Vol. 12 OCTOBER, 1969 No. 1

PROCEEDINGS OF THE ROCHESTER ACADEMY OF SCIENCE

STUDIES ON THE PLANTS OF THE GENESEE COUNTRY (WESTERN NEW YORK STATE)

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CITATIONS IN THE ROCHESTER ACADEMY OF SCIENCE

BACK NUMBERS OF THE PROCEEDINGS OF THE ROCHESTER ACADEMY OF SCIENCE

PUBLISHED BY THE ACADEMY
ROCHESTER, NEW YORK

PROCEEDINGS OF THE ROCHESTER ACADEMY OF SCIENCE

ESTABLISHED 1881

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Vol. 12, No. 1, pp. 1–76 October, 1969

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STUDIES ON THE PLANTS OF THE GENESEE COUNTRY (WESTERN NEW YORK STATE)

1. Prospectus for a Flora of the Genesee Country

ELWOOD B. EHRLE[1] AND BABETTE B. COLEMAN[2]

ABSTRACT. The history of botanical studies in the Genesee Country is reviewed. A description is presented of the intended work in re-collecting the area and electronically processing the resulting data toward a monographic treatment of the flora. Participation is invited by anyone interested in the project.

INTRODUCTION

The Genesee Country of western New York State includes the valley and drainage basin of the Genesee River and some of the lands adjacent thereto. A natural physiographic unit, the Genesee Country covers all or portions of ten counties. Arranged according to area in square miles, these are: Steuben, Allegany, Monroe, Ontario, Livingston, Wayne, Wyoming, Genesee, Orleans and Yates. Geologically and historically the Genesee Country is well known, but as yet few botanical studies have encompassed it thoroughly.

Monroe County plants have been studied more intensively than those of any other county of the Genesee Country. The earliest botanical records are in Chester Dewey's *Catalogue of Plants and Time of Flowering in and about the City of Rochester for the year 1841* published in the 55th Annual Report of the Regents. There was an active Botanical Section in the Rochester Academy of Science as early as 1881. Members individually and collectively explored, collected, maintained herbaria, and in some cases even published; i.e., Seeley's list of the indigenous ferns of the area (1891) and Searing's *Flora of Long Pond* (1895). The culmination of all the early botanical activity in the county was the publication in 1896 of Beckwith and Macauley's *Plants of Monroe County, New York, and Adjacent Territory,* which included parts of Genesee, Livingston, Orleans, Wayne and Ontario counties. Supplementary lists of Monroe County plants, prepared by Beckwith, Macauley, and Baxter, followed in 1910 and 1917. Boughton published the *Hymenomyceteae of Rochester and Vicinity* in 1917, and in 1928, Edson's work on the ferns in Monroe and adjacent counties appeared. William James, in 1935, researched and wrote a paper entitled *The Ecology of the Mendon Ponds Area; a Preliminary Study*

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which has not been published. Goodwin reported studies in the same area as *The Flora of Mendon Ponds Park* in 1943, and simultaneously Shanks and Goodwin presented additional information on the vascular flora in their *Notes on the Flora of Monroe County, New York.* From 1938–1942 Royal E. Shanks, Temporary Plant Ecologist with the New York State Museum, headed a team of workers making an ecological survey of the vegetation of Monroe County. Ensuing circumstances prevented the publication of this work until 1966. With the exception of the Dewey catalogue, all of the other published papers mentioned above appeared in the *Proceedings of the Rochester Academy of Science.*

Published botanical investigations in Genesee County have concentrated on one area, the swamp between the towns of Bergen and Byron. The Bergen Swamp, mentioned by Paine (1864) and Day (1882), was the area for an investigation by Stewart and Merrell who reported their results in *The Bergen Swamp; an ecological study* published in the *Proceedings of the Rochester Academy of Science,* August 1937. The same publication carried, from 1946–1951, parts I–IX of *The Vegetation of Bergen Swamp.* This complete survey, undertaken by W. C. Muenscher of Cornell University and a group of his graduate students, includes vascular plants, Myxomycetes, epiphytic plants, algae, diatoms, fungi, Bryophytes, and lichens.

R. E. Stauffer studied an area in Wayne County both ecologically and floristically over a number of years. He published *The Zurich Mud Pond Preserve* in *Wildflower,* November 1960.

Although there was early exploration for plants in Orleans County, publications dealing with its botany are limited to three papers reporting on the hymenomycetes, puffballs, slime molds, cup fungi, and pyrenomycetes. All of these are by Fairman and were published in the *Proceedings of the Rochester Academy of Science* in 1893, 1900 and 1905.

More recently, a group of workers has undertaken investigations of the bryoflora of the Genesee Country. Their work has appeared in *The Bryologist* as: *The Bryophytes of Wheelers Gully* by Elwood B. Ehrle and Babette B. Coleman (1963); *Some Bryophytes of Northern Wayne County* by Charlotte H. Alteri and Babette B. Coleman (1965); and *A Preliminary Survey of the Bryophytes of Orleans County* by Evelyn L. Lyman and Babette B. Coleman (1966). *The Bryophytes of Livingston County* by Elwood B. Ehrle and Babette B. Coleman has been published in *The Bryologist.*

Warren H. Wagner, Jr. and F. S. Wagner were attracted to the Rochester area by an herbarium specimen of a fern collected by W. A. Matthews in Monroe County in 1945. The results of their visit to the area, aided by members of the Botany Section of the Rochester Academy of Science, led to the publication of *Rochester Area Log Ferns (Dryopteris celsa) and their Hybrids* (1965) and have served to stimulate new interest and activity in assessing the taxonomy of ferns in the Genesee Country.

Several more general works include portions of the Genesee Country. Among them are Paine's *Catalogue of the Plants of Oneida County and Vicinity* (1864), Day's *The Plants of Buffalo and Vicinity* (1882), Fairman's *Fungi of Western New York* (1890), and more recently Zenkert's *The Flora of the Niagara Frontier Region; ferns and flowering plants of Buffalo, New York and vicinity* (1934). In 1934 and 1937 Knoblock and Bleekman listed some of the Bryophytes of western New York in *The Bryologist* volumes 37 and 40. R. M. Schuster's *Hepaticae of Central and Western New York* (1949) is a noteworthy contribution to the taxonomy, ecology and distribution of the liverworts in the area of its title, which includes the Genesee Country.

This historical account shows that while botanical studies in the Genesee Country span the period from 1864–1968, there has been no broad attack on the flora of the entire Genesee Country. This fact impressed the Rochester Area Botanical Faculty[1] and resulted in a concern for the documentation of the flora and vegetation as it exists at the present time. Soon after its inception in 1965 this group decided that a consistent effort should be made on a long term basis to study the flora of the Genesee Country and formed a "Local Flora Committee". This committee decided to encourage a series of studies on the plants of the Genesee Country among the members of the RABF, the members of the Botany Section of the Rochester Academy of Science, and others. The committee intends to promote the publication of the results of these studies. While its primary concern is with the vascular plants, studies on any group of plants will be entertained. Furthermore, all types of studies are encouraged, be they based primarily on taxonomy, floristics, ecology, genetics, or physiology. If the various authors are willing, these studies will be published under the title of *Studies on the Plants of the Genesee Country* toward that time in the future when it will be possible to prepare a monograph on *The Flora of the Genesee Country.*

ACQUISITION OF SPECIMENS

While the Herbarium of the Rochester Academy of Science contains

1. The Rochester Area Botanical Faculty (RABF) is a loosely confederated group of botanists working in the Greater Rochester Area. Member botanists have come from University of Rochester, State University Colleges at Geneseo and Brockport, St. John Fisher College, Nazareth College, Rochester Institute of Technology, Monroe County Parks Department, and Harris Seed Company. Anyone interested in joining this group may contact the authors or the current President, Dr. Melvin Wentland, Department of Biology, St. John Fisher College in Rochester, N.Y. The group hopes to continue to work cooperatively with the Botany Section of the Rochester Academy of Science.

a rich collection of the plants of the Genesee Country, most of these were collected thirty or more years ago. To base the present and future studies exclusively on this herbarium would only succeed in describing a flora as it was in the past rather than as it is now. The first step in the preparation of a new flora therefore, is field observation and adequate collection of the plants in the area. Only when the distribution of area plants is documented by current collections of still extant plant populations, can a valid and valuable flora be written.

A veritable army of collectors is needed for adequate sampling of the 6800 square miles of the Genesee Country. In this effort, professional and amateur, teacher and student, can join ranks in a meaningful scientific work.

If the work is to proceed in a regular and orderly fashion some one place must serve as the storage and documentation center for all specimens and information relating to the flora of the area. At the present time, the Herbarium of the Department of Biology at the State University College at Geneseo, New York serves this function.

Two alternative ways of processing collections have been formulated by the Local Flora Committee:

(a) *Specimens may be sent* to Geneseo in duplicated sets. After making or routinely checking identifications, worksheets will be prepared, and the collections will be mapped and stamped "Recorded-Flora of the Genesee Country." One set will then be sent to the Herbarium of the Rochester Academy of Science, presently housed at the Monroe County Parks Department; the other set will remain at Geneseo and be viewed as being on permanent loan to the storage and documentation center. Collections need not be mounted or identified prior to sending them to Geneseo. If they are, of course, the work of the herbarium staff will be greatly facilitated. Labels, or at least pertinent data, must accompany each collection. This data should include: collector's name, collector's specimen number, geographic point where collection was made, habitat of the plant, and name of the plant, if known. The Geneseo Herbarium will provide identifications to the contributors of specimens as requested. If triplicate sets of unknowns are sent, one identified set will be returned to the sender. The Geneseo Herbarium will also stock local flora labels printed especially for Genesee Country Collections, and will supply them to prospective collectors on request.

(b) *Specimens may be loaned* to the local flora committee. In this case, the identifications will be routinely checked, the collections recorded on worksheets and distribution maps, the sheets stamped, and the specimens returned to the sender.

PREPARATION OF THE DATA

It is estimated that twenty-five to fifty thousand specimens will be needed to provide an adequate data base for the proposed monograph. The accumulation of a variety of types of information from so many specimens can be a monumental task in itself. For this reason, the Local Flora Committee decided to avail itself of the equipment and advice of the Computer Center of the State University College at Geneseo. The procedure described below was worked out in consultation with Dr. Raymond Roth, Director of that Center.

As each new specimen is processed through the documentation center, a variety of types of information will be recorded on a worksheet for that specimen. These worksheets will later go to a key-punch operator, who will transfer the numerically coded information to standard eighty column IBM cards. Table I, presented below, indicates the intended distribution

Table I. A GUIDE FOR WORKSHEET PREPARATION.

Column #	*Nature of Data*	*Description*
1–6	Accession #	As recorded on herbarium sheet. Blank if column not needed.
7–12	Date Accessioned	As recorded on herbarium sheet.
13	Major Plant Group	Use 1 for Vascular Plants.
14–16	Plant Family	As arranged at storage and documentation center.
17–22	Genus and Species	17–19 Genus # as given in *Gray's Manual,* 8th ed. 20–22 Species # as given in *Gray's Manual,* 8th ed.
23–24	Major Political Division	23 Blank 24 Use 1 for New York State.
25–26	County	25 Blank 26 Use 0—Orleans, 1—Monroe, 2—Wayne, 3—Genesee, 4—Wyoming, 5—Livingston, 6—Ontario, 7—Yates, 8—Allegany, 9—Steuben
27–30	Geographic location	To be read from a 10,000 square grid overlay and a map of the ten counties.
31–32	Major Ecosystem	31 Blank 32 Use 1 for Northeastern Deciduous Forest.
33–34	Major habitat types	See text discussion and Table III.
35–37	Specific habitat	Keep duplicate card file of assigned numbers.
38–43	Date collected	As recorded on herbarium specimen.
44–48	Collector	Keep duplicate card file of assigned numbers.
49–54	Collection #	As recorded on herbarium sheet. Blank if there is no collection number.
55–56	Phenology	See text discussion and Table IV.
57–62	Date work sheet prepared	Date it is completed.
63–80	Blank	

of the data on the IBM cards; Table II illustrates the application of this system to a particular specimen. On the cards, several blank columns have been intentionally incorporated into the system to allow for expansion

TABLE II. AN EXAMPLE OF WORKSHEET DATA PREPARED FROM A PARTICULAR SPECIMEN.

Column #	*Punch*	*Translation*
1–6	003168	Accession # in Geneseo Herbarium.
7–12	011068	Accessioned into collection on Jan. 10, 1968.
13	1	Specimen is a vascular plant.
14–16	053	Fifty-third family in Geneseo Herbarium (Liliaceae).
17–19	016	Sixteenth genus in Liliaceae in *Gray's Manual,* 8th ed. (Lilium).
20–22	005	Fifth species in Lilium in *Gray's Manual,* 8th ed. (L. Canadense L.).
23–24	01	Specimen collected in New York State.
25–26	05	Specimen collected in Livingston County.
27–30	2334	Geogr. location from grid map (E. of Caledonia, N.Y.).
31–32	01	Ecosystem from which specimen was taken is Northeastern Deciduous Forest.
33–34	06	Plant growing in marsh, marshy areas, drainage ditch, or pond margins.
35–37	013	Dense thicket along pond margin (from card file).
38–43	071467	Specimen collected July 14, 1967.
44–48	00001	Collector—Elwood B. Ehrle (from card file).
49–54	005099	Ehrle collection #5099.
55–56	07	Bisexual flowers mature, at anthesis.
57–62	061568	Date worksheet prepared (June 15, 1968).
63–80		Blank.

of present studies and also for the incorporation of future studies into the same data framework. Thus, column 23 along with 24 could be used to code specimens from other than New York State, and column 25 along with 26 could be used to code New York State counties outside of the Genesee Country. Finally, eighteen blank columns at the end of each card allows for the incorporation of a third again as many additional types of data, should future experience indicate that it would be desirable to assemble and sort types of data not provided for in the first sixty-two columns.

Individuals making collections can well study the tables. This will give them a good idea of basic notes they should make regarding location and habitat.

Preparation of a worksheet for each specimen will permit the numerical coding of all data pertinent to that specimen. Two types of data present special problems deserving of further comment. There are an infinite number of possible intergradations between habitat types and an infinite number of possible developmental or phenological stages in the life of any one plant. For these two types of data, some arbitrary boundaries must be defined if the information is to be coded numerically. Tables III and

IV present the categories which will be used in the preparation of the Flora of the Genesee Country. In each case, the utilization of two columns on the IBM card permits discrimination of one hundred categories. Initially, only fifteen habitat types and twenty phenological stages will be utilized.

TABLE III. MAJOR HABITAT TYPES.

Code #	*Description*
00	Lake or stream: submerged aquatic.
01	Lake or stream: free floating aquatic.
02	Lake or stream: rooted-floating aquatic.
03	Lake or stream: at edge of or growing on rocks in.
04	Bog.
05	Bog margins.
06	Marsh, marshy areas, drainage ditch, pond margins.
07	Stream banks.
08	Near streams.
09	Pasture.
10	Deciduous woods.
11	Edge of woods or clearing in woods; wooded roadside.
12	Mixed-deciduous and evergreen woods.
13	Old fields and fence rows.
14	Roadsides and waste places.
15	Unclassified.

TABLE IV. PHENOLOGICAL AND DEVELOPMENTAL STAGES.

Code #	*Description*
00	Vegetative growth only, no reproduction.
01	Vegetative growth with asexual reproduction.
02	Male flowers immature.
03	Male flowers mature.
04	Female flowers immature.
05	Female flowers mature.
06	Bisexual flowers immature, in bud.
07	Bisexual flowers mature, at anthesis.
08	Bisexual flowers and immature fruit.
09	Bisexual flowers and mature fruit and/or seed.
10	Sporangia, immature only.
11	Sporangia mature, may be shedding spores.
12	Male cones immature.
13	Male cones mature.
14	Female cones immature.
15	Female cones mature.
16	Female cones open.
17	Male and female cones, both immature.
18	Male and female cones, one or other mature.
19	Male and female cones, one or other open.
20	Unclassified.

If future experience indicates this to be inadequate, additional types and stages can be easily incorporated. Furthermore, columns thirty-five through thirty-seven permit the numerical cataloguing of a thousand variations within each of the habitat types recognized. It is hoped that this will provide for the entire gamut of ecological diversification in the Genesee Country.

In analyzing the information, it will first be sorted according to families, genera, and species, using columns fourteen through twenty-two. If, at this stage, a systematic print-out is desired, a list of all the plants known to be growing in the Genesee Country can be readily produced. A second type of print-out would couple an x-y plotter with the cards of individual species. The x-y plotter reads columns twenty-seven through thirty and prints dots in a ten thousand square grid on a previously prepared map of the Genesee Country to give a print-out of the known geographical distribution of each species. A third type of print-out would provide a list of all known habitats in which each of the species grows. Additional options include county lists, flowering dates, and lists of the contributions of particular collectors. If one wants to know what grasses are in bloom in July along the shores of Lake Ontario, the information is there. The machinery produces no new information. It can only sort what it has been fed; hence, the need for a great many specimens.

Armed with a variety of print-outs and a familiarity with the plants and the area, the investigators should be in an enviable position for the preparation of a comprehensive, detailed, and definitive monograph. It is our hope that progress toward this end will provide additional impetus for many related studies by many people resulting in a total product that far exceeds the significance of the monograph itself.

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2. A Description of the Genesee Country

BABETTE B. COLEMAN[1] AND ELWOOD B. EHRLE[2]

ABSTRACT. The geological and physiographic history of the Genesee Country is described along with its climate, soils, waters, and vegetation.

GEOLOGICAL AND PHYSIOGRAPHIC HISTORY

The diversity of ecological niches available for plant invasion and community development has increased during the long geologic and vegetational history of the Genesee Country. Habitats varying in altitude, substratum, available moisture, amount of insulation, and biotic impact were produced as the region developed.

An early cycle of physiographic diversity was begun when the compacted Ordovician, Silurian, and Devonian seabottom sediments, which underlie the Genesee Country today, dipped to the south causing the development of a south-trending drainage system as the naturally ensuing cycle of erosion proceeded. Two subsequent uplifts have also affected the Genesee Country. First, the Appalachian revolution gently raised the Allegheny Plateau, the northern part of which forms the southern portion of the Genesee Country. Simultaneously, and with pronounced folding, this uplift created the Appalachian mountains to the south and southwest. The second uplift, gradual in nature, occurred in the Tertiary. At this time the surface of the great peneplane and its southerly pattern of drainage created by Mesozoic erosional forces, exposed east-west-trending beds of differentially resistant rock. This feature, in conjunction with the rejuvenated land surface, contributed, in the following cycle of erosion, to the development of east-west valleys of which the Ontarian River Valley was the dominant one for the Genesee Country. Drainage into the great valley of this river accounts for the birth of the north-flowing Genesee River and for the characteristic cuesta topography in the Genesee Country.

The Genesee River and its north-flowing, preglacial tributaries deepened their valleys southward and captured southerly streams as the divide between north and south drainages was lowered to the north. The north-facing escarpments of the cuestas in the Genesee Country were formed from the hard Niagara and Onondaga limestones. The Tully limestone, which shows a similar form eastward did not form outcrops in the Genesee Country. Further south, the discontinuous and irregular Portage escarpment, composed of durable sandstones of the late Devonian, formed the

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third cuesta front in the area. Gentle slopes resulted from erosion of the weaker sedimentary beds between the scarp faces.

More recently, continental glaciation, which made two major invasions of the Genesee Country (von Engeln, 1961) contributed greatly to the physiographic diversity of the region. The effects of the first Pleistocene ice sheet showed in its excavation activities (von Engeln, 1961). These modified the bed rock itself, deepened stream channels and produced steep, vertical valley walls. The second glacial advance fitted into the grooves created by the first (von Engeln, 1961). Its major contribution to the topography of the Genesee Country was the glacial till and stratified drift it deposited. This material formed the Valley Heads Moraine at the southern ends of the Finger Lakes and to their north the Hamburg-Batavia-Victor, the Mendon-Waterloo-Auburn and the Rochester-Albion moraines (Guidebook, University of Rochester, 1956). Profound changes in topography resulted as these deposits modified the courses of rivers and streams, dammed valleys producing lakes, and, in general, covered the land surface. Glaciation left a multitude of drumlins, eskers, kames, and kettles, especially in the northern lowland portion of the Genesee Country.

The most striking effects of glaciation in the Genesee Country occurred upon the river itself. Preglacially, at the end of the Tertiary, the Genesee emptied into the Ontarian River Valley, now occupied by Lake Ontario, by way of the deep valley of Irondequoit Bay. South of Mount Morris two tributary streams joined to form the main stream. The more easterly of these had its headwaters in the Canandaigua Lake area. The other rose in the high land of the Allegheny Plateau south of the present New York-Pennsylvania border. Broad, mature valleys characterized these streams. From their junction, the Genesee flowed north beyond Avon where its course was diverted eastward over the weak Salina shales and then north again. Postglacially, the main eastern tributary was blocked by the tremendous deposits of the Valley Heads Moraine; the south-rising tributary was forced by other deposits of the same moraine to carve a new, young valley through Devonian sandstones and shales from Portageville to Mount Morris. In the Portage Canyon the river drops 317 feet over three falls. The river valley is 500 feet deep through the Portage High Banks. Some miles further north it cut the Mount Morris Canyon before finding its preglacial valley. The latter valley is dramatically broad and flat with high but rounded, sloping walls (Guidebook, University of Rochester 1956). North of Avon the preglacial river valley was also blocked. This resulted in the carving of a new channel more directly north through the area that is now the city of Rochester. Here, the river cut the Rochester Canyon into middle and lower Silurian beds. Three falls, over resistant dolomite, limestone, and sandstone, break its descent as the Genesee River drops 229 feet through the Rochester Canyon to Lake Ontario.

The modern Genesee traverses a distance of more than one hundred miles from its source to its mouth. It descends from an elevation of nearly two thousand feet at its source on the Allegheny Plateau, to the surface of Lake Ontario, 246 feet above sea level. Some altitudinal, though not great latitudinal, range is provided throughout the river valley and its tributaries. The landscape displays lowlands and dissected plateaus; deeply incised young valleys and broad, mature valleys; steep scarp faces, and gently rolling hills; winding streams, waterfalls and cascades; sluggish streams, marshy meadows and swamp lands; and well-drained hilltops. These, with all intermediate conditions of topographic and drainage variation, afford a rich variety of habitat for biotic expression.

Physiographically classified, the southern portion of the Genesee Country, from the plateau margin north of the Finger Lakes to the Pennsylvania border, belongs to the glaciated Allegheny Plateau Section of the Appalachian Plateau Province. The northern portion, from the margin of the plateau to Lake Ontario, is included in the Great Lakes section of the Central Lowland Province (Fenneman, 1938; Hunt, 1966).

CLIMATE

The climate of the Genesee Country is classified as a humid continental climate (Critchfield, 1966). This class of climate is divided into a warm summer type known by some as the "oak-maple-hickory climate" lying to the south of the Genesee Country and a cool summer or "spring-wheat type" lying mostly to the north of the Genesee Country (Trewartha, 1954). The demarcation between the warm summer and cool summer types is better indicated by a wide zone between them than by a line on a map. The Genesee Country lies within this zone. Some years the area experiences cool summers and other years very warm summers. In winter, the differences are even more apparent for as Trewartha (1954) indicates, "In no other types of climate are rapid and marked non-periodic weather changes in winter so characteristic as in the humid continentals, for it is in these latitudes that the conflict between polar and tropical air masses reaches a maximum development". In any case, the region is exposed to rather severe changes in climate from season to season making annual averages of temperature and precipitation difficult to interpret.

In his discussion of the *Climate of New York State,* Mordoff (1949) describes some aspects of the variability of the climate in different portions of the Genesee Country. By studying his maps one sees for instance that the mean annual precipitation in the Genesee Country is 30-40 inches. The most significant departure from this is that most of Livingston County and the areas immediately bordering it on the east and west, receive less than 30 inches. Mean temperatures for selected months for most of the

Genesee Country are given as: January 20–25°, April 40–50°, July 65–75°, and October 45–55°. Mean minimum temperatures for these months are 10–20°, 30–40°, 55–65°, and 35–45° respectively. The mean maximum temperatures are given as 30–40°, 50–60°, 80–85°, and 55–65° respectively. In each case study of Mordoff's maps reveals considerable variability in these measurements in various portions of the Genesee Country.

The data presented in Table I represent averages derived from an analysis of the *Annual Summaries of Climatological Data for New York*

TABLE I. RANGES OF TEN YEAR AVERAGES OF CLIMATIC DATA FOR THE COUNTIES OF THE GENESEE COUNTRY.

(Extracted from Annual Summaries of Climatological Data for New York, 1958–1967).

County	*Average Temperature*	*Annual Precipitation*	*Frost Free Days*
Allegany	42.2–46.7	22.92–48.07	91–152
Genesee	46.0–48.8	22.36–51.64	113–181
Livingston	45.2–49.2	18.72–27.53	113–170
Monroe	46.5–48.8	19.99–35.8	121–175
Ontario	46.1–48.6	21.88–38.19	149–186
Orleans	46.7	30.89	149
Steuben	46.1–48.8	22.73–44.12	112–153
Wayne	46.0–48.8	28.70–42.86	113–168
Wyoming	42.9–46.4	31.96–46.33	78–152
Yates	47.6–50.3	23.57–34.54	123–186

issued by the U. S. Weather Bureau. Here, again, considerable variation is seen from county to county, with Livingston County stations recording the lowest annual precipitation in the Genesee Country.

Tables II to IV present data for six selected weather stations in the

TABLE II. TEMPERATURE EXTREMES.

(Extracted from Annual Summary of Climatological Data for New York, 1967).

Station	*County*	*Highest*	*Date*	*Lowest*	*Date*
Addison	Steuben	93	6–17	—14	2–13
Alfred	Allegany	89	6–16	—15	2–13
Batavia	Genesee	90	6–16	—11	2–13
Rochester	Monroe	91	6–16	—7	2–13
Dansville	Livingston	94	6–17	—8	2–13
Geneva	Ontario	92	6–17	—8	2–13

Genesee Country as extracted from the *Annual Summary of 1967*. Comparable data are available in the *Annual Summaries* for ten additional stations in the Genesee Country.

TABLE III. AVERAGE TEMPERATURES BY MONTHS.

(Extracted from Annual Summary of Climatological Data for New York, 1967).

Station	*County*	*J*	*F*	*M*	*A*	*M*	*J*	*J*	*A*	*S*	*O*	*N*	*D*	*Annual*
Addison	Steuben	31.0	21.2	31.6	45.2	48.3	69.4	67.9	66.4	58.9	49.5	33.8	30.0	46.1
Alfred	Allegany	28.3	19.7	30.4	44.4	46.8	67.0	65.4	63.2	56.0	48.0	32.7	28.8	44.2
Batavia	Genesee	29.9	21.3	32.1	47.1	49.1	70.4	69.2	66.2	59.4	51.6	35.1	31.4	46.8
Rochester	Monroe	31.1	21.4	32.5	46.4	49.1	70.4	69.4	67.6	60.4	52.1	36.3	32.3	47.4
Dansville	Livingston	31.6	21.2	31.2	45.5	48.7	69.7	69.1	67.0	58.9	50.7	36.5	32.1	46.9
Geneva	Ontario	31.0	20.6	31.2	45.4	49.6	69.9	69.3	67.7	60.5	50.5	36.4	31.1	46.9

TABLE IV. TOTAL PRECIPITATION BY MONTHS.

(Extracted from Annual Summary of Climatological Data for New York, 1967).

Station	*County*	*J*	*F*	*M*	*A*	*M*	*J*	*J*	*A*	*S*	*O*	*N*	*D*	*Annual*
Addison	Steuben	.83	1.09	3.54	3.14	4.08	5.12	4.37	5.01	2.81	3.38	2.88	1.77	38.02
Alfred	Allegany	1.31	3.06	2.90	3.31	3.85	2.56	4.12	5.15	5.36	4.07	3.51	2.26	41.46
Batavia	Genesee	1.47	.96	.81	2.16	3.66	1.72	1.78	3.42	6.49	5.37	2.24	1.59	31.67
Rochester	Monroe	.94	1.67	1.31	1.69	2.74	1.57	2.68	4.64	3.84	4.35	2.89	1.52	29.84
Dansville	Livingston	.43	1.24	1.45	2.97	3.07	1.94	4.24	2.56	4.99	3.08	2.20	1.06	29.23
Geneva	Ontario	.84	1.21	1.62	2.46	2.79	1.47	4.01	4.45	3.16	3.41	2.73	1.58	29.73

SOILS

Soil influences the invasion and establishment of plant species (Braun, 1959) and consequently plays a role in plant distribution. Pioneering and growth activities of plants change a substrate such as rock and initiate the development of soil. In the Genesee Country, outcropping limestones, sandstones, and shales of Devonian and Silurian origin have been subjected to such invasion. It is not this invasion, however, which produces the principal characteristics of the soils in the northern part of the Genesee Country. These soils have been most strongly affected by glaciation. In the Ontarian Plain Section of the Genesee Country, glacial deposits of various kinds cover much of the land surface. Till, outwash deltas, and varied lacustrine and glacial river deposits account for the youthfulness of the soils and for much of their variety.

Cline (1961) classified the soils and soil associates of New York State. He recognized five groups based on the parent material of the soil catena and selected characteristics of the best-drained member. All of these, represented at least by some member in the Genesee Country, are:

1. Soils on glacial till or frost-fractured material.
2. Soils on gravelly deposits of glacial outwash, beaches, and alluvial fans.
3. Soils on sands of deltas and beaches.
4. Soils on fine sorted material, mainly lacustrine but including loess and older alluvium.
5. Soils on recent alluvium. (Cline, 1961)

Parent material in the southern part of the Genesee Country varies from several types of limestone and dolomite to shales, siltstones, sandstones and mixtures of all of these. Their texture, acidity, lime-content, and drainage qualities show wide diversity.

Among the major types of well-drained soils several stages of development can be recognized: very young alluvial soils, brown forest soils, gray-brown podzolic soils, and acid brown earths and podzols with and without fragipan (Cline, 1961). The accompanying map (Figure 1) indicates the distribution and diversity of soils in the Genesee Country. A close inspection of this map will indicate that the northern (Ontarian Plain) section of the Genesee Country is dominated by glacial and alluvial soils, whereas the southern (Allegheny Plateau) section is dominated by soils developed from bedrock parent material.

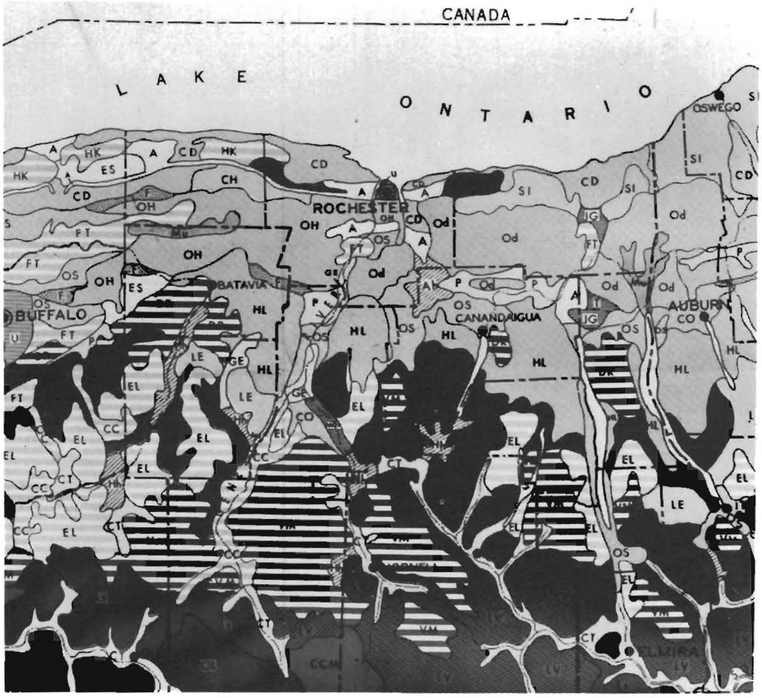

FIGURE 1. Soils of the Genesee Country. (Photographed from Soil Association Map of New York State compiled by M. G. Cline, Dept. of Agronomy, Cornell University, 1961). For key to map symbols, see below.

Key to Soil Map Symbols:

A, C, CCO, ES, JG, Ah	Areas dominated by coarse-textured soils on gravel and sand.
CO, HL, NA, Od, OH, HK, OR, F, NW, GS	Areas dominated by medium and moderately fine-textured high-lime soils on glacial till or by their shallow associates.
CT, GE, H, P, WH, Hh	Areas dominated by medium to moderately coarse-textured soils on gravel and recent alluvium.
LC, M, DR, Ds, L	Areas dominated by medium and moderately fine-textured medium and low-lime soils without fragipans on glacial till or by their shallow associates.
CH, LE, SI, EL	Areas dominated by medium-textured acid soils with neutral to slightly acid fragipans on glacial till.
BL, BC, VM, LV, Ls	Areas dominated by deep, medium to moderately coarse-textured acid soils with strongly acid fragipans on glacial till; from gray shale, sandstone, slate, or schist; or by shallow soils from similar rocks.
CCM, OL	Areas dominated by deep medium-textured acid soils with strongly acid fragipans on glacial till, from reddish sandstone and shale, or by shallow soils from similar rocks.
CD, OS, CC, FT, T	Areas dominated by medium to fine-textured soils on glacial lake or marine sediments.
Mu	Muck.

(Diagonal lines, horizontal bars, stippling, and shading indicate variations in drainage).

WATERS

The major aquatic features of the Genesee Country are the Genesee River and Lake Ontario, into which the Genesee flows. Its major tributaries, either east- or west-flowing for a portion of their course, include: Black Creek, rising in Genesee County; Oatka Creek, with headwaters in Wyoming County; Honeoye Creek, its source in several of von Engeln's "Finger Lakes west"; Conesus Lake outlet; the Canaseraga Creek; and numerous others to the south, with headwaters in Allegany and Steuben Counties. Honeoye, Canandaigua, Hemlock, Canadice, Conesus, and Silver Lakes are the "Finger Lakes west", the smaller members of the larger well-known Finger Lakes group.

Numerous small lakes, ponds, glacial lakes, and kettles are present in the area. Many of these are ringed by marshes and swamp forests which developed as these bodies of water were invaded and dominated by vegetation. Lake Ontario is bordered by many small streams, as well as by a series of spits, bays, and ponds. Some of the ponds resulted from modification of the lake shore. This culminated in the segregation and enclosure of small bodies of lake water by wave-built deposits.

VEGETATION

The lowland portion (Ontarian Plain) of the Genesee Country lies in the Beech-Maple Forest Region of the Deciduous Forest Formation (Braun, 1959). This forest developed postglacially on the youthful topography of the portions of the Genesee Country covered with glacial drift. The principal postglacial source of major species for this forest was the Mixed Mesophytic Forest which continued south of the glacial front since the Tertiary. A refugium of this forest, the Driftless Area of Wisconsin, was another probable source from which major species could recolonize glacially denuded areas (Braun, 1959).

The beech and sugar maple, dominant species in the Beech-Maple Forest Region, are found in other forest regions as well, but their dominance elsewhere is not as pronounced. The beech-maple forest has fewer canopy species than other forest climaxes and is relatively uniform. Along its margins, however, past and present migrations have permitted the infiltration of a number of species from adjacent regions. Within the Beech-Maple Forest Regions, the presence of numerous bogs suggests prior occupancy of the region by a northern conifer forest (Braun, 1959).

Quoting from Braun (1959) the Beech-Maple Forest Region is "a large area of flat, rolling country, diversified by occasionally fairly deep and youthful valleys in its marginal parts, where transitional forests occur; by sluggish streams controlled by glacial topography and bordered by swampy tracts, often extensive, and occupied by phases of swamp forest, of which the elm-ash-maple is most general; by more or less circular or irregular boggy depressions without outlet, occupied by bog communities, and usually remnants of northern coniferous forest vegetation; and by sandy and gravelly morainal and beach ridges and flats with their dry oak forest and prairie plants".

Several intensive investigations in the northern portion of the Genesee Country generally support Braun's concept of the Beech-Maple Forest. Shanks (1966), in his study of vegetation of Monroe County, reaches conclusions similar to those of Braun. He laments that the Beech-Maple Forest Region, as he saw it (1938–42), was mostly farm country. This region of New York State was one of the most productive agricultural areas of the United States. A louder cry to be heeded today is that this rich region is being given over to housing developments, commercial enterprises and highways.

Shanks' work makes it abundantly clear that diversity of vegetational development and cover, mark the Beech-Maple Forest Region. In Monroe County, he recognized a number of communities as original forest types in the vegetation of the county. They are beech-maple, hemlock-white pine-hardwoods, oak-chestnut-pine, upland oaks and oak hickory, swamp forest, bog forest, and marsh.

In Muenscher's (1946) study of a limited portion (the 2000 acres of Bergen-Byron Swamp) of the Ontarian Plain Section of the Genesee Country, ten vegetation zones or plant communities are delimited: birch-maple-elm forest, pine-hemlock forest, alder swamp, arbor-vitae swamp, open marl bog, secondary marl bog, *Sphagnum* bog, *Carex riparia* swamp, alluvial soil zone, and aquatic zone. Stewart and Merrell (1937), for the same area, recognized five: the open marl association, the secondary marl zone, the Sphagnum association, the pine-hemlock zone, and the beech-maple zone.

Goodwin (1943) emphasized the presence of diverse stages in the development of vegetation in his study of the Mendon Ponds area. This area is noted for its glacial topography of kames, eskers, and kettles. He categorized the plant communities as upland oak forest, beech-maple forest, oak openings, swamp forest, bogs, marsh, marsh meadow, and aquatic.

The Allegheny Plateau portion of the Genesee Country is quite well known to the authors and others from field observations, although the area has not been subjected to intensive study, Braun (1959) classified the vegetation here as the Allegheny Section of the Northern Appalachian Highland Division of the Hemlock-White Pine-Northern Hardwoods Region. She interpreted it as a separate formation from the Deciduous Forest and one "whose climax associations are still in a state of flux".

At present much of this area of the Genesee Country is being disturbed by human activity. Agriculture, lumbering, fire, and (along the New York-Pennsylvania line) oil pumping operations, have profoundly affected the flora. Various parts of the area have been subjected to natural gas explorations. Areas where these endeavors have been abandoned are naturally reforesting to second growth woodland in which sugar maple and white ash are conspicuous constituents. Some portions of the area have been, and are being reforested with plantings of conifers. Conspicuous among these are red and white pines, trees native to the area.

Braun points out that the development of the forest in this area, and throughout the whole extent of the Hemlock-White-Pine-Northern Hardwoods Region is a "mosaic of hardwood conifer and mixed communities". This mosaic has resulted from postglacial migrations. Expansions of the vegetation have come from the southern unglaciated portion of the plateau as well as from the northern Allegheny mountains. The usual primary deciduous communities contain (1) sugar maple, beech, and basswood, (2) sugar maple and beech, or (3) sugar maple and basswood. Yellow birch, white elm and red maple are often found with the above. Such forests are found on the slopes of the hills surrounding the "Finger Lakes west". Ridges and rims of the gorges of the Genesee River and its tributaries contain among their forest constituents red, white and pitch pine.

Streams, left in hanging valleys, have cut into the Devonian rock strata which formed the erosional surface of the area since the retreat of the ice. The young valleys of these streams are often east-west in direction. Their gorges, frequently with waterfalls and sharp drops, are characterized by the development of hemlock-hardwood communities. Excellent examples of this forest type are found in some of the deeper gorges. Better drained areas on higher ground are occupied by upland oak and oak-hickory associations. At one time chestnut was conspicuous in these areas but it has been destroyed by disease. Locally, the woodlands are interrupted by marsh and swamp vegetation. Marsh, marsh-meadow, alder, elm-ash, or red maple swamps are features of the lake outlets and inlets. Bogs in some areas show characteristic muskeg conifers, such as larch and black spruce. In other swamps, balsam fir can be found along with more usual swamp constituents. Thus, the vegetational diversity in the dissected Allegheny Plateau section of the Genesee Country continues to evolve.

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3. A Pollen Profile from Kennedy's Bog in Mendon Ponds Park

DONALD YEAGER

ACKNOWLEDGMENTS

Whenever one undertakes to study a specific problem, the work always seems to progress more easily if the load can be distributed amongst others. This study was no exception. More than a few people have made their contributions and the author is grateful to each of them. The unsung heroes are Roy Ketchum and C. David White, who under the supervision of Dr. Babette Brown Coleman, made the borings and extracted the cores. I can only repeat Potzger's description of sampling . . . "it is hot, hard, and dirty work." And I sympathize. Many, many thanks.

To George Hamell, my personal thanks for the tedious, repeated slide preparations in the laboratory.

To my wife, Sylvia, must go credit for grammatical corrections and typing. Who ever has enough thanks for this job?

To the Rochester Academy of Science for underwriting the isotope dating, which was done at the Yale Radiocarbon Laboratory.

Particularly I am grateful to Dr. Babette Coleman of the University of Rochester Biology Department for sponsoring this work and for the time and effort spent in directing and supervising this study.

INTRODUCTION

Since 1939 only five pollen analytical studies have been carried out and published in New York State. Most of these were in the eastern and central part of the state. The present study adds one more pollen profile to the record. Before refining the postglacial patterns of vegetation for the entire state, many additional cores in western New York must be analyzed.

The author's interest in postglacial vegetational history was aroused by related problems. In the course of preparing interpretive natural history exhibits for the Mendon Ponds Visitor Center, it was necessary to ascertain the correct habitat for mastodon and prehistoric beaver. There was only one way to find out—to turn to pollen analysis and prepare a profile of one of the bogs existing in the park. Since the core used had already been extracted, and the author was currently involved in making pollen identifications for the Allergy Clinic at Strong Memorial Hospital, the time was ripe for plotting another pollen profile, from western New York State.

Thus the present study developed and the results are presented herewith.

HISTORICAL BACKGROUND

Historical Development of Pollen Analysis

Marcell Malpighi and Nehemiah Grew were the founders of microscopic anatomy. Although Grew lived in England and Malpighi in Italy they observed and described pollen grains almost simultaneously. Each was quite familiar with the work of the other and they even exchanged material freely. Today we regard them as the co-founders of the science of pollen-grain morphology.

It was not until 1694 that Rudolph Camerarius, at the botanical garden of Tubigen, finally discovered the real purpose of pollen. He removed the male flowers of *Ricinus* and discovered the plant under these conditions produced no seeds. He concluded that seed formation could not take place without the aid of pollen to prepare the flowers.

In the years that followed many learned men continued to observe pollen. They studied the particles, described them, theorized and published. Probably Carl Fischer can be considered the founder of pollen grain morphology as we know it today. In 1889 he published his classic work on pollen identification.

As early as 1836 fossil pollen was observed in peaty sediments (Brown, 1960). It is stated with certainty that these microfossils were observed and identified in peat in the year 1885 (Flint, 1957).

At the University of Stockholm the value of pollen analysis was finally shown to the world. Professor G. Lagerheim and Dr. L. von Post, in 1916, published the first paper using pollen profiles and percentages in connection with a study on Swedish bogs. Now pollen analysis is firmly established and universally accepted as a valuable scientific tool.

It fell to another native of Sweden to apply further and extend the already existing knowledge of pollen analysis. His name is Gunnar Erdtman and few will doubt that he is a major contributor to the field. The term "palynology" was coined by Hyde and Williams (Faegri, 1956). An inclusive term, it covers all work with pollen grains and spores whether fossiliferous or modern. Today we refer to people involved in pollen analysis as "palynologists." According to the latest census, in 1958, there were over 500 registered workers in the field (Brown, 1960).

Some Findings and Generalizations from Pollen Studies in the United States

Though many pollen profiles are available for study, thoroughness and adequacy of techniques and results vary. Not every pollen histogram represents a complete analysis of its station. Many kinds of pollen are not considered important to the scope of all studies and are therefore lumped together or omitted. Not all palynologists have used the same methods in calculating percentages or what they represent. Some profiles represent a much longer period of time than others. Equivalent depths at which the pollen is found do not necessarily mean equivalent periods of time; nor do depth intervals always match time intervals.

Certain pollens are over-represented and others are under-represented in a core. For instance, pine is generally over-represented because the staminate cones produce an abundance of pollen; while beech is generally under-represented as its flowers produce only small quantities of pollen. (McCulloch, 1939.)

The following are arranged in order of decreasing pollen production: *Pinus, Corylus, Alnus, Betula, Carpinus, Abies, Picea, Fagus, Quercus, Tilia, Acer.* (Modified after Faegri and Iversen, 1964).

There are some general areas of agreement within palynological circles, however. Pollen profiles are regional. In postglacial times there have been three main climatic phases as were first described by von Post (1946). Sears (1931), Potter (1947), Deevey (1943) and others have gone further and proposed that there is a correlation between genera and type of climate (Cox, 1959):

Abies and *Picea* . . wet, cold

Pinus . . . . dry, cool; warmer than preceding

Tsuga . . . . moist, cool to warm (Hemlock is more an indicator of moisture than of temperature.)

Fagus . . . . moist, warm (Beech may be taken to indicate a drier degree of mesophytism than hemlock.)

Quercus . . . . warm (As an indicator of moisture this genus is less reliable than as an indicator of warmth. Usually, it is taken to indicate the drier side of mesophytism.)

Another generalization is that the climatic shift that came with glacial retreat was of greater magnitude than anything that has occurred since. Also the shift from fir-spruce-pine to hemlock-hardwood is always clearly marked and occurs between the first and middle third of the pollen profile (Cox, 1959).

A further generalization is that a "xerothermic" period (maximum warmth and dryness) was reached some time ago and that "climatic deterioration" (a period of decreasing warmth) has been taking place for some time. In pollen profiles the xerothermic period is characterized by a maximum of oak and lesser broad-leaved species like hickory. However, even this varies with local species. Climatic deterioration is characterized by a return of spruce, especially in northern stations in the United States.

Certain basic assumptions of palynologists (as stated by Cox, 1959) are essential for interpreting the results of pollen profiles. (1) Climatic factors that have determined plant distribution in the past are the same as those that affect plant distribution today. (2) The factors responsible for plant succession in the past are the same as those that cause it today. It is generally accepted that succession is ordinarily toward greater mesophytism. Consequently, vegetational changes other than those toward greater mesophytism, if they cover a broad area, may be interpreted to indicate climatic fluctuation.

Recently (Davis, 1965) it has been pointed out that a number of factors contribute to the inaccurate interpretation of pollen profiles. Pollen percentages for species do not mean that an equivalent percentage of tree species were actually present in the forest during pollen deposition. Davis also points out that changes in pollen profiles thought to have been influenced by climate might actually represent changes brought about by European man. One might go further and suggest that the Archaic Indian participated in the alteration of vegetation through controlled burning.

Summary of Pollen Studies in New York State

There have been five papers dealing with pollen analysis in New York State. McCulloch (1939) worked on Sandy Ridge Bog in Central New York State. Deevey (1943) did work at Queechy Lake on the southeastern border of the state. Sheldon (1952) analyzed seven bogs within a 30-mile radius of Syracuse, New York, and Cox (1959) studied 12 bogs extending from Albany to Auburn in an east-west direction and from Ogdensburg to Oneonta in a north-south range. The fifth paper is referred to at the end of this section.

It is interesting to compare pollen profiles of Sandy Ridge Bog where both Sheldon and McCulloch worked. McCulloch and Sheldon report different gymnosperm counts in the lower levels (Cox, 1959). McCulloch found *Abies* in quantities greater than 50 percent, and *Picea* appeared in the lowest level at 29 percent. Sheldon on the other hand reports *Abies,* less than 30 percent and *Picea* at 48 percent. They do, however, agree on this early spruce-fir period though their percentages differ.

It appears that Deevey's stations at Queechy Lake are truncated at the bottom and do not give a complete record although from the pine period to the surface his profile is complete.

Cox's (1959) work is important to the discussion of this paper because it represents pollen profiles closest to the area of the present study. The 12 bogs he worked on have been divided into two natural groups: those having two distinct *Tsuga* maxima in the profile and located south of latitude 43° 30′; and those not showing two *Tsuga* maxima and located north of this latitude.

The profiles south of the above latitude show *Picea, Abies,* and *Pinus* in rather uniform sequence during the first period of the profile. Next there is a period of *Pinus* dominance which gives way to hemlock-hardwoods. This era continues to the present. However, it is marked by three distinct phases. The first phase, after the decline of *Pinus,* consists of a rise of *Tsuga, Fagus, Quercus* and other broad-leaved genera. The next phase of the hemlock-hardwood interval shows a sudden decrease in *Tsuga* with an increase of *Fagus.* The last phase shows *Tsuga* returning to a position of prominence (Cox, 1959).

Cox recorded pine pollen size-frequencies in some stations he sampled. In these profiles the "small-pollen" pine occurs most abundantly in the lowest levels. Later during the pine period it is replaced by a "large-pollen" pine. Cox has interpreted this as a replacement of *Pinus banksiana* by either *Pinus strobus* and/or *Pinus resinosa.* Since the genus is usually over-represented, it is dubious whether designation of species is important. Furthermore, size variations could be induced by laboratory preparations.

A note of interest is that he records the lack of a xerothermic period in his profiles from the two northern stations in the 12 bog survey. The surface layers in these unusual profiles do show a return of *Picea* and *Abies* which would in other cases, if the xerothermic period existed, indicate climatic deterioration. However, in these profiles one wonders climatic deterioration from what? Certainly not a departure from a period of maximum warmth and dry conditions. In these northern stations it might be best to regard the return of *Picea* and *Abies* in the surface layers as merely a return of *Picea* and *Abies.*

Other investigators, Sheldon (1952), Deevey and McCulloch, agree in showing a hemlock minimum associated with an increase in oak and pine. This is their xerothermic period. However it must be admitted that of Sheldon's 6 stations the above condition is discernible in only two instances.

From Cox's (1959) profiles it is seen that *Tsuga* is the chief indicator for the hemlock-hardwood section of the pollen record in New York State. It increases as pine decreases. McCulloch (1939), Deevey (1943), Sheldon (1952) and Cox (1959) all found a sudden drop in *Tsuga* in the upper third of their profiles, with a return of this genus to a period of dominance near the top of the profile. Cox (1959) reports 9 bogs having double *Tsuga* maxima. *Tsuga* has a tendency to reach two maxima in other nearby areas such as New England, New Jersey and Quebec. This is substantiated by Deevey (1943), Krauss and Kent (1944), Niering (1953) and Potzger and Otto (1943) and again by Potzger in that order. LaSalle's (1966) study of Lake Hertel shows *Tsuga* reaching maxima three times.

In almost all pollen profiles for New York State, there is a fir-spruce-pine interval in the lowest levels followed by a pine maximum which decreases to *Tsuga* and hardwoods. This is generally true of surrounding regions too. During the early and late phases of the *Tsuga*-hardwood interval, *Fagus* seems to be the dominant hardwood in New York State. There is much regional variation in other areas as to the hardwood which accompanies hemlock in this interval. In New York State in the middle phase of the *Tsuga*-hardwood interval, there is a characteristic decrease in *Tsuga* and a rise in *Fagus* (Cox, 1959). This is true in at least 7 of Cox's profiles.

The second *Tsuga* maximum in the New York State pollen history apparently can be accounted for as the result of a climatic trend toward cooler and more mesophytic conditions.

Between the initial preparation of this manuscript and publication, Cox and Lewis (1965) have published another pollen study conducted at Crusoe Lake near Savannah, New York. Essentially there is not much difference in the pollen profile except that they report a very high percentage of *Tsuga* (38%) at its maximum. Non-arboreal pollen is recorded which was not shown in Cox's earlier study of twelve bogs. Both the Crusoe Lake (Cox and Lewis, 1965) and Bullhead Pond (Cox, 1959) studies are important to this paper since they are in adjacent counties.

THE NEED FOR WORK IN THE AREA

Western New York State is virgin territory with respect to pollen analysis. Cox and Sheldon seem to have done rather representative sampling in eastern and central New York, but apparently no one has concentrated on western New York.

Many of the bogs in this area are currently under some type of management, either by wilderness preservation groups or local park departments. Bergen Swamp and Zurich Mud Pond are largely owned by the Bergen Swamp Preservation Society Incorporated. Kennedy's Bog as well as 10 other bogs or boggy areas are in Mendon Ponds Park, which is under management by the Monroe County Parks Department.

These, of course, are only a few bogs in western New York. Others like Ellenberg Bog near Buffalo, New York, and Diver's Lake and Burma Woods Bog near Brockport, New York, would be prime targets for pollen analysts.

Even if analysis of cores cannot be accomplished immediately, sampling of these bogs should be accomplished soon and the results stored until such time as pollen analysts can work on them.

It is imperative that studies of this nature be undertaken with haste, for there are many dangers assailing them from real estate and highway developments to water use and peat industries.

Scope and Limitations of the Present Study

This paper represents the results of the analysis of pollen in a single core from one bog. Alone, the pollen profile from this bog is of little value. Yet, the percentage histograms can be reliable indicators of general climatic and ecological change if compared with those from other areas.

The ultimate goal, of course, is to have samples from various bogs in an area and several samples from each bog. When studied, a series of completed profiles for a specific region would result, thus affording a picture of past vegetation and perhaps correlated climate for the region.

The percentage profile from this study becomes significant when compared and contrasted with other pollen profiles from the State as a basis for establishing vegetational and climatic sequences for the area. It represents the first core studied in western New York State.

It is the hope that this study may stimulate others to search for the vegetational records in other bogs of western New York State not yet subjected to pollen analysis, so that the complete picture of past vegetation and climate may be drawn.

Location, Description and Zonation of Kennedy's Bog

Kennedy's Bog is located in the lower half of the Mendon Ponds, N. Y. Quadrangle, 7.5 minute series at latitude 43° 2′ 20″ North and longitude 77° 34′ West (Figure 1).

It lies in the north-west part of Mendon Ponds Park about 16 miles southeast of the center of Rochester, New York, in Monroe County (Figure 2).

At various times it has been known as the "Cranberry Bog" and "Kinter's Bog". The latter name apparently came from the Kinter family, who once lived on the west side of Clover Street opposite the current residence of Olin Mathews in the town of Pittsford, New York. There is a Jane Kinter buried in the Quaker Cemetery in the town of Mendon. It is commonly agreed by local residents that she resided in the above-mentioned Kinter residence.

The author has been unable to discover the origin of the current name "Kennedy's Bog". Because this name is known amongst local amateur botanists in the Rochester area, it is surmised that the bog has received its current name from one of these people named Kennedy.

The bog probably was once an undrained kettle-hole of glacial origin. It is about five acres in area. It is bounded on the north by the steep slopes of an esker and on the south by kame deposits (Fairchild, 1926). Both of these features are glacial. The nearby upland is heavily wooded with oak and hickory. Surrounding the bog is a moat-like wet zone with a

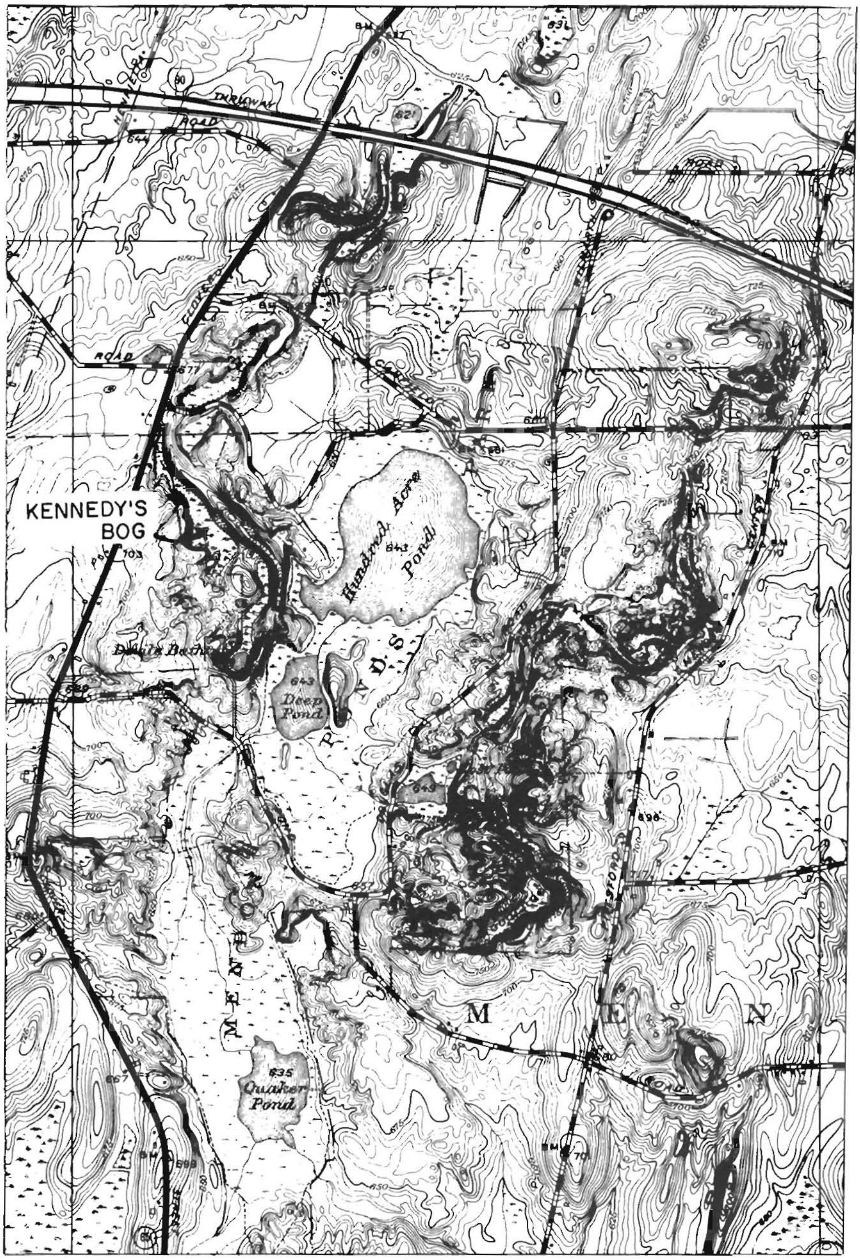
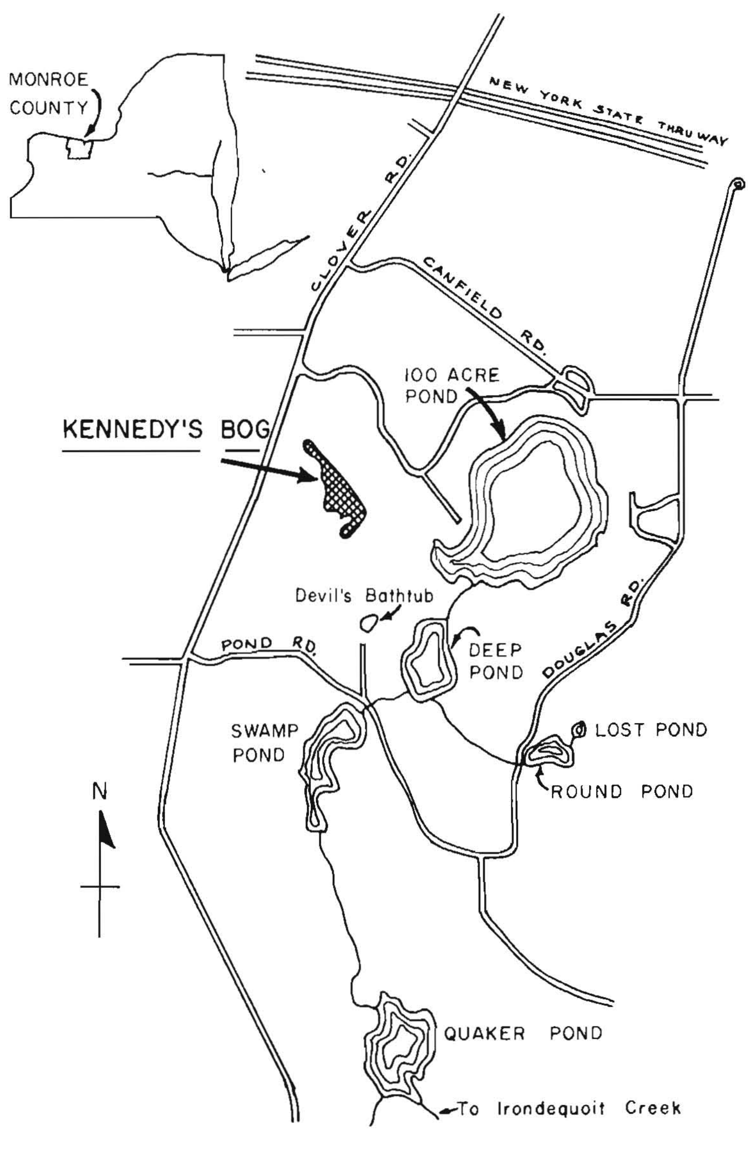


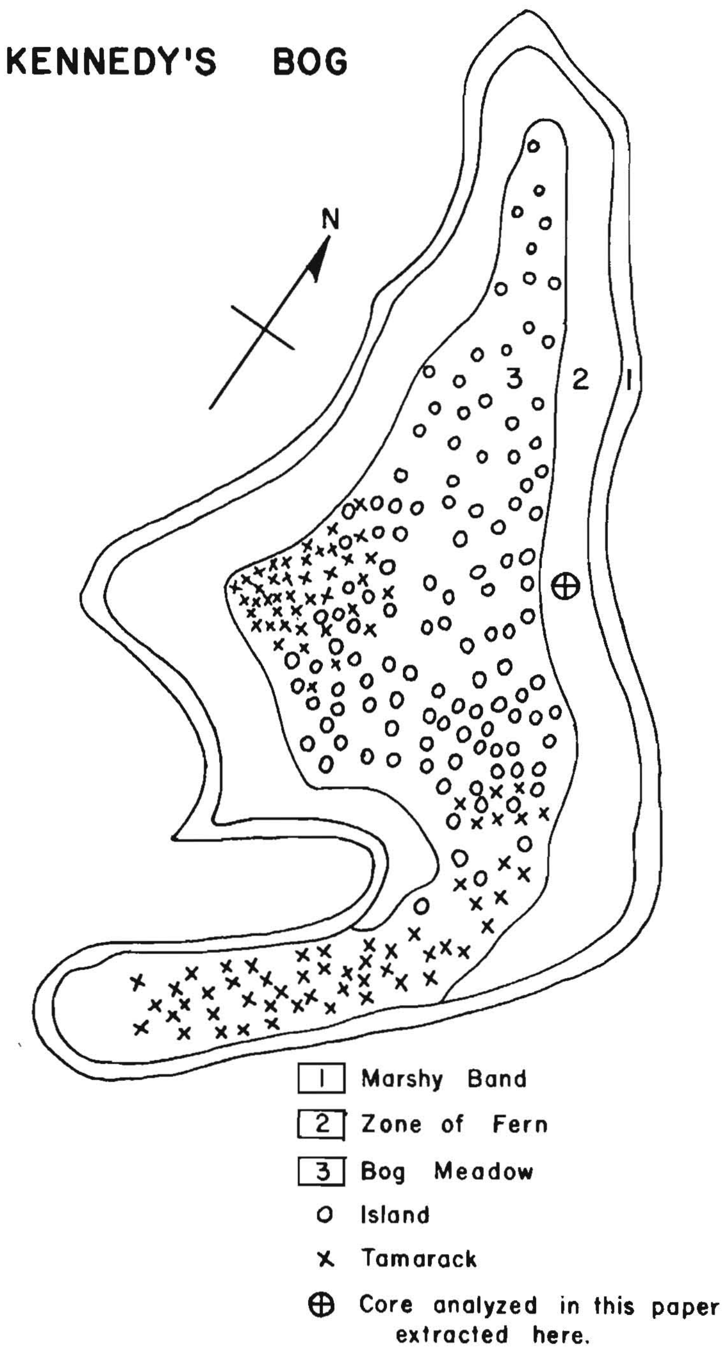
FIGURE 1. Part of Mendon Ponds, New York 7.5′ sheet.

foot or more of standing water during the wet season. Elsewhere the margin of the bog is filled with dense growth of tall shrubs. Beyond this marginal zone lies the bog proper, commonly called the "open bog"

(Goodwin, 1943). The next zone consists of an almost complete band of *Woodwardia virginica*. The fern is accompanied by many of the typical components of the bog meadow such as *Sphagnum*, sedges, and *Chamaedaphne*. The inner bog meadow contains many vegetational islands (Figure 3). The typical island has at its center one or more tamarack trees. Immediately around the trees occurs a ring of shrubs composed principally

MENDON PONDS PARK





(from James, 1935)

of *Vaccinium corymbosum, Gaylussacia baccata* and *Pyrus arbutifolia. Picea mariana* is frequently associated with these and may occur in the center of the island with the tamarack. Generally the shrubs decrease in size towards the outside of the islands. The well-defined islands attain their most typical development near the center of the bog. There are areas in the bog where tamarack and spruce are more vigorous and attain larger size. The vegetation islands are more irregular and less well defined in these areas. It would appear that these two areas are more advanced and have dried out to a greater degree than the other portions of the bog (James, 1935).

PROCEDURE OF THE INVESTIGATION

Field Sampling

Five borings were made with a Davis peat sampler during the summer of 1962. The first four borings were the deepest. One of these produced a depth of 31 feet. The stratification in three of the borings began with alternations of fine and coarse sand at the lowest level. Throughout the remainder of the strata were pockets of water, silt and some peat. The fourth boring consisted of compact clay and fine silt at the lower levels with water and peat in the middle and at the top. A complete core was not recovered until the fifth boring.

The fifth boring was made north and east of the central bog meadow in the band of *Woodwardia virginica* (Figure 3). Maximum depth was 15½ feet. It seems reasonable to conclude that maximum depth of the bog was not reached in this boring in view of the depth of the earlier borings. From 15½ feet up to 13 feet the core contained a mixture of fine, sandy silt embedded in peat. From 13 feet to the top of the core, the contents were entirely peat.

The samples were pushed out of the borer chamber into glass vials without being exposed to the air, thereby avoiding contamination with other current pollens in the air. They were tightly corked and each vial was marked with a carborundum pencil at the collecting site.

Laboratory Preparation

Numerous techniques for pollen preparation are described in Brown's *Palynological Techniques*. Modifications of these technique descriptions are constantly being made in pollen analysis.

In a discussion with Gooding (July, 1965) it was learned that he and Kapp had used modifications and combinations of techniques, described by Brown, during analysis in the Whitewater Basin vegetational studies (1962), the Wells Mastodon Site (1964) and the Sunbeam Prairie Bog

Site (1964). An important consideration is to have professional laboratory technicians carefully control and standardize whatever process is used.

Cox (1959) used both the KOH centrifuging technique as well as a simple and time-saving distilled water process as described under process #3 which follows. He claims the results were just as satisfactory with the latter method as the former. The author agrees. It would seem that the most important consideration is to find the technique that gives the best results and suits the individual identifying and counting the pollen.

For the pollen analysis of the Kennedy's Bog core, two hundred twenty slides were prepared. Three techniques were used and are described later in this section. Only 32 slides were used for final study, although more than one hundred slides were examined. These supplementary slide examinations were carried out to determine if one technique of preparation was better than another. To illustrate, three slides from one specific level, each prepared differently, were examined to determine which of the three pollen-preparation processes rendered the pollen in best physical condition, quantity, and most adequately stained.

At the 14½ foot level, where a reasonable amount of gymnosperm pollen should have been encountered, a total of twelve pollen grains were discovered, only two of them gymnospermous. To be certain that poor slide preparation techniques were not responsible, six additional preparations involving two slides each for the three techniques were made from the same core sample. This was done three times with a final total of 18 slides representing the 14½ foot level. Of the 18 slides, only one reported 12 pollen grains, while the remaining 17 all contained fewer than 12.

A Bausch and Lomb Dynoptic microscope with calibrated mechanical stage was used to make the pollen counts and identifications. A 100 power scanning objective and a 430 power close-up objective were used. Counts of 150 tree pollens were made at intervals of 6 inches in the core. In some instances a paucity of pollen grains forced lower counts. The count from each level was made from a single slide. The slide was examined by a series of controlled sweeps with the mechanical stage. Two types of unidentified pollen grains were not recorded. The first type were grains that were collapsed and/or deteriorated beyond recognition. The other were grains apparently in good condition but not recognizable due to lack of clear, definite morphological characteristics. In this instance coordinates on the mechanical stage were recorded so that critical identifications could be made under oil immersion.

In the case of fragmented pine and spruce pollens, breakage ratios were computed according to Martin (1958) as follows. The number of broken pieces (wings and bodies) were divided by three times the number of unbroken grains present plus the number of broken pieces. Breakage ratios were higher in the lower part of the core sample. Pine pollen sizes were not recorded.

Pollen Preparation Processes

1. A small pea-sized sample was removed from the interior of the core with a clean forceps. It was placed in a clean test tube with 15 cc. of 5% KOH. The sample was broken up with a clean glass stirring rod. The mixture was boiled for 15 minutes. Two slides were prepared from the sample. One from the top part of the concentrate before the sediment had settled and another from the sediment. A drop of the concentrate was put on a clean slide. Then a drop of warm glycerine jelly was added which had been prestained with Calberla's solution (5 ml. glycerine, 10 ml. 95% alcohol, 15 ml. distilled water, 2 or 3 drops saturated aqueous solution basic fuchsin). Both drops were thoroughly mixed with a teasing needle and a cover glass was applied. The slide was then inverted until the preparation was dry.

2. A small pea-sized sample was removed from the interior of the core with a clean forceps. It was placed in a clean test tube filled $\frac{1}{3}$ with 95% alcohol. This was stirred with a camel's hair brush and then boiled until $\frac{2}{3}$ of the alcohol had evaporated. Calberla's stain was added during the boiling process. A drop of the concentrate was spread on the center of a slide and the evaporation of the alcohol drew the pollen away from the debris. A drop of warm glycerine jelly was added and the cover glass put in place. The slide was inverted until dry.

3. A tiny amount of peat was removed with a clean forceps from the interior of the core sample and placed on a clean glass slide. A drop of distilled water was added and mixed thoroughly with the peat by using a teasing needle. Several drops of warm glycerine jelly prestained with Calberla's solution were added and the cover glass put in place. The slide was not inverted during the cooling process. A simple modification of this technique works just as well. Mix the specimen of peat directly with the stain eliminating the distilled water. Add warm glycerine jelly, mix again, add cover glass and let cool.

Of the three techniques described above, the author found that #3 best suited his purposes. More pollen seemed to be available for counting and it was in better condition than it appeared in processes #1 and #2.

It is quite possible that some pollen was lost in processes #1 and #2 due to the fine droplets of KOH or alcohol sputtering off into the air during the boiling process. Experimentation was tried in techniques #1 and #2 by boiling the concentrate in beakers as well as test tubes to eliminate sputtering of the concentrate. The results appeared to be no different.

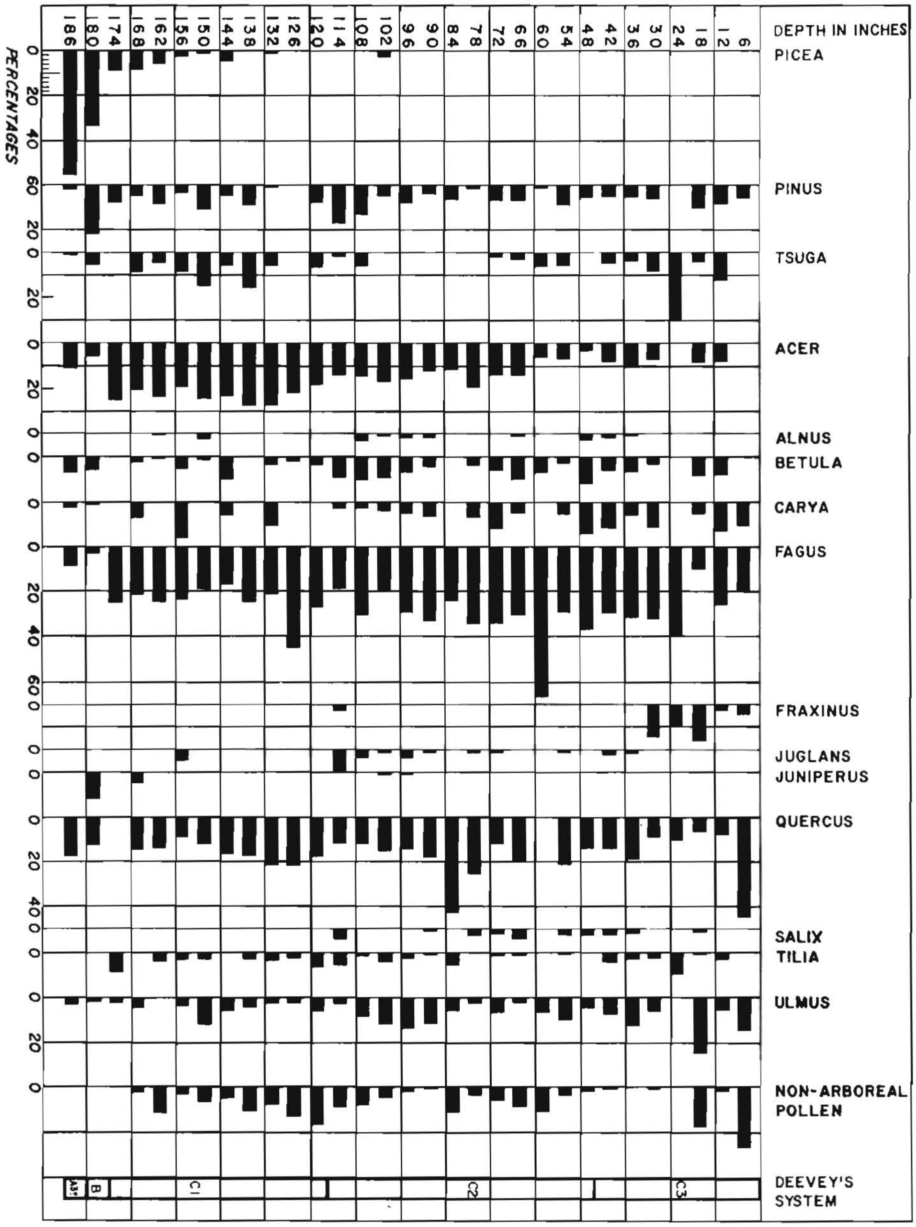


FIGURE 4. Pollen profile, Kennedy's Bog.

DISCUSSION

In discussing the results of the pollen analysis of Kennedy's Bog, it seems important to compare the pollen profile with Deevey's (1943) southern New England work and Cox's (1959) eastern and central New York work.

Deevey has used a system of symbols by which pollen sequence periods are indicated. The major divisions are spruce-fir, pine and deciduous forest zones. They are represented by A, B, and C, respectively, and numerals indicate subdivisions where necessary. A-1 is a spruce-fir period, allowing for over-representation of pine. A-2 contains a secondary spruce maximum. B is the pine period. C-1 is characterized by hemlock-oak, C-2 by a hickory maximum, C-3 by another rise in hemlock and a hardwood—depending upon locality, and sometimes spruce, but with a decline of hickory and oak. The climatic interpretation of these periods looks like this:

C-3 moister and/or cooler
C-2 warm, dry
C-1 warm, moist
B warmer, dry
A-2 cooler (last glacial advance?)
A-1 cool

The author believes that Kennedy's Bog (Figure 4) shows a questionable A-3 period at the 15½ foot level.

It is characterized by an abundance of spruce with fir missing. There is apparently no over-representation of pine. As a matter of fact, the entire histogram for pine does not seem to indicate an over-representation of pine anywhere. Since there is some obvious telescoping here at this level, the A and B periods are conjectural on the pollen profile. The B period is found at the 15–14½ foot level. This should be the pine period and is characterized by the pine maximum in the histogram and is accompanied by oak. The C-1 period is characterized by hemlock-oak and lies between the 14½ and 9½ foot levels. Of real interest is the beech-maple association between these levels. This will be discussed later. C-2 is characterized by a beech, hickory and oak maximum with a decline in hemlock. This obviously is the xerothermic period and is noticeable between the 9½ and 4 foot level. The remainder of the profile is the C-3 period. Near the surface, hemlock builds to a maximum again. Beech, after maintaining dominance throughout the thermal maximum, decreases at the surface as do *Acer* and *Betula*. The absence of spruce is conspicuous.

The Kennedy's Bog pollen profile probably resembles Cox's Mud Lake, Tully, N. Y. profile more than any other thus far studied (Cox, 1959). There are the usual two hemlock maxima and a long xerothermic interval. Beech is of special interest because it shows a minimum at the same time hemlock reaches a minimum. This situation is true of Cox's profile. Like the Mud Lake profile beech appears in a series of increases and decreases throughout the profile and is the most abundant species. *Acer* is some-what abundant in the Mud Lake profile. In this respect the profiles are similar because *Acer*, too, is abundant in the Kennedy's Bog profile.

This brings us to the *Acer* histogram. The Kennedy's Bog profile shows a remarkably large amount of *Acer* pollen as compared with other hardwoods in the same profile. Nowhere do Deevey's many profiles for New England and adjacent areas show this concentration of *Acer* pollen, nor does McCulloch's profile of Sandy Ridge Bog show an abundance of this pollen. In only one profile, Mud Lake (Jordanville, N. Y.) does Cox show an *Acer* histogram indicating this species to represent 20% of the total tree pollen. It does not exceed this percent in any of his other profiles. Yet the Kennedy's Bog histogram for this species shows a maximum of 28% at the 11 and 11.5 foot levels. Actually the preponderance of *Acer* pollen is in the C-1 period and gradually decreases as the upper levels are reached. One exception is a sudden rise at the peak of the xerothermic period.

In the Kennedy's Bog area of New York State, *Fagus* appears to be an indicator of drying brought about by a rise in temperature. This would seem evident from the preponderance of *Fagus* pollen throughout the pollen profile as opposed to the quantity of *Quercus* pollen. Cox (1959) finds more *Fagus* pollen than *Quercus* pollen in the bogs he studied. Sheldon's profiles show the same evidence; however, neither investigator has attached any significance to this data. The author would like to suggest that *Fagus* is the important indicator of drying brought about by a rise in temperature rather than *Quercus*, at least in central and western New York State. Nevertheless *Fagus*, *Quercus* and *Carya* associated should be studied as a unit for indications of warm-drying conditions.

Interpretation

During the Wisconsin glacial period, a small lobe-like portion of southwestern New York State near Salamanca, New York, was left unglaciated. The unglaciated Allegheny Plateau and Allegheny Mountains undoubtedly were vegetation refugia during the Pleistocene (Braun, 1950). It is probable that at least a part of this area was continuously occupied during Wisconsin time by forest vegetation. The lobe in S. W. New York State was apparently an important plant migration re-entry area. From it, forest types moved northward, after the ice retreated, and spread out laterally over the once-glaciated land. The forest type occupying this lobe during Wisconsin time was probably a sort of Hemlock-White Pine-Northern Hardwoods Forest. After the initial migration, the Beech-Maple association developed as a result of migration from the south. It was derived from the Mixed-Mesophytic association by separation of climax dominants which were able to advance more rapidly onto the area of latest glaciation. In mesophytism, the Beech-Maple association is comparable to its progenitor the Mixed-Mesophytic forest. Both seem to develop readily on recently de-glaciated land and immature soils (Braun, 1950). The Beech-Maple association will progress beyond its climax stage given enough time and favorable topographic conditions.

The pollen profile for Kennedy's Bog seems to show this sequence. *Acer, Fagus* and *Quercus* are the most strongly represented of the hardwoods after the demise of the Pine Period. The migration of the Beech-Maple association by way of the unglaciated refugia-lobe is indicated by the increase of beech and maple pollens in the period beginning at the 14½ foot level, oak at the same level being less preponderant. Then there follows a gradual but steady rise in the beech and maple histograms suggesting the development of the Beech-Maple climax. As maple begins to decline slightly, oak gradually increases, for a short period only. Oak declines again, then steadily rises, along with hickory, during the xerothermic period. Later, beech comes on strong again and maple remains steady. This probably represents the Beech-Maple climax forest as we understand its structure today. The strong topographic relief of the Kennedy's Bog area might indicate less alteration by ancient and European man, thus giving us a stronger position to base the previous interpretation upon.

If the Davis and Goodlett (1960) pollen-percentage correction theory, used at Brownington Pond, is applied, the actual vegetation pattern may be different. These authors sampled not only sediment from Brownington Pond, but also sampled pollen from the surface. They compared corrected percentages of pollen from the surface with a census of the actual forest present in the vicinity of the pond. Pollen and species percentages were equal. The correction factors were based on pollen productivity of the species represented, pollen transport distances, degree of preservation in matrix and local variations in species distribution as well as frequency of present vegetation.

Therefore, it is possible that oak was not as heavily represented at the Kennedy's Bog area as the histogram for this species seems to indicate. On the other hand, maple and beech were probably more heavily represented.

It appears then that, at the Kennedy's Bog area, a beech-maple association existed for a rather long period both before and after the xerothermic period. Furthermore this association seems to have been established at a relatively early period after the demise of the Pine Period.

RADIO-CARBON DATING ANALYSIS

Carbon 14 dating was determined from peat at the 15 foot and 5½ foot levels. These levels were selected, first to establish the age of the B period and the age of what appears to be the most classic part of the xerothermic period. The 15 foot sample also dates the deepest salvageable peat available for dating.

The 15 foot (Y-2623) sample dates at 6940 ± 120 years B.P. The $5\frac{1}{2}$ foot (Y-2622) sample dates at 2830 ± 160 years B.P. These dates seem to be rather consistent with other published Radiocarbon Dates from Pollen Sequences of Northeastern United States, Table #2, Davis (1965). Peat samples provided for dating came from the original core.

SUMMARY

Pollen analysis of Kennedy's Bog in Mendon Ponds Park represents a first attempt to describe postglacial vegetation from records in western New York State.

The profile from this bog is similar to profiles from other New York State bogs inasmuch as it shows an early period of *Picea-Pinus* (although *Abies* is missing). This is followed by a period of *Pinus* dominance which gradually gives way to a hemlock-hardwood interval. The hemlock-hardwood period continues to the present though at one period the profile shows hemlock disappearing entirely. The hemlock-hardwood period contains three phases: the first phase, following the decline of pine is characterized by a rise of *Tsuga* accompanied by *Fagus, Quercus* and other broad-leaved genera; the middle phase of the hemlock-hardwood period is marked by the disappearance of *Tsuga* and rise in *Fagus* and *Carya;* the last phase shows a return of *Tsuga* to prominance.

Throughout the entire profile *Acer* is abundant and *Fagus* shows a series of increases and decreases.

In western New York State the xerothermic period is marked by a rise in the association of *Fagus, Quercus* and *Carya* with a decrease of *Tsuga.*

It is surmised that an abundance of *Acer* pollen should be expected to occur in other western New York State bogs. This might be explained by the proximity of the refugia re-entrant lobe extending into the Salamanca, N. Y. area. The further the bog station from this re-entrant lobe, the less *Acer* pollen would be expected to occur.

The amount of non-arboreal pollen (NAP) in the histogram is relatively small compared with the large amounts of arboreal pollen. However it is interesting to note the inexplicable and steady rise of NAP beginning at the 12 foot level and reaching a maximum at the 10 foot level. If the pollen frequency chart (Illus. #5) is consulted one sees that the family accounting for the bulk of NAP is the Cyperaceae. The major tree species, *Acer, Fagus* and *Quercus* show a decline which is associated with the decline of Cyperaceae. Since there is a slight but definite rise in *Pinus* at the same time, this could be interpreted as a climatic shift to cooler

weather just before the beginning of the xerothermic period.* Since the rise of *Quercus* during the xerothermic period is slight, and is probably over-represented anyhow, there is every reason to believe that there was little variation in the type of forest, in the Kennedy's Bog area, during the long xerothermic interval. The data indicate that a Beech-Maple association existed from the close of the Pine Period to very recent time. By coincidence this agrees with Braun's (1950) forest-type association map for the area under discussion. More important, is the agreement with Shank's (1966) ecological survey of the vegetation of Monroe County which indicates very extensive Beech-Maple coverage of the area.

DEPTH IN INCHES	PICEA	PINUS	TSUGA	JUNIPERUS	ACER	ALNUS	BETULA	CARYA	FAGUS	FRAXINUS	JUGLANS	QUERCUS	SALIX	TILIA	ULMUS	TOTAL ARBOREAL POLLEN	COMPOSITAE	ERICACEAE	NYMPHAEACEAE	TYPHACEAE	CHENOPODIACEAE	LYCOPODIACEAE	CYPERACEAE	RANUNCULACEAE	TOTAL NON-ARBOREAL POLLEN
6		1						2	4	1		9			3	20	6	1	1						8
12		7	10		7		6	12	22	3		7		4	5	83		1	1						2
18		5	2		5		5	3	9	10		4	1	1	15	60	10	2	2						14
24			3						4	1		1		1		10									
30		5	6		6		3	9	26	12		7		2	5	81			1						1
36		5	2		11	1	7	6	34		1	20	2	4	14	107	1								1
42		8	8		13	3	10	18	48		3	24		9	13	162	1	1							2
48		2			1	1	4	5	13			5	1		3	35	1								1
54		18	10		11		5	9	48		2	35	5	2	17	162	3		3	1					7
60		1	1		1		1		10						1	15		1			1				2
66		4	2		10	1	6	3	18			12	3	1	1	61	4	1	1						6
72		11	4		22	1	10	19	55		2	19	3	3	12	161	1	7	1						9
78		1			14		3	5	24		1	18	2		2	70		1	1			1			3
84		1			2				4			7		1	1	16							2		2
90		4			12	2	4	7	30		1	16	1	1	11	89	1								1
96	1	10		2	25	3	10	8	45		6	21		5	20	156		2	1						3
102	4	8	9	2	26	3	14	7	31		3	29		8	19	158		4	4						8
108		16	1		20	5	13	4	40	1	5	16		3	10	134		2	5				4		11
114		22	3		18	1	12	4	25	3	11	15	3	8	4	129	1	7					5		13
120		8	8		23	4	5		32		1	21	1	9	8	120	3	1					16		20
126		1	1		29	1	3		58			28		3	4	128	10						6	1	17
132	2	3	7		44	2	6	16	32			32		6	5	155	2	1					10		13
138	1	13	22		42	1	1		37			26		4	8	155			1				16		17
144	9	7	9		37		15	10	28			26		1	15	157		2	2	2			3		9
150	3	13	19		35	4	2		25			16		4	16	137		1	5				4		10
156	5	4	15	1	30		8	23	36		7	13		4	6	152	2	1					1		4
162	9	11	7		30	1	1		31			17		5	16	128	1	8					6		15
168	12	8	14	8	32		5	11	32			23		1	8	154		1					4		5
174	1	1			3				3					1	3	12									
180	42	27	7	15	7		6	1	4			15			3	127							1		1
186	91	4	3		18		11	5	13			28			6	168									

* Perhaps fire was responsible.

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4. The Genus Lycopodium in Livingston County, New York

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ABSTRACT. The flora of Livingston County, New York was examined to determine the frequency and distribution of the genus Lycopodium. Five species and two varieties were collected. Of 71 stations visited, Lycopodium species were found at 16.

INTRODUCTION

Livingston County is located in western New York State and covers an area of approximately 638 square miles (County and City Data Book, 1962). Of the 44,053 inhabitants of this county, 12.5 percent of the population are residents of rural farms (County and City Data Book, 1962). The agricultural industry comprises 288,196 acres of the 408,320 acres in the county, for a total of seventy-one percent of the available land area (Census of Agriculture, 1959).

The northern portion of the county differs from the southern section in many ways. The land decreases in elevation and becomes flatter and less rolling as one moves toward the north, resulting in an increase in the proportion devoted to agriculture. Consequently, the northern landscape is quite open; the wooded areas are scattered and small in comparison to the more rugged terrain and heavily wooded regions in the southern sector of the county.

The types of wooded areas vary considerably from the northern to the southern portions of the county. To the north the woods are almost exclusively dominated by deciduous trees and tend to be quite heavily undergrown, especially along their outer perimeters. Toward the south, the wooded areas contain mixtures of coniferous and deciduous trees with several sectors of hemlock-maple-beech woods. Many of these are rather moist and richly populated with mosses, ferns, and other plants which inhabit environments similar to those favorable for the genus *Lycopodium.*

Livingston County is in the center of the ten-county region known as the Genesee Country. This region includes the valley and drainage basin of the Genesee River. According to Braun (1959), the lowland portion of this drainage basin, which would include the northern section of Livingston County, lies in the Beech-Maple Forest Region of the Deciduous Forest Formation. Although beech and sugar maple are found in other regions of the Deciduous Forest Formation, they are not found in as great abundance as here.

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In contrast, the upland area in the southern portion of Livingston County is probably best described as part of what Braun (1959) classifies as the Hemlock-White Pine-Northern Hardwoods Region. This area is striking in the amount of variation present in its vegetational communities. Much of this diversity is a result of lumbering and agriculture. Fire is probably also responsible for some of the differences in composition. Among the several varied but characteristic woodlands present in the southern part of the county are: (1) hemlock woods in cooler regions at higher elevations and along many of the north-facing slopes of the numerous ravines, (2) white and red pine stands and scattered trees along ravine walls, and (3) oak-hickory and former oak-chestnut groves in the more well-drained upland regions between ravines.

MATERIALS AND METHODS

Collection stations were chosen from topographic maps and from previous field experience in the area. Each station visited was recorded on a map of Livingston County. Identical maps were kept to show the distribution of all species and varieties of *Lycopodium* collected. Whether or not *Lycopsida* were found, the environments present in all places visited were described in a field journal. A total of 71 stations were visited and described. *Lycopodium* species were found at 16 of these stations.

Herbarium sheets[1] of *Lycopsida* collected in the Northeastern United States were studied and distribution maps were prepared. Some 150 sheets of 11 different species were used for reference in identification and in locating probable habitats for collection. The collections of the genus *Lycopodium* made during this study are on file in the Herbarium of the State University College at Geneseo, New York. A duplicate set has been prepared for the Herbarium of the Rochester Academy of Science, presently housed by the Monroe County Parks Department in Rochester, New York.

RESULTS

Fernald (1950) describes 13 species and several varieties of *Lycopodium* for the Northeastern United States. Of these, seven, *L. porophilium, L. selago, L. carolinianum, L. alopecuroides, L. inundatum, L. sabinaefolium,* and *L. alpinum* would not be expected to be found in western New York State. The habitats of some of these are confined to coastal plains, swamps, and bogs, and others are characteristic only in cold woods of higher altitude or higher latitude. Five of the remaining six species were collected in Livingston County. These are *L. lucidulum, L. annotinum, L.*

1. The authors wish to thank Mr. Robert Clark and Mr. Bernard Harkness for their cooperation in making available the collections of the Monroe County Parks Department and Rochester Academy of Science Herbaria.

clavatum, L. obscurum, and *L. complanatum. L. tristachyum* remains to be found in the county. This species may be better adapted to colder woods than those found in Livingston County.

Two species, *L. obscurum* and *L. lucidulum,* were found to have the most widespread occurrence in Livingston County. All five species were collected in the southern half of the county. No species of *Lycopodium* were found in Livingston County north of Lakeville, New York. The species found in the most abundance, but confined more or less to the southeast corner of the county, was *L. complanatum.* The entire area of Hunt Hill Road and Pardee Hollow Road southeast of Tabors Corners, New York, showed particularly heavy populations of this species. At one collection site, Reynolds Gully, on the southeast side of Hemlock Lake, all five species were found in abundance. Here they occur in one large mixed community. In other areas, only *L. lucidulum* and *L. obscurum* were found in mixed communities. In agreement with the findings of this study, distribution maps prepared from herbarium sheets also showed *L. obscurum, L. complanatum,* and *L. lucidulum* to be the most abundant Lycopsid species in western New York.

The habitats of all species collected could be generally described as moist peaty soil in cool open woods. The habitats in which Lycopsids were most frequently found were north-facing slopes, above ravines in moist woods, and in the cooler, shaded regions in woods of higher elevations. Furthermore, a greater proportion of the collections were made in hemlock than deciduous woods.

CATALOGUE OF THE LYCOPSIDA OF LIVINGSTON COUNTY, NEW YORK

LYCOPODIUM L.

1. **L. lucidulum** Michx.—Common. Moist, peaty, hemlock-maple woods; among moist leaves and mosses in open woods; on rotting stumps, along tree bases, and on the edge of mossy rocks. Collection numbers[1] 3, 8, 15, 18, 22, 27, 32, 33, 35, 37.

2. **L. clavatum** L.—Infrequent. Moist, peaty, hemlock-maple woods with four other species of *Lycopodium;* and in a rich portion of an open hemlock-hickory-maple woods. Collection numbers 12, 28.

3. **L. annotinum** L. var. **acrifolium** Fern.—Infrequent. Moist, peaty, hemlock woods with other species of *Lycopodium.* Collection numbers 11, 13, 21.

4. **L. obscurum** L.—Common. Moist, peaty, hemlock woods among

1. All collection numbers are those of the senior author.

ferns, mosses, and fallen leaves. Collection numbers 4, 5, 6, 7, 20, 26, 31, 34, 36.

var. **dendroideum** (Michx.) D. C. Eat.—Infrequent. Moist, peaty, hemlock-maple woods; and in rich open mixed deciduous woods among ferns and mosses. Collection numbers 10, 14, 19.

5. **L. complanatum** L. var. **flabelliforme** Fern.—Common. Moist, peaty, hemlock-maple woods; open mixed deciduous woods; wooded slopes, ravines and small gullies; clearings in pine woods. Collection numbers 1, 2, 9, 16, 17, 23, 24, 25, 29.

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5. The Spring Flowering Plants of Letchworth State Park

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ABSTRACT. Letchworth State Park and the distribution of its plants is described. A compilation of the flowering plants found in the park during the Spring of 1967 is presented. 46 families, 116 genera, and 150 species were collected, identified, and catalogued. The ecology and distribution of each species is briefly described.

INTRODUCTION

This paper presents the results of a survey of the spring flowering plants of Letchworth State Park. The park was chosen for investigation since it provided a nearby and relatively undisturbed sample of the Northeastern Deciduous Forest. The survey is based on the herbaceous flowering plants blooming during the spring, excluding the grasses and sedges.

Previous botanical efforts in the park include a study of the woody plants conducted by George V. Nash of the New York Botanical Garden in 1907. His work resulted in the labeling of the more representative trees along the paths and drives (G. W. Howe, 1948).

In 1912, at William Pryor Letchworth's request, an arboretum was initiated in the vicinity of the park office and maintenance buildings. It consists of a collection of the world's timber trees likely to thrive in this climate. The arboretum was started as an educational and experimental endeavor (Short and Dake, 1942). It was to fulfill this dual role by testing the value of various tree species and also to serve as a living illustration of the processes of development.

The most recent contribution to the knowledge of the flora of the park consists of a study of the trees and shrubs by Dr. Crystal L. Rork in 1947. The herbarium which resulted from this study is located in the park museum (Short and Dake, 1942).

All the botanical studies undertaken, excluding the present one, have concentrated on the southern end of the park. The property comprising the northern end of the park was acquired after the earlier studies were completed.

The Genesee Parks Commission, which has been most cooperative during this study,[3] is interested in ascertaining which herbaceous plants bloom in the park during the spring, not only as a matter of record, but

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3. The cooperation of Mr. F. W. Short of the Genesee State Parks Commission is most gratefully acknowledged.

also to facilitate the development of the park as an educational and recreational area for the public.

Letchworth State Park is located in the Genesee Region of New York State, 35 miles south of Rochester and 55 miles east of Buffalo (see Fig. 1). Entrances to the park are near the towns bordering the park, each of which is accessible through numerous routes. New York State highways 39 and 245 provide means of reaching one or more of the park's five entrances.

The Genesee River, after which this region is named, is the boundary separating Livingston and Wyoming Counties. Since the river also divides the park into east and west sections, the park property lies in

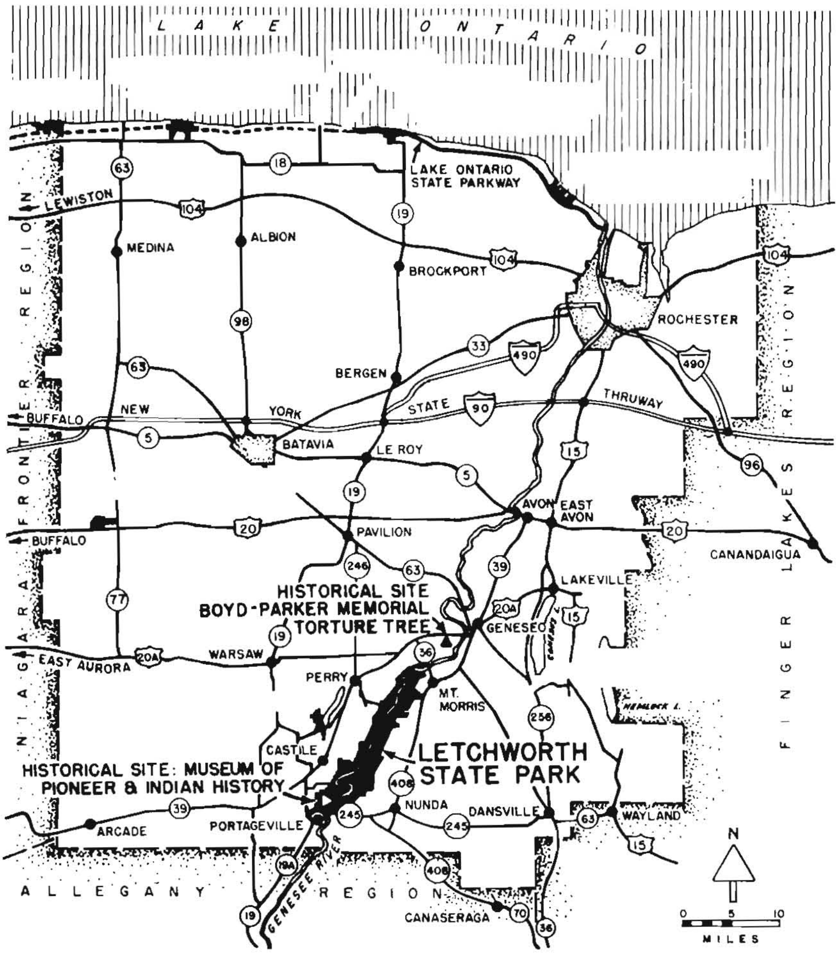

FIGURE 1. A roadmap of the Genesee Region, the northwestern portion of the Genesee Country, showing the location of Letchworth State Park (Reprinted by permission).

both counties. The shape of the park is long and narrow, its major axis extending from the northeast to the southwest. It consists of 22.4 square miles of land. The Genesee River travels 18 miles in its course through the park.

"The Genesee River is an obsequent stream which cuts northward across the inclined beds of the Devonian rocks of the area and in its lower course, the entire Silurian section. Due to the southerly dip of the rocks, each of the several formations exposed is largely or wholly accessible for study, at some point at least, in the eighteen miles of gorge and open valley between Mount Morris and Portageville". (G. W. Howe, 1948). The most outstanding features of the park are its three magnificent falls and the deep gorge through which the river flows. At places the canyon walls rise five hundred feet above the river to the woodlands above.

Among the various conditions affecting the flora, it appears that rainfall, temperature and soils have been most significant. Rainfall is fairly evenly distributed throughout the year. The mean annual precipitation for Wyoming County is 27.96" (Yearbook of Agriculture, 1941). Temperature variations characterize the annual seasonal changes. The recorded data for Letchworth State Park (Yearbook of Agriculture, 1941) indicate an average January temperature of 25.2° F., an average July temperature of 69.1° F. The growing season averages 141 days in length with the average dates for the last killing frost in the spring being May 14 and the first killing frost in the fall being October 2. Additional climatic data for the Genesee Country is given in the second paper in this series. Soils in the area of Letchworth State Park have been strongly affected by erosion since glaciation and by the rugged topography characterizing the area. The Park is dominated by medium to fine-textured soil produced by fragmentation and erosion of the shale and sandstone cliffs, slopes, and banks present throughout the park.

The vegetation of the park is characteristic of the Temperate Deciduous Forest area. The dominant association is Maple-Beech-Hemlock, and the secondary one is Oak-Hickory. Both of these communities include Birch, Basswood, Tulip Tree, Willow, and Elm in various places.

The appearance of the vegetation in various parts of the park reflects the history of land acquisition for the park. The land comprising the northern end of the park has been recently acquired. This land was previously farmed, but as the individual lots were acquired by the park, landscaping to complement the natural processes was undertaken. The southern end of the park has been under protective care since the original 1,000 acres were acquired by William Pryor Letchworth. This property includes about three miles of land bordering the Genesee River on either side and just north of Portageville, N. Y., thereby containing the three falls. After the donation of Mr. Letchworth's land to the state, more property was obtained, mainly from farmers, expanding the original 1,000 acres to the more than 14,340 acres that comprise the present park.

MATERIALS AND METHODS

A preliminary study of the area was undertaken using topographic maps

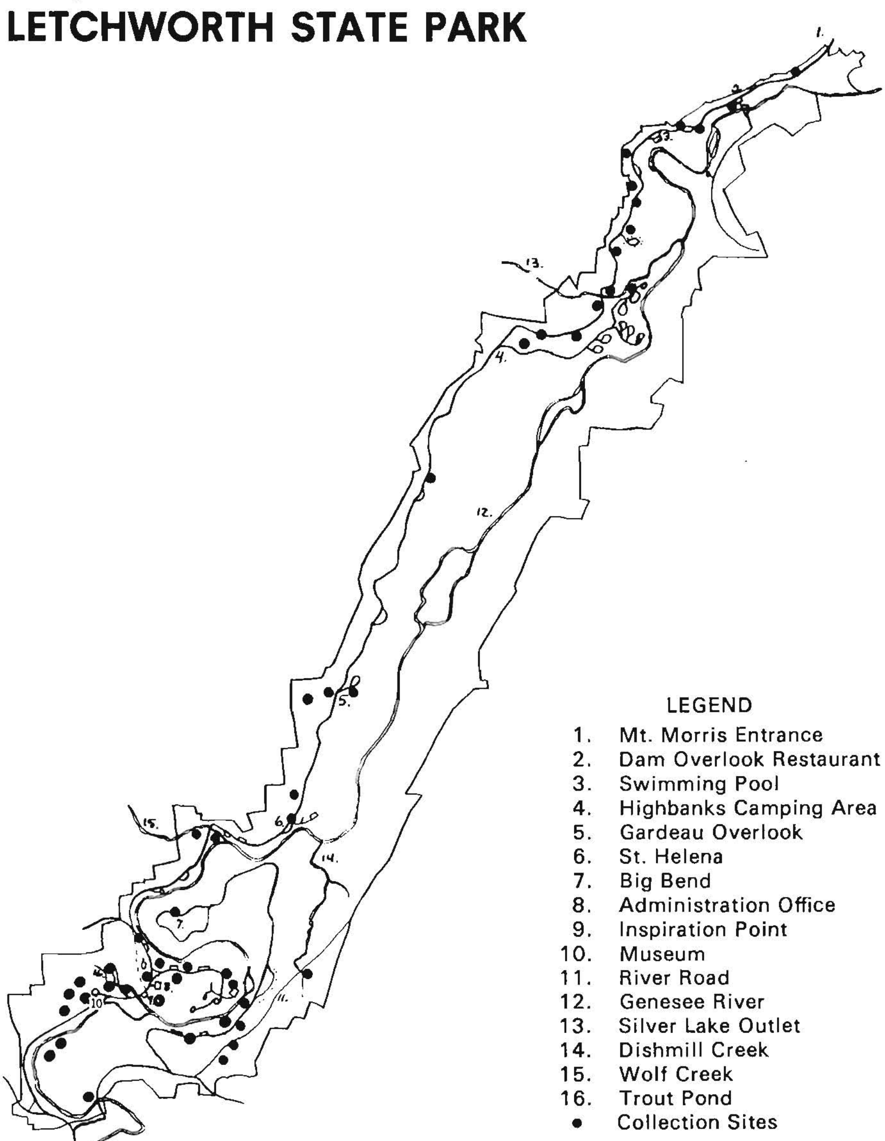

FIGURE 2. Map showing the locations of collection sites (Base-map reprinted by permission).

and aerial photographs as well as property and outline maps supplied by the park. Perusal of the area by car provided orientation, familiarity with the terrain, and considerable help in selecting future collecting sites.

Collection sites were chosen so that the various ecological habitats present in the park would be covered throughout the spring blooming period. Representative areas frequented by tourists were given preference, but not to the exclusion of a thorough examination of more remote areas.

During the spring months of April through June, 1967, approximately 1,150 miles were traveled while collecting the spring flora of the park. Sixty-one collection sites (see Fig. 2) were visited yielding 262 specimens. A complete set is filed in the documentation center of the "Flora of the Genesee Country" project at the Herbarium of the Biology Department, State University College at Geneseo, N. Y. Wherever possible, duplicates were prepared for the Herbarium of the Rochester Academy of Science, presently housed by the Monroe County Parks Department in Rochester, N. Y. To eliminate wasteful expenditure of time and avoid acquisition of unnecessary specimens, species already collected at several locations were recorded as being observed at the site rather than being collected again.

Data recorded in the field were integrated with that produced by the examination of specimens and the resulting information transferred to herbarium labels and species maps. The habitats in which the plants were growing were listed and described on the backs of the maps. These maps, and the ecological data recorded on them, formed the primary resource for the development of the catalogue which follows.

CATALOGUE OF THE SPRING FLOWERING PLANTS OF LETCHWORTH STATE PARK

The nomenclature and taxonomic sequence used below is based on that of Fernald (1950). Each catalogue entry includes specific epithet, author citation(s), common name, frequency estimate, habitat, and the collection numbers of P. A. Miller. The frequency estimates are based on the number of locations at which a species was seen as well as on prior knowledge of the species present in the park. They are not intended to imply frequency estimates for the same species in other portions of the Genesee Country.

TYPHACEAE (CAT-TAIL FAMILY)

Typha latifolia L. Common Cat-tail—Frequent. Bog near Portageville, N. Y. 227.

SPARGANIACEAE (BUR-REED FAMILY)

Sparganium americanum Nutt. Bur-reed—Rare. Bog near Portageville, N. Y. 228.

ALISMATACEAE (WATER-PLANTAIN FAMILY)

Alisma subcordatum Raf. Common Water-Plantain—Rare. Stream bed near Silver Lake Outlet.

ARACEAE (ARUM FAMILY)

Arisaema triphyllum (L.) Schott. Jack-in-the-pulpit—Common. Damp slopes, wooded stream banks, and wooded areas throughout the park. 38, 70, 119.

Symplocarpus foetidus (L.) Nutt. Skunk-cabbage—Common. Wet wooded areas. 34.

JUNCACEAE (RUSH FAMILY)

Luzula acuminata Raf. Woodrush—Frequent. Wooded areas, especially in the southern part of the park. 7, 57.

Luzula campestris (L.) DC. Field Woodrush—Rare. Damp forest bordering a bog near Portageville, N. Y. 219.

LILIACEAE (LILY FAMILY)

Veratrum viride Ait. White Hellebore—Rare. Damp forest bordering a bog near Portageville, N. Y. 224.

Allium vineale L. Field-Garlic—Common. Wet stream banks, roadsides, and open woods. 211.

Hemerocallis fulva L. Common Day-Lily—Infrequent. Edge of wooded areas near Big Bend. 209.

Erythronium americanum Ker. Trout-Lily—Common. Throughout wooded portions of the park. 26, 43.

Smilacina racemosa (L.) Desf. False Solomon's-seal—Abundant. Moist woods and cleared slopes throughout the park. 80.

Maianthemum canadense Desf. Wild Lily-of-the-valley—Common. Moist wooded areas and cleared slopes, mainly in the southern end of the park. 110.

Polygonatum pubescens (Willd.) Pursh. Solomon's-seal—Infrequent. Wooded areas near Wolf Creek. 81.

Trillium grandiflorum (Michx.) Salisb. Large-flowered Trillium—Common. Wooded areas throughout the park. 16, 49, 50.

Smilax herbacea L. Jacob's ladder—Rare. Slopes at Gardeau Overlook. 89.

AMARYLLIDACEAE (AMARYLLIS FAMILY)

Narcissus pseudo-narcissus L. Daffodil—Infrequent. Escaped from cultivation at several places in the park. 11.

IRIDACEAE (IRIS FAMILY)

Sisyrinchium montanum Greene. Blue-eyed Grass—Rare. Banks of Trout Pond. 108.

Iris versicolor L. Blue Flag—Rare. Bog near Portageville, N. Y. 230.

ORCHIDACEAE (ORCHIS FAMILY)

Cypripedium calceolus L. Lady's-slipper—Rare. Rich woods at Big Bend. 194.

Spiranthes lucida (H. H. Eat.) Ames. Ladies'-tresses—Rare. Damp banks of Trout Pond. 107.

SANTALACEAE (SANDALWOOD FAMILY)

Comandra umbellata (L.) Nutt. Bastard-Toadflax—Rare. Thickets. 87.

ARISTOLOCHIACEAE (BIRTHWORT FAMILY)

Asarum canadense L. Wild Ginger—Frequent. Wooded slopes. 21.

POLYGONACEAE (BUCKWHEAT FAMILY)

Rumex acetosella L. Sheep-Sorrel—Frequent. Roadside grass and wooded areas scattered throughout the park. 91, 125, 143, 222.

Rumex crispus L. Yellow Dock—Infrequent. Waste areas at both ends of the park. 144, 247a.

PORTULACACEAE (PURSLANE FAMILY)

Claytonia virginica L. Spring-beauty—Infrequent. Rich woods.

CARYOPHYLLACEAE (PINK FAMILY)

Arenaria serphyllifolia L. Thyme-leaved Sandwort—Rare. Open areas near cabin area "E". 129.

Cerastium vulgatum L. Common Mouse-ear Chickweed—Frequent. Damp grassy areas throughout the park. 35, 74.

Lychnis alba Mill. White Campion—Infrequent. Roadsides and waste places. 98.

Silene cucubalus Wibel. Bladder-Campion—Infrequent. Roadsides, waste places, and open woods. 204.

Saponaria officinalis L. Bouncing-Bet—Infrequent. Roadsides, waste places, and open woods. 250.

Dianthus armeria L. Deptford Pink—Infrequent. Roadsides and open wooded areas. 205, 249.

RANUNCULACEAE (CROWFOOT FAMILY)

Ranunculus arbortivus L. Kidneyleaf-Buttercup—Abundant. Wooded areas and cleared slopes throughout the park. 46, 60.

Ranunculus acris L. Common Buttercup—Abundant. Roadsides, waste places, and wooded areas throughout the park. 83, 102, 159.

Thalictrum dioicum L. Quicksilver-weed—Frequent. Stream banks and moist slopes, mainly in the southern end of the park. 15, 58, 69.

Thalictrum polygamum Muhl. Muskrat-weed—Infrequent. Stream banks and moist wooded areas. 170, 176, 212.

Anemonella thalictroides (L.) Spach. Rue-Anemone—Frequent. Wooded areas throughout the park.

Hepatica acutiloba DC. Sharplobe Hepatica—Frequent. Slopes and stream banks in the southern portion of the park.

Hepatica americana (DC.) Ker. Roundlobe Hepatica—Common. Slopes and wooded areas throughout the park. 12.

Anemone quinquefolia L. Wood-Anemone—Infrequent. Wooded slopes bordering streams. 25.

Anemone virginiana L. Thimbleweed—Infrequent. Stream banks and cleared areas. 184, 213.

Caltha palustris L. Marsh-Marigold—Infrequent. Wet areas. 63.

Aquilegia canadensis L. Wild Columbine—Infrequent. Slopes and moist wooded areas. 78.

Cimicifuga racemosa (L.) Nutt. Black Snakeroot—Infrequent. Wooded areas. 253.

Actaea pachypoda Ell. White Baneberry—Infrequent. Rich woods.

Actaea rubra (Ait.) Willd. Red Baneberry—Infrequent. Rich woods.

BERBERIDACEAE (BARBERRY FAMILY)

Podophyllum peltatum L. May-Apple—Abundant. Wooded areas throughout the park. 120.

Caulophyllum thalictroides (L.) Michx. Papoose-Root—Frequent. Wooded areas, particularly in the southern end of the park. 23.

PAPAVERACEAE (POPPY FAMILY)

Sanguinaria canadensis L. Bloodroot—Abundant. Stream banks and wooded areas. Scattered throughout the park. 44.

Dicentra cucullaria (L.) Bernh. Dutchman's-breeches—Infrequent. Rich moist woods.

CRUCIFERAE (MUSTARD FAMILY)

Lepidium campestre (L.) R.Br. Cow-Cress—Infrequent. Thickets and waste places. 86, 141.

Lepidium virginicum L. Poor-Man's Pepper—Rare. Open area bordering woods near Cabin Area "E". 130.

Capsella bursa-pastoris (L.) Medic. Shepherd's-purse—Common. Lawns and waste places. 36.

Alliaria officinalis Andrz. Garlic-Mustard—Infrequent. Waste places.

Hesperis matronalis L. Dame's-Violet—Infrequent. Roadside near Highbanks Camping Area. 113.

Barbarea vulgaris R. Br. Yellow Rocket—Abundant. Roadsides, thickets, and waste places throughout the park. 37, 45, 75.

Dentaria diphylla Michx. Two-leaved Toothwort—Infrequent. Rich wooded areas. 56.

Dentaria laciniata Muhl. Slashed Toothwort—Frequent. Rich wooded areas throughout the park. 8.

Cardamine douglassii (Torr.) Britt. Bitter Cress—Infrequent. Wooded areas. Mainly in the southern end of the park. 41, 42.

SAXIFRAGACEAE (SAXIFRAGE FAMILY)

Saxifraga virginiensis Michx. Early Saxifrage—Common. Wooded areas and slopes. Scattered throughout the park. 18, 31.

Tiarella cordifolia L. Foamflower—Infrequent. Wooded areas near Silver Lake Outlet. 162.

Mitella diphylla L. Bishop's-cap—Infrequent. Wooded areas near the Museum. 61, 82.

Chrysosplenium americanum Schwein. Water-carpet—Rare. Wet seep spot in a wooded area across from Great Bend Overlook.

ROSACEAE (ROSE FAMILY)

Fragaria virginiana Duchesne. Strawberry—Infrequent. Roadsides, waste places, and edges of woods.

Potentilla argentea L. Silvery Cinquefoil—Infrequent. Overgrown area near Mount Morris entrance. 140.

Potentilla recta L. Five-finger—Frequent. Wooded stream banks and wet woods throughout the park. 181, 203.

Potentilla simplex Michx. Old-field-Cinquefoil—Frequent. Roadsides, thickets, and waste places throughout the park. 106, 118, 127, 133, 159a, 223.

Geum canadense Jacq. Canadian Avens—Infrequent. Rich moist woods. 206, 215.

LEGUMINOSAE (PULSE FAMILY)

Trifolium agrarium L. Hop-Clover—Common. Roadsides and waste places. 177.

Trifolium hybridum L. Alsike Clover—Common. Roadsides, lawns, and waste places. 100.

Trifolium pratense L. Red Clover—Common. Roadsides, lawns, and waste places. 101.

Trifolium procumbens L. Low Hop-Clover—Frequent. Roadsides, lawns, and waste places. 105.

Melilotus alba Desr. White Melilot—Common. Roadsides, waste places, and edges of woods. 197.

Melilotus officinalis (L.) Lam. Yellow Melilot—Frequent. Thickets, roadsides, and waste places throughout the park. 84, 142.

Lotus corniculatus L. Birdsfoot-Trefoil. Infrequent. Roadsides and waste places at the northern end of the park. 99.

Desmodium nudiflorum (L.) DC. Tick-trefoil—Infrequent. Wooded areas near Portageville, N. Y. 248.

Vicia caroliana Walt. Wood-Vetch—Infrequent. Roadside lawns and thickets in the northern end of the park. 121, 146.

Vicia cracca L. Canada-Pea—Infrequent. Wooded area near Portageville, N. Y. 251.

Vicia dasycarpa Ten. Vetch—Infrequent. Wooded slopes near Gardeau Overlook. 90.

Lathyrus latifolius L. Everlasting Pea—Rare. Stream banks near Highbanks Camping Area. 175.

Lathyrus ochroleucus Hook. Wild Pea—Rare. Slope near Gardeau Overlook. 92.

OXALIDACEAE (WOOD-SORREL FAMILY)

Oxalis europaea Jord. Wood-Sorrel—Frequent. Roadsides, waste places, and edges of woods. 178, 225.

GERANIACEAE (GERANIUM FAMILY)

Geranium maculatum L. Wild Cranesbill—Abundant. Roadsides and wooded areas throughout the park. 67, 79, 112, 136, 147, 171.

Geranium robertianum L. Herb-Robert—Frequent. Wooded areas and stream banks. 111, 166, 168.

POLYGALACEAE (MILKWORT FAMILY)

Polygala senega L. Seneca-Snakeroot—Rare. Slope newly cleared for observation. Near the Mount Morris swimming pool. 188.

MALVACEAE (MALLOW FAMILY)

Malva moschata L. Musk-Mallow—Infrequent. Open fields near Portageville, N. Y. 232, 233.

GUTTIFERAE (ST. JOHN'S-WORT FAMILY)

Hypericum perforatum L. St. John's-wort—Frequent. Wooded areas. Mainly in the southern part of the park. 27, 185, 218.

VIOLACEAE (VIOLET FAMILY)

Viola papilionacea Pursh. Meadow-Violet—Infrequent. Wooded areas near the Museum. 64, 71.

Viola pubescens Ait. Downy Yellow Violet—Infrequent. Rich moist woods.

Viola rostrata Pursh. Long-spurred Violet—Infrequent. Wooded stream banks near the Administration Building. 53.

ONAGRACEAE (EVENING-PRIMROSE FAMILY)

Oenothera perennis L. Perennial Evening-Primrose—Frequent. Waste places. 183.

ARALIACEAE (GINSENG FAMILY)

Aralia nudicaulis L. Wild Sarsaparilla—Rare. Wooded areas near Big Bend. 192.

UMBELLIFERAE (PARSLEY FAMILY)

Cicuta maculata L. Spotted Cowbane—Infrequent. Wooded areas near Portageville, N. Y. 262.

Taenidia integerrima (L.) Drude. Yellow Pimpernel—Rare. Wooded area near Cabin Area "E". 135.

Pastinaca sativa L. Parsnip—Infrequent. Waste places. 186, 247b.

ERICACEAE (HEATH FAMILY)

Epigaea repens L. Trailing Arbutus—Infrequent. Rich wooded slopes in the southern part of the park. 24, 137.

Gaultheria procumbens L. Teaberry—Frequent. Wooded areas throughout the park. 30.

PRIMULACEAE (PRIMROSE FAMILY)

Lysimachia nummularia L. Moneywort—Rare. At the base of a retaining wall in the parking area adjacent to the Museum. 173.

Lysimachia quadrifolia L. Whorled Loosestrife—Infrequent. Wooded areas. Mainly in the southern part of the park. 198, 220, 241.

APOCYNACEAE (DOGBANE FAMILY)

Vinca minor L. Common Periwinkle—Frequent. Moist woods and waste areas. Mainly in the southern part of the park. 10.

Apocynum androsaemifolium L. Spreading Dogbane—Infrequent. Edges of wooded areas in the southern end of the park. 193.

ASCLEPIADACEAE (MILKWEED FAMILY)

Asclepias incarnata L. Swamp-Milkweed—Infrequent. Bog near Portageville, N. Y. 229.

Asclepias quadrifolia Jacq. Four-leaved Milkweed—Rare. Wooded areas near Big Bend. 196.

Asclepias syriaca L. Common Milkweed—Common. Roadsides and waste places. 235.

CONVOLVULACEAE (CONVOLVULUS FAMILY)

Convolvulus sepium L. Hedge-Bindweed—Frequent. Roadsides and waste places. 231.

POLEMONIACEAE (POLEMONIUM FAMILY)

Phlox subulata L. Moss-Phlox—Infrequent. Dry open edges of slopes.

HYDROPHYLLACEAE (WATERLEAF FAMILY)

Hydrophyllum virginianum L. John's-Cabbage—Rare. Wooded slopes behind the Museum. 174.

BORAGINACEAE (BORAGE FAMILY)

Cynoglossum officinale L. Common Hound's-tongue—Rare. Overgrown area near the Mount Morris entrance. 145.

Myosotis arvensis (L.) Hill. Forget-me-not—Infrequent. Roadsides and waste places. 109.

VERBENACEAE (VERVAIN FAMILY)

Verbena hastata L. Blue Vervain—Infrequent. Damp woods and thickets. 226.

LABIATAE (MINT FAMILY)

Glechoma hederacea L. Run-away-Robin—Common. Moist wooded stream banks and roadsides throughout the park. 32, 33, 39.

Prunella vulgaris L. Selfheal—Frequent. Wooded stream banks, waste areas, and roadsides throughout the park. 179.

Leonurus cardiaca L. Common Motherwort—Infrequent. Wooded areas and waste places. 208, 239.

Stachys palustris L. Woundwort—Rare. Wooded area overlooking the gorge near Portageville, N. Y. 259.

Satureja vulgaris (L.) Fritsch Basil—Infrequent. Wet places in the southern part of the park. 195, 214, 217.

SOLANACEAE (NIGHTSHADE FAMILY)

Solanum dulcamara L. Nightshade—Frequent. Moist wooded areas throughout the park. 150, 164.

Physalis heterophylla Nees. Ground-cherry—Rare. Railroad right-of-way near Portageville, N. Y. 234.

SCROPHULARIACEAE (FIGWORT FAMILY)

Verbascum blattaria L. Moth-Mullein—Infrequent. Wooded areas near Big Bend. 207.

Linaria vulgaris Hill. Butter-and-eggs—Common. Waste places and edges of wooded areas. 254.

Penstemon digitalis Nutt. Beard-tongue—Infrequent. Along railroad right-of-way. 236, 238.

Penstemon hirsutus (L.) Willd. Hairy Beard-tongue—Frequent. Open woods, edges of woods, roadsides, railroad right-of-way. 134, 148, 149, 255.

Veronica officinalis L. Gypsyweed—Frequent. Roadsides and moist wooded areas. Scattered throughout the park. 103, 124, 156, 160, 216.

Veronica serpyllifolia L. Thyme-leaved Speedwell—Rare. Grassy banks of Trout Pond. 76.

Melampyrum lineare Desr. Cow-wheat—Infrequent. Open wooded areas. 138, 200.

PLANTAGINACEAE (PLANTAIN FAMILY)

Plantago lanceolata L. Ribgrass—Common. Lawns, waste places, and edges of wooded areas. 201, 245. Other species of this genus were present in similar environments throughout the park. They are excluded from this list since they do not bloom during the spring.

RUBIACEAE (MADDER FAMILY)

Galium aparine L. Spring-Cleavers—Infrequent. Edges of thickets and rich woods. 117, 180.

Galium boreale L. Northern Bedstraw—Infrequent. Waste areas near the Mount Morris swimming pool. 152, 182.

Galium circaezans Michx. Wild Licorice—Infrequent. Cleared slopes and wooded areas near Mount Morris swimming pool. 189, 202b.

Galium mollugo L. White Bedstraw—Rare. Open area bordering woods near Cabin Area "E". 131.

Galium palustre L. Marsh Bedstraw—Infrequent. Wooded areas overlooking the gorge near the Museum. 256, 260.

Asperula odorata L. Sweet Woodruff—Rare. Waste areas south of the Mount Morris swimming pool. 187.

Mitchella repens L. Partridge-berry—Frequent. Wooded areas.

CAPRIFOLIACEAE (HONEYSUCKLE FAMILY)

Triosteum perfoliatum L. Horse Gentian—Rare. Roadside bordering stream near Highbanks Camping Area. 114.

COMPOSITAE (COMPOSITE FAMILY)

Bellis perennis L. English Daisy—Common. Grassy roadsides and waste areas, mainly in the southern portion of the park. 9, 72, 93.

Erigeron philadelphicus L. Philadelphian Fleabane—Abundant. Roadsides and wooded areas throughout the park. 95, 116, 126, 128, 157, 161.

Antennaria neglecta Greene. Pussy's-toes—Common. Wooded areas. 51.

Antennaria plantaginifolia (L.) Hook. Plantain-leaved Pussy's-toes—Infrequent. Wooded areas and slopes in the southern end of the park. 13, 52, 121, 122.

Anaphalis margaritacea (L.) C. B. Clarke. Pearly Everlasting—Frequent. Deserted railroad right-of-way near Portageville, N. Y. 261.

Rudbeckia hirta L. Coneflower—Common. Waste places and edges of woods and thickets. 242.

Achillea lanulosa Nutt. Wooly Yarrow—Infrequent. Waste places. Scattered throughout the park. 165, 191, 240.

Anthemis arvensis L. Corn-Chamomile—Infrequent. Overgrown areas. 85.

Chrysanthemum leucanthemum L. White Daisy—Abundant. Waste places and edges of wooded areas throughout the park. 97, 158, 167.

Tussilago farfara L. Coltsfoot—Frequent. Wet woods, streamsides, and mud and gravel around ponds. 3, 22.

Senecio aureus L. Golden Ragwort—Infrequent. Rich moist woods.

Tragopogon pratensis L. Goat's-beard—Infrequent. Waste places. 190.

Taraxacum officinale Weber. Common Dandelion—Common. Roadsides, lawns, and waste places throughout the park.

Hieracium aurantiacum L. Devil's Paint-brush—Frequent. Grassy roadsides. 94.

Hieracium flagellare Willd. Hawkweed—Rare. Thickets at the northern end of the park. 139.

Hieracium pratense Tausch. King Devil—Abundant. Grassy roadsides and thickets throughout the park. 104, 155.

Hieracium venosum L. Rattlesnake-weed—Infrequent. Wooded areas. 202a.

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CITATIONS IN THE ROCHESTER ACADEMY OF SCIENCE

1968

CHESTER F. CARLSON

Fellow

Many of us grew up with tales of industrial giants who founded monumental industries on simple basic ideas: new steels, electric filaments, photographic film, horseless carriages, vulcanized rubber, carbon microphones, and even chicle. Such feats almost seem to belong to a legendary era. Yet the accomplishments of one of our members, whom we now honor, remind us that such classic opportunities still await determined men today.

His contribution, like the others, meets a need arising out of the complexities of our cultural progress. And through his tenacity coupled with that of his associates, a cotton handkerchief rubbed over a sulphur plate in 1938 has metamorphosed into a system that will make many billions of copies in 1968.

The technical difficulties of reducing the photoelectrostatic phenomenon to an operative machine entailed almost as much technology as that spanning the invention of the wheel and the building of the first automobile. And finding a company farsighted enough to back the necessary development was almost as challenging as to have persuaded a Roman chariot maker to manufacture a sports car. Similarly remote are the first small kitchen laboratory in Astoria, Long Island, and the huge complex of buildings that today houses the Xerox Corporation.

Our candidate graduated in 1930 from the California Institute of Technology as a physicist. He joined the research department of the Bell Telephone Laboratories in New York. He later entered the patent department of P. R. Mallory and Company. He attended the New York Law School at night. The need for copying numerous documents and drawings in his work and studies, coupled with a boyhood interest in the graphic arts, stimulated his search for any easy method of duplication.

With the help of the research facilities at the Battelle Memorial Institute, a workable process was devised. In 1947, the former Haloid Company of Rochester became interested in building a marketable machine. He came to Rochester to help with the ten years of development required before the new copiers began their invasion of the business and academic worlds.

He joined our Mineral Section in 1957. In keeping with our desire to honor the scientific and technical achievements of our outstanding members, we are pleased to extend to him our Fellowship.

JOSEPH W. TAYLOR

Fellow

Civilization is a means, not an end. The interests of our next honored member indicates a keen appreciation of this. As Treasurer of the Bausch and Lomb Optical Company, he is a potent factor in maintaining a part of the worldwide industry that provides a livelihood for our ever burgeoning numbers. It just is not practical for us all to live close to the Nature from which we sprang. Nevertheless, we can periodically return for refreshment of the spirit.

As President of the Hawk Mountain Sanctuary Association in Pennsylvania, he helps to maintain a natural retreat. As past Vice-President of the Genesee Ornithological Society, and publisher of the Goshawk, he has encouraged many people to study birds.

He has recorded 652 species, which places him among the top five observers in North America. By lecturing before the Sanctuary group, to our Academy meetings, and at Cornell University, he has shared his broad knowledge of birds. Throughout his home he displays 24 of the full-size original Audubon prints.

Other activities, such as raising salt-water tropical fish, rose growing, photography, and camping in every state, indicate a keen interest in nature. This is further demonstrated by his position as Trustee for the Seneca Zoological Society.

He is a native Rochesterian, and a Yale graduate in history. He returned to Rochester, after completing a degree at the Harvard Law School, 1939, to work in the firm of Nixon, Hargrave, Devans and Doyle, remaining with them for 5 years. He joined his present company 23 years ago.

For having the ability to advance with civilization and the wisdom to retreat occasionally from it, we are pleased to confer on him our degree of Fellowship.

WALTER W. WHYMAN

Fellow

Industry requires three basic types of men: inventors, administrators, and craftsmen. Our next candidate completes the triumvirate. He was born in Pembroke, New York and later moved to Batavia. He has been with the American Telephone and Telegraph Company there since 1929. He is a specialist in electronics.

His interest in astronomy drew him into our Astronomy Section. Like many there, he got started in the time-honored way by building a 6-inch Newtonian telescope. In 1956, a new facet of his hobby presented itself to him and to many of his cohorts—that of satellite tracking. With a 5-inch refractor, an accurate mount he constructed, and an improvised rotating shelter, he is able to procure valuable scientific information. He has forwarded 380 observations to the Smithsonian Astrophysical Observatory. He is a charter member of the Moonwatch team, and works with those in our Section who carry out this intriguing program locally.

A paper delivered to the Astronomical League and many other activities as one of its members are evidence of his enthusiasm. Furthermore, he belongs to the Buffalo Astronomical Association and the Lockport Astronomy Association. He has served them all as officer or director. He still is an easy mark for a Boy Scout Troop eager for a lecture on space.

He varies his interests by working out intriguing, and sometimes even useful, electronic devices. And for good measure he photographs covered bridges.

There is adventure, as well as purpose, in observing artificial satellites. By 1967 he had assembled convincing evidence that Echo should have a minimum life in orbit of 30 years, and continued existence for a century. Yet, sad to relate, he is now preparing for its deathwatch this summer.

For skill in his profession and generous devotion in his avocation, we are happy to welcome him as a Fellow.

1969

JOHN McMASTER

Fellow

There is a current tendency to assume that a new social order can only be built by first leveling the old after the fashion of the *successful* European *conquest* of South America—though the *unsuccessful suppression* of its ancient culture. Our candidate feels that new building must be done *on* the old, not *over* it. In professional retirement from photographic technology, he is now active in making contributions to archaeology.

He has seen life in England, where he was born; in Scotland, the home of his parents; in Maine, the scene of his school days; in Buffalo, where he received his B.Sc. degree from the University of Buffalo in 1925; in Rochester, where he started his career as a Kodak chemist; on Guam, for the Bureau of Aeronautics; in Mexico, to visit archaeological ruins; and in Spain, for postgraduate study in Anthropology at the University of Madrid in 1966. With such a background he realizes that Society is not something that can be neatly and quickly rearranged like building blocks.

He has enjoyed the rewards of an energetic professional career. He retired in 1966 as the Director of Graphic Arts Sales Development for the Eastman Kodak Company. He is past-president of the Technical Association of the Graphic Arts and of the Kodak Camera Club. Besides being a member of our Academy, he belongs to the Lewis H. Morgan Chapter of the New York State Archaeological Association, to the Archaeological Society of New Mexico, to the Explorers' Club, and several photographic and photoengravers' clubs.

He also finds time for a game at the Monroe Golf Club. But his more noteworthy digging has been for unusual minerals on Guam and in Utah and New Mexico, and on various archaeological locations—an ancient Indian pueblo in New Mexico, a site in Idaho, and a Roman fort in Scotland. Last summer he helped in the Rochester Museum excavation of a 4,000-year old Late Archaic site near Scottsville, New York. There, numerous Indian stone and bone artifacts are spelling out Man's early endeavors.

For bringing the past to the attention of the present for the use of the future, we are proud to extend to him our honor of Fellowship.

Albert C. Smith, Jr.

Fellow

Research is done wherever a question to be answered is asked, whether in the cubic confines of a Kodak emulsion laboratory or within the hemisphere of space around Ellesmere Island. And our candidate has explored these two contrasting extremes. His doctorate in chemistry at Harvard in 1951 prepared him for the first. Boyhood in the hardy state of Vermont and the fascination of the Arctic found him taking a leave of absence on the ice shelf in 1960.

Like spectrograms and tree rings, a hand-drilled, 120-foot core of ice carries an intricate message that is no longer a secret when read by the eyes of science. Passages have been written by the weather, by volcanoes, by pollenating trees, and by atomic bombs. When the same stratification is found in two different places, it is possible to prove that the Ellesmere ice shelf is the source of many of the ice islands located in the Arctic.

Far distant from the 24-hour days, the white-outs, the sun dogs, the acrobatic compass, and the plight and rescues of a crevasse-prone colleague—all documented by his photography—he works with the secrets that make photography possible. He is responsible for many emulsion advances and holds several patents on new products.

As Program Chairman and Chairman of the Mineral Section of our Academy, he has helped to foster many of its enthusiastic new programs.

Boat-building and skiing activities with his children, still leave him time to devote to painstaking tasks for the West Irondequoit school system. Sometimes, when recovering from a decibel bombardment suffered while chaperoning a high school dance, he longs for the lullaby of a howling blizzard on Ellesmere Island.

For his lively interest in people, places, and progress, we are happy to name him a Fellow in our Academy.

Edward T. Wentworth

Fellow

The happiest man is he who enjoys a useful profession and an intriguing hobby, and who helps others to enjoy theirs in good health. By this standard our candidate is most successful. He has seen many changes since he started as a water boy for railroad construction gangs until he retired in 1963 after being the Chief of Orthopedic Service at the Rochester General Hospital. But two factors have not changed for him—hard work and the appreciation of Nature.

Born in the soft-coal mining region of Pennsylvania, he has seen steam give way to diesel power, trains to jet planes. An enthusiastic photographer since his youth, he has used glass plates and modern color films, hand-cranked cine cameras and those driven by tiny nickel-cadmium cells, early plate cameras and elaborate gyro-stabilized telephoto cameras.

He was quick to appreciate the value of the camera in railroad engineering, and later in medical practice. Now he is building an enormous collection of ornithological and wild-flower slides.

His varied educational background is indicative of his vocational and avocational adaptability. After some experience in railroad construction, he studied the classics, chemistry, and biology at Harvard. Then in 1913 he graduated, *cum laude,* with a degree in medicine. One of the highlights of his career occurred in 1939 when, as a Colonel, he was assigned to be Commanding Officer of the 19th General Hospital. Since that time, he has been consultant in orthopedic surgery for three hospitals, and the president of three medical societies.

He is active in our Ornithology Section, the Bergen Swamp Preservation Society, and in garden clubs. For forty years he has been growing fruit and studying pest control—the bushels of apples he has given away are only outnumbered by the photographs he has made.

For his distinguished medical career, and for his advancement of the enjoyment of Nature as efficacious spiritual therapy, we are honored to welcome him as a Fellow.

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