. On June 5, 1914, a nest was found in a cavity between the bark and trunk on a dead red pine near the edge of a cedar swamp. It was only about four feet from the ground and contained one egg on the date given and three more on June 10.

155. **Sitta canadensis.** Red-breasted Nuthatch.—This bird is a common summer resident. It was seen almost daily in the jack pines, pine forests, cedar swamps and the spruce-balsam forests. At the end of the point, flocks of migrating birds were seen on May 14 and later dates.

156. **Penthestes atricapillus atricapillus.** Chickadee.—This chickadee is not common in the region except during migration. The resident birds seemed to prefer the cedar and tamarack swamps. On May 14, 1914, the writer saw a few flocks of this species at the end of the point, and on May 17, large flocks containing hundreds of birds were to be seen in many places. These disappeared in the succeeding two days, for on the twentieth only a few remained on the point. On May 18, a great flock was seen to rise upward until almost out of sight, and then fly across the bay to the Canadian shore. Large flocks again gathered on the point on May 27, and these disappeared before June 3, leaving a few pairs which bred about Vermilion.

157. **Penthestes hudsonicus hudsonicus.** Hudsonian Chickadee.—This bird was first noted on May 18, 1914, with the small flocks of black-capped chickadees mentioned above. A few were subsequently seen each day until May 27, when large flocks appeared. On June 3, numbers were seen in the

[1]Bulletin of the Mich. Ornith. Club, 1, 1897, No. 3-4, p. 29.

jack pines near the postoffice, feeding on the seeds of that tree. The Hudsonian Chickadees could be easily distinguished from the other species by the habits as well as by the call notes. When the former lit in the small jack pines, most of the birds would seek the topmost branches, and, when perched, held the body more erect than did the black-capped chickadees, which would moreover fly into the trees. Several birds were again seen near Vermilion on June 9, and single birds were noted a few times in July. On August 7, the writer saw an adult female feeding five downy young. This family or another one was seen on August 11, and the young were still being fed by the parent. This is evidence that the species at least at times nests in the region, and adds another breeding species to the Michigan list.

158. **Regulus satrapa satrapa.** Golden-crowned Kinglet.—This species was not seen at the end of the point during the migration, and was first found near Vermilion on June 27, 1914, when a nest was discovered in the spruce and pine forest. The nest was constructed of moss, lined with fur, and was suspended beneath a large black spruce limb about twenty feet from the ground. On July 13, it contained seven fresh eggs. Young birds just out of the nest were seen on July 10.

159. **Hylocichla guttata pallasi.** Hermit Thrush.—In 1914, this species was heard singing in July, and a nest was found on July 28 in the pine forest. It was built on the ground and contained three light blue unmarked eggs. It must be considered a rather rare summer resident.

160. **Hylocichla aliciæ aliciæ.** Gray-cheeked Thrush.—This species was only seen during migration, and was found at the end of the point in small numbers from May 20 to 30, 1914.

161. **Hylocichla ustulata swainsoni.** Olive-backed Thrush.—This thrush was often seen and heard during the summer, both in 1912 and 1914. It was found in all the wooded habitats. A young bird just able to fly was seen on August 15, 1914, at the edge of a burning near the pine forest. On May 19, 1914, this species was found with other migrants at the end of the point.

162. **Planesticus migratorius migratorius.** Robin.—The robin is apparently rather rare in the region. It was more common at Vermilion than elsewhere, but only a few were seen even there. On July 29, 1912, several —evidently a brood—were seen at the meadow near a small beaver pond. In 1914, a nest which contained three young nearly ready to fly was found near Vermilion.

163. **Sialia sialis sialis.** Bluebird.—This species is not rare. It was a common migrant at the end of the point between May 17 and 30, 1914, and several nests were found in old stubs in the burnings and clearings at Vermilion. On June 25, 1914, a nest contained three young just able to fly.

THE BIRDS OF DICKINSON COUNTY, MICHIGAN.[1]

BY FREDERICK M. GAIGE.

All of the following observations were made in the region about Brown Lake, Dickinson County, in the northern peninsula of Michigan in the summer of 1909. The writer was then attached to a field party sent out by the Michigan Geological and Biological Survey to investigate the biology of the region. The period of observation extended from June 30 to August 24 both inclusive, every day of which was devoted to field work.

HABITATS AND HABITAT DISTRIBUTION OF SPECIES.

The region studied was wild as was shown by the presence there of many of the species which are disappearing in Michigan, e. g., deer, bear, wolf and wildcat. It was in a natural state except that the pine had been removed and the plains had recently been swept by a severe fire. Brown Lake is situated in the northern part of Waucedah Township, near the junction of the east and west branches of the Sturgeon River. It is about one mile in length and a half mile wide and is really an enlargement of the East Branch. The latter enters at one end and leaves at another, and shortly after leaving the lake joins the West Branch. The camp was situated near the junction of the streams, and was the permanent headquarters of the party.

The region about Brown Lake fell into five general habitats: (1) the burned lands; (2) the unburned hardwood forest; (3) the unburned ash and alder thickets; (4) the unburned tamarack, cedar and spruce swamps; (5) the mud flats along the river. These five habitats are briefly described in subsequent paragraphs.

1. The Burned Lands—The burned pine lands in the region studied are the sandy plains bordering the Sturgeon River and its branches, thus forming a semi-barren strip on both sides of the river with a total width of several miles, which gives place to a hardwood forest on the adjacent moraines. Brown Lake lies in this area, as do two smaller lakes, Jackson and Tomahawk. The burn extended to the very edge of these lakes except in the case of the former where in several places large marshes intervened. While most of this burned area was formerly pine forest, there were a few low cedar and spruce swamps in it, which had also been devastated by the fire. The pine land proper had been largely cleared of the pine which had been succeeded by a dense growth of poplars and birches. The fire killed practically all of these, though a few patches, together with several small groves of medium sized pines, still survived. The fire varied much in its intensity and in places the heat had been so great that the old pine stumps were entirely consumed even to the roots, and the earth left loose and friable with a dull red color, while in other places the trees remained standing, gaunt and dead, blackened at the base and slowly rotting as they stood. Most of the latter were small trees and saplings, with trunks not more than a few inches in diameter and with a height of from ten to thirty feet, but

[1]From the Michigan Geological and Biological Survey.

along the river there was a narrow margin of dead trees which were much larger than these. The majority were white ash, and many had attained a diameter of from one to two feet. There was another burned strip along the hardwood forest which will be described under that head. The herbaceous plants and the underbrush were practically all consumed.

As stated above, there were burned cedar and tamarack swamps in the pine lands, and these fall under this head because they were burned. The fire swept them clean of all living vegetation, but left a tangle of charred logs strewn among the blackened stumps. These places were very difficult to work as they were frequently wet in addition to the confusion of logs left by the fire. There was on the whole little bird life in them, the two species most frequently noted being the white-throated sparrow and the house wren. These swamps had usually recuperated little from the fire, but the bareness of the pine land was softened by large areas of fireweed, Canada thistles and a few other flowering plants, while in some places even a scanty growth of grass covered the soil.

A third division of the burned lands was the narrow strip of large trees along the river, referred to before. As stated, these trees were largely white ash, a growth that lay just beyond the alder and willow thickets that margined the river. Most of the trees were standing, though they were soft and punky from decay. These trees formed excellent nesting sites for all those species of birds that nest in hollows in trees, and woodpeckers, tree swallows and blue birds were characteristic of the area. The pileated woodpecker was a notable exception to this rule, for it remained in the hardwood forest.

2. The Hardwood Forest—The hardwood forest was the second large habitat studied. It was found on the undulating area of morainal material which lies between the two branches of the Sturgeon River and just north of Brown Lake. The principal trees were maples, elms, basswoods, hemlocks, and yellow birch. The fire did little damage to the forest, killing only a narrow strip of trees along its margin, though a more or less thorough ground burn penetrated farther. The unburned edge of the forest was plentifully supplied with bird life, while the farther one entered the fewer species and individuals were found. At the edge towhees, seven species of warblers, chickadees, chipping sparrows and other species were numerous, but deeper in only an occasional black and white warbler, wood pewee or red-eyed vireo were noted.

3. The Unburned Ash and Alder Thickets—The unburned ash and alder thickets along the streams were a most important factor in the local distribution of the bird life. As they afforded the most favorable feeding grounds for considerable distances, a notable amount of bird life was there concentrated. This fact was true both during the breeding season and during the small amount of migration that took place while the field work was in progress. These thickets were composed of ash trees, a few poplars and elms with a more or less dense undergrowth of alders and willows. An average width for the habitat would be about fifty yards. The beaver meadows and their margins fell naturally into this habitat.

4. The Unburned Spruce, Cedar and Tamarack Swamps—The unburned spruce, cedar and tamarack swamps were, in general, little inhabited by birds. These swamps had a considerable area, and were uniformly covered with a dense growth of trees. The few open spaces that occurred were in most instances covered with a dense growth of blueberry bushes. The most of the bird life noted in this habitat was along old lumber roads that

had been constructed many years previously, and which, while mere vestiges overgrown with young trees and bushes, were more open than the rest of the swamp. As one left these roads and entered deeper into the recesses of the swamps, he found very few species and individuals of birds. The chickadee was the commonest, the white-throated sparrow, winter wren and Canada ruffed grouse being characteristic too, but less frequently noted.

5. *The Mud Flats along the Rivers*—The mud flats along the rivers were too limited in number and area to play an important part in the local distribution, but formed a habitat so distinct from all others as to be worthy of recognition. They consisted of small isolated patches of bare mud and drift wood, often of an area of only a few square feet, quite too small to furnish feeding grounds to any number of waders, and were submerged completely with the rise of the river coincident with rains. The spotted sandpiper fed along them, later solitary sandpipers lingered a time on their scanty expenses, while the bronzed grackles in little flocks took advantage of the feeding grounds afforded by the larger flats just below camp.

MIGRATION.

As before stated but little migration took place previous to our departure from the region. A few flocks of sandpipers that appeared July 29 were the first real migrants; the middle of August saw a flight of sparrow hawks, and later large flocks of warblers were noted along the Sturgeon River, and in the hardwood forest. It is very probable that these latter flocks were in reality gatherings of local residents rather than migrating birds. These flocks began to appear commonly August 18 and 19. A flight or two of swallows and a single large flight of chimney swifts about completes the migration noted though certain observations are recorded in the list of species under various other forms.

EFFECTS OF THE BURN ON THE LOCAL DISTRIBUTION OF THE BIRDS.

Certain effects of the burn were most noticeable. It excluded some species that must otherwise have been present, and favored the introduction of others by influencing food, nesting sites and enemies, and it effected the birds both in their breeding and migration seasons. Very interesting are the species favored by the burn. They fall directly into two classes, those furnished with suitable breeding conditions and those supplied with well provisioned halting places during migration.

In the first of these classes—those species which found especially suitable breeding conditions both in an abundance of favorable nesting sites and abundant food as a result of the burn—were the woodpeckers, the tree swallows, the chimney swifts and the bluebirds. Large numbers of tall dead trees particularly along the rivers, were soft and punky from decay and the wood in this condition is filled with larvae that are easily accessible, and it was easily excavated to form nests. The result was an abundance of woodpeckers, particularly the downy, which took advantage of food and nesting sites so closely approximated. Even more conspicuous was the case of the tree swallow, which was influenced by the abundance of woodpeckers as well as by the burn, since it found numbers of suitable nesting sites in the abandoned woodpecker holes and an abundance of flying insects over the water. Consequently the species was abundant, and along the river there were so many colonies that almost every dead tree was inhabited, and, especially when the young emerged, the species dominated the

riparian ornis. The chimney swift, to all appearances, was also favored by the hollow trees, though this case was difficult to determine definitely. The bluebird also fell into this group.

Another noteworthy division of this class was made up of those species which do not nest in holes or hollows of trees, but are characteristic of the open. To them the fire provided a long, new area of open land, much of which has since been covered to a greater or less degree with weeds and grasses. This permitted the birds to enter a region previously excluded from their range. The vesper sparrow must early have taken advantage of this condition, as it was a common species in 1909. The goldfinch, too, fed commonly on patches of Canada thistles that had succeeded the fire while the cowbird more rarely lingered to feed among the long grasses. The ruby-throated hummingbird, too, haunted the acres of flowering fireweed.

In the second class—the migrants—the sandpipers were the favored species. As it left undeniably insufficient food for large flocks, the burn must have been unfavorable for many species during migration, yet it did actually favor others. Thus the sparrow hawks found grasshoppers—a favorite food—in abundance in local areas as they passed. More interesting are the waders. As stated, the mud flats of the river were of minor habitat significance owing to their small size, a fact which would tend to be unfavorable to waders. The conditions on the flats, however, were extended by the burned spruce, cedar and tamarack swamps. Many of these furnished wide shallow ponds, with muddy shores and bottoms in which was abundant food. These conditions made possible the occurrence in greater numbers of such species as the least sandpiper, the solitary sandpiper and, more particularly, the lesser yellowlegs, and there can be but little doubt that other species and more flocks visited the region than are recorded. The swamps provided with these conditions were remote from camp, widely distributed, and quite impossible of thorough study by a single observer in the limited time available.

Another phase of the effect of the burn was a concentration of the birds along the streams in the willow and alder thickets. In the main, this concentration of life in the stream thickets effected both the residents and the migrants and for the same reasons. First, it was here that the food was to be found; for many species, as some of the warblers, the only considerable food supply was in these living thickets. Water was abundant, which also increased the number of insects over that of the dark forests bordering the burn. Second, the breeding species find favorable nesting sites and concealment which they cannot find in the burn. These thickets along the streams afforded an abundant bird life, both as regards species and individuals. Usually, too, the species were here relatively fearless, reluctant to leave the cover and eager to return to it. In general, then, the burn has concentrated the bird life quite as the forest species are restricted to the wooded margins of streams in the plains areas.

ACKNOWLEDGMENTS.

The writer here wishes to acknowledge the indebtedness of the survey to Mr. R. C. Flannigan and his family, who placed their camp and caretaker at our disposal and in other ways did much to further the work of the expedition and to contribute to the personal comfort of the men while in the field.

LIST OF SPECIES.

In the following list the writer has endeavored to give an idea of the local distribution of each species in respect to the habitats recognized. In addition to this aim, he has attempted to record the abundance of the several species, the time of its appearance and disappearance whenever possible, the time of nesting, and such miscellaneous data as food, methods of procuring it, characteristic actions of certain species, and other field observations. In addition to these observations and records, further detailed notes were kept in the field catalog, such as the hour of the day when each specimen was taken, as well as the habitat, and, if judged to be of sufficient importance, what the bird was doing at the time of collection. The stomach of every bird taken was preserved in formalin and tagged with the number corresponding to that of the specimen in the catalog. The nature of each individual's food can thus be ascertained at any future time in the laboratory by an examination of the stomach contents. All specimens collected were examined for external parasites, which were also preserved for future identification.

It will be noted that a few species are listed from Holmes Farm, and from nowhere else. This farm was traversed both enroute to camp and in return. It is located some eight or ten miles from Brown Lake, and is under a good state of cultivation. All the other observations and records are from the wild lands of the lake region.

1. **Podilymbus podiceps.** Pied-billed Grebe.—This species was noted but three times during the summer. The first was a single bird seen July 5. Others were recorded August 10 and 17, on each of which occasions two birds were seen together. All were on Brown Lake.

2. **Gavia immer.** Loon.—The first of this species was recorded July 7, when a single bird was seen on Brown Lake. Two more were about the lake on July 10 and 11. They were exceedingly shy and wary of approach, and both flew away on the evening of the eleventh when pursued in a canoe, and no others were seen.

3. **Anas platyrhynchos.** Mallard.—A single female was seen along the river near the rock outcrop on July 30. She was very shy and flushed at sight, leaving the river and flying high over the burn. No further records of the species were obtained.

4. **Ardea herodias herodias.** Great Blue Heron.—There were a few individuals of this species that were seen almost daily during the entire summer. They fed along the edge of the lakes and rivers, from which places they were frequently flushed. Sometimes on the rivers when turning a sharp bend, one surprised the big birds at close range, but usually they were shy and stayed on the more regular shore of Brown Lake, where they could see for longer distances. Flushed here, they flew directly to one of several large dead trees some hundreds of yards from the shore and alighted in the top, sometimes remaining there for an hour or more before resuming their feeding. The caretaker of the camp informed us that there were several nests in a group of trees somewhere along the river where these birds had been for years, but he never showed them to us and none of the party ever found the place. An immature bird, fully plumaged, was taken on August 9.

5. **Porzana carolina.** Sora.—As we left camp August 24, we flushed one bird in the long grass of the marshy area near the river. It was the only rail seen.

6. **Fulica americana.** Coot.—Two coots were heard calling in the large marsh not far from the Beaver Meadow on July 16. The marsh was largely covered with water, in which grew a profusion of tall reeds and willows that afforded an excellent cover for a breeding site.

7. **Pisobia minutilla.** Least Sandpiper.—A flock of fifteen or twenty of this species was found about a pond in a burned cedar swamp on July 29. As soon as disturbed, the flock left the ponds and the entire locality and no others were seen. These birds were the first certain migrants.

8. **Totanus flavipes.** Yellow-legs.—A flock of eight of these birds was noted, July 29, near the place where the least sandpiper was found. Like the latter, the yellow-legs were migrants which left the region upon being disturbed. No further flocks were seen.

9. **Helodromas solitarius solitarius.** Solitary Sandpiper.—These birds first appeared on July 29, when a large number were found about the pond in the burned swamp mentioned under the two preceding species. After that date they became common along the river and about all the ponds and were still present in numbers at the time we left, August 24. They were very tame and fearless; often they remained standing close to the water by their feeding grounds until one approached by boat near enough to strike them down were he quick enough. On several occasions individuals actually attempted to alight on the bow of our canoe while the paddler was working in the stern. They fed on the mud flats along the river, and on the lower banks both of the lakes and streams, singly or in twos and threes, but gathered in flocks of twelve to fifteen about the ponds in the burned swamps.

10. **Actitis macularia.** Spotted Sandpiper.—This species was seen daily during the summer. It was common along the rivers, where it fed on mud flats and low banks, but became rather less abundant after August 14. As a whole the species was less fearless than the preceding one, tho often a bird lingered at his feeding until approached within a boat length. The birds were surprisingly active in the water. One, an immature male, was wounded on a mud flat and immediately attempted to fly across the river. He fell in the water and was pursued in a canoe. As it came alongside of the bird, he dove readily, and swam by using the wings, actually flying thru the water. After traversing several yards in this fashion, he appeared on the surface only to immediately disappear again, and it was with some difficulty that he was finally captured. The young birds in the down frequently deliberately took to the water when frightened, and swam readily on the surface.

In the former part of July young birds of this species, in the downy plumage, were noted on several occasions, while the white breasted young fully able to care for themselves steadily increased in numbers until the middle of August. On July 6 a bird was flushed from a nest, which was not found.

11. **Oxyechus vociferus.** Killdeer.—A single bird of this species was seen several times during the first twelve days of July on the larger mud flats below camp. After this date none were recorded until August 12, when one bird was found feeding along the river in company with several solitary sandpipers. These two birds were all that were seen.

12. **Bonasa umbellus togata.** Canada Ruffed Grouse.—This grouse was frequently seen during the summer. Birds were most often noted at the edges of the spruce and tamarack swamps in the hardwood forest, and in second growth poplars, but were met with in the burned lands as well. They were not shy, but on the contrary they were often quite fearless and reluc-

tant to fly or hide. August 11, a covey of ten birds, the young grown almost to adult size, was found in blueberry bushes near a spruce swamp. The birds walked deliberately away, much like a flock of hens. On numerous occasions birds were found in low trees, and were then very easily approached.

On July 13 a female grouse with a number of chicks was found in the burned pine lands not far from camp. The chicks were only a few days old, but were so clever at concealment, that, in spite of an apparent lack of any cover, but three were found.

13. **Circus hudsonius.** Marsh Hawk.—This species was recorded three times in July and four times in August. The first bird seen was a beautiful male flying over Brown Lake, July 2. Later in July another male, quite possibly the same one, was noted about the cabin clearing. During the last two weeks of the field work several females and young birds were noted.

14. **Accipiter velox.** Sharp-shinned Hawk.—A single bird of this species was noted about the barns at Holmes Farm, August 24.

15. **Accipiter cooperi.** Cooper's Hawk.—A single individual was seen in the burned lands about Jackson Lake, July 12. Several times it flushed a flock of sandpipers about the lake shores, but made no attempt to capture them. The species was not recorded again.

16. **Buteo borealis borealis.** Red-tailed Hawk.—This hawk was noted at intervals during the summer. The first was seen and heard on July 1, and by its actions it had a nest in the vicinity even then, but if so it was not found. On several subsequent occasions, one and, more rarely, two birds were seen in the same locality, hunting over the burned lands. In August the species was seen more frequently than in the preceding month, which might have been due either to the beginning of migration or merely to the advent of a few broods of locally reared young.

17. **Haliæetus leucocephalus leucocephalus.** Bald Eagle.—A bald eagle was seen flying over Holmes Farm on August 18 by Dr. Ruthven. This is the only record for the summer.

18. **Falco sparverius sparverius.** Sparrow Hawk.—A single bird of this species was recorded, July 16, from the burned lands near Brown Lake. It furnished the only July record, but on August 13 the species suddenly became common, and was noted daily until the twentieth. A flock of a score at least collected about an area covered with a grass that supported numbers of grasshoppers and gorged themselves with these insects. The birds were unusually fearless at this time, but as they gradually decreased in numbers they became more shy. On the twentieth of August about ten of them still remained in the locality, but after that morning no more were seen.

19. **Pandion haliætus carolinensis.** Osprey.—A single osprey was seen over Brown Lake on August 19. It did not linger about the lake, but soon departed.

20. **Bubo virginianus pallescens.** Great Horned Owl.—This species was recorded twice during the summer. The first was observed just at evening on July 29. It was perched in a large dead tree at the edge of Brown Lake. The second was seen in a burned tamarack and spruce swamp.

21. **Coccyzus erythrophthalmus.** Black-billed Cuckoo.—A single bird of this species was taken in a burned tamarack swamp, July 1.

22. **Ceryle alcyon.** Belted Kingfisher.—This bird was seen daily about the lakes and rivers, usually singly, more rarely in pairs. The birds ranged widely along the water courses, and were generally shy. They often pre-

ceded a canoe for long distances along the river until, too far from their accustomed haunts, they circled back over the burn to the old feeding grounds. Not once were they observed to pass directly over a boat. A pair of this species was found about a little lake several miles south of camp, and when observed were very busy fishing with most indifferent success. Where this pair bred is a mystery, for it was miles to a suitable location. Along the river, young birds began to appear late in July.

23. **Dryobates villosus villosus.** Hairy Woodpecker.—While not abundant, this species was recorded daily during the summer. It was most frequently seen near the river, sometimes in the ash and alder thickets, sometimes in the adjacent dead trees. A few individuals were also present in the hardwood forest and its margin of fire killed trees. Nests were noted all along the river in the belt of standing dead trees. The first was discovered on July 2 and contained young birds nearly ready to leave it. No nests containing eggs were found.

24. **Dryobates pubescens medianus.** Downy Woodpecker.—This woodpecker was abundant all summer, especially in dead trees near the river, where it nested in numbers. When the young birds had left the nests—and most of them had done so by the last week in July —the species had a very noticeably wider distribution. Then it overflowed into the burn, and the spruce and tamarack swamps had a larger population. The families remained together for days after the young could fly, so in August the species was usually encountered in small groups. Numerous nests were found in dead trees along the rivers, where excellent nesting sites and abundant food had attracted the birds. The first nest, found July 5, contained five well grown young birds, some of which left the nest the following day. As was the case with the preceding woodpecker, no nests of this species were found which contained eggs.

25. **Sphyrapicus varius varius.** Yellow-bellied Sapsucker.—This species was common all summer. It was most frequently seen in the standing dead timber along the river, but many birds were living in the hardwood forest and the standing dead trees at its margin. The birds fed on both the live and dead trees without exhibiting much choice, therein differing from the preceding species, which greatly preferred the dead wood. A nest found on July 2 in a large dead white ash on the river bank was opened on July 3 and found to contain six young birds nearly ready to fly. On July 12 a second nest was opened which contained four newly hatched birds.

26. **Phlœotomus pileatus abieticola.** Northern Pileated Woodpecker.—This species was first seen on July 24, when a young male was taken near the hardwood forest on the Foster City trail. Birds were heard calling and hammering on trees on numerous occasions during August, but were very shy and difficult of observation. Signs of their work were plentiful, and almost daily trees were noted that had a thick layer of chips about their bases from the vigorous attacks of the woodpecker. On one occasion a large fire-killed maple was found in which these woodpeckers had been working. It was literally hammered to pieces—one excavation four feet from the ground was about three feet in height and a foot in depth. The trunks of the dead trees were attacked almost exclusively, the limbs being excavated only very rarely. On July 31 a nest was found in a dead maple, more than forty feet from the ground. There were evidences that it had been recently occupied, but no birds were observed at the time.

27. **Melanerpes erythrocephalus.** Red-headed Woodpecker.—The species

was noted rarely, only five times in all. The first seen were in a group of tall, standing dead trees near the edge of a burned swamp. They were nesting here in the very top of one of the trees, fifty feet or more high. When observed the adults were engaged in carrying food to the nest hole. July 24 another pair was found in a similar group of trees in the burned lands, and a week later three of the gray-headed young were seen in the same trees. After August 16 no more were recorded.

28. **Colaptes auratus luteus.** Northern Flicker.—The flicker frequented the burned lands, where it was commonly observed all summer, altho the numbers rapidly decreased after August 16. The species was typical of the burned lands wherever a few trees remained standing. The narrow belt of fire-killed trees bordering on the hardwood forest was a favorite resort, but the birds seldom entered the forest itself. The species was very shy during July, but, as the young became more abundant, it became one of the tamest. During the blueberry season, the birds were flushed in numbers from the ground among the bushes, and later haunted the wild cherry trees in the same fashion. Both fruits were favorites, and the birds stayed in their vicinity until after the fruits were gone. Nests were frequently found, the first on July 1. This nest contained young nearly large enough to fly. The last nest was found on July 20, and the young in this nest were very recently hatched.

29. **Antrostomus vociferus vociferus.** Whip-poor-will.—This species was present during the two months spent in the field, but was noticeably more common in July. Just at dusk the birds began to call, and frequently came into the clearing about camp after it was too dark to see. After August 16, they were seldom heard calling, that is one would hear a call twice or thrice in an evening. As a species they preferred the burn, and always were heard calling from there. On several occasions in the very early morning between three and four o'clock, whip-poor-wills were found flying thru the cold mists that hung over the lakes and rivers at that hour. On several occasions at this time the birds were quite numerous, and came so close to the canoe as to be readily recognized. To a considerable extent, the species fed on the all too plentiful mosquitoes, in that habit much resembling the nighthawks.

30. **Chordeiles virginianus virginianus.** Nighthawk.—This species was common during our stay in the field. Every evening the birds were seen flying above the burned lands and over the water, and in the early evenings of the first two weeks, were frequently heard "booming." As the dusk deepened they came lower and lower, until often quite close to the earth. In August many more birds appeared than were evident in the preceding month, and in Waucedah on the evening of August 24, a large flock was seen flying about over the town. In the early morning the birds were usually quite abundant also, and during the day an occasional bird would be seen very high in the air. A nest found on July 1 contained two young birds in the down. The nest was a mere hollow in the hot soil of the bare burned lands, and was without protection from the hot sun or from passing hawks. The parent was on the nest, and sat very close. When finally flushed, it flopped off a little way in the characteristic manner and then very reluctantly took wing.

31. **Chætura pelagica.** Chimney Swift.—This species was noted almost daily during the summer. Just at evening, flocks of from four or five to twenty would appear flying over the burned lands, usually a little before the nighthawks began to feed, and would disappear before dark. During the day a few individuals would be seen well up in the air; this was espe-

cially true about the rock outcrop along the river. On August 16 a number of these birds were seen at this place catching flies (see cedar waxwing). A specimen taken here was found to have been feeding on the same flies as those captured by the waxwings. On August 23, a flock of some hundreds of swifts suddenly appeared over Brown Lake, drank with a wild flutter and much chittering, and then rose high in the air and disappeared to the southward. It was undoubtedly a migrating flock, but as we immediately left the region, it is impossible to determine if the local birds left at the same time. No nests were found, but it seems certain that they bred in the immediate region, and as there were numbers of huge hollow trees, good nesting sites were plentiful.

32. **Archilochus colubris.** Ruby-throated Hummingbird.—This species was seen not rarely during the entire summer. In numbers it neither dedecreased nor increased. It was found most commonly in the burned lands where large areas of fireweed were in full bloom. Here the bird found food in abundance, but probably few nesting sites. Later, as the fireweed died down, the birds haunted the Canada thistles. No breeding records were obtained, but both males and females were noted and a bird taken on August 20 was a male of the year.

33. **Tyrannus tyrannus.** Kingbird.—During July and the first two weeks of August this species was common along the water courses. Particularly after August 15, the species rapidly decreased in number, but at the time of our departure, on the twenty-fourth, a few individuals remained. Nests were frequently found. The first, discovered on July 2, contained three young just ready to fly. This nest was situated in the concave top of a dead stub eight feet above the water level in a ponded part of the river. Three days later, another nest was found in which there were three newly hatched birds, and on July 24 a nest with an incomplete set of two fresh eggs was recorded.

34. **Sayornis phœbe.** Phœbe. But two individuals of this species were seen in July, the first an adult male taken on the nineteenth near an old dam on the river. On the thirtieth another bird was seen in the burned lands near Jackson Lake. In August the species became more abundant, especially in the alder and willow thickets along the river but also far out in the burned lands. On August 17, eight phœbes were seen in a grove of unburned pines in the burned lands. This was the largest number ever seen in a day.

35. **Nuttallornis borealis.** Olive-sided Flycatcher.—This species was first noted on July 29, when two males were taken at the edge of the hardwood forest. From that date, birds were seen and heard frequently until August 7, but after that date but two were seen—on the eleventh and fourteenth. The males have a very loud note, plainly recognizable for several hundred yards, and this, with their habit of choosing the most conspicuous perches, quickly attracts the attention. Whenever a bird was heard calling, a scrutiny of the surrounding trees always revealed it at the very top of the tallest tree in the vicinity. Dead trees were preferred, or at least trees with most of the top dead, and those along the margin of the hardwood forest were most frequented, altho the species was not uncommon far out in the burn, where a tree or two still stood. As a whole the species was very shy and difficult to approach.

36. **Myiochanes virens.** Wood Pewee.—Until the tenth of July this species was rarely observed, but after that date it was common along the river. In August it was more plentiful in the hardwood forest than along the water, and as a species was becoming more abundant when we left the field on the

the twenty-fourth. Young birds out of the nest but still fed by the adults were seen on July 28.

37. **Empidonax minimus.** Least Flycatcher.—This species was common during July among the thickets by the water courses and more rarely in the burned lands far from water. It reached its maximum abundance the last week in July, and after that time was rarely recorded. A very few individuals remained up to the time of our departure. Nests were often found along the river during the first part of July. The first was found on July 5, and contained three birds about to fly—in fact two did fly as the nest was approached. This nest was situated in a dead white birch at a height of fifteen feet. On the following day a pair of birds was observed building a nest near camp. On July 12, in a small grove of standing dead hardwoods in the burned lands, a family of these little flycatchers was found. The young were barely able to fly. The empty nest was found in a low dead birch, and was fully a thousand yards from water. On July 29, a family of four well fledged birds and one adult were seen near Brown Lake.

38. **Cyanocitta cristata cristata.** Blue Jay.—While this species was frequently noted in July, it became much more abundant in August. It was most commonly seen at the edge of the hardwood forest, but was not restricted to that area, as it was observed along the rivers, in poplar growths and in the swamps. Very rarely a single bird would be found in the burned lands far from cover. A family of young birds just able to fly from branch to branch was found near the hardwood forest not far from Jackson Lake on August 3.

39. **Corvus brachyrhynchos brachyrhynchos.** Crow.—This species was seen occasionally all summer, usually in small flocks of from three to seven, flying over the burned lands. In numbers it remained constant during the period of observation. Three young birds that were still fed by the accompanying adults were seen on July 27 near the beaver meadows.

40. **Molothrus ater ater.** Cowbird.—Several flocks of this species were seen while the party was enroute to camp. All were in the burned pine lands, feeding along the road where the sparse dry grass supported a few insects. During July a few individuals were seen daily in the burn, and a small flock stayed about the beaver meadows. In August the species was rarely recorded, not at all after the eighteenth. On July 12, in an ash and alder thicket along the Sturgeon River, a male redstart was observed feeding a nearly mature cowbird. The two were watched some six minutes, during which period the impostor was fed a like number of times. Neither a female redstart nor any young were seen. A red-eyed vireo nest found on July 20 contained one young vireo, two vireo eggs and a cowbird egg.

41. **Agelaius phœniceus phœniceus.** Red-winged Blackbird.—After July 8, small flocks of these birds were frequently observed in the marshes by the lakes. A large colony inhabited the large marsh at the northwest side of Brown Lake, but during the last week of July and the first in August this colony broke up. During these two weeks the species was most abundant of any time and the most widely distributed in the various habitats. After August 9 the numbers rapidly decreased, altho a few individuals were still to be seen about Brown Lake on the twenty-fourth. The birds bred in the marshes mentioned above, numbers of young birds were seen and about the first of August the young outnumbered the adults.

42. **Sturnella magna magna.** Meadowlark.—Several meadowlarks were seen at Holmes farm while the party was enroute to camp on June 29. At Brown Lake but a single bird was noted—a young male in the clearing about

camp on August 7. The species was again recorded at Holmes farm on August 24.

43. **Quiscalus quiscula æneus.** Bronzed Grackle.—This species was observed daily until August 15. In general, it frequented the banks of the river, but occasionally, particularly on wet days, it strayed into the burned lands. Previous to July 16 none but adult birds were noted, but after that date young birds began to appear and gradually outnumbered the adults. Where the birds bred could not be determined. They did not breed along the river, and all the young seen were capable of sustained flight, and yet day after day they came to the river to feed on the flats and the lower banks. Rarely adults were seen to leave the feeding grounds with food, but they followed no common direction, some went south, some north and some west. The species rapidly decreased in numbers after August 15, and was practically absent from the region by August 24.

44. **Carpodacus purpureus purpureus.** Purple Finch.—The first bird of this species observed was an adult male near camp on July 3. This bird was in splendid plumage. A second male was recorded on July 6, in a cedar swamp near the river, and on the twelfth a female was taken in a group of dead hardwoods in the burned lands. No more were seen.

45. **Astragalinus tristis tristis.** Goldfinch.—This species was recorded commonly during the summer. It was observed most ferquently in the burned lands, where it fed about the weeds that had succeeded the fire. In many places, usually not far from the hardwood forest, there were quite extensive areas of Canada thistles, and here the birds naturally congregated in the largest numbers. It was noticeable that the species was busy at its feeding grounds during the hottest part of the day, when most of the other birds were silent and retiring in habits.

46. **Poœcetes gramineus gramineus.** Vesper Sparrow.—This sparrow was seen commonly throughout the summer in the burned pine lands. Just as the species is noted along the dusty roads of the cultivated country, so it was observed in the wild places. Most commonly it frequented the old wagon road that wound thru the burn, and wherever a little patch of dry grass had obtained foothold there was sure to be a vesper sparrow or two present. It avoided the damper places, and of course the wooded areas.

The first breeding record was obtained on July 19, when a nest containing three fresh eggs was found. It was placed close to a dusty road, in the short wiry grass, and was sunk into the ground. Another nest found on July 29 was in the bare burned lands. It contained three eggs, also quite fresh. One of these eggs was about one-fourth the length and diameter of a normal egg, with the same shape and coloring.

47. **Zonotrichia albicollis.** White-throated Sparrow.—The white-throated sparrow was abundant during July and August, in actual numbers surely exceeding any other single species. It was most common in the burned pine lands and burned swamps, a smaller number of birds were found in clearings in the hardwood forest, and still fewer were observed along the rivers and in the poplar growths. The birds sang all day long, and sometimes during the night a few notes would be heard. The songs showed a wide variation in different individuals, particularly in length. Frequently a song would continue for more than half a minute, and again only two or three initial notes would be given and then repeated. We even learned to distinguish certain of the individuals by their song length, which proved to be quite constant, at least in some cases. The species was fearless on the whole, and permitted easy observation. On July 12 a young bird barely

able to fly was taken in a burned swamp, and shortly after this young birds became abundant. A nest found on July 14, in low bushes in an unburned swamp, contained four eggs in an advanced state of incubation. The parent bird was on this nest when it was found, and was so fearless that she was touched before she became alarmed enough to fly.

48. **Spizella passerina passerina.** Chipping Sparrow.—This species was rather common thruout the burned lands and the margin of the hardwood forest. During July, the birds seemed to feed almost entirely on the ground, but after the first week in August they were found almost exclusively in the trees. As a result of this change, it became increasingly numerous in the margin of the hardwood forest. It congregated, too, in the groves of unburned pines in the burn, where the birds fed so much like warblers that a few were at first mistaken for the latter. A pair of birds were seen building a nest on July 3. On the twentieth, a family of four young birds just out of the nest were noted near camp, and shortly after this date, young birds became common. The species was not decreasing in abundance at the time of our departure on August 24.

49. **Junco hyemalis hyemalis.** Slate-colored Junco.—Common thru July, this species became still more abundant in August, and in that month must have vied closely with the white-throated sparrow in numbers. It frequented the burned lands and the brush along the margin of the hardwood forest and the rivers. In general the birds fed on the ground, but as the summer advanced, they were often seen in the pines and hemlocks in company with the chipping sparrows. One young bird barely able to fly was seen with the two adults on August 4, and other young birds were seen at about this time, quite largely near the unburned swamps of spruce, cedar and tamarack.

50. **Melospiza melodia melodia.** Song Sparrow.—This species was abundant during both July and August. It frequented the margins of the beaver meadows and the thickets along the water courses. In July, the birds were occasionally noted in the spruce and tamarack swamps, but they left these places in the latter part of the month. In August they were more widely distributed, and were often seen in the burned lands and about clearings in the forest. The first young birds were seen on July 8, when an adult was discovered feeding two recently fledged young. On the following day, a pair of birds was observed building a nest in a thicket opposite camp. A nest found on July 24 along the Foster City road contained four eggs in an advanced state of incubation.

51. **Melospiza georgiana.** Swamp Sparrow.—A young swamp sparrow was taken at the beaver meadow on July 19. It was the only record secured, but on that date several others were seen in the same place. The species had entirely disappeared on the twenty-seventh and was not noted again.

52. **Pipilo erythrophthalmus erythrophthalmus.** Towhee.—This species was common during July, especially at the margin of the hardwood forest and in thickets along the water courses. In August the birds were found to be more abundant in the burned cedar swamps that had partially grown up with brush. They avoided the open burn. The first young birds were recorded on July 13. On this date a family of five was seen at the edge of the hardwoods. The young were just able to fly. Immediately after this date young birds became common.

53. **Zamelodia ludoviciana.** Rose-breasted Grosbeak.—Thruout the summer, this species was noted along the margin of the hardwood forest and in the river thickets. It became gradually rarer in August, and after the

ninth no records were made. Both males and females were noted, but no nests or young birds were found.

54. **Piranga erythromelas.** Scarlet Tanager.—There are but five records of this species, three for July and two for August. The first noted was a beautiful male in an ash and alder thicket along the river. Other males in the breeding plumage were seen on July 6 and 8.

55. **Progne subis subis.** Purple Martin.—A single purple martin was seen flying over Brown Lake on August 13. It was the only one of its species seen in the region, altho both at Foster City and Waucedah we were told that the birds nested about the buildings.

56. **Hirundo erythrogastra.** Barn Swallow.—A number of birds of this species were noted about Holmes farm on June 29. They undoubtedly nested here about the buildings. At Brown Lake the species was noted three times, July 29, 30 and 31, on each of these dates a few individuals being observed over the lake in company with tree swallows. They were possibly migrating birds.

57. **Iridoprocne bicolor.** Tree Swallow.—This swallow was abundant during July and the first three days of August. Numbers were seen daily flying over the rivers and Brown Lake. On July 5, a number of young birds were seen perched along a branch of a dead tree by the river. We approached in a boat and shot one young bird. It fell fluttering and not quite dead into the quiet backwater, and in a few seconds the air was filled with a twittering, darting flock of swallows, swirling down to the wounded bird and up again, often almost enveloping us. In a few moments the bird was motionless, and the flock dispersed, a number of them alighting on the perch from which the one had just fallen. The whole performance reminded one strikingly of the behavior of terns under similar circumstances. The birds bred commonly along the river. Numbers of nests were found in old woodpecker holes, and in hollows in trees. Sometimes a nest would not be more than five or six feet above the ground, but more often from fifteen to forty. About the fifth of July, the young birds began to appear in numbers, and by the tenth, one saw rows and rows of them on dead limbs over the river, waiting to be fed by the hurrying adults. A nest opened on July 3 contained five young birds about ready to leave it, while as late as the eighteenth adults were seen to carry food into holes in the trees.

58. **Riparia riparia.** Bank Swallow.—A small colony of bank swallows bred in an old gravel pit close to an abandoned dam on the main river. There were some six or eight pairs here. A nest was dug out July 5 which contained five eggs in a very advanced stage of incubation. During the last four days of July, birds of this species were seen about Brown Lake. The last seen was a single bird on August 3.

59. **Bombycilla cedrorum.** Cedar Waxwing.—This species was not frequently seen in July, and was then confined mainly to the trees along the river, in which the birds perched high in the air, and caught insects on the wing like true flycatchers. In August the species became more abundant, particularly as the wild cherries began to ripen, when flocks of twenty or more would be seen in a single clump of trees. This lasted about ten days, from August 6 to 16. On the latter date a flock of eight birds was seen by the rock outcrop engaged in catching large Tabanid flies. Two birds were collected, and their crops and even their mouths were found to be full of these flies. In catching these insects they exhibited almost the dexterity of a true flycatcher. A nest found on July 19 in a black spruce and tamarack swamp contained three newly hatched nestlings.

60. **Vireosylva olivacea.** Red-eyed Vireo.—This species was one of the very abundant ones. It occurred in the hardwood forest, along the river, in the thickets, in the birch and aspen growth, and rarely in the burn. The first nest was found on July 10 on a partly burned hillside that sloped to Brown Lake. When found it contained two eggs, two days later there was one more, and by the following day a cowbird had left an egg in it. This nest was constructed almost entirely of strips of birch bark. On July 27 a young bird just able to fly was found near camp.

61. **Lanivireo solitarius solitarius.** Blue-headed Vireo.—An adult female, taken on July 28, in the burn near the forest, furnished the only record for the species.

62. **Mniotilta varia.** Black and White Warbler.—This warbler was first noted on July 5, when two birds were seen at the edge of a backwater along the river. Three more birds were recorded in July in the hemlocks of the hardwood forest. In August the species became more plentiful, and small flocks, mainly of young birds, were seen frequently. They always exhibited a preference for the hemlocks, but were not rarely noted in the river thickets. By August 11 the species had practically disappeared.

63. **Vermivora rubricapilla rubricapilla.** Nashville Warbler.—The Nashville warbler was noted first on July 14, when a male was observed in full song at the edge of a spruce and tamarack swamp. He was perched in the very top of a dead tamarack, and from his actions had a nest in the immediate vicinity. On July 19 another male was seen in a poplar growth near the river. In August the species was occasionally seen along the edge of the hardwood forest, but on the whole it was much more typical of the ash and alder thickets along the river. Small flocks composed exclusively of this species were seen on August 7 and 11.

64. **Compsothlypis americana usneæ.** Northern Parula Warbler.—A single bird of this species was collected on August 11 from a flock of several species of warblers in a thicket along the river. It was the only one seen.

65. **Dendroica cærulescens cærulescens.** Black-throated Blue Warbler.—A male black-throated blue warbler was taken in the hemlock forest on July 12. On the seventeenth a female was seen in the same place. Small flocks were recorded on August 11 in the thickets along the river, and on the fourteenth the last bird of the species was seen in a similar habitat.

66. **Dendroica coronata.** Myrtle Warbler.—An adult male myrtle warbler was taken on July 19 in a spruce and tamarack swamp. No others were seen.

67. **Dendroica magnolia.** Magnolia Warbler.—The first of this species recorded was an adult male in the hemlock forest on July 31. On August 5 two birds were seen in the brush along the Foster City trail, and on the fourteenth, another male was noted. Small flocks of from ten to twenty of these birds were seen on August 17.

68. **Dendroica pensylvanica.** Chestnut-sided Warbler.—This warbler was frequently heard singing in July, and was commonly seen in August. Thickets near running water were its favorite haunts, and as the Foster City trail afforded many such, the species was noted there very commonly. It was rare in the forest and in the unburned swamps.

69. **Dendroica fusca.** Blackburnian Warbler.—This species was first recorded on July 17, when a small flock of eight males in the most brilliant breeding plumage were observed feeding in the hemlocks. On July 28 another small flock of duller colored birds was seen on the Foster City trail, and others or the same flock were observed here on several subsequent

days. From August 18 to 22 many small flocks were observed, mainly in the hemlocks. On July 17, a nest of this species was found by watching a female carry food to the young. The nest was situated about thirty feet from the ground in a small hemlock in the hemlock and birch forest, and contained three very young birds.

70. **Dendroica virens.** Black-throated Green Warbler.—In July this bird was noted but once—on the twenty-third when an adult female was taken in the hardwood forest. On August 3 and 4, several small flocks were observed feeding in the hardwood forest. On the eleventh, small flocks became frequent in the river thickets, and from that date the species was noted in numbers daily.

71. **Seiurus aurocapillus.** Oven-bird.—An adult male taken July 8 was the first record for the species. From that date the birds were frequently seen and heard singing in the lower, damper areas of the hardwood forest until the first week in August, when most of them disappeared.

72. **Seiurus noveboracensis notabilis.** Grinnell's Water-thrush.—This species was frequently observed during the first two weeks of July. After the sixteenth, it rapidly decreased in numbers, and was recorded but once in August—a young male being taken on the twelfth of that month. All along the rivers where the dense tangled thickets came to the water's edge, or where there were tangled piles of driftwood, this species was sure to be seen slipping about in its shy, secretive manner. Rarely males were heard in full song. On several occasions birds were seen to carry food as if feeding young birds, but no nests were found.

73. **Oporornis philadelphia.** Mourning Warbler.—This species was first recorded on July 14 in a willow thicket on a little tributary of the river. The male was in full song when first seen, and from his actions had a nest nearby. Three days later a pair were observed in a dense thicket on a hillside on the Foster City road. Another male was noted near this place. The species was seen several times in August, and the last bird was observed just before we left camp, on the twenty-fourth.

74. **Geothlypis trichas trichas.** Maryland Yellow-throat.—This species was not common in the region, and was mostly confined to the river thickets and the willows in the beaver meadow. By the end of July it had practically disappeared, altho on August 5 twenty or more birds were noted along the Foster City trail—as many individuals as were seen all the rest of the time in the field—but these had all gone on the next day. On July 12 a family of four young birds just able to feebly flutter about was found in a thicket near Jackson Lake.

75. **Wilsonia canadensis.** Canada Warbler.—At least a few of these warblers bred about Brown Lake. On July 4 a male and a female were seen in a cedar swamp near the river. The latter was several times seen bearing food in her bill as if bound for a nest. This pair was seen several times subsequently. On July 21 another male was seen, and in August a few birds were observed almost daily along the watercourses until the twelfth.

76. **Setophaga ruticilla.** Redstart.—This species was quite frequently recorded during July, and became common about August 4. It was typically an inhabitant of the river thickets, but was occasionally noted in the edge of the forest. During the first two weeks of August, numerous flocks were observed often in the the same localities in which the birds had nested and fed during the summer. On August 24, the date of the conclusion of field work, the species was still common. The species undoubtedly bred in the region. (See cowbird).

77. **Dumetella carolinensis.** Catbird.—This species was seen frequently during July, but had disappeared entirely by August 10. It reached its maximum abundance during the last week in July.

78. **Toxostoma rufum.** Brown Thrasher.—A few pairs of thrashers bred in the burned lands, but the species was rare. On July 8 to 30 two pair were often seen about camp, but were not recorded after the latter date. They were extremely shy. A nest with four eggs was found in the burned land, July 11. It was situated on the ground under a partly dead bush. On July 29 it contained three young birds, which had fallen prey to some enemy by August 2. The adults also had disappeared by that time.

79. **Troglodytes aedon aedon.** House Wren.—This species was common during the summer, becoming more abundant in the latter part. It was often found in the burned cedar swamps, where, with the white-throated sparrow, it often furnished the only visible bird life. All thru the burned lands it was heard and seen daily, and even came into the willow thickets along the river. A pair of wrens started to build a nest on July 3 in a stub near camp. When it was completed, the birds abandoned it and built another in the decayed end of a pine log in the side of the house, and here raised their brood. The first young birds to be recorded were a family of five in a burned cedar swamp on July 13.

80. **Nannus hiemalis hiemalis.** Winter Wren.—This wren was heard almost daily in July and the first week in August, but after the sixth of August it rapidly decreased in numbers and was not recorded after the twelfth. It frequented the densest of the river thickets, the depths of the unburned swamps, and the lower, wet swales in the hardwood forest. It was most typical of the first two habitats. Were it not for the loud, unmistakable song of the males, the species could easily be overlooked, as it is extremely shy.

81. **Certhia familiaris americana.** Brown Creeper.—This species was seen but rarely. The first record was made on July 10 when a single bird was found among the hemlocks. A juvenile bird taken August 9 at the edge of the forest was the last record.

82. **Sitta carolinensis carolinensis.** White-breasted Nuthatch.—This species was seen occasionally during the summer, usually in the hardwood forest, more rarely in the burned lands where a few trees had remained standing.

83. **Penthestes atricapillus atricapillus.** Chickadee.—The chickadees were rarely seen far from the unburned cedar, spruce and tamarack swamps in July In these places, however, they were commonly seen and their notes were frequently heard when the birds themselves were invisible. As August advanced, they were found more frequently in the hardwood forest and among the hemlocks. They fed there in company with the warblers that had left the river thickets, and very frequently flocks were located by the chickadee's note. Rarely the species was observed in the burned lands, and rather more frequently in the river thickets. On July 19 a family of five young just able to fly, in company with the two adults, was seen in an unburned spruce swamp near the beaver meadow. After this date, several other broods were observed.

84. **Regulus satrapa satrapa.** Golden-crowned Kinglet.—Two individuals of this species were seen on July 23 in the hemlocks. They were with a small flock of chickadees and warblers. The one collected was a juvenile male.

85. **Hylocichla fuscescens fuscescens.** Veery —This species was fre-

quently noted in the burned lands, but had practically disappeared by August 16. It was seen most frequently in the wild cherry trees as the fruit ripened, where it fed in company with the cedar waxwings. It was often noted in the dense poplar growths.

86. **Hylocichla guttata pallasi.** Hermit Thrush.—This thrush was often seen about the burned lands and the margin of the hardwood forest. It was very shy, but the clear sweet song of the male even in the hotter parts of the day proclaimed its presence. It was rarely noted after the tenth of August.

87. **Planesticus migratorius migratorius.** Robin.—The robin was common thruout the burned lands during the summer. Its numbers decreased noticeably after August 13, but many individuals were still present when we left the region, August 24. Two nests found on July 2 and 23 each contained three young birds nearly ready to fly.

88. **Sialia sialis sialis.** Bluebird.—This species was frequently seen in both July and August. It avoided the unburned areas, and bred commonly in the burn where trees had been left. There were always plenty of abanoned woodpecker holes and other hollows for nesting sites in these places. In August the birds were often found feeding high up in the groves of unburned pines in company with the chipping sparrows. Young birds just able to fly were recorded on July 6, and from that date till the sixteenth young birds in various stages were frequently seen.

RESULTS OF THE SHIRAS EXPEDITIONS TO WHITEFISH POINT, MICHIGAN.—MAMMALS.

BY NORMAN A. WOOD.

As elsewhere stated,[1] the Museum of Zoology, University of Michigan, and the Michigan Geological and Biological Survey cooperated in an investigation of the biota of Whitefish Point, Chippewa County, Michigan, in 1912, 1913, and 1914. In 1912 and 1913 the work was carried on by the Museum with the assistance of Hon. George Shiras, 3d, and in 1914 it was supported by the Survey. During the first and last years the field work included a study of the mammals, and was entrusted to the writer, who spent five weeks in the field in 1912 (July 6 to August 11) and fourteen weeks in 1914 (May 11 to August 19). In 1912 the writer was alone in the field and most of the time was given to the study of the birds, but in 1914 Mr. Frank Novy, of the University of Michigan, assisted in the collecting of mammals, and assistance was also had in the bird work, so that the mammals received considerable attention.

A description of the region has been given in the report on the birds, and as the data obtained on the habitats of the mammals is inadequate for generalizations a very brief description will be sufficient for this report. The point is considered to extend from a line drawn from the Luce-Chippewa County line at Lake Superior to the Shelldrake River and down this river to its mouth. The topography consists of sand ridges with intervening swales containing ponds or marshes, and there are numerous small streams. The vegetation consists, toward the end of the point, of a jack pine forest on the ridges and grassy or timbered swamps in the swales, toward the base of the point, of dense deciduous woods and balsam-spruce forests, and on the moraine on the Luce-Chippewa County line, of dense deciduous woods.

The localities on the point mentioned in the list of species are as follows:

Vermilion, a small town on the north shore and near the base of the point.

Whitefish Point postoffice, a settlement of a few houses on the north shore of the point and about three miles from the end. Camp was established at this place.

Light House, the Whitefish Point Light House is situated at the end of the point.

Beech-maple forest, a dense deciduous forest on the moraine on the Luce-Chippewa County Line: only explored near the end.

Little Lake, a long shallow lake near the Whitefish Point postoffice.

East Vermilion Lake, a series of long narrow ponds near Vermilion.

The principal results of the work on the mammals of Whitefish Point are the addition of one species to the state fauna, a fairly complete list of the mammals of the region, new localities for several species of doubtful range in Michigan, and a series of skins and skeletons of the mammals of the region, which include a number of vanishing forms. The specimens are in the Museum of Zoology. It should be stated here that Mr. John Clarke, who has resided on the point for thirty years, has collected and preserved

[1]See the report on the birds of the expedition in this volume.

mammals as well as birds, so that proof of the former existence of several now extinct or nearly extinct species is available. The Clarke collection is in the high school and in the store of A. H. Eddy at Sault Ste. Marie, and has been examined by the writer.

ACKNOWLEDGMENTS.

In addition to the general assistance received while in the field, and acknowledged in the report upon the birds, the writer wishes to acknowledge the aid of John Clarke, Fred Weatherhog, Palmer Barrows, Benjamin Butler, James Youmans, William Clarke, William McGraw, Captain Carpenter and all the members of the crew at the Life Saving Station.

LIST OF SPECIES.

1. **Rangifer caribou.** (Gmelin). Woodland Caribou.—In 1914, the writer obtained at Vermilion the basal half of a caribou antler from Captain Carpenter of the Life Saving Station. This antler was picked up on the hills just south of Vermilion. The basal half of a pair of caribou antlers was also found at the lumber camp of James Youmans, four miles southeast of Vermilion. He stated that they were picked up in the woods near the camp in 1912. Later the man who found them told the writer that some of the bones of the carcass were scattered about the spot when discovered, but that they had subsequently been destroyed by forest fires. These antlers are well preserved and evidently not many years old, and hence substantiate the statement of many of the old residents that the caribou formerly came into this region in winter.

2. **Alces americanus** (Jardine). Eastern Moose.—This species is still to be found in the eastern half of the upper peninsula. Fred Weatherhog, who carries the mail daily between Whitefish Point postoffice and Vermilion, saw a large bull moose, in October, 1911, near the road about midway between those places. On July 15, 1912, he met another with smaller antlers (in the velvet) about two miles west of the postoffice. The writer went to the place with him the next morning and saw the tracks, and followed them a long distance into a large marsh. A few days afterward another resident discovered the tracks of a moose crossing a hay meadow at the lower end of Little Lake, where the writer also saw the tracks again. Hawkins informed the writer that in 1908 three moose came across the bay and crossed his yard at Whitefish Point, tearing down rods of wire fence; they went southwest, crossing Little Lake. Although outside of the region explored it is of interest to note that there are in the Museum mounted heads of a bull shot near Brimley, Chippewa County, in the fall of 1912, and a cow taken in Schoolcraft county in November, 1912.

3. **Odocoileus americanus borealis** (Miller). Northern White-tailed Deer.—This species is still very common in the Whitefish Point region, and both in 1912 and 1914, the writer saw numbers of them and in many different habitats. Mr. Hawkins stated that formerly all the deer migrated south to southwest, and that they still leave the open marshes and sand ridges and winter in the hard wood forests a few miles southwest of the point.

4. **Sciurus carolinensis leucotis** (Gapper). Northern Gray Squirrel.—This species was formerly abundant on the point, according to all of the old hunters, but it is now rare. The residents claim that the decrease is due to the great numbers of red squirrels which drive them away. According

to the hunters the black phase was also common, but it too has almost entirely disappeared. None were seen by the writer.

5. **Sciurus hudsonicus loquax** (Bangs). Southeastern Red Squirrel.—This is the most conspicuous and perhaps the most abundant mammal on the point. Scores were seen every day and they were very tame, often coming within a few feet of one. On the point their enemies are few, except that during the spring and fall migrations the hawks probably prey upon them. Their greatest enemies were the fisher and marten, but these are now rare on the point. This squirrel lives principally on the seeds of the white and jack pine, and often makes its home under the roots of trees and stumps, burrowing under the snow in winter.

6. **Eutamias quadrivittatus neglectus** (Allen). Neglected Chipmunk.—This chipmunk is common on the point where it seems to prefer the open woodland. In old burnings and clearings, its burrows are found under old logs and stumps. It finds plenty of food in this habitat in the seeds of grasses and berries, and one shot had its pouches full of the cleaned seeds of the blueberry.

7. **Tamias striatus lysteri.** (Rich.). Northeastern Chipmunk.—Unlike the Lake Superior chipmunk, the striped chipmunk is rare on the point proper. A family of five was seen near the postoffice on July 6, eating the seeds of a maple. These were seen but a few times here as the red squirrels drove them away. This species was only noted again on July 24, when one was taken on the first sand dune on the east side of the point. One was heard late one afternoon near the road past Beaver Lake five miles west of camp. The species is no doubt more common than these records indicate, as it is very shy and thus very difficult to find in dense forests. The one taken had its cheek pouches full of the seeds of some berry. At Vermilion in 1914, this species was more abundant—especially in open woodland and old burnings, but the preceding species was more common in all this region.

8. **Marmota monax canadensis** (Erxleben). Canada Woodchuck.—The woodchuck is very rare on the point. Only one specimen was found, and no burrows were seen. The old hunters stated that it is decidedly rare.

9. **Sciuropterus macrotis** (Shaw). Northern Flying Squirrel.—No flying squirrels were seen in the field by the writer, but three specimens were collected for the Museum by Mr. John Clarke during the winters of 1912-13 and 1913-14. These are typical sabrinus. The resident hunters stated that they were not rare in the hemlock-beech forest at the base of the point, and were sometimes taken in traps set for mink and marten.

10. **Castor canadensis michiganensis** (Bailey). Woods Beaver.—In 1912 the beaver was fairly common on the point where the conditions are favorable for the building of their dams and houses, and were seen by the writer. The largest occupied house was found about a mile south of Little Lake, in a small lake or pond that had no running outlet. This house contained several wagon-loads of peeled sticks, and the size was probably due to the fact that there being no dam to maintain, the sticks were added to the house. At East Vermilion Lake, which was long and narrow, there were several houses, and here the beaver had a small dam across the outlet—a swift narrow stream that emptied into Lake Superior. The largest colony was found at the cranberry farm of John Clarke, of Vermilion, where they were protected. Here are numbers of long narrow ponds made partly by the beavers and partly by Mr. Clarke to regulate the water in the cranberry marsh. The beavers had several houses in these ponds in 1912 and constructed dams to regulate the water about them. These dams often held back water so that

Mr. Clarke had to cut them out in order to get what water he needed and the beavers kept repairing them until the cranberries were harvested in the late fall; the dams were then undisturbed. One dam examined was several rods long and constructed across a brook that emptied into one of the ponds. Clarke estimated the number of beavers on his four hundred acres at one hundred. He stated that in the spring he frequently observed them in the drainage ditches, but that during the remainder of the year they remained in the ponds. Since January, 1913, the beaver have been nearly exterminated in the ponds about Vermilion, and in 1914 the writer found only skulls and decaying carcasses. A skin and skeleton of an adult female weighing 41 pounds was secured in 1912, and several skulls in 1914. An adult female, taken near Vermilion in 1913-14, was said to have weighed 68 pounds. and, according to residents, another, taken a few miles west of Vermilion in the winter of 1914, weighed 71 pounds.

11. **Mus musculus** (Linn.). House Mouse.—This species s common about the buildings of the settlers.

12. **Peromyscus maniculatus gracilis** (LeConte). Michigan Mouse.—The Michigan mouse was found in abundance on the wooded sand dunes and on the sand of the beaches to near the water's edge. It was also taken about the cranberry house of John Clarke at Vermilion, and in winter is said to often become quite troublesome about the buildings. It also occurs in the beech-maple forest. In the wooded areas it lives in old logs and stumps and no doubt also in hollows of standing trees.

13. **Evotomys gapperi** (Vigors). Red-backed Mouse.—This species occurs in the heavy forest near Vermilion, where several were trapped in July and August, 1914.

14. **Microtus pennsylvanicus** (Ord.). Meadow Vole.—This species is common in suitable habitats—the meadows or cranberry marshes and about ponds and lakes—where they do some damage by cutting open the cranberries (no doubt for the seeds.) Mr. House stated that when these marshes are flooded in order to gather the berries, he usually sees numbers of this species about the sod dykes, also running about the marsh and sometimes swimming. In 1912 the writer saw one on the bank of the Shelldrake River south of Vermilion, and trapped twelve at the edge of Little Lake in an area less than two rods square, and in 1914 took several about East Vermilion Lake.

15. **Ondatra zibethica** (Linnaeus). Northern Muskrat.—This species is not rare in the region studied although not as common as in southern Michigan. A few lived in the dykes about the cranberry marsh at Little Lake, and it was quite common about the beaver ponds at Vermilion. These animals are also seen occasionally on the beach near the outlets of streams and ditches. They are not protected from the trappers, as they do some damage to the dams and embankments which control the water on the cranberry marshes. It is much trapped and particularly recently on account of the high price of its fur.

16. **Zapus hudsonius** (Zimm.). Northern Jumping Mouse.—This was the only jumping mouse found. A male and four females were trapped at Little Lake in 1912, and three specimens were taken at Vermilion in 1914. Of the latter, two were found dead and the third, an immature male, was caught on the beach west of Vermilion, in a dense growth of beach grass and wild pea vines.

17. **Erethizon dorsatum** (Linn.). Canadian Porcupine.—This species is rather common and was found in all of the terrestrial habitats. It was oc-

casionally found on the lake beach, and we were shown a three inch plank at the Life Saving Station that was nearly destroyed by them in search of the salty flavor. This plank was in a pile of drift wood on the beach, and one of the crew hearing a noise under it turned it over and found a porcupine lying on its back and gnawing the hard oak wood; for several feet there was only a thin shell left of this plank. This animal is hated by campers and trappers alike, as it enters their camps and destroys many articles, especially those of leather and wood. On June 20, 1914, the writer found five in an old lumber camp in the beech-maple forest west of Vermilion.

18. **Lepus americanus** (Erxleben). American Varying Hare.—This species is common, particularly in the spruce-balsam forests and thickets. The writer saw tracks on the sand dunes and occasionally on the lake beaches, and found their runways in thickets and swamps. Very few were seen and but two, both females, secured. On May 20, 1914, two young, but a few days old, were taken.

19. **Lynx canadensis** (Kerr). Canada Lynx.—This lynx was not seen, but the writer examined a mounted specimen taken near the Whitefish Point postoffice years ago. The hunters and trappers say that it is still occasionally found, although much hunted on account of the high price of its fur.

20. **Lynx ruffus** (Guelden.). Bay Lynx.—Unlike the Canada lynx this species does not seem to be decreasing rapidly. The writer saw footprints in the sand on several dunes, and during the summer one of the life-saving crew at Vermilion saw one, early in the evening, near the beach a mile east of the station. The writer also saw one mounted that was taken near the camp a few years ago.

21. **Canis occidentalis** (Rich.). Timber Wolf.—In 1912 this species was rather common. The tracks were seen less than half a mile from camp, on the sandy plains south of Vermilion, and on the beach just west of that town the writer saw where a very large one had chased a deer out of the woods a short time before. In 1875 a pack of thirteen wolves was seen on the point by Hawkins, and his son shot two in 1910 and one in the winter of 1911. Clarke stated that he once counted the remains of six deer that had been destroyed in one place by wolves. In the winter of 1912-13 it was hunted persistently and since that time has not been seen on the point.

22. **Vulpes fulvus** (Desm.). Red Fox.—The red fox is apparently not very common as few tracks and but one specimen were seen. In May, 1914, one was seen near Vermilion and there is a mounted one in the Clarke collection that was taken near the postoffice a few years ago. The hunters stated that it is not rare and some are taken each year. Very rarely a cross fox is seen, and one black fox is said to have been shot here.

23. **Ursus americanus** (Pallas). Black Bear.—The black bear is still common in the Whitefish Point region. The expedition secured two skins, two skeletons and four skulls, and observed signs of its presence on a number of occasions. There is a small mounted specimen in the Clarke collection, which was taken near the postoffice, and records were secured of a specimen taken west of Vermilion in 1911, and of twenty-seven trapped in the Whitefish Point region in the winter of 1913-1914.

24. **Procyon lotor** (Linn.). Raccoon.—This species is rare on the point, but a few are to be found in the vicinity of the hardwoods about the streams and ponds. Weatherhog caught one, in 1909, near the Whitefish Point postoffice. This skin was given to the Museum. On August 3, 1912, the writer caught an adult female in a trap set for beaver at the outlet of a small beaver pond. This specimen was in good condition and measured, length 900 mm.,

tail 265 mm., foot 115 mm. This is not a very favorable region for the raccoon as there are few frogs, clams and crayfish. They no doubt eat acorns and perhaps berries, but the winters are so long and severe as probably to be unfavorable.

25. **Taxidea taxus** (Schreber). American Badger.—The badger is apparently rare on the point as no tracks or burrows were noted and the hunters stated that it is only occasionally seen. On March 22, 1914, a large badger was found dead in the Shelldrake River just south of Vermilion by a resident. One was also killed about ten miles west of Vermilion on July 13, 1912, by Truman Trowbridge, but this was outside of the territory covered by this work.

26. **Mephitis hudsonica** (Rich.). Northern Plains Skunk.—This species is still common, notwithstanding the fact that for the past few years it has been extensively trapped on account of the high price of its fur. One was shot near the postoffice just before the writer's arrival in 1912. One was seen by the writer near the same place, and a half-grown one was also seen near Vermilion, one evening in August. In the early winter the trappers capture and keep these animals in pens, feeding them until the fur is prime.

27. **Martes americana** (Turton). Eastern Marten.—No signs of the marten were seen by the writer, and it is only placed in this list because the old hunters and trappers stated that it was formerly common and still persists in the beech-maple forests south and west of Vermilion, where some are trapped each year.

28. **Martes pennanti** (Erx.) Fisher.—Like the marten, the fisher is also said to have been common formerly. It is certainly rare on the point at the present time. No signs were seen, but a skelton of a specimen trapped by William McGraw, on the Shelldrake River south of Vermilion, in March, 1913, was secured from John Clarke.

29. **Mustela vison** (Schreber). Northeastern Mink.—According to the residents this species was also formerly common on the point. It is now rare but is occasionally seen and taken, especially on the ponds and trout streams near Vermilion. In the winter of 1913-14, two were taken at Vermilion Lake, the skulls of which are in the Museum.

30. **Mustela cicognanii** (Bonap.). Small Brown Weasel.—This weasel seems to be more plentiful than the following species. Several are in the Clarke collection. It is easily identified by the relatively shorter tail, but the trappers consider their specimens to be the young of the northern weasel. The only other Michigan records for the species are those of the Porcupine Mountains and Isle Royale expeditions. The writer secured from trappers two skins taken in 1912, and the skull of a specimen secured in the winter of 1913–1914, and saw a skin taken at the light house in 1914.

31. **Mustela noveboracensis** Emmons. Northern Weasel.—No live specimens of the northern weasel were seen by the writer, although the hunters stated that it is not rare and is often caught in the traps set in the fall and winter. There are several mounted ones in the Clarke collection, and the writer examined the skin of a specimen caught at the light house, in April, 1914.

32. **Lutra canadensis** (Schreber). Canada Otter.—There are a few otters still in the region, according to the hunters and trappers. No specimens were seen on the point, but the tracks were observed by the writer on the bank of the Shelldrake River about two miles south of Vermilion.

33. **Sorex personatus** Geoffroy. Masked Shrew.—This appears to be the

most common shrew in the region. Several were trapped at various places and the remains of three that had been eaten by hawks and owls were found. Shrew tracks, probably all made by this species, were frequently observed on the sand beaches. A nest found beneath a board in a marsh, on June 29, 1914, was made of fine grass and contained an adult but no young.

34. **Sorex richardsonii** Bachman. Richardson's Shrew.—A single specimen of this shrew was secured, an adult male that was brought to camp at Vermilion by a domestic cat. This is the second Michigan specimen to be recorded.

35. **Neosorex palustris** (Richardson). Marsh Shrew.—A freshly killed adult female of the marsh shrew was found in the mud in a dried-up pond near Vermilion, on August 14, 1914. The species was not previously known from Michigan.

37. **Myotis lucifugus** (Le Conte). Little Brown Bat.—This bat is not rare on the point. Specimens were taken at the postoffice and at Vermilion, and it was frequently observed at various places.

38. **Lasionycteris noctivagens** (Le Conte). Silvery Bat.—This species was not seen in 1912, and was not observed in 1914 until the night of August 10, when large numbers were seen flying over the beach of Lake Superior. Four of these were secured, all males. After this date a few others were seen. This appears to be the first record of the occurrence of the species in the northern peninsula of Michigan.

39. **Nycteris borealis** (Müller). Red Bat.—The red bat was first observed on August 8, when three were shot at Vermilion. Specimens were subsequently taken on August 9, 10 and 16. It was apparently the most common bat at the time the above mentioned specimens were taken.

ORIGIN OF CONTINENTAL FORMS, V.

HOWARD B. BAKER.

One of the most important objections to the theory of the post-Cretaceous separation of mass from the earth as I have developed it in preceding papers before this section, is based upon the relative values of the coastal margins of the continents and the submerged continental borders.

Fisher, 1882, referred only to the very broadest geographical features and did not concern himself with the submarine border. Pickering, 1907, also used very general features, but he supposed that comparisons must deal with the submerged continental margins. In contrast with their methods, I have not only compared continental margins in considerable detail, but my whole development of the theory is built up primarily upon the form of coastal margins as actually represented upon the globe.

Against this method the criticism arises that the position of the strand is not a permanent feature, that it is ever varying. Very slight crustal movements must suffice greatly to change the outlines of land and sea. Both erosion and sedimentation are constantly at work; it would seem to many that nothing is more unstable or less reliable, for such a purpose, than the fleeting picture which the map presents of the present-day relations of land and sea. As contrasted with the strand line, the submarine margin of the continental plateau is held to be the real margin. The ocean basins, so called, are said to be slightly over-full. The hundred fathom contour is regarded as about the brink of the real oceanic depressions of the globe.

It is objected that any comparisons of opposite coasts, which may or may not match each other's curves, must be made on the basis of this real continental margin and that coastal evidence must be thrown out as inadmissible. What is there to be said in reply?

The first point to be made in reply is that this objection gives preference to the *a priori* method over the analytical. To investigate coastal curves as actually charted is to study at first hand facts which are as much beyond denial as those connected with the submerged margin. If opposite coasts match together that geological fact demands explanation and is not to be brushed aside merely because in the light of previous conclusions the reason for the fact is not at once apparent. And, I may add, it is no more proper to attribute coastal parallelisms to chance than to assign to slaty cleavage or rock stratification the same fickle origin. And yet, are there not even today and even in the ranks of geologists a few who attempt in some such way to remove from discussion the, to them, unwelcome fact that coasts are fractured margins and the fractures fit together?

We might suppose that the hundred fathom contour or some other would be more reliable for times as remote as the end of the Mesozoic than the zero contour which is the strand, but can that be proved? Quite the contrary.

The second point is that the proper use of the coast lines necessarily makes provision for the submerged areas.

The coasts are not straight, they are made up of curves, and when we place them parallel with each other the major curves are concentric. It is very noticeable that the coastal curves are not parallel, i. e., concentric,

when crowded to contact. There is for each pair of coasts one distance, and of course only one, by which they are separated when their curves are concentric. This distance is easily determined by experiment. Between North America and Africa it averages 200 to 300 miles, between Africa and South America it is about 300 miles. There are a few places, as between the Brazilian coast and that of upper Guinea where the distance is so small as to be almost negligible.

One reason why the submerged border is not to be relied upon is that it is rapidly changing.

Whereas denudation proceeds on all exposed surfaces, marine deposition is confined for the most part to a narrow strip about the borders, and in this relatively small sedimentary area the rate of building up must be many times the rate at which the general continental surface is being lowered. Not only this, but owing to the irregular distribution of rivers and currents sedimentation is of necessity most irregular. These factors are at work constantly modifying the depth contours near the land and working always in the direction of heterogeneity so that after the lapse of any considerable geological time it is not to be supposed that the hundred fathom depth will retain its former contours.

The indications of severe denudation in northern America and Europe during Tertiary time, culminating in the exceptional conditions of the glacial epoch, point to the oceans of similar latitudes as areas of even greater sedimentary blanketing, and the inference appears to be well borne out by the bathymetrical chart. There is a greater area within the hundred fathom curve to the east and south of Newfoundland than is occupied by that island itself. From Cape Hatteras northeast the hundred fathom line runs, excepting inlets, at an increasing distance from the shore. Upon the opposite side of the ocean, beginning near the deep in the southern part of the Bay of Biscay, the line keeps well out to the west around Ireland and the islands of the Scottish coast, bending east and south and reaching the coast of southern Norway after including nearly the whole of the North Sea.

The 2000 fathom area in the North Atlantic is noticeably restricted, being encroached upon from the west and the north and broken in the middle by the Dolphin Ridge. North of the fiftieth parallel there is little 2000 fathom water and what there is diminishes to the northwestward and northeastward with converging boundaries, these prolongations hinting of the division of the ocean to the west of Greenland and east of Iceland.

The 1000 fathom outline is likewise considerably restricted. One finger pointing up in Davis Strait, a second to the west of Iceland, and a third and fourth between Iceland and Ireland.

For all these depths the Atlantic is thus seen to shoal out as we proceed toward the north and toward the land. All these contours are inseparably connected with the present major distributions of land and sea, and yet they show individuality, each from the others. It is as if all had been profoundly altered, but by no means equally, in short as if the North Atlantic were in course of irregular filling up, which it is, of course, the process accelerating with latitude, and the natural inference is that we are viewing the effects which the rigors of northern climate have had in the tearing down of land and the transporting of materials. That the evidences of heavy sedimentation are here observed at such great distances from land is very likely attributable to transport by floating ice. How much of the alteration of the bottom must be set down to crustal movement is a question unanswered; even the Dolphin Ridge, too far separated as it is from land by deep areas

to have been built up by outwashed sediments, may in part represent crustal materials left when the Atlantic rent opened, instead of being wholly the result of upheaval of the ocean floor.

Clearly, in these contours of the northern ocean bottom we are confronted with changes of profound significance and to single out any particular depth curve and apply it as a test of interpretations reaching back to the dawn of Tertiary time would be improper.

The Gulf of Mexico receives the silt from an area approximately four times its own and its filling up must be correspondingly rapid. When the Great Lakes emptied by way of the Mississippi river the drainage area was considerably greater, probably five times that of the Gulf, and yet, the evidences of filling are nowhere near what they are about the borders of the North Atlantic. There is still a small 2000 fathom area left in the western part and the 1000 fathom outline includes perhaps a half of the whole.

There is just one feature in connection with these depths in the Gulf that I wish to mention particularly and that is the relation of Florida to the coast of Yucatan and Honduras. It will be recalled that in the replacement of middle America I place the peninsula of Yucatan to the west of that of Florida with a gap between about as wide as the latter peninsula. Reference to the bathymetrical charts discloses the 100 fathom curve about that distance from the west coast of Florida, but on the east coast of Yucatan it is close inshore and the bottom drops rapidly clear down to 2300 fathoms (2.6 miles). Here is a case where it would seem that the west Florida shoal corresponds to the missing area, and the deep off the Yucatan coast would harmonize with the scheme of matching together. But after all this is a mere approximation; the depths involved are not great enough and moreover we no sooner begin such comparisons than we find insuperable obstacles to their continuance elsewhere. Just as in the matching together of Africa and the Americas we find too little land at the borders and have to leave spaces between, so here in the attempted use of the submarine contours, 100 fathoms or greater, we find too much and have to lap them by, sometimes more, sometimes less. But this difference is vital—in the one case we have coast lines to guide us, in the other there are no guides whatever.

Of all South America the greater part of the disintegrated material is dumped upon the eastern coast to the north of the Amazon and the south of La Plata. Along this coast the submarine border must be changing both rapidly and irregularly and where a given depth still maintains a fairly regular distance from the shore, as is doubtless true over great stretches in spite of undoubted disturbing agencies, that fact may require special explanation.

Touching next upon vertical crustal movements, it is to be observed that for purposes of movement the submarine margin is inseparable from the rest of the continental structure. Any vertical movements which may effect the strand may also affect the hundred fathom depth although, as Shaler[1] pointed out, the changes may possibly be in opposite directions under the sea and upon the land. Under the theory advanced by Chamberlin and Salisbury[2], Shaler's concept of sinking sea bottom is extended to imply pressure towards the continents, shearing and deformation with creeping of the soft sediments of the continental shelf. The evidence which is being

[1]Shaler, N. S., "On the Nature of the Movements Involved in the Changes of Level of Shore Lines." Proc. Boston Soc. Nat. Hist. vol. xii, 1868-69, pp. 128-136.
[2]Chamberlain and Salisbury, "Geology" 1906 vol. iii, pp. 526-530.

presented in the present series of papers was not available when this theory was promulgated and will perhaps in time lead to profitable reconsideration. In any case it is apparent that if the permanence of the coast lines be questionable on the score of vertical movement the submarine border contours are no less so.

Marine encroachment by the action of waves and tides in tearing down the land structure is doubtless a real force tending toward change of outline and while its action is localized to the actual strand and marginal shallows the resulting deposition is spread over a considerable area so that this factor presumably changes the coastal outline faster than it does the hundred fathom curve. The importance of this change for the present inquiry is quite problematical, but it would seem, both *a priori* and in view of the coastal parallelisms observed, that whatever its mean rate and whatever its local variations this kind of marine encroachment has acted over long stretches of coast with such a fair degree of uniformity that the major relations have remained from the time of fracture to the present day.

It seems reasonable to suppose that the edges of the continental shelf, submerged to the depth of a hundred fathoms or thereabouts, formerly represented the edges of the elevated plateaus left by the disruption of the crust at the end of the Cretaceous period.

If the Tertiary or even only the Pliocene, opened with the oceans very low the processes of erosion must have been extremely active upon the heights and most active of all at the edges. The edges of all the lands being precipitous would naturally crumble and break down rapidly. Sea cliffs two or three miles high could not long endure, the continental borders would speedily be rounded down. And the material removed would pile up at the bottom. Thus a more or less gentle slope would be established from the general ocean bottom up to the ever-receding brink of the continental plateau. The general land surface meanwhile, would be lowered, as it is always subject to the erosive forces, but less rapidly than at the borders because of lower gradient.

I infer from evidence previously presented that at least one cause of the Pleistocene Glacial Epoch was high altitude of land above sea level and that such relative elevation was world wide in its occurrence. Also that its duration exceeded that of the glaciation which it helped to bring about. Chamberlin and Salisbury[1] speak of the Pliocene with the Pleistocene as together constituting, except for the presence and effects of the ice, "a single period of great land relief and oceanic restriction."

This condition of high relief extended over the period when the great rivers were cutting down deep gorges in their progress toward the reduction of the general land level to that of the then low sea. During this time the marginal slopes, at first theoretically vertical, were being lowered to gentle grades simultaneously about all lands and if at any time we could have traced their crests upon a map we should doubtless have found them maintaining fairly well their parallelism with the original fractured margins of which they were but modifications All curves would be moved inland concentrically, the convexities of coast made smaller, the concavities larger.

In view of the evidence indicative of such a former general state of high relief of the lands, and considering the huge gorges which were carved by the rivers flowing to the sea, some of which are still traceable upon the submerged shelf, it would seem that there must have been ample time for the

[1]Geology, vol. iii, 1906, p. 327.

crests to have moved inland in some places to great distances And still a certain degree of uniformity might be maintained over long stretches.

Suppose now, succeeding upon such a stage of high relief, a rise of sea level until the basins are slightly over-full. No matter where upon the coastal slope the new strand formed it would be roughly parallel to the original torn outline because its plane would intersect a slope derived from that. The brink or crest contour having moved inland, all slopes having been merged into one another, that crest might be drowned to a depth of a hundred fathoms or to some other depth. On the seaward side of this the slope would be more or less rapid, on the land side gentle. The curves of the new coast line would tend to remain roughly parallel to the original brink.

Then comes sedimentation. The submerged slopes receive the materials washed down from the land. Sediments from large areas are deposited on small, making up in thickness what they lose in area. The inevitable result must be the alteration of the submerged contours out of proportion to the changes produced on the lands by the removal of the transported materials. Ultimately we must expect the hundred fathom curve to be so changed that it cannot at all be taken as representing, what it once did, an approximation to the original torn outline. But the coast line might continue longer to retain its ancient parallelisms.

In matching together two such coasts we should be struck at once with the concentricity of the greater curves, for these curves would be derived from the former crests moved inland. And is this not exactly what we find upon the globe today? And would not the distances, center to center of given land masses, be quite as rigidly prescribed as if we were dealing with freshly torn edges? It seems that such would be the case.

To sum up then, in reply to the challenge of the use of the coastlines, we may emphasize the following points:

1. The preference for the hundred fathom or other submarine curve is based upon *a priori* grounds as opposed to the analytical study of observed facts. It puts a premium on prejudice.

2. Speaking generally, the proper use of the coast lines necessarily provides for the submerged margin.

3. The submerged contours are highly changeable and unreliable because of sedimentary alteration.

4. The submerged contours are fully as objectionable on the score of vertical crustal movements as are the coast lines.

5. Change of coast lines by encroachment of waves and tides varies in detail but seems to be fairly uniform over greater marginal features.

6. A hypothetical rise of sea level in the less remote geological past (close of the Pleistocene) would be compatible with the observed facts.

INCUBATION PERIOD AND DURATION OF INFECTION IN RATS AND IN GUINEA PIGS, INOCULATED WITH TRYPANOSOME GAMBIENSE.

J. FRANKLIN MORGAN.

This article is a compilation of the records of rats and guinea pigs inoculated with Trypanosome Gambiense at the University of Michigan. The record starts from the receiving of two rats from Liverpool, England, during the latter part of June, 1906 and extends over a period of seven years to August, 1913. During this time, 453 animals (331 rats and 122 guinea pigs) were inoculated, not counting the 12 reinoculations—1 rat and 11 guinea pigs. Over one-fourth of the rats were bled for cultural experiments *in vitro*—while only 6 guinea pigs were used for that purpose. The remainder were stock animals—that is, animals for perpetuating the organism.

TABLE I.

Incubation period.

Time of inoculation till the appearance of organism in the blood.

Rats.		Guinea Pigs.	
Days:		Days:	
No record	6	2	1
1	24	3–5	8
2–5	81	7–10	16
6–10	121	11–15	14
11–15	47	17–25	50
16–20	18	26–30	6
21–25	8	31–43	9
26	1	48	2
28	3	49	1
Total infected	309	Total infected	108
Not infected	23	Not infected	25
Total	332	Total	133
Maximum	28 days	Maximum	49 days
Minimum	1 day	Minimum	2 days
Average	8 days	Average	19 days

From the above table it will be seen that 121 rats infected from 6-10 days are near their entire average of 8 days and that 50 guinea pigs infected from 17-25 days are near their average of 19 days. Nearly one-half of the animals were near their entire average. The longer time required for a guinea pig to become infected is probably due to the larger size of the animal.

TABLE II.

Duration of Infection.

Time of inoculation till the death of animals that were infected.

Rats.		Guinea pigs.	
Days:		Days:	
4	2	16–19	4
5–10	44	22, 23, 25, 27, 28, 29, 31	8
11–15	55	35–43	12
		44–55	13
16–20	46	56–66	12
21–25	22	69–80	13
26–32	14	81–89	11
34–45	10	91–100	12
52, 56, 58, 63	4	104, 105, 107, 110, 111	5
106	1	130, 135, 142, 162	4
No. dying from infection	198	No. dying from infection	94
No record	19		
Bled	91	No record	8
Killed	1	Bled	6
Total	309	Total	108
Maximum	106	Maximum	162
Minimum	4	Minimum	16
Average	18	Average	68

Averages are based upon only those dying from infection.

The ratio in Table I is not found in Table II of the animals dying from the infection, especially among the rats. More of them died below the average than above while the guinea pigs are about equally divided. The rats have an average of 18 days and the guinea pigs an average of 68 days a little over three times that of the rats.

TABLE III.—RATS.

(a) Inoculated with blood from rats.

Animal number.	I. C.	D. I.	A. I.	P. F.	P. I.
19	10	31	1–4 cc.	5	I. P.
37	2	35	1–4 cc.	20	I. P.
38	2	23	1–4 cc.	20	I. P.
57	25	bled.	1–4 cc.	1–20	I. P.
199	12	18	2 gtts.	100	I. P.
97	26	58	1 gtt.	1–2	S. C.
98	4	5	1 gtt.	2–3	S. C.
427	11	13	1–2 gtt.	100	S. C.
448	7	19	1–5 gtt.	10	S. C.
449	7	14	1–8 gtt.	75	S. C.

(b) Inoculated with Blood from Guinea Pigs.

Animal number.	I. C.	D. I.	A. I.	P. F.	P. I.
68	28	bled.	1–10 cc.	1–20	S. C.
88a	22	106	1 gtt.	3	S. C.
118	19	63	1 gtt.	1	S. C.
119	19	23	1 gtt.	1	S. C.
123	22	27	1–2 gtt.	50	S. C.
133	28	52	1 gtt.	50	S. C.
143	6	43	2 gtt.	1	I. P.
144	6	18	1 gtt.	1	I. P.
150	11	19	1 gtt.	20	I. P.
198	9	28	2 gtts.	3	I. P.

NOTE.—Per field is the average number of organisms seen in a field of a drop of blood with a No. 7 objective.

Abbreviations:—I. C.—incubation period—days.
D. I.—duration of infection—days.
A. I.—amount of blood injected.
P. F.—per field.
P. I.—place of inoculation.
S. C.—Sub cutaneously.
I. P.—Intra peritoneally.

The place of injection and the amount of blood used plays an important part in the length of the incubation period. The susceptibility of the animal is also an important factor. Three rats, Nos. 33, 34, and 35, were injected intraperitoneally at the same time, with the same amount of blood from the same animal. The first one did not show any infection for 18 days, while the other two were positive on the sixth. As these animals were bled for cultural purposes, no conclusions can be drawn from the duration of infection. As to the amount of blood, number of organisms present, place of injection, compare Nos. 37 and 38 with Nos. 68, 427, 448 and 449 (Table III). With fewer number of organisms and subcutaneous injections, the incubation period is longer. There are some exceptions, but on the whole this has proved true among the guinea pigs.

There also appears to be a longer incubation period and duration of infection of rats inoculated from guinea pigs than of those inoculated from rats. This is not so true among the guinea pigs.

Rat No. 88a was inoculated twice. No infection showing in 65 days, it was reinoculated with blood from a guinea pig. The first time it was inoculated with guinea pig blood, but this was much richer than the second inoculation. It contained 100 organisms per yield instead of 3. The incubation period was nearly three times the average and the duration of infection was the longest of any rat, 106 days or nearly six times the average for the duration of infection. Whether the first injection had anything to do with the prolonging the life of the rat, the writer is not prepared to say.

TABLE IV.—GUINEA PIGS.

(a) Inoculated with blood from rats.

Animal number.	I. C.	D. I.	A. I.	P. F.	P. I.
10	21	81	1–4 cc.	200	I. P.
14	18	94	1–4 cc.	75	I. P.
189	15	92	2 gtts.	10	I. P.
247	7	41	2 gtts.	100	I. P.
81	38	51	4 gtts.	100	S. C.
116	48	60	1–2 gtts.	+2	S. C.
135	4	18	1–2 gtt.	1–10	S. C.
197	35	44	1 gtt.	3	S. C.
278	42	107	2 gtts.	50	S. C.

(b) Inoculated with blood from guinea pigs.

Animal number.	I. C.	D. I.	A. I.	P. F.	P. I.
167	4	18	1–2 gtt.	10	I. P.
253	7	43	1 gtt.	15	I. P.
254	22	62	1 gtt.	15	I. P.
255	9	80	2 gtts.	1–5	I. P.
316	13	61	1 gtt.	1–10	I. P.
403	48	162	S. S. of mashed heart of rat dead about 10 hrs.		I. P.
136	10	111	1 gtt.	50	S. C.
147	31	97	1 gtt.	15	S. C.
196	33	99	1 gtt.	1–2	S. C.
309	43	81	1 gtt.	10	S. C.
310	10	28	1 gtt.	10	S. C.
337	49	110	1 gtt.	10	S. C.
386	32	92	2 gtts.	5	S. C.
429	19	104	1 gtt.	5	S. C.
432	22	142	9 gtts.	1	S. C.
451	26	81	1 gtt.	5	S. C.

NOTE.—S. S.—A suspension made in a sterile physiologically salt solution.

The guinea pigs that were inoculated intraperitoneally had on the average a shorter period of incubation than those inoculated subcutaneously, either with blood from a rat or from a guinea pig. The duration of infection is in favor of the subcutaneous method of injection as is seen from the above tables. Guinea pig No. 403 is an exception. This is due probably to the organism being attenuated by its living in the dead guinea pig so long.

The length of the incubation period is not always a sure guide as to the duration of infection, as is seen by Nos. 10, 14, 189, 255, 136, 316 and 429. Notice the difference in the incubation period and the duration of infection in guinea pigs Nos. 309 and 310. These animals were inoculated at the same time with blood from the same animal, yet the former was four times longer in showing the infection and lived nearly three times longer than the latter. Compare these with 337, which had three times as much blood injected, but yet lived longer than the two together.

From the above records, the following conclusion can be drawn: The smallest amount of virulent blood that will infect, with subcutaneous inoculations, will generally give a longer duration of infection than the same amounts with intraperitoneal injections.

Another interesting thing that was noted in the study of these records was the disappearing and reappearing of the organisms in the blood of the animals. This was quite marked in the blood of the guinea pigs, due probably

to its having a longer duration of infection than that in the rats. Sometimes the animals died without showing any reappearance of the organism in their blood.

As the animals were examined only twice a week, no definite information can be given as to when these organisms disappeared from the blood and when it reappeared in it. If the animal was positive once it will in most cases be positive again.

The value of any record depends upon the authenticity of its various items. In this case, the series of inoculations and examinations, extending over a period of seven years, were made by seven or eight individuals, not as an experiment, but as a part of a laboratory routine. The fact that with a few exceptions of a minor importance as far as the above compilation is concerned, the record is complete, vouches for the accuracy and completeness of note taking. All the records were made at the Hygienic laboratory under the immediate supervision of Prof. F. G. Novy and the credit belongs to him for the trustworthiness of the records. This summary was made at his suggestion. It is hoped that its publication will stimulate similar compilation from other laboratories to the end that comparisons of the virulence of the various strains of this species and of other species, even after a long laboratory culture will be made possible.

A preliminary report was given at the spring meeting of 1913 of Michigan Academy of Science, but publication was deferred to allow complete summary of the data to be made.

East Lansing, Michigan, 1914.

A CATALOGUE OF THE FLORA OF ISLE ROYALE, LAKE SUPERIOR.[1]

WILLIAM S. COOPER.

Introduction.

This catalogue is a portion of the outcome of two summers' work upon Isle Royale, in the years 1909 and 1910. The main purpose of the study was ecological, and the results have appeared in the four papers noted in the list of literature appended to this preface. The first three are strictly ecological; the fourth may be regarded as supplementary to the present list.

I have included here a number of species reported by previous collectors upon the island, but not seen by me. These are indicated by an asterisk.

In describing the habitats of the species listed I have taken pains to avoid such time-honored but meaningless phrases as "hillsides," "glades," "thickets," "woods," "rich woods," "open woods," "cool dry woods," "cool moist woods," "rich, dark, moist woods," etc., and have endeavored to define as accurately as possible the habitat of each plant, and to assign it to its successional place or places.

For detailed information regarding the plant associations and successions of Isle Royale the reader is referred to a previous paper (No. 6 in the list of literature). It will be well, however, to sketch briefly here the courses of the successions. The climax forest is composed mainly of *Abies balsamea*, *Betula alba papyrifera*, and *Picea canadensis*, and covers the island almost completely. Only along the shores and in bog areas are there tracts of any great extent controlled by other plant associations. It is in the latter situations that we find indications of the successional processes that have resulted in the establishment of the climax forest over nearly all of the island; and these situations too are far richer in number of species than is the great mass of the forest. We may distinguish four primary lines of succession, and a fifth which follows the burning of the forest. The *rock shore succession* progresses through crustose, foliose, and fruticose lichen, crevice, rock pool, heath mat, and xerophytic forest stages to the climax state. The *beach succession* is unimportant, beaches of any kind being uncommon upon Isle Royale. The *bog succession* proceeds through aquatic, sedge, shrub-sphagnum, and bog forest stages, ending with the establishment of the climax forest. The *delta swamp succession*, developing upon the deposits at the mouths of streams, has a similar course, differing in the interpolation of a grass stage after the sedges, and in the absence of sphagnum. The *burn succession* begins with the "fireweeds," and progresses through a "burn forest," composed mainly of birch sprouts, to the re-establishment of the climax forests, unless the burning has been very severe, in which case the succession is practically a repetition of that characteristic of the rock shores.

I am greatly indebted to Doctor M. L. Fernald, of the Gray Herbarium

[1]From the Michigan Geological and Biological Survey.

of Harvard University, who has verified the grasses and sedges, and all doubtful determinations of my own.

LITERATURE DEALING WITH THE FLORA OF ISLE ROYALE.

1. Adams, C. C. An Ecological Survey in Northern Michigan. A report from the University Museum, University of Michigan, published by the State Board of Geol. Surv. as part of report for 1905. Lansing, Mich., 1906. Portions written by Dr. A. G. Ruthven deal with the ecology and flora of Isle Royale.

2. ————. An Ecological Survey of Isle Royale, Lake Superior. A report from the University of Michigan Museum, published by the State Geol. and Biol. Surv., as a part of report of 1908. Lansing, Mich., 1909. Sections by Dr. Adams, Dr. H. A. Gleason, and Mr. W. P. Holt deal with the plant ecology and flora.

3. Beal, W. J. Michigan Flora. A list of the fern and seed plants growing without cultivation. Published by the State Board of Agriculture. Lansing, Mich., 1904.

4. Cooper, W. S. Reproduction by layering among Conifers. Bot. Gaz., 52: 369–379. 1911.

5. ————. The Ecological Succession of Mosses, as illustrated upon Isle Royale. Plant World, 15: 197–213. 1912.

6. ————. The Climax Forest of Isle Royale, Lake Superior, and its Development. Bot. Gaz., 55: 1–44, 115–140, 189–235. 1913.

7. ————. A List of Mosses Collected upon Isle Royale, Lake Superior. The Bryologist, 16: 3–8. 1913.

8. Foster, J. W., and Whitney, J. D. Report on the geology of the Lake Superior Land District. Pt. II, the Iron Region. Sen. Doc., Spec. Sess., 32d Cong., 3. 1851. Contains a list of plants of the Upper Peninsula by W. D. Whitney, including some from Isle Royale.

9. Gleason, H. A. See Adams 2.

10. Holt, W. P. See Adams 2.

11. Ruthven, A G. See Adams 1.

12. Wheeler, W. A. Notes on Some Plants of Isle Royale. Minn. Bot. Stud., 2:619–620. 1901.

LIST OF SPECIES.

Polypodiaceae. Fern Family.

1. **Polypodium vulgare** L. Polypody. Climax forest, cliffs and boulders.

2. **Phegopteris polypodioides** Fée. Beech Fern. Bog forest, common.

3. **Phegopteris Dryopteris** (L.) Fée. Oak Fern. Bog forest, abundant; climax forest, frequent.

*4. **Adiantum pedatum** L. Maidenhair Fern. "Sparingly distributed in mesophytic forest." Holt.

5. **Pteris aquilina** L. Brake. Burn forest and early stages of Burn Succession.

6. **Cryptogramma achrostichoides** R. Br. Rock Brake. Heath mat and rock shore crevices.

*7. **Asplenium Trichomanes** L. Maidenhair Spleenwort. "On thinly soil-covered rocks, rare. Rock cliff along Siskowit cabin trail." Holt. Also T. C. Porter, in Beal.

8. **Asplenium Filix-foemina** (L.) Bernh. Lady Fern. Bog forest; wet places in climax forest; occasional in sheltered rock shore crevices.

9. **Aspidium Thelypteris** (L.) Sw. Marsh Shield Fern. Sedge zone, bog Succession, frequent; bog forest.

10. **Aspidium fragrans** (L.) Sw. Fragrant Shield Fern. Rock shore crevices; exposed interior cliffs.

*11. **Aspidium Filix-mas** (L.) Sw. Male Fern. "Fairly abundant in rich moist woods. Especially abundant near Benson Brook." Holt.

12. **Aspidium cristatum** (L.) Sw. Crested Shield Fern. Climax forest; Siskowit Bay.

13. **Aspidium spinulosum** (O. F. Müller) Sw. Common Shield Fern. Climax forest, frequent.

14. **Aspidium spinulosum** (O. F. Müller) Sw. var. **dilatatum** (Hoffm). Hook Raspberry Island.

15. **Cystopteris bulbifera** (L.) Bernh. Bladder Fern. McCargoe's Cove. Rare.

16. **Cystopteris fragilis** (L.) Bernh. Fragile Fern. Climax forest, on rocks and cliffs; sheltered shore rocks.

17. **Woodsia ilvensis** (L.) R. Br. Rusty Woodsia. Rock shore crevices; exposed interior cliffs.

*18. **Onoclea sensibilis** L. Sensitive Fern. "Fairly abundant." Holt.

19. **Onoclea Struthiopteris** (L.) Hoffm. Ostrich Fern. Brook bank in forest; Sargent Lake trail near Rock Harbor.

Osmundaceae. Flowering Fern Family.

20. **Osmunda regalis** L. Royal Fern. Brookside at Forbes Lake, only locality. Same occurrence noted by Holt.

21. **Osmunda Claytoniana** L. Interrupted Fern. Wet place in climax forest near Tobin's Harbor.

22. **Osmunda cinnamomea** L. Cinnamon Fern. Stream bank in climax forest: Sargent Lake trail near Rock Harbor.

Ophioglossaceae. Adder's Tongue Family.

23. **Botrychium Lunaria** (L.) Sw. Moonwort. Open burn forest, abundant in one locality near Park Place.

24. **Botrychium ternatum** (Thumb.) Sw. var. **intermedium** D. C. Eaton. Grape Fern. Occasional: burn forest; rock shore crevice.

25. **Botrychium virginianum** (L.) Sw. Rattlesnake Fern. Bog forest, occasional.

Equisetaceae. Horsetail Family.

26. **Equisetum arvense** L. Common Horsetail. Occasional in diverse habitats; sphagnum-shrub stage of Bog Succession, shingle beach.

27. **Equisetum sylvaticum L.** Wood Horsetail. Bog forest, abundant.

28. **Equisetum palustre** L. Swamp Horsetail. Sedge zone of Delta Swamp Succession.

29. **Equisetum fluviatile** L. Water Horsetail. Aquatic zones of Bog and Delta Swamp Successions, common; sedge zone as relict from aquatic zone.

30. **Equisetum scirpoides** Michx. Park Place.

Lycopodiaceae. Club Moss Family.

31. **Lycopodium Selago** L. Rock shore crevices: Scovill Point; Passage Island.
32. **Lycopodium lucidulum** L. Bog forest, occasional.
33. **Lycopodium inundatum** L. Bog Club Moss. Sedge zone of Bog Succession, Forbes Lake.
34. **Lycopodium annotinum** L. Stiff Club Moss. Bog forest; Climax forest.
35. **Lycopodium clavatum** L. Common Club Moss. Bog forest; climax forest.
36. **Lycopodium obscurum** L. Ground Pine. Climax forest; bog forest.
37. **Lycopodium complanatum** L. Climax forest.

Selaginellaceae. Selaginella Family.

38. **Selaginella selaginoides** (L.) Link. Moist sheltered crevices of rock shores.
39. **Selaginella rupestris** (L.) Spring. Rock surfaces, early stages of Rock Shore Succession.

Isoetaceae. Quillwort Family.

40. **Isoetes macrospora** Dur. Quillwort. Aquatic: sheltered bays, delta streams, and inland lakes; depth up to one meter. Tobin's Harbor; Amygdaloid Lake; Chippewa Harbor; Hay Bay.

Taxaceae. Yew Family.

41. **Taxus canadensis** Marsh. Yew; Ground Hemlock. Climax forest, very abundant; bog forest.

Pinaceae. Pine Family.

42. **Pinus Strobus** L. White Pine. Climax forest, occasional; talus slopes along northwest sides of ridges. There is no indication that the White Pine was ever an important constituent of the forest.
43. **Pinus Banksiana** Lamb. Jack Pine. The most characteristic tree of the xerophytic forest stage which sometimes intervenes between the heath mat and the climax forest in the Rock Shore Succession. Dry rocky ridges.
44. **Pinus resinosa** Ait. Red Pine; Norway Pine. Dry ridges, rare. Successional place undetermined. Near Sumner Lake; Lane Cove.
45. **Larix laricina** (DuRoi) Koch. Tamarack. Most characteristic tree of the bog forest; common in the delta swamp forest; also occurs sparingly in the climax forest.
46. **Picea canadensis** (Mill) BSP. White Spruce. One of the three climax trees, and the least abundant of them; frequent as a pioneer upon rock shores, and occasional in the bog forest.
47. **Picea mariana** (Mill) BSP. Black spruce. One of the three important bog trees, occurring especially in areas where sphagnum is abundant, rarely where it is absent; also an important constituent of the xerophytic forest, the other species being Pinus Banksiana; occurs sparingly throughout the climax forest, occasionally partially or wholly replacing Picea canadensis.
48. **Abies balsamea** (L.) Mill. Balsam Fir. The most abundant tree of the climax forest, making 75 percent of the entire stand, but only 33 percent

of the mature trees. Enters bog areas soon after or actually with the bog trees; is frequent as a rock shore pioneer.

49. **Thuja occidentalis** L. Arbor Vitae; White Cedar. Common constituent of the bog forest, especially where sphagnum is practically absent, rarely where it is abundant; most characteristic tree of the delta swamp forest; occurs frequently as a rock shore pioneer, often taking the "krummholz" form; sparingly in the climax forest, usually near its edge.

50. **Juniperus communis** L. var. **depressa** Pursh. Low Juniper. Abundant crevice plant upon rock shores, later becoming a constituent of the heath mat; frequent upon bare burned ridges where rock shore conditions are duplicated, and persisting into the burn forest stage.

51. **Juniperus horizontalis** Moench. Trailing Juniper. Abundant rock shore crevice plant, becoming the most important binding agent in the formation of the heath mat.

Typhaceae. Cat-tail Family.

52. **Typha latifolia** L. Common Cat-tail. Sedge zone of Delta Swamp Succession; shores of very sheltered coves.

Sparganiaceae. Bur-reed Family

53. **Sparganium diversifolium** Graebner. Bur-reed. Aquatic, Delta Swamp Succession.

54. **Sparganium angustifolium** Michx. Tobin's Harbor.

55. **Sparganium minimum** Fries. Aquatic, Delta Swamp Succession.

Najadaceae. Pondweed Family.

56. **Potamogeton natans** L. Pondweed. Aquatic, Delta Swamp Succession.

57. **Potamogeton epihydrus** Raf. Pool in bog: head of Siskowit Bay.

58. **Potamogeton alpinus** Balbis. Delta stream: McCargoe's Cove.

59. **Potamogeton amplifolius** Tuckerm. Delta stream; sheltered cove; bog lake.

60. **Potamogeton heterophyllus** Schreb. Frequent aquatic in sheltered bays, bog lakes, and delta streams.

61. **Potamogeton heterophyllus** Schreb. f. **terrestris** Schlecht. Very wet places on sedge mat, Bog Succession; edge of Sedge mat. Delta Swamp Succession.

62. **Potamogeton praelongus** Wulf. Sheltered cove: Hay Bay.

63. **Potamogeton perfoliatus** L. Commonest pondweed in sheltered bays.

64. **Potamogeton zosterifolius** Schumacher. Bog lakes and sheltered bays.

65. **Potamogeton obtusifolius** Mertens and Koch. Delta stream: McCargoe's Cove.

66. **Potamogeton filiformis** Pers. Sheltered cove: Hay Bay.

*67. **Potamogeton pectinatus** L. "Margin of Sumner Lake." Holt.

68. **Najas flexilis** (Willd.) Rostk. and Schmidt. Bog aquatic: Sumner lake.

Juncaginaceae. Arrow Grass Family.

69. **Scheuchzeria palustris** L. Sedge mat, Bog Succession.

70. **Triglochin maritima** L. Sedge mat, Bog Succession.

Alismaceae. Water-plantain Family.

71. **Sagittaria latifolia** Willd. f. **hastata** (Pursh) Robinson. Arrow-head. Aquatic, Delta Swamp Succession: McCargoe's Cove.
72. **Sagittaria arifolia** Nutt. Bog aquatic.
73. **Sagittaria cuneata** Sheldon. Floating Arrow-head. Delta streams: McCargoe's Cove: Hay Bay.

Hydrocharitaceae. Frog's Bit Family.

74. **Vallisneria spiralis** L. Eel Grass. Sheltered coves and delta streams.

Gramineae. Grass Family.

*75. **Panicum xanthophysum** A. Gray. Panic Grass. "Dry rocky ridges, and rocks with little soil." Holt.
76. **Phalaris arundinacea** L. Reed Canary Grass. Sandy beaches, occasional.
77. **Oryzopsis pungens** (Torr.) Hitchc. Mountain Rice. Rock shore crevices, occasional.
78. **Oryzopsis asperifolia** Michx. Rock shore crevices and heath mat.
79. **Muhlenbergia racemosa** (Michx.) BSP. Sedge mat, Bog Succession, frequent.
80. **Phleum pratense** L. Timothy. Clearings.
81. **Agrostis alba** L. Red Top. Shingle beach near Blake Point.
82. **Agrostis hyemalis** (Walt.) BSP. Hair Grass. Occasional in a variety of habitats: rock shore crevices; heath mat; rock pool margin; bog sedge mat; recent burn.
83. **Calamagrostis canadensis** (Michx.) Beauv. Blue-joint Grass. The most abundant species in the grass zone of the Delta Swamp Succession; also common on rock shores, in crevices, and around pools; forming a thick growth upon the bare rocks of Gull Islands; characteristic of the marginal zone of bogs.
*84. **Calamagrostis Langsdorfii** (Link) Trin. Wheeler. Previously collected by T. C. Porter.
85. **Calamagrostis hyperborea** Lange. Rock shore crevices, frequent.
86. **Cinna latifolia** (Trev.) Griseb. Wood Reed Grass. Brook banks in climax forest.
87. **Trisetum spicatum** (L.) Richter. Rock shore crevices, frequent.
88. **Deschampsia flexuosa** (L.) Trin. Common Hair Grass. Rock shore crevices occasionally, but more commonly in rock openings in the climax forest and on bare burned ridges.
89. **Deschampsia caespitosa** (L.) Beauv. Rock shore crevices, abundant.
90. **Avena sativa** L. Common Oat. Occasional on sand beaches.
91. **Danthonia compressa** Austin. Wild Oat Grass. Forbes Lake vicinity.
92. **Danthonia intermedia** Vasey. Rock shore crevices; heath mat.
*93. **Phragmites cummunis** Trin. Reed. Washington Creek. Holt.
*94. **Melica Smithii** (Porter) Vasey. "Dr. Robbins, in Gray's Manual." Beal.
95. **Melica striata** (Michx.) Hitchc. Melic Grass.
96. **Poa compressa** L. Wire Grass. Various xerophytic habitats and clearings.
97. **Poa alpina** L. Alpine Meadow Grass. Shore rocks; sheltered crevices.

98. **Poa glauca** Vahl. Rock shore crevices and bare burned ridges.
99. **Poa nemoralis** L.
100. **Poa triflora** Gilib. Fowl Meadow Grass. Burn forest; grass zone, Delta Swamp Succession.
101. **Poa pratensis** L. June Grass; Kentucky Blue Grass. Clearings; bare burned ridges; burn forest.
*102. **Glyceria Torreyana** (Spreng.) Hitchc. Manna Grass. "Margin of Siskowit cabin trail bog." Holt.
103. **Glyceria canadensis** (Michx.) Trin. Rattlesnake Grass. Bog forest.
104. **Glyceria nervata** (Willd.) Trin. Bog forest.
105. **Glyceria borealis** (Nash) Batchelder. Delta stream: McCargoe's Cove.
106. **Festuca occidentalis** Hook. Fescue Grass. Rock Harbor Lighthouse.
107. **Festuca ovina** L. Sheep's Fescue. Rock shore crevices and bare burned ridges.
108. **Bromus ciliatus** L. Brome Grass. Climax forest, brook bank.
109. **Agropyron Smithii** Rydb. Burn forest: Park Place.
110. **Agropyron tenerum** Vasey. Park Place.
111. **Agropyron caninum** (L.) Beauv. Park Place.
112. **Hordeum jubatum** L. Squirrel Tail Grass. Clearing: Passage Island Lighthouse.

Cyperaceae. Sedge Family.

113. **Dulichium arundinaceum** (L.) Britton. Edges of bog lakes, infrequent.
114. **Eleocharis palustris** (L.) R. and S. Common Spike Rush. Aquatic, bog lakes.
115. **Eleocharis palustris** (L.) R. and S. var. **glaucescens** (Willd.) Gray. Aquatic, bog lakes.
116. **Eleocharis acicularis** (L.) R. and S. Delta Swamp Succession, margin of sedge zone.
117. **Eleocharis acuminata** (Muhl.) Nees. Tobin's Harbor.
118. **Scirpus caespitosus** L. Most characteristic plant of rock pool margins; also forms the bulk of the sedge mat in some bogs.
119. **Scirpus hudsonianus** (Michx.) Fernald. Alpine Cotton Grass. Sedge zone, Bog Succession, frequent.
120. **Scirpus subterminalis** Torr. Aquatic, Delta Swamp Succession.
121. **Scirpus validus** Vahl. Common Bulrush. Aquatic: sheltered coves and bog lakes.
122. **Scirpus rubrotinctus** Fernald. Brook bank: Ransom Clearing.
123. **Scirpus atrocinctus** Fernald. Edges of rock pools and other swampy habitats.
124. **Eriophorum callitrix** Cham. Cotton Grass; Hare's Tail. Sedge and sphagnum zones, Bog Succession, frequent.
125. **Eriophorum tenellum** Nutt. Slender Cotton Grass. Sedge and sphagnum zones, Bog Succession.
126. **Eriophorum viridi-carinatum** (Engelm.) Fernald. Tall Cotton Grass. Sedge and sphagnum zones, Bog Succession.
127. **Rhynchospora alba** (L.) Vahl. White Beak Rush. Sedge zone, Bog Succession frequent.
128. **Cladium mariscoides** (Muhl.) Torr. Twig Rush. Sedge Zone, Bog Succession: Sucker Lake.

*129. **Carex scoparia** Schk. Washington Club grounds. Holt.
130. **Carex tribuloides** Wahlenb. var. Mott Island.
131. **Carex Crawfordii** Fernald. Siskowit Lake.
132. **Carex pratensis** Drejer. Smithwick Island; Park Place.
133. **Carex festucacea** Schkuhr. McCargoe's Cove.
134. **Carex festucacea** Schkuhr var. **brevior** (Dewey) Fernald. Park Place.
135. **Carex Bebbii** Olney. Head of Siskowit Bay.
*136. **Carex foenea** Willd. Dr. J. H. Sandberg, in Beal.
137. **Carex aenea** Fernald. Bare grassy burn: Park Place.
138. **Carex exilis** Dewey. Sedge zone, Bog Succession: head of Siskowit Bay.
139. **Carex stellulata** Good. var. **excelsior** (Bailey) Fernald. Sedge zone, Bog Succession.
140. **Carex scirpoides** Schkuhr.
141. **Carex canescens** L. var. **subloliacea** Laestad.
142. **Carex canescens** L. var. **disjuncta** Fernald. Bog forest.
143. **Carex brunnescens** Poir. Park Place; Sumner Lake.
144. **Carex tenuiflora** Wahlenb. Bog forest, common.
145. **Carex trisperma** Dewey. Most abundant sedge in the bog forest, carpeting large areas.
146. **Carex tenella** Schkuhr. Bog forest, common.
147. **Carex diandra** Schrank. Sedge zone of Bog and Delta Swamp Successions.
148. **Carex chordorrhiza** L. f. Sedge and sphagnum zones of Bog Succession; occasionally in sedge zone of Delta Swamp Succession.
*149. **Carex crinita** Lam. "Along road to 'Island Mine,' head of Siskowit Bay." Holt.
150. **Carex aquatilis** Wahlenb. Shores and sand bars of sheltered bays.
151. **Carex aquatilis** Wahlenb. var. **elatior** Bab.
152. **Carex lenticularis** Michx. Shores and sand bars of sheltered bays.
153. **Carex stricta** Lam. Sedge and sphagnum zones, Bog Succession.
154. **Carex bicolor** All. Margins of rock pools and gravelly beaches.
155. **Carex pauciflora** Lightf. Sphagnum zone, Bog Succession.
156. **Carex leptalea** Wahlenb. Bog forest, common.
157. **Carex Halleri** Gunn. Sheltered rock shore crevices and margins of rock pools.
158. **Carex atrata** L. var. **ovata** (Rudge) Boott. Rock shore crevices and margins of rock pools.
159. **Carex polygama** Schkuhr. Sedge zone, Bog Succession; margins of rock pools, Rock Shore Succession.
160. **Carex gracillima** Schwein. Brook bank in climax forest.
161. **Carex communis** Bailey. Park Place.
162. **Carex livida** (Wahlenb.) Willd. Sedge zone. Bog Succession, frequent.
163. **Carex vaginata** Tausch. Bog forest.
164. **Carex paupercula** Michx. var. **pallens** Fernald. Margins of rock pools.
165. **Carex limosa** L. The most important mat former in certain of the Isle Royale bogs. Either this or C. filiformis is usually dominant in a given locality.
166. **Carex eburnea** Boott. Margins of rock pools.

167. **Carex laxiflora** Lam. var. **varians** Bailey.
168. **Carex flava** L.
*169. **Carex Oederi** Retz var. **pumila** (Cosson and Germain) Fernald. "Edges of rock pools, and on moister parts of rock beach." Holt.
170. **Carex castanea** Wahlenb. Bog forest.
171. **Carex capillaris** L. var **elongata** Olney. Margins of rock pools.
*172. **Carex arctata** Boott. "Dry woods, Washington Harbor." Holt.
173. **Carex filiformis** L. Dominant in the sedge zone of many of the bogs, and also in the sedge zone of the Delta Swamp Succession.
174. **Carex oligosperma** Michx. Sedge zone, Bog Succession.
*175. **Carex riparia** Curtis. "Creek margin head of Rock Harbor." Holt.
*176. **Carex retrorsa** Schwein. "Along Washington Creek." Holt.
177. **Carex intumescens** Rudge var. **Fernaldii** Bailey. Margin of Lake Richie.
178. **Carex Michauxiana** Boeckl. Sedge zone, Bog Succession.
179. **Carex vesicaria** L.
180. **Carex vesicaria** L. var. **jejuna** Fernald. Sand bar; Duncan Bay.
181. **Carex rostrata** Stokes. Sedge zone, Bog Succession. frequent.
*182. **Carex Tuckermani** Dewey. "Along Washington Creek." Holt.

Araceae. Arum Family.

183. **Calla palustris** L. Water Arum. Aquatic: inland lakes and delta streams.
184. **Symplocarpus foetidus** (L.) Nutt. Skunk Cabbage. Bog and delta swamp forests and margins of very sheltered coves.

Lemnaceae. Duckweed Family.

185. **Lemna trisulca** L. Ivy-leaf Duckweed. Aquatic: delta streams.

Eriocaulaceae. Pipewort Family.

186. **Eriocaulon septangulare** Withering. Pipewort. Margin of Sargent Lake.

Juncaceae. Rush Family.

187. **Juncus Dudleyi** Wiegand. Tobin's Harbor.
188. **Juncus filiformis** L. Margins of rock pools, common.
189. **Juncus brevicaudatus** (Engelm.) Fernald. Margins of rock pools; margin of bog pond, head of Siskowit Bay.
190. **Juncus pelocarpus** Mey. Margin of bog pond, head of Siskowit Bay.
191. **Juncus alpinus** Vill. Margins of rock pools.
*192. **Juncus articulatus** L. Wheeler.
193. **Luzula campestris** (L.) DC. Wood Rush.

Liliaceae. Lily Family.

194. **Tofieldia palustris** Huds. False Asphodel. Sheltered rock shore crevices and margins of rock pools.
195. **Tofieldia glutinosa** (Michx.) Pers. Same habitat as last.
*196. **Uvularia perfoliata** L. "Rich, moist woods, scattered." Holt.

197. **Allium Schoenoprasum** L. var. **sibiricum** (L.) Hartm. Wild Chives. Sheltered rock shore crevices and margins of rock pools: Scovill Point; Passage Island.

198. **Lilium philadelphicum** L. Wild Red Lily. Rock shore crevices and heath mat, occasional; burn forest, abundant.

199. **Clintonia borealis** (Ait.) Raf. Clintonia. Climax forest; bog forest.

200. **Smilacina trifolia** (L.) Desf. Three-leaved Solomon's Seal. Bog forest; sphagnum zone, Bog Succession.

201. **Maianthemum canadense** Desf. Two-leaved Solomon's Seal. Climax forest; bog forest.

202. **Streptopus amplexifolius** (L.) DC. Twisted-stalk. Bog forest; brook bank in climax forest.

203. **Streptopus roseus** Michx. Pink-flowered Twisted-stalk. Bog forest; climax forest.

204. **Trillium erectum** L. Purple Trillium. Bog forest; climax forest.

*205. **Trillium grandiflorum** (Michx.) Salisb. Large White Trillium. "Flood plain of Washington Creek." Holt.

Iridaceae. Iris Family.

206. **Iris versicolor** L. Blue Flag; Fleur-de-Lis. Sedge zone, bog forest, and marginal zone, of Bog Succession; sedge zone of Delta Swamp Succession.

207. **Sisyrinchium angustifolium** Mill. Blue-eyed Grass. Rock shore crevices; sand beaches.

Orchidaceae. Orchid Family.

*208. **Cypripedium arietinum** R. Br. Ram's-head, Lady's Slipper. Dr. A. B. Lyons, in Beal.

209. **Cypripedium parviflorum** Salisb. Smaller Yellow Lady's Slipper. Bog forest: Sargent Lake.

*210. **Cypripedium parviflorum** Salisb. var. **pubescens** (Willd.) Knight. Larger Yellow Lady's Slipper. Holt.

*211. **Cypripedium hirsutum** Mill. Showy Lady's Slipper. "Wet places in woods; not abundant." Holt.

*212. **Orchis rotundifolia** Pursh. Round-leaved Orchis. "Rare; tamarack forest." Holt.

213. **Habenaria bracteata** (Willd.) R. Br. Wet place in climax forest: Duncan Bay.

214. **Habenaria hyperborea** (L.) R. Br. Rein Orchis. Sedge zone, Bog Succession, common.

215. **Habenaria dilatata** (Pursh) Gray. White Rein Orchis. Same habitat as last.

216. **Habenaria clavellata** (Michx.) Spreng. Sedge zone of Bog Succession: Forbes Lake.

217. **Habenaria obtusata** (Pursh) Richards. Bog forest, abundant; also climax forest.

218. **Habenaria Hookeri** Torr. Heath mat in rock opening in climax forest: ridge northwest of Tobin's Harbor: one plant only.

219. **Habenaria orbiculata** (Pursh)Torr. Climax forest; bog forest, rare.

220. **Habenaria psycodes** (L.) Sw. Purple Fringed Orchis. Sedge zone of Bog Succession, frequent.

221. **Pogonia ophioglossoides** (L.) Ker. Pogonia. Sedge zone of Bog Succession.

222. **Arethusa bulbosa** L. Arethusa. Same habitat as last.

223. **Spiranthes Romanzoffiana** Cham. Lady's Tresses. Same habitat as last.

224. **Epipactis repens** (L.) Crantz. var. **ophioides** (Fernald) A. A. Eaton. Rattlesnake Plantain. Bog forest; climax forest.

225. **Epipactis tesselata** (Lodd) A. A. Eaton. Bog forest; climax forest.

226. **Epipactis decipiens** (Hook.) Ames. Climax forest.

*227. **Epipactis pubescens** (Willd.) A. A. Eaton. Downy Rattlesnake Plantain. "Rather dry woods." Holt.

228. **Listera cordata** (L.) R. Br. Twayblade. Bog forest, common.

229. **Listera auriculata** Wiegand. Bog forest: Park Place; also mossy bank of sheltered cove, same locality.

230. **Listera convallarioides** (Sw.) Torr. Bog forest: Monument Rock trail.

231. **Corallorhiza trifida** Chatelain. Early Coral Root. Climax forest.

232. **Corallorhiza maculata** Raf. Large Coral Root. Park Place.

233. **Corallorhiza striata** Lindl. Striped Coral Root. Burn forest: Park Place.

*234. **Liparis liliifolia** (L.) Richard. "Moist woods and along bog margins." Holt.

235. **Liparis Loeselii** (L.) Richard. Sedge and sphagnum zones, Bog Succession.

236. **Calypso bulbosa** (L.) Oakes. Calypso. Park Place.

Salicaceae. Willow Family.

237. **Salix balsamifera** Barratt. Balsam Willow. Shore crevices and bare burned ridges.

238. **Salix pedicellaris** Pursh. Bog Willow. Shrub zone, Bog Succession.

239. **Salix discolor** Muhl. Glaucous Willow. Shrub zone, Delta Swamp Succession; rock shore crevice.

240. **Salix humilis** Marsh. Heath mat in rock opening in climax forest; burn forest.

241. **Salix rostrata** Richards. Rock shore crevices; burn forest.

242. **Salix pellita** Anders. Tobin's Harbor:

243. **Salix phylicifolia** L. Shrub zone, Bog Succession: head of Siskowit Bay; Gull Islands.

244. **Populus tremuloides** Michx. Aspen. Occasional in the climax forest and in rock shore crevices; frequent in the xerophytic forest stage of the Rock Shore Succession; abundant in the burn forest, second only to Betula alba papyrifera.

*245. **Populus grandidentata** Michx. Large-toothed Aspen. "Principally along the Greenstone Ridge; not at all common as compared with P. tremuloides." Holt.

246. **Populus balsamifera** L. Balsam Poplar. Occasional in the climax and burn forests and in rock shore crevices.

Myricaceae. Sweet Gale Family.

247. **Myrica Gale** L. Sweet Gale. One of the two principal shrubs of the shrub zone of the Delta Swamp Succession, the other being Alnus incana; also frequent in the shrub zone of the Bog Succession.

Betulaceae. Birch Family.

248. **Corylus rostrata** Ait. Beaked Hazelnut. Abundant in open burn forest.

*249. **Betula lenta** L. Cherry Birch; Sweet Birch. "Associated with B. lutea." Holt.

*250. **Betula lutea** Michx. f. Yellow Birch. "Noted only along the forest road from Washington Harbor to Lake Desor, where it was very common along the Greenstone Ridge. Specimens 36 inches in diameter noted." Holt.

251. **Betula alba** L. var. **papyrifera** (Marsh) Spach. Paper, Canoe, or White Birch. Second in abundance of the three climax trees. Persists after fire in its underground parts, and sprouting from the stump makes the bulk of the burn forest. Frequent in the bog forest and as a rock shore pioneer.

252. **Betula pumila** L. Low Birch. Occasional in the shrub zone of the Bog Succession.

253. **Alnus crispa** (Ait.) Pursh. Green or Mountain Alder. Climax forest, very abundant along its edge where it borders sheltered bays; frequent in rock shore crevices.

254. **Alnus incana** (L.) Moench. Hoary or Speckled Alder. Shrub zone of Bog Succession and bog forest, especially in localities where sphagnum is practically absent; abundant in shrub zone of Delta Swamp Succession.

Fagaceae. Beech Family.

*255. **Quercus rubra** L. Red Oak. "A single specimen was noted along the forest road between Washington Club and Lake Desor." Holt.

*256. **Quercus velutina** Lam. Black Oak. Adams (1908: p. 30) mentions Black Oak as occurring along the Lake Desor trail upon the summit of the Greenstone Range.

Urticaceae. Nettle Family.

257. **Urtica gracilis** Ait. Nettle. Clearings: Gull Islands.

Santalaceae. Sandalwood Family.

258. **Comandra livida** Richards. Frequent in climax forest, bog forest, and heath mat.

Aristolochiaceae. Birthwort Family.

*259. **Asarum canadense** L. Wild Ginger. "Flood plain, Washington Creek." Holt.

Polygonaceae. Buckwheat Family.

260. **Rumex Britannica** L. Great Water Dock. Sedge zone, Delta Swamp Succession.

261. **Rumex crispus** L. Curled Dock. Clearings.

262. **Rumex Acetosella** L. Sheep Sorrel. Clearings.
263. **Polygonum aviculare** L. Knotweed. Clearings.
264. **Polygonum Douglasii** Greene. Rock shore crevices, heath mat, and bare burned ridges.
265. **Polygonum viviparum** L. Alpine Buckwheat. Protected rock shore crevices and margins of rock pools.
266. **Polygonum tomentosum** Schrank. Sand beaches.
267. **Polygonum cil node** Michx. Recent burn: Smithwick Island: Gull Islands.

Chenopodiaceae. Goosefoot Family.

268. **Chenopodium capitatum** (L.) Asch. Strawberry Blite.
269. **Chenopodium album** L. Lamb's Quarters. Clearings.

Caryophyllaceae. Pink Family.

270. **Sagina nodosa** (L.) Fenzl. Pearlwort. Rock shore crevices.
271. **Stellaria borealis** Bigel. Climax forest: on cliffs and boulders and on the ground in wet places.
*272. **Stellaria longifolia** Muhl. Long-leaved Stitchwort. Holt.
273. **Cerastium vulgatum** L. Mouse-ear Chickweed. Clearings.
274. **Silene antirrhina** L. Sleepy Catchfly. Rock shore crevices and bare burned ridges.
275. **Silene noctiflora** L. Night-flowering Catchfly. Clearings.

Ceratophyllaceae. Hornwort Family.

276. **Ceratophyllum demersum** L. Hornwort. Delta streams.

Nymphaeaceae. Water Lily Family.

277. **Nymphaea advena** Ait. Yellow Pond Lily. Common aquatic in bog lakes, sheltered bays, and delta streams.
278. **Castalia odorata** (Ait.) Woodville and Wood. White Water Lily. Bog lakes and delta streams.
279. **Castalia tetragona** (Georgi.) Lawson. Small Northern Water Lily. Delta streams: Chippewa Harbor; Duncan Bay.

Ranunculaceae. Buttercup Family.

280. **Ranunculus aquatilis** L. var. **capillaceous** DC. White Water Crowfoot. Delta streams and sheltered bays.
281. **Ranunculus Flammula** L. var. **reptans** (L.) Mey. Creeping Spearwort. Muddy shores.
282. **Ranunculus rhomboideus** Goldie. Dwarf Buttercup. Heath mat and bare burned ridges.
283. **Ranunculus abortivus** L. Small-flowered Buttercup. Depression in climax forest.
284. **Ranunculus Macounii** Britton. Macoun's Buttercup. Sand beaches.
285. **Ranunculus acris** L. Tall Buttercup. Clearings.
286. **Thalictrum dasycarpum** Fisch. and Lall. Tall Meadow Rue. Grass Zone, Delta Swamp Succession.
287. **Hepatica triloba** Chaix. Very old burn west of Sumner Lake.
288. **Anemone multifida** Poir. Northern Anemone. Rock shore crevices: Mott Island.

289. **Anemone canadensis** L. Clearings.
290. **Clematis verticillaris** DC. Large-flowered Clematis. Rocks in climax forest and bare burned ridges.
291. **Caltha palustris** L. Marsh Marigold. Sedge zone of Bog and Delta Swamp Successions; bog forest.
292. **Coptis trifolia** (L.) Salisb. Goldthread. Climax forest, bog forest.
293. **Aquilegia canadensis** L. Columbine. Shore rocks; clearings.
294. **Actaea rubra** (Ait.) Willd. Red Baneberry. Bog, burn, and climax forests.
295. **Actaea rubra** (Ait.) Willd. f. **neglecta** (Gillman) Robinson. Same habitat as last.

Fumariaceae. Fumitory Family.

296. **Corydalis sempervirens** (L.) Pers. Pale Corydalis. Heath mat and rock shore crevices; bare burned ridges.
297. **Corydalis aurea** Willd. Golden Corydalis. Clearings.

Cruciferae. Mustard Family.

298. **Draba arabisans** Michx. Rock crevices: shores and interior cliffs.
299. **Draba arabisans** Michx. var. **orthocarpa** Fernald and Knowlton. Gull Islands.
*300. **Thlaspi arvense** L. Field Penny Cress. Washington Club grounds. Holt.
301. **Lepidium virginicum** L. Wild Pepper Grass. Clearings.
302. **Capsella Bursa-pastoris** (L.) Medic. Shepherd's Purse. Clearings.
303. **Brassica arvensis** (L.) Ktze. Field Mustard. Clearings.
304. **Sisymbrium altissimum** L. Hedge Mustard. Clearings.
*305. **Braya humilis** (C. A. Mey.) Robinson. Wheeler; Gillman, in Beal.
306. **Erysimum cheiranthoides** L. Worm-seed Mustard. Clearings.
307. **Erysimum parviflorum** Nutt. Clearings.
308. **Barbarea vulgaris** R. Br. Winter Cress. Sand beaches.
309. **Cardamine pennsylvanica** Muhl. Sandy shore: Tobin's Harbor.
310. **Arabis lyrata** L. Rock Cress. Rock shore crevices.
311. **Arabis Drummondii** Gray. Rock shore crevices and bare burned ridges.
312. **Arabis brachycarpa** (T. and G.) Britton. Rock shore crevices.
313. **Arabis hirsuta** (L.) Scop. Recent burn: Smithwick Island.

Sarraceniaceae. Pitcher-plant Family.

314. **Sarracenia purpurea** L. Pitcher-plant. Sedge and sphagnum zones of Bog Succession.

Droseraceae. Sundew Family.

315. **Drosera rotundifolia** L. Common Sundew. Sedge and sphagnum zones of Bog Succession; occasionally, margins of rock pools.
316. **Drosera anglica** Huds. Sedge zone of Bog Succession: Raspberry Island.
317. **Drosera longifolia** L. Sedge zone of Bog Succession.
318. **Drosera linearis** L. Sedge zone of Bog Succession.

Saxifragaceae. Saxifrage Family.

319. **Saxifraga virginiensis** Michx. Early Saxifrage. Rock shore crevices.
320. **Saxifraga tricuspidata** Rottb. Rock shore crevices, frequent.
321. **Saxifraga Aizoon** Jacq. Rock shore crevices, rare.
322. **Mitella nuda** L. Mitrewort. Climax forest; bog forest.
323. **Parnassia parviflora** DC. Grass of Parnassus. Margins of rock pools, and sheltered crevices.
324. **Parnassia palustris** L. Same habitat as last.
325. **Ribes oxyacanthoides** L. Gooseberry. Shore rocks, and rocks in climax forest.
326. **Ribes lacustre** (Pers.) Poir. Swamp Black Currant. Duncan Bay.
327. **Ribes prostratum** L'Her. Skunk Currant. Climax forest; burn forest.
328. **Ribes triste** Pall. Wild Red Current. McCargoe's Cove.
329. **Ribes triste** Pall var. **albinervium** (Michx.) Fernald. Climax forest.

Rosaceae. Rose Family.

330. **Physocarpus opulifolius** (L.) Maxim. Nine-bark. Shingle beaches; shrub zone of Delta Swamp Succession; rock shore crevices.
*331. **Pyrus melanocarpa** (Michx.) Willd. Black Chokeberry. "A single specimen noted on north side of Rock Harbor." Holt. Also Whitney.
332. **Pyrus americana** (Marsh) DC. Mountain Ash. Climax forest, scattered, more abundant along its edge; persisting after fires and making a portion of the burn forest; shingle beaches; often the only tree upon exposed rocky islets, for example, Gull Islands.
333. **Amelanchier canadensis** (L.) Medic. Shad Bush; Service Berry. Rock shore crevices and bare burned ridges.
334. **Amelanchier oblongifolia** (T. and G.) Roem.
335. **Amelanchier spicata** (Lam.) C. Koch.
336. **Amelanchier oligocarpa** (Michx.) Roem. Rock shore crevices; bare burned ridges; occasional in bog and climax forests.
337. **Fragaria virginiana** Duchesne. Wild Strawberry. Heath mat; burn forest; clearings.
338. **Fragaria vesca** L. var. **americana** Porter. Smithwick Island.
339. **Waldsteinia fragarioides** (Michx.) Trattinick. Barren Strawberry. Burn forest: Sargent Lake trail near Rock Harbor.
340. **Potentilla arguta** Pursh. "N. to Isle Royale." Beal.
341. **Potentilla monspeliensis** L. Rock crevices; clearings.
342. **Potentilla pennsylvanica** L. Rock shore crevices.
343. **Potentilla palustris** (L.) Scop. Marsh Five-finger. Aquatic and sedge zones, Bog and Delta Swamp Successions.
344. **Potentilla fruticosa** L. Shrubby Cinquefoil. Shore crevices; shrub zone of Bog Succession: head of Siskowit Bay.
345. **Potentilla tridentata** Ait. Three-toothed Cinquefoil. The commonest species in rock shore crevices, persisting into the heath mat stage; also common upon interior cliffs and bare burned ridges.
346. **Potentilla Anserina** L. Silver Weed. Sand beaches.
347. **Potentilla canadensis** L.
348. **Rubus idaeus** L. var. **aculeatissimus** (C. A. Mey.) Regal and Tiling. Red Raspberry. Shingle beaches; rock shore crevices; follows the fireweeds in the Burn Succession, and persists into the burn forest stage.

349. **Rubus parviflorus** Nutt. Salmon Berry. Shingle beaches; occasional in the climax forest; most characteristic of open burn forest, where it is usually very abundant.

350. **Rubus triflorus** Richards. Dwarf Raspberry. Rock shore crevices; shingle beaches; bog forest.

*351. **Rubus arcticus** L. Arctic Raspberry. "Sparingly distributed in moist woods and filled bog areas." Holt.

352. **Rosa acicularis** Lindl. Wild Rose. Rock shore crevices; beaches; burn forest.

353. **Rosa acicularis** Lindl. var. **Bourgeauiana** Crepin. Gull Islands; Mott Island.

354. **Prunus virginiana** L. Choke Cherry. Burn forest.

355. **Prunus pennsylvanica** L. f. Pin Cherry; Fire Cherry. Rock shore crevices, occasional; bare burned ridges, often abundant, persisting into the burn forest stage.

Leguminosae. Pea Family.

356. **Trifolium pratense** L. Red Clover. Clearings.

357. **Trifolium repens** L. White Clover. Clearings.

358. **Trifolium hybridum** L. Pink Clover. Clearings.

359. **Vicia americana** Muhl. Vetch.

360. **Lathyrus maritimus** (L.) Bigel. Beach Pea. Sand beach: entrance to Duncan Bay.

361. **Lathyrus palustris** L. Vetchling. Sedge and grass zones of Delta Swamp Succession.

362. **Lathyrus ochroleucus** Hook. Same habitat as last.

Oxalidaceae. Wood Sorrel Family.

363. **Oxalis Acetosella** L. Wood Sorrel. Climax forest: Smithwick Island; Duncan Bay.

Geraniaceae. Geranium Family.

364. **Geranium Bicknellii** Britton. Heath mat and clearings.

Polygalaceae. Milkwort Family.

365. **Polygala paucifolia** Willd. Fringed Polygala. Climax forest.

Callitrichaceae. Water Starwort Family.

366. **Callitriche palustris** L. Water Starwort. Aquatic: Delta Swamp Succession.

Empetraceae. Crowberry Family.

367. **Empetrum nigrum** L. Crowberry. Rock shore crevices and margins of rock pools.

Anacardiaceae. Cashew Family.

368. **Rhus typhina** L. Sumach.

Aceraceae. Maple Family.

*369. **Acer pennsylvanicum** L. Striped Maple; Moosewood. Holt.

370. **Acer spicatum** Lam. Mountain Maple. Climax forest; bog forest.

*371. **Acer saccharum** Marsh. Sugar Maple. "One part of the island, on the summit of the Greenstone Ridge along the forest road from Washington Harbor to Lake Desor, it is very abundant. Reported to occur sparingly along other parts of the Greenstone, but seems to be confined entirely to the higher parts of the summit ridge. Along this 'forest road' it forms almost pure stands, in other places there is Betula lutea and B. lenta mixed with it. Some of the trees are 2–3 feet in diameter." Holt. Reported also by Adams, Ruthven, and others.

372. **Acer rubrum** L. Red Maple. Bare burned ridge: Sargent Lake trail near Rock Harbor.

Balsaminaceae. Touch-me-not Family.

373. **Impatiens biflora** Walt. Jewel Weed. Depression in climax forest: Duncan Bay.

Rhamnaceae. Buckthorn Family.

374. **Rhamnus alnifolia** L'Her. Buckthorn. Sheltered cliff: Passage Island; Shrub zone of Bog Succession: head of Siskowit Bay.

Hypericaceae. St. John's-wort Family.

375. **Hypericum virginianum** L. Marsh St. John's wort. Sedge zone of Bog Succession.

Violaceae. Violet Family.

376. **Viola novae-angliae** House. Depression in climax forest: Duncan Bay.

377. **Viola pallens** (Banks) Brainerd. Depression in climax forest: Duncan Bay.

378. **Viola incognita** Brainerd. Sweet White Violet. Bog forest; climax forest.

379. **Viola renifolia** Gray. Delta swamp forest.

380. **Viola labradorica** Schrank. Rock Violet. Sheltered rock shore crevices.

*381. **Viola arenaria** DC. "Rocky shore near Siskowit cabin." Holt.

Elaeagnaceae. Oleaster Family.

382. **Shepherdia canadensis** (L.) Nutt.

Onagraceae. Evening Primrose Family.

383. **Epilobium angustifolium** L. Fireweed. Very abundant in recent burns; occasional in many other habitats.

384. **Epilobium palustre** L. Willow-herb. Sedge zone of Bog Succession.

385. **Epilobium adenocaulon** Haussk. Rock crevices: Chippewa Harbor.

386. **Oenothera biennis** L. Evening Primrose. Sandy shores and clearings.

387. **Circaea alpina** L. Enchanter's Nightshade. Depression in climax forest: Duncan Bay.

Haloragidaceae. Water Milfoil Family.

388. **Myriophyllum alterniflorum** DC. Water Milfoil. Tobin's Harbor.

389. **Myriophyllum spicatum** L. Aquatic, Delta Swamp Succession.

390. **Myriophyllum verticillatum** L. var. **pectinatum** Wallr. Aquatic, Delta Swamp Succession.

391. **Hippuris vulgaris** L. Mare's-tail. Delta streams and sheltered bays.

Araliaceae. Ginseng Family.

392. **Aralia hispida** Vent. Bristly Sarsaparilla. Recent burn: Smithwick Island.

393. **Aralia nudicaulis** L. Wild Sarsaparilla. Climax forest; bog forest.

394. **Fatsia horrida** (Sw.) B. and H. Devil's Club. Low places and sheltered cliffs in the climax forest. First reported by W. A. Wheeler, who found it at Blake Point and on Passage Island. Two other localities, Smithwick Island and Gull Islands, have been added by the present writer. At Blake Point there is a single dense thicket of the shrub, with few stragglers, occupying a moist depression in the climax forest. Conditions upon Smithwick Island are very similar. At the latter locality there are perhaps two hundred plants in all, while at the former it is more abundant. Upon Passage Island the species is distributed through the forest over the whole island being especially abundant upon the sheltered cliffs that surround the central cove. Upon Gull Islands, a group of rocky knobs far out in the lake, seven km. northeastward from Passage Island, about six specimens were found inhabiting a thicket-like growth of Pyrus americana and Calamagrostis canadensis. These bore curled and yellow leaves because of the severe conditions, but all were fruiting. The nearest known station to Isle Royale is in the Rocky Mountains of Montana.

Umbelliferae. Parsley Family.

395. **Sanicula marilandica** L. Black Snakeroot. Sargent Lake trail near Rock Harbor.

396. **Osmorhiza divaricata** Nutt. Sweet Cicely. Park Place.

397. **Cicuta bulbifera** L. Water Hemlock. Aquatic and sedge zones of Bog and Delta Swamp Successions.

398. **Pastinaca sativa** L. Parsnip. Clearings.

399. **Heracleum lanatum** Michx. Cow Parsnip. Clearings.

Cornaceae. Dogwood Family.

400. **Cornus canadensis** L. Bunchberry. Climax forest, persisting after fires and becoming very abundant in the burn forest; bog forest.

401. **Cornus circinata** L'Her. Round-leaved Dogwood. Climax forest, rare.

402. **Cornus stolonifera** Michx. Red-osier Dogwood. Shingle beaches; shrub zone of Delta Swamp Succession, and occasionslly of Bog Succession; bog forest and shore crevices, occasional.

Ericaceae. Heath Family.

403. **Chimaphila umbellata** (L.) Nutt. Pipsissewa. Climax forest.

404. **Moneses uniflora** (L.) Gray. One-flowered Pyrola. Bog forest; climax forest.

405. **Pyrola minor** L. Small Shin Leaf. Climax forest.

406. **Pyrola secunda** L. Nodding Shin Leaf. Bog forest; climax forest.

407. **Pyrola chlorantha** Sw. Climax forest.

408. **Pyrola elliptica** Nutt. Sedge zone, Bog Succession: near Tobin's Harbor.

409. **Pyrola asarifolia** Michx. Bog forest; sedge zone of Bog Succession.

410. **Pyrola asarifolia** Michx. var. **incarnata** (Fisch.) Fernald.

411. **Monotropa uniflora** L. Indian Pipe. Bog forest; climax forest.

412. **Monotropa Hypopitys** L. Pinesap. Climax forest: Duncan Bay.

413. **Ledum groenlandicum** Oeder. Labrador Tea. Shrub zone of Bog Succession, very abundant, especially where sphagnum is abundant; occasional on margins of rock pools.

414. **Kalmia polifolia** Wang. Pale Laurel. Shrub zone of Bog Succession, not abundant.

415. **Andromeda glaucophylla** Link. Andromeda. Abundant in shrub zone of Bog Succession, in all bog localities; also occasionally on rock pool margins.

416. **Chamaedaphne calyculata** (L.) Moench. Leather Leaf. The most abundant of the bog shrubs.

417. **Arctostaphylos Uva-urisi** (L.) Spreng. Bearberry; Kinnikinnick. Important rock shore crevice plant, becoming one of the principal constituents of the heath mat, and persisting into the xerophytic forest stage; also upon bare burned ridges.

418. **Chiogenes hispidula** (L.) T. and G. Creeping Snowberry. Bog forest; sphagnum-shrub zone of Bog Succession.

419. **Vaccinium pennsylvanicum** Lam. Early Blueberry. Rock shore crevice plant and a constituent of the heath mat.

420. **Vaccinium canadense** Kalm. Velvet-leaf Blueberry. Heath mat and rock shore crevices.

421. **Vaccinium uliginosum** L. Bog Bilberry. Rock shores, especially around rock pools.

422. **Vaccinium Oxycoccos** L. Small Cranberry. Sphagnum zone of Bog Succession.

423. **Vaccinium Oxycoccos** L. var. **intermedium** Gray.

424. **Vaccinium macrocarpon** Ait. Large Cranberry. Bog northwest of Tobin's Harbor.

Primulaceae. Primrose Family.

425. **Primula mistassinica** Michx. Mistassini Primrose. Sheltered shore crevices and margins of rock pools.

426. **Lysimachia terrestris** (L.) BSP. Loosestrife. Sedge zones of Bog and Delta Swamp Successions.

427. **Lysimachia thyrsiflora** L. Tufted Loosestrife. Shallow water in bog lakes and sheltered bays.

428. **Trientalis americana** (Pers.) Pursh. Star Flower. Climax forest; bog forest.

Oleaceae. Olive Family.

429. **Fraxinus americana** L. White Ash. Very old burn west of Sumner Lake; bog forest: Lake Eva. Rare.

430. **Fraxinus nigra** Marsh. Black Ash. Delta swamp forest, common and characteristic.

Gentianaceae. Gentian Family.

431. **Gentiana linearis** Froel var. **latifolia** Gray. Gentian. Park Place; McCargoe's Cove; Sargent Lake trail near Rock Harbor.

432. **Halenia deflexa** (Sm.) Griseb. Spurred Gentian. Sandy shores; burn forest.

433. **Menyanthes trifoliata** L. Buckbean. Aquatic and sedge zones of Bog and Delta Swamp Successions.

Apocynaceae. Dogbane Family.

434. **Apocynum androsaemifolium** L. Spreading Dogbane.

Convolvulaceae. Convolvulus Family.

435. **Convolvulus spithamaeus** L. Erect Bindweed. Bare burned ridges.

Hydrophyllaceae. Waterleaf Family.

436. **Phacelia Franklinii** (R. Br.) Gray. Burns and clearings, occasional.

Labiatae. Mint Family.

*437. **Scutellaria lateriflora** L. Mad-dog Skullcap. "Along flood plain of Washington Creek." Holt.

438. **Scutellaria galericulata** L. Skullcap. Sedge zone of Bog Succession.

439. **Nepeta hederacea** (L.) Trevisan. Ground Ivy. Clearings.

440. **Prunella vulgaris** L. Self-heal. Clearings.

441. **Satureja vulgaris** (L.) Fritch. Basil.

442. **Lycopus uniflorus** Michx. Bugle Weed. Sedge zone of Bog Succession.

443. **Mentha arvensis** L. var. **canadensis** (L.) Briquet. Wild Mint. Sargent Lake trail near Rock Harbor.

444. **Mentha arvensis** L. var. **glabrata** (Benth.) Fernald. Sandy shores.

Scrophulariaceae. Figwort Family.

445. **Verbascum Thapsus** L. Common Mullein. Clearings.

*446. Scrophularia leporella Bicknell. Figwort. "Along Washington Creek." Holt.

447. **Chelone glabra** L. Turtlehead. Sedge zones of Bog and Delta Swamp Successions, infrequent.

*448. **Veronica americana** Schwein. American Brooklime. "Along Washington Creek on low ground." Holt.

449. **Castilleja pallida** (L.) Spreng. var. **septentrionalis** (Lindl.) Gray. Paintbrush. Shore crevices, occasional; open burn forest, very abundant.

450. **Melampyrum lineare** Lam. Cow Wheat. Heath mat, bare burned ridges, and burn forest.

451. **Euphrasia arctica** Lange. Eyebright. Rock shore crevices and sandy shores, infrequent.

Lentibulariaceae. Bladderwort Family.

452. **Utricularia vulgaris** L. var. **americana** Gray. Common Bladderwort. Aquatic: Bog and Delta Swamp Successions.

453. **Utricularia minor** L. Smaller Bladderwort. Delta stream: Duncan Bay.

454. **Utricularia intermedia** Haynes. Aquatic and sedge zones, Bog and Delta Swamp Successions.

455. **Utricularia cornuta** Michx. Horned Bladderwort. Sedge zones, Bog and Delta Swamp Successions.

456. **Pinguicula vulgaris** L. Butterwort. Sheltered rock shore crevices and margins of rock pools.

Plantaginaceae. Plantain Family.

457. **Plantago major** L. Common Plantain. Clearings.

Rubiaceae. Madder Family.

*458. **Galium Aparine** L. var. **Vaillantii** (DC) Koch. "Low grounds along Washington Creek." Holt.

459. **Galium trifidum** L. Sedge zone, Bog Succession.

460. **Galium Claytoni** Michx. Sedge zone of Bog Succession; bog forest.

461. **Galium asprellum** Michx. Rough Bedstraw. Sedge zone, Bog Succession; grass zone, Delta Swamp Succession.

462. **Galium triflorum** Michx. Sweet-scented Bedstraw. Bog forest.

Caprifoliaceae. Honeysuckle Family.

463. **Diervilla Lonicera** Mill. Bush Honeysuckle. Abundant in the burn forest; also found in a variety of habitats, such as rock shore crevices, heath mat, beaches, and climax forest.

464. **Lonicera caerulea** L. var. **villosa** (Michx.) T. and G. Mountain Fly Honeysuckle. Shrub zone, Bog Succession: head of Siskowit Bay; McCargoe's Cove.

465. **Lonicera canadensis** Muhl. American Fly Honeysuckle. Climax forest; bog forest.

466. **Lonicera involucrata** (Richards) Banks. Bog forest, infrequent.

467. **Lonicera hirsuta** Eaton. Hairy Honeysuckle. Heath mat.

468. **Lonicera glaucescens** Rydb. Heath mat; rock shores.

469. **Symphoricarpos racemosus** Michx. var. **pauciflorus** Robbins. Snowberry. Ransom Clearing.

470. **Linnaea borealis** L. var. **americana** (Forbes) Rehder. Twinflower. Climax forest, abundant; bog forest; burn forest; heath mat; rock shore crevices.

471. **Viburnum pauciflorum** Raf. Squashberry. Climax, bog, and burn forests; rock shore crevices; shrub zone of Delta Swamp Succession.

*472. **Sambucus canadensis** L. Common Elder. "Light house clearing at Rock Harbor. Holt.

473. **Sambucus racemosa** L. Red-berried Elder. Climax forest.

Cucurbitaceae. Gourd Family.

474. **Echinocystis lobata** (Michx.) T. and G. Wild Cucumber. Sandy shores and clearings.

Campanulaceae. Bluebell Family.

475. **Campanula rotundifolia** L. Bluebell. Rock shore crevices; heath mat; bare burned ridges; clearings (sometimes very abundant).

476. **Campanula uliginosa** Rydb. Marsh Bellflower. Sedge zones, Bog and Delta Swamp Successions.

Lobeliaceae. Lobelia Family.

477. **Lobelia Kalmii** L. Rock shore crevices; sedge zone, Bog Succession.
*478. **Lobelia Dortmanna** L. Dr. A. B. Lyons, in Beal.

Compositae. Composite Family.

479. **Eupatorium purpureum** L. Joe-Pye Weed.
480. **Eupatorium purpureum** L. var. **maculatum** (L.) Darl. Sedge zone, Delta Swamp Succession: Chippewa Harbor.
481. **Solidago hispida** Muhl. Rock shore crevices, common; bare burned ridges.
482. **Solidago uliginosa** Nutt. Bog Goldenrod. Sedge zone, Bog Succession.
483. **Solidago juncea** Ait. Early Goldenrod. Bare burned ridges; burn forest.
484. **Solidago nemoralis** Ait. Heath mat; bare burned ridges.
485. **Solidago canadensis** L.
486. **Solidago altissima** L. Clearing: Duncan Bay.
487. **Solidago graminifolia** (L.) Salisb. Sandy shores.
488. **Aster macrophyllus** L. Large-leaved Aster. Climax and bog forests; burn forest, very abundant.
489. **Aster Lindleyanus** T. and G. McCargoe's Cove; Sargent Lake trail near Rock Harbor.
*490. **Aster lateriflorus** (L.) Britton var. **hirsuticaulis** (Lindl.) Porter. "Woods along Washington Creek; one locality only." Holt.
491. **Aster junceus** Ait. Sedge zone, Bog Succession: McCargoe's Cove.
492. **Aster puniceus** L.
493. **Aster umbellatus** Mill. var. **pubens** Gray. Sedge zone, Bog Succession.
494. **Aster ptarmicoides** T. and G. Rock shore crevices.
495. **Erigeron canadensis** L. Horse-weed. Recent burns and clearings.
496. **Erigeron acris** L. var. **asteroides** (Andrz.) DC. Recent burns, occasional.
497. **Antennaria neodioica** Greene. Everlasting. Rock shore crevices, heath mat, and bare burned ridges.
498. **Anaphalis margaritacea** (L.) B. and H. Pearly Everlasting. Recent burns, very abundant; occasional in many other xerophytic habitats.
499. **Gnaphalium decurrens** Ives. Cudweed
500. **Ambrosia psilostachya** DC. Ragweed. Clearing: McCargoe's Cove.
501. **Rudbeckia hirta** L. Black-eyed Susan.
502. **Bidens Beckii** Torr. Water Marigold. Delta streams: Duncan Bay.
503. **Achillea Millefolium** L. Yarrow. Shore crevices, bare burned ridges, and clearings.
504. **Chrysanthemum Leucanthemum** L. White Daisy. Clearings.
505. **Tanacetum vulgare** L. Tansy. Clearings.
506. **Artemisia canadensis** Michx. Wormwood. Rock shore crevices.
507. **Petasites palmatus** (Ait.) Gray. Sweet Coltsfoot. Bog forest, common.

*508. **Senecio discoideus** (Hook.) Britton. Wheeler.

509. **Senecio Balsamitae** Muhl. Ragwort. Rock shore crevices; bare burned ridges; burn forest.

510. **Arctium minus** Bernh. Burdock. Clearings.

511. **Cirsium arvense** (L.) Scop. Canada Thistle. Clearings.

512. **Taraxacum officinale** Weber. Dandelion. Rock shore crevices, bare burned ridges, and clearings.

513. **Lactuca canadensis** L. Wild Lettuce.

514. **Lactuca pulchella** (Pursh.) DC. Clearings and bare burned ridges.

515. **Lactuca villosa** Jacq. Clearing: Park Place.

516. **Prenanthes racemosa** Michx. Rattlesnake-root. Rock shore crevices and margins of rock pools; sand beaches.

517. **Prenanthes alba** L.

518. **Hieracium scabrum** Michx. Hawkweed.

519. **Hieracium umbellatum** L. Rock shore crevices, bare burned ridges, and burn forest.

THE FLOWERING PLANTS, FERNS AND FERN ALLIES GROWING WITHOUT CULTIVATION IN LAMBTON COUNTY, ONTARIO.

BY C K. DODGE.

INTRODUCTION.

To one interested in plant distribution, the need for gathering the data at once is very apparent. The advent of the white man into North America has been attended by sweeping changes in the vegetation, and every year the opportunities of obtaining a working knowledge of the primitive flora are becoming less. The need of immediate work may seem somewhat less in Michigan and adjoining territory because there are still considerable areas of nearly virgin ground, and yet it is very urgent, even with us, as is illustrated by the region that is reported upon in the present paper.

It is relatively but a few years since Michigan and Ontario were covered with dense forests traversed only by a few rude trails. At the present time much of the forest has been cleared away, many of the minor species have disappeared in the process, and the ground is occupied largely by introduced species both cultivated and wild. Nor, unfortunately for the botanist, have the changes ceased. Every year the native associations are becoming modified or terminated, and it will be but a relatively short time until most of the data on the original conditions will have to be gleaned from books.

It is believed that a record of the present vegetat'on of Lambton County will prove of interest to students both of the Ontario and Michigan flora, as well as to the general student, for no botanist in studying the plants and their distribution along the Great Lakes and their connecting streams can do the work well without examining both sides from Lake Erie to Sault Ste. Marie. The following list has been the result of investigations, which extend over a period of over twenty-five years.

I am much indebted to the late Prof. C. F. Wheeler of the Department of Agriculture, Bureau of Plant Industry, for kindly looking over the various species of Cyperaceae, to A. S. Hitchcock, agrostologist of the United States Department of Agriculture, for the determination of many grasses, to Newton Tripp, of Forest, and T. C. Wheatley, of Blackwell Station, Lambton County, who have given much assistance in the following compilation, and to Prof. John Macoun, who has given me much encouragement in this work.

LOCATION OF THE COUNTY.

The County of Lambton in the Province of Ontario is situated at the foot of Lake Huron and east of the St. Clair River, having about 40 miles of Lake Huron shore and about 35 miles of St. Clair River shore, and extending east from the river over 30 miles. It is one of the extreme southwestern counties of the province, and includes the delta islands of St. Clair River which belong to Ontario and lie immediately west of the northern part of Kent County. The larger islands are Walpole Island, Squirrel Island and St. Ann's Island.

LAKES AND RIVERS.

Within the county small lakes are not numerous. There were formerly a few in the northeastern part, but these were shallow and are now mostly drained. There are two prominent drainage areas, the streams of the one flowing to the north into Lake Huron and those of the other south into Lake St. Clair. The mouths of those flowing into Lake Huron are usually closed during the summer months with sand and gravel washed up by the waves, but in the spring and fall floods they are opened. The Aux Sables River, the largest of the streams, entering the county from the northeast appears to flow continuously, but its present winding course and the large number of abandoned beds, show conclusively that its flow to Lake Huron has often been obstructed and very materially changed. This river has cut deep into the drift and rock making a narrow wooded flood plain. Along this stream and its small branches, especially near Rock Glen, appear fossil bearing rock exposures which have proved of great interest to geologists. Along its high banks is the finest scenery in Lambton County. In the southeast, streams of considerable size enter the county and have carved out narrow flood plains, formerly well wooded.

GENERAL SURFACE CONDITIONS.

The surface of Lambton County is generally low and level, there being very few hills and very little rolling land. In early times it was considered a very wet country, and was heavily wooded and difficult to penetrate. On the north shore of Lake St. Clair bordering on the lower ends of the delta islands, the water for some distance is very shallow, and the adjacent land, recently made, very wet and boggy. Various parts away from shore are prairie-like, usually very wet in spring and fall but very dry and spongy in summer and covered mostly with sedges and grasses. Sandy spots and a very few sand ridges are noticed at the upper ends. In various other parts of the county, tamarack swamps, marshy and boggy places and a few ponds are noticed, but all these have partially disappeared and have been greatly modified in recent years by drainage and fires.

The delta islands are very interesting. These without doubt were mostly formed by the deposit of material carried down by the river into Lake St. Clair, and it has been estimated that about one fourth of the original lake area has thus been filled up.[1]

Along the Lake Huron shore for nearly the whole distance from Point Edward to the northeast limit of the county are sand dunes, usually parallel with the shore, ranging from a few to many feet in height and extending back from a few rods to a mile. For a short distance near Kamlachie and Kettle Point, the latter place famous for its peculiar rock formation, the sand dunes for the most part disappear, and flat and naturally wet land, covered with the prevailing forest of the country, runs down to the shore. These dunes are pure sand and owe their origin exclusively to local conditions and the combined action of wind and waves. They are not so extensive here as on the west coast of Michigan and not very prominent except at and near Port Franks, where a vast amount of sand has been piled up and ridge succeeds ridge for about a mile back from shore. Here, in comparison with the surrounding country, they are very striking in appearance and some of

[1]See report of Leon J. Cole on "The Delta Islands of St. Clair River." Geological Survey of Michigan, Vol. IX, Part 1.

them rise to nearly 100 feet in height. Most of them are fixed, being covered and held in place with trees, shrubs and herbaceous plants, but near the lake, especially at Port Franks, the dunes are still forming and being blown first one way and then another, nowhere so far as observed encroaching upon good agricultural land. As the Lake Huron shore of the county runs quite regularly northeast and southwest, the question naturally arises as to why the dunes are so much larger at Port Franks than at other points along the shore. On the west coast of Michigan it has been noticed that by far the largest dunes have been formed at the mouths of rivers[2] and this perhaps fully explains the situation at Port Franks. At this point the Aux Sables River enters the lake and brings down and carries into it an immense quantity of sand which is again washed up by waves and then blown up into dunes.

HABITAT DISTRIBUTION OF PLANTS.

From the foregoing it will be seen that in a general discussion of distribution, the district under consideration may be divided into three fairly well defined kinds of habitats, the very wet or hydrophytic, the medium wet or mesophytic, and the very dry or xerophytic.

Hydrophytic Habitats.

These habitats are particularly interesting, altho the plants of the small rivers and small dried-up lakes do not form any considerable part of the flora. On the borders of Lake St. Clair, along the several mouths of the St. Clair River and on the delta islands, the bogs, coves, small bays, and large areas of shallow and apparently rather stagnant water, are sufficiently permanent and free from variations to encourage the growth of all plants fitted to thrive under such conditions. The pondweeds (*Potamogetons*) flourish, about 27 species or forms having been noticed and in many places on the borders of Lake St. Clair and the mouths of the St. Clair River and often extending out some distance into the deeper water, the rush, *Scirpus occidentalis*, is so dense that it is difficult to row a small boat through it. With the latter is often associated an abundance of *Equisetum fluviatile*, and usually nearer the shore, sometimes however in shallow water or in very wet places, *Scirpus validus*, *S. heterochaetus*, *Sparganium eurycarpum* and *Bidens beckii* are abundant. In the coves and still water the pickerel-weed, *Najas flexilis*, water shield, *Nymphaea advena* and *Castalia tuberosa* are very frequent and *Eleocharis quadrangulata* occasional. In very wet places, for at least part of the year, and often as it appears in strips, or in the beds of old but now mostly discontinued streams, the common reed (*Phragmites communis*) is abundant, and is a very striking feature of the vegetation when in bloom. The renowned Indian rice *Zizania palustris* L., and *Vallisneria spiralis*, known among sportsmen as wild celery, both known to furnish valuable food for wild ducks, are found, the former plentiful in spots, the latter common everywhere in shallow water. Another plant, *Sagitaria latifolia*, sometimes known as swan root, the root or rootstock of which is said to furnish food for ducks and swans, is very common in mud and shallow water.

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[2] "The Ecological Relations of the Vegetation on the Sand Dunes of Lake Michigan," by Henry Chandler Cowles. Botanical Gazette, Vol. XXVII, Nos. 2-3-4-5, 1899.

Mesophytic Habitats.

By far the largest part of this region is included here. But a short time ago, comparatively speaking, Lambton County was covered with an almost impenetrable forest. At that time conditions were such that large quantities of water, received in the form of rain and snow, were retained for nearly the whole summer season. The creeks and small rivers, more or less clogged with rubbish, drained the wooded surface very slowly and the forests were then known as "wet woods." Since that time a radical change has taken place. At present the whole region is fairly well drained and most of the timber has been cut; there are left here and there "wood lots" that partially show the former conditions, although not very well as they are generally heavily pastured. The Indian reservations below Sarnia and on the delta islands, having undergone a less radical change, although parts are fairly well cultivated, show better than any other localities what the original vegetation was. From an examination of woods near Sarnia, Port Franks, Rock Glen, Wyoming, Watford, Alvinston, and the Indian reservations, especially on the delta islands (places covering the whole of the county), it appears that, at least approximately, the original trees were in order of abundance much as follows: American elm, black ash, red maple, basswood, beech, sugar maple, ironwood (*Ostrya virginiana*), blue beech (*Carpinus caroliniana*), silver maple, *Crataegus punctata*, red oak, bur oak, cottonwood, yellow birch, shag-bark hickory, bitternut, sycamore, peach-leaved willow, red ash, rock elm and slippery elm. Pin oak is the dominant tree on the delta islands and here, or perhaps in parts of Kent County, reaches its northern limit. The big shell-bark hickory, *Carya laciniosa* (Michx. f.) Loud., comes as far north as Kent County and very probably exists on Walpole Island.

In such wet forests the species of plants in the undergrowth are not very numerous. Among others were noticed the spice bush, moosewood, red-berried elder, lizard's tail, jack-in-the-pulpit, wild leek (formerly very abundant), wild garlic, groundnut (*Panax trifolium*), spikenard, wild sarsaparilla, *Circaea alpina*, wood nettle, *Cardamine douglassii*, and *Claytonia virginica*. Much of the prairie-like land of the delta islands naturally falls within this division. Hundreds of acres there are covered with *Habenaria leucophaea*, *Liatris spicata* (a beautiful plant when in bloom), Indian grass, several species of *Panicum*, vanilla grass, *Gerardia paupercula*, numerous sedges, and *Spartina Michauxiana*. In spots are found *Asclepias sullivantii*, *Tradescantia reflexa*, *Viola sagittata*, *Vernonia illinoensis Gleason*, *Polygala incarnata*, *Panicum virgatum*, and *Cypripedium candidum*.

Xerophytic Habitats.

The beech and sand dunes at the foot of Lake Huron provide and illustrate xerophytic conditions for plants. The beach has a very limited vegetation, and many plants peculiar to itself and not equally distributed. *Cakile edentula* is seldom abundant but fairly well distributed, prefers pure sand and grows so near the water's edge as to be frequently washed by waves. *Euphorbia polygonifolia* is abundant in spots and is often found in the drifting sand of the beach. *Artemisia caudata* is frequent but this is also found on the dunes. One plant of the beach, perhaps deserving particular notice, is *Circium pitcheri*, a thistle known only along the Great Lakes, and named for Dr. Zina Pitcher, an army physician stationed more than 60 years ago

at Fort Gratiot, Michigan, now a part of the city of Port Huron. This plant, common at Port Franks, loves the wave-washed shore and often creeps up the first shoreward dune, but very seldom goes beyond. *Amophila arenaria* and *Calamovilfa longifolia*, two grasses not very equally distributed but plentiful in places on the beach, the former usually nearer the water, the latter farther up on the beach, but both also noticed on dunes. They are true and efficient sand-binders, both having a root or rootstock system which very effectually protects the sand from the action of wind and waves.

The beach pea, also frequent at Port Franks, is another strong sand binder and has been known to extend its rootstock in sand over nine feet horizontally. *Juncus balticus littoralis* also frequently establishes itself on the beach as a strong sand binder, but it is common also in other localities.

The sand dunes are far more stable than the beach and support a more varied vegetation. Since the beach and dunes are the least productive of any part of the county, they are at present useful only for timber growth and a small amount of pasture. Generally only the plants adapted to dry, sandy conditions, grow on them. The vegetation has not been much changed and hence is fairly primitive. Only those plants thrive which have developed special powers of resistance and can best endure the hard conditions imposed upon them. In this region the dune plant covering varies in many respects in different places.

Immediately east of Point Edward the dominant trees are white oak, yellow-barked oak, and red oak. Balsam poplar is often abundant on the dune nearest the lake and makes a good sand binder. The bur oak, although usually found in rich, damp ground, is frequent here on the shoreward dune and acts as a good sand binder and dune builder. In this situation, however, it is generally small and scraggy, often having its trunk buried several feet in the sand, but usually producing a great abundance of acorns. White pine and sassafras are also very frequent. The prevailing smaller trees and shrubs are the choke cherry, witch-hazel, *Rhus typhina*, *R. canadensis*, *R. toxicodendron*, *Amelanchier spicata*, black huckleberry, low sweet blueberry, and in places *Ceanothus ovatus*, bearberry, *Ceanothus americanus Symphoricarpos racemosus pauciflorus*, *Rosa humilis*, sand cherry, *Vitis vulpina*, dewberry, and *Amelanchier oblongifolia*. On the upper beach near many of the summer cottages and along the first dune, *Salix purpurea* has been planted, thrives, and is proving to be a strong sand binder. The prevailing herbaceous plants, many of them plentiful in places, are *Sporobolus cryptandrus*, *Elymus canadensis*, *Agropyron dasystachyum*, *Bromus kalmii*, porcupine grass, *Lithospermum gmelini*, *L. angustifolium*, *Anemone cylindrica*, *Arabis lyrata*, *Liatris scariosa*, *L. cylindracea*, *Viola pubescens*, *V. fimbriatula*, *V. pedata lineariloba*, *Senecio balsamitae*, *Campanula rotundifolia*, *Lespedeza capitata*, *L. frutescens*, *Acerates virdiflora lanceolata*, *Polygonum tenue*, *Draba caroliniana*, wild lupine, *Solidago hispida*, *S. rigida*, *Aster azureus*, *Lilium philadelphicum andinum*, *Asclepias syriaca*, and *A. tuberosa*.

Farther to the northeast, beyond Kettle Point and toward Port Franks, where the dunes are more massive, the change in plant association is very apparent. Here the Norway pine (red pine) is well established and abundant, reaching its southern limit for this locality. The white pine is far more common, the common juniper, low juniper and red cedar become abundant, and two oaks, *Querens Muhlenbergii* and *Q. prinoides*, occasionally seen on or near the dunes farther west, become very plentiful at Port Franks. The scarlet oak is occasional. *Celtis occidentalis pumila* is very common and

the late Rev. Mr. Currie of Thedford reports having seen one or two specimens of the species near that place. *Salix gluacophylla* is abundant on the upper beach and dunes and is a substantial sand binder. *Shepherdia canadensis* is also very abundant in places, and many herbaceous plants, a few not seen elsewhere, also find a congenial home here. On the shaded sides of high dunes are *Oryzopsis racemosa* and *Carex eburnea*, and in the drifting sands, bugseed grows in great abundance. In places *Buchnera americana*, *Aster ptarmicoides*, and *Viola arenaria* are frequent.

In a few places on the delta islands, xerophytic conditions prevail. Within a small area on Squirrel Island, the following assemblage of plants was observed: *Liatris scariosa*, *Hieracium longipilum*, butterfly-weed, wild lupine, *Lespedeza capitata*, *Ceanothus americanus*, *Gentiana puberula*, *Bucknera americana*, *Stipa comata*, *Andropogon scoparius*, *Gerardia skinneriana*, and *G. parvifolia*.

LOCAL AND INTRODUCED SPECIES.

Some localities are noted for the occurrence of one or more species seldom seen or at least not noticed elsewhere. Not far from the dunes fine specimens of the tulip tree are noticed and the butternut is not uncommon. In the wooded river flood plains, many large trees of the black walnut still exist. At the north end of Walpole Island, the scarlet painted cup and *Cerastrium arvense oblongifolium* are abundant, the latter not noticed in any other place. About the middle of the north half of the same island, several places are thickly covered with *Silphium terebinthinaceum*, long ago reported by Prof. John Macoun. On the bank of the Aux Sable River, Mr. Newton Tripp of Forest found *Cacalia tuberosa* and *Astragalus neglectus*, both rare for this region. In and about a pond north of Sarnia, *Utricularia resupinata* is very plentiful.

The changes brought about by the destruction of the native flora are accompanied by the introduction of numerous species. At Point Edward, where the Grand Trunk railway formerly crossed the St. Clair River into Michigan, the following introduced plants have been well established for a number of years on sandy ground and in streets and waste places: *Datura stramonium*, *D. tatula*, *Ambrosia psilostachya*, *Amaranthus blitoides*, Russian thistle, Catnip, *Solanum carolinense*, *Euphorbia lucida*, *Artemisia vulgaris*, *A. pontica*, *A. frigida*, *Echium vulgare*, *Ribes aureum*, Matrimony vine, *Linaria vulgaris*, *L. minor*, *Verbena stricta*, *V. bracteosa*, *Cycloloma atriplicifolium*, *Chenopodium botrys*, *Thlaspi arvense*, *Onopordum acanthium*, *Bromus brizaeformis*, *B. tectorum*, *Sisymbrium altissimum*, *Petalostemon purpureum* and others.

Scientific names are according to Gray's New Manual of Botany, Illustrated.

LIST OF SPECIES.

Polypodiaceae. Fern Family.

Phegopteris dryopteris (L.) Feé, Oak Fern.—Occasional in rich woods.

Adiantum pedatum L. Maidenhair.—Frequent in damp woods and thickets.

Pteris aquilina L. Common Brake.—Common both on damp and dry ground.

Woodwardia virginica (L.) Sm. Chain Fern.—Occasional on low and marshy ground. Newton Tripp.

Asplenium angustifolium Michx. Narrow-leaved Spleenwort.—Occasional in rich woods. Newton Tripp.

Asplenium acrostichoides Sw. Silvery Spleenwort.—In moist woods. Newton Tripp. Apparently rare.

Asplenium filix-femina (L.) Bernh. Lady Fern.—Very common on open, damp ground or in damp, open thickets.

Polystichum acrostichoides (Michx.) Schott. Christmas Fern.—Frequent in damp woods and on shady banks of streams.

Aspidium thelypteris (L.) Sw. Marsh Shield Fern.—Very common on marshy ground and in damp thickets.

Aspidium noveboracense (L.) Sw. New York Fern. Noticed in rich woods near Forest, Ont. Apparently infrequent. N. Tripp.

Aspidium marginale (L.) Sw. Evergreen Wood Fern.—Frequent in rich woods and on shaded banks of streams.

Aspidium goldianum Hook. Goldie's Fern.—Occasional in rich woods and shaded alluvial ground. Newton Tripp.

Aspidium cristatum (L.) Sw. Crested Shield Fern. Frequent in open swampy ground or damp thickets. Newton Tripp.

Aspidium cristatum clintonianum D. C. Eaton. Clinton's Crested Shield Fern.—Damp rich woods near Port Franks.

Aspidium spinulosum (O. F. Miller) Sw. Spinulose Shield Fern.—Common in rich woods.

Aspidium spinulosum intermedium (Muhl.) D. C. Eaton.—American Shield-Fern.—Common in rich woods and thickets.

Cystopteris bulbifera (L.) Bernh. Bulb-bearing Fern.—Occasional along shaded banks of streams and in rich open woods.

Cystopteris fragilis (L.) Bernh. Brittle Fern.—Frequent in damp rich woods.

Onoclea sensibilis L. Sensitive Fern.—Very common in damp open woods and thickets.

Onoclea struthiopteris (L.) Hoffm. Ostrich Fern.—Occasional in damp woods and thickets. Newton Tripp. One of our best ferns for cultivation.

Osmundaceae. Flowering Fern Family.

Osmunda regalis L. Flowering Fern.—Very common in swamps, wet and marshy places.

Osmunda claytoniana L. Clayton's Fern.—Common in damp open woods and thickets. A beautiful fern for cultivation. The finest specimens noticed on Squirrel Island, one of the delta islands of St. Clair River.

Osmunda cinnamomea L. Cinnamon Fern.—Very common in damp open woods and thickets. A fine fern for cultivation.

Ophioglossaceae. Adder's Tongue Family.

Ophioglossum vulgatum L. Adder's Tongue.—Occasional on the delta islands of St. Clair River. A plant easily overlooked.

Botrychium obliquum Muhl. Ternate Grape-fern.—Occasional in open or slightly shaded ground on the delta islands of St. Clair River.

Botrychium virginianum (L.) Sw. Rattlesnake Fern.—Common in rich open woods and thickets.

Equisetaceae. Horsetail Family.

Equisetum arvense L. Common Horsetail.—Very common, especially in sandy ground, on roadsides and along railways. A good sand binder.

Equisetum pratense Ehrh. Thicket Horsetail.—Reported by Prof. John Macoun as found near Sarnia, Ont. Apparently rare.

Equisetum sylvaticum L. Wood Horsetail.—Common in damp open woods and thickets.

Equisetum fluviatile L. Swamp Horsetail. Pipes.—Common in swamps, ditches, shallow water, on borders of ponds and slow streams.

Equisetum hyemale intermedium A. A. Eaton. Scouring Rush.—Common in dry and sandy ground. At first mistaken for **E. laevigatum,** A. Br.

Equisetum hyemale affine (Engelm.) A. A. Eaton. Smaller Scouring Rush.—On railroad embankment near Blackwell Station.

Equisetum hyemale robustum (A. Br.) A. A. Eaton. (E. nobustum A. Br.) Large Scouring Rush.—Occasional in damp sandy ground. Abundant along the G. T. Railway near Blackwell Station.

Equisetum variegatum Schleich. Variegated Equisetum.—Abundant in several places at Port Franks in wet ground.

Equisetum variegatum jesupi A. A. Eaton. Smaller Variegated Equisetum.—Occasional on dry or damp sandy ground.

Equisetum scirpoides Michx. Sedge-like Equisetum.—Occasional in moist shaded places. Abundant at Rock Glen. A plant easily overlooked.

Lycopodiaceae. Club Moss Family.

Lycopodium lucidulum Michx. Shining Club Moss.—Frequent in cool damp woods.

Lycopodium annotinum L. Stiff Club-moss. Pine woods near Port Franks Occasional.

Lycopodium clavatum L. Common Club-moss. Dry woods. Frequent.

Lycopodium obscurum dendroideum D. C. Eaton. Ground Pine.—Occasional in dry woods.

Lycopodium complanatum L. Trailing Christmas Green.—Occasional in woods and thickets, more common in pine woods near Port Franks.

Selaginellaceae. Selaginella Family.

Selaginella apus (L.) Spreng. Creeping Selaginella.—Frequent in damp open places.

Isoetaceae. Quillwort Family.

Isoetes macrospora Dur. Lake Quillwort. Abundant in the mouths of St. Clair River.

Taxaceae. Yew Family.

Taxus canadensis Marsh. American Yew. Ground Hemlock.—Occasional in damp woods and thickets; frequent among pines near Port Franks.

Pinaceae. Pine Family.

Pinus strobus L. White Pine.—Occasional south of Lake Huron shore, and other parts of the county. Frequent at Port Franks. Formerly abundant near Thedford in sandy spots. At present few large trees left.

Pinus sylvestris L. Scotch Pine.—Frequently planted but not spreading.

Pinus resinosa, Ait. Red Pine. Norway Pine.—Abundant at Port Franks on sand ridges, probably reaching here its southern limit. Not noticed elsewhere in county.

Larix laricina (Du Roi) Koch. American Larch. Tamarack.—Formerly very abundant in what was popularly called tamarack swamps. Now becoming scarce from cutting, drainage and fires.

Picea canadensis (Mill.) B. S. P. White Spruce.—Often planted but not spreading. Growing wild near Southampton, Bruce Co.

Picea mariana (Mull.) B. S. P. Black spruce.—Occasionally planted as an ornamental tree, but not spreading.

Picea abies (L.) Karst. Norway Spruce.—Planted in yards and cemeteries, but not spreading. Occasionally planted as a highway ornamental tree.

Abies balsamea (L.) Mill. Balsam Fir.—Occasionally planted but not spreading.

Tsuga canadensis (L.) Carr. Hemlock.—Occasionally noticed not far from the Lake Huron shore. More frequent near Port Franks.

Thuja occidentalis L. Arbor Vitae. White Cedar—Occasional in swampy places not far from the Lake Huron shore. Forming small cedar swamps near Port Franks.

Juniperus cummunis L. Common Juniper.—Occasional in dry woods, especially at and near Port Franks, and in woods near the lake shore. Perhaps doubtful.

Juniperus communis depressa Pursh. Low Juniper.—Abundant on the sand dunes at Port Franks acting as a sand binder.

Juniperus viriniana L. Red Cedar.—Frequent at Port Franks on and near the sand dunes. Not noticed elsewhere.

Typhaceae. Cat-tail Family.

Typha latifolia L. Common Cat-tail.—Very common in wet and boggy ground.

Typha angustifolia L. Narrow-leaved Cat-tail.—Occasional in wet and boggy ground and often growing with the preceding species.

Sparganiaceae. Bur-reed Family.

Sparganium eurycarpum Engelm. Broad-fruited Bur-reed.—Very common on borders of ponds, lakes, slow streams, and in wet places.

Sparganium americanum androcladum (Engelm.) Fernald and Eames. Branching Bur-reed.—Frequent in wet and boggy places.

Sparganium simplex Huds. Simple-stemmed Bur-reed.—Occasional in very wet and boggy places.

Najadaceae. Pondweed Family.

Potamogeton natans L. Common Floating Pondweed.—Abundant in Sarnia Bay and in still water near Lake St. Clair.

Potamogeton epihydrus Raf. Nuttall's Pondweed.—Frequent in Sarnia Bay and along the mouths of St. Clair River.

Potamogeton alpinus Balbis. Northern Pondweed.—Frequent in water at the mouths of St. Clair river.

Potamogeton americanus C. and S. Long-leaved Pondweed.—Common in water at the mouths of St. Clair River.

Potamogeton amplifolius Tuckerm. Large-leaved Pondweed.—Frequent in Sarnia Bay and in coves of streams.

Potamogeton hererophyllus Schreb. Various-leaved Pondweed.—Frequent along the borders of streams, especially about the mouths of St. Clair River.

Potamogeton angustifolius Berchtold and Presl. Ziz's Pondweed.—Frequent about the mouths of St. Clair River.

Potamogeton lucens L. Shining Pondweed.—Frequent in coves and still water about the mouths of St. Clair River.

Potamogeton praelongus Wulf. White-stemmed Pondweed.—Frequent in still water near the mouths of St. Clair River.

Potamogeton richardsonii (Benn.) Rydb. Richardson's Pondweed.—Frequent in still water about the mouths of St. Clair River.

Potamogeton perfoliatus L. Clasping-leaved Pondweed.—Common in St. Clair River and its mouths.

Potamogeton zosterfolius Schumacher. Eel-grass Pondweed.—Frequent along the mouths of St. Clair River.

Potomageton hillii Morong. Hill's Pondweed.—Frequent in still water near the mouths of St. Clair River.

Potamogeton obtusifolius Mertens & Koch. Blunt-leaved Pondweed.—Frequent in and about the mouths of St. Clair River.

Potamogeton friesii Rupr. Fries' Pondweed.—Frequent in still water near the mouths of St. Clair River.

Potamogeton pusillus L. Small Pondweed.—Frequent in coves and still water along and near the mouths of St. Clair River.

Potamogeton lateralis Morong. Opposite-leaved Pondweed.—Frequent along and near the mouths of St. Clair River.

Potamogeton vaseyi Robbins. Vasey's Pondweed.—Frequent in still and slowly flowing water in big ditches and about the mouths of St. Clair River.

Potamogeton rutilus Wolfgang. Slender Pondweed.—Frequent in still and slowly flowing water along the mouths of St. Clair River.

Potamogeton foliosus Raf. Leafy Pondweed.—Frequent in still water along and near the mouths of St. Clair River.

Potamogeton foliosus niagarensis (Tuckerm.) Morong. Smaller Leafy Pondweed. Frequent in slowly running water along the mouths of St. Clair River.

Potamogeton hybridus Michx. Rafinesque's Pondweed. Frequent in still and shallow water near the mouths of St. Clair River.

Potamogeton dimorphus Raf. Spiral Pondweed.—Frequent in still water and ditches along and near the mouths of St. Clair River.

Potamogeton filiformis Pers. Filiform Pondweed.—Frequent in shallow water along St. Clair River and its mouths.

Potamogeton pectinatus L. Fennel-leaved Pondweed.—Abundant along and about the mouths of St. Clair River.

Potamogeton robbinsii Oakes. Robbin's Pondweed.—Frequent in still water near the mouths of St. Clair River.

Najas flexilis (Willd.) Rostk. and Schmidt. Slender Naias.—Frequent in Sarnia Bay, in coves and ponds throughout.

Najas flexilis robusta Morong. Larger Naias.—Frequent in still water.

Juncaginaceae. Arrow Grass Family.

Scheuchzeria palustris L. Scheuchzeria.—In wet and marshy ground at Port Franks. Apparently rare.

Triglochin maritima L. Seaside Arrow-Grass.—Frequent in bogs and very wet marshes.

Triglochin palustris L. Marsh Arrow Grass.—Very common in damp sand along the Lake Huron shore near Port Franks. Seldom seen elsewhere.

Alismaceae. Water Plantain Family.

Sagittaria latifolia Willd. Broad-leaved Arrow-head.—Common in shallow water and mud.

Sagittaria arifolia Nutt. Arum-leaved Arrow-head.—Frequent in mud and shallow water, especially about Lake St. Clair and near the mouths of St. Clair River.

Sagittaria heterophylla Pursh. Sessile-fruited Arrow-head.—Occasional about St. Clair Flats in mud and shallow water.

Sagittaria graminea Michx. Grass-leaved Sagittaria.—Frequent in Sarnia Bay and in mud and shallow water along the mouths of St Clair River.

Alisma plantago-aquatica L. Water Plantain. Very common in ditches, mud and very wet places.

Hydrocharitaceae. Frog's Bit Family.

Elodea canadensis Michx. Water Thyme. Water-weed.—Very common in still and slowly flowing water. Reported as a very troublesome weed in England.

Vallisneria spiralis L. Tape-grass. Eel-grass. Wild Celery.—Very common in still and slowly moving water. Said to be an excellent food for ducks and carp. Abundant at St. Clair Flats.

Gramineae. Grass Family.

Andropogon scoparius Michx. Broom Beard-grass.—Common in dry open ground.

Andropogon furcatus Muhl. Forked Beard-grass.—Common in dry open or slightly shaded ground.

Sorghastrum nutans (L) Nash. Indian Grass. Wood Grass.—Frequent in dry ground. Abundant on the lower end of Walpole Island.

Digitaria humifusa Pers. Small Crab-Grass.—Frequent on dry and sandy ground. Usually prostrate.

Digitaria sanguinalis (L.) Scop. Crab Grass.—Very common and a vicious weed in gardens and cultivated grounds.

Panicum capillare L. Old-witch Grass.—Very common as a weed in cultivated grounds and waste places.

Panicum flexile (Gattinger) Seribn. Wiry Panicum.—In open ground wet in spring and fall but dry in summer, especially on delta islands of St. Clair River.

Panicum miliaceum L. European Millet.—Occasional in fields and waste places as an escape from cultivation.

Panicum virgatum L. Switch Grass.—Often in stools or bunches on very poor and dry ground. Abundant on the delta islands of St. Clair River where it often covers the ground and resembles a stand of large red-top.

Panicum depauperatum Muhl. Starved Panicum.—Frequent on dry and poor open or shaded ground.

Panicum dichotmum L. Forked Panicum.—Common on dry ground and in dry open woods.

Panicum lindheimeri Nash. Lindheimer's Panicum.—In sandy open ground near Sarnia, and on Squirrel Island.

Panicum huachucae Ashe. Woolly Panicum.—In prairie-like ground on Walpole Island.

Panicum huachusae silvicola Hitch. and Chase. Sylvan Panicum.—Borders of woods on prairie-like ground on the delta islands of St. Clair River.

Panicum implicatum Scribn. Hairy-panicled Panicum.—In damp ground near Sarnia and on the Delta Islands.

Panicum meridionale Ashe. Matting Panic-grass.—In sandy ground near Sarnia.

Panicum praecocius Hitchc. and Chase. Early-branching Panic-grass.—Occasional in open prairie-like ground on the delta islands of St. Clair River.

Panicum villosissimum Nash. Atlantic Panicum.—In dry, poor ground on Squirrel Island.

Panicum tsugetorum Nash. Hemlock Panicum.—Occasional in sandy ground near Sarnia.

Panicum sphaerocarpon Ell. Round-fruited Panicum.—Occasional on the delta islands of St. Clair River.

Panicum commutatum Schultes. Variable Panicum.—Frequent on borders of woods on the delta islands of St. Clair River.

Panicum scribnerianum Nash. Scribner's Panicum.—Frequent in dry and prairie-like ground on the delta islands of St. Clair River, and occasional in other places.

Panicum leibergii (Vasey) Scribn. Leiberg's Panicum.—Frequent in prairie-like ground on the delta islands of St. Clair River.

Panicum xanthophysum Gray. Slender Panicum.—Occasional in dry open woods near Port Franks.

Panicum clandestinum L. Hispid Panicum.—Occasional in wet grounds.

Panicum latifolium L. Large-fruited Panicum.—Frequent in dry ground. Abundant on St. Ann's Island.

Echinochloa crusgalli (L.) Beauv. Barnyard Grass.—Very common as a weed in gardens and moist waste places.

Echinochloa walteri (Pursh) Nash. Salt-marsh Cockspur-Grass.—Occasional in ditches and damp places.

Setaria glauca (L.) Beauv. Foxtail. Pigeon Grass.—Very common as a weed in cultivated and waste grounds.

Setaria viridis (L.) Beauv. Green Foxtail. Bottle Grass.—Very common as a weed in cultivated grounds and waste places.

Setaria italica (L.) Beauv. Italian Millet.—Occasionally escaping from cultivation into waste places.

Cenchrus carolinianus Walt. Sandbur. Bur Grass.—Very common in dry and sandy ground. Fast invading dry sandy fields and pastures.

Zizania palustris L. Water Rice. Indian Rice. Water Oats.—Abundant in Sarnia Bay, in shallow water along St. Clair River, its mouths and in wet marshes about Lake St. Clair, often over 8 feet high.

Zizania aquatica L. Smaller Water Rice. Not yet noticed for certain in Lambton Co., but found near Port Huron, St. Clair Co., Mich., along Black River and in creeks.

Leersia virginica Willd. White Grass.—Frequent in rich damp woods and thickets.

Leersia oryzoides (L.) Sw. Rice Cut-Grass. Scratch Grass.—Common in swamps, ditches, and on borders of slow streams.

Phalaris canariensis L. Canary Grass.—Occasional on roadsides and in waste places about towns and villages.

Phalaris arundinacea L. Reed Canary Grass.—Frequent and often abundant in wet marshy places.

Phalaris arundinacea picta L. Ribbon Grass.—Frequently escaping from cultivation into wet places and persisting.

Hierochloe odorata (L.) Wahlenb. Vanilla Grass. Seneca Grass.—Frequent in moist open ground on the delta islands of St. Clair River. Basal leaves used by the Indians of Walpole Island to make small ornamental boxes and baskets.

Milium effusum L. Tall Millett-Grass.—Occasional in damp open woods.

Oryzopsis pungens (Torr.) Hitchc. Slender Mountain Rice.—Frequent in dry and sandy ground. Common on the sand dunes at Port Franks.

Oryzopsis asperifolia Michx. White-grained Mountain Rice.—Frequent in open woods and on shaded hillsides.

Oryzopsis racemosa (Sm.) Ricker. Black-fruited Mountain Rice.—On shaded sides of sand dunes at Port Franks. Not noticed elsewhere.

Stipa comata Trin. and Rupr. Western Stipa.—Plentiful in dryish ground on Squirrel Island, one of the delta islands of St. Clair River. Probably from the west.

Stipa spartea Trin. Porcupine Grass.—Occasional on shaded shores of Lake Huron.

Aristida purpurascens Poir. Arrow-grass.—Abundant in spots in dry ground on Squirrel Island.

Muhlenbergia sylvatica Torr. Wood Muhlenbergia.—Occasional in damp woods and along shaded banks of streams.

Muhlenbergia mexicana (L.) Trin. Meadow Muhlenbergia.—Occasional in waste places and along shaded banks of streams.

Muhlenbergia racemosa (Michx.) BSP. Marsh Muhlenbergia.—Frequent on borders of marshes, in moist meadows and low ground.

Muhlenbergia shreberi J. F. Gomel. Dropseed. Nimble Will.—In dry woods near Lake Huron shore, along roads, and in dry waste places.

Brachyelytrum erectrus (Shreb.) Beauv. Brachyelytrum.—Frequent in dry open woods in northern part of county.

Phleum protense L. Timothy.—Common as an escape from cultivation.

Alopercurus geniculatus aristulatus Torr. Marsh Foxtail.—Common in shallow water and wet places.

Sporobolus vaginiflorus (Torr.) Wood. Sheathed Rush Grass.—Frequent in sterile fields and waste places.

Sporobolus neglectus Nash. Small Rush Grass.—Frequent in dry and poor ground.

Sporobolus cryptandrus (Torr.) Gray. Sand Dropseed.—Common in dry and sandy ground and in sand along the lakeshore. A good sand-binder.

Agrostis alba L. Red-top. White Bent Grass.—Common in damp meadows and fields. Often cultivated.

Agrostis hyemalis (Walt.) BSP. Hair Grass.—Frequent in dry or moist open ground.

Agrostis perennans (Walt.) Tuckerm. Thin Grass.—Occasional in low open ground or damp shaded places. T. C. Wheatley.

Calamovilfa longifolia (Hook.) Hack. Long-leaved Reed Grass.—Common and often very abundant on drifting sand along the Lake Huron shore. One of the very best sand-binders.

Calamagrostis canadensis (Michx.) Beauv. Blue-joint Grass.—Common in swamps and wet places, especially on the delta islands of St. Clair River.

Calamagrostis neglecta (Ehrh.) Gaertner, Meyer and Scherbius. Narrow Reed Grass.—Occasional along railways and in dry open woods.

Ammophila arenaria (L.) Link. Sea Sand-reed. Beach Grass.—Frequent in drifting sand along the Lake Huron shore. One of the best sand-binders against the action of both wind and wave.

Cinna arundinacea L. Wood Reed Grass.—Frequent in moist woods and shaded swampy places.

Sphenopholis abtusata (Michx.) Scribn. Blunt-scaled Eatonia.—Occasional on the delta islands of St. Clair River.

Koeleria cristata (L.) Pers. Koeleria.—Frequent on dry and sandy ground.

Danthonia spicata (L.) Beauv. Common Wild Oat Grass. Common on dry and poor open or shaded ground.

Spartina michauxiana Hitchc. Slough Grass.—Frequent in marshes and wet places. Abundant on the delta islands of St. Clair River. Formerly included with **S. cynosuroides** (L.) Roth., Salt Reed Grass.

Phragmites communis Trin. Reed.—Formerly very common in swamps and very wet places. Abundant yet in very wet places on the delta islands of St. Clair River.

Triplasis purpurea (Walt.) Chapm. Sand Grass.—On sand along the Lake Huron shore. Apparently rare.

Eragrostis hypnoides (Lam.) BSP. Creeping Eragrostis.—Frequent on damp ground, in dry ditches, and along sandy and gravelly shores.

Eragrostis frankii (Fisch., Mey. and Lall.) Steud. Frank's Eragrostis.—Frequent on moist open ground.

Eragrostis pilosa (L.) Beauv. Pursh's Eragrostis.—Frequent on dry and often hard ground about depots, freight yards, and along railway embankments. Also often named **E. purshii,** Schrad.

Eragrostis megastachya (Koeler) Link Strong-sc ented Eragrostis.—Frequent as a weed in gardens, cultivated grounds, and waste places.

Melica Smithii (Porter) Vasey. Smith's oat—Rich woods near Port. Franks, apparently infrequent.

Melica striata (Michx.) Hitchc. Purple Oat.—Occasional in open woods.

Dactylis glomerata L. Orchard grass. Frequent in yards, fields, and on roadsides. Cultivated.

Poa annua L. Low Spear Grass.—Becoming very common in lawns, fields and open woods.

Poa compressa L. Canada Blue Grass. Wire Grass.—Very common on sandy ground, in dry pastures and fields.

Poa triflora Gilib. Fowl Meadow Grass.—In wet meadows and damp open woods.

Poa pratensis L. June Grass. Kentucky Blue Grass.—The common grass of our yards and lawns. Abundant in pastures, fields, meadows and open woods.

Poa debilis Torr. Weak Spear Grass.—Occasional in open woods and thickets.

Poa alsodes Gray. Grove Meadow Grass.—Occasional in open woods and thickets.

Glyceria torreyana (Spreng.) Hitchc. Long Manna Grass.—Reported by Prof. John Macoun as noticed in woods near Sarnia. Apparently rare.

Glyceria canadensis (Michx.) Trin. Rattlesnake Grass.—Frequent in swamps, marshes and wet places. A beautiful grass.

Glyceria nervata (Willd.) Trin. Fowl Meadow Grass.—Abundant in moist meadows, wet places, and damp open woods.

Glyceria grandis Wats. Reed Meadow Grass.—Frequent in wet meadows, ditches and on damp banks of streams.

Glyceria septentrionalis Hitchc. Northern Manna Grass. Frequent in still shallow water. Formerly included with **G. fluitans** (L.) R. Br., Floating Manna Grass.

Festuca octoflora Walt. Slender Fescue Grass.—Frequent on dry and sandy ground. Usually very short.

Festuca rubra L. Red Fescue Grass.—On dry and sandy ground near Blackwell Station. Apparently rare. T. C. Wheatley.

Festuca ovina L. Sheep's Fescue.—Common on dry and sandy open ground.

Festuca elatior L. Meadow Fescue.—Frequent in yards, fields, meadows, and along railways.

Festuca nutans Spreng. Nodding Fescue.—Occasional in woods, thickets and open places.

Bromus secalinus L. Cheat. Chess.—Common in fields and waste places. Often a bad weed in wheat and oat fields.

Bromus hordeaceus L. Soft Chess.—Frequent on roadsides and along railways.

Bromus brizaeformis Fisch. and Mey. Quake-grass Brome.—Occasional in depot grounds, freight yards, and along railways.

Bromus tectorum L. Downy Brome Grass.—Occasional on dry and sandy ground. Noticed in particular at Weis Beach near Point Edward where it has persisted more than 10 years. Abundant at Point Edward in sand. Becoming very common.

Bromus sterilis L. Barren Brome-Grass.—Near Sarnia. T. C. Wheatley.

Bromus ciliatus L. Fringed Brome Grass.—Common in moist open woods and along shaded banks of streams.

Bromus pungens L. Hairy Wood Chess.—Moist open woods near Port Franks. Apparently infrequent.

Bromus kalmii Gray. Kalm's Chess.—Frequent on dry sandy ground and abundant in dry open woods. Noticed in particular as plentiful in one place on Squirrel Island, one of the delta islands of St. Clair River.

Lolium perenne L. Common Darnel. Perennial Rye Grass.—Occasional on roadsides and along railways.

Lolium multiflorum Lam. Italian Rye Grass.—Occasional in fields and on roadsides.

Lolium temulentum L. Bearded Darnel.—Occasional along railways.

Agropyron smithii Rydb. Western Wheat Grass.—Occasional in towns, villages, and along railways. Easily recognized by its conspicuous bluish green leaves.

Agropyron repens (L.) Beauv. Quack Grass. Couch Grass. Quitch Grass. Quick Grass.—Occasional on roadsides. Abundant along railways. A vicious weed in gardens and cultivated fields.

Agropyron dasystachyum (Hook.) Scribn. Northern Wheat Grass.—Occasional on sand along the Lake Huron shore. A good sand-binder.

Agropyron tenerum Vasey. Slender Wheat Grass.—Occasional on dry damp ground along railways.

Agropyron caninum (L.) Beauv. Awned Wheat Grass.—Occasional in damp ground. Noticed in particular in a marshy place near Point Edward.

Hordeum jubatum L. Squirrel-tail Grass.—Becoming frequent in towns.

villages, on roadsides, and along railways. Fast creeping into damp meadows. Liable to become a vicious weed. When mixed in hay said to be very dangerous to stock, the beards being more injurious than those of common barley.

Secale cereale L. Rye.—Often inclined to persist a few years in fields and along railways.

Elymus virginicus L. Virginia Wild Rye.—Frequent in moist ground and along the damp banks of streams.

Elymus canadensis L. Nodding Wild Rye.—Common on dry and sandy ground especially along the Lake Huron shore. A good sand-binder.

Elymus striatus Willd. Slender Wild Rye.—Occasional in open woods and along shaded banks of streams.

Hystrix patula Muench. Bottle-brush Grass.—Common in damp open woods and thickets.

Cyperaceae. Sedge Family.

Cyperus diandrus Torr. Low Cyperus.—Common in wet and marshy places.

Cyperus rivularis Kunth. Shining Cyperus.—Frequent in wet ground.

Cyperus esculentus L. Yellow Nut Grass.—Occasional. Often a vicious weed in cultivated grounds, but not yet troublesome here so far as observed.

Cyperus strigosus L. Straw-colored Cyperus.—Frequent in moist meadows and along the grassy low banks of streams.

Cyperus houghtonii Torr. Houghton's Cyperus.—Occasional in dry and sandy ground. Usually near the lake shore.

Cyperus filiculmis Vahl. Slender Cyperus.—Common on dry and poor ground.

Dulichium arundinaceum (L.) Britton. Dulichium.—Frequent in swamps and on borders of ponds.

Eleocharis quadrangulata (Michx.) R. and S. Quadrangular Spike Rush.—Occasional in shallow water. Noticed in Sarnia Bay and near the mouths of St. Clair River.

Eleocharis obtusa (Willd.) Schultes. Spike Rush.—Common in damp open ground.

Eleocharis palustris (L.) R. and S. Creeping Spike Rush.—Very common in shallow water and wet grassy ground.

Eleocharis palustris glaucescens (Willd.) Gray. Slender Creeping Spike Rush.—Frequent on damp grassy ground.

Eleocharis palustris calva (Torr.) Gray. Naked Creeping Spike Rush.—Abundant in Sarnia Bay and still water near the mouths of St. Clair River.

Eleocharis palustris vigens Bailey. Larger Creeping Spike Rush.—Frequent in water along St. Clair River, especially its mouths.

Eleocharis acicularis (L.) R. and S. Needle Spike Rush.—Common around living springs and on wet and muddy shores.

Eleocharis tenuis (Willd.) Schultes. Slender Spike Rush.—Frequent on wet and marshy ground.

Eleocharis acuminata (Muhl) Nees. Flat-stemmed Spike Rush.—Frequent on wet and marshy ground.

Stenophyllus capillaris (L.) Britton. Hair-like Stenophyllus.—Occasional in dry and sandy open ground.

Fimbristylis castanea (Michx.) Vahl. Marsh Fimbristylis.—Abundant in prairie-like ground on the delta islands of St. Clair River. Not noticed elsewhere.

Scirpus nanus Spreng. Dwarf Club Rush.—Occasional in wet ground.

Scirpus pauciflorus Lightf. Few-flowered Club Rush.—Occasional in damp ground. Noticed in particular on borders of coves and ponds in damp sand at Port Franks.

Scirpus subterminalis Torr. Water Club Rush.—Frequent in ponds and slow streams. Noticed in particular in Sarnia Bay, and in still water near Lake St. Clair.

Scirpus debilis Pursh. Weak-stalked Club Rush.—Frequent on muddy borders of ponds and slow streams. Abundant near the mouths of St. Clair River.

Scirpus americanus Pers. Three-square.—Very common in water and wet places, on borders of ponds, lakes, and streams.

Scirpus validus Vahl. Great Bulrush. Lake Bulrush.—Common in margins of lakes, ponds and streams.

Scirpus occidentalis (Wats.) Chase. Western Bulrush.—Frequent on borders of St. Clair River and Great Lakes.

Scirpus heterochaetus Chase. Unequal-bristled Bulrush.—Frequent in wet marshy places.

Scirpus fluviatilis (Torr.) Gray. River Bulrush.—Occasional on borders of lakes and streams. Noticed in particular as abundant along the mouths of St. Clair River and in low wet places on Walpole Island.

Scirpus atrovirens Muhl. Dark-green Bulrush.—Common in marshes, bogs, wet places and damp meadows.

Scirpus georgianus Harper. Club Rush.—Occasional in wet open woods.

Scirpus lineatus Michx. Reddish Bulrush.—Frequent in wet and marshy ground.

Scirpus cyperinus pelius Fernald. Wool Grass.—Common in open swamps and wet meadows.

Eriophorum viridi-carinatum (Engelm.) Fernald. Tall Cotton-grass. Frequent in bogs and very wet meadows.

Eriophorum virginicum L. Sheathed Cotton Grass.—Occasional in very boggy open places.

Rynchospora alba (L.) Vahl. White Beaked Rush.—Occasional in very wet and marshy places. Noticed in particular near a pond east of Point Edward.

Rynchospora capillacea Torr. Capillary Beak Rush.—Frequent in wet and marshy ground.

Rynchospora glomerata (L.) Vahl. Clustered Beak Rush.—Occasional in low ground. Abundant in prairie-like ground on the delta islands of St. Clair River.

Cladium mariscoides (Muhl.) Torr. Twig Rush.—Common in bogs, very wet and marshy places.

Scleria triglomerata Michx. Tall Nut Rush.—Abundant in prairie-like ground on the delta islands of St. Clair River. Not noticed elsewhere.

Seleria Pauciflora Muhl. Papillose Nut-rush.—In dry open ground on the delta Islands. Frequent.

Scleria verticillata Muhl. Low Nut Rush.—Frequent in damp sandy ground along the mouths of St. Clair River. Not noticed elsewhere.

Carex muskingumensis Schwein. Muskingum Sedge.—Frequent in moist woods and thickets.

Carex scoparia Schkuhr. Pointed Broom Sedge.—Common in dry or damp open ground.

Carex tribuloides Wahlenb. Blunt Broom Sedge.—Frequent in damp meadows and moist open woods.

Carex tribuloides reducta Bailey. Smaller Blunt Broom Sedge.—Frequent in very wet woods.

Carex siccata Dewey. Dry-spiked Sedge.—Frequent on dry and sandy open or shaded ground.

Carex cristata Schwein. Crested Sedge.—Frequent in damp meadows and moist open woods.

Carex mirabilis Dewey. Larger Straw Sedge.—On dry banks and in open dry woods.

Carex mirabilis perlonga Fernald. Smaller Straw Sedge.—Occasional in dry open woods.

Carex straminea Willd. Straw Sedge.—Frequent in dry meadows and open woods.

Carex straminea echinodes Fernald. Prickly Straw Sedge.—Frequent in dry woods.

Carex bicknellii Britton. Bicknell's Sedge.—Frequent in dryish ground. Abundant on dry and prairie-like ground on the delta islands of St. Clair River.

Carex alata Torr. Broad-winged Sedge.—Frequent in marshes and damp open woods.

Carex suberecta (Olney) Britton. Prairie Straw Sedge.—Occasional in open marshy places.

Carex festucacea Schkuhr. Fescue Sedge.—Occasional in dry and sandy ground.

Carex festucacea brevior (Dewey) Fernald. Smaller Fescue Sedge.—On sandy shores of Lake Huron.

Carex bebbii Olney. Bebb's Sedge.—Frequent in low ground. Noticed in particular on the delta islands of St. Clair River.

Carex stelulata Good. Little Prickly Sedge.—Frequent in open low ground.

Carex stelulata excelsior (Bailey) Fernald. Larger Prickly Sedge.—Frequent in low ground.

Carex stelulata cephalantha (Bailey) Fernald. Smaller Prickly Sedge.—Frequent in damp ground.

Carex scirpoides Schkuhr. Inland Sedge. Frequent in damp ground. Noticed in particular on the delta islands of St. Clair River.

in **Carex canescens** L. Silvery Sedge.—Frequent in wet places.

Carex canescens subloliacea Laestad. Smaller Silvery Sedge.—Frequent damp and wet places.

Carex bromoides Schkuhr. Brome-like Sedge.—Common in swamps and rich open woods.

Carex deweyana Schwein. Dewey's Sedge.—Frequent in rich open woods and on shaded banks.

Carex tenuiflora Wahlenb. Sparse-flowered Sedge.—Frequent in wet marshy places.

Carex trisperma Dewey. Three-fruited Sedge.—In swamps often growing in sphagnum.

Carex tenella Schkuhr. Soft-leaved Sedge.—Frequent in very wet swampy places.

Carex rosea Schkuhr. Stellate Sedge.—Common in open dry woods and thickets.

Carex rosea radiata Dewey. Slender Stellate Sedge.—Common in rich woods.

Carex muhlenbergia Schkuhr. Muhlenberg's Sedge.—Common in dry and sandy ground.

Carex cephalophora Muhl. Oval-headed Sedge.—Occasional in dry open woods and on hillsides.

Carex sparganioides Muhl. Bur-reed Sedge.—Common in rich open woods.

Carex cephaloidea Dewey. Thin-leaved Sedge.—Frequent in rich woods and thickets.

Carex vulpinoidea Michx. Fox sedge. Common in low damp open or shaded ground.

Carex diandra Schrank. Lesser Panicled Sedge.—Frequent in bogs and wet meadows.

Carex diandra ramosa (Booth) Fernald. Small panicled sedge. Wet boggy places. Frequent.

Carex stipata Muhl. Awl-fruited Sedge.—Common in swamps and very wet meadows.

Carex sartwellii Dewey. Sartwell's Sedge.—Common in ditches, swamps, and very wet places.

Carex crinita Lam. Fringed Sedge.—Common in swamps and wet open woods.

Carex aquatilis Wahlenb. Water Sedge.—Occasional in swamps. Plentiful near and along the mouths of St. Clair River.

Carex stricta Lam. Tussock Sedge.—Common in swamps and very wet places.

Carex aurea Nutt. Golden-fruited Sedge.—Common in damp grassy places.

Carex leptalea Wahlenb. Brittle-stalked Sedge.—Frequent in bogs and wet meadows.

Carex polygama Schkuhr. Brown Sedge.—Frequent in open bogs and very wet places.

Carex virescens swanii Fernald. Swan's Green Sedge.—Occasional in dry woods.

Carex formosa Dewey. Handsome Sedge.—Occasional along the shaded banks of St. Clair River.

Carex gracillima Schwein. Graceful Sedge.—Frequent in meadows and moist open woods.

Carex umbellata Schkuhr. Umbel-like Sedge.—Occasional in very poor and dry ground.

Carex communis Bailey. Fibrous-rooted Sedge.—Frequent in dry open woods

Carex varia Muhl. Emmons' Sedge.—Frequent in dry ground and dry open woods.

Carex pennsylvanica Lam. Pennsylvania Sedge.—Very common in dry sandy ground, and dry open woods.

Carex pubescens Muhl. Pubescent Sedge.—Frequent in open woods and thickets.

Carex livida (Wahlenb.) Willd. Livid Sedge.—Noticed only in one very wet, marshy place among cranberries north of Sarnia.

Carex tetanica Schkuhr. Marsh Sedge.—Frequent in bogs and damp meadows.

Carex tetanica woodii (Dewey) Bailey. Wood's Sedge.—Frequent in shady places.

Carex tetanica meadii (Dewey) Bailey. Mead's Sedge.—Frequent in swamps and wet meadows.

Carex paupercula irrigua (Wahlenb.) Fernald. Wazellan Sedge.—Occasional in bogs and tamarack swamps.

Carex prasina Wahlenb. Drooping Sedge—Occasional in damp open woods and thickets.

Carex eburnea Boott. Bristle-leaved Sedge.—Abundant on shaded sides of sand dunes at Port Franks. Not noticed elsewhere.

Carex pedunculata Muhlen. Long-stalked Sedge.—Frequent in rich woods.

Carex laxiflora patulifolia (Dewey) Carey. Two-edged Sedge.—Frequent on shaded dry ground.

Carex laxiflora varians Bailey. Woodland Sedge.—Frequent in open woods.

Carex laxiflora blanda (Dewey) Boott. Sylvan Sedge.—Frequent in open woods.

Carex laxiflora latifolia Boott. White Bear Sedge.—Frequent in rich woods. Noticed in particular along the Au Sable River.

Carex hitchcockiana Dewey. Hitchcock's Sedge.—Occasional in rich woods.

Carex grisea Wahlenb. Gray Sedge.—Frequent in meadows and damp open woods.

Carex granularis Muhl. Meadow Sedge.—Frequent in damp open woods and very common in damp meadows.

Carex granularis heleana (Olney) Porter. Schriver's Sedge.—Frequent in meadow-like ground.

Carex crawei Dewey. Crawe's Sedge.—Frequent in moist places. Noticed at Port Franks and on the delta islands of St. Clair River.

Carex flava L. Yellow Sedge.—Common in very damp or wet places.

Carex oederi pumila (Cosson and Germain) Fernald. Green Sedge.—Occasional in damp sand and damp places.

Carex castanea Wahlenb. Chestnut Sedge.—Sandy ground near Port Franks.

Carex capillaris L. Hair-like Sedge.—A small piece of marshy ground covered with it north of Sarnia. Not noticed elsewhere.

Carex arctata Boott. Drooping Wood Sedge.—Frequent in woods and thickets.

Carex filiformis L. Slender Sedge.—Very common in bogs and shallow water. Very prominent as a peat-forming plant.

Carex lanuginosa Michx. Woolly Sedge.—Common in damp meadows and very wet places.

Carex aligosperma Michx. Few-seeded Sedge.—In wet boggy places, near Port Franks.

Carex trishocarpa aristata (R. Br.) Bailey. Awned Sedge.—In marshy ground on Walpole Island.

Carex riparia W. Curtis. River-bank Sedge.—Common in swamps and very wet places.

Carex pseudo-cyperus L. Cyperus-like Sedge.—Frequent in bogs and shallow water. Noticed in particular about Lake St. Clair.

Carex comosa Boott. Bristly Sedge.—Occasional in swamps.

Carex hystericina Muhl. Porcupine Sedge.—Common in wet and marshy places.

Carex lurida Wahlenb. Sallow Sedge.—Frequent in swamps and wet woods.

Carex retrorsa Schwein. Retrosse Sedge.—Frequent in wet places.

Carex retrorsa hartii (Gray) Dewey. Hart Wright's Sedge.—Frequent in wet ground.

Carex lupuliformis Sartwell. Hop-like Sedge.—Frequent in swamps and wet meadow-like places.

Carex lupulina Muhl. Hop Sedge.—Common in swamps and wet woods.

Carex lupulina pedunculata Dewey. Stalked Hop Sedge.—Range and habitat same as above.

Carex grayii Carey. Gray's Sedge.—Frequent in rich damp woods and damp meadows.

Carex intumescens Rudge. Bladder Sedge.—Frequent in swamps, rich open woods and damp meadows.

Carex intumescens fernaldii Bailey. Fernald's Sedge.—Frequent in damp woods.

Carex rostrata Stokes. Bottle Sedge.—Occasional in very wet and swampy places.

Carex rostrata utriculata (Boott.) Bailey. Larger Bottle Sedge.—Frequent in swamps and shallow water.

Carex tuckermani Dewey. Tuckerman's Sedge.—Frequent in damp places.

Araceae. Arum Family.

Arisaema triphyllum (L.) Schott. Indian Turnip. Jack-in-the-pulpit.—Common in rich moist woods and thickets.

A. dracontium (L.) Schoot, not yet noticed in Lambton Co., but is found along Black river near Port Huron, St. Clair Co., Mich.

Calla palustris L. Water Arum. Wild Calla.—Occasional on borders of tamarack swamps.

Symplocarpus foetidus (L.) Nutt. Skunk Cabbage.—Common in swamps, on wet banks and hillsides.

Acorus calamus L. Sweet Flag.—Frequent in swamps and on margins of slow streams.

Lemnaceae. Duckweed Family.

Spirodela polyrhiza (L.) Schleid. Greater Duckweed.—Common in still water and often on mud.

Lemna trisulca L. Ivy-leaved Duckweed.—Noticed in stagnant water near the mouths of St. Clair River.

Lemna minor L. Lesser Duckweed.—Common in ponds, stagnant water, and on mud.

Commelinaceae. Spiderwort Family.

Tradescantia reflexa Raf. Reflexed Spiderwort.—Abundant in dryish ground on the delta islands of St. Clair River. Not noticed elsewhere.

Tradescantia virginiana L. Virginia Spiderwort.—Occasionally escaping from cultivation and persisting.

Pontederiaceae. Pickerel-weed Family.

Pontederia cordata L. Pickerel-weed.—Frequent in shallow water on borders of ponds, lakes, and slow streams.

Pontederia cordata augustifolia Farr. Pickerel-weed. Reported about Lake St. Clair in shallow water.

Juncaceae. Rush Family.

Juncus bufonius L. Toad Rush.—Common in damp open ground and on roadsides.

Juncus tenuis, Willd. Slender Rush.—Common in fields and on roadsides,

Juncus greenei Oakes and Tuckerm. Greene's Rush.—In one place on Walpole Island. Apparently rare.

Juncus balticus littoralis Engelm. Baltic Rush.—Common in damp or dry and sandy ground. Often abundant on the Lake Huron shore where it acts as a good sand-binder.

Juncus effusus L. Common Rush. Soft Rush.—Very common in wet and marshy ground.

Juncus brachycephalus (Engelm.) Buchenau. Small-headed Rush.—Frequent in marshes and wet places.

Juncus canadensis J. Gay. Canada Rush.—Frequent in marshy places.

Juncus pelocarpus Mey. Brownish-fruited Rush.—Frequent in wet sand and swampy places. Noticed in particular on the delta islands of St. Clair River.

Juncus nodosus L. Knotted Rush.—Frequent in damp and marshy ground and on damp gravelly banks.

Juncus torreyi Coville. Torrey's Rush.—Frequent in damp or marshy ground, in ditches, and abundant on the delta islands of St. Clair River.

Juncus acuminatus Michx. Sharp-fruited Rush.—Frequent in damp ground,

Juncus alpinus insignis Fries. Richardson's Rush.—Frequent along St. Clair River and on the delta islands formed by its mouth.

Juncus articulatus L. Jointed Rush.—Frequent in wet ground. Abundant at Alvinston on damp banks along railroad.

Luzula saltuensis Fernald. Hairy Wood Rush.—Common in dryish open woods and on shaded banks.

Luzula campestris multiflora (Ehrh.) Celak. Common Wood Rush.—Common in fields, meadows and open woods.

Liliaceae. Lily Family.

Tofieldia glutinosa (Michx.) Pers. Glutinous Tofieldia.—Frequent in open moist and wet grounds.

Uvularia grandiflora Sm. Large-flowered Bellwort.—Common in rich open woods and thickets.

Oakesia sessilifolia (L.) Wats. Sessile-leaved Bellwort.—Very common in damp open woods, thickets and meadows. Often called wild oats.

Allium tricoccum Ait. Wild Leek.—Occasional in rich woods. Formerly very abundant but nearly exterminated by pasturage. **Allium schoenoprasum sibiricum** (L.) Hastm., Chives, and **A. cerunum,** Roth., Wild onion, are reported as formerly existing by old residents, but have not been noticed of late. Chives are often cultivated.

Allium canadense L. Wild Garlic.—Often very abundant in damp meadows, less frequent in open woods and thickets. **Allium vineale,** L., field garlic, has not been noticed but may be expected to appear as a weed.

Hamerocallis fulva L. Common Day Lily.—Frequent on roadsides and along railways, having become well naturalized.

Lilium philadelphicum andinum (Nutt.) Ker. Western Red Lily.—Frequent along the Lake Huron shore. Abundant on sand dunes at Port Franks, and on Squirrel Island, one of the delta islands of St. Clair River.

Lilium superbum L. Turk's Cap Lily.—Frequent in rich damp ground, fields, and often in open damp woods.

Lilium canadense L. Wild Yellow Lily.—Occasional on the delta islands of St. Clair river.

Lilium tigrinum Ker. Tiger Lily.—Occasionally escaping from cultivation to roads and along railways.

Erythronium americanum Ker. Yellow Adder's Tongue.—Frequent in rich open woods and thickets.

Erythronium albidum Nutt. White Dog's-Tooth Violet.—Occasional in rich open woods. Formerly abundant on Stag Island in St. Clair River below Sarnia.

Muscari batryoides (L.) Mill. Grape Hyacinth.—Cultivated and inclined to persist for many years.

Yucca filamentosa L. Adam's Needle.—Planted and inclined to persist in sandy ground for many years.

Asparagus officinalis L. Asparagus.—Well established as an escape and frequent in dry sandy ground and open dry woods, along roads and railways.

Clintonia borealis (Ait.) Raf. Yellow Clintonia.—Frequent in wet open woods, and formerly abundant in and about tamarack swamps.

Smilacina racemosa (L.) Desf. False Spikenard.—Common in most open woods and thickets. Occasionally abundant in dry and sandy shaded ground.

Smilacina stellata (L.) Desf. Star-flowered Solomon's Seal.—Common in damp ground, damp open woods and thickets. Often abundant in dry and sandy ground along the Lake Huron shore.

Smilacina trifolia (L.) Desf. Three-leaved Solomon's Seal.—Occasional in wet and boggy ground.

Maianthemum canadense Desf. False Lily-of-the-Valley.—Very common in dry or moist open woods and thickets.

Streptopus roseus, Michx. Sessile-leaved Twisted Stalk.—Frequent in damp woods and thickets.

Polygonatum biflorum (Walt.) Ell. Small Solomon's Seal.—Frequent in damp open woods and thickets.

Polygonatum commutatum (R. and S.) Dietr. Great Solomon's Seal.—Frequent on prairie-like ground and along shaded banks of streams, especially on the delta islands of St. Clair River.

Convallaria majalis L. Lily of the Valley.—An ornamental plant but inclined to persist for many years.

Medeola virginiana L. Indian Cucumber-root.—Frequent in rich damp woods and thickets.

Trillium erectum L. Ill-scented Wake Robin.—Frequent in rich woods and thickets.

Trillium grandiflorum (Michx.) Salisb. Large-flowered Wake Robin.—Very common in rich damp woods and thickets. **Trillium declinatum** (Gray) Gleason. Gleason's Drooping Wake Robin. Reported as found in rich woods near Port Franks. Prof. Bowman. **T. undulatum** Willd., painted trillium,

not yet noticed in Lambton Co., is occasionally found near Port Huron, St. Clair Co., Mich.

Aletris farinosa L. Colic-root. Star Grass.—Occasional in open prairie-like ground on the delta islands of St. Clair River. A few specimens noticed in damp ground north of Sarnia.

Smilax herbacea L. Carrion-flower.—Frequent in moist meadows and along banks of streams.

Smilax ecirrhata (Engelm.) Wats. Upright Smilax.—Frequent in damp rich woods and thickets.

Smilax hispida Muhl. Hispid Greenbrier.—Common in open woods and thickets.

Dioscoreaceae. Yam Family.

Dioscorea villosa L. Wild yam-root. Common in thickets. According to Bulletin 89 of the U. S. Agricultural Department, Bureau of Plant Industry, this should be named **Dioscorea paniculata** Michx.

Amaryllidaceae. Amaryllis Family.

Hypoxis hirsuta (L.) Coville. Star Grass.—Frequent and often abundant in meadows and open woods.

Iridaceae. Iris Family.

Iris versicolor L. Larger Blue Flag.—Very common in wet places.

Iris germanica L. Fluer-de-lis.—Inclined to escape from cultivation into streets and roads and persist.

Sisyrinchium mucronatum Michx. Michaux's Blue-eyed Grass.—Occasional in meadows, fields, and open woods.

Sisyrinchium angustifolium Mill. Northern Blue-eyed Grass.—Frequent in meadows, fields, and damp sandy ground.

Sisyrinchium granineum Curtis. Common Blue-eyed Grass.—Frequent in damp meadows.

Orchidaceae. Orchid Family.

Cypripedium arietinum R. Br. Ram's Head Lady's Slipper.—Occasional in sandy shaded ground among small oaks and poplars at Port Franks. A few small specimens found growing on sand dunes. First noticed by Miss Maggie McKinley of Sarnia.

Cypripedium parviflorum Salisb. Smaller Yellow Lady's Slipper.—Frequent in very wet and marshy ground.

Cypripedium parviflorum pubescens (Willd.) Knight. Larger Yellow Lady's Slipper.—Frequent in rich woods and thickets. Small specimens in sand noticed at Port Franks. Becoming scarce.

Cypripedium candidum Muhl. Small White Lady's Slipper.—Frequent in damp places on the delta islands of St. Clair River. A few specimens noticed north of Sarnia.

Cypripedium hirsutum Mill. Showy Lady's Slipper.—Formerly abundant in swamps and borders of damp woods. Now very scarce and liable to become extinct from constant picking.

Cypripedium acaule Ait. Stemless Lady's Slipper.—Occasional in dry open woods.

Orchis spectabilis L. Showy Orchis.—Occasional in rich woods and thickets.

Habenaria bracteata (Willd.) R. Br. Long Bracted Orchis.—Occasional in damp open woods and thickets.

Habenaria flava (L.) Gray. Tubercled Orchis.—Occasional in damp places.

Habenaria hyperborea (L.) R. Br. Tall Leafy Green Orchis.—Occasional in peat bogs and wet woods.

Habenaria dilatata (Pursh.) Gray. Tall White Bog Orchis.—Occasional in wet meadows, bogs, and wet open woods. Noticed in particular near a pond east of Point Edward.

Habenaria clavellata (Michx.) Spreng. Small Green Wood Orchis.—Occasional in rich moist woods near Forest. Newton Tripp.

Habenaria hookeri Torr. Hooker's orchis.—Occasional in dry or damp open woods.

Habenaria orbiculata (Pursh.) Torr. Large Round-leaved Orchis.—Occasional in pine woods near Port Franks. Newton Tripp.

Habenaria lacera (Michx.) R. Br. Ragged Fringed Orchis.—Occasional in moist open or shaded ground.

Habenaria leucophaea (Nutt.) Gray. Prairie White Fringed Orchis.—Abundant on the delta islands of St. Clair River. Seldom noticed elsewhere.

Habenaria psycodes (L.) Sw. Smaller Purple-fringed Orchis.—Occasional in swamps and wet meadows.

Pogonia ophioglossoides (L.) Ker. Rose Pogonia.—Formerly very abundant in wet and boggy places near Sarnia. Becoming scarce on account of drainage and fires.

Calopogon pulchellus (Sw.) R. Br. Grass Pink. Calopogon.—Frequent in boggy and very wet places.

Spiranthes gracilis (Bigel.) Beck. Slender Ladies Tresses.—Occasional in dry and sandy ground.

Spiranthes lucida (H. H. Eaton) Ames. Wide-leaved Ladies' Tresses.—Moist places near Lake Huron Shore. Newton Tripp.

Spiranthes cernua (L.) Richard. Nodding Ladies' Tresses.—Common in bogs and wet ground.

Spiranthes romanzofiana Cham. Hooded Ladies' Tresses.—One specimen found in a very wet and swampy place north of Sarnia. Apparently rare.

Epipactis repens ophioides (Fernald) A. A. Eaton. Lesser Rattlesnake Plantain.—Occasional in dry ground among pines near Lake Huron shore. Newton Tripp.

Epipactis pubescens (Willd.) A. A. Eaton. Downy Rattlesnake Plantain.—Occasional in dry ground among pines. Newton Tripp.

Corallorrhiza trifida Chatelain. Early Coral-root.—Occasional in tamarack swamps.

Corallorrhiza maculata Raf. Large Coral-root. Frequent in rich woods and thickets.

Liparis loeselii (L.) Richard. Fen Orchis.—Occasional in damp prairie-like ground on the delta islands of St. Clair River and near Port Franks.

Aplectrum hyemale (Muhl.) Torr. Adam-and-Eve. Putty-root.—Occasional in rich woods and thickets.

Piperaceae. Pepper Family.

Saururus cernuus L. Lizard's Tail.—Occasional in swamps and shallow water.

Salicaceae. Willow Family.

Salix nigra, Marsh. Black Willow.—Frequent as a shrub or small tree in damp ground and on banks of ponds, lakes, and streams.

Salix amygdaloides Anders. Peach-leaved Willow.—Our principal native tree willow. Abundant in damp ground, on borders of streams and in open places of damp woods.

Salix pentandra L. Bay-leaved Willow.—Frequently planted, but not escaping so far as observed.

Salix lucida Muhl. Shining Willow.—Very common in wet and marshy ground.

Salix serissima (Bailey) Fernald. Autumn Willow.—Occasional in damp marshy ground. Pistillate catkins persist till autumn.

Salix fragilis L. Crack Willow.—Occasional as a small tree throughout the county.

Salix alba L. White Willow.—Well established as an escape and frequent in damp places and on banks of streams.

Salix alba vitellina (L.) Koch. Yellow Willow.—Noticed often in cultivation.

Salix alba caerulea (Sm.) Koch. Blue Willow.—Noticed as occasional in cultivation.

Salix babylonica L. Weeping Willow.—Planted frequently, especially in cemeteries, but not escaping so far as noticed.

Salix longifolia Muhl. Sand Bar Willow.—Frequent on and near the shore of Lake Huron and along the banks of streams.

Selix cardota Muhl. Heart-leaved Willow.—Frequent in damp places and along streams.

Salix glaucophylla Bebb. Broad-leaved Willow.—Abundant on Lake Huron shore and sand dunes at Port Franks. A good sand binder. Not noticed elsewhere.

Salix pedicillaris Pursh. Bog Willow.—Frequent in boggy places and wet meadows.

Salix discolor Muhl. Glaucous Willow.—Common on borders of marshes, damp woods, and along banks of streams.

Salix petiolaris Sm. Slender Willow.—Common in marshy ground.

Salix humilis Marsh. Prairie Willow.—Frequent in dry and sandy ground.

Salix sericea Marsh. Silky Willow.—Frequent in wet places.

Salix rostrata Richards. Bebb's Willow.—Frequent on dry or moist ground, on borders of marshes, damp woods and along banks of streams.

Salix candida Flugge. Sage Willow. Hoary Willow.—Common in very wet and boggy places.

Salix purpurea L. Purple Willow.—Planted by cottage owners and thriving on Lake Huron shore near Sarnia. It seems to be a good sand-binder.

Populus alba L. White Poplar. Silver-leaved Poplar.—Planted and spreading by root in sandy ground. Have noticed pistillate flowers only.

Populus tremuloides Michx. American Aspen.—Very common. It often takes almost entire possession of marshes and burned-over districts.

Populus grandidentata Michx. Large-toothed Aspen.—Common in rich open woods, on borders of marshes and streams. Often on very dry and sandy ground.

Populus balsamifera L. Balsam Poplar.—Very common on and near the Lake Huron shore. Occasional in other places. A good sand-binder.

Populus candicans Ait. Balm of Gilead.—Occasionally planted, but not escaping so far as observed.

Populus deltoides Marsh. Cotton-wood.—Frequent in various situations, usually in rich ground. Often a very large tree. A tree very similar to this has been extensively planted for shade under name of Carolina poplar or large-leaved poplar and it has generally been referred to this species. After investigation Prof. C. E. Bessy has named it **Populus arguta,** applying the name **P. deltoides** to the eastern and **P. occidentalis** to the western cotton-wood. Have noticed staminate flowers only on the Carolina poplar. Not recommended as a street, road or ornamental tree.

Populus nigra italica Du Roi. Lombardy Poplar.—Much planted and often spreading in sandy ground by its roots. Have noticed staminate flowers only.

Myricaceae. Sweet Gale Family.

Myrica asplenifolia L. Sweet Fern.—Frequent in very dry and sandy ground.

Juglandaceae. Walnut Family.

Juglans cinerea L. Butternut.—Frequent in rich ground, with other trees. Often in damp places not far from Lake Huron shore.

Juglans nigra L. Black Walnut.—Occasional in rich ground, mostly creek bottoms. Most abundant along the Aux Sables river.

Carya ovata (Mill.) K. Koch. Shag-bark Hickory.—Frequent in rich woods.

Carya laciniosa (Michx. f.) Loud. Big Shell-bark. King Nut.—Certainly as far north as the northern part of Kent Co., and very probably on Walpole Island its probable northern limit.

Carya microcarpa Nutt. Small-fruited Hickory.—Occasional in dryish ground with other trees.

Carya cordiformis (Wang.) K. Koch. Bitter Nut.—Frequent in damp ground with other trees.

Betulaceae. Birch Family.

Corylus americana Walt. Hazelnut.—Very common usually on good ground, in thickets and on borders of woods.

Corylus rostrata Ait. Beaked Hazelnut.—Occasional in dryish open ground and on hillsides. Newton Tripp.

Ostrya virginiana (Mill.) K. Koch. American Hop Hornbeam.—Ironwood. Frequent in rich woods

Carpinus caroliana Walt. Blue Beach.—Common in rich woods and along streams.

Betula lutea Michx. f. Yellow Birch.—Frequent with other trees in rich moist ground. Some expert botanists much doubt whether this is properly named, and do not believe that **B. lenta, L.,** cherry birch, exists in Western Ontario or Eastern Michigan, but suggest that both should be named **B. alleghaniensis,** Britton, southern yellow birch.

Betula alba papyrifera (Marsh.) Spach. Paper Birch. Canoe Birch. White Birch.—Common in damp rich ground, and frequent in sand along the Lake Huron shore.

Betula pumila L. Low Birch.—Occasional in bogs and swampy places.

Alnus incana (L.) Muench. Speckled Alder. Hoary Alder.—Common in swamps, wet open woods, and along streams.

Fagaceae. Beech Family.

Fagus grandifolia Ehrh. Beech.—Frequent in rich ground with other trees.

Castanea dentata (Marsh.) Berkh. Chestnut.—Occasionally planted, but not native or spreading so far as noticed, but pioneers report native trees as formerly existing in eastern part of county.

Quercus alba L. White Oak.—Frequent and usually in dryish, but good ground. Noticed occasionally in poor sandy ground, especially along the Lake Huron shore.

Quercus macrocarpa Michx. Bur Oak.—Frequent and usually in good ground, but occasionally on sandy ridges near the shore of Lake Huron, where it is small and becomes a good sand-binder.

Quercus bicolor Willd. Swamp White Oak.—Frequent and usually in rich ground with other trees on borders of swamps and streams.

Quercus muhlenbergii Engelm. Chestnut Oak. Frequent among the sand dunes at Port Franks, and farther west near lake shore.

Quercus prinoides Willd. Scrub Chestnut Oak.—Abundant on the sand dunes at Port Franks. Not noticed elsewhere.

Quercus rubra L. Red Oak.—Common in poor and sandy ground, frequent also in rich woods.

Quercus palustris Muench. Pin Oak.—Abundant in low wet ground on the delta islands of St. Clair River; also on the mainland where it probably reaches its northern limit.

Quercus coccinea Muench. Scarlet Oak.—Occasional along the sandy shore of Lake Huron. Noticed in particular at Port Franks, but doubtful elsewhere.

Quercus velutina Lam. Yellow Oak. Yellow-barked Oak. Black Oak. —Common in poor and sandy ground, especially along Lake Huron shore.

Urticaceae. Nettle Family.

Ulmus fulva Michx. Slippery Elm. Red Elm.—Occasional along banks of streams. Frequent along the Aux Sables river and its branches.

Ulmus americana L. American Elm. White Elm.—Very common on rich and wet ground. Formerly the most common tree in the county.

Ulmus racemosa Thomas. Cork Elm. Rock Elm.—Occasional and usually in rich damp ground. Plentiful along the Aux Sables River.

Celtis occidentalis L. Sugarberry.—Along the Aux Sables river but apparently infrequent. Rev. H. Currie.

Celtis occidentalis pumila. Muhl. Small Sugarberry.—A shrub seldom over 10 feet high. Abundant on sand dunes at Port Franks.

Celtis occidentalis crassifolia (Lam.) Gray.—Occasional along the Aux Sables river. Newton Tripp.

Cannabis sativa L. Hemp.—Occasionally noticed as established along roads and in waste places.

Humulus lupulus L. Hop. Hops.—Occasionally noticed as an escape along fences.

Maclura pomifera (Raf.) Schneider. Osage Orange.—Occasionally planted

for hedges, but not escaping so far as noticed. Apparently not a success as a hedge plant in this locality.

Morus alba L. White Mulberry.—Occasionally planted for ornament, but not spreading.

Urtica gracilis Ait. Slender Nettle.—Very common in moist ground, damp open woods, and along fence rows.

Laportea canadensis (L.) Gaud. Wood Nettle.—Common in rich woods and thickets.

Pilea pumila (L.) Gray. Richweed. Clearweed.—Frequent in rich open woods and thickets.

Boehmeria cylindrica (L.) Sw. False Nettle.—Common in moist or shady ground. Abundant on marshy ground near Port Franks.

Santalaceae. Sandalwood Family.

Comandra richardsiana Fernald.—Bastard Toad-flax.—Very common in dry and sandy ground. Formerly included in **C. umbellata** (L.) Nutt.

Aristolochiaceae. Birthwort Family.

Asarum canadense L. Wild Ginger.—Frequent in damp rich woods and thickets.

Polygonaceae. Buckwheat Family.

Rumex britannica L. Great Water Dock.—Frequent in swamps and wet marshy places.

Rumex crispus L. Yellow Dock.—Very common in cultivated and waste grounds. A miserable weed in hay fields, grain fields, and pastures.

Rumex altissimus Wood. Pale Dock.—On Walpole Island near an Indian dwelling. Apparently rare.

Rumex verticillatus L. Swamp Dock.—Frequent in swamps and along low banks of streams.

Rumex obtusifolius L. Bitter Dock.—Common on roadsides, and in waste places. A bad weed in cultivated grounds and pastures.

Rumex acetosella L. Field Sorrel. Sheep Sorrel.—Very common especially as a weed in old fields.

Polygonum aviculare L. Knot-grass. Door-weed.—Common in yards, lawns, fields and waste places.

Polygonum aviculare littorale (Link.) Koch. Shore Knotweed.—Frequent in hard clay ground. Often covering large ant-hills on the delta islands of St. Clair River.

Polygonum aviculare vegetum Ledeb. Larger Knotweed. Near a grain elevator at Point Edward. Apparently infrequent.

Polygonum erectum L. Erect Knotweed.—Common on roadsides, in cultivated grounds and waste places.

Polygonum tenue Michx. Slender Knotweed.—Noticed in poor and sandy ground near Blackwell Station. T. C. Wheatley.

Polygonum lapathifolium L. Slender Pink Persicaria.—Frequent in damp ground. Often a garden weed.

Polygonum amphibium L. Water Persicaria.—Frequent in marshy places, on borders of ponds, lakes, and slow streams.

Polygonum amphibium hartwrightii Gray. Hartwright's Persicaria.—Frequent in damp marshy places. Noticed in particular near a large pond north of Sarnia.

Polygonum muhlenbergii (Meisn.) Wats. Swamp Persicaria.—Common on borders of ponds, lakes, in swamps and shallow water of slow streams.

Polygonum pennsylvanicum L. Pennsylvania Persicaria.—Frequent in damp moist ground and damp waste places.

Polygonum hydropiper L. Common Smartweed.—Common in damp and usually rich open or shaded ground.

Polygonum acre HBK. Water Smartweed.—Occasional in wet marshy places and along the low wet banks of streams.

Polygonum orientale L. Prince's Feather.—Occasionally escaping from cultivation and persisting. Often a garden weed.

Polygonum persicaria L. Lady's Thumb.—Common in damp and waste places.

Polygonum hydropiperoides Michx. Mild Water Pepper.—Very common in damp ground, shallow water, ditches, and along slow streams.

Polygonum virginianum L. Virginia Knotweed.—Common in damp rich open woods and thickets.

Polygonum sagittatum L. Arrow-leaved Tear-thumb.—Common in low damp open or shaded ground.

Polygonum convolvulus L. Black Bindweed.—Common as a weed in cultivated and waste grounds.

Polygonum cilinode Michx. Fringed Black Bindweed.—Frequent in open woods and thickets.

Polygonum scandens L. Climbing False Buckwheat.—Frequent in moist thickets.

Polygonum cuspidatum Web. and Zucc. Japanese Knotweed.—Often planted and persisting for many years but not permanently escaping.

Fagopyrum esculentum Muench. Buckwheat.—Escaping from cultivation to roadsides and copses and persisting at least for a time. Often remaining as a weed in cultivated fields.

Polyganella articulata (L.) Meisn. Coast Jointweed.—Occasional on the sand dunes along Lake Huron.

Chenopodiaceae. Goosefoot Family.

Cycloloma atriplicifolium (Spreng.) Coult. Winged Pigweed.—Occasional in poor and sandy ground. Noticed in particular in sand at Point Edward.

Kochia scoparia (L.) Schrad. Kochia. —An ornamental plant inclined to escape and persist.

Chenopodium ambrosioides L. Mexican Tea.—Waste places in towns, villages and cities. Apparently infrequent.

Chenopodium botrys L. Jerusalm Oak. Feather Geranium.—Frequent in sandy ground. Abundant at Point Edward.

Chenopodium capitatum (L.) Asch. Strawberry Blight.—Frequent in poor ground and on newly cleared land.

Chenopodium glaucum L. Oak-leaved Goosefoot.—In cities, villages, towns, gardens and fields. Frequent.

Chenopodium hybridum L. Maple-leaved Goosefoot.—Frequent in open woods and waste places. Often a field and garden weed.

Chenopodium album L. Lamb's Quarters. Pigweed.—Very common as a weed in fields, gardens, and waste places.

Chenopodium urbicum L. Upright Goosefoot.—Noticed as a weed near Lambton. Apparently infrequent.

Atriplex patula hastata (L.) Gray. Halberd-leaved Orache.—Common as a weed in gardens, fields and waste places.

Atriplex patula littorale (L.) Gray. Spreading Orache.—Occasional along the Lake Huron shore and in waste places.

Corispermum hyssopifolium L. Bug-seed.—Abundant on the sand dunes at Port Franks. Not noticed elsewhere.

Salsola kali tenuifolia G. F. W. Mey. Russian Thistle.—Becoming very common in dry and sandy ground along railways, about grain elevators, in freight yards and waste places. Not believed it will prove to be a troublesome weed in this locality.

Amaranthaceae. Amaranth Family.

Amaranthus retroflexus L. Green Amaranth. Amaranth Pigweed.—A very common weed in cultivated grounds.

Amaranthus hybridus L. Slender Pigweed.—Occasional in streets of towns and villages and in cultivated grounds.

Amaranthus paniculatus L. Purple Amaranth.—Occasional in waste places and along roads.

Amaranthus graecizans L. Tumble Weed.—Frequent in waste places and a weed in cultivated grounds.

Amaranthus blitoides Wats. Prostrate Amaranth.—Very common along railways, on roadsides, and as a weed in cultivated grounds.

Amaranthus spinosus L. Thorny Amaranth.—Occasional along railways.

Aenida tuberculata Moq. Western Water-hemp.—Occasional in damp open or shaded ground in the southeastern part of county.

Nyctaginaceae. Four-o'clock Family.

Oxybaphus nyctagineus (Michx.) Sweet. Heart-leaved Umbrella-wort.—Occasional along railroads. From the west.

Aizoaceae. Carpet-weed Family.

Mollugo verticillata L. Carpet Weed.—Common in poor and sandy ground along railways, on roadsides, and in cultivated grounds.

Caryophyllaceae. Pink Family.

Spergula arvensis L. Corn Spurry.—Occasional as a weed in gardens and sandy cultivated fields.

Arenaria lateriflora L. Blunt-leaved Sandwort.—Occasionally in shaded ground on the delta islands.

Arenaria serpyllifolia L. Thyme-leaves Sandwort.— Very common in dry and sandy ground, especially in cultivated grounds.

Arenaria stricta Michx. Rock Sandwort.—Frequent on sand ridges along the Lake Huron shore.

Stellarai longifolia Muhl. Long-leaved Stitchwort.—Common in damp grassy places.

Stellaria graminea L. Lesser Stitchwort.—In fields and grassy places as a weed near Forest. Newton Tripp.

Stellaria media (L.) Cyrill. Common Chickweed. — Very common as a weed in garden and fields.

Cerastium arvense L. Field Chickweed.—Occasional as a weed about Forest. Newton Tripp.

Cerastium arvense oblongifolium (Torr.) Hollick and Britton. Field Chickweed.—Occasional. Very abundant in dry ground at the north end of Walpole Island. Not noticed elsewhere in county.

Cerastium vulgatum L. Common Mouse-ear Chickweed.—Very common as a weed in lawns, gardens, fields and waste places.

Cerastium semidecandrum L. Small Mouse-ear Chickweed.—Abundant in sand at Point Edward.

Cerastium nutans Raf. Nodding Chickweed.—Frequent in sandy or moist rich ground. Newton Tripp.

Agrostemma githago L. Cockle. Corn Cockle.—Frequent as a weed in grain fields.

Lychnis coronaria (L.) Desr. Mullen Pink.—Occasional in poor and sandy ground. Noticed at Port Franks and Uttoxeter. F. M. McCordick.

Lychnis alba Mill. White Campion.—Becoming common in dry and sandy ground on roadsides, in fields and waste places.

Silene antirrhina L. Sleepy Catchfly.—Common in dry and sandy ground and in fields and waste places.

Silene armeria L. Sweet William Catchfly.—Occasionally escaping to roadsides and persisting.

Silene noctiflora L. Night-flowering Catchfly.—Frequent in cultivated grounds and waste places.

Silene virginica L. Fire Pink. Open woods near Port Franks. Apparently infrequent.

Silene latifolia (Mill.) Britten and Rendle. Bladder Campion.—In cities, villages and towns and along railways. Frequent.

Saponaria officinalis L. Soapwort. Bouncing Bet.—Becoming very common in dry and sandy ground along railways and near the Lake Huron shore.

Saponaria vaccaria L. Cow-herb.—Occasional along railways and in the streets of towns and villages.

Gypsophila paniculata L. Tall Gypsophyll.—Occasional as a weed about Forest. N. Tripp.

Dianthus chinensis L. China Pink.—Inclined to persist in sandy ground at Point Edward.

Portulacaceae. Purslane Family.

Claytonia virginica L. Spring Beauty.—Common in rich open woods and thickets.

Portulaca oleracea L. Common Purslane.—Very common as a weed in cultivated and waste grounds.

Ceratophyllaceae. Hornwort Family.

Ceratophyllum demersum L. Hornwort.—Frequent in slow streams and in ponds.

Nymphaeaceae. Water Lily Family.

Nymphaea advena Ait. Yellow Water Lily. Cow Lily.—Very common in still or stagnant water.

Castalia tuberosa (Paine) Greene. White Water Lily.—Frequent in ponds,

shallow lakes and slow streams. Formerly very abundant in Sarnia Bay, long supplying the people of Sarnia and Port Huron with its exquisite flowers.

Brasenia schreberi Gmel. Water Shield.—Frequent in ponds, coves and slow streams. Noticed in Sarnia Bay, at Port Franks, and in still water at St. Clair Flats.

Ranunculaceae. Crowfoot Family.

Ranunculus circinatus Sibth. Stiff Water Crowfoot.—Frequent in ditches, ponds, and slow streams.

Ranunculus delphinifolius Torr. Yellow Water Crowfoot.—Common in ditches, coves, pools, shallow ponds and edges of slow streams. The form growing in the absence of water, **C. delphinifolius terreatris** (Gray) Farwell is frequent.

Ranunculus flammula reptans (L.) Mey. Creeping Spearwort.—Occasional in damp sandy ground along the mouths of St. Clair River. Not noticed elsewhere.

Ranunculus rhomboideus Goldie. Prairie Crowfoot. Dwarf Buttercup. —Frequent in open woods on dry and sandy ground.

Ranunculus sceleratus L. Cursed Crowfoot.—Frequent in bogs, ditches, and very wet places.

Ranunculus abortivus L. Small-flowered Crowfoot.—Very common in rich open woods and thickets.

Ranunculus recurvatus Poir. Hooked Crowfoot.—Common in rich open woods and thickets.

Ranunculus fascicularis Muhl. Early Crowfoot.—Occasional in damp ground on the delta islands of St. Clair River.

Ranunculus septentrionalis Poir. Swamp Buttercup.—Common in damp open woods and thickets, and in marshy places.

Ranunculus repens L. Creeping Buttercup.—Frequent in yards, streets, and waste places of cities and villages.

Ranunculus pennsylvanicus L. f. Bristly Crowfoot.—Frequent in wet and marshy places.

Ranunculus bulbosus L. Bulbous Crowfoot.—Occasional along railways, Newton Tripp.

Ranunculus acris L. Tall Crowfoot.—Becoming very common on roadsides and a troublesome weed in moist meadows and pastures.

Thalictrum dioicum L. Early Meadow Rue.—Very common in damp or dryish open woods and thickets.

Thalictrum dasycarpum Fisch. and Lall. Purplish Meadow Rue.—Very common on margins of marshes and along streams.

Hepatica triloba Chaix. Round-lobed Liver-leaf.—Common in rich open woods and thickets.

Hepatica acutiloba DC. Sharp-lobed Liver-leaf.—Frequent and usually in damp rich woods and thickets.

Anemone cylindrica Gray. Long-fruited Anemone.—Common in poor and sandy open or shaded ground.

Anemone virginiana L. Tall Anemone.—Frequent in damp ground, meadows, and on shaded banks.

Anemone canadensis L. Canada Anemone.—Common in damp places and on shaded banks of streams.

Anemone quinquefolia L. Wood Anemone.—Common in open woods and thickets.

Clematis virginiana L. Virginia Virgin's Bower.—Frequent in damp shaded ground and on banks of streams.

Isapyrum biternatum (Raf.) T. and G. False Rue Anemone.—Shaded high banks of the Aux Sables river. Apparently rare.

Caltha palustris L. Marsh Marigold.—Common in swamps, wet open woods, thickets and wet meadows.

Coptis trifolia (L.) Salisb. Goldthread.—Frequent in damp shaded places and swamps.

Aquilegia canadensis L. Wild Columbine.—Common in dry and sandy ground.

Delphinium consolida L. Field Larkspur.—Occasionally escaping from cultivation to roadsides and fields.

Actaea rubra (Ait.) Willd. Red Baneberry.—Common in rich open woods and thickets.

Actaea alba (L.) Mill. White Baneberry.—Frequent in rich open woods.

Hydrastis canadensis L. Golden Seal.—Common in northeastern part of Walpole Island. Not noticed elsewhere.

Magnoliaceae. Magnolia Family.

Liriodendron tulipifera L. Tulip Tree—Occasional in rich ground with other trees.

Menispermaceae. Moonseed Family.

Menispermum canadense L. Moonseed.—Common in damp shady ground and along banks of streams.

Berberidaceae. Barberry Family.

Podophyllum peltatum L. May Apple. Wild Mandrake.—Common in rich open woods and thickets.

Jeffersonia diphylla (L.) Pers. Twin Leaf.—Abundant along the banks of the Aux Sables River. Not noticed elsewhere.

Caulophyllum thalictroides (L.) Michx. Pappoose Root.—Common in damp rich woods and thickets.

Berberis vulgaris L. Common Barberry.—Inclined to escape from cultivation and persist.

Lauraceae. Laurel Family.

Sassafras variifolium (Salisb.) Ktze. Sassafras.—Common in the western part of the county and along the Lake Huron shore.

Benzoin aestivale (L.) Nees. Spice Bush.—Common in damp woods and thickets.

Papaveraceae. Poppy Family.

Sanguinaria canadensis L. Bloodroot.—Common in damp rich woods and thickets.

Chelidonium majus L. Celandine.—Occasional near towns and villages. Newton Tripp.

Papaver somniferum L. Common Poppy.—Occasional as an escape from cultivation.

Papaver rhoeas L. Corn Poppy.—Inclined to escape and remain in dry and sandy ground at Point Edward.

Argemone mexicana L. Mexican Poppy.—Occasional in the streets of Sarnia and along railways.

Fumariaceae. Fumitory Family.

Adlumia fungosa (Ait.) Greene. Climbing Fumitory.—Occasional in woods and thickets. A beautiful vine. Abundant in places in northeastern parts of the county.

Dicentra cucullaria (L.) Bernh. Dutchman's Breeches.—Occasional in damp rich woods and thickets. Newton Tripp.

Dicentra canadensis (Goldie) Walp. Squirrel Corn.—Frequent in rich woods.

Corydalis sempervirens (L.) Pers. Pale Corydalis.—Occasional in dry and sandy ground.

Corydalis aurea Willd. Golden Corydalis.—Occasional on shaded sides of sand dunes at Port Franks. Not noticed elsewhere. Newton Tripp.

Cruciferae. Mustard Family.

Draba caroliniana Walt. Carolina Whitlow Grass.—Common on sand ridges and in sandy places along the Lake Huron shore.

Berteroa incana (L.) DC. Hoary Alyssum.—About a grain elevator at Point Edward. Rare.

Lobularia maritima (L.) Desv.—Sweet Alyssum.—Inclined to escape and persist in cemeteries and yards.

Alyssum alyssoides L. Yellow Alyssum.—Common in sandy ground in fields, about towns and villages.

Thlaspi arvense L. Field Penny Cress.—Occasional in dry and sandy ground along railways, in towns and villages.

Lepidium virginicum, L. Wild Peppergrass.—A common weed on roadsides, in gardens and fields. Much resembling the next.

Lepidium apetalum Willd. Apetalous Peppergrass.—Common in dry and sandy ground on roadsides and along railways. Much resembling the preceding.

Lepidium sativum L. Garden Cress.—Occasional as an escape in the streets and waste places of cities, villages and towns.

Lepidium campestre (L.) R. Br. Field Cress. Cow Cress.—Occasional in cultivated grounds and waste places. Newton Tripp.

Capsella bursa-pastoris (L.) Medic. Shepherd's Purse.—A common weed in gardens and cultivated fields.

Camelina sativa (L.) Crantz. False Flax.—Occasional in towns, villages, and along railways.

Neslia paniculata (L.) Desf. Ball Mustard.—Recently introduced as a weed near Forest. N. Tripp.

Cakile edentula (Bigel.) Hook. American Sea Rocket.—Common in sand along the shores of Lake Huron and St. Clair River. Not noticed elsewhere.

Raphanus sativus L. Radish.—Inclined to persist in old gardens for many years.

Eruca sativa Mill. Roquette. Rocket Salad.—Becoming a weed in towns and fields. Recent.

Brassica alba (L.) Boiss. White Mustard.—Occasionally noticed in towns, villages and along railways.

Brassica arvensis (L.) Ktze. Charlock. Wild Mustard.—Too common in cultivated grounds. A pernicious weed in grain fields.

Brassica juncea (L.) Cosson. Indian Mustard.—Occasional as a weed in gardens and fields. Newton Tripp.

Brassica nigra (L.) Koch. Black Mustard.—Occasional in towns, villages and fields.

Brassica campestris L. Rutabaga.—Occasional in towns, villages, and along railways.

Diplotaxis tenuifolia (L.) DC. Wall Rocket.—Occasional along railroads, and in cities and villages. Recent.

Conringia orientalis (L.) Dumort. Hare's-ear Mustard.—Occasional about towns and along railways. Recent.

Sisymbrium officinale (L.) Scop. Hedge Mustard.—Occasional as a weed in towns, villages, gardens, and waste grounds.

Sisymbrium officinale leiocarpum DC. Smooth-Podded. Hedge Mustard. Very common as a weed throughout the county.

Sisymbrium altissimum L. Tumble Mustard.—Occasional in freight yards and along railways. Not yet a troublesome weed here.

Hesperis matronalis L. Dame's Violet.—Occasional as a weed.

Erysimum cheiranthoides L. Worm-seed Mustard.—Frequent on banks of streams, and as a weed in gardens and cultivated fields.

Erysimum parviflorum Nutt. Small Erysimum.—Occasional in towns, villages, and along railways. Noticed near the grain elevator at Point Edward.

Erysimum repandum L. Repand Erysimum.—Near the Grain Elevator at Point Edward. Not persisting.

Erysimum asperum D. C. Western Wall-flower.—About the grain elevator at Point Edward in sandy ground. Apparently persisting.

Radicula nasturtium-aquaticum (L.) Britten and Randle. True Water Cress.—Very common in ditches, small streams, and wet places.

Radicula palustris (L.) Muench. Marsh Cress.—Common in wet places, ditches, and shallow water.

Radicula palustris hispida (Desv.) Robinson. Hispid Yellow Cress.—Frequent in wet places, especially in wet sand about ponds and along streams.

Radicula armoracia (L.) Robinson. Horseradish.—Frequent as an escape to wet marshy ground, and long persisting in old cultivated grounds.

Barbarea vulgaris R. Br. Common Winter Cress.—Occasional in damp ground and along streams. Often a weed.

Dentaria diphylla Michx. Two-leaved Toothwort.—Common in damp rich woods and thickets.

Dentaria laciniata Muhl. Cut-leaved Toothwort.—Occasional in rich damp woods. Newton Tripp.

Cardamine bulbosa (Schreb.) BSP. Spring Cress.—Common in wet meadows and springy places.

Cardamine douglasii (Torr.) Britton. Purple Cress.—Very common in damp rich woods and thickets.

Cardamine pratense L. Cuckoo Flower.—Frequent in wet grassy places and occasionally around small ponds and along slow streams.

Cardamine pennsylvanica Muhl. Pennsylvania Bitter Cress.—Frequent in damp rich woods and thickets. Often in water on the grassy bottoms of slow creeks.

Matthiola bicornis (B. and S.) D. C. Stock Flower.—Plentiful in one place growing in sand on Lake Huron shore near summer cottages.

Arabis lyrata L. Rock Cress.—Very common on sand ridges not far from Lake Huron shore.

Arabis glabra (L.) Bernh. Tower Mustard.—Occasional in dry woods and thickets.

Arabis drummondi Grey. Drummond's Rock Cress.—Occasional about Port Franks.

Arabis hirsuta (L.) Scop. Hairy Rock-Cress.—Noticed near Blackwell Station. Apparently rare.

Arabis laevigata (Muhl.) Poir. Smooth Rock Cress.—Frequent in poor and sandy ground, usually near the Lake Huron shore or along the dry banks of streams.

Arabis canadensis L. Sickle Pod.—Occasional in woods and thickets.

Capparidaceae. Caper Family.

Polanisia graveolens Raf. Clammy Weed.—Reported by Prof. John Macoun as noticed on the lake shore near Point Edward. Rare.

Sarraceniaceae. Pitcher-plant Family.

Sarracenia purpurea L. Pitcher-Plant.—Now plentiful in swampy places at Port Franks. Formerly very abundant in and about tamarack swamps.

Droseraceae. Sundew Family.

Drosera rotundifolia L. Round-Leaved Sundew.—Frequent in peat-bogs, and growing in Sphagnum of swamps.

Crassulaceae. Orpine Family.

Penthorum sedoides L. Ditch Stonecrop.—Very common in wet open places.

Sedum acre L. Mossy Stonecrop.—Common in dry and sandy ground near towns, villages and in cemeteries.

Sedum purpureum Tausch. Live-for-ever.—Frequent in poor and sandy ground as an escape from cultivation. Slow to bloom.

Saxifragaceae. Saxifrage Family.

Tiarella cordifolia L. False Miterwort.—Common in damp rich woods and thickets.

Mitella diphylla L. Two-leaved Bishop's Cap.—Very common in rich woods and thickets.

Mitella nuda L. Stoloniferous Miterwort.—Common in moist woods and thickets.

Chrysosplenium americanum Schwein. Golden Saxifrage.—Frequent in very wet, usually shady places, and about living springs.

Parnassia caroliniana Michx. Carolina Grass of Parnassus.—Common in marshy open places.

Ribes cynosbati L. Prickly Gooseberry.—Common in open woods and thickets.

Ribes oxyacanthoides L. Smooth Gooseberry.—Frequent in damp places, rich open woods and thickets.

Ribes floridum L'Her. Wild Black Currant.—Common in damp rich woods and thickets.

Ribes vulgare Lam. Red Currant.—Occasional as an escape from cultivation. Noticed often along fences and on borders of woods, also on Walpole Island.

Ribes triste Pall. Swamp Red Currant.—Frequent in damp rich woods and tamarack swamps.

Ribes aureum Pursh. Buffalo Currant.—Occasional as an escape from cultivation to fences and roadsides. Abundant and spreading in sand at Point Edward.

Hamamelidaceae. Witch-hazel Family.

Hamamelis virginiana L. Witch-hazel.—Abundant in damp open woods or in poor and dry open ground.

Platanaceae. Plane Tree Family.

Platanus occidentalis L. Sycamore. Buttonwood.—Frequent in rich ground, especially along streams and on river bottoms.

Rosaceae. Rose Family.

Physocarpus opulifolius (L.) Maxim. Nine-bark.—Frequent in damp open thickets and along the banks of streams.

Spiraea salicifolia L. Meadow-sweet.—Common in low ground, on borders of marshes and around ponds.

Sorbaria sorbifolia (L.) A. Br. Mountain Ash Spiraea.—Occasionally found as an escape in towns and villages.

Pyrus communis L. Common Pear.—Inclined to escape and remain in a few places.

Pyrus baccata L. Siberian Crab.—Occasionally found as an escape to the bank of St. Clair River on the Indian Reservation south of Sarnia.

Pyrus coronaria L. American Crab.—Very common in open woods, thickets, and on dry banks of streams.

Pyrus malus L. Apple.—Frequent as an escape in open woods, thickets, and along streams. Abundant on the Indian reservations. A very large tree, probably set out by missionaries, a Rhode Island greening, noticed on Ste. Anne's Island, over two and one-half feet in diameter two feet from ground.

Pyrus arbutifolia atropurpurea (Britton) Robinson. Chokeberry.—Frequent among other shrubs in swampy places.

Pyrus melanocarpa (Michx.) Willd. Black Chokeberry.—Often very common in damp and swampy places.

Pyrus americana (Marsh.) DC. American Mountain Ash.—Planted for ornament and inclined to escape. Several small trees, apparently native, on top of Gilnockie, one of the highest sand dunes at Port Franks. This may be the form described by Prof. C. S. Sargent under name of Sorbus Americana decora. Sarg.

Amelanchier canadensis (L.) Medic. Shad Bush. Juneberry.—Common on dryish ground in open woods and thickets. Often a tree eight inches in diameter and 60 feet high.

Amelanchier oblongifolia (T. and G.) Roem. Service Berry.—Frequent in dry and sandy ground, especially on sand dunes bordering Lake Huron shore.

Amelanchier spicata (Lam.) C. Koch. Round-leaved June Berry.—Frequent with other shrubs on sand ridges near Lake Huron shore.

Crataegus.

The Crataegi here given for Lambton Co. are taken from "Crataegus in Southern Ontario" by Prof. C. S. Sargent of the Arnold Arboretum, Jamaica Plain, Mass. The finest and largest thorns the writer has ever seen are found on Walpole Island. The fruit of many is delicious. One tree noticed has fruit nearly an inch in diameter.

Crataegus oxyacantha L. English Hawthorn.—Cultivated and inclined to escape. Often planted for a hedge, but not a success in this locality.

Crataegus arduennae Sarg. Thorn.—Frequent on Walpole Island. No. 96 of C. K. Dodge.

Crataegus punctata Jaquin. Large Fruited Thorn.—Very common. No. 103 of C. K. Dodge. North of Sarnia. Fruit usually large, reddish or yellow. A beautiful tree in bloom or fruit.

Crataegus confragosa Sarg. Thorn.—Occasional on the bank of St. Clair River below Sarnia. A beautiful tree both in bloom and fruit. Fruit large, red, smooth and shining, beautiful and very palatable. Type tree No. 122 of C. K. Dodge.

Crataegus gravis Ashe. Thorn.—North of Sarnia in sandy ground. No. 59 of C. K. Dodge. Tree beautiful in bloom.

Crataegus sarniensis Sarg. Thorn.—On the bank of St. Clair River south of Sarnia. Type tree No. 119 of C. K. Dodge.

Crataegus matura Sarg. Thorn.—On the bank of St. Clair River south of Sarnia. No. 120 of C. K. Dodge.

Crataegus mollis (T. and G.) Scheele. Red-fruited Thorn.—On Walpole Island. No. 52 and north of Sarnia 135 of C. K. Dodge. Fruit large, red, beautiful, and very palatable. A fine thorn.

Crataegus sera Sarg. Thorn. On the bank of St. Clair River south of Sarnia. No. 53 of C. K. Dodge. Fruit medium size, red, beautiful, and very palatable. Trees often large for thorns.

Crataegus ellwangeriana Sarg. Thorn.—On bank of St. Clair River south of Sarnia. No. 100 of C. K. Dodge. Also No. 60 north of Sarnia. Fruit red, beautiful, large, palatable. A fine thorn in bloom or fruit.

Crataegus miranda Sarg. Thorn.—On bank of St. Clair River south of Sarnia. No. 99 of C. K. Dodge. Fruit, red, beautiful and palatable.

Crataegus splendida Sarg. Thorn.—On the bank of St. Clair River south of Sarnia. Type tree No. 101 of C. K. Dodge. Tree beautiful in bloom and in fruit. Fruit large, beautiful and very palatable.

Crataegus flavida Sarg. Thorn.—North of Sarnia. No. 102 of C. K. Dodge. Very common on the Michigan side.

Crataegus dodgei Ashe. Dodge's thorn.—On the bank of St. Clair River south of Sarnia. No. 124 of C. K. Dodge. Very common on the Michigan side. In general appearance this and the preceding thorn much resemble each other.

Crataegus tomentosa L. Pear Thorn.—Frequent on the St. Clair River bank south of Sarnia and in other places. Nos. 54 and 55 of C. K. Dodge. fruit, red, small, beautiful and palatable. Beautiful thorn in bloom or fruit.

Crataegus pubifolia Ashe. Thorn.—On Walpole Island. No. 96 of C. K. Dodge. Fruit small, red and beautiful. A beautiful tree in bloom or fruit.

Crataegus structilis Ashe. Thorn.—On the bank of St. Clair River south of Sarnia. No. 57 of C. K. Dodge.

Crataegus flammea Sarg. Thorn.—Bank of St. Clair River south of Sarnia. No. 121 of C. K. Dodge.

Crataegus prinoides Sarg. Thorn.—Bank of St. Clair River south of Sarnia. Type tree No. 58 of C. K. Dodge.

Crataegus gemmosa Sarg. Thorn.—Bank of St. Clair River south of Sarnia. No. 98 of C. K. Dodge. Fruit red, small, beautiful, and palatable. A beautiful thorn in bloom or fruit.

Crataegus pisifera Sarg. Thorn.—Bank of St. Clair River south of Sarnia. No. 90 of C. K. Dodge.

Fragaria virginiana Duchesne. Common Strawberry.—Common in dry ground, fields, and open woods.

Fragaria vesca americana Porter. American Wood Strawberry.—Common in damp meadows, damp open woods and thickets.

Waldsteinia fragarioides (Michx.) Trattinick. Barren Strawberry.—Occasional in thickets and on shaded hillsides. Abundant along the banks of Aux Sables River.

Potentilla arguta Pursh. Tall Cinquefoil.—Near Port Franks in dry open ground. Apparently infrequent. Newton Tripp.

Potentilla monspeliensis L. Rough Cinquefoil.—Common in fields and open ground.

Potentilla argentea L. Silvery Cinquefoil.—Common in dry and sandy ground.

Potentilla intermedia L. Downy Cinquefoil.—Occasional on road sides and in waste places near Forest. Newton Tripp.

Potentilla recta L. Rough-fruited Cinquefoil.—Occasional near Forest. On roadsides and in fields. Newton Tripp.

Potentilla palustris (L.) Scop. Marsh Five-finger.—Frequent in wet and marshy places. Often abundant.

Potentilla fruticosa L. Shrubby Cinquefoil.—Frequent in wet or dry open ground. Very abundant at Port Franks where it is called Sage Brush.

Potentilla anserina L. Silver Weed.—Abundant near the lake and St. Clair River shores.

Potentilla canadensis L. Common Cinquefoil.—Frequent in dry and sandy ground. Much smaller than the following.

Potentilla canadensis simplex (Michx.) (T. and G.) Decumbent Five-finger.—Frequent and often abundant in sandy ground.

Potentilla reptans L. Trailing Cinquefoil.—In grassy places about Forest. Frequent. Newton Tripp.

Geum canadense Jacq. White Avens.—Common in damp open woods and thickets.

Geum virginianum L. Rough Avens.—Frequent in low ground and on borders of woods.

Geum strictum Ait. Yellow Avens.—Common in moist meadows and thickets.

Geum vernum (Raf.) T. and S. Spring Avens.—Noticed by Prof. John Macoun near Wallaceburg, Kent Co. Also noticed on Walpole Island in 1910.

Geum rivale L. Water Avens.—Frequent in wet meadows and rich open woods.

Rubus idaeus aculeatissimus (C. A. Mey.) Regal and Tiling. Wild Red Raspberry.—Common in dry ground and in thickets.

Rubus occidentalis L. Black Raspberry. Black Caps.—Common in damp open woods and thickets.

Rubus odoratus L. Purple Flowering Raspberry.—Frequent in open woods and thickets, usually not far from the Lake Huron shore.

Rubus triflorus Richards. Dwarf Raspberry.—Common in wet open woods and thickets.

Rubus allegheniensis Porter. High-bush Blackberry.—Very common in dry open thickets, burned-over ground, and recent clearings.

Rubus hispidus L. Hispid Blackberry.—Common in low open woods and swampy places, and on dry open ground.

Rubus villosus Ait. Dewberry. (**R. canadensis** of authors). (**R. procumbens,** Muhl.)—Common in sandy ground and dry open places.

Agrimonia griposepala Wallr. Tall Hairy Agrimony.—Frequent in dry open woods and thickets. **A. parviflora,** Ait., Many-flowered Agrimony, not noticed yet in Lambton Co., but is very common in the south-western part of St. Clair Co., Mich.

Rosa setigera Michx. Climbing Rose.—Noticed by Prof. John Macoun growing wild near Wallaceburg, Kent Co.

Rosa blanda, Ait. Meadow Rose. Common and usually on dry open or shaded ground. Also in sandy ground along Lake Huron shore.

Rosa rubiginosa L. Sweetbrier.—Frequent on roadsides and in pastures.

Rosa carolina L. Swamp Rose.—Common in damp places, on borders of swamps and along streams.

Rosa humilis Marsh. Pasture Rose.—Frequent in dry and sandy ground.

Prunus serotina Ehrh. Wild Black Cherry. Rum Cherry.—Frequent with other trees in dry or damp open woods.

Prunus virginiana L. Choke Cherry.—Common in low or dry and sandy ground with other trees. Abundant near Lake Huron Shore.

Prunus pennsylvanica L. f. Wild Red Cherry.—Frequent on borders of dry woods and along fences. Often abundant.

Prunus cuneata Raf. Appalachian Cherry. Damp open ground near Port Franks. Apparantly infrequent. Newton Tripp.

Prunus pumila L. Sand Cherry.—Frequent in sand along the Lake Huron shore and in dry and poor ground.

Prunus avium L. Sweet Cherry.—Occasionally planted, but not spreading so far as observed.

Prunus cerasus L. Common Cherry. Sour Cherry.—Very common as an escape along fences and on roadsides, especially on the Indian reservations.

Prunus americana Marsh. Wild Plum.—Common on borders of woods and along banks of streams.

Leguminosae. Pulse Family.

Gleditsia triacanthos L. Honey Locust.—Often planted, but not observed as spreading. Occasionally set out for hedges, but generally not a success.

Cercis canadensis L. Redbud.—Occasionally planted, but not spreading.

Baptisia tinctoria (L.) R. Br. Wild Indigo.—Noticed only in dry sandy ground on Walpole Island. Newton Tripp.

Lupinus perennis L. Wild Lupine.—Frequent in poor and sandy ground especially on shaded sand dunes along Lake Huron shore.

Trifolium incarnatum L. Crimson Clover.—Occasionally sown as an experiment, but not spreading or persisting. An annual.

Trifolium pratense L. Red Clover.—Common in fields, meadows, and open woods. Large farms of this species, it seems, have pedunculate heads, and have perhaps been erroneously identified as **T. medium** L. Zigzag Clover.

Trifolium repens L. White Clover.—Common everywhere, especially in pastures.

Trifolium hybridum L. Alsike Clover.—Common everywhere as an escape from cultivation.

Trifolium agrarium L. Yellow Clover.—Occasional on roadsides and along railways.

Trifolium procumbens L. Low Hop Clover.—Occasional in freight yards and along railways. Persisting and spreading.

Melilotus officinalis (L) Lam. Yellow Melilot.—Occasional in cultivated and waste places.

Melilotus alba Desr. White Melilot. Sweet Clover.—Very common on roadsides in hard clay. Becoming a common and rank weed in waste places. Said to be a good fodder plant, and one of the best for bees.

Medicago sativa L. Alfalfa.—Occasional on roadsides and along railways. Often cultivated in this locality and many fine fields of it noticed.

Medicago lupulina L. Black Medic.—Common in waste places and fields.

Petalostemum purpureum (Vent.) Rydb. Violet Prairie-clover.—About the grain elevators at Point Edward. From the western prairies.

Robinia pseudo-acasia L. Common Locust.—Cultivated as an ornamental tree and escaping to banks, fence rows, and waste places; subject to attack and destruction by boring insects.

Astragalus canadensis L. Carolina Milk Vetch.—Occasional in damp ground along streams. Noticed in particular on the delta islands of St. Clair River.

Astragalus neglectus (T. and G.) Sheldon. Cooper's Milk Vetch.—Noticed in abundance near Rock Glen. Newton Tripp.

Desmodium nudiflorum (L.) D. C. Naked-flowered Tick-trefoil.—Frequent in dry woods and thickets.

Desmodium grandiflorum (Walt.) DC. Pointed-leaved Tick-trefoil.—Common in rich open woods and thickets, and on shaded banks of streams.

Desmodium rotundifolium (Michx.) DC. Prostrate Tick-trefoil.—In poor and sandy ground at Blackwell Station. T. C. Wheatley. Not noticed elsewhere.

Desmodium bracteosum (Michx.) DC. Large-bracted Tick-trefoil.—Occasional in dry woods and thickets. Newton Tripp.

Desmodium dillenii Darl. Dillen's Tick-trefoil.—Frequent in dry open woods and thickets, especially near the Lake Huron shore.

Desmodium paniculatum (L.) DC. Panicled Tick-trefoil.—Frequent and usually in open dry ground.

Desmodium canadense (L.) DC. Canadian Tick-trefoil.—Common in open woods and on banks of streams. Abundant on the delta islands of St. Clair River.

Desmodium rigidum (Ell.) DC. Rigid Tick-trefoil.—Occasional in dry and sandy ground.

Desmodium marilandicum (L.) DC. Small-leaved Tick-trefoil.—Occasional in dry and sandy ground. Noticed in particular near Blackwell Station. T. C. Wheatley.

Lespedeza frutescens (L.) Britton. Wand-like Bush Clover.—Occasional

in dry and sandy ground, especially on the shaded and fixed sand dunes along the Lake Huron shore.

Lespedeza hirta (L.) Hornem. Hairy Bush Clover.—Common in dry and sandy ground.

Lespedeza capitata Michx. Round-headed Bush Clover.—Frequent in dry and sandy ground, especially near Lake Huron shore, and on the delta islands.

Vicia sativa L. Spring Vetch.—Occasional as a weed in gardens, fields and on roadsides.

Vicia angustifolia (L.) Reichard. Common Vetch.—Frequent along highways and railroads, and often in gardens and fields as a weed.

Vicia sepium L. Bush Vetch. Wild Tare.—Becoming frequent along roads and in bushy pastures.

Vicia tetraperma (L.) Maench. Slender Vetch.—Occasional along railroads.

Vicia cracca L. Cow Vetch.—Frequent on railway embankments and borders of thickets.

Vicia caroliniana Walt. Carolina Vetch.—Frequent in shaded ground and on banks of streams. Abundant in open dry ground on the north end of Walpole Island.

Vicia americana Muhl. American Vetch.—Reported by Prof. John Macoun as noticed near Point Edward. Apparently rare.

Vicia villosa Roth. Hairy Vetch.—Often cultivated and inclined to escape to roads and waste places and persist.

Lathyrus maritimus (L.) Bigel. Beach Pea.—Frequent in sand along the Lake Huron shore. Abundant on the sand dunes at Port Franks. A good sand binder.

Lathyrus palustris L. Marsh Vetchling.—Frequent in damp grassy places on borders of damp rich woods and banks of streams.

Lathyrus palustris linearifolius Ser. Winged Marsh Vetchling.—Frequent on borders of open woods especially on the delta islands.

Lathyrus palustris myrtifolius (Muhl.) Gray. Myrtle-leaved Marsh Pea.—Frequent in ditches, and near lakes and streams.

Lathyrus venosus Muhl. Veiny Pea.—Reported by Prof. John Macoun as noticed near Sarnia. Apparently rare.

Lathyrus ochroleucus Hook. Cream-colored Vetchling.—Occasional in dry open woods and thickets. Newton Tripp.

Lathyrus latifolius L. Everlasting Pea.—Inclined to escape and persist on roadsides near Sarnia.

Apios tuberosa Moench. Groundnut. Wild Bean.—Frequent on borders of woods and thickets.

Strophostyles helvola (L.) Britton. Trailing Wild Bean.—Reported by Prof. John Macoun as noticed on or near sandy shore of Lake Huron north of Sarnia. Apparently rare. Common on Lake Erie shore.

Amphicarpa monoica (L.) Ell. Hog Pea-nut.—Frequent in dry open woods and thickets. Much smaller than the following.

Amphicarpa pitcheri, T. and G. Pitcher's Hog Pea-nut.—Frequent in damp rich open woods, and thickets and along streams. Noticed especially on the delta islands.

Linaceae. Flax Family.

Linum usitatissimum L. Common Flax.—Occasional in fields, on roadsides, and along railways. Cultivated. Occasionally noticed as a weed in fields.

Linum virginianum L. Wild Flax.—In poor and sandy shaded ground near Blackwell Station. T. C. Wheatley. Not noticed elsewhere. **L. medium** (Planch) Britton, stiff yellow flax, not yet noticed in Lambton Co., but found near Port Huron, Mich.

Oxolidaceae. Wood Sorrel Family.

Oxalis stricta L. Upright Yellow Wood Sorrel.—Common in dry and sandy ground. Often a weed in gardens and fields.

Oxalis carnicutata L. Lady's Sorrel.—Common in open dryish ground throughout the county. It appears to the writer that the expert botanists and manual writers do not agree very well as to the species of this genus.

Geraniaceae. Geranium Family.

Geranium maculatum L. Wild Cranesbill.—Common in open woods, thickets and fields.

Geranium robertianum L. Herb Robert.—Occasional in moist woods and thickets. Newton Tripp. Abundant along the banks of the Aux Sables river.

Geranium carolinianum L. Carolina Cranesbill.—Frequent in poor and sandy open ground.

Geranium bicknellii Britton.—Reported by Prof. John Macoun as noticed near Sarnia. Apparently rare. Common northward.

Geranium pusillum Burm. f. Small-flowered Cranesbill.—Frequent on roadsides, in cultivated grounds, and waste places. Often a lawn weed.

Erodium cicutarium (L.) L'Her. Storksbill.—Frequent about towns and villages as a weed.

Rutaceae. Rue Family

Zanthoxylum americanum Mill. Northern Prickly Ash.—Common in damp open woods and thickets, and along banks of streams.

Simarubaceae. Quassia Family.

Ailanthus glandulosa Desf. Tree of Heaven. Ailanthus.—Planted for ornament, escaping, and persisting about towns and villages. Apparently well established.

Polygalaceae. Milkwort Family.

Polygala paucifolia Willd. Fringed Polygala.—Frequent and usually in shaded dry sandy ground.

Polygala polygama Walt. Racemed Milkwort.—Occasional in dry and sandy ground. Noticed in particular on shaded sand dunes along Lake Huron.

Polygala senega L. Seneca Snakeroot.—Frequent in dry open woods and on hillsides. Abundant at Rock Glen.

Polygala senega latifolia T. and G. Large-leaved Snakeroot.—Occasional near Forest. N. Tripp.

Polygala incarnata L. Pink Milkwort.—Abundant in dry prairie-like ground on the delta islands of St. Clair River. Not noticed elsewhere.

Polygala sanguinea L. Field Milkwort.—Occasional in moist sandy ground. Abundant in many places on the delta islands of St. Clair River. **P. verticillata** L., whorled milkwort, and **P. verticillata ambigua** (Nutt.)

Wood, loose-spiked milkwort, not yet noticed in Lambton Co. but are found near Port Huron, Mich., and on Harsen's Island, one of the delta islands of St. Clair River.

Euphorbiaceae. Spurge Family.

Acalypha virginica L. Three-seeded Mercury.—Frequent in fields and open places.

Euphorbia polygonifolia L. Seaside Spurge.—Common in sand along the Lake Huron shore. Not noticed elsewhere.

Euphorbia preslii Guss. Large Spurge.—Frequent in dry open ground.

Euphorbia hirsuta (Torr.) Wiegand. Hairy Spurge.—Frequent along railways and in towns and cities.

Euphorbia maculata L. Milk Purslane.—Common in open places, on roadsides, and along railways.

Euphorbia humistrata Engelm. Hairy Spreading Spurge.—In rich ground on Walpole Island. Not noticed elsewhere. In my judgment the identification is doubtful.

Euphorbia marginata Pursh. Snow-on-the-Mountain.—Cultivated as an ornamental plant, but escaping and persisting a few years.

Euphorbia corollata L. Flowering Spurge.—Common in poor and dry ground, on sand ridges, and railway embankments. This is the species known in Lambton Co., Ont., and St. Clair Co., Mich., only by the popular name "Go-quick." Its root is a powerful cathartic.

Euphorbia platyphylla L. Broad-leaved Spurge.—Occasional on roadsides near Sarnia. Abundant in many places on Walpole Island.

Euphorbia helioscopia L. Wortweed.—Occasional in waste places about Forest. N. Tripp.

Euphorbia cyparissias L. Cypress Spurge.—Frequent in dry and poor ground. An escape from cultivation.

Euphorbia lucida Waldst. and Kit. Shining Spurge.—Occasional in dry and sandy ground. Spreading in sand at Point Edward.

Euphorbia peplus L. Petty Spurge.—Found in waste places near Forest. N. Tripp.

Callitrichaceae. Water Starwort Family.

Callitriche palustris L. Vernal Water Starwort.—Common in pools, borders of ponds, and slow streams.

Anacardiaceae. Cashew Family.

Rhus typhina L. Staghorn Sumach.—Common in dry and sandy ground.

Rhus glabra L. Smooth Sumach—Occasional in dry ground.

Rhus vernix L. Poison Sumach.—Frequent in wet and swampy places.

Rhus toxicodendron L. Poison Ivy.—Very common on shaded sand ridges, in open woods and thickets, and also in swamps. Occasionally climbing trees as a vine, which form is designated by some authors as **Rhus toxicodendron radicans** (L.) Torr., climbing poison ivy. At Point Pelee, Essex Co., Ontario, a point running south into Lake Erie about 9 miles; vines over three inches in diameter were noticed taking complete possession of trees 40 and 50 feet high.

Rhus canadensis Marsh. Fragrant Sumach.—Very common on sand ridges near Lake Huron shore.

Aquifoliaceae. Holly Family.

Ilex verticillata (L.) Gray. Black Alder. Winterberry.—Common on low ground, in damp open woods and thickets.

Nemopanthes mucronata (L.) Trel. Mountain Holly.—Common in damp thickets, and in tamarack swamps.

Celastraceae. Staff Tree Family.

Evonymus obovatus Nutt. Running Strawberry Bush.—Frequent and usually in rich shaded ground.

Celastrus scandens L. Climbing Bittersweet.—Common along streams and in damp open woods. In western Ontario and in Michigan called "bittersweet."

Staphyleaceae. Bladder Nut Family.

Staphylea trifolia L. American Bladder Nut.—Frequent along streams, in rich open woods and thickets.

Aceraceae. Maple Family.

Acer spicatum, Lam. Mountain Maple.—Frequent in damp woods and thickets.

Acer saccharum, Marsh. Sugar Maple.—Frequent in rich ground with other trees.

Acer saccharum nigrum (Michx. f.) Britton. Black maple.—Noticed along the Aux Sables river. Plentiful.

Acer saccharinum L. Silver Maple.—Frequent in rich ground with other trees and on banks of streams.

Acer rubrum L. Red Maple.—Common in wet rich ground and on river bottoms with other trees.

Acer platanoides L. Norway Maple.—Often planted but not spreading.

Acer psuedo-platanus L. Sycamore Maple.—Occasionally planted but not spreading.

Acer negundo L. Box Elder.—Planted and spreading by seed.

Sapindaceae. Soapberry Family.

Aesculus hippocastanum L. Common Horse-chestnut.—Planted and occasionally escaping to roadsides, fields and waste places.

Balsaminaceae. Touch-me-not Family.

Impatiens pallida Nutt. Pale Touch-me-not.—Occasional in damp shaded places and in rich shaded ground along streams.

Impatiens biflora Walt. Spotted Touch-me-not.—Very common in damp shaded ground.

Rhamnaceae. Buckthorn Family.

Rhamnus alnifolia L'Her. Alder-leaved Buckthorn.—Common in swamps, damp thickets and open marshy ground.

Ceanothus americanus L. New Jersey Tea.—Common on dry and sandy ground in open woods and thickets.

Ceanothus ovatus Desf. Smaller Red-root.—Common in many places on shaded sand ridges near Lake Huron shore.

Vitaceae. Vine Family.

Psedera vitacea (Kneer.) Greene. American Woodbine.—Frequent in rich open woods, thickets, and along streams. Often cultivated.

Vitis bicolor Le Conte. Summer Grape.—Frequent in woods and thickets.

Vitis vulpina L. Frost Grape. River-bank Grape.—Common along streams. Often abundant in sand along Lake Huron shore. A good sand-binder.

Tilliaceae. Linden Family.

Tilia americana L. Basswood.—Common in rich ground with other trees.

Malvaceae. Mallow Family.

Abutilon theophrasti Medic. Velvet Leaf. Indian Mallow.—Occasional on roadsides and in waste places. Often a garden and field weed.

Malva rotundifolia L. Common Mallow.—Common in waste places and cultivated grounds.

Malva sylvestris L. High Mallow.—Occasionally escaping from cultivation to roadsides and waste places. Noticed in particular on Walpole Island.

Malva moschata L. Musk Mallow.—Occasional on roadsides and in old fields. Well established as an escape.

Hibiscus moscheutos L. Swamp Rose Mallow.—Noticed in marshy ground on the south shore of Lake St. Clair. It may yet be found on the delta islands of St. Clair River. I am informed this is the plant lately named by Dr. E. L. Greene as **H. opulifolius,** the type plant coming from the big marsh at Point Pelee on Lake Erie, Essex Co., Ont., where it was formerly abundant.

Hibiscus trionum L. Flower-of-an-hour —Occasional as a weed in gardens and fields near Forest. Newton Tripp.

Hypericaceae. St. John's-wort Family.

Hypericum ascyron L. Great St. John's-wort.—Frequent in damp ground and along banks of streams. Noticed in particular along the Aux Sables river.

Hypericum perforatum L. Common St. John's-wort.—Frequent in poor and sandy ground on roadsides and in fields. Often a bad field weed.

Hypericum punctatum Lam. Spotted St. John's wort.—Frequent in damp shaded places.

Hypericum prolificum L. Shrubby St. John's-wort.—Frequent in open woods and thickets.

Hypericum kalmianum L. Kalm's St. John's-wort.—Abundant in damp sand along the Lake Huron shore, especially at and near Port Franks.

Hypericum mutilum L. Dwarf St. John's-wort.—Common in low damp ground.

Hypericum majus (Gray) Britton. Larger Canadian St. John's-wort.—Occasional in damp grassy ground.

Hypericum canadense L. Canadian St. John's-wort.—Occasional in damp marshy ground.

Hypericum virginicum L. Marsh St. John's-wort.—Common in swamps and marshy ground.

Cistaceae. Rockrose Family.

Helianthemum canadense L. (?) Michx. Frostweed.—Common on dry and sandy ground, especially near the Lake Huron shore.

Helianthemum majus BSP. Hoary Frostweed.—Frequent in poor and sandy ground.

Lechea villosa Ell. Large Pinweed.—Frequent in dry and sandy ground.

Lechea intermedia Leggett. Large-podded Pinweed.—Occasional in dry and sandy ground, especially near the Lake Huron shore.

Violaceae. Violet Family.

Hybanthus concolor (Forster) Spreng. Green Violet.—Along Aux Sables River. Abundant in one place. Newton Tripp.

Viola pedata lineariloba DC. Bird-foot Violet.—Abundant in several places on shaded sand ridges near Lake Huron shore. Newton Tripp. A very beautiful violet.

Viola cucullata Ait. Marsh Blue Violet.—Common in damp and marshy places. A beautiful violet.

Viola nephrophylla Greene. Small Mottled Blue Violet.—Noticed at Rock Glen in 1906 by Dodge and near Sarnia by N. Tripp.

Viola affinis LeConte. LeConte's Violet. Wet ground on borders of woods. Frequent.

Viola palmata L. Early Blue Violet.—In damp woods on the delta islands of St. Clair River. Fast disappearing.

Viola sororia Willd. Woolly Blue Violet.—Common in meadows and woods.

Viola fimbriatula Sm. Ovate-leaved Violet.—Occasional in dry and sandy ground, especially on and near the shaded and fixed sand dunes along Lake Huron shore.

Viola sagittata Ait. Arrow-leaved Violet.—Moist prairie-like ground on the delta islands of St. Clair River. Abundant in spots.

Viola pallens (Banks) Brainard. Northern White Violet.—Frequent in wet springy places. A small white violet appearing very early in the spring.

Viola blanda Willd. Sweet White Violet.—Moist rich woods near Forest. Frequent. Newton Tripp.

Viola incognita Brainard. Large-leaved White Violet.—Common in moist woodlands.

Viola renifolia Gray. Kidney-leaved Violet.—Frequent in swamps. Newton Tripp.

Viola pubescens Ait. Downy Yellow Violet.—Frequent in dry open woods and thickets, especially on the shaded and fixed sand dunes along the Lake Huron shore.

Viola scabriuscula Schwein. Smooth Yellow Violet.—Common in damp open woods and thickets.

Viola canadensis L. Canada Violet.—Frequent in rich woods and thickets.

Viola striata Ait. Striped Violet. Damp shaded ground near Forest. Newton Tripp.

Viola conspersa Reichenb. American Dog Violet.—Common in low and shaded ground.

Viola arenaria DC. Sand Violet.—Common on the sand dunes at Port Franks.

Viola rostrata Pursh. Long-spurred Violet. Frequent in rich open woods and thickets.

Viola tricolor L. Pansy.—Occasionally escaping and persisting at least for a time.

Viola rafinesquii Greene. Wild Pansy. Woods and open places. Often abundant in old fields. Newton Tripp.

Thymelaeaceae. Mezereum Family.

Dirca palustris L. Leather-wood. Moose-wood.—Frequent in damp rich woods, especially near Sarnia.

Elaeagnaceae. Oleaster Family.

Shepherdia canadensis (L.) Nutt. Canadian Buffalo-Berry.—Occasional in dry and sandy ground. Very abundant on the sand dunes at Port Franks.

Lythraceae. Loosestrife Family.

Decodon verticillata (L.) Ell. Water Willow.—Occasional in swampy ground. Abundant in one place on the edge of a pond north of Sarnia, and about the small lakes in the northeast part of the county.

Lythrum alatum Pursh. Wing-angled Loosestrife.—Occasional in swamps and damp meadows. Plentiful on the delta islands of St. Clair River.

Lythrum salicaria L. Spiked Loosestrife.—Well established at Pt. Edward. in meadow-like ground.

Onagraceae. Evening Primrose Family.

Ludvigia alternifolia L. Seedbox.—Occasional on the delta islands. Noticed by Prof. John Macoun near Point Edward. Apparently infrequent.

Ludvigia polycarpa Short and Peter. Many-fruited Ludwigia.—Occasional in wet and swampy places.

Ludvigia palustris L. (Ell.) Water Purslane.—Common in ditches, muddy places, and on wet shores.

Epilobium angustifolium L. Great Willow-herb.—Common in damp ground and open woods. Usually very abundant on burnt-over ground for a couple of years. Recently it has acquired the name of fireweed.

Epilobium molle Torr. Downy Willow-herb.—In wet meadow-like places near Port Franks. Apparently infrequent.

Epilobium densum Raf. Linear-leaved Willow-herb.—Frequent in damp marshy ground.

Epilobium coloratum Muhl. Purple-leaved Willow-herb.—Occasional in low damp ground.

Epilobium adenocaulon Haussk. Northern Willow-herb.—Very common in rich damp open ground.

Oenothera biennis L. Common Evening Primrose.—Common in dry and sandy ground, especially along and near the Lake Huron shore.

Oenothera fruticosa hirsuta Nutt. Hairy Sundrops.—Occasional in dry and sandy ground near Port Franks. Newton Tripp.

Oenothera pratensis (Small) Robinson.—Meadow Sundrops. Low ground near Port Franks. Newton Tripp.

Oenothera serulata Nutt. Tooth-leaved Primrose.—Occasional in sandy ground along railways. An immigrant from the west.

Circaea lutetiana L. Enchanter's Nightshade.—Common in damp open woods and thickets.

Circaea alpina L. Smaller Enchanter's Nightshade.—Common in wet woods and thickets.

Haloragidaceae. Water Milfoil Family.

Myriophyllum alterniflorum DC. Loose-flowered Water-milfoil.—Ponds and ditches near Lake St. Clair. Frequent. W. S. Cooper.

Myriophyllum spicatum L. Spiked Water Milfoil.—Frequent, growing in water on borders of slow streams, in ditches and ponds, especially along and near the mouths of St. Clair River.

Myriophyllum heterophyllum Michx. Various-leaved Water Milfoil.—Frequent in ponds, ditches and on borders of slow streams, especially in still water about Lake St. Clair and the mouths of St. Clair River.

Proserpinaca palustris L. Mermaid-weed.—Frequent in wet places, shallow water, ditches, along slow streams, and on muddy borders of ponds.

Araliaceae. Ginseng Family.

Aralia racemosa L. Spikenard.—Frequent in damp rich woods and thickets.

Aralia hispida Vent. Bristly Sarsaparilla, Wild Elder.—Frequent in dry and sandy ground.

Aralia nudicaulis L. Wild Sarsaparilla.—Very common in rich open woods and thickets. Also often in dry sandy ground.

Panax quinquefolium L. Ginseng.—Formerly abundant in damp rich woods. Becoming rare, being constantly dug up by Indians and others. Not noticed, but reported everywhere in the county, especially by the Indians, in rich shaded ground.

Panax trifolium L. Ground-nut.—Frequent in rich woods and thickets, especially among beeches and maples.

Umbelliferae. Parsley Family.

Sanicula marilandica L. Sanicle. Black Snakeroot.—Common in damp open woods and thickets. It is believed that **S. gregaria** Bicknell, and **S. canadensis** L., will yet be found in Lambton Co. **S. trifoliata** Bicknell, has been noticed near Port Huron, Mich.

Erigenia bulbosa (Michx.) Nutt. Harbinger of Spring.—Plentiful in patches in rich woods and thickets. Newton Tripp.

Osmorrhiza claytoni (Michx.) Clarke. Woolly Sweet Cicely.—Common in rich open woods and thickets.

Osmorrhiza longistylis (Torr.) DC. Smoother Sweet Cicely.—Frequent in rich open woods and thickets.

Conium maculatum L. Poison Hemlock.—Frequent in waste places. Often cultivated as an ornamental plant.

Aegopodium podagraria L. Gout Weed. Escaping from cultivation and persisting.

Cicuta maculata L. Water Hemlock.—Common in damp meadows, marshy places, damp open woods and thickets. Root very poisonous.

Cicuta bulbifera L. Bulb-bearing Water Hemlock.—Common along ditches in very wet places and swamps. Root believed to be very poisonous.

Carum carvi L. Caraway.—Frequent as an escape on roadsides, along railways, and in waste places.

Sium cicutaefolium Schrank. Water Parsnip.—Common in ditches, wet muddy places, and swamps.

Cryptotaenia canadensis (L.) DC. Honewort.—Very common in damp open woods and thickets.

Zizia aurea (L) Koch. Golden Alexanders.—Frequent in meadows on borders of woods and banks of streams. Abundant in prairie-like land on the delta islands of St. Clair River.

Taenidia integerrima (L.) Drude. Yellow Pimpernel.—Common in shaded dry and sandy ground.

Thaspium barbinode (Michx.) Hairy-jointed Meadow-Parsnip.—Near Port Franks. Apparently rare. N. Tripp.

Pastinaca satvia L. Parsnip.—Frequent and well established on roadsides, banks of streams, along railways and in waste places.

Heracleum lanatum Michx. Cow Parsnip.—Frequent on banks of streams and in open rich woods. Sometimes cultivated as an ornamental plant.

Conioselinum chinense (L.) BSP. Hemlock Parsley.—Abundant north of Thedford in shade on a wet springy bank of a receding lake. Not noticed elsewhere.

Angelica atropurpurea L. Great Angelica.—Occasional along damp banks of streams near Blackwell Station. T. C. Wheatley.

Daucus carota L. Carrot.—Becoming too frequent on roadsides, along railways, in depot grounds, and fast creeping into meadows, hay and grain fields, as a bad weed.

Cornaceae. Dogwood Family.

Cornus canadensis L. Dwarf Cornel.—Frequent in damp woods and thickets.

Cornus florida L. Flowering Cornel.—A few trees near Sarnia in dry ground. More frequent along and on the sides of the high banks of the Aux Sables River.

Cornus circinata L'Her. Round-leaved Cornel.—Frequent in dry and sandy ground, especially on and near the Lake Huron shore. Abundant at Port Franks.

Cornus amomum Mill. Silky Cornel.—Frequent in damp ground and wet places.

Cornus stolonifera Michx. Red Osier Dogwood.—Very common in wet places. Abundant and usually in damp sand at Port Franks.

Cornus paniculata L'Her. Panicled Cornel.—Very common on borders of woods, along banks of streams, and in damp thickets.

Cornus alternifolia L. f. Alternate-leaved Cornel.—Frequent in rich open woods and thickets.

Nyssa sylvatica Marsh. Black Gum. Pepperidge.—Occasional and usually in rich open ground with other trees. Noticed near the high banks of the Au Sable River below Rock Glen.

Ericaceae. Heath Family.

Chimaphila umbellata (L.) Nutt. Pipsissewa. Prince's Pine.—Frequent in dry open woods, especially on the shaded sand dunes along the Lake Huron Shore and under pines at Port Franks. **Moneses uniflora** (L.) Gray, one-flowered pyrola, not yet noticed in Lambton Co. but found under pines near Port Huron, Mich.

Pyrola secunda L. One-sided Wintergreen.—Frequent in rich woods.

Pyrola chlorantha Sw. Greenish-flowered Wintergreen.—Occasional in dry open woods, especially among pines at Port Franks. Newton Tripp.

Pyrola elliptica Nutt. Shin Leaf.—Frequent in dry woods and thickets.

Pyrola americana Sweet. Round-leaved Wintergreen.—Frequent in dry open woods and thickets.

Pyrola asarifolia incarnata (Fisch.) Fernald. Bog Wintergreen.—Occasional in tamarack swamps. Noticed in very wet places at Port Franks.

Monotropa uniflora L. Indian Pipe. Corpse Plant.—Frequent in rich open woods and thickets.

Monotropa hypopitys L. Pinesap. False Beech Drips.—Occasional along Aux Sables River. Apparently rare. N. Tripp. **Pterospora andromedea** Nutt., Pine Drops, not yet noticed in Lambton Co., but found under pines near Port Huron, Mich.

Ledum groenlandicum Oeder. Labrador Tea.—In a very wet thicket, north of Sarnia. Apparently rare.

Kalmia polifolia Wang. Pale Laurel.—Occasional in very wet places. Newton Tripp.

Andromeda glaucophylla Link. Bog Rosemary.—Occasional in very wet places. Newton Tripp. Formerly included with **A. polifolia** L.

Chamaedaphne calyculata (L) Muench. Leather Leaf.—Occasional in boggy places. Newton Tripp.

Epigaea repens L. Mayflower. Trailing Arbutus.—Occasional along the shaded sand dunes of Lake Huron.

Caultheria procumbens L. Teaberry.—Common on poor and sandy ground, in open woods and thickets. Known here and in Michigan as "wintergreen."

Arctostaphyles uva-ursi (L.) Spreng. Bearberry.—Common in poor and sandy ground along the Lake Huron shore. Very abundant at Port Franks and on sand dunes. A good sand binder.

Chiogenes hispidula (L.) T. and G. Moxie Plum.—Creeping snowberry. Occasional in tamarack swamps and boggy places.

Gaylussacia frondosa (L.) T. and G. Blue Tangle. Dangleberry.—Reported found near Sarnia by Prof. John Macoun. Apparently infrequent. See contributions to Canadian botany XVI 218.

Gaylussacia baccata (Wang.) C. Koch. Black Huckleberry.—Abundant usually on dry and sandy ground, in open woods and thickets.

Vaccinium pennsylvanicum Lam. Dwarf Blueberry.—Common on poor and sandy ground, especially near by and on the sides of shaded and fixed sand dunes along Lake Huron shore.

Vaccinium canadense, Kalm. Sour-top. Canada Blueberry.—Occasional in dry ground at Port Franks. Newton Tripp.

Vaccinium corymbosum L. High Blueberry. High-bush Huckleberry.—Frequent in swamps and damp open woods.

Vaccinium macrocarpon Ait. American Cranberry.—In bogs, swamps, and wet places. Formerly very abundant. Becoming scarce on account of drainage and fires.

Primulaceae. Primrose Family.

Samolus floribundus HBK. Water Pimpernel.—Occasional, usually along the muddy banks of streams. Newton Tripp.

Lysimachia terrestris (L.) BSP. Bulb-bearing Loosestrife.—Frequent in

low marshy ground. **L. quadrifolia,** L., Crosswort, Whorled Loosestrife, not yet noticed in Lambton Co., but found near Port Huron, Mich.

Lysimachia numularia L. Moneywort.—A frequent escape from cultivation. Often a bad lawn weed. North of Thedford it has become very abundant on the banks of ditches and creeks and following the streams down it covers the adjacent marshes in thick mats.

Lysimachia thyrsiflora L. Tufted Loosestrife.—Frequent in ditches, pools, small slow streams and very wet places.

Steironema ciliatum (L.) Raf. Fringed Loosestrife.—Common in low ground, damp open woods and thickets.

Steironema quadriflorum (Sims.) Hitchc. Prairie Moneywort.—Frequent in low marshy ground.

Trientalis americana (Pers.) Pursh. Star Flower.—Common in rich woods and thickets.

Oleaceae. Olive Family.

Fraxinus americana L. White Ash.—Frequent in rich and moist ground with other trees.

Fraxinus pennsylvanica Marsh. Red Ash.—Occasional in low damp ground with other trees.

Fraxinus pennsylvanica lanceolata (Barkh.) Sarg. Green Ash.—Occasional on low ground and along streams with other trees.

Fraxinus nigra Marsh. Black Ash.—Formerly very abundant in swamps and wet woods, but becoming scarce on account of drainage and fires.

Syringa vulgaris L. Common Lilac.—Occasionally escaping from cultivation to roadsides and persisting.

Ligustrum vulgare L. Privet.—Inclined to escape and persist on roadsides. Noticed especially north of Sarnia.

Gentianaceae. Gentian Family.

Gentiana procera Holm. Smaller Fringed Gentian.—Frequent in moist ground. Have not been able to fine **G. crinita** in Lambton Co., Ont., nor **G. procera** in St. Clair Co., Mich.

Gentiana quinquefolia L. Stiff Gentian.—Usually on moist hillsides, occasionally on river bottoms. Noticed at Rock Glen. Newton Tripp.

Gentiana puberula Michx. Downy Gentian. Dry ground on Squirrel Island. Abundant. Not noticed elsewhere.

Gentiana saponaria L. Soapwort Gentian.—Noticed in moist ground on Squirrel Island, one of the delta islands of St. Clair River. Apparently rare.

Gentiana andrewsii Griseb. Closed Gentian.—Frequent in moist ground. Flowers often pure white.

Halenia deflexa (Sm.) Griseb. Spurred Gentian.—Occasional in damp open woods and thickets. Newton Tripp.

Bartonia virginica (L.) BSP. Yellow Bartonia.—Occasional in poor and sandy ground.

Menyanthes trifoliata L. Buckbean.—Occasional in bogs and shallow water. Becoming scarce on account of drainage. Abundant at Port Franks.

Apocynaceae. Dogbane Family.

Vinea minor L. Common Periwinkle.—Popularly called "myrtle."—Noticed as a frequent permanent escape.

Apocynum androsaemifolium L. Spreading Dogbane.—Common in dry ground, open woods and thickets.

Apocynum cannabinum L. Indian Hemp.—Frequent in damp and marshy ground. Bark has a very strong fiber which was formerly used by the Indians for strings.

Apocynum cannabinum pubescens (R. Br.) DC. Velvet Dogbane.—Frequent in dry ground. Noticed in particular near Blackwell Station.

Apocynum cannabinum hypericifolium (Ait.) Gray. Clasping-leaved Dogbane.—Frequent in damp and marshy ground, perhaps the prevailing form in this locality.

Asclepiadaceae. Milkweed Family.

Asclepias tuberosa L. Butterfly-weed.—Frequent in dry and sandy ground. The prostrate form now included with this species but formerly named **A. decumbens** L., decumbent butterfly-weed, is plentiful near Blackwell Station.

Asclepias purpurascens L. Purple Milkweed.—Occasional in damp or dry ground.

Asclepias incarnata L. Swamp Milkweed.—Very common in open wet and marshy places.

Asclepias syriaca L. Common Milkweed.—Very common in poor and dry ground. Often a bad field weed.

Asclepias sullivantii Engelm. Sullivant's Milkweed.—Frequent in damp ground on the delta islands of St. Clair River.

Asclepias phytolaccoides Pursh. Poke Milkweed.—Frequent in rich ground, open woods and thickets.

Acerates viridiflora Ell. Green Milkweed.—Frequent on sand ridges, and in sand along Lake Huron shore. T. C. Wheatley.

Acerates viridiflora lanceolata (Ives) Gray. Lance-leaved Green Milkweed.—Frequent in sandy ground along Lake Huron shore.

Convolvulaceae. Convolvulus Family.

Ipomoea purpurea (L.) Roth. Common Morning Glory.—Inclined to escape and persist in waste places in towns and cities.

Convolvulus spithamaeus L. Upright Bindweed.—Occasional in dry and sandy ground.

Convolvulus sepium L. Hedge Bindweed.—Frequent in damp ground and along banks of streams.

Convolvulus arvensis L. Field Bindweed. Common about towns and cities along railroads and in fields.

Cuscuta epithymum Murr. Thyme Dodder. Clover Dodder.—Occasionally found on clover. Newton Tripp.

Cuscuta gronovii, Willd. Gronovius' Dodder.—Frequent and usually in damp ground. A parasite on herbaceous plants and shrubs.

Polemoniaceae. Polemonium Family.

Phlox paniculata L. Garden Phlox.—Inclined to escape to roadsides and persist.

Phlox divaricata L. Blue Phlox.—Frequent and often abundant in damp open woods and thickets.

Phlox drummondii Hook. Common Phlox.—Inclined to escape from cultivation and persist in sand at Point Edward.

Gilia rubra (L.) Heller. Standing Cypress. Escaping from cultivation to roadsides and persisting near Sarnia.

Hydrophyllaceae. Waterleaf Family.

Hydrophyllum virginianum L. Virginia Waterleaf.—Occasional in rich woods. Noticed in particular at Kettle Point.

Hydrophyllum canadense L. Broad-leaved Waterleaf.—Occasional along the high banks of the Aux Sables River.

Boraginaceae. Borage Family.

Cynoglossum officinale L. Common Hound's Tongue.—Common on roadsides, in pastures and waste places.

Cynoglossum boreale Fernald. Northern Wild Comfrey.—Occasional in dry woods.

Lappula virginiana (L.) Greene. Beggar's Lice.—Frequent in open woods and thickets.

Lappula echinata Gilibert. European Stickseed.—Common along roads and in waste places.

Myosotis scorpioides L. True Forget-me-not.—Becoming frequent in wet places as an escape from cultivation.

Myosotis laxa Lehm. Smaller Forget-me-not.—In very wet places and tamarack swamps near Thedford. Abundant.

Myosotis arvensis (L.) Hill.—Field Scorpion-grass.—In poor ground near Port Franks. Apparently rare. N. Tripp.

Lithospermum arvense L. Corn Gromwell.—Frequent on roadsides and in fields. Often a field weed.

Lithospermum officinale L. Common Gromwell.—Occasional on roadsides and in pastures. Newton Tripp. Noticed in particular near Lambton.

Lithospermum latifolium Michx. American Gromwell.—Occasional in rich open woods. Noticed particularly along the Aux Sables River.

Lithospermum gmelini (Michx.) Hitchc. Hairy Puccoon.—Common in poor and sandy ground, seldom far from Lake Huron shore.

Lithospermum canescens (Michx.) Lehm.—In dry ground and abundant on the delta islands of St. Clair River. Not noticed elsewhere.

Lithospermum angustifolium Michx. Narrow-leaved Puccoon.—Frequent in poor and sandy ground, usually near Lake Huron shore.

Echium vulgare L. Blue Weed. Blue Devil.—Frequent on roadsides and along railways. Abundant at Point Edward.

Verbenaceae. Vervain Family.

Verbena urticaefolia L. White Vervain.—Frequent on roadsides, in old fields and waste places.

Verbena angustifolia Michx. Narrow-leaved vervain.—Occasional along railways, in freight yards and waste places. Appears to be adventive here.

Verbena hastata L. Blue Vervain.—Very common on roadsides and in damp ground.

Verbena stricta, Vent. Hoary Vervain.—Abundant in sandy ground at Point Edward. Not noticed elsewhere.

Verbena bracteosa Michx. Large-bracted Vervain.—Occasional in freight yards and along railways. Abundant in sand at Point Edward.

Verbena bracteosa X stricta.—In poor sandy ground at Point Edward. An interesting form.

Lippia lanceolata Michx. Fog-fruit.—Not yet noticed in Lambton Co. but is abundant in spots near the north shore of Lake St. Clair, on the Michigan side.

Labiatae. Mint Family.

Teucrium canadense L. American Germander. Wood Sage.—Frequent in rich low open ground and on damp banks of streams.

Teucrium occidentale Gray. Hairy Germander. Frequent in damp and marshy ground, especially on marshy ground near Sarnia.

Scutellaria lateriflora L. Mad-dog Skullcap.—Common in wet or shaded ground.

Scutellaria galericulata L. Hooded Willow-herb.—Frequent in wet and marshy places.

Marrubium vulgare L. Common Horehound.—Frequent on roadsides and in waste places. Abundant in sand at Point Edward.

Agastache nepetoides (L.) Ktze. Catnep Giant-Hyssop.—Occasional on borders of woods and in thickets. Newton Tripp.

Nepeta cataria L. Catnip.—Common near dwellings, on roadsides, in fields and waste places. Often a bad garden and field weed.

Nepeta hederacea (L.) Trevisan. Ground Ivy.—Common in damp and shaded places. Thoroughly naturalized. Often a vicious lawn weed.

Dracocephalum parviflorum Nutt. Dragon Head. Near grain elevator at Point Edward. Not noticed elsewhere. Apparently introduced.

Prunella vulgaris L. Heal-all.—Very common in open woods, fields and thickets. Often a bad lawn weed.

Galeopsis tetrahit. Common Hemp Nettle.—Near Forest. Apparently rare. N. Tripp.

Lamium amplexicaule L. Henbit.—Often a weed in sandy cultivated ground, especially in strawberry patches.

Lamium maculatum L. Spotted Dead Nettle.—Occasionally escaping from cultivation to roadsides and borders of woods.

Leonurus cardiaca L. Common Motherwort.—Common as a weed around dwellings and in waste places.

Stachys tenuifolia Willd. Smooth Hedge Nettle.—Wet open ground. Frequent.

Stachys tenuifolia aspera (Michx.) Fernold. Rough Hedge Nettle.—Open damp ground. Frequent.

Stachys palustris L. Woundwort.—Frequent in wet and marshy places.

Monarda didyma L. Oswega Tea. Bee Balm.—Occasional in moist rich woods. Abundant in woods near Kettle Point.

Monarda fistulosa L Wild Bergamot.—In damp, or dryish ground. Apparently rare. Perhaps very doubtful.

Monarda fistulosa rubra Gray. Purple Bergamot.—Occasional in damp shaded ground. Abundant in woods at Kettle Point.

Monarda mollis L. Pale Wild Bergamot.—Abundant in dry and poor ground. The prevailing form in this locality.

Blephilia ciliata (L.) Raf. Downy Blephilia.—Dry open ground on Walpole Island. Apparently rare.

Blephilia hirsuta (Pursh.) Benth. Wood Mint.—Occasional in moist rich woods and thickets.

Hedeoma pulegioides (L.) Pers. American Pennyroyal.—Occasional in dry open ground. Newton Tripp.

Satureja hortensis L. Summer Savory.—Inclined to escape from cultivation to roadsides.

Satureja vulgaris (L.) Fritsch. Basil.—Frequent in dry woods, thickets and on dry banks of streams.

Origanum vulgare L. Wild Marjoram.—Occasional on roadsides and in fields, usually in dry and poor ground. Newton Tripp.

Pycnanthemum virginianum (L.) Durand and Jackson. Virginia Mountain Mint.—Very common in wet and marshy ground.

Lycopus virginicus L. Bugle Weed.—Frequent in damp rich ground.

Lycopus uniflorus Michx. Common Bugle Weed.—Frequent in damp rich woods and thickets.

Lycopus lucidus americanus Gray. Western Water Hoarhound.—Well established around grain elevators and along railways.

Lycopus americanus Muhl. Cut-leaved Water Hoarhound.—Very common in damp open or shaded ground.

Mentha spicata L. Spearmint.—Frequent on roadsides and in waste places.

Mentha piperita L. Peppermint.—Common in damp ground, on roadsides, in damp open woods, thickets and waste places.

Mentha citrata Shrh. Bergamot Mint.—Noticed in damp ground on Walpole Island where it has persisted more than 20 years.

Mentha arvensis L. Corn Mint. In damp rich open ground at Point Edward. Apparently infrequent.

Mentha arvensis canadensis (L.) Briquet. American Wild Mint.—Frequent in damp ground, damp open woods and thickets.

Collinsonia canadensis L. Rich-weed —Frequent in rich moist woods and thickets.

Solanaceae. Nightshade Family.

Solanum dulcamara L. Bittersweet.—Common everywhere even in deep woods. Thoroughly naturalized. Known here and in Michigan as nightshade or deadly nightshade.

Solanum nigrum L. Common Nightshade. Black nightshade.—Common in shaded and rich open ground, open woods and thickets. Often a garden and field weed. Fruit formerly supposed to be poisonous, but now known to be harmless when ripe.

Solanum carolinense L. Horse Nettle.—Occasional in dry sandy ground. It has persisted in sand at Point Edward for over ten years.

Solanum rostratum Dunal. Buffalo Bur.—Occasional along railways and in depot grounds. From the west.

Physalis grandiflora Hook. Large White-flowered Ground-cherry.—Occasional in sandy ground at Port Franks. Abundant and rank in spots near Stony Point. N. Tripp.

Physalis heterophylla Nees. Clammy Ground-cherry.—Common in dry and sandy ground. Often a garden and field weed.

Physalis subglabrata Mackenzie and Bush. Smooth Ground-cherry.—In rich open ground. Occasional. Newton Tripp.

Nicandra physalodes (L.) Pers. Apple of Peru.—Occasional about towns and villages.

Lycium halimifolium Mill. Matrimony Vine.—Occasionally escaping from cultivation to roadsides and into waste places. Noticed in particular at Point Edward in sand.

Hyoscyamus niger L. Black Henbane.—Occasional in sandy ground and waste places.

Datura stramonium L. Stramonium.—Frequent in waste places. Very abundant in sand at Point Edward.

Datura tatula L. Purple Thorn Apple.—Frequent in waste grounds. Abundant in sandy ground at Point Edward. More common than the preceding species.

Scrophulariaceae. Figwort Family.

Verbascum thapsus L. Common Mullein.—Common in dry ground. Often a bad weed in fields and pastures.

Verbascum blattaria L. Moth Mullein.—Occasional as a weed near Forest. N. Tripp.

Linaria vulgaris Hill. Butter and Eggs.—Common on roadsides and in waste places. Often a field weed.

Linaria minor (L.) Desf. Small Toadflax.—Abundant along railways, and in depot grounds. Adventive.

Scrophularia leporella Bicknell. Hare Figwort.—Frequent in open woods and thickets. Occasionally found in open ground.

Pentstemon hirsutus (L.) Willd. Hairy Beard-tongue.—Frequent in dry and sandy open or slightly shaded ground.

Pentstemon tubiflorus Nutt. Funnel-form Beard-tongue.—Inclined to escape from cultivation and persist near Forest. Newton Tripp.

Pentstemon laevigatus digitalis (Sweet) Gray. Foxglove Beard-tongue.—Dry open ground. Frequent.

Chelone glabra L. Turtlehead.—Frequent in damp ground on borders of woods and thickets.

Mimulus ringens L. Square-stemmed Monkey Flower.—Common in damp and wet places, especially in the bottoms of ditches and small creeks.

Veronica virginica L. Culver's-root.—Frequent in damp rich ground. Abundant on the delta islands of St. Clair River.

Veronica anagallis-aquatica L. Water Speedwell.—Occasional in brooks and ditches. N. Tripp.

Veronica americana Schwein. American Brooklime.—Occasional along brooks, in ditches and damp open places.

Veronica scutellata L. Marsh Speedwell.—Common in swamps and very wet places.

Veronica officinalis L. Common Speedwell.—Occasional in dry open ground near Forest. Newton Tripp.

Veronica chamaedrys L. Bird's-eye.—In pastures, open woods and cemeteries. Frequent.

Veronica serpyllifolia L. Thyme-leaved Speedwell.—Very common in damp grassy ground. Often a bad lawn weed.

Veronica peregrina L. Purslane Speedwell.—Common in cultivated and waste grounds. Often a garden weed.

Veronica arvensis L. Corn Speedwell.—Frequent in cultivated grounds, waste places, open woods and thickets.

Veronica tournefortii C. C. Gmel. Buxbaum's Speedwell.—Frequent in cultivated grounds and waste places. Often a garden weed.

Gerardia pedicularia L. Fern-leaved False Foxglove.—Frequent in open woods on dry and sandy ground.

Gerardia paupercula (Gray) Britton. Small-flowered Gerardia.—Frequent in low wet ground, also on sandy shores and sterile ground. Abundant on the delta islands of St. Clair River.

Gerardia tenuifolia Vahl. Slender Gerardia.—Frequent in low or dry open ground.

Gerardia skinneriana Wood. Skinner's Gerardia.—Abundant in one place on Squirrel Island in dry and poor ground. Not noticed elsewhere.

Gerardia parvifolia Chapm. Small Ten-lobed Gerardia.—In poor dry ground on Squirrel Island where it is abundant. Not noticed elsewhere.

Buchnera americana L. Blue Hearts.—Occasional in poor ground on the delta islands of St. Clair River. Abundant in sandy ground at Port Franks.

Castilleja coccinea (L.) Spreng. Scarlet Painted Cup.—Occasional in damp ground. Abundant on the north end of Walpole Island.

Melampyrum lineare Lam. Cow Wheat.—Common in dry open woods.

Pedicularis canadensis L. Common Lousewort. Wood Betony.—Common in dry open woods and thickets.

Pedicularis lanceolata Michx. Swamp Lousewort.—Frequent in wet and marshy open places.

Lentibulariaceae. Bladderwort Family.

Utricularia vulgaris americana Gray. Greater Bladderwort.—Common in ponds and slow streams.

Utricularia resupinata B. D. Greene. Reversed Bladderwort.—Abundant in and about a large pond north of Sarnia. Not noticed elsewhere.

Utricularia cornuta Michx. Horned Bladderwort.—Occasional in ditches near Blackwell Station. T. C. Wheatley. Abundant in wet sandy places at Port Franks.

Orobanchaceae. Broom-rape Family.

Epifagus virginiana (L.) Bart.—Frequent under beach trees.

Conopholis americana (L. f.) Wallr. Squaw-root. Cancer-root.—Occasional in woods. T. C. Wheatley.

Orobanche uniflora L. One-flowered Cancer-root.—Occasional in damp woods. Noticed at Kettle Point, Newton Tripp, and on Squirrel Island, Dodge.

Bignoniaceae. Begnonia Family.

Tecoma radicans (L.) Juss. Trumpet Creeper. Cultivated but not spreading.

Catalpa speciosa Worden. Catawba Tree.—Often planted, but not spreading.

Catalpa bignonioides Walt. Catalpa.—Cultivated as a street and lawn tree but not spreading.

Phrymaceae. Lopseed Family.

Phryma leptostachya L. Lopseed.—Frequent in moist open woods and thickets.

Plantaginaceae. Plantain Family.

Plantago cordata Lam. Heart-leaved Plantain.—Frequent along streams, in pools, ditches, wet places and wooded swamps.

Plantago major L. Common Plantain.—Very common in yards, pastures, hay fields, and waste places. Often a bad lawn weed.

Plantago rugelii Dcne. Rugel's Plantain.—Frequent in yards, fields and pastures. Often a field weed.

Plantago lanceolata L. English Plantain.—Very common on roadsides, in pastures and hay fields. Often a lawn weed.

Plantago aristata Michx. Frequent in dry and poor ground and along railways. An immigrant from the southwest.

Plantago virginica L. Dwarf Plantain.—Occasional in poor and dry open ground.

Rubiaceae. Madder Family.

Sherardia arvensis L. Field Madder.—Occasionally a weed about Forest. N. Tripp.

Galium aparine L. Clevers. Goose Grass.—Occasional in rich and shaded ground.

Galium verum L. Yellow Bedstraw.—Occasional in dry fields near Forest. Newton Tripp.

Galium pilosum Ait. Hairy Bedstraw.—Common on dry and sandy ground in open woods and thickets.

Galium circaezans Michx. Wild Liquorice.—Common in rich woods.

Galium lanceolatum Torr. Torrey's Wild Liquorice.—Frequent in rich dry woods.

Galium boreale L. Northern Bedstraw.—Common in damp or dry ground.

Galium mollugo. Wild Madder.—Occasional on roadsides and in fields near Forest. Newton Tripp.

Galium trifidum L. Small Bedstraw.—Frequent in wet, springy, and shaded places.

Galium Claytoni Michx. Clayton's Bedstraw. Very wet and swampy ground. Noticed in particular near Point Edward.

Galium tinctorium L. Stiff Marsh Bedstraw.—Frequent in damp, marshy, open and shaded places.

Galium asprellum Michx. Rough Bedstraw.—Common in damp thickets.

Galium triflorum Michx. Sweet-scented Bedstraw.—Very common in dry rich woods and thickets.

Mitchella repens L. Partridge Berry.—Very common in dry woods, especially among pines near Lake Huron shore.

Cephalanthus occidentalis L. Buttonbush.—Abundant in swamps, wet places, about ponds and along low wet banks of streams.

Caprifoliaceae. Honeysuckle Family.

Diervilla lonicera Mill. Bush Honeysuckle.—Common in dry sandy ground.

Lonicera tatarica L. Tartarian Honeysuckle.—Inclined to escape and persist. Well established as an escape along the bank of St. Clair River in St. Clair Co., Mich.

Lonicera canadensis Marsh. American Fly Honeysuckle.—Abundant in damp or dry open woods and thickets.

Lonicera oblongifolia (Goldie) Hook. Swamp Fly Honeysuckle.—Occasional in wet and swampy ground. Abundant in a marshy place north of Sarnia.

Lonicera glaucescens Rydb. Douglas' Honeysuckle.—Frequent and usually in dry and poor ground.

Symphoricarpos occidentalis Hook. Wolfberry.—Occasional in dry and sandy ground, usually not far from Lake Huron shore.

Symphoricarpos racemosus Michx. Snowberry.—Occasional in dry shaded ground. Abundant along the Aux Sables River.

Symphoricarpos racemosus pauciflorus Robbins. Low Snowberry.—Frequent and usually in shaded places on poor and sandy ground. Noticed in particular near Lake Huron shore north of Sarnia.

Linnaea borealis americana (Forbes) Rehder.—Frequent in damp open woods and thickets.

Triosteum perfoliatum L. Tinker's Weed.—In rich ground on St. Ann's Island, one of the delta islands of St. Clair River.

Triosteum aurantiacum Bicknell. Scarlet-fruited Horse Gentian.—Frequent in open woods and thickets, the usual form in this region.

Viburnum opulus americanum (Mill.) Ait. Cranberry-tree.—Frequent in woods, damp thickets and along streams.

Viburnum acerifolium L. Dockmackie.—Frequent in dry woods and thickets.

Viburnum pubescens (Ait.) Pursh. Downy Arrow-wood.—Frequent in dry woods and thickets.

Viburnum dentatum L. Arrow-wood.—Abundant in rich woods northeast of Sarnia. T. C. Wheatley. Not noticed elsewhere.

Viburnum cassinoides L. Withe-rod.—Common in wet open ground.

Viburnum lentago L. Nannyberry.—Frequent in rich woods, thickets, and on banks of streams.

Sambucus canadensis L. Common Elder.—Very common in damp ground, rich open woods and thickets.

Sambucus racemosus L. Red-berried Elder.—Common in swamps, wet woods and thickets.

Dipsacaceae. Teasel Family.

Dipsacus sylvestris Huds. Wild Teasel.—Occasional on roadsides. In this locality often growing very thick and taking almost entire possession of damp pastures, thus becoming a pernicious weed.

Cucurbitaceae. Gourd Family.

Sicyos angulatus L. One-seeded Bur Cucumber.—Frequent as a weed in alleys, back yards, and waste places of towns and villages.

Echinocystis lobata (Michx.) T. and C. Wild Balsam Apple.—Frequent as an escape from cultivation.

Campanulaceae. Bluebell Family.

Specularia perfoliata (L.) A. DC. Venus's Looking-glass.—Occasional in dry open ground. Noticed in particular as a weed in the gardens of Indians on Walpole Island.

Campanula rapunculoides L. Creeping Bellflower.—Occasional as an escape from cultivation to roadsides.

Campanula americana L. Tall Bellflower.—Frequent in rich open woods and thickets.

Campanula rotundifolia L. Harebell.—Common in dry and sandy open

ground. Abundant on the shaded and fixed sand dunes along the Lake Huron shore.

Campanula aparinoides Pursh. Marsh Bellflower.—Common in wet grassy places.

Lobeliaceae. Lobelia Family.

Lobelia cardinalis L. Cardinal-flower.—Frequent in low damp ground.

Lobelia siphilitica L. Great Lobelia.—Common in low wet ground.

Lobelia spicata Lam. Spiked Lobelia.—Common in dry or moist open ground.

Lobelia kalmii L. Brook Lobelia.—Frequent in wet marshy places.

Lobelia inflata L. Indian Tobacco.—Occasional in dry fields and open ground.

Compositae. Composite Family.

Vernonia illinoensis Gleason. Drummond's Ironweed.—Abundant on the delta islands of St. Clair River and south-western part of the county. Not noticed elsewhere.

Eupatorium purpureum L. Joe-pye Weed.—Common in low ground, open rich woods and thickets.

Eupatorium purpureum maculatum (L.) Darl. Spotted Joe-pye Weed.—Very common in wet and marshy open ground.

Eupatorium perfoliatum L. Thoroughwort. Boneset.—Very common in damp low open ground.

Eupatorium urticaefolium Reichard. White Snakeroot.—Common in rich woods and thickets. Said to be injurious to stock. Variable.

Liatris cylindracea Michx. Cylindric Blazing Star.—Frequent on sand ridges near Lake Huron shore.

Liatris scariosa Willd. Large Button Snakeroot.—Common on sand ridges along Lake Huron shore, also on Squirrel Island. Flowers occasionally pure white.

Liatris spicata (L.) Willd. Dense Button-Snakeroot.—Occasional in moist and wet ground. Abundant north of Sarnia and on the delta islands of St. Clair River. Flowers occasionally; pure white.

Grindelia squarrosa (Pursh) Duval. Broad-leaved Gum-plant.—Near the grain elevator at Point Edward. From the west. Occasional in cultivated fields.

Solidago caesia L. Blue-stemmed Goldenrod.—Common in dryish open woods and thickets.

Solidago caesia axillaris (Pursh.) Gray. Larger Blue-stemmed Goldenrod.—Frequent in damp open woods and thickets.

Solidago latifolia L. Zigzag Goldenrod.—Common in damp woods and on shaded banks of streams. Abundant in rich woods at Port Franks.

Solidago hispida Muhl. Hairy Goldenrod.—Common in sandy ground, dry open woods and thickets. **S. bicolor** L., white goldenrod, silver-rod, not yet noticed in Lambton Co., but is found in dry woods near city of St. Clair, St. Clair Co., Mich.

Solidago randii (Porter) Britton. Rand's Goldenrod.—On dry and sandy open ground near Port Franks. Frequent. Newton Tripp.

Solidago uliginosa Nutt. Bog Goldenrod.—Occasional in wet and boggy places.

Solidago speciosa augustata T. and S. Slender Showey Goldenrod.—No-

ticed on Squirrel Island in dryish prairie like ground and in other parts of the county. Newton Tripp.

Solidago patula Muhl. Rough-leaved Goldenrod.—Frequent in wet shaded places and on damp shaded banks of streams.

Solidago juncea Ait. Early Goldenrod.—Very common in dry sandy ground and in dry open woods and thickets.

Solidago neglecta T. and G. Swamp Goldenrod.—Common in wet and marshy places.

Solidago rugosa Mill. Wrinkled-leaved Goldenrod.—Abundant on roadsides, in dry open woods and thickets, usually in dry sandy ground.

Solidago nemoralis Ait. Gray Goldenrod.—Common in dryish open ground and on dry banks.

Solidago canadensis L. Canada Goldenrod.—Very common in rich open ground and thickets.

Solidago altissima L. Tall Goldenrod.—Common in rich open ground.

Solidago serotina Ait. Late Goldenrod.—Common in rich open ground and thickets.

Solidago serotina gigantea (Ait.) Gray. Large Late Goldenrod.—Frequent in low ground.

Solidago rigida L. Stiff Goldenrod.—Frequent in dry sandy ground, dry open woods and thickets. Abundant in spots on the delta islands of St. Clair River.

Solidago chioensis Riddell. Ohio Goldenrod.—Common in wet places and open swampy ground.

Solidago ridellii Frank. Riddell's Goldenrod.—Frequent in wet marshy places. Abundant north of Sarnia and on the delta islands of St. Clair River.

Solidago graminifolia (L.) Salisb. Bushy Goldenrod.—Very abundant in moist open ground.

Bellis perennis L. English Daisy.—Inclined to escape from cultivation to streets, and persist.

Aster macrophyllus L. Large-leaved Aster.—Common in dry open woods and thickets.

Aster novae-angliae L. New England Aster.—Common on moist roadsides and in damp open places.

Aster azureus Lindl. Sky-blue Aster.—Frequent in dry open woods, usually on very poor and sandy ground.

Aster cordifolius L. Common Blue Wood Aster.—Common in open woods and thickets.

Aster sagittifolius Wedemeyer. Arrow-leaved Aster.—Occasional in dry open woods.

Aster laevis L. Smooth Aster.—Very common in open woods and thickets usually in dry and sandy ground.

Aster ericoides L. White Heath Aster.—In poor ground near Blackwell Station. Apparently rare. T. C. Wheatley.

Aster depauperatus parviceps (Burgess) Fernald. Small-headed Aster.—In prairie-like ground at Point Edward. Abundant in one spot.

Aster amethystinus Nutt. Amethyst Aster.—Occasional on the delta islands of St. Clair River.

Aster multiflorus Ait. Dense-flowered Aster.—Occasional in dry and sandy ground. Abundant in dry ground on the delta islands of St. Clair River.

Aster dumosus L. Bushy Aster.—Occasional in dry and sandy ground.

Aster vimineus Lam. Small White Aster.—Noticed near Point Edward by Prof. John Macoun. Seen again in 1913, Dodge.

Aster vimineus foliolosus (Ait.) Gray. Noticed by J. M. Macoun near Point Edward.

Aster lateriflorus (L.) Britton. Starved Aster. Calico Aster.—Very common in damp thickets, dry or damp open places and fields.

Aster tradescanti L. Tradescant's Aster.—Very common in low damp and marshy open ground.

Aster paniculatus Lam. Tall White Aster.—Common in wet meadows and damp thickets. Very variable.

Aster salicifolius Ait. Willow Aster.—Low ground on Squirrel Island. Apparently infrequent.

Aster junceus Ait. Rush Aster.—Frequent in open wet meadows and boggy places.

Aster longifolius Lam. Long-leaved Aster. Plentiful near a grain elevator at Point Edward. Apparently introduced.

Aster puniceus L. Purple-stem Aster.—Common in low damp thickets and swampy places.

Aster puniceus lucidulus Gray. Leafy Purple-stem Aster.—Frequent in wet and marshy ground. with the species.

Aster umbellatus Mill. Tall Flat-top White Aster.—Very common in damp open woods and thickets.

Aster ptarmicoides T. and G. Upland White Aster.—Frequent on the grass-covered and shaded sand dunes at Port Franks. Newton Tripp. Not noticed elsewhere.

Erigeron pulchellus Michx. Robin's Plantain.—Frequent in dry open woods, open places and thickets.

Erigeron philadelphicus L. Philadelphia Fleabane.—Popularly known as field daisy. Very common as a weed in hay fields and pastures.

Erigeron annus (L.) Pers. Sweet Scabious.—Common in damp open woods, thickets, hay fields and pastures.

Erigeron ramosus (Walt.) BSP. Daisy Fleabane.—Common in fields, pastures and cultivated grounds. These three fleabanes are often found together as field weeds.

Erigeron canadensis L. Horseweed.—Very common as a weed in gardens, cultivated fields and waste places.

Antennaria canadensis Greene. Canadian Cat's-foot.—Frequent in dry open ground.

Antennaria fallax Greene. Everlasting. Tall Cat's-foot.—Common on dry or damp rich ground in open woods, fields and along railways.

Antennaria neodioica Greene. Smaller Cat's-foot.—Frequent in open dryish woods, open places and fields.

Antennaria neglecta Greene. Field Cat's-foot.—Common on dry ground in fields, open places and open woods. Very abundant in dry places on the delta islands of St. Clair River.

Antennaria petaloidea Fernald. Common Cat's-foot.—Very abundant in fields, open ground and on dry banks. Since the revision of this genus there has not been time to make a thorough search. It is very probable that the following will yet be found: **A. parlinii** Fernald, **A. plantaginifolia** (L.) Richards, and **A. occidentalis**, Greene.

Anaphalis margaritacea (L.) B. and H. Pearly Everlasting.—Frequent in dry open woods, thickets, and on dry hills.

Gnaphalium polycephalum Michx. Common Everlasting.—Common on

poor sandy ground, in dry open woods, thickets, fields and occasional in damp ground.

Gnaphalium decurrens Ives. Clammy Everlasting.—Frequent in poor and sandy ground. Often growing with the preceding.

Gnaphalium uliginosum L. Low Cudweed.—Frequent in low ground and on roadsides. Often abundant as a weed in cultivated fields and pastures. **G. purpureum** L., purple cudweed not yet noticed in Lambton Co., but found near Algonac, St. Clair Co., Mich.

Inula helenium L. Elecampane.—Frequent on roadsides and in cultivated fields. Noticed also in open dry woods.

Polymnia canadensis L. Small-flowered Leafcup.—Occasional in damp shaded places. Newton Tripp.

Silphium terebinthinaceum Jacq. Prairie Dock.—Abundant in spots on Walpole Island. Not noticed elsewhere.

Iva xanthifolia Nutt. Burweed. Marsh Elder. Occasional in waste places of towns and villages. Noticed by Prof. Macoun at Wallaceburg, Kent Co. About a grain elevator at Point Edward, Dodge.

Ambrosia trifida L. Great Ragweed.—Occasional as a weed in towns, villages and along railways.

Ambrosia trifida integrifolia (Muhl.) T. and G. Smaller Ragweed.—Usually growing with the species.

Ambrosia artemisiaefolia L. Ragweed.—Very common as a weed on roadsides, in gardens and cultivated fields.

Ambrosia psilostachya DC. Western Ragweed.—Well established in dry sandy ground at Point Edward, having persisted there over five years.

Xanthium canadense Mill. American Cocklebur.—Common on damp roadsides and in rich moist places.

Xanthium commune Britton. Common clotbur.—Occasional in open ground.

Xanthium echinatum Murr. Beach Clotbur.—Frequent in waste places about Sarnia and occasional along Lake Huron shore.

Heliopsis helianthoides (L.) Sweet. Ox-eye.—Common in damp places, on damp roadsides and banks of small streams.

Rudbeckia hirta L. Yellow Daisy.—Black-eyed Susan.—Very common in dry meadows, dry open places and along railways.

Rudbeckia laciniata L. Tall Cone-flower.—Frequent in low thickets and damp open places. Known in cultivation as golden glow.

Lepachys columnaris (Sims.) T. and G. Prairie Cone-flower.—In dry ground near the grain elevator at Point Edward. An immigrant from the west. Persisting.

Helianthus annuus L. Common Sunflower.—Occasionally escaping but it does not seem to persist long.

Helianthus petiolaris Nutt. Prairie Sunflower.—Occasional along railroads. From the West.

Helianthus scaberrimus Ell. Stiff Sunflower.—Occasional along railroads and in depot grounds. From the West.

Helianthus subrhomboideus Rydb. Rhombic-leaved Sunflower.—Along railways and in towns and cities. Recent. Becoming frequent.

Helianthus occidentalis Riddell, Few-leaved Sunflower.—Occasional along railroads and in waste places. From the West.

Helianthus giganteus L. Tall Sunflower.—Common in damp places, low thickets and swampy ground.

Helianthus maximiliani Schrad. Maximilian's Sunflower. Near a grain elevator at Point Edward. An immigrant.

Helianthus divaricatus L. Rough Sunflower.—Common in dry open woods and thickets.

Helianthus hirsutus Raf. Stiff-haired Sunflower. Plentiful about a grain elevator at Point Edward.

Helianthus strumosus L. Pale-leaved Wood Sunflower.—Frequent in damp thickets and along banks of streams.

Helianthus tracheliifolius Mill. Throatwort sunflower.—Occasional on borders of dry open woods.

Helianthus decapetalus L. Thin-leaved Sunflower.—Occasional in damp open woods, thickets and on damp shaded banks of streams.

Helianthus tuberosus L. Jerusalem Artichoke.—Apparently an escape from cultivation in this locality.

Coreopsis tinctoria Nutt. Garden Tickseed.—Inclined to escape and persist in sandy ground at Point Edward.

Coreopsis tripteris L. Tall Coreopsis.—Not yet noticed in Lambton Co. but found near Algonac, St. Clair Co., Mich.

Bidens discoidea (T. and G.) Britton.—Small Beggar-ticks.—Occasional in swampy places near Forest. N. Tripp.

Bidens frondosa L. Beggar-ticks.—Common in damp ground. A weed in damp open ground and cultivated fields.

Bidens comosa (Gray) Wiegand. Leafy-bracted Tickseed.—Occasional in rich ground.

Bidens connata Muhl. Swamp Beggar-ticks.—Frequent in ditches and swamps.

Bidens cernua L. Stick-tight.—Common in wet open places.

Bidens laevis (L.) BSP. Larger Bur-marigold.—Common in swamps and wet open places.

Bidens trichosperma tenuiloba (Gray) Britton. Tickseed Sunflower.—Frequent in marshy places. The species has not yet been noticed.

Bidens beckii Torr. Water Marigold.—Frequent in stagnant and slow-flowing water among sedges and other plants on the delta islands of St. Clair River, and in pools along the Aux Sables River at Port Franks. Newton Tripp.

Galinsoga parviflora Cav. Galinsoga. In waste places of cities and villages and in depot grounds. Often abundant.

Helenium autumnale L. Sneezeweed.—Frequent in wet ground and along banks of streams.

Achillea millefolium L. Common Yarrow.—Common everywhere in dryish open ground.

Anthemis cotula L. May-weed.—Common on roadsides and in cultivated grounds and about farm buildings.

Chrysanthemum leucanthemum pinnatifidum Lecoq and Lamotte. Oxeye Daisy.—Very common as a weed in hay fields. Often abundant along railways.

Chrysanthemum segetum L. Corn Marigold.—Apparently growing wild among weeds on Walpole Island.

Chrysanthemum balsamita tanacetoides Boiss. Costmary.—Well established as an escape to roadsides and fields.

Tanacetum vulgare L. Common Tansy.—Well established as an escape to roadsides and waste places.

Tanacetum vulgare crispum DC. Crispy Tansy.—Common in many places.

Artemisia caudata Michx. Tall Wormwood.—Common in sand and on sand ridges along Lake Huron shore.

Artemisia abrotanum L. Southernwood.—Inclined to escape and persist in poor and sandy ground.

Artemisia ludoviciana Nutt. Western Mugwort.—Frequent in dry sandy open ground and along railways.

Artemisia vulgaris L. Common Mugwort.—Frequent in waste places and along railways. Well established at Point Edward.

Artemisia pontica L. Hungarian Wormwood.—Well established in sand at Point Edward, but not blooming. Has persisted for over ten years.

Artemisia stelleriana Bess. Beach Wormwood.—Inclined to escape and persist in sand at Point Edward.

Artemisia biennis Willd. Biennial Wormwood.—Frequent in damp ground and waste places. From the west.

Artemisia absinthium L. Wormwood.—Occasional in poor and sandy ground as an escape.

Artemisia frigida Willd. Pasture Sage-brush.—Well established near the grain elevator in sandy ground at Point Edward.

Petasites palmatus (L.) Gray. Palmate-leaf Sweet Coltsfoot.—Occasional in wet woods, swamps and recent clearings. Newton Tripp.

Erechtites hieracifolia (L.) Raf. Fireweed.—Common in moist open woods, thickets and recently burned-over ground.

Cacalia tuberosa Nutt. Tuberous Indian Plantain.—Observed at Rock Glen and along the flood plain of the Aux Sables River. Newton Tripp.

Senecio vulgaris L. Common Groundsel.—Occasional in waste grounds. T. C. Wheatley.

Senecio aureus L. Golden Ragwort.—Common in wet meadows, damp thickets and swamps.

Senecio aureus gracilis (Pursh.) Britton. Slender Golden Ragwort.—Noticed on Squirrel Island.

Senecio balsamitae Muhl. Balsam Groundsel.—Common on poor and sandy ground, usually on fixed sand ridges not far from Lake Huron shore. Abundant at Port Franks growing in sand.

Arctium minus Bernh. Common Burdock.—Common as a weed in gardens, fields, open woods and waste places.

Circium lanceolatum (L.) Hill. Bull Thistle.—Common in pastures, fields, open woods and thickets.

Circium pitcheri (Torr.) T. and C.—Pitcher's Thistle. Common on lake shore and sand dunes at Port Franks. Not noticed in other places.

Circium discolor (Muhl.) Spreng. Field Thistle.—Frequent in rich open ground.

Circium muticum Michx. Swamp Thistle.—Common in swamps and marshy open places.

Circium hillii (Canby) Fernald. Hill's Thistle.—Occasional in prairie-like ground on Squirrel Island, one of the delta islands of St. Clair River. Apparently rare.

Circium arvense (L.) Scop. Canada Thistle.—Common in cultivated grounds, pastures, open woods, thickets and waste places. A pernicious weed in hay and grain fields.

Onopordum acanthium L. Scotch Thistle—Apparently well established in sandy ground at Point Edward.

Silybum marianum (L.) Gaert. Lady's Thistle. Milk Thistle.—Frequent as a weed in gardens and waste places.

Centaurea cyanus L. Bachelor's Button.—Inclined to escape from cultivation to roadsides.

Centaurea nigra L. Spanish Buttons.—Along roads and in old fields. Frequent. Newton Tripp.

Centaurea maculosa Lam. Spotted Knap-weed.—Along roads and in old fields.

Cichorium intybus L. Common Chicory.—Common in clayey ground on roadsides and in waste places. Occasional as a weed in fields.

Krigia amplexicaulis Nutt. Cynthia.—Occasional in moist open woods and on damp banks.

Leontodon autumnalis L. Fall Dandelion. Occasional along roads and in fields.

Tragopogon porrifolius L. Salsify.—Frequent along railways and in waste places. Apparently well established as an escape.

Tragopogon pratensis L. Goat's Beard.—Occasional in towns, villages, depot grounds, and along railways.

Taraxacum officinale Weber. Common Dandelion.—Very common in pasture fields, lawns, open woods, and waste places.

Sonchus arvensis L. Field Sow Thistle.—Occasional along railways and in depot grounds. Noticed as a bad weed in grain fields.

Sonchus oleraceus L. Common Sow Thistle.—Frequent as a weed in gardens, cultivated fields and waste places.

Sonchus asper (L). Hill. Spiny-leaved Sow Thistle.—Frequent in gardens, cultivated fields and waste places.

Lactuca scariola L. Prickly lettuce.—Occasional along banks of ditches and railroads.

Lactuca scariola integrata Gren. and Godr. Prickly Lettuce.—Common along railways, on roadsides, in gardens, cultivated fields, pastures and waste places.

Lactuca canadensis L. Wild Lettuce.—Commom in rich ground on borders of fields, in damp open woods and thickets.

Lactuca integrifolia Bigel. Arrow-leaved Lettuce.—Reported by Prof. John Macoun as noticed in woods near Wyoming Apparently rare.

Lactuca hirsuta Muhl. Hairy Wood Lettuce.—Frequent in dryish open ground and open woods.

Lactuca spicata (Lam.) Hitchc. Tall Blue Lettuce.—Common in damp open woods, thickets and damp places.

Prenanthes racemosa Michx. Glaucous White Lettuce.—Frequent in damp and marshy places. T. C. Wheatley.

Prenanthes racemosa pinnatifida Gray.—Pinnatifid white lettuce. Usually found with the preceding.

Prenanthes alba L. Rattlesnake Root.—Common in rich open woods and thickets.

Prenanthes altrissima L. Tall White Lettuce.—Common in rich open woods and thickets.

Hieracium venosum L. Rattlesnake-weed.—Common in dry open ground, dry open woods and thickets.

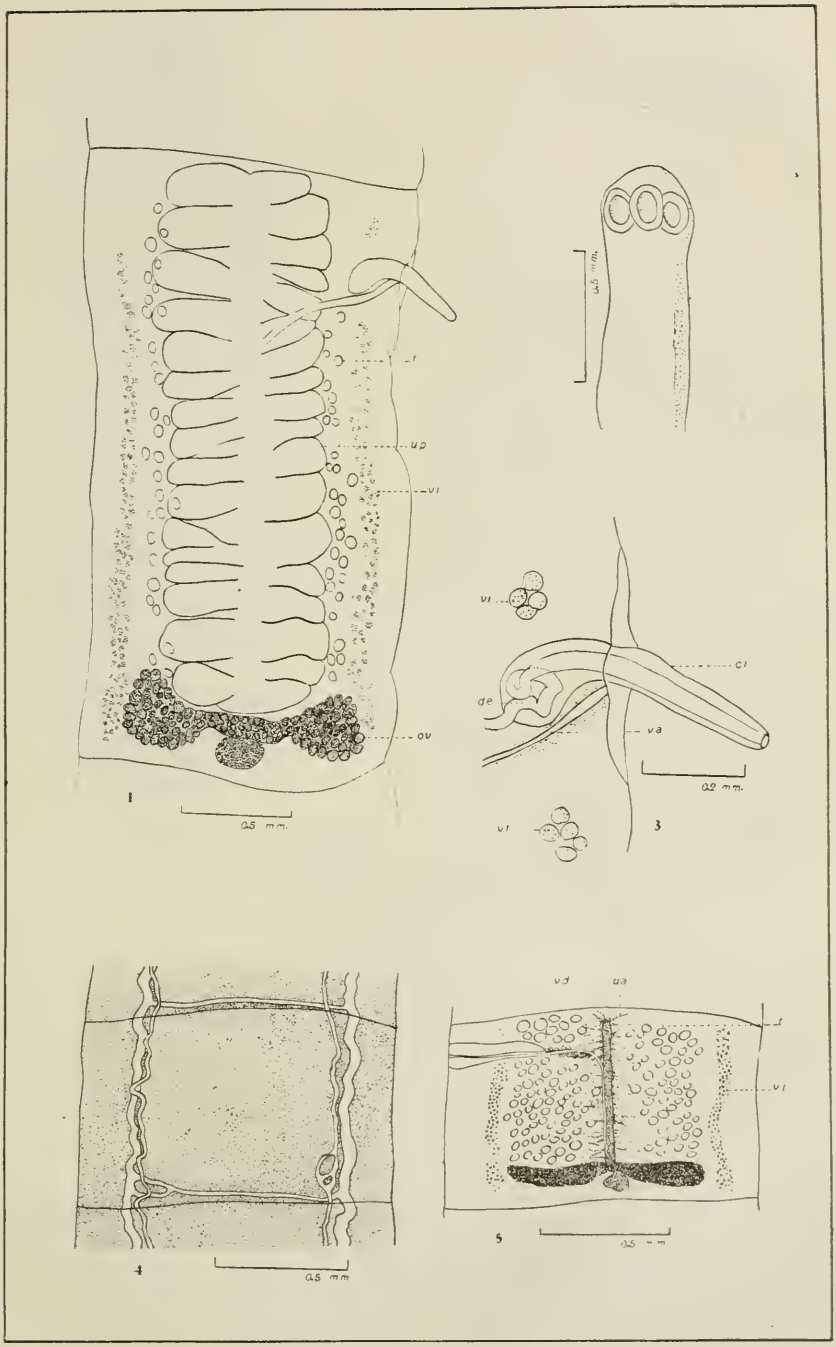
Hieracium scabrum Michx. Rough Hawkweed.—Frequent in dry woods, thickets and pastures.

Hieracium gronovii L. Gronovius' Hawkweed.—Frequent on dry sandy ground in open woods and thickets.

Hieracium longipilum Torr. Long-bearded Hawkweed —Occasional along Lake Huron shore. Prof. John Macoun. Abundant on Squirrel Island, one of the delta islands of St. Clair River.

Hieracium canadense Michx. Canada Hawkweed.—Frequent on poor and sandy ground in open woods and thickets.

PLATE I.



LARUE.

PLATE II.

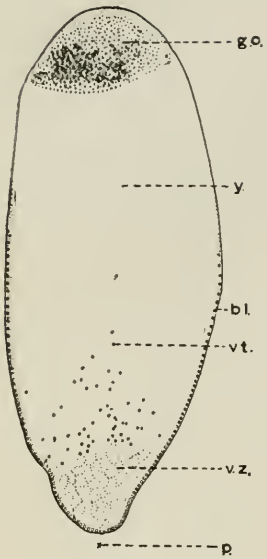
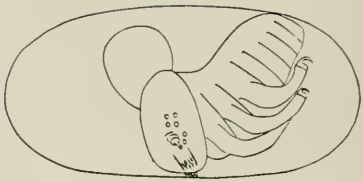


Fig. 1.



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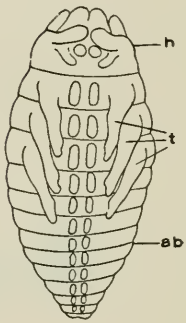

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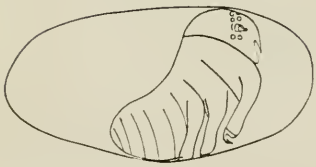


Fig. 2.

Fig. 3.

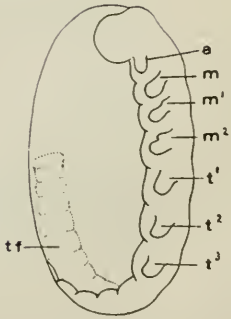
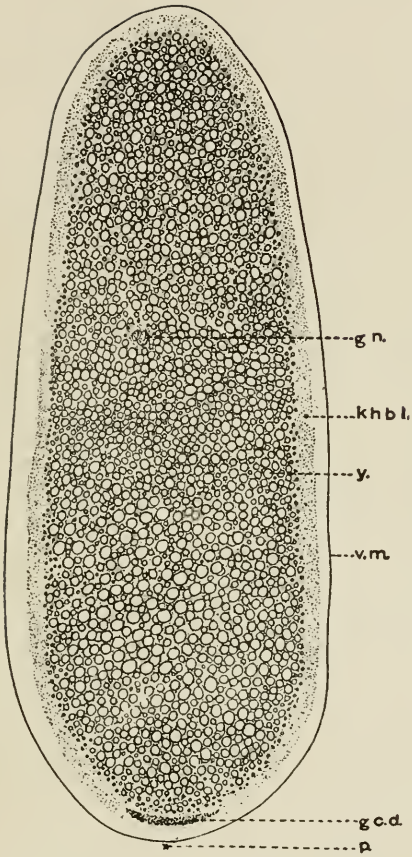


Fig. 6.

HEGNER.

PLATE III.



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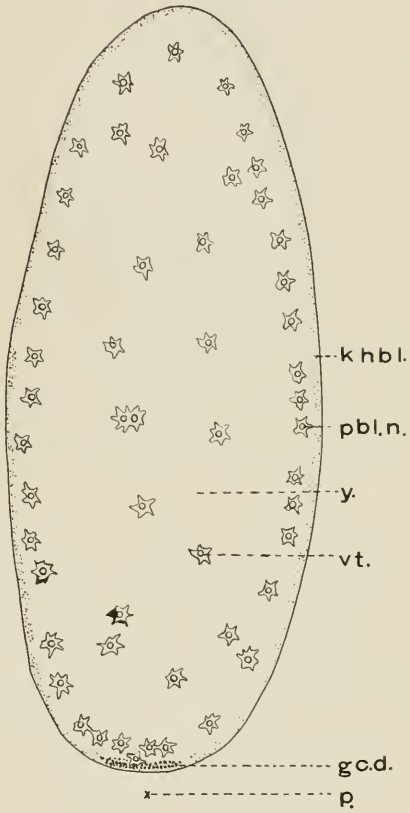

Fig. 8.

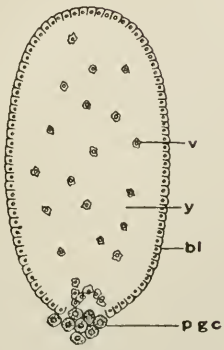

Fig. 9.

HEGNER.

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