AN ECOLOGICAL STUDY OF THE FORT GARRY SWAMP.

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1934

A THESIS PRESENTED TO THE DEPARTMENT OF BOTANY,
AT THE UNIVERSITY OF MANITOBA, AS A PARTIAL
REQUIREMENT FOR THE DEGREE OF MASTER OF SCIENCE.

CONTENTS.

I. PRESENTATION OF THE PROBLEM.

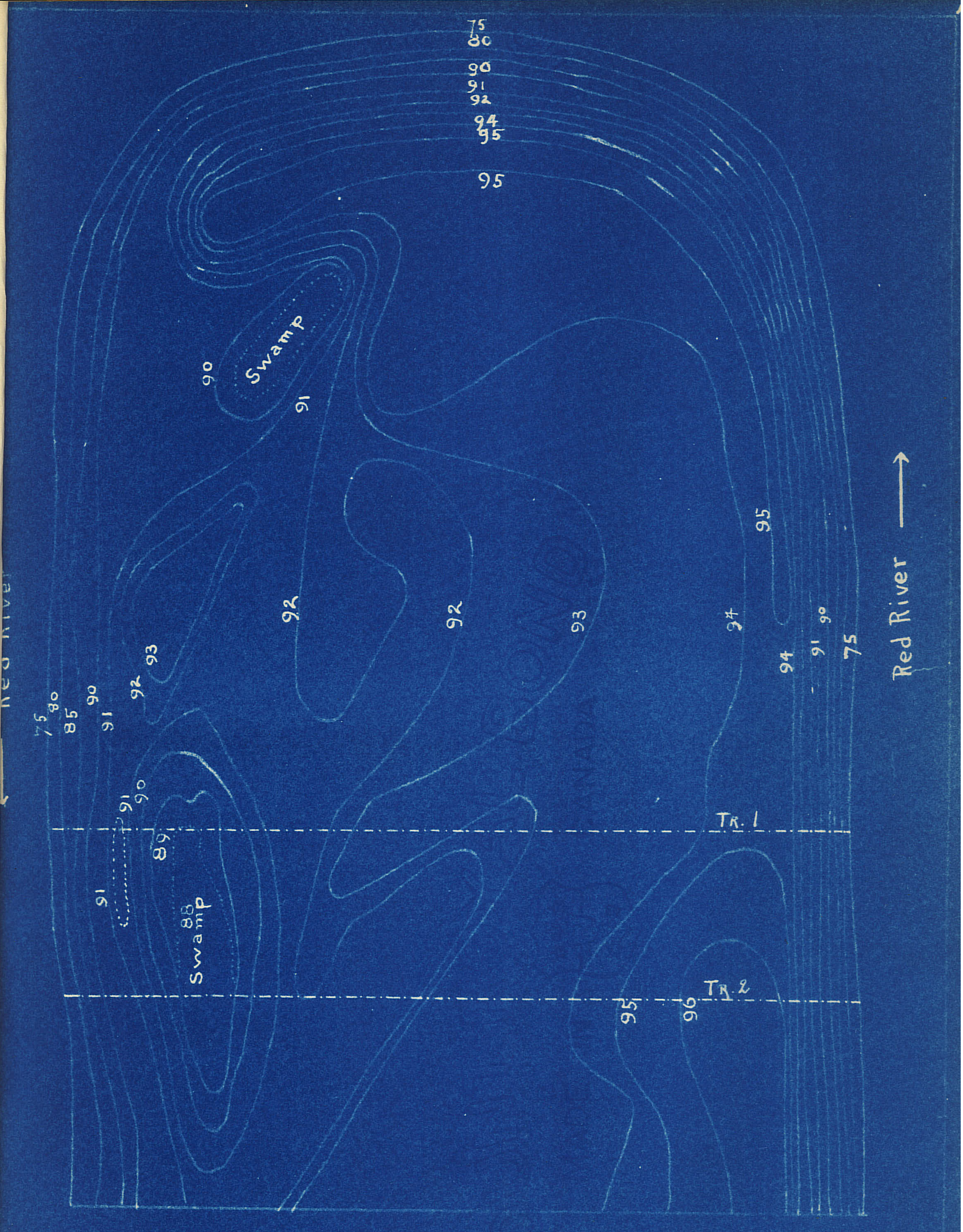
Comparatively little work of an ecological nature has been done in Manitoba and Western Canada. In the years 1926, 1928 and 1929 three papers were published dealing with the vegetation of Alberta by Dr. E. S. Dowding and collaborators.

A problem of great interest was found in close proximity to the Fort Garry buildingsof the University of Manitoba, in the nature of a swampy area some 400 yards east of the buildings. It was therefore suggested to the writer, that he undertake this investigation.

The problem is an investigation of the vegetation of the swamp with its surroundings and the conditions under which it exists, including the proximity of the Red River and the effects of occasional flooding. It was realized, at the time when the problem was begun, that it would be impossible to give a full report after only one year of investigation.

Owing to the fact that a large proportion of this investigation had to be done in the winter, more emphasis was given to the identification of various plants and animals, which could be obtained by cultures from superficial samples of the soil, rather than to field-work.

The problem was suggested by Professor C. W. Lowe, who had visited the swamp a number of times in May and June of 1933 and at those occasions collected a certain amount of information concerning it which has been incorporated in this thesis. The writer made his first visit to the swamp in the late summer of 1933, but had frequently studied the plant life surrounding the swamp in previous years.

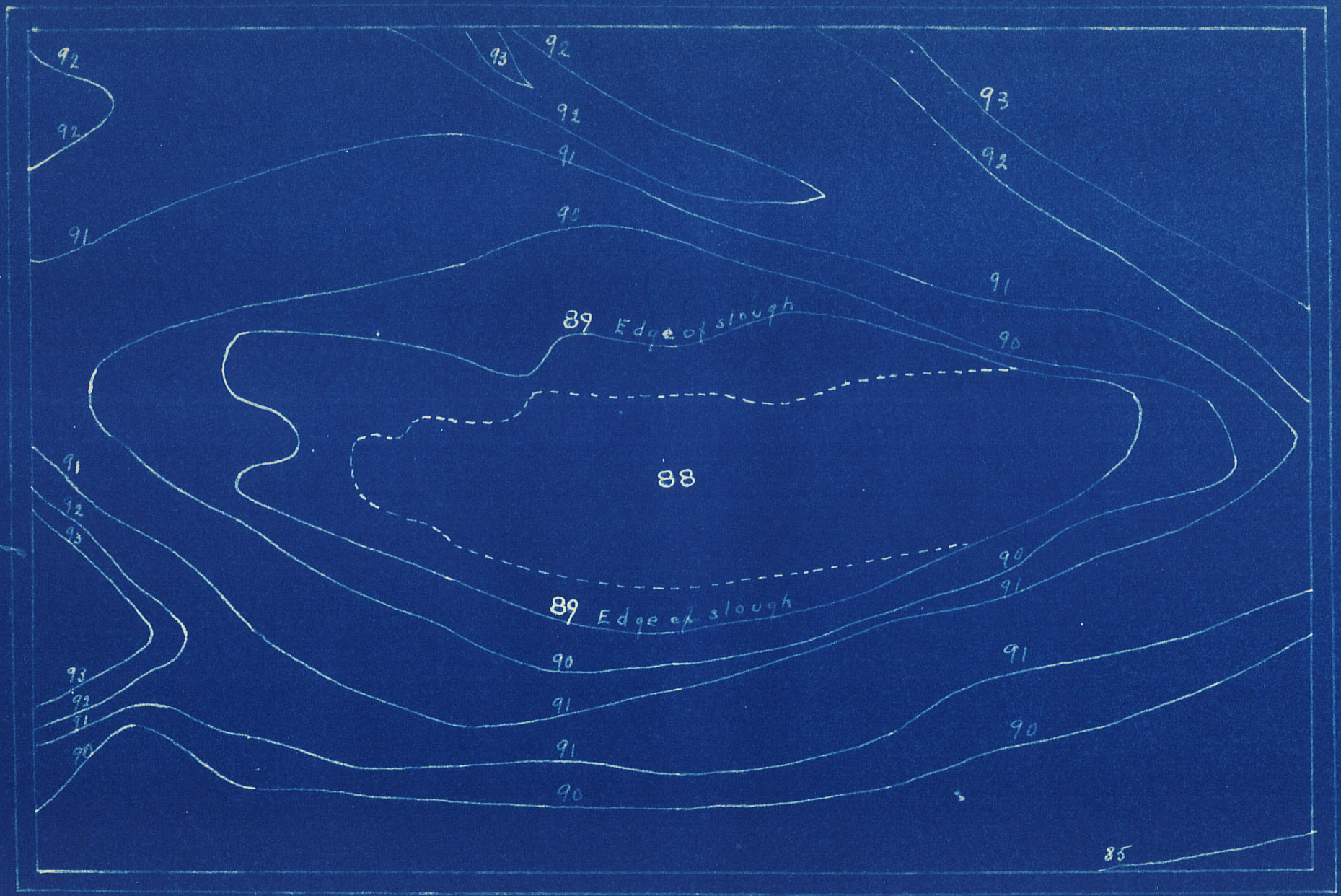


Topographical Map

II. STUDY OF HABITAT.

(a) Physiographical Features: Position and topography of the area. The swampy area, which was investigated, lies on a point of land formed by a horseshoe bend of the Red River, as it passes near the University buildings at Fort Garry. Approaching the swampy area from the section of the river bank nearest to it, we notice a gradual rise of the ground from the river bank, which amounts to about 20 feet. The figures on both topographical maps denote contour lines and are relative numbers only, since they are not based on sea level, but they were used by the Manitoba Government Survey in 1924 and we are indebted to the Public Works Department for this map. The top of the river bank is represented by contour line 75, and the differences in height, by feet are added to that. The figures on the map illustrate, that up to near the swamp the ground is generally rising for a distance of 300-350 yards on the north side of the point. Some 150 feet north of the swamp, and on this map between contour line 91, is a slight depression. The position of the swamp is indicated by the name swamp and the edges of it are also sufficiently well marked. The depression in the swamp is quite considerable, so much so in fact, that as a result of it the vegetation is altogether different from that of the surrounding. The actual depression in the swamp varies as much as 2 feet, as ascertained from the water level marks left on the trunks of young Ash Trees (see photograph No.7.).

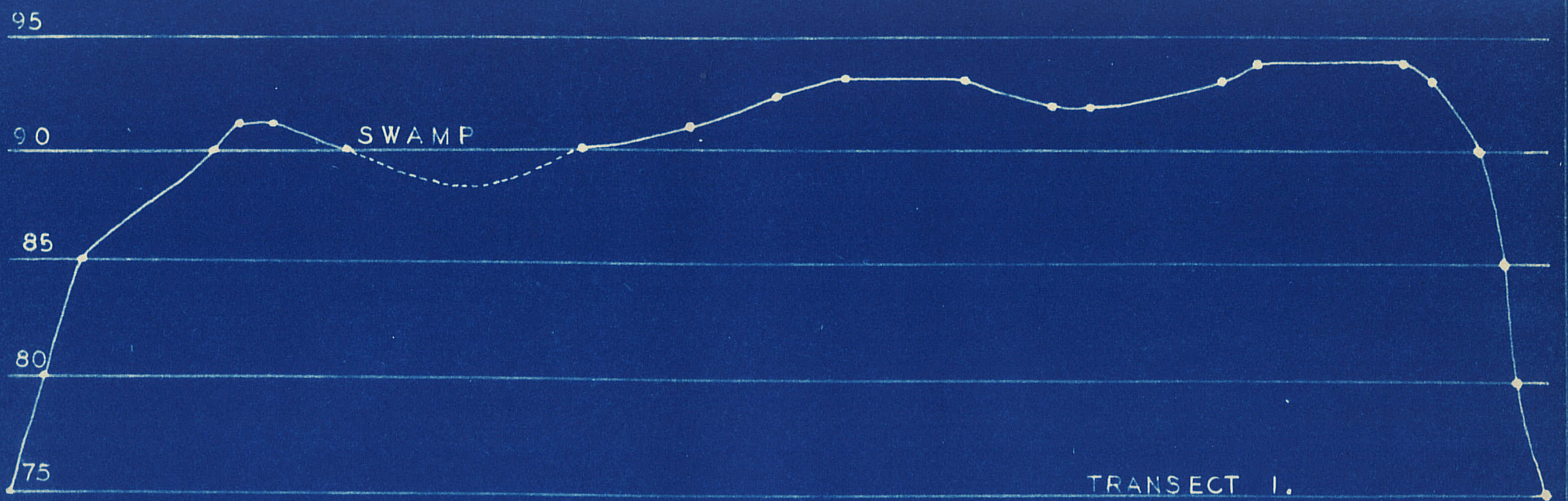
The rise already noticed, is even more pronounced when the approach is made in a similar direction, some distance farther down near the bend of the river. Not only is this rise noticeable on the north

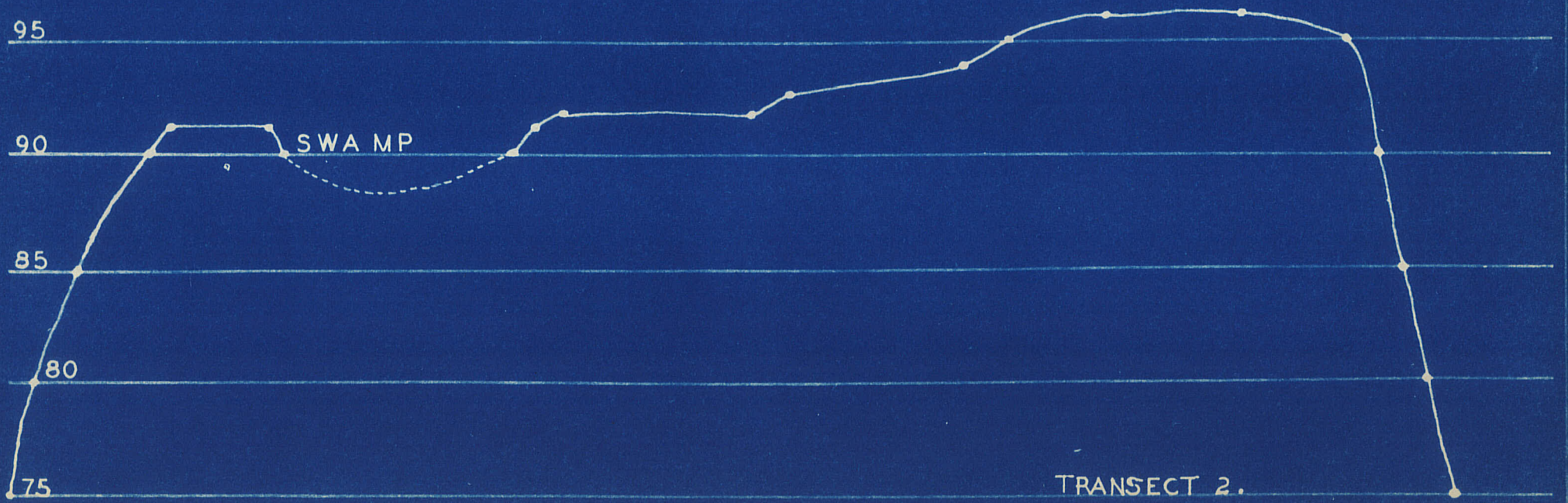


Topographical Map of Swamp.

side of the poimt but it is general around the whole point, particularly so on the south side. The interior of the point suggests the shape of a saucer. A glance at the contour lines on the topographical map will show, that the level in the interior part of the point varies within 4 feet. This when compared to the relatively steep slope along the river bank of about 18-20 feet, which is still more augumented if the water level of the river is considered, in that case amounting to 25 - 30 feet, is comparatively little. Naturally it appears to the observer, that the region comprising the outer slope around the whole point should be fairly well drained. This is actually the case. It is different however when we approach the inner part of the point. This part is not well drained, particularly a number of smaller spots in it. There are a few small depressions, which have no complete drainage at all. Thus the depression already mentioned between contour lines 91 about 150 feet north of the swamp drains toward it. Another slough or little swamp if found further down the point toward the north-east. Both swamps have their edges indicated by the same contour lines, 90.

Drainage of the rest of the central area is more or less poor. The land slopes toward the swamp generally. This is shown in the transects of the point from side to side cutting through the larger swamp in two places. (See transects 1 & 2). Natural drainage probably takes its course to the north in two places, and to a limited extent to the north west, along a ditch dug in a northerly direction some distance from the western extremity of the swamp. On the map this ditch would come just below the lower left hand corner. When drainage is spoken of, it does not mean getting rid of


95
90
85
80
75
SWAMP
TRANSECT 1.


95
90
85
80
75
SWA MP
TRANSECT 2.

The excess of water accumulated from rains but also of the melted snow accumulated during the long winter period. This accumulation of snow is very considerable as a rule and has been particularly so in the winter of 1932-33, and even more so in the past winter of 1933-34. See graph number 5 illustrating atmospheric precipitations.

(b) Climatic Influences.

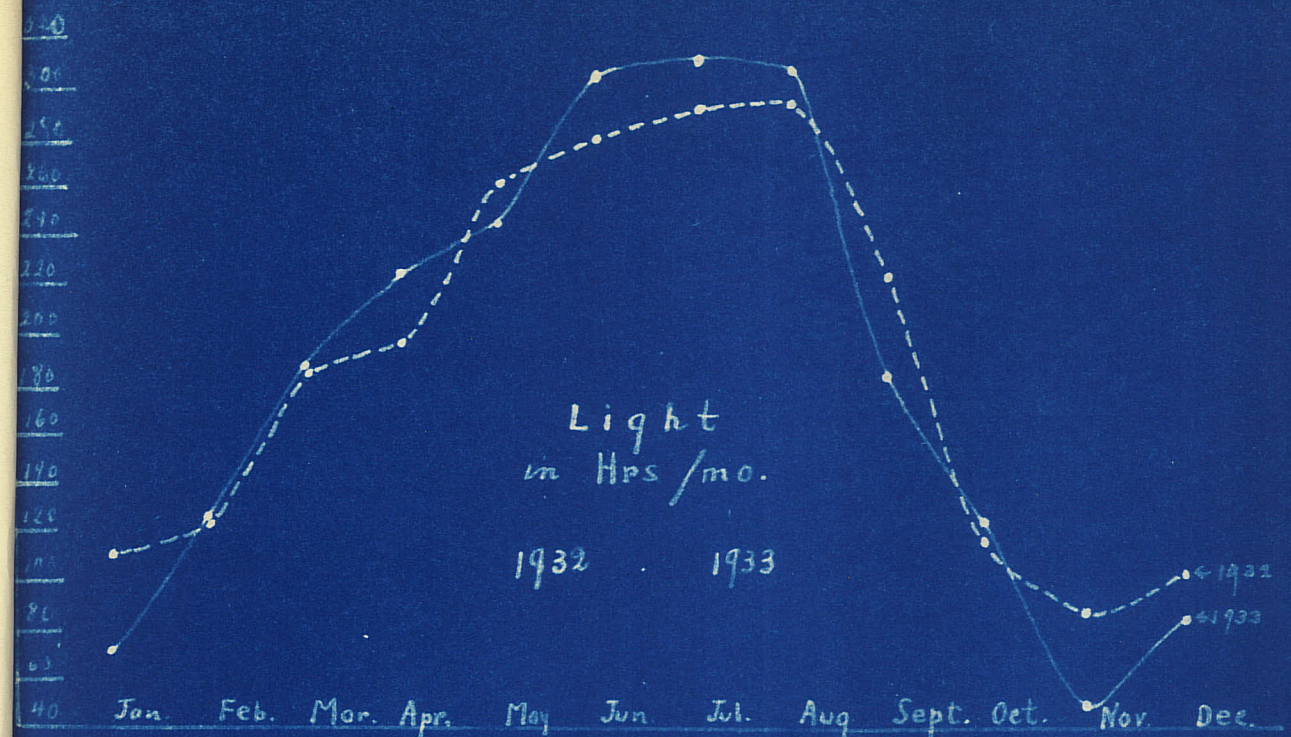
Under this heading we focus our interest on such conditions as light, temperature, rain and snow, moisture conditions of the air and the effect of winds.

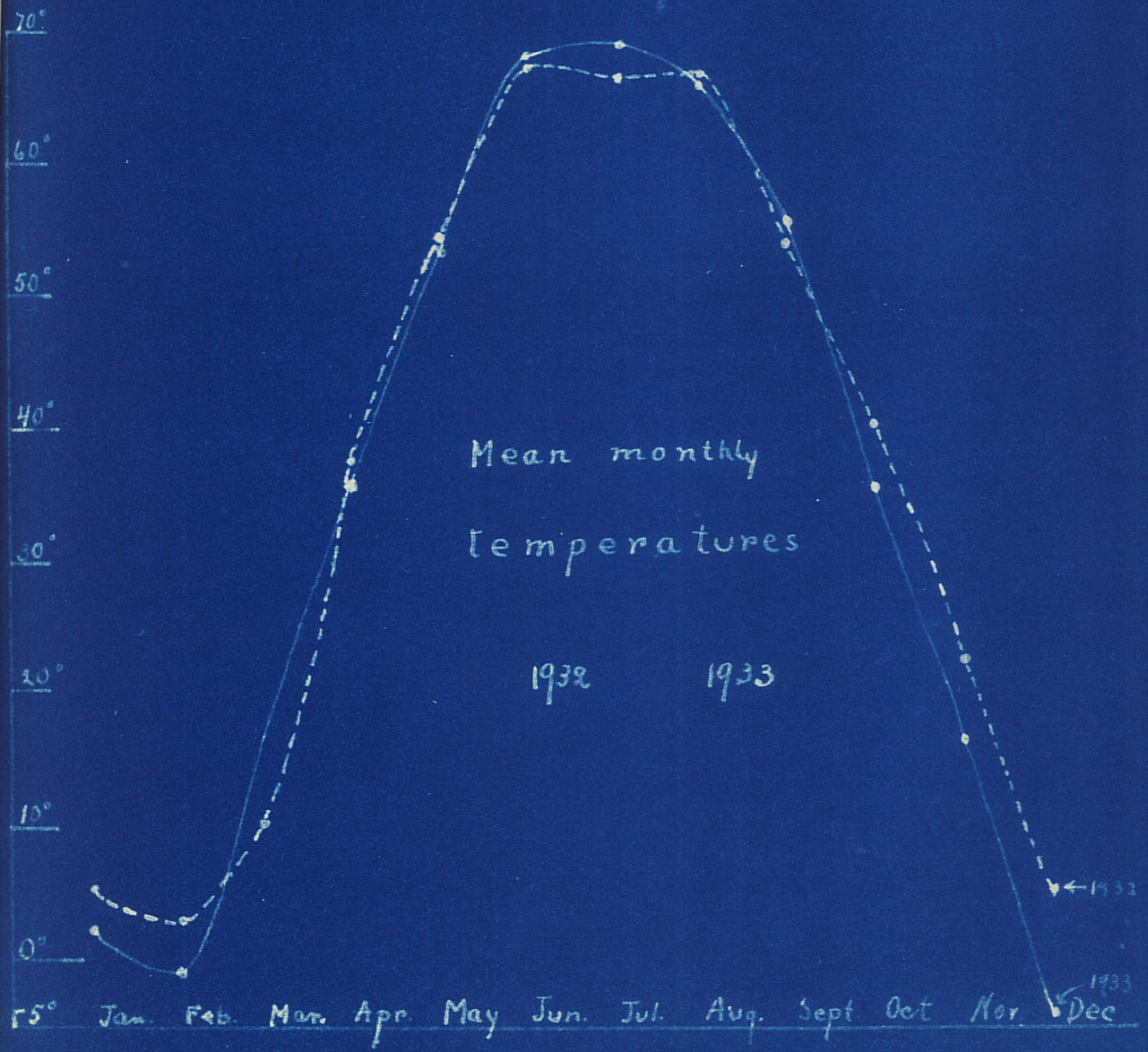
Light.

The active vegetative season coincides with the period of greatest light for most of the swamp vegetation. For aquatic vegetation the active period comes before the period of greatest light, during May. Shortly before the middle of June, when the swamp was visited, no free water was noticed, only mud and damp earth being present. By the end of June the upper layer of the ground is dry and could be powdered with the fingers. The flowering plants continued growth until checked by the excessively hot weather in the latter part of June, They are species which normally have completed flowering by the end of July. Canada Thistle was the only plant which continued flowering through the late summer.

Temperature and Moisture.

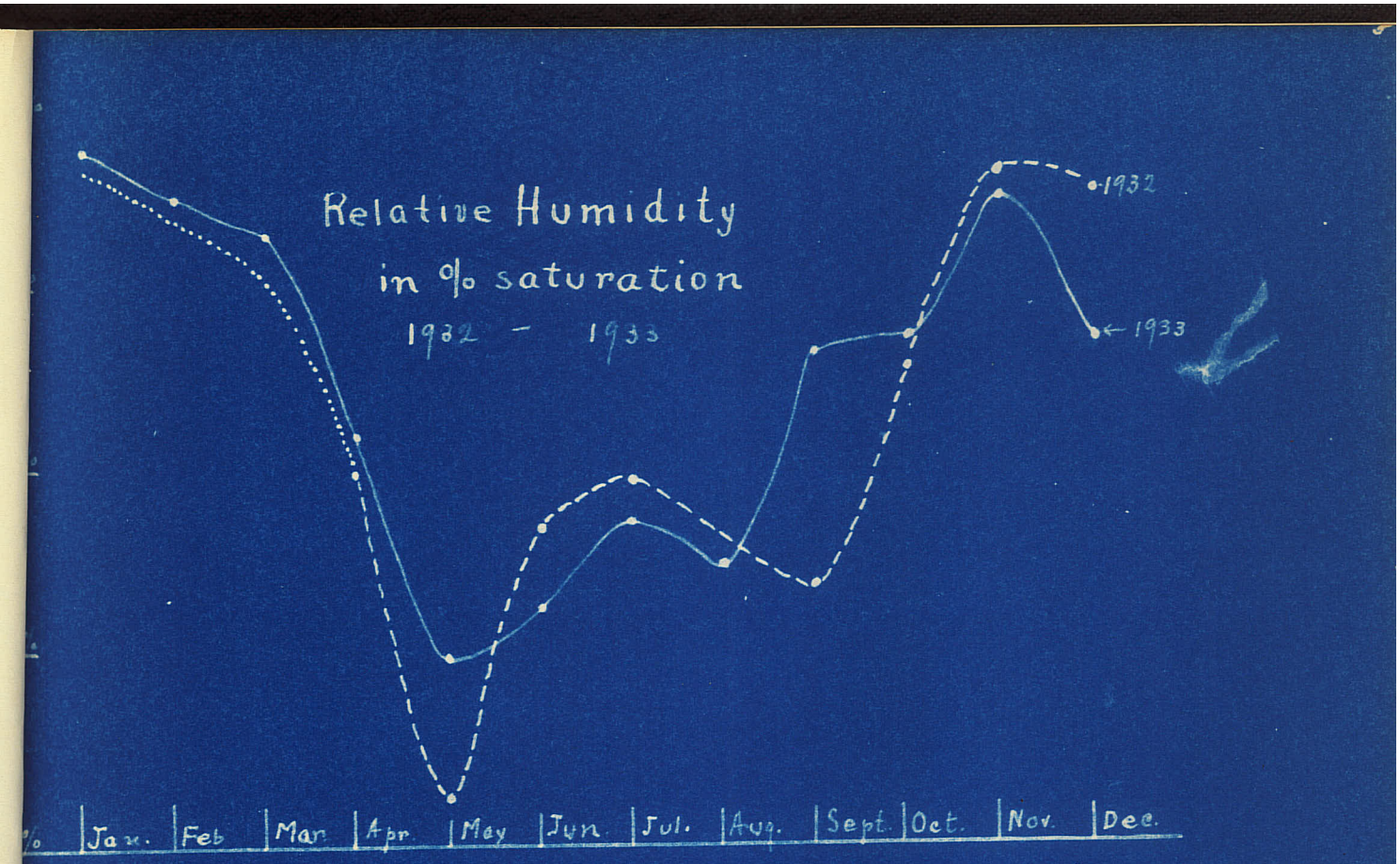
Since the vegetation is all at rest during the winter period, and the ground vegetation under a thick covering of snow, temperature changes during winter periods are practically of little importance. With the rise in temperature in spring, the melting snow drains from the higher

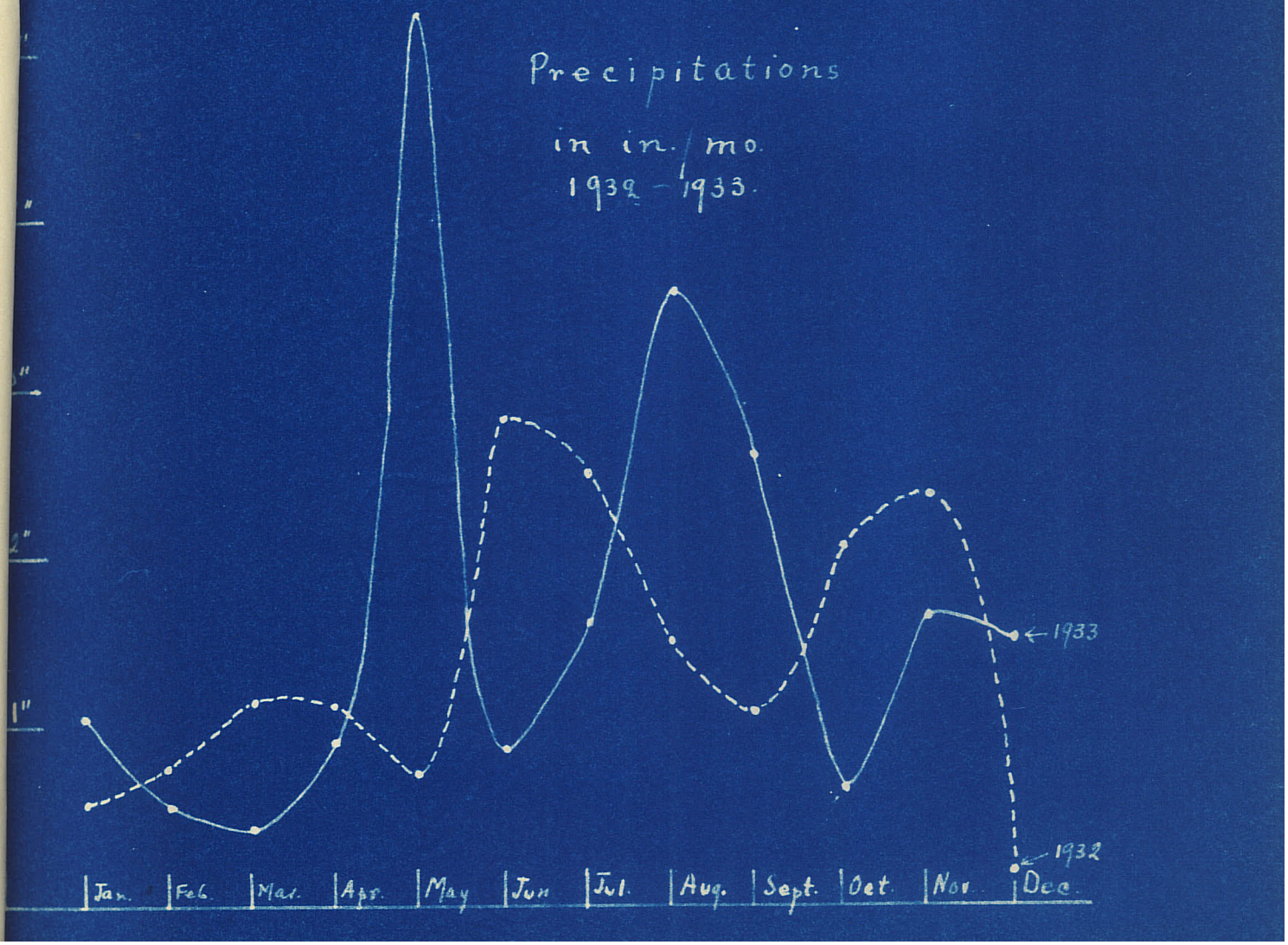

Light
in Hrs/mo.
1932 1933
1932
1933
Jan. Feb. Mar. Apr. May Jun. Jul. Aug Sept. Oct. Nov. Dec.


70°
60°
50°
40°
30°
20°
10°
0°
Mean monthly
temperatures
1932 1933
1932
1933
Jan. Feb. Mar. Apr. May Jun. Jul. Aug. Sept. Oct Nov. Dec

regions into the swamp. The ground above the level of the swamp, exposed to the sun's rays, warms up more rapidly than the water in the swamp and the mud below. This results in the vegetation surrounding the swamp showing signs of growth earlier than that in the water. The grasses and herbaceous plants around the swamp showed a number of green leaves or shoots early in May, while the Carex species and other submerged plants showed very little growth before the beginning of June. Since the swamp is being sheltered by tall trees on all sides except from the south, conditions are such, that a fairly still atmosphere results at all times except when a dry south wind prevails. This results in a more or less humid atmosphere for most of the time. When Professor Lowe visited the swamp the first week in May, the swamp held a considerable quantity of water. The depth of it was measured in a number of places as being around 15 inches. A number of deeper places were not accessible. Water marks left on the trunks of Green Ash trees were later measured by the writer and found to vary up to 22 inches. Further observations of Professor Lowe showed that the swamp contained a fair amount of water at the end of May. By the end of the third week in June all free water had disappeared and the swamp was now just wet ground. On July 4th., the upper quarter inch of mud had dried, and was cracking and fryable. This rapid drying was brought about by the strong hot south winds during the latter part of June. Temperatures varying from 85° to over 95° were recorded a number of times during this period.

From that time on until snow fell, there was no standing water in the swamp (during the rest of the summer season.) Professor Lowe states,


Relative Humidity
in % saturation
1932 - 1933
1932
1933
% Jan. Feb Mar Apr May Jun Jul. Aug. Sept Oct. Nov. Dec.


Precipitations
in in. / mo.
1932 - 1933
1"
2"
1933
1932
Jan. Feb. Mar. Apr. May Jun Jul. Aug. Sept. Oct. Nov. Dec.

that on each occasion of his visits to the swamp the latter part of May and June, a casual examination of the water showed a definite aquatic flora and fauna, which would make an interesting ecological study. The flora contained a number of algae and the fauna included a large number of microscopic plankton organisms and insects: Chironomus, Apus, and Beetles. The temperature and moisture conditions for the previous year were similar to the summer of 1933. During 1933, between May and August, rain was slight and largely in local thunderstorms. Rainfall for June amounted to .97 inches and for July to 1.61 inches. The mud was so dry in the swamp,that rain was immediately absorbed after each fall and there was no accumulation of water at any time. In 1932 the spring rainfall was only a little more than half that of 1933,and was later in the season. The dry spell during the summer was also later in the season. Probably the swamp passed through the same state of dessication as in 1933, as the summers were not abnormal in any respect. It is therefore probable that the summer of 1933 was a more or less average one. See graph number 5-4.

Since the effect of winds in the sheltered condition of the swamp is a highly problematical factor, and since no measurements of this factor for the swamp proper are available no discussion of it will be made.

(c) Edaphic Factors.

It is a well known fact, that the nature of the soil affects vegetation. The chemical constituents , the physical nature of the soil, the presence of peat or humus, each have their value in deter-

mining the type of flora.

The soil on the slight elevation around the swamp is one with a mildly acid humus. The humus varies in depth from two to three feet (Observation of Professor V. W. Jackson). The soil from the swamp itself showed a definite acid reaction. No chemical analyses were made to ascertain the salts present in the soil. The soil on the whole point differs definitely with the soil across the river, which is of a clay river-terraced variety and in the long past must have been greatly affected by repeated overflows of the Red River. Overflows have not figured prominently in recent times in the history of the point. The point of land containing the swamp is on a higher level, than the land across the river and has not been inundated to the same extent. The last high water to overflow any of the land in question was recorded in 1916, and affected a great part of the central region of the point. Since that time there has been no direct connection between the waters of the swamp and the river. Disintegration of fallen leaves is retarded in the swamp. There is therefore a greater accumulation of litter, i.e. non-disintegrated remains of dead leaves, stems, etc., than in the surrounding woods. This may be due to a combination of features, such as lack of oxygen at the bottom of the swamp, the slower rise in temperature in spring and the absence of humus producing fungi. Underneath the litter is humus, below that mineral soils. It was largely the litter that was taken into the laboratory and used for the culture of the aquatic organisms, which had thrived in the earlier part of the season and passed into a resting state with the approach of drought.

(b) Biotic Factors.

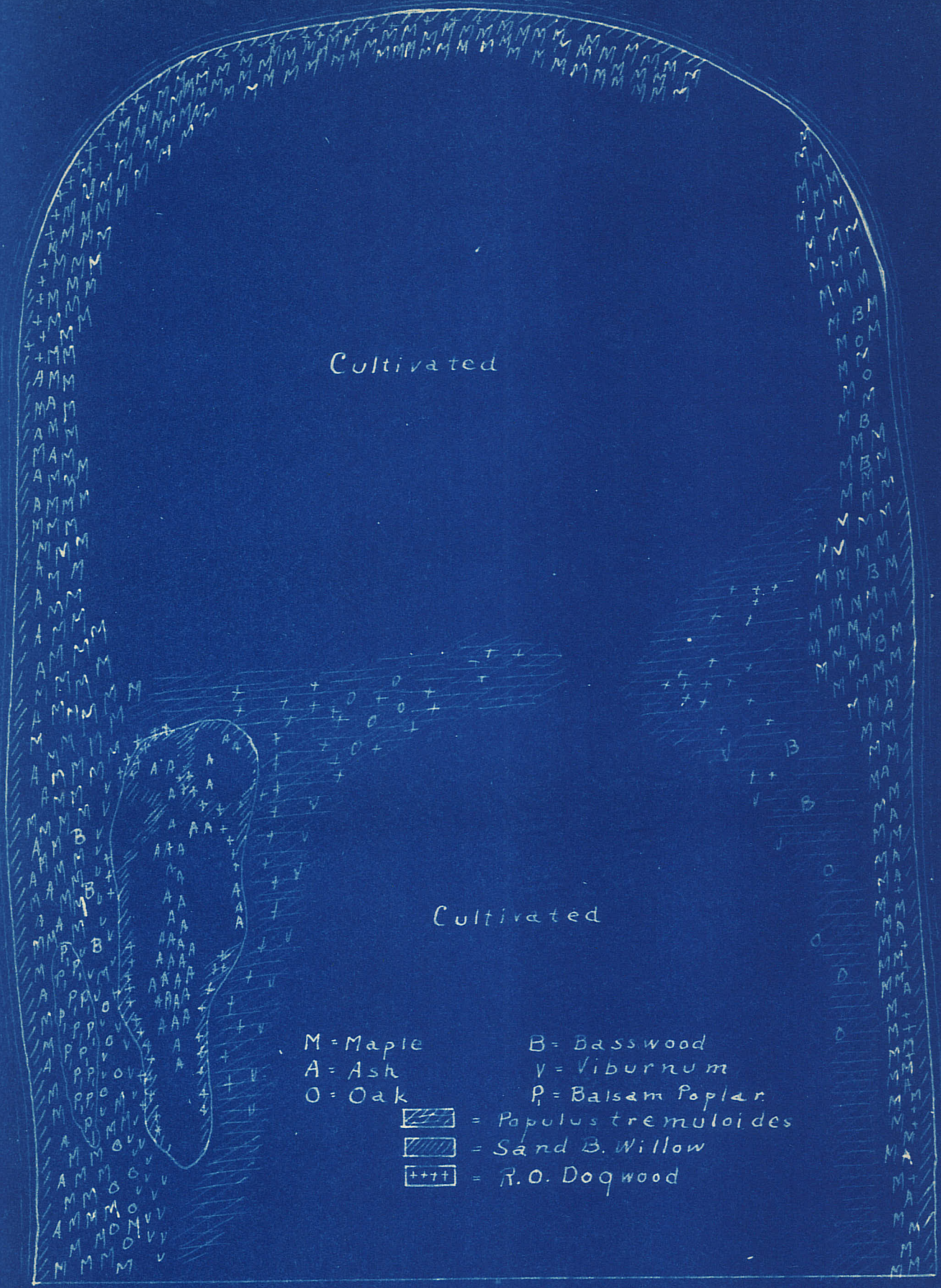
The situation of the swamp and its protection have more or

less reduced biotic factors to a minimum. The biggest change in this area during the last 20 years has been through the influence of man. In the central part of the point of land and around the swamp a large number of trees have been removed and what was once poplar woodland in the center of the point is now largely cultivated land. Comparatively recently a ditch was made to drain the southwestern part which has slightly lowered the water level of the swamp. This ditch as indicated previously is just out of the area of the map. Of the native life it is interesting to note, that in addition to rabbits and squirrels the following were observed in the spring of 1933: Red Winged Blackbirds with nests, Bitterns, Ducks and Rails. These were recorded a number of times, in and around the swamp. Apart from bringing into the swamp, on their feet, any seeds from plants elsewhere, they would have little other influence upon the vegetation of the swamp life.

III. GENERAL DESCRIPTION OF THE VEGETATION OF THE POINT.

The point was originally covered by trees and was a fringing woodland formation characteristic of the river banks and adjacent lands elsewhere in Manitoba. The river bank is characterized by willows of which Salix longifolia Muhl, (Sand Bar Willow), is the dominant species. Associated with this is Cornus stolonifera Michx. (Red - Osier Dogweed). Above the river bank is a prominent belt of Acer Negundo L. (Box Elder). Trunks of many of these trees are up to 18 inches in diameter. Mixed with the Box Elder (also known as Manitoba Maple) are to be found Populus deltoides Marsh.(Cotton-wood), Populus balsamifera L. (Balsam Poplar), Populus tremuloides Michx. (American Aspen), Tilia americana L. (Basswood, Quercus macrocarpa Michx. (Bur Oak). Shrubs in the undergrowth are numerous, such as the Cornus solonifera Michx. (Red Osier Dogweed). Corylus rostrata Ait. (Beaked Hazelnut), Corylus americana Walt.(Hazelnut), Viburnum opulus L., var. americanum (Mill), Ait. (Cranberry-tree), and others. There is also a comparatively rich herbaceous under-growth.

In order to give a general idea of the vegetation of the point and the region immediately surrounding the swamp a list of the more common plants follows:



GENERAL VEGETATION of the POINT

PTERIDOPHYTA

Botychium Virginianum (L) Sw. (Rattlesnake Fern)

Onoclea Struthiopteris (L) Hoffm. (Ostrich Fern)

SPERMATOPHYTA

Gramineae

Beckmannia erucaeformis (L) Host. (Slough Grass)

Bromus purgans L. (Brome Grass)

Bromus ~~purgans~~ ciliatus L. (Hairy Wood Chess)

Elymus Macounii Vasey (Macoun's Wild Rye)

" curvatus (Short-awned Wild Rye)

" virginicus L. (Virginia Lime-grass)

" canadensis L. (Canada Lime-grass)

Juncaceae

Luzula campestris (L) DC.(?) (Common Wood Rush)

Liliaceae

Smilacina stellata (L) Desf. (False Spikenard)

Maianthemum canadense Desf. (Two-lvd. Solomon's Seal)

Trillium cernum L. (Nodding T.)

Smilax herbacea L. (Carrion Flower)

Salicaceae

Populus balsamifera L. (Balsam Poplar)

" tremuloides Michx. (American Aspen)

Salix longifolia Muhl. (Sand Bar Willow)

" amygdaloides Anders. (Peach-leaved Willow)

Betulaceae

Corylus americana Walt. (Hazelnut)

" rostrata Ait. (Beaked Hazelnut)

Facaceae

Quercus macrocarpa Michx. (Bur Oak)

Ulmaceae

Ulmus americana L. (American or White Elm)

Urticaceae

Urtica dioica L. (Stinging Nettle)

" gracilis Ait. (Tall Nettle)

Laportea canadensis(L) Gaud. (Wood Nettle)

Ranunculaceae

Anemone canadensis L. (Canada Anemone)

" multifida Poir. (Anemone)

Thalictrum dioicum L. (Early Meadow Rue)

Menispermaceae

Menispermun canadense L. (Canada Moonseed)

Saxifragaceae

Ribes floridum L'Her. (Wild Black Currant)

" cynosbati L. (Prickly Gooseberry)

Rosaceae

Potentilla anserina L. (Silverweed)

Fragaria virginiana Duch. (Nothern Wild Strawberry)

Rubus idaeus L.
Var. aculeatissimus (C. A. Mey.)
Regel & Tiling (Wild Red Raspberry)

Rubus triflorus Richards. (Dwarf Raspberry, Dewberry)

Rosa pratincola arkansana Green. (Weed)

Amelanchier spicata (Lam.) C. Koch. (Saskatoon Berry)

Crataegus coccinea L. (Hawthorn)

Prunus americana Marsh. (Wild Plum)

Prunus pennsylvanica L.	(Pin Cherry)
" virginiana L.	(Choke Cherry)
Leguminosae	
Vicia americana Muhl.	(Purple Vetch)
Lathyrus ochroleucus Hook.	(Pale Vetchling)
" venosus Muhl.	(Veiny Peavine)
Amiphicarpa monoica (L) Ell.	(Hog Peanut)
Anacaediaceae	
Rhus Taxixodendron L.	(Poison Ivy)
Celastraceae	
Celastrus scandens L.	(Climbing Bittersweet)
Aceraceae	
Acer Negundo L.	(Box Elder, Man. Maple)
Vitaceae	
Vitis vulpina L.	(River-bank or Frost Grape)
Psedera quinquefolia (L) Greene	(Virginia Creeper)
Tiliaceae	
Tilia americana L.	(Basswood)
Violaceae	
Viola cucullata Ait.	(Common Blue Violet)
" pubescens Ait.	(Downy Yellow Violet)
" canadensis L.	(Canada Violet)
Umbelliferae	
Sanicula marilandica L.	(Black Snakeroot)
Osmorhiza longistylis (Torr) DC.	(Sweet Sicely)
Cornaceae	
Cornus stolonifera Michx.	(Red Osier Dogwood)

Cornus canadensis L. (Dwarf Cornel)

Oleaceae

Fraxinus pennsylvanica Marsh, var. lanceolata (Borkh.) Sarg. (Green Ash)

Asclepidaceae

Asclepias syriaca L. (Common Milkweed)

" ovalifolia Dene (Dwarf Milkweed)

Concolvulaceae

Concolvulus sepium L. (Hedge Bindweed)

Cuscuta Gronovii Willd. (Aster Dodder)

Boraginaceae

Lappula echinata Gilibert (Blue Bur.)

Labiatae

Dracocephalum parviflorum Nutt. (Dragon Head)

Stachys palustris L. (Woundwort)

Mentha arvensis L. Var. canadensis L. (Wild Mint)

Rubiaceae

Galium boreale L. (Northern Bedstraw)

Caprifoliaceae

Viburnum opulus L. var. americanum Ait. (Highbush Cranberry)

" Lentago L. (Nannyberry)

" pubescens (Ait.) Pursh. (Downy Arrowwood)

Symphoricarpos occidentalis Hook. (Woolfberry)

Compositae

Solidago canadensis L. (Canada Golden-rod)

" rigida L. (Stiff Golden-rod)

Aster laevis L. (Smooth Aster)

Aster cordifelius L. (Blue Wood Aster)

" Lindleyanus T. & G. (Lindley's Aster)

" paniculatus Lam. (W. F.)

Bidens frondosa L. (Beggar-tricks)

Achillea Millefolium (Common Yarrow, Milfoil)

IV. PLANT LIFE OF THE SWAMP.

(a) Flowering Plants.

The whole of the swampy region is more or less populated by flowering plants. One of the noticeable features of the swamp is the presence of a number of young Ash trees (Fraxinus pennsylvanica Marsh, var., lanceolata, [Borkh] Sarg.), the quantity of willow (Salix longifolia, tricophra Muhl. var., aristata R. Br. Bailey) and the abundance of sedge (Carex retrorsa Schwein and Carex).

Carex retrorsa is almost in complete dominance. It occupies a fairly large proportion of the southern half of the swamp and is also common along the nothern margin and eastern extremity. Carex aristata is present only in a small area in the southwest corner. All through the Carex area Polygonum Muhlenbergii (Meisn.) Wats., and Mentha arvensis L., canadensis (L.) Briquet are plentiful.

The ash trees occupy the center and deeper part of the depression. The ground here is bare of vegetation, except for these trees, which are nearly all 12 years of age, a few of which may be a year or two younger.

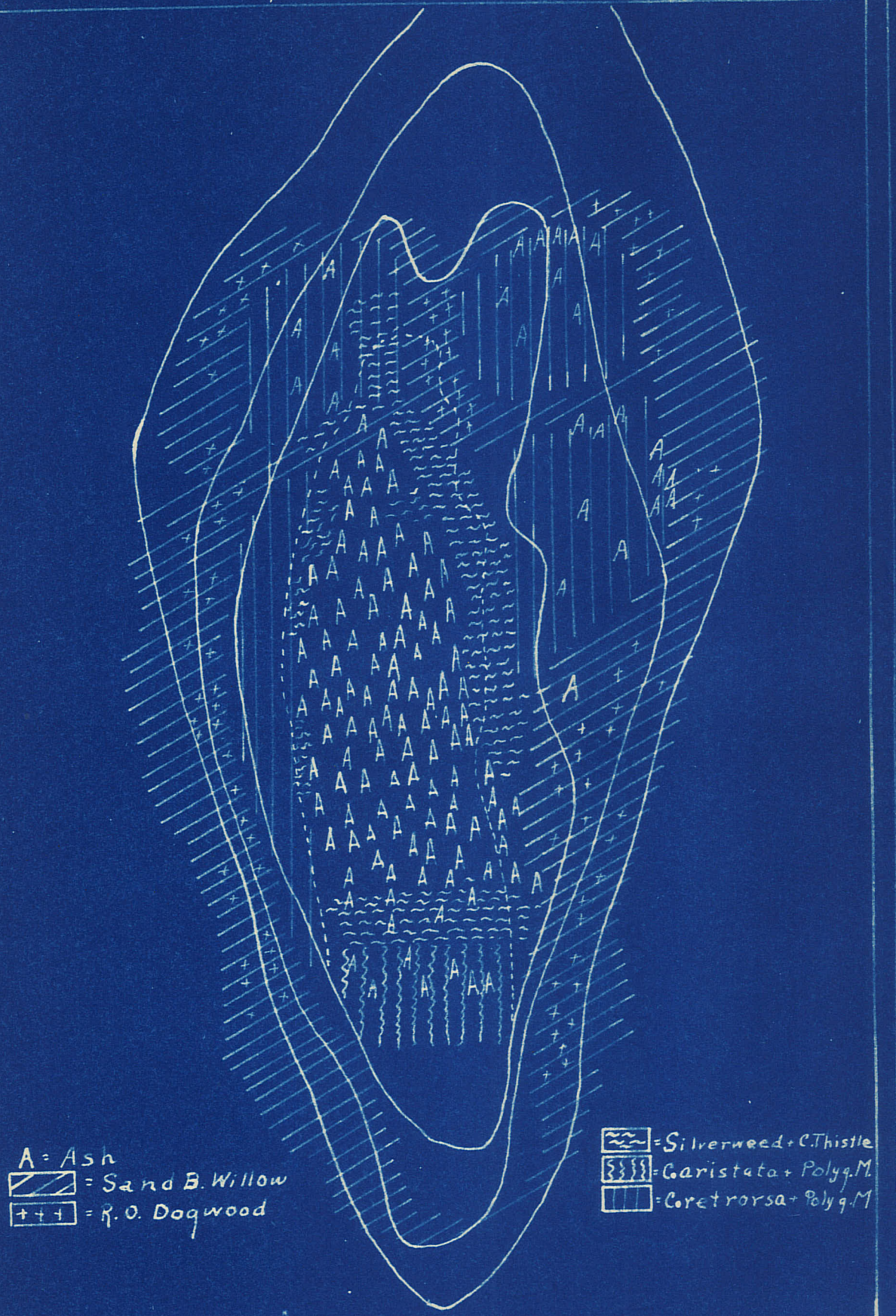
In a number of small areas between the Carex species and the Ash trees were found patches of Silverweed (Potentilla Anserina L.), and the Canada Thistle (Cirsium arvensex (L.) Scop.). As a general rule these plants were not mixed with one another to any large extent or with other vegetation. The swamp for purposes of study was subdivided into sections A, B and C.

The margin of the swamp is made up of willow (Salix longifolia) The Willows along the northern and southern margin, of section "A", approach each other toward

the eastern extremity leaving a narrow passage leading to a smaller section of the swamp designated on the map as section "B". Here again vegetation is made up of Carex retrorsa, Polygonum Muhlenbergii, Potentilla Anserina, Cirsium arvense. Ash were scattered here too, but more sparsely. This is due partly to the slightly higher ground and possibly to the more ready invasion of other plants. The willow is apparently slowly invading the swamp from the margin towards the center.

Going directly south from section "B" a distance of a few feet, one comes into section "C". This section is surrounded by willows on all sides. A few young Ash trees are again found in the low places. Carex retrorsa dominates the whole section. Here Polygonum Muhlenbergii was found to be plentiful. Mentha canadensis on the other hand was entirely missing in this section. The following represents a list of plants collected in the region of the swamp in late September 1933, and later identified.

Explain A, B, & C
not on map



GENERAL VEGETATION of the SWAMP

SPERMATOPHYTA.

Cyperaceae

Carex retrorsa Schwein.

" trychophora Muhl;
var aristata (R. Br.) Bailey.
These two herbaceous perennials dominate the vegetation of the swamp and are very plentiful.

Salicaceae

Populus tremuloides Michx. (American Aspen)

" deltoides Marsh. (Cotton-wood)
Both these plants are scattered around the margin.

Salix longifolia Muhl. (Sand Bar Willow)
This plant fringes the swamp on almost the whole margin and is characterized by the shape of its leaves.

Betulaceae.

Corylus americana Walt. (Hazelnut)
Sparse, on western extremity of the swamp.

Urticaceae

Urtica dioica L. (Stinging Nettle)

Polygonaceae

Polygonum Muhlenbergii (Meisn.) Wats. (Knotweed)
Is plentiful, interspersed with Carex ssp.

Ranunculaceae

Anemone canadensis L. (Canada Anemone)
Found at western extremity of the swamp.

Thalictrum dioicum L. (Early Meadow Rue)
Found at western extremity of the swamp.

Saxifragaceae

Ribes floridum L'Her. (Wild Black Currant)
Found at western extremity of the swamp.

Rosaceae

Potentilla anserina L. (Silverweed)
This plant was spreading by slender jointed runners at the margin between Ash and Carex retrorsa.

Potentilla monspeliensis L. var. Norvegica (L.) Rydb.

Aceraceae

Acer Negundo L. (Box Elder)

Cornaceae

Cornus stolinifera Michx. (Red Osier Dogwood)
Abundant around the margin of the swamp interspersed with willow; interesting for its leaves and smooth red stem.

Oleaceae

Fraxinus pennsylvanica Marsh., var. lanceolata (Borkh.) Sarg. (Green Ash)
Is very anundant in the swamp; interesting as it is a more recent invasion of the swamp; also shows adaptation of lenticels below the water level to conditions of the swamp; two epiphytic lichens, named below, were found on this plant.

Rubiaceae

Galium trifidum L. (Small Bedstraw)

Compositae

Cirsium arvense (L.) Scop (Canada Thistle)
Very plentiful in company with Silverweed.

Helenium autumnale L. (Sneezeweed)
Not frequent.

Aster laevis L. (Aster)
At western extremity of the swamp

Labiatae

Mentha arvensis L.; var. canadensis (L.) Briquet. (Wild Mint)

Lichens

Physicia stellaris (L.) Nyl.
Found on young ash; common on trunks of trees; widely distributed.

Teloschistes lychneus (Ach.) Tuck;
Found on young ash mixed with the preceeding; elsewhere common on trees and rocks.

(b) Algae and other Aquatic Life.

A study of the aquatic life of the swamp was made in order to ascertain what species of algae and other organisms could thrive in the few weeks in which there was sufficient free water for them to live, and could produce resting stages which would resist dessication, heat and cold, and take up active life again with the return of normal aquatic conditions the following spring.

When the swamp was dry, the soil may be said to consist of three layers: (superficially) the litter, next a layer of raw humus and thirdly fully formed humus. As the swamp dried up, the resting stages of the algae settling down in the water would finally come to rest on or in the top layer, the litter. In order to thoroughly investigate the organisms, which were adapted to pass the summer and winter in this litter, careful collections of litter samples were gathered in late September and early in October. No severe frost had occurred when the last collection was made. The litter at this time of the year was not quite as dry as it had been during the hotter part of the summer. The samples were taken from different parts of the swamp and in all cases near to an ash tree where a suitable mark could be left to indicate the sample number.

Culture number 1, was taken on September 28, from the same locality as number 3. It was found at that time to be not thoroughly dry and to have the appearance of containing some algae in the vegetative state. It was thought that some of this algae life might continue to grow. Subsequent observation showed this to be the case. It was used for most of the earlier work and allowed the writer to become familiar with the plants and other organisms which might appear later in the cultures from other samples. The other

samples (2-19) were all air dried by exposure to the air of the laboratory for a period of one month or more.

SAMPLES 2-7 were collected from Section "A" in the following places

No: 2 at a place near the entrance from the south, ordinarily submerged to a depth of 10 inches.

No: 3 and 4, along the southern margin of the section ordinarily submerged to a depth of 15 inches.

No: 7 was collected under a heavy stand of ash at a submersion of 17 inches.

Nos: 5 and 6, were collected under sedge at a submersion of 17 inches.

Submersion between 10 to 12 inches.

SAMPLES 8-13 were collected from Section "B", as follows:

Nos: 8 and 9, were collected under willows.

No: 10 was collected under sedge and ash (mixed).

No: 11 " " " sedge.

No: 12 " " " Ash with no undergrowth.

No: 13 " " " sedge.

SAMPLES 14-19 were collected from Section "C", largely under willow and ash around the margin and under sedge in the center of the section at an average submersion of 10 to 12 inches.

All the early work was done on material developed in cultures from sample No: 1. From this material a large number of forms were identified. Later in the investigation, portions of the air dried, samples were placed in sterilized crystallizing dishes with a quantity of distilled water and placed in the light of a north east laboratory window. The plant cultures were slow in appearing at first. Later this became more rapid. First signs of life were usually indicated by ciliated and flagellated protozoa. The algae appeared a few days later. Frequently is happened that cultures suddenly were seen to be

swarming with zoospores or chlamydomonad forms. From hanging drop cultures it was proved that some of these zoospores were Chlamydomonas other species were zoospores of Oedogonium, Tribonema and Chlorococcum. The investigation was assisted by making subcultures of original cultures. These were made by taking a quantity of the original solution and adding this to a quantity of either distilled water or to a culture solution known as Bristol's Sodium Nitrate Solution and made up as follows:

Monopotassium phosphate	(KH_2PO_4)	0.5 grm.
Sodium nitrate	($NaNO_3$)	0.5 "
Magnesium sulphate	($MgSO_4$)	0.15 "
Calcium chloride	($CaCl_2$)	0.5 "
Sodium chloride	($NaCl_2$)	0.05 "
Ferric chloride	($FeCl_2$)	0.01 "
Water	(H_2O)	1000.00 "

The subcultures were not so rich at first in the number of species or individuals and therefore it made identification of organisms easier. Whenever possible camera lucida drawings were made to assist identification of the algae and other organisms.

Culture No: 1 gave the writer experience in determining the group genus, and species, to which the different organisms belonged. By the end of February all cultures showed fair growth and each culture produced a mass of growth which interested the writer and gave great pleasure whilst determining the contents.

In the following list are given the genera and species where possible of the microscopic plant and animal life identified from the cultures. Most of the species were obtained directly from the

first cultures and a few from nutritive solution subcultures. The writer has endeavored to record only those species of which he was definitely convinced. Where some doubt remained in his mind, this has been so indicated. Where grave doubts about the identity were entertained, no record was made. The writer is therefore quite conscious of the fact that this list is by no means exhaustive and representative of all the organisms in the swamp, also because at the time of writing, other species and unfamiliar forms were constantly met with and added to the list of identified. The classification followed in this record is that of West and Fritsch (1927).

ISONKONTAE

GROUP I VOLVOCALES

Series Chlamdomonadales

Chlamydomonadaceae

1. Chlamydomonas globosa, Snow; as indicated by the name is spherical in shape; no anterior beak; the chloroplast largely filling the cell with one pyrenoid at the posterior end. Cells from 5-10 mic. br.

2. Chlamydomonas Snowii; Printz; cells ovoid in shape and frequently recorded in the cultures; often in palmella stage; pyrenoid centrally with cells 7-8 br., and 10-15 mic., l.

3. Pandorina morum Bory; very abundant early in cultures; both the adult coenobium and the groups of vegetative coenobia within the parent were observed (the latter once only); the coenobium is globose invested by a broad colorless gelatinous investment, generally 16 celled, two cilia passing through from each cell to outside. Cells pyroform to angular compressed (both observed) cells 8-16 mic.,; colonies not over 45 mic.

4. Eudorina elegans Ehren.; resembles the preceeding; but cells here are arranged perpherally so as to leave a hollow sphere in the centre; cells spherical; the two cilia parallel while they pass through an outside investment then, diverge widely. Eyespot near base of cilia and several pyrenoids in cells. Recorded a few times only; cells 12-24 mic, colonies 50-100 mic.

5. Gonium pectorale Muell.; a beautiful green colony of 16 cells arranged in a square fashion with three cells making up each side of the square and four others arranged in the centre; the essentially chlamydomonas cells are connected to each other with fine gelatinous strands, making a whole resemble a fairly rigid plate. Each cell has two cilia; colonies move in a tumbling motion through cultures; easily identified by shape.

6. Gonium sociale (Duj.) Warming; four celled colony similar to the above described G. pectorale; often classed with it; essentially the same in all respects only smaller in size.

Series Tatrasporales

Palmellaceae

1. Asterococcus superbus (Cienk) Scherffel; cells generally spherical both solitary and in colonies with a wide homogeneous or lamellated gelatinous envelope; single round chloroplast with one pyrenoid; often found in four celled colonies; cells 25-35 mic in diam.

2. Gleocystis gigas(Kuetz) Lagerh; the cells quite spherical; found

singly and in fours very often; distinct gelatinous lamellated sheath surrounds each cell; if colonies of four these sheath don't become confluent and an extra sheath encloses the colony; varies in size; cells 10-20 mic., colonies 45-90 mic.

Tetrasporaceae

1. Tetraspora gelatinosa (Vauch.) Desv.; recorded several times during the work; cells apparently grouped in twos and fours with cilia many times their length passing through gelatinous integument to outside; cells about 6 mic.

GROUP II CHLOROCOCCALES.

Series Zoosporinae

Chlorococcaceae

1. Chlorococcum humicola (Naeg.) Rab.; occurred abundantly in the cultures investigated; cells vary much in size from spherical to angular if pressed together; cannot be mistaken once recognized.

2. Characium Prigsheimii A. Br.; and epiphytic unicellular alga found particularly on threads of Oedogonium; it was frequently found in fall in culture number 1, but rarely in the partially air-dried cultures; cells ovoid elongated of fusiform, sessile and attached by a small disc; one pyrenoid usually present when young, later breaks up.
(18-35 mic. l., 5-11 mic., br.).

Hydrodictyaceae

1. Euastropsis Richteri (Lagerh.); a free floating two celled coenobium; cells with bases flattened and opposed to each other; sides and particularly distal ends emarginated; resembling two trapezia approximated at bases; single parietal chloroplast in each cell containing one pyrenoid.

2. Pediastrum integrum Naeg.; recorded twice definitely; coenobium circular without perforations; two barely visible rudimentary projections on marginal cells, whose outer walls were smooth and practically straight; diam. cells 15 mic.

3. Pediastrum Boryanum (Turpin) Menegh; most abundant of the three spp. found; characterized by the deeply emarginated outer cell walls making two marginal projections, one on either side very prominent; no internal perforations; a sexual stage i.e. division of cells into numerous zoospores was observed both in cultures and petri dish; 8-16-32 coenobia found.

4. Pediastrum tetras (Ehren.) Ralfs; 8-16-32 celled coenobia of this alga were recorded; not very frequent; characterized by four rather sharp projections on the outer wall of a marginal cell and a long narrow fissure in the middle of the marginal wall leaving two projections on either side of the emargination.

Series Autosporinae

Oocystaceae

1. Tetraedron caudatum (Corda) Hansgirg; cells small, flattened five-sided; four sides slightly concave and the fifth invised; single spines protruding from each of the five anglesin the same plane as the flat cell; 6 mic. diam., spines 2 mic. l.

2. Tetraedron pentaedricum (W. & G. S. West); cells small with four of five corners in one plane and the other at an angle of 30-90 degrees; short spines protruding from each corner; single chloroplast with one pyrenoid; 7 mic.

3. Tetraedron regulare Kuetz; cells larger than those of preceeding two, tetragonal; sides slightly concave; angles with a single blunt spine; in culture number 1 only; 10 mic.

4. Tetraedron muticum (Reinsch) de Toni; cells not very large, triangular flattened; sides convex in front view; corners sharp without spines; diam. 15 mic.

Selenastraceae

1. Dactylococcus bicaudatus A. Br.; Cells ellipsoidal fusiform boatshaped asymmetrical with acute apices; solitary; cell-wall thin mucilaginous; chloroplast single parietal with a single pyrenoid; recorded once only.

2. Dactylococcus bicaudatus var. subramosus(W. & G. S. WEST; much like above; differs in that this forms branching colony which is characteristic; found in culture number 1, once only.

3. Ankistrodusmus falcatus Corda; cells acicular in shape gradually tapering at the ends; found both solitary or loosely aggregated in a number side by side; one chloroplast often broken up into smaller pieces observed; numerous in culture number 1, diam. cells 1.5-3 mic., l. 40-50.

4. Actinastrum Hantzchii Lagerheim; was found in the form of coenobium of 8 cells radiating from common center; recorded in one culture on one day only but very numerous on that day; cells several times as long as broad; single laminate parietal chloroplast with one pyrenoid observed, broad 6 mic., l., 30 mic.

5. Kirchneriella elongata G. M. Smith; cells elongate, cylindrical, irregularly twisted; occurred in colony of 8 cells in center of a gelatinous mass; recorded once only; 2-3 mic. br., 25 mic. br.

6. Kirchneriella obesa (W. West) Schmidle; has the appearance of a round sphere with an incision on one side thus making it look like a sickle with the inner edges close together and nearly parallel, the apices almost touching; single chloroplast containing one pyrenoid fills the whole cell; again found in a hyaline mucilaginous envelope; once only recorded.

Coelastraceae

1. Scenedesmus abundans (Kirchner) Chodat; coenobium is flat, four celled; each cell of ovoid shape pressed close to each other; terminal cells have a spine at each corner and another spine between the two already mentioned; occasionally even more spines were noticed on outer wall of terminal cell; cells vary in size; 4-7 mic. br., 7-12 mic long; coenobe 12 mic. br. and from 20-30 mic. l., very abundant, particularly in culture number 1.

2. Scenedesmus obliquus (Turpin) Kuetzing; coenobes of four to eight cells observed; cells fusiform with rather acute apices; cell wall smooth without angular or terminal spines; variable in size; 4-9 mic. br., 12 mic. l.

3. Scenedesmus quadricauda (Turpin) Breb.; 4 celled coenobia of this form were found rather rarely and only in culture number 1, cells ovoid in shape and the single spine at each corner curved.

4. Scenedesmus bijuga (Turpin) Lager.; 4 celled coenobes of this type were found frequently; cells were oblong ovoid in shape, had a smooth wall and no spines at the extremities; 4-6 mic. br., 7-15 mic. l, coenobes 7-15 mic. br., up to 30 mic. l.

5. Scenedesmus acuminatus (Lagerhe) Chodat; found in 4 celled coenobia only; two cells characteristically curved away from center of coenobium; cell wall smooth without spines; frequent in Nov. in culture number 1, cells 3-8 mic. br., 30-50 mic. between apices.

6. Scenedesmus dimorphus (Turpin) Kuetz.; 4-celled coenobia with two inner cells characteristically erect and two outer cells (one on each side of the erect inner cells) lunate i.e. bent away with apices in a characteristic manner; cell wall smooth without spines.

GROUP III ULOTRICHALES

Series Eu-Ulotrichales

Ulotrichaceae

1. Ulothrix variabilis (Kutz) Kutz; a filamentous alga forming flocose masses; cells 5-6 mic. diam., $\frac{1}{2}$-1$\frac{1}{2}$ times as long; cell wall rather thin; chromatophores vary in shape and peculiar of the spp. and are therefore helpful in identifying the form; may be parietal on either side of cell, also in the form of a rectangular plate suspended from sides and ends of cell; found to be very abundant; a practically pure culture was obtained by a modification of the dilution method; a floccose mass was put on a slide and washed with distilled water until all other microscopic vegetation was washed away; it was then transferred into a nutritive solution in an Erlenmeyer flask and there left to grow; to date the filaments are living.

2. Ulothrix tenerrima (Kutz) Kutz; this form resembles U. variabilis very much and differs only in diameter of filaments, otherwise essentially the same.

Microsporaceae

1. Microspora stagnorum (Kuetz.) Lager.; filaments of this alga are cylindrical, about 8 mic. in diam., 1-3 times as long; the chromatophore is quite granular, of a light green appearance; the writer is not convinced of this form and suspects identity with Trib. bombycinum.

GROUP IV CHAETOPHORALES

Chaetophoraceae

1. Chaetophora incrassata (Huds.); the colony is irregularly lobed and extended; the branches bear densely crowded terminal fascicles which are long-setiferous; cells vary in diameter from 8-16 mic. and are several times as long; terminal branchlets curved.

2. Microthamnion Kuetzingianum (Naeg.) Kuetz.; mature plants are densely and irregularly branched; main trunk not distinguishable; branchlets one to several celled; cells 3-4 mic in diam; 2-4 times as long; chromatophore bright green approaching yellow-green.

3. Microthamnion strictissimum macroccystis Schmidle, Hedwigia; plants taller than preceding; branchlets more erect, slender and ascending; cells 2-5 mic. br., 15 mic. l.; chrematophore a paler green than in the other sp. recorded; ends of terminal cells hyaline in appearance.

4. Stigeoclonium (Myxonema) stagnatile Hansen; filaments elongated, floating; branches attenuated into long seta; diam. cells 8-11 mic. 1-3 times as long.

5. Pseudulvella americana (Snow) Wille; Thallus of this alga is discoid with several cells in thickness at the center; no setae observed; cells exhibit well developed pyrenoid near the center; cells arranged in apparently radiating lines diverging from the center; all lines held together in place by a gelatinous investment.

Trentepohliaceae

1. Gongrosira viridis Kuetz; this form was found frequently in the initial stages of the 18 cultures started in November; cell wall rather thick; parietal chloroplast; pyrenoids not well defined; akinete stage also observed.

2. Coleochaete scutata Breb.; this epiphytic form was recorded about 6 times; it is made up of a thallus enveloped in mucillage; it has the shape of an irregular one layered disk; the cells radiate from the center much like branches; cells quite rectangular in shape with one prominent chloroplast; characteristic setae containing one slender thread of protoplasm arose from the thallus in several places.

3. Chaetospheridium globosum (Nordst.) Kleb; is an epiphytic form common in filaments of coarser Chlorophceae; has spherical cells each of which bears a single long seta at its distal end; the alga was observed about 8 times, never singly but always in clusters, the seta has a cytoplasmic

filament whose basal portion is ensheathed by a gelatinous cylinder. A common gelatinous envelope was observed about the cluster of cells.

GROUP V OEDOGONIALES

Oedogoniaceae

1. Oedogonium geniculatum Hirn; monoecious; oogonium 1. obovoid-globose, pore superior; oosporeglobose, not filling oogonium, smooth; antheridia 1-5 subepigynou or subhypogynous; veget. cell 37-48x60-135 mic., oogonium 56-63x56-68; oospores 48-59x48-59; antheridium 37-44x5-9;

2. Oedogonium plagiostomum Wittrock; dioecious, macrandrous; oogonium 1, obovoid globose; pore superior; oospore globose to subglobose filling oogonium; spore wall smooth thickened; antheridia 1-6; veg. cell 22-27x65-120 mic; oogonium 42-49x50-60; oospore 41-47x42-49; anth. 20-24x8-10;

3. Oedogonium fragile var. robustum (West & West) Tiffany; monoecious; oogonium 1, globose, with superior pore; oospore globose, filling oogonium smooth; antheridium 2x7; veg. cell 19-23x40-90 mic; oog. 53-58x50-60; oospore 51-56x47-53; anther. 19x5-7.

GROUP VI CONJUGATAE

Series Euconjugatae

(b) Zygnemales

Zygnemaceae

1. Spirogyra Spreeiana Rabenhorst; filaments 18-21 mic. in diam; cells 10-25 diam. l.; chromatophore single, slender making 1½-4 turns; fertile cells swollen, not shortened, 30-42 diam. spores ellipsoid 2-3 diam. l. up to 36 mic.

2. Spirogyra spp. at least two more species of this alga were found; none of them could be identified definitely owing to find the spores resulting from conjugation; they were forms with two and three chloroplasts; also forms with reticulate walls and without them; cells were cylindrical but varied in diameter; chloroplasts observed in all of them in characteristic spiral form containing pyrenoids.

3. Zygnema species; only one genus identified; it was impossible to define its species due to the fact that the spores were not found; two large stellate chloroplasts, characteristic of the genus, were observed in each cell.

Closteriae

1. Closterum pronum Bréb.; this form was much elongated and had a length of 220 mic. by a width of 11-12 mic.; 4-6 chloroplasts in each of the two chloroplasts; fairly straight and extreme points a little rounded;

two moving granules in each of the terminal vacuoles; a pretty green color; recorded once.

2. Closterium Venus Kuetz.: this form was small, strongly curved with fairly acute apices; cell wall smooth and colorless; chloroplast ridged with 3 pyrenoid; in terminal ~~cavuoes~~ vaevoles moving granules observed.

3. Closterium parvulum Naeg; small strongly curved with acutely rounded apices; chloroplasts ridged with series of pyrenoids; again moving granules in terminal vacuoles; frequent;

4. Closterium eboracense Turner; medium sized, with thick and broadly rounded apices; smooth cell wall; chloroplast distinctly ridged with a series of 4 pyrenoids; large terminal vacuoles with moving granules.

5. Closterium Dianae Ehren; large alga, strongly curved with obtusely rounded apices; chloroplasts somewhat ridged with a series of 7 pyrenoids; numerous moving granules in terminal vacuoles.

6. Closterium Dianae var. arcuatum (Bréb.) Rabenh.; More strongly curved than the preceding form; shorter in distance between apices; number of pyrenoids in a chloroplast L. 170 mic. , W.25 mic.

7. C. juncideum Ralfs; cells elongate and slender; 20-40 times longer than broad, straight parallel margins 4-7 pyrenoids in each chloroplast; terminal vacuoles elongated with several moving granules; l. 110-330 mic., br. 4.5 -8 mic. With zygospore

Cosmarieae

1. Cosmarium reniforme (Ralfs)Arch.; this form is not of large size slightly longer than broad; deeply constricted, the sinus narrow and closed; semicells reniform; end view of cell elliptic; cell wall granulate with rounded granules; chloroplasts axile with two pyrenoids; l. 46-57 mic., br. 44-54 mic.

2. Cosmarium logiense Bisset; cells not large, of medium size deeply constricted with slightly dilated extremity otherwise linear; semicells much like preceding form i.e. reniform except that both extremities appear to be flattened very little; vertical view elliptic as above; axile chloroplast with two pyrenoids. = Vertical

3. Arthrodesmus convergens Ehrenb.; medium sized cells; deeply constricted sinus opening widely from a narrow sublinear extremity; semicells elliptic in shape, dorsal margin being slightly more convex than lower; cells furnished with short incurved spines at each corner; no chloroplasts; seen once only.

4. Staurastrum avicula Bréb.; var subarcuatum (Wolle) West; made up of two cells, small; deeply constricted then opening widely; vertical view triangular with sides slightly concave and a spine visible at each corner; semicells subelliptical; granules in concentric rows;

5. Staurastrum muricatum Breb.; medium sized cells, deeply constricted, sinus narrow opening wider; semicells subelliptical; dorsal margin more convex than ventral; angles dulled; minute granules arranged in concentric rows around angles; vertical view triangular; chloroplast axile with pyrenoid in center of each cell.

HETEROKONTAE

GROUP I. HETEROCHLORIDALES

Series Chloramoebales

1. Stipitococcus urceolatus W & G.S. West; a plasmodial protoplast is surrounded by a lorica open at the upper end with an irregular margin. Each lorica attached to the substrate by a stipe terminating in a disc; a chromatophore was observed in the protoplast; the algae appeared hyaline; epiphytic on Oedogonium; found often; l. 7 mic., br. 4 mic.

GROUPII. HETEROCOCCALES

Ophiocytiaceae

1. Ophiocytium arbusculum (A.Br)Rab.; characteristic of semipermanent or permanent pools; sessile or epyphytic upon one another forming branching colonies; cells straight cylindrical; the protoplast within the cell is multinucleate and consists of several elongated chromatophores; often these chromatophores were found arranged around the neck in a whorl of from 4-8.

GROUP III. HETEROTRICHALES

Tribonemaceae

1. Tribonema bombycinum (Ag.) Derbes & Sol.; this filamentous alga was very frequently met with at the earlier stages of the cultures; is easily recognizable due to its chromatophore arrangement and the H shaped sections that make up its cells; filaments are unbranched without a sheath; chromatophores from 2-12 in cells; cell wall thin; diam.6-11 mic. and several times as long.

2. Tribonema minus (Wille) Hazen; less frequent than the other form; much like it; from 2-4 chromatophores (in pairs usually) ; diam of cell 5-6 mic.

3. Monocilia viridis Geneck; a freely branched multicellular filament with several discoid chromatophores; in culture No. 1.

4. Monocilia flavescens Gerneck; even more branching and kind of radiating from a center into all directions; chromatophore arrangement as in other species.

CHRYSOPHYCEAE

GROUP I. CHRYSOMONADALES

Series Hymenomonadales

Euhymenomonadaceae

1. Synura uvella Ehrenberg; cells arranged in oblong free-swimming colony not enclosed by a gelatinous sheath; individual cells pyriform with narrower end toward center of colony; outer more oval portion of cell fringed with small spines and two cilia arising in the vicinity of the spines; two chromatophores apparently precent; cells 10 mic.br., 25 mic.

BACILLARIALES

GROUP B PENNATAE

Series Fragilarioideae

Fragilariaceae

1. Fragilaria sp;rectangular frustules joined to form ribbon like colonies; pseudoraphe barely visible; quite abundant; vary regarding width; yellowish chromatophores in two plates, also in granular form observed; measurements noted 70 mic. l., 15 mic. br; 40 m.l.-15br.

2. Synedra radians Kuetz; long spindle shaped, quite narrow; central area small, roundish; 40 mic. l., 2 mic. br.; usually many individuals on a mucilaginous mass in company with other algae.

3. Eunotia gracilis Ehren; frustules bent slightly to resemble a bow, narrow and long; with nearly parallel sides; ends slightly rounded, bent back; raphe delicate, faint; 70-160 l., 2mic. br. occurs singly as a rule.

4. Eunotia lunaris Ehren; generally like the preceding, but shorter; length not over 100 mic. 2mic br; usually in colonies held together by mucilage at one end much in the shape of a fan; abundant.

5. Eunotia impressa Ehren; frustules linear slightly bent, slender back with two slight elevations; raphe distinct, parallel, slightly radiating toward the end; 25-55 mic. long, 7-10 mic. wide.

6. Eunotia praerupta Ehren; frustules bent, fairly wide; inner side nearly straight; opposite side quite convex with small emarginations just before the end; ends rounded; raphe distinct, radiating toward extremities; 40-80 mic. l., 12 mic. br.

7. Eunotia arcus var. bidens; Ehren; frustules bent; inner side nearly straight, outside with two definite humps; raphe distinct; 30-70 mic. long, 3-4 mic. wide.

Series Naviculoideae

Naviculaceae

1. Navicula major Kuetz; frustules slender, linear, slightly thickened at the center; ends rounded; raphe very distinct, radiating in the center and converging towards end; abundant; l. 200-300 mic. br. 30 mic.

2. Navicula viridis Ehreb; much like preceding but with sides parallel (no widening at center); shorter; l. 140-170 mic. br. 20-25 mic.; very abundant.

3. Pinnularia brecicostata Cleve; frustule linear, with parallel side ends rounded; raphe parallel; l. 100-120 mic. br. 15-16 mic.

4. Navicula cuspidata Kuetz; frustules wide at the middle, gradually taper toward the rounded ends; transverse raphe very faint; longitudinal raphe prominent; l. 100 mic., br. mic.

5. Navicula fasciata Lagerstedt; frustules rectangular in girdle view with slightly convex sides; transverse raphe faint, parallel, absent in the middle, thus forming a wide clear stretch transversely across frustule; l. 30 mic., br. 8 mic.

6. Navicula gastrum Ehren; frustule widely elliptical; ends drawn out and bluntly rounded; raphe prominent alternating in length at the middle; longitudinal area narrow; transverse area a little wider.

7. Navicula gastrum var. placentula; A form much like preceding but ends not so definitely drawn out; central transverse raphe not definitely alternating in length; about the same size as preceding.

8. Stauroneis phoenicenteron Ehren; frustules characterized by a definite central transverse band known as the stauros; general shape that of an ellipse drawn out at either end; longitudinal band also fairly prominent; raphe in dotted lines, faint, varying in size; 70-200 mic. long, 30-40 mic. wide; very abundant.

9. Stauroneis anceps Ehren; much smaller and generally shorter than the other form described; ends drawn out into heads at both ends; l. 24-80 mic., br. 6-17 mic; very abundant.

Cymbellaceae

1. Cymbella(Cocconema) helvetica Kuetz; frustules unsymetrical, boat-shaped, fairly wide; inner side nearly straight, outer very convex; ends slightly rounded and bent back; transverse markings in dotted lines; longitudinal raphe running toward knots at the extremities, from which fissures seem to extend around the end; l. 36-85 mic., br. 15 mic.

2. Cymbella gastroides Kuetz; frustule generally like preceding, except much larger; transverse markings more radiating; l.150-180 mic. br. 33-35 mic.

Series Nitzschioideae

Nitzschiaceae

1. Hantzschia amphioxys (Kuetz) Grunow; frustules slightly bent, solitary or in bands; keel on concave sides with prominent carinal dots girdle view rectangular; very abundant; following varieties thought to be present:

   (a) var. vivax; much elongates, delicately slender, 100 mic.l;
   (b) " elongata; with a prominent bend midway, very long; 300 mic.l;
   (c) " pusilla; quite short and relatively wide;25-40 mic l;

DINOPHYCEAE

1. Glenodinium cinctum Ehrenb; cells of nearly bilateral symmetry, with ends well rounded; a transverse furrow cutting across the tenter of the organism, from which a flagellum rises; surface rough, dark brown in appearance; presence of yellow brown chromatophores indicated in peripheral position; resting stage more rounded, also membrane more permanent; l. 43 mic., br. 40 mic.

2. Peridinium sp.; probably P. cinctum Ehrenberg, but once only recorded and hence not confirmed; characteristic markings were disregarded at that time, although the writer is sure of the genus.

EUGLENACEAE

1. Euglena splendens Dang; long oval cell about 89 mic. by 25 mic.; chromatophores arranged in spirals; observed moving only; beautiful in appearance particularly because of green chromatophores.

2. Euglena spp.; no doubt other members of this genus such as E. viridis E. spirogyra, E. dices were present in the cultures; since the cultures were very populated and the suspected organisms removed rapidly, difficulties were encountered in measuring and identifying them.

3. Phacus pleuronectes (O.F.M.) Duj.; slightly longer than broad (nearly spherical) 45-49 mic, l., 30-33 mic. br.; occurs solitary; periplast is ornamented with striae in longitudinal direction; numerous discoid chloroplasts occur between the stiae; a fold extends from one end of the organism to about half the distance toward the other end; a flagellum arises at the beginning of this fold; a small twisted tail finishes the characteristics of this pretty organism; recorded three times.

4. Phacus longicauda (Ehren,) Duj.; 85-115 mic. by 46-70 mic; much like the other form except for size and a long straight tail as indicated by the name; recorded once only.

5. Trachelomonas hispida (Perty) Stein; oval in shape with short spines, numerous; 20-42 mic. l., 15-26 mic. br.; short neck; several chromatophores; flagella twice as long as the cell; also the following:
   var, punctata; without spines
   " coronata; with short spines and a corona of spines around the neck.

6. Trachelomonas volvocina Ehren.; sperical smooth, 7-21 mic. in diam; opening of flagellum in form of ring; flagellum three times length of cell.

7. Trachelomonas inconstans; Carter; integument ovoid, ellipsoid; a flagellum equal to length of cell; slightly yellowish, due probably to presence of iron; living cell quite green in color.

8. Colacium arbuscula Stein; cells found on long branching mucilaginous stalks; cells egg shaped; once recorded.

MYXOPHYCEAE

GROUP I CHROOCOCCALES

Chroococcaceae

1. Merismopedia elegans A. Br.; colony small arranged in groups of four partially disorganized due to disturbance; colony flat, cells spherical and pressed closely together by twos; 5-7 mic. br., 5-9 l.

2. Merismopedia glauca (Ehren.) Naeg.; much like other form, only smaller in size; about 3-4 mic.

3. Coelosphaerium dubium Grunow; colonies sperical, enclosed by a gelatinous envelope; cells arranged peripherally, are spherical and pretty blue in color; abundant; cells 7-8 mic. in diam; colony over 100 mic. diam.

4. Gomphospheria aponina Kuetz.; colonies with a thick hyaline envelope; cells in a pyriform shape scattered at the periphery of the mucilaginous layer, often in pairs with obtusely pointed ends toward center of colony; no connecting strands observed; cells 5 mic. br., 12 mic. l; colonies from 50-90 mic.

5. Microcystis pulvera (Wood) Migula; spherical or elongated colonies with delicate gelatinous envelope; cells spherical and crowded together in colony in a solid mass; contents blue green; 2-3 mic. diam. of cells.

6. Microcystis aeruginosa Kuetz; colonies like preceding except that cells are larger and not crowded together as in other form. 3-4 mic. diam. of cells.

GROUP III HORMOGONALES

Oscillatoriaceae

1. Oscillatoria limosa Agardh; plant mass dark blue green, not constricted at joints; apical cell not tapering and with a convex outer wall; walls granulated; trichomes 11-20 mic. diam; cells 2-5 mic.

2. Oscillatoria brevis Kuetz.; plant mass dark green; trichomes 4-6.5 mic. in diam.; scattered in filaments or fragments; not constricted at joints; inflated and refringent cells; apex somewhat pointed and twisted, not capitate; walls not granulate; contents finely granular, 1.5-2.8 diam. of cells.

3. Oscillatoria chalybea Mertens; dark green mass; trichomes 8-13 mic. wide; fragile; often twisted into spirals; slightly constricted at joints tapering for a long distance from apex; not capitate; calyptra none; cell contents finely granulated; 4-8 mic. diam. of cells.
   N.B. Great difficulties were encountered with this genus and no doubt more species were present, which the writer could not identify with reasonable accuracy.

4. Phormidium autumnale Agardh; plant mass expanded; filaments generally straight, mucous, agglutinated to each other; trichomes 4-7 in diam. not constricted at joints; apex briefly tapering, scarcely curved, capitate; rotund calyptra present; walls often granulated; abundant in culture number 1, cells 2-5 mic. long.

5. Phormidium tenue (Meneghini) Gamont; plant mass membranaceous, pale blue green; filaments long finely diffluent into mucous; trichomes 1-2 mic. slightly constricted at joints; apical cell acute conical; cells 2.5-5 mic. l.; pale blue green color.

6. Phormidium molle (Kuetz.) Gom; this form resembled closely and seemed to be identical with the same form illustrated in West and Fritch. p. 472; the filaments are about 2-2.5 mic. br. and the cells about as long too; several filaments agglutinized, mucous; slightly constricted; pale green in color.

7. Lyngbya contorta Lemme; filaments free floating; generally twisted to form spiral; thin sheath; not constricted at joints; contents pale blue green; 1.5-3 mic. br., l. 3-6 mic.; spirals 15-20 mic. br., 10 mic. between turns.

Nostocaceae

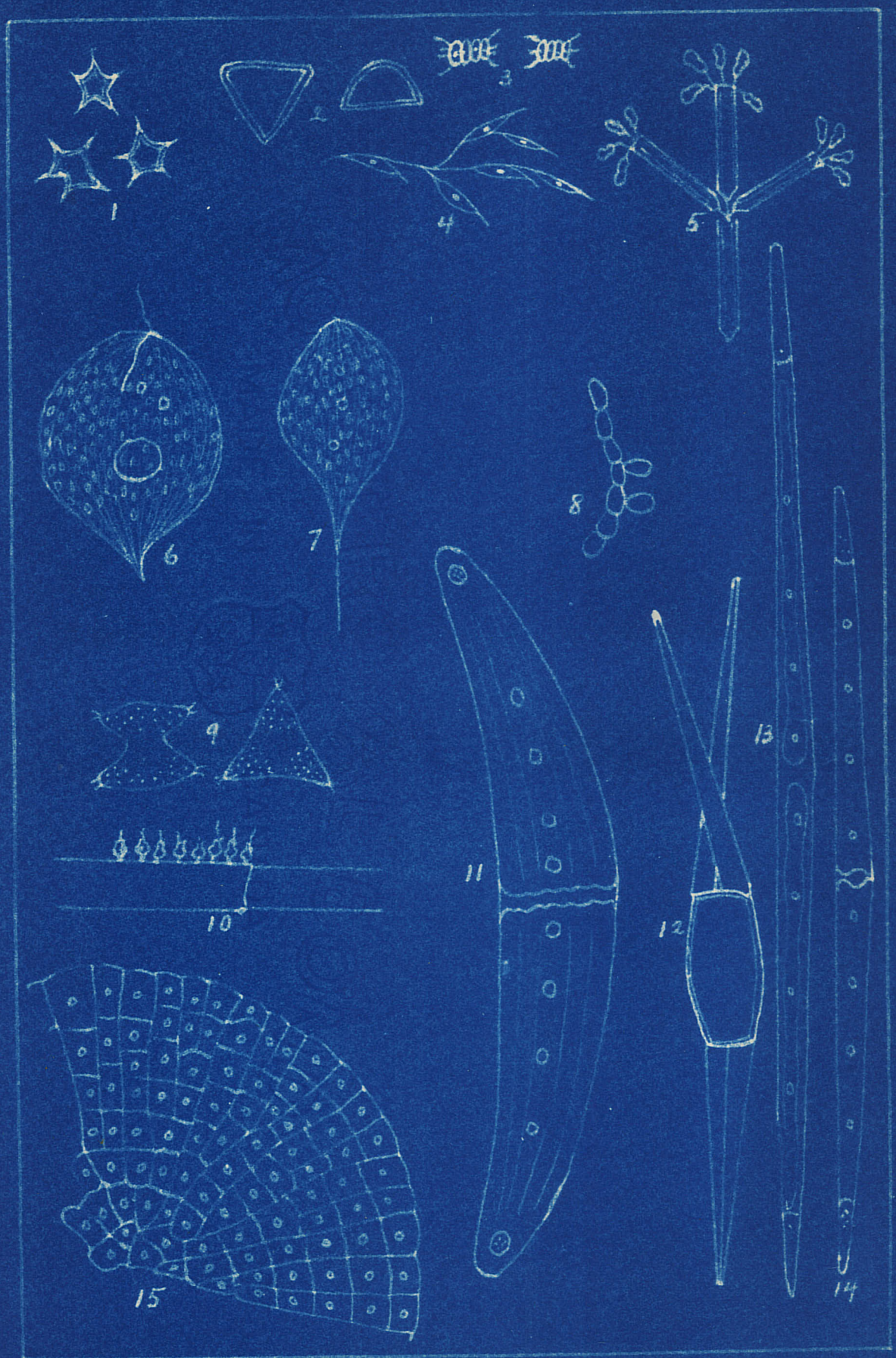
1. Nostoc commune Vauch; plant mass gelatinous firm; at first spherical then flattening out into sheets, blue, green, olive in color; filaments flexuous, entangles; trichomes 4.5-6 mic in diam; cells spherical or barrel shaped; heterocysts 7 mic. in diam., spherical, up to three or five in number; no gonidia.
   N.B. Again with this family great difficulties were experienced and accurate identification of other members of the family could not be made.

2. Anabaena affinis Lemm; filaments solitary free floating; straight or flexed with a faint hyaline envelope; heterocysts spherical; spore remote from heterocysts, elongated, cylindrical; cells 5-6 mic. br., heterocysts 7.5-10 mic; spores 9.5-12 mic br., 17-26 mic. l.,

Rivulariaceae

1. Calothrix sp. Agardh; just one species met with by the writer; it could not be identified with respect to the species; filament imbedded in a cylindrical hyaline sheath and tapering from apex to base.

ALGAE ILLUSTRATED.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The following zoological microorganisms were identified during the work on the algae:

Phylum Protozoa

Class Rhizopoda

1. Ameoba proteus Leidy; protoplast very changeable in form with numerous pseudopodia; single large nucleus, one or more contractile vacuoles; very abundant.

2. Ameoba radiosa Ehren; body spherical with ray-like pseudopodia more or less rigid, not withdrawn or reformed rapidly; common.

3. Ameoba limax Dujardin; slug-like, usually moving with broad end forward; posterior end villous; usually contains numerous algae.

4. Arcella vulgaris Ehren; very abundant, shell smooth, brownish in color; protoplasm very transparent; round and concavo-convex in other plane with mouth on lower side.

5. Centropyxis aculeata Stein; a spherical shell compressed laterally dark brown; usually dead organisms only observed; common.

6. Euglypha ciliata Ehren; shell compressed, elongate oval; plates oval or round with needle like spines arising from shells.
N.B. Several other spp. of this genus are thought to be present.

7. Actinophrys sol. Ehren; body spherical with protoplasm highly vacuolated; pseudopodia extending from all parts of body.

Mastigophora

1. Mastigamoeba longifiium Stokes; very changeable in shape; often with apparent pseudopodia; slow movement; flagellae long, nucleus small and a contractile vacuole.

2. Anthophysa vegetans Mueller; very abundant in culture number 1, consisted of a branched stalk, brown mucilaginous, to whose extremities clusters of zooids were attached; often these got loose and travelled through the culture medium in a rolling motion.

3. Astasia trichophora Ehren; body elongate hormally, wide posteriorly; primary flagellum thick at base and long; contractile vacuo anteriorly located; not common.

Infusoria

1. Leucophrys patula Ehren; body oval; pharynx tubular curved; nucleus central; contractile vacuole posterior.

2. Dalloria frontata Stokes; body as long as broad; posteriorly tapering; anteriorly drawn out narrowed; frequent;

3. Paramoecium caudatum Ehren; very common, ovoid, lengthened; cilliate

organism well supplied with trichocysts also a groove leading to the mouth; about 250 mic. long.

4. Vorticella microstoma Stein; characteristic on retractile stalk, body bell shaped, often ringed; a series of strong cilia encircle the central elevated disc; mouth eccentric between peristome and ciliary disc. N.B. Other spp. probably V. campanula also present.

5. Podophrya fixa Mueller; body spherical or pear shaped, attached to stalk; tentacles knobbed scattered; both active forms and cysts seen

6. Lacrymaria olor; the species is common, it has a characteristic swan like neck from 50-70 mic.

Nematoda

Many of these were observed but no efforts made to identify them.

Rotataria

1. Monostyla spp. Ehren.; characterised by one style; abundant.

2. Anuraea cochlearis Gosse; spines at the anterior or posterior edge of the lorica; not very frequent.

3. Rotifer spp. Shrank; (Rotifer citrinus Ehren.) corona of two nearly circular discs raised on short stalks when working; two eyes on proboscis; frequent;
N.B. Other rotifers were no doubt present.

Gastrotricha

1. Chaetonotus sp. Ehren; very abundant; frequent attempts to identify species failed because of extreme mobility; head probably 6-lobed; resemble ciliate protozoa in movement.

Arachnida

Group Tardigrada

Macrobiotus sp. a minute free living form abundant in earlier cultures.

CONCLUSIONS.

One of the peculiarities of the swamp is the stand of ash trees in the deepest part of it. The ground immediately surrounding many of these young ash trees is quite bare (see photograph number 5 & 6). The trees are apparently 12 years of age or less. They are more or less of uniform size, height and diameter (see photograph number 3-7). One tree was cut down at the base, and the section showed 12 annual rings. This means that the seedlings germinated as early as 1921. In the area surrounding the swamp, there are a number of ash trees, which are considerably older and at least twice the size of the trees in the swamp. In the fringing woodland of the river bank there are ash trees with trunks 12 inches or more in diameter.

The interest in the young ash trees centers upon the conditions, which made it possible for the seedling of 1921 and after two survive, while there is entire absence of trees just a few years older. On the other hand seeds must have been carried there for many years. One of the factors which may have considerably helped in this respect is the construction of a ditch in 1924 already referred to, which is a short distance out of the swamp and just out of the locality included in the map.

This ditch undoubtedly reduced the spring level of the swamp, making it possible for the deeper part to dry up earlier in the season. More suitable conditions were thus created for the growth of land plants. No records were available as to the condition of the swamp before this date. It was likely rarely so dry as it has been the last few years. One point of evidence in favor of the view that the center of the swamp

was scarcely ever completely dry is the fact that the lowest land in the swamp is still bare except for the presence of these ash trees. Apparently the Carex is invading this new area from the outside. The inner fringe of Carex is made up of young plants, and no matured flowering spikes were found within several feet of the margin. (See footnote#) If these observations are correct, it will not be long before all the bare ground is covered by Carex and other swamp plants.

There is also evidence of invasion of the surrotnding Willow into the Carex zone, which would follow the lowering of the water level of the swamp. Ecologically the swampy area is in a transitional stage between marsh vegetation and woodland. The increase of vegetation and accumulation of humus will slowly raise the general soil level and so make conditions more favorable for land plants.

The investigation of the aquatic life shows the presence of a definite flora and fauna, which can complete its active life histories during the few weeks in which there is standing water in the swamp. During the rest of the season, which would be approximately nine months or more, all life would be in a resting stage in or on the litter covering the muddy bottom. Here they will be exposed to extremes of temperature and dessication. With the advent of spring thaws these organisms return to active life.

The investigation of the alga showed, that there were 64 genera and 119 species identified, whilst about 20 zoological microorganisms were also identified. The organisms all seemed to be those characteristic of standing waters and swamps. None were noted, that are characteristic of rivers only. Although some of these organisms may have entered into this

region with the high flood in 1916 or earlier, they are all adapted to the swamp habitat at present.

"The early advent of snowy weather prevented returns to the locality to make measurements on these observations.

In conclusion, the writer wishes to avail himself of this opportunity, to express his sincere appreciation to Professor C. W. Lowe for suggesting the above problem, for valuable suggestions and general direction of the work, also for help rendered when difficulties about identification were encountered. Thanks are also offered to Professor Bisby for identification of the two lichens recorded, and similarly, to Professor V. W. Jackson for identification of the two Carex species.

DESCRIPTION OF PHOTOGRAPHS

TAKEN ON OR ABOUT OCTOBER 20, 1933 IN THE SWAMP.

PHOTOGRAPHS.

No: 1

No: 2

PHOTOGRAPHS.

No: 3

No: 4

PHOTOGRAPHS.

No: 5

No: 6

PHOTOGRAPHS.

No: 7

LITERATURE.

1. Britton & Brown; Illustrated Flora of the Northern States and Canada Vols. I-III.

2. Collins; The Green Algae of North America.

3. Common & Cairns; Colonization of a Disused Millpond at Hillsborough County Down.

4. Fred & Waksman; Laboratory Manual of General Microbiology.

5. Fritch F. E.; Some Aspects of the Ecology of Fresh Water Algae.

6. Gray's New Manual of Botany.

7. Hazen Tracey Elliott. The Ulotricaveae & Chaetophoraceae of the U.S.A.

8. Hanson, Clements & Weaver; Plant Competition.

9. Lowe C. W. ; Some Freshwater Algae of Southern Quebec.

10. Lewis & Dowding; The Vegetation and Retrogressive Changes of Peat Areas (Muskegs) in Central Alberta. (P. 1).

11. Pascher A.; (Prag) Die Suesswasserflora Deutschlands, Oesterreichs und der Schweiz.

12. Smith; Phytoplankton of the Inland Lakes of Wisconsin. Parts I and III, Bull. No: 57, Wisconsin Survey.

13. Smith; Freshwater Algae of the United States.

14. Tilden; Minnesota Algae.

15. Tansley A. G. Practical Plant Ecology.

16. Tansley A. G. Types of British Plant Vegetation.

17. Tansley A. G. The New Phytologist No: 1.

18. Tiffany; The Oedogoniaceae.

19. Ward & Whipple; Freshwater Biology.

20. West; British Desmidiaceae Vols. I-V.

21. Whipple; Microscopy of Drinking Water.

22. West. Algae. Cambridge Botanical Handbook 1916.

23. West; British Freshwater Algae 1904.

24. West & Fritch; Freshwater Algae 1927.