PROCEEDINGS

OF THE

ROCHESTER ACADEMY OF SCIENCE

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ILLUSTRATIONS.

PROCEEDINGS OF THE ROCHESTER ACADEMY OF SCIENCE

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PLANTS OF MONROE COUNTY, NEW YORK, AND ADJACENT TERRITORY.

SUPPLEMENTARY LIST.

BY FLORENCE BECKWITH, MARY E. MACAULEY, AND MILTON S. BAXTER,

Committee of the Botanical Section.

CONTENTS.

EXPLANATION.

In 1896, after years of earnest labor, the Botanical Section of the Rochester Academy of Science published a list of the "Plants of Monroe County, New York, and Adjacent Territory."

The list aimed to give the names of plants growing without cultivation in Monroe and adjoining counties, and at the time it was published it was thought to be quite complete for Monroe county, though it was not claimed to be so for the adjacent ones.

The publication of that list, however, stimulated the botanists of this region to renewed efforts, with the result that so large a number of new plants was found and so many new stations for some which had been considered scarce or rare, that the publication of a supplementary list was shown to be necessary. A Committee of the Botanical Section, as named above, was appointed to prepare a new list.

From the records of the Section, the Committee has prepared the following list. Specimens of the plants named are contained in the herbarium of the Academy, or in the collections of the members of the Botanical Section and of the Park Commission of Rochester, unless otherwise noted.

Territory Included.

The territory included covers the same area as the list of 1896, comprising the whole of Monroe county and parts of Genesee, Orleans, Ontario, Wayne and Livingston counties. A few plants which our botanists have found in Allegany and Wyoming counties have been included in this list, as these counties lie in the drainage basin of the Genesee river, and also because it seemed desirable that a record should be made of them.

Acknowledgments.

The thanks of the Committee are especially due to Mr. J. B. Fuller for much painstaking work in the determination of specimens and on the herbarium; to Mrs. J. H. McGuire, whose faithful and conscientious labor as Recorder of the Botanical Section for many years was of great service; and to all the members of the Section whose zeal and enthusiasm have added new plants to the list and given encouragement to the Committee.

It is with regret that the Committee announces the deaths of two botanists who had done much for botanical research in our county: Dr. Charles M. Booth and Mr. Charles W. Seelye.* Dr. Booth was a most enthusiastic collector, and in the fall of 1896 added largely to the number of plants named in the following list, especially the newly introduced ones along our railroads. For many years he had been greatly interested in Mosses and the Carices, and his large collections of these plants have been given to the Academy of Science. Mr. Seelye, who was especially interested in Ferns, some years ago presented his extensive collection to the Academy, together with valuable publications pertaining to them. (*See Vol. 3, p. 186*).

*Since this paper was completed and in the hands of the printer, two more of our botanists have passed away: Mr. Joseph B. Fuller, of Rochester, and Mr. E. L. Hankenson, of Newark, N. Y.

Mr. Fuller's death occurred on February 16, 1910, at the age of 82. For many years he was Curator in Botany of the Academy and the leading authority in the Botanical Section. Mr. Hankenson was a well-known botanist of Wayne county and contributed many specimens from that locality to the herbarium of our Academy. It is proposed to publish biographical sketches of Mr. Fuller, Dr. Booth, Mr. Seelye, Mrs. Mary E. Streeter and Mr. Hankenson in a later brochure of these Proceedings.

Introduction of Species.

As our territory is traversed by a number of railroads, new plants are constantly being introduced. Many of these new introductions are from the West.

At the time of the publication of the original list of plants, in the summer of 1896, the Russian Thistle (*Salsola Kali tenuifolia*) had not been found in this vicinity. Its arrival, however, was confidently expected, and a close watch was kept, with the result that it was soon observed by Dr. Booth along the tracks of the New York Central railroad. Now it has spread to many parts of the county. The rapidity with which it increases and takes possession of the land was particularly noted last summer. A short branch of the Pennsylvania railroad was built about two years ago from Scottsville to Garbutt, through a section where the Russian Thistle was absolutely unknown. Now the roadbed is thickly lined with this immigrant from western fields.

A number of plants which were noted as rare or scarce in the list of 1896, are now abundant in many localities. Among these may be mentioned the following :

Nasturtium sylvestre is plentiful along the flood plain of the Genesee river for many miles south of Rochester ; *Trifolium procumbens* is now frequently found ; *Potentilla recta* has so increased as to be very plentiful along roadsides, particularly in the southern part of Monroe county ; *Hieracium aurantiacum* is now a pernicious weed in many places ; *Sonchus arvensis* has spread over a large territory, and is constantly being reported in new localities ; *Lysimachia nummularia* is plentiful in lawns in Rochester and vicinity, and along Oatka creek, in Scottsville, is growing like a weed, in company with *Myosotis palustris* ; *Vincetoxicum nigrum* has spread rapidly in the southern part of Rochester, and has been reported in other parts of the county ; *Chenopodium Botrys* is frequently found along the New York Central railroad in Rochester and in adjoining towns. A few specimens of *Sisymbrium altissimum* were first found in Rochester about two years ago ; now the plant is growing plentifully in many parts of the city and adjacent towns.

Recently Described Species.

Although it had been noticed by our botanists that many of the specimens of Crataegus found in and around Rochester did not answer to any species described in the botanies, there was apparently no way in which they could be disposed of except to consider them as variations from the types, and in our former list of plants only six species were given. These were all that could be expected to be found in our locality, according to the Sixth Edition of Gray's Botany.

In 1899, Mr. John Dunbar called the attention of Dr. Charles S. Sargent, of the Arnold Arboretum, to this subject, with the result that Dr. Sargent, assisted by a number of our botanists, began a careful and systematic study of the thorns of this vicinity. Hundreds of specimens of flowers and fruit have been collected and forwarded to Dr. Sargent for examination, and he has made numerous visits to Rochester to examine types. Seeds of more than two hundred specimens have also been collected and sent to Dr. Sargent; these have been planted and are now growing on the grounds of the Arnold Arboretum.

This study of the Crataegus has been carried on unremittingly since 1899, with the result that seventy-nine species found growing within our limits have been named by Dr. Sargent. These will be found on pages 12-17 of this list.

Mr. C. C. Laney, Mr. John Dunbar, Mr. M. S. Baxter, Mr. V. Dewing, Mr. Henry T. Brown and Mr. Bernard Slavin have been enthusiastic workers in this field, and to their untiring labors, supplementing that of Dr. Sargent, is due the large number of new species which have been found and named. Dr. Sargent notes that the lower valley of the Genesee is remarkably rich in species of Crataegus, and as the work is still being carried on, it is probable that further additions may be made to the list.

We are aware that a few botanical authorities doubt the validity of some of these numerous species, regarding them as mere varieties. But as they have been most carefully studied and named by the very best authority on the genus; have been repeatedly grown from seed and remain constant to type and seem true species according to all recognized tests; and their validity having been recognized by a majority of the eminent botanists of America, we have no hesitation in giving all of those which have been found growing within our limits their proper place in our list.

Descriptions of these new species, or reference to the original publication, down to 1907, may, with few exceptions, be found either in the Proceedings of the Rochester Academy of Science, Vol. 4, pp. 93-136, June, 1903, or the Report of the New York State Botanist for 1907 (New York State Museum Bulletin 122).

The species described since 1907, and those not referred to in the above publications, are properly credited in the list, being numbers 1422, 1433, 1434, 1456, 1457, 1480. The majority of the new species are also described in the Silva of North America XIII, or in Trees and Shrubs, by Dr. Sargent.

The Violas given in the list have been submitted to Ezra Brainerd, of Middlebury, Vt., and the different species of Rubus have all been examined by William H. Blanchard, of Westminster, Vt., who has visited Rochester for this purpose.

The hybrid Ferns have been determined by Dr. Philip Dowell, of Port Richmond, N. Y., who has made a careful study of these intermediate forms, and has published the results of his investigations in the Bulletin of the Torrey Botanical Club and in Torreya. Specimens of these Ferns may be found in the herbaria of the Academy of Science, and growing plants can be collected at the stations noted.

The growth of our city is rapidly crowding out many native plants, but owing to the wisdom and foresight of our Superintendent of Parks, Mr. C. C. Laney, these large enclosures of hundreds of acres have been left, as far as possible, in their natural state, and thus many plants have had their habitat preserved, and are to be found flourishing under the most favorable conditions. This is particularly true of the newly classified genera Viola and Rubus, and many of the type specimens of Crataegus are found within the limits of our city parks.

STATISTICS.

There have been added to our list since 1896, the following :

Species and varieties native to the Monroe Flora,	149	
Species and varieties introduced to the Monroe Flora,	76	
Total number of species and varieties,		225
Introduced species and varieties in Monroe County,	70	
Introduced species and varieties in other counties,	6	

New localities are given for 96 species and varieties noted as rare or scarce in the list of 1896.

In the original list of plants 1208 species and varieties were reported in Monroe county. In the other counties represented in the list 106 species were reported which, up to that time, had not been reported in Monroe county. Of these 106 species, 11 are now reported as growing in Monroe county.

The total number of species and varieties reported in the Monroe Co. Flora, including the list of 1896 and the present one, is 1584. Total number for Monroe county, 1387.

THE CATALOGUE.

EXPLANATION OF THE PLAN.

Authorities.—In arrangement and nomenclature this list follows the plan of the list published in 1896, using as its standard of authority the sixth edition of Gray's Manual of Botany. For new species not mentioned in the sixth edition, the seventh edition of Gray's Botany is followed except for the Crataegus, in which Dr. Charles S. Sargent, Director of the Arnold Arboretum is accepted as authority.

Typography and Reference Marks.—Each species, variety or marked form regarded as an established member of our flora is given a catalogue number. Those without numbers are not considered fully established.

Heavy-faced type indicates species believed to be indigenous. Names of introduced species are printed in capitals, as are, also, the common or popular names.

Parentheses following catalogue names enclose the names used in Gray's fifth edition.

Brackets indicate that the enclosed matter is the designation given in the Illustrated Flora of the Northern States and Canada by Britton and Brown.

The name of the discoverer of a plant new to our district, or of a new station for a rare or scarce plant, is given in italics.

In the present list, the genera are given the same number and follow the same order as in the old list. New genera are inserted in their proper order and, to prevent confusion, are lettered, as 34a, etc.

The list of 1896 closed with the number 1359. All numbers beyond that in this supplementary list denote new species and varieties. Where new stations are given for rare or scarce plants, the number given in the original list is retained.

PHÆNOGAMIA [*SPERMATOPHYTA.*]

DICOTYLEDONES.

RANUNCULACEÆ.

6. *RANUNCULUS* Tourn. [L.] CROWFOOT. BUTTERCUP.

22. **R. repens** L. TRAILING CROWFOOT.
Frequent in lawns in Rochester. Scottsville, *Florence Beckwith.*
A double-flowered form found by *F. W. Ross* at the eastern wide-waters, Rochester, N. Y., May 24, 1897.

1360. R. BULBOSUS L. BULBOUS CROWFOOT OR BUTTERCUP.
Rare. Sibley Place, Rochester, 1905 to 1909; East Avenue, Meigs Street and University Campus, 1909. *Lewis S. Gannett.*

13. *HYDRASTIS* Ellis.

33. **H. Canadensis** L. ORANGE-ROOT. GOLDEN SEAL.
Riga, *Florence Beckwith.*

BERBERIDACEÆ.

20. *JEFFERSONIA* Barton. TWIN-LEAF.

40. **J. diphylla** Pers. [*J. diphylla* (L.) Pers.]
Avon, *C. Vollertsen.* Geneseo, *M. S. Baxter.*

CRUCIFERÆ.

34. *ARABIS* L. ROCK CRESS.

67. **A. perfoliata** Lam.
Greece, *Mary E. Macauley.*

1361. **A. confinis** Watson.
Limestone region of Le Roy. *E. J. Hill.*

34a. *DRABA* Dill. [L.]

1362. D. VERNA L. WHITLOW GRASS.
Occasional in sandy waste places about Rochester. *C. Vollertsen.*

37. *NASTURTIUM* R. Br. [RORIPA SCOP.] WATER CRESS.

73. **N. palustre** DC. var. hispidum Gray. [*Roripa hispida* (Desv.) Britton.]
Brighton, *C. Vollertsen.*

39. *HESPERIS* Tourn. [L.]

78. H. MATRONALIS L. DAME'S VIOLET.
Near Caledonia, 1903; near Mumford, 1909, *Miss Beckwith.*

40. *ERYSIMUM* Tourn. [L.]

79. E. **cheiranthoides** L. WORM-SEED MUSTARD.
To stations given in list of 1896 add localities: Greece, Perinton, Pittsford.

41. *SISYMBRIUM* Tourn. [L.]

1363. S. Sophia L. Flixweed. Herb Sophia.
Reservoir Avenue, Rochester, 1909. *Florence Beckwith.* Specimen in herbarium of State Botanist.

1364. S. altissimum L. Tumble Mustard.
Along N. Y. C. R. R., Brighton, *M. S. Baxter* and *V. Dewing.* South Goodman Street, *C. Vollertsen.* Speedway, Culver Street, and near Irondequoit creek, University Avenue dugway, *Florence Beckwith.* Webster, *Lewis S. Gannett.*

81. S. Thaliana Gaud. [*Stenophragma Thaliana* (L.) Celak.] Mouse-ear Cress.
Rochester Junction, 1897, *M. S. Baxter.* Eastern wide-waters, *C. Vollertsen.*

42. *BRASSICA* Tourn. [L.]

82. B. Sinapistrum Boiss. Yellow Mustard. English Charlock.
A smooth form, Scottsville, *Florence Beckwith.*

42a. *TEESDALIA* R. Br.

1365. T. nudicaulis R. Br.
Vacant lot near East Avenue, Rochester, 1898, *C. Vollertsen.*

42b. *CONRINGIA* [Heist.] Link. Hare's-ear Mustard.

1366. C. orientalis (L.) Dumort.
Railroad weed. *M. S. Baxter* and *V. Dewing.*

45. *LEPIDIUM* Tourn. [L.]

1367. L. sativum L. Garden Cress.
Occasional in waste places.

VIOLACEÆ.

50. *VIOLA* Tourn. [L.] Violet.

1368. V. **affinis** Le Conte.
Common in Seneca Park, Rochester.

1369. V. **papilionacea** Pursh.
Common around Rochester.

1370. V. **sororia** Willd.
Seneca Park, Rochester, 1908, *B. H. Slavin.* Riga, 1907, *Miss Florence Beckwith.*
A white form of V. sororia was also found by *Miss Beckwith* growing abundantly by the roadside in the same locality as the type.

1371. V. **fimbriatula** Sm. (*V. ovata* Nutt.)
Common in Seneca Park.

1372. V. **pallens** (Banks) Brainerd.
Irondequoit, *B. H. Slavin.*

1373. V. **incognita** Brainerd.
Seneca Park and Irondequoit.

1374. V. **scabriuscula** Schwein.
Seneca Park and Irondequoit.

105. V. **striata** Ait. PALE VIOLET.
Damp woods near West Rush ; local, *M. S. Baxter.* Scottsville, 1909, *Florence Beckwith.*

1375. V. **conspersa** Reichenb.
Common in Seneca Park.

1376. V. **Labradorica** Schrank.
Common in Seneca Park.

108. V. TRICOLOR L. var. ARVENSIS Ging. [*V. tenella* Muhl.]
Near Despatch, *Miss Beckwith.* Back of Mount Hope, *C. Vollertsen.*

CARYOPHYLLACEÆ.

54. *SILENE* L. CATCHFLY. CAMPION.

113. S. CUCUBALUS Wibel. (*S. inflata* Smith.) [*S. vulgaris* (Mœnch) Garcke.]
BLADDER CAMPION.
Canandaigua, *Mrs. E. O. Cartwright.*

1377. S. DICHOTOMA Ehrh. FORKED CATCHFLY.
Rare. Canandaigua, *Mrs. E. O. Cartwright,* July, 1899.

55. *LYCHNIS* Tourn.

1378. L. VESPERTINA Sibth. WHITE CAMPION.
Staminate flower, roadside, Parsells Avenue, Rochester, August 14, 1899, *Dr. C. M. Booth.*

56. *ARENARIA* L. SANDWORT.

121. A. **Michauxii** Hook. f. (*A stricta* Michx.) [*A stricta* Michx.]
Fairport, *A. J. Perkins.*

57. *STELLARIA* L. [*Alsine* L.] CHICKWEED. STARWORT.

1379. S. **uliginosa** Murr. SWAMP STITCHWORT.
Scarce. Roadsides. *Dr. C. M. Booth.*

59. *BUDA* Adans.

129. B. RUBRA Dumort. (*Spergularia rubra* Presl. var. *campestris* Gray.) [*Tissa rubra* (L.) Britton.] SAND-SPURREY.
A weed in cultivated grounds, Greece, *Miss M. E. Macauley.*

60. *SPERGULA* L.

130. S. ARVENSIS L. CORN SPURREY.
Rochester, *C. Vollertsen.*

1380. S. MORISONII *Boreau.*
Fields, Rochester, *C. Vollertsen,* 1897.

HYPERICACEÆ.

63. HYPERICUM Tourn. [L.]

134. **H. Ascyron** L. (*H. pyramidatum* Ait.) GREAT ST. JOHN'S-WORT.
Near Le Roy. *M. S. Baxter.*

TILIACEÆ.

68. TILIA Tourn. [L.] LINDEN. BASSWOOD.

1381. **T. Michauxii** Nutt. (Gray's Bot. 7th ed.)
Common around Rochester. *John Dunbar.*

GERANIACEÆ.

70. GERANIUM Tourn. [L.]

1382. G. COLUMBINUM L. LONG-STALKED CRANESBILL.
Rare. Pinnacle Hill, Rochester, *Mary E. Macauley.*

70a. ERODIUM L. Her. STORKSBILL.

1383. E. CICUTARIUM L. [*E. cicutarium* (L.) L'Her.]
Roadside, East Rochester, *Dr. C. M. Booth*, 1896. Reservoir Ave., 1909, *Florence Beckwith.*

72. OXALIS L.

1384. **O. Acetosella** L. WOOD-SORREL.
Rare. Stony Brook Glen, near Dansville, *Florence Beckwith, M. S. Baxter.*

CELASTRACEÆ.

80. EUONYMUS Tourn. [L.]

167. **E. atropurpureus** Jacq. BURNING BUSH. WAAHOO.
Near Geneseo, *M. S. Baxter.*

ANACARDIACEÆ.

88. RHUS L. SUMACH.

189. **R. Canadensis** Marsh. (*R. aromatica* Ait.) [*R. aromatica* Ait.]
Near Geneseo, *M. S. Baxter.*

POLYGALACEÆ.

89. POLYGALA Tourn. [L.]

191. **P. polygama** Walt.
This species, given as rare in 1896, is now represented by numerous plants covering a large area of the Despatch sand fields.

LEGUMINOSÆ.

91. LUPINUS Tourn. [L.]

198. **L. perennis** L. WILD LUPINE.
A form with white flowers observed by *Mrs. H. G. Pierce*, at Forest Lawn, 1904.

92a. ONONIS L.

1385. O. ARVENSIS L. (*O. repens* L. *O. procurrens* Wallr.)
Old apple orchard, *Dr. C. M. Booth.*

94a. HOSACKIA Douglas.

1386. H. PURSHIANA Benth.
On railroad track, Pittsford, 1896, *J. B. Fuller.*

100. CORONILLA L.

218. C. VARIA L.
Buffalo Road, Gates, *George Arnold*, 1908.

101. DESMODIUM Desv. [MEIBOMIA Adans.] TICK-TREFOIL.

229. **D. ciliare** DC. [*Meibomia obtusa* (Muhl.) A. M. Vail.]
East side of Irondequoit Bay, Webster, *M. S. Baxter.*

103. VICIA Tourn. [L.] VETCH.

1387. V. SATIVA var. ANGUSTIFOLIA Seringe.
Dr. Booth's orchard, Irondequoit, *Dr. C. M. Booth, J. B. Fuller.*

1388. V. HIRSUTA Koch. [*V. hirsuta* (L.) Koch.]
East Main Street, Rochester, between Union and Alexander Streets, *Dr. C. M. Booth.* Has been established there several years.

104. LATHYRUS Tourn. [L.] EVERLASTING PEA.

1389. L. PRATENSIS L.
Linden Street, Rochester, *V. Dewing.*

106. STROPHOSTYLES Ell.

245. **S. angulosa** Ell. (*Phaseolus diversifolius* Pers.) [*S. helvola* (*L.*) *Britton.*]
Shore of Lake Ontario, east of Troutburg, *Florence Beckwith.*

ROSACEÆ.

110. PRUNUS Tourn. [L.]

1390. P. MAHALEB L. PERFUMED CHERRY.
Abundant along roadsides and in thickets around Rochester.

111. SPIRÆA L. MEADOW-SWEET.

1391. S. SORBIFOLIA L.
Naturalized and spreading in a field on Lincoln road, Penfield, *John Dunbar.*

113. RUBUS Tourn. [L.]

1392. **R. idaeus** L.
Naturalized around Rochester.

1393. **R. neglectus** Peck.
Three stations in Brighton, *Dr. C. M. Booth.* Seneca Park, Irondequoit. Fruit cream-colored.

1394. **R. occidentalis** L. var. *pallidus* Bailey.
Seneca Park, Rochester.

1395. **R. recurvans** Blanchard.
Common around Rochester.

1396. **R. Andrewsianus** Blanchard.
Common around Rochester.

1397. **R. villosus** Ait. var. *humifusus* Torr & Gray.
Seneca Park, Rochester. Wayne county, *A. H. Perkins.*

1398. **R. invisus** Britton.
Durand Park.

117. FRAGARIA Tourn. [L.] STRAWBERRY.

1399. **F. vesca** L. var. *alba* Ehrh.
Frequent in and around Rochester.

118. POTENTILLA L. CINQUE-FOIL.

1400. **P. arguta** Pursh.
Limestone region of Le Roy, *E. J. Hill.*

119. AGRIMONIA Tourn. [L.]

1401. **A. parviflora** Ait.
Rush, *Earl H. Clapp. J. B. Fuller.*

121. ROSA Tourn. [L.]

291. **R. blanda** Ait.
Rush Junction, Monroe County, Buttermilk Falls, near Le Roy, and shores of Canandaigua Lake, *M. S. Baxter.*

122. PYRUS L.

300. **P. arbutifolia** L. f. var. *melanocarpa* Hook. [*Aronia nigra* (Willd) Britton.]

Parma, *M. S. Baxter.* Despatch, *Mrs. E. M. Young.* Riga, *Miss Beckwith.* Probably more common than the type.

1402. **P. arbutifolia** var. *atropurpurea* (Britton) Robinson.
Mendon Ponds, *B. H. Slavin.* Local.

123. CRATAEGUS L. HAWTHORN. WHITE THORN.

1403. **C. persimilis** Sargent.
Type on Highland Avenue, Rochester. Also found at Black creek, and on East Avenue.

1404. **C. crus-galli** var. pyracanthifolia Aiton.
Rochester, *M. S. Baxter* and *V. Dewing.*

1405. **C. geneseensis** Sargent.
Rochester, *John Dunbar.* Tuscarora, Livingston County, *M. S. Baxter* and *V. Dewing.*

1406. **C. beata** Sargent.
Type near Pennsylvania R. R. roundhouse. Common. Also occurs in Ontario, Allegany and Erie counties.

1407. **C. Lennoniana** Sargent.
Type in Seneca Park, Rochester. Frequent.

1408. **C. leiophylla** Sargent.
Type in Maplewood Park. Frequent. Also occurs in Livingston and Allegany counties.

1409. **C. formosa** Sargent.
Type in Ritters Hollow, Rochester. Frequent.

1410. **C. compta** Sargent.
Type near Driving Park Avenue bridge, Rochester. Common.

1411. **C. diffusa** Sargent.
Type near Driving Park Avenue bridge. Frequent.

1412. **C. opulens** Sargent.
Type in Ritter's Hollow. Scarce. Also occurs in Allegany county.

1413. **C. Maineana** Sargent.
Type in Maplewood Park. Occasional. Also found in Allegany county.

1414. **C. pruinosa** K. Koch.
Belfast, Allegany county, and Canandaigua, *M. S. Baxter* and *V. Dewing*.

1415. **C. arcana** Beadle.
Canandaigua, *B. H. Slavin.*

1416. **C. cognata** Sargent.
Near Hemlock Lake, Livingston county, *Henry T. Brown.*

1417. **C. plana** Sargent.
Near Hemlock Lake, *Henry T. Brown.*

1418. **C Barryana** Sargent.
Rochester, *John Dunbar.*

1419. **C. inusitula** Sargent.
Chapinville Ontario county, *John Dunbar, M. S. Baxter.*

1420. **C. livingstoniana** Sargent.
Roadside, near east bank of Hemlock Lake, *Henry T. Brown.*

1421. **C. macera** Sargent.
In dense thickets near east bank of Hemlock Lake, *Henry T. Brown.*

1422. **C. longipedunculata** Sargent. (Described Ont. Nat. Sci. Bull. Nos. 41, 26, 1908) Canandaigua, Mrs. E. C. Webster.

1423. **C. foetida** Ashe (C. Baxteri Sargent, Proc. Roch. Acad. Sci. IV., p. 107.)
Occurs in Western New York, New England and in eastern Pennsylvania, whence it was described earlier than from Rochester.

1424. **C. verecunda** Sargent.
Type in Seneca Park. Infrequent.

1425. **C. barbara** Sargent.
Brighton, near Rochester, *B. H. Slavin.*

1426. **C. Dewingii** Sargent.
Open thickets, Belfast, *Vincent Dewing* and *M. S. Baxter.*

1427. **C. Crocata** Ashe.
Genesee Valley Park, *John Dunbar.*

1428. **C. Fulleriana** Sargent.
Type east of Genesee river. Occasional.

1429. **C. Ellwangeriana** Sargent.
Type in Ellwanger & Barry's nursery. Common. Also found in Livingston, Allegany, Wyoming and Ontario counties.

1430. **C. Pringlei** Sargent.
Occasional. Also occurs in Livingston and Allegany counties.

1431. **C. spissiflora** Sargent.
Type in Genesee Valley Park, Rochester. Occasional.

1432. **C. radians** Sargent.
Knickerbocker woods, Rochester, *M. S. Baxter* and *V. Dewing.*

1433. **C. Champlainensis** Sargent. (Described in Rhodora III, 20, 1901.)
Canandaigua, *B. H. Slavin.*

1434. **C. submollis** Sargent. (Described, Bot. Gaz. XXXI, 7, 1901.)
Canandaigua, *B. H. Slavin.*

1435. **C. Durobrivensis** Sargent. ROCHESTER THORN.
Type in Maplewood Park. Common. Also found in Allegany and Ontario counties.

1436. **C. Holmesiana** Ashe.
Common. Also found in upper Genesee valley.

1437. **C. acclivis** Sargent.
Type in Maplewood Park, Rochester. Common. Also found at Niagara Falls.

1438. **C. pedicellata** Sargent.
Type in Genesee Valley Park. Common. Also found in Wyoming county.

1439. **C. parviflora** Sargent.
Type in Seneca Park. Common.

1440. **C. Streeterae** Sargent.
Type along Oak Hill, Rochester. Occasional. Also found at Belfast, Allegany county.

1441. C. **glaucophylla** Sargent.
Common.

1442. C. **ornata** Sargent.
Type along Oak Hill. Occasional.

1443. C. **rubicunda** Sargent.
Type along Oak Hill. Infrequent.

1444. C. **tenuiloba** Sargent.
Type in Genesee Valley Park. Also found in Allegany county.

1445. C. **colorata** Sargent.
Type near Driving Park Avenue bridge, Rochester. Also found in Erie, Ontario, Wyoming and Allegany counties, and at Toronto, Ont.

1446. C. **Beckwithae** Sargent.
Type on west side of Genesee river, above Elmwood Avenue, Rochester. Scarce.

1447. C. **matura** Sargent.
Common. Also found in Ontario, Erie, Allegany, Livingston and Orleans counties.

1448. C. **Dunbari** Sargent.
Type in Ritter's Hollow. Frequent. Also found in Orleans and Erie counties.

1449. C. **benigna** Sargent.
Type in Genesee Valley Park. Frequent.

1450. C. **Slavini** Sargent.
Brighton, near Rochester, *B. H. Slavin.*

1451. C. **Boothiana** Sargent.
Wooded banks, near Rochester, *John Dunbar.* Murray, Orleans county, *M. S. Baxter.* Fillmore, Allegany county, *M. S. Baxter* and *V. Dewing.*

1452. C. **leptopoda** Sargent.
East bank of Hemlock Lake, *Henry T. Brown.*

1453. C. **gracilipes** Sargent.
Thickets near eastern bank of Hemlock Lake, *Henry T. Brown.*

1454. C. **genialis** Sargent,
Belfast, Allegany county, *M. S. Baxter* and *V. Dewing.*

1455. C. **bella** Sargent.
Belfast, *M. S. Baxter* and *V. Dewing*, Canandaigua, *B.H. Slavin.*

1456. C. **stolonifera** Sargent. (Described in Proc. Acad. Nat. Sci. Phila., 1903.) Tuscarora, *M. S. Baxter* and *V. Dewing.*

1457. C. **demissa** Sargent. (Described in Rhodora, May, 1903.)
Tuscarora, *M. S. Baxter* and *V. Dewing.*

1458. **C. cupulifera** Sargent.
Type east side of river, Genesee Valley Park. Common.

1459. **C. Macauleyae** Sargent.
Type in Genesee Valley Park. Occasional. Also found in Ontario county.

1460. **C puberis** Sargent.
Near Belfast, *M. S. Baxter* and *V. Dewing*.

1461. **C. neo Baxteri** Sargent.
Near Tuscarora, Livingston county, *M. S. Baxter* and *V. Dewing*.

1462. **C. Harryi** Sargent.
Richmond, Ontario county, *Henry T. Brown*.

1463. **C. Dodgei** Ashe.
Tuscarora, Livingston county, and Canandaigua, *M. S. Baxter* and *V. Dewing*.

1464. **C. succulenta** Link.
Common. Also found in Allegany and Erie counties.

1465. **C. gemmosa** Sargent.
Type in Genesee Valley Park. Rare.

1466. **C. Deweyana** Sargent.
Type in Hagaman swamp, near Rochester. *John Dunbar*. Occasional.

1467. **C. macracantha** Koehne.
Occasional.

1468. **C. ferentaria** Sargent.
Type in Genesee Valley Park. Common. Also found in Livingston and Allegany counties.

1469. **C. Laneyi** Sargent.
Type in Genesee Valley Park. Scarce.

1470. **C. structilis** Ashe.
Seneca Park, Rochester, *B. H. Slavin*.

1471. **C. finitima** Sargent.
Canandaigua, *B. H. Slavin*.

1472. **C. Calvini** Sargent.
Near Canandaigua, Ontario county, *C. C. Laney*, *M. S. Baxter*.

1473. **C. efferata** Sargent.
Near Hemlock railroad station, Livingston county, *H. T. Brown*.

1474. **C. honeoyensis** Sargent.
Roadside west of Honeoye Lake, Ontario county, *H. T. Brown*.

1475. **C. limosa** Sargent.
Hagaman's swamp, near Rochester, *John Dunbar*.

1476. **C. Letchworthiana** Sargent.
Meadows near Portage, *M. S. Baxter* and *V. Dewing*.

1477. **C. gloriosa** Sargent.
Near border of woods, Rochester, *John Dunbar*. Knickerbocker woods, Rochester, *M. S. Baxter* and *V. Dewing*.

1478. **C. simulans** Sargent.
Near road east side of Hemlock Lake, *H. T. Brown*.

1479. **C. scabrida** Sargent.
Belfast, Allegany county, *M. S. Baxter* and *V. Dewing*.

1480. **C. confinis** Sargent. (Described in Ont. Nat. Sci. Bull., 1908.)
Tuscarora, *M. S. Baxter* and *V. Dewing*.

1481. C. MONOGYNA Jacquin.
Cultivated species from Europe, sparingly naturalized throughout Monroe county.

SAXIFRAGACEÆ.

125. *SAXIFRAGA* L.

313. **S. Pennsylvanica** L. SWAMP SAXIFRAGE.
Mendon Ponds.

129a. *PHILADELPHUS* L. MOCK ORANGE. SYRINGA.

1482. P. CORONARIUS L.
Occasionally escaped from cultivation on the Pinnacle Hills, *John Dunbar*.

130. *RIBES* L.

320. **R. rotundifolium** Michx.
Occasional around Rochester, *John Dunbar*.

ONAGRACEÆ.

141. *EPILOBIUM.* L. WILLOW-HERB.

1483. **E. adenocaulon** Haussk.
Frequent around Rochester, *M. S. Baxter*.

142. *ŒNOTHERA* L. EVENING PRIMROSE.

1484. O. SINUATA L.
Railroad yard, eastern part of Rochester, *Dr. C. M. Booth*, 1896.

349. **O. pumila** L. [*Kneiffia pumila* (L.) Spach.]
Chili, near Black Creek, *Mrs. J. H. McGuire*. Irondequoit, *Miss Beckwith*.

143. *GAURA.* L.

1485. G. COCCINEA Nuttall.
New York Central railroad, near Despatch, *M. S. Baxter* and *V. Dewing*.

FICOIDEÆ.

146a. *MOLLUGO.* L.

1486. M. VERTICILLATA L. INDIAN CHICKWEED. CARPET WEED.
Railroad yard, Brighton, 1896, *Dr. C. M. Booth.* Railroad yard near North Avenue, Rochester, 1896, *J. B. Fuller*, several plants. Genesee Junction, *M. S. Baxter* and *V. Dewing*.

UMBELLIFERÆ.

163. *HYDROCOTYLE* Tourn. [L.]

376. **H. Americana** L. WATER PENNYWORT.
Rich's Mills, Penfield, *M. S. Baxter.* Greece, *Miss Beckwith* and *Miss M. E. Macauley.*

CORNACEÆ.

166. *CORNUS* Tourn. [L.] CORNEL. DOGWOOD.

1487. **C. Purpusi** Koehne.
Common in Genesee Valley Park. *John Dunbar.*
Cornus Purpusi is recognized as a variety of *C. amomum* in the Seventh Edition of Gray's Botany. As a matter of fact, *C. amomum* does not appear to grow in a wild state in Monroe county or vicinity. It is, however, quite common in cultivation in Rochester.

1488. **C. Baileyi** Coulter & Evans.
Durand Park, *John Dunbar.*

CAPRIFOLIACEÆ.

168. *SAMBUCUS* Tourn. [L.]

393. **S. Canadensis L.** COMMON ELDER.
A distinct variety of *S. Canadensis* with dark yellow fruit has been found growing naturally in a swamp on the west side of Durand Park, *John Dunbar.*

394. **S. racemosa** L. [*S. pubens Mich.*] RED-BERRIED ELDER.
A yellow-fruited variety of *S. racemosa* has been found growing naturally in Scottsville, also in Seneca Park and Durand Park, *John Dunbar.*

169. *VIBURNUM* L ARROW-WOOD.

1489. V. LANTANA L. (Gray's Bot. 7th edition.) WAYFARING TREE.
Established around Rochester, *John Dunbar.*

395. **V. lantanoides** Michx. [*V. alnifolium* Marsh.] HOBBLE BUSH.
Big Woods, Forest Lawn, *Mrs. H. G. Pierce.*

400. **V. cassinoides** L. (*V. nudum* var. *cassinoides* Torr & Gray).
Penfield, *M. S. Baxter.*

172. *SYMPHORICARPOS* Dill. [Juss.] SNOWBERRY.

406. **S. racemosus** Michx var. *pauciflorus* Robbins [*S. pauciflorus* (Robbins) Britton.]
Hill at Mendon, *Lewis S. Gannett.*

173. *LONICERA* L.

1490. L. XYLOSTEUM L. EUROPEAN FLY HONEYSUCKLE.
Naturalized in hedgerows etc., around Rochester. Pinnacle Hills.

1491. **L. sempervirens** Ait. TRUMPET HONEYSUCKLE.
Roadside, near Mumford, *Florence Beckwith*, 1909.

1492. **L. hirsuta** Eaton. HAIRY HONEYSUCKLE.
Limestone region of LeRoy, *E. J. Hill.*

1493. L. **Douglasii** Hook. [*L. glaucescens* Rydb.]
Rocky bank Genesee river near Glen House, Rochester, *J. B. Fuller.*

RUBIACEÆ.

175. *HOUSTONIA* L.

413. **H. cœrulea** L. BLUETS. INNOCENCE.
Hemlock Lake. *John Dunbar.*

177a. *DIODIA* Gronov.

1494. D. TERES Walt.
Railroad track, Pittsford, 1896. *Dr. C. M. Booth.*

178a. *SHERARDIA* Dill.

1495. S. ARVENSIS L.
Vacant lot, East Avenue, Rochester, *C. Vollertsen.*

VALERIANACEÆ.

179. *VALERIANA.* Tourn. [L.]

430. **V. sylvatica** Banks.
Powder Mills, Perinton, and Bushnell's Basin, *M. S. Baxter.*

DIPSACEÆ.

181a. *SCABIOSA* L.

1496. **S. australis** Wulf.
Rare. Wyoming, N. Y., *George Hartnell.*

COMPOSITÆ.

184. *SOLIDAGO* L. GOLDEN-ROD.

1497. **S. bicolor** L. var CONCOLOR T. & G.
Infrequent. Northeastern part of Rochester. *J. B. Fuller.*

454. **S. Ohioensis** Riddell.
Swamp one mile northeast of Pittsford, *M. S. Baxter.*

456. **S. lanceolata** L. [*Euthamia graminifolia* (L.) Nutt.]
Frequent now in and around Rochester.

184a. BELLIS Tourn. DAISY.

1498. B. PERENNIS L.
Persistent in lawns in various parts of Rochester and Scottsville.

186. ASTER L.

461. **A. Novæ-Angliæ** L.
A form with white flowers observed at Forest Lawn by *Mrs. H. G. Pierce*, 1904.

1499. **A. Lowrieanus** Porter.
Woods, fields, river banks; common.

1500. **A. sagittifolius urophyllus** (Lindl.) Burgess.
Greece, *J. B. Fuller.*

467. **A. lævis** L.
A white-flowered form was collected at the University Avenue Dugway by *Miss Beckwith*, September, 1896. A late-flowering variety, blooming in November, has been found by *Mr. C. Vollertsen* on the Pinnacle Hills for several years in succession. It differs from the type in elongated leaves and long, narrow panicle.

1501. **A. lævis amplifolius** Porter.
Collected by Botanical Section in the vicinity of Rochester.

469. **A. multiflorus** Ait.
Collected by Botanical Section in the vicinity of Rochester.

1502. **A. lateriflorus pendulus** (Ait.) Burgess.
Banks of Genesee river, Rochester, *J. B. Fuller.*

1503. **A. Novi-Belgii** L. var **elodes** Gray.
Scarce. Mendon Ponds, *M. S. Baxter.*

193. AMBROSIA L. RAGWEED.

1504. **A. trifida** L. var. **integrifolia** T. & G.
Plentiful along the railroad in Brighton, *J. B. Fuller* and *Dr. C. M. Booth.*

1505. A. PSILOSTACHYA DC.
Railroad yard northeastern part of Rochester, *Dr. C. M. Booth.*

197. RUDBECKIA L.

507. **R. hirta** L. YELLOW DAISY. CONE-FLOWER.
A form with all ray flowers tubular found by *F. W. Ross.*

508. **R. hirta** L. var ——. This variety, with band of dark brown at base of ray flowers, first reported in 1891, still persists in the same locality in Gates.

198. *HELIANTHUS* L. SUNFLOWER.

1506. H. ANNUUS L.
Introduced western forms, railroad embankment from Coldwater to Penfield station, *J. B. Fuller* and *Dr. C. M. Booth*, 1896.

1507. H. PETIOLARIS Nutt.
Railroad embankment at Pittsford and Gates, *J. B. Fuller* and *C. M. Booth.*

1508. H. RIGIDUS Desf. (the form *Harpalium rigidum* Cass.)
Railroad embankment Pittsford and Gates, *Dr. C. M. Booth* and *J. B. Fuller*, 1896.

1509. **H. giganteus** L.
Pittsford, *C. M. Booth.* Gates, *J. B. Fuller.*

1510. H. MAXIMILIANI Schrad.
Railroad weed, Pittsford, *Dr. C. M. Booth.* Gates, *J. B. Fuller.*

199. *COREOPSIS* L. TICKSEED.

1511. C. TINCTORIA, Nutt.
Scottsville, *Florence Beckwith.*

200. *BIDENS* L. STICKTIGHT. BEGGAR-TICKS.

1512. B. TENUISECTA Gray.
Highland Park, 1909, *Florence Beckwith.* Specimen in Herbarium of State Botanist.

200a. *GALINSOGA* Ruiz and Pavon.

1513. G. PARVIFLORA Cav. var. HISPIDA DC.
First reported by *Miss Beckwith* on Milburn Street, in 1898. Now plentiful in eastern and southeastern part of Rochester.

200b. *CHAENACTIS* DC.

1514. C. STEVIOIDES Hook. & Arn.
Reservoir Avenue, July, 1909. *Florence Beckwith.* Specimen in Herbarium of State Botanist.

203a. *MATRICARIA* Tourn. WILD CHAMOMILE.

1515. M. INODORA L.
Fields and roadsides, Rochester, 1897, *C. Vollertsen.*

204. *CHRYSANTHEMUM* Tourn. [L.]

1516. C. BALSAMITA L. var. TANACETOIDES Boiss. COSTMARY. MINT GERANIUM.
Roadsides. Pinnacle Avenue, Rochester, and Erie railroad just south of Genesee Valley Park, *John Dunbar.* Sweden, *M. S. Baxter.*

206. *ARTEMISIA* L. WORMWOOD.

532. A. BIENNIS Willd.
Railroad yard eastern part of Rochester, *Dr. C. M. Booth*; plentiful at Glen Haven, *M. S. Baxter.* Railroad yard at Le Roy, 1896, *J. B. Fuller.*

210. CACALIA L.

539. **C. suaveolens** L. INDIAN PLANTAIN.
Near Le Roy, *M. S. Baxter.*

212. ARCTIUM L. BURDOCK.

542. A. LAPPA L. var. MINUS Gray. COMMON BURDOCK.
Waste places; common.

1517. A. LAPPA L. var. MAJUS Gray. GREAT BURDOCK.
Rare. Buttermilk Falls, Genesee county, *M. S. Baxter.*

215. CENTAUREA L.

550. C. BENEDICTA L. BLESSED THISTLE.
Ash dump near eastern widewaters, Rochester, September, 1903, *Lewis S. Gannett.*

216. LAMPSANA Tourn. [Lampsana L.] NIPPLE-WORT.

552. L. COMMUNIS L.
Roadside, Scottsville, *Florence Beckwith.*

216a. SERINIA Raf.

1518. S. OPPOSITIFOLIA (Raf.) Kuntze.
Brighton, *C. Vollertsen.*

218a. THRINCIA Roth.

1519. T. HIRTA Roth.
Roadsides, Rochester. Rare. *C. Vollertsen.*

218b. LEONTODON L., Juss.

1520. L. AUTUMNALIS L. FALL DANDELION.
Roadside, Rundell Park, Rochester, 1882, *J. B. Fuller.* Neglected lawn, East Avenue, Rochester, *Dr. C. M. Booth.* Park Avenue, Rochester, 1898, *M. S. Baxter.* Le Roy, 1896, *J. B. Fuller.*

218c. ARNOSERIS Gaertn.

1521. A. MINIMA Dumort.
Fields, Rochester, *C. Vollertsen*, 1897. A specimen collected previous to 1892 was found among our unrecognized plants by *J. B. Fuller*, in 1899.

218d. HYPOCHAERIS L. CAT'S-EAR.

1522. H. RADICATA L.
Rochester and Brighton, *C. Vollertsen.*

219. HIERACIUM Tourn. [L.]

1523. H. PILOSELLA L. MOUSE-EAR.
Ellwanger & Barry nurseries, Rochester, *C. Vollertsen.* Seneca Park, *B. H. Slavin.*

220. CREPIS L.

562. C. VIRENS L.
Mt. Hope, 1866, *J. B. Fuller*; school grounds, Fairport, N. Y., *Mary E. Macauley*; roadside, Culver Park, 1882, *J. B. Fuller.*

563. C. TECTORUM L.
Rare. Brockport, *Prof. W. H. Lennon.*

221a. LYGODESMIA Don.

1524. L. EXIGUA Gray.
Highland Park, 1909, *Florence Beckwith.* Specimen in Herbarium of State Botanist.

LOBELIACEÆ.

225. LOBELIA.

576. **L. spicata** Lam.
Forest Lawn, 1904, *Mrs. H. G. Pierce.*

ERICACEÆ.

229. VACCINIUM L. BLUEBERRY.

1525. **V. atrococcum** (Gray) Heller. (V. *corymbosum* var. *atrococcum* Gray.)
Mendon, *B. H. Slavin.*

235. CASSANDRA Don. [CHAMÆDAPHNE Mœnch.]

599. **C. calyculata** Don. [*Chamædaphne calyculata* (L.) Mœnch.] LEATHER-LEAF.
Penfield, *M. S. Baxter.*

236. KALMIA. L.

1526. **K. glauca** Ait. PALE LAUREL.
Moss Lake, Allegany county, *M. S. Baxter* and *V. Dewing.* The only previous record for western New York is Machias, Cattaraugus county, in the Buffalo district. The same species is also reported by *Mr. Baxter* from Pedee swamp, five miles west of Hermitage, Wyoming county, the third station known in western New York.

ASCLEPIADACEÆ.

254. VINCETOXICUM. Mœnch. [CYNANCHUM L.]

638. V. NIGRUM Mœnch. [*Cynanchum nigrum* (L.) Pers.]
Roadside, Parma, *M. S. Baxter.*

GENTIANACEÆ.

254a. ERYTHRÆA Richard. CENTAURY.

1527. E. CENTAURIUM Pers.
On canal embankment beyond Cartersville, *M. S. Baxter.*

256. FRASERA Walt.

645. **F. Carolinensis** Walt. AMERICAN COLUMBO.
Allen's creek, *Mrs. F. W. Ross.* Geneseo, *M. S. Baxter.* Avon, *Vincent Dewing.*

257. BARTONIA Muhl.

646. **B. tenella** Muhl. [*B. Virginica* (L.) B. S. P.]
Springwater, Livingston county, *M. S. Baxter.*

BORRAGINACEÆ.

261. *CYNOGLOSSUM* Tourn. [L.]

654. **C. Virginicum** L. WILD COMFREY.
Mendon, *Mrs. J. H. McGuire.*

264. *MYOSOTIS* Dill. [L.]

1528. M. PALUSTRIS Withering. TRUE FORGET-ME-NOT.
Along Oatka creek, Scottsville, *Florence Beckwith.*

1529. **M. arvensis** Hoffm.
Brighton, *C. Vollertsen.*

1530. M. VERSICOLOR Pers.
Vacant lot, Park avenue, Rochester, *M. S. Baxter.* Brighton, *C. Vollertsen.*

265. *LITHOSPERMUM* Tourn. [L.] GROMWELL.

662. **L. latifolium** Michx.
Scottsville, *Florence Beckwith.*

266. *SYMPHYTUM* Tourn. [L.]

664. S. OFFICINALE L. COMMON COMFREY.
A white form collected by *Mary E. Macauley.*

665. S. ASPERRIMUM Sims. PRICKLY COMFREY.
On road between Chili and Gates, 1895; Greece, 1897, and June, 1898, *Mrs. J. H. McGuire.*

CONVOLVULACEÆ.

269. *IPOMŒA* L.

1531. **I. pandurata** Meyer. WILD POTATO-VINE. MAN-OF-THE-EARTH.
One mile south of West Rush, along roadside wall, *W. Streeter* and *M. S. Baxter.* Ridgeway Avenue, Greece, *Mary E. Macauley.*

SOLONACEÆ.

272. *SOLANUM* Tourn. [L.]

675. S. CAROLINENSE L. HORSE-NETTLE.
Railroad embankment, Brighton, *Dr. C. M. Booth* and *J. B. Fuller.* Boulevard, Greece, near Kodak Park, 1899, *Rev. John Walton.* Penfield, *V. Dewing.*

676. S. ROSTRATUM Dunal.
Railroad embankment near Scio street, 1896, *J. B. Fuller.* Railroad embankment, Pittsford, 1896, *C. M. Booth.*

273. *PHYSALIS* L. GROUND CHERRY.

1532. **P. Philadelphica** Lam.
Railroad embankment, Gates, September, 1896, *C. M. Booth* and *J. B. Fuller.* Rush, August, 1899, *Earl H. Clapp.*

679. **P. Virginiana** Mill. (*P. viscosa* Man.) [*P. heterophylla* Nees.]
Grand avenue, Rochester, and along N. Y. C. R. R., Brighton, *Dr. C. M. Booth.* Roadside, Culver street, *J. B. Fuller.* Plentiful at sand cut, near Penfield station, *J. B. Fuller.* Greece, *Miss Beckwith.*

1533. **P.** LANCEOLATA var. HIRTA Gray. [*Physalis pumila Nutt.*]
Railroad embankment, Rochester, *Dr. C. M. Booth.*

SCROPHULARIACEÆ.

281. *LINARIA* Tourn. [Juss.]

1534. L. CYMBALARIA (L.) Mill. KENILWORTH or COLISEUM IVY.
A single plant, Penfield station, *Dr. C. M. Booth.* Persistent in a lawn in Scottsville for many years, *Florence Beckwith.*

283a. *COLLINSIA* Nutt.

1535. **C. verna** Nutt.
Local. Rich bottom land, West Rush, *M. S. Baxter* and *William Streeter.*

285. *PENTSTEMON* Mitchell. [Soland.] BEARD-TONGUE.

1536. **P. laevigatus** Solander.
South Goodman street, Rochester, *C. Vollertsen.* Black Creek, *M. S. Baxter* and *V. Dewing.* Honeoye Falls, *M. S. Baxter.* Andrews road, Chili, *Mrs. J. H. McGuire.*

289. *VERONICA* L.

710. V. BUXBAUMII Tenore. [*V. Byzantina* (Sibth. & Smith) B. S. P.]
Monroe avenue, Rochester, 1898, *M. S. Baxter.* Irondequoit, field southwest of Float Bridge, 1908, *Lewis S. Gannett.*

290. *BUCHNERA* L.

711. **B. Americana** L. BLUE-HEARTS.
University avenue dugway, 1897, *M. S. Baxter.* Perinton, near powder mill, *James Bishop.*

VERBENACEÆ.

301. *VERBENA* Tourn. [L.] VERVAIN.

1537. V. BRACTEOSA Michx.
A railroad weed, near Leighton avenue, *Dr. C. M. Booth.*

LABIATÆ.

305. *MENTHA* Tourn. [L.]

1538. M. CITRATA Ehrh. BERGAMOT MINT.
Wayne county, *A. J. Perkins.*

308. *PYCNANTHEMUM* Michx. [KOELLIA Mœnch.] MOUNTAIN MINT. BASIL.

745. **P. lanceolatum** Pursh. [*Koellia Virginiana* (L.) Mac M.]
Mendon, *J. B. Fuller, George T. Fish, Florence Beckwith.* Swamp northeast of Pittsford, *M. S. Baxter.*

1539. **P. linifolium** Pursh. [*Kœllia flexuosa* (Walt.) Mac M.]
Swamp northeast of Pittsford, *M. S. Baxter.* River road, Rochester, *C. Vollertsen.* Near Canandaigua Lake, *Mrs. George C. King.*

747. **P. incanum** Michx.
Forest Lawn, Webster road, *Mrs. H. G. Pierce.*

310. *THYMUS* Tourn [L.]

749. T. SERPYLLUM L. WILD THYME.
Penfield, *Dr. C. M. Booth.* Seneca Park, *B. H. Slavin, Florence Beckwith, Mary E. Macauley.*

314. *MONARDA* L.

754. **M. didyma** L. BEE BALM.
Scottsville, *Florence Beckwith.* The Gulf, Genesee County, *M. S. Baxter.*

1540. **M. fistulosa** L.
Near Rochester, *Otto Betz.*

PLANTAGINACEÆ.

325. *PLANTAGO* Tourn. [L.] PLANTAIN.

1541. P. PATAGONICA Jacq. var ARISTATA Gray. [*P. Aristata* Michx.]
Parsells avenue, *Dr. C. M. Booth*, six or eight plants. On the Culver road between Park avenue and the canal bridge, about fifteen plants, *J. B. Fuller* and *C. M. Booth.* East Avenue, *C. Vollertsen.* Sodus Bay, *A. J. Perkins.*

NYCTAGINACEÆ.

325a. *OXYBAPHUS* Vahl. [L'Her.]

1542. O. HIRSUTUS Sweet. [*Allionia hirsuta* Pursh.]
Railroad yard, eastern part of Rochester, *Dr. C. M. Booth*, 1895. Allen's creek, *M. S. Baxter* and *V. Dewing*.

ILLECEBRACEÆ.

325b. *SCLERANTHUS* L.

1543. S. ANNUUS L.
Waste lot near East avenue, Rochester, *C. Vollertsen.* Park avenue, *M. S. Baxter.*

AMARANTACEÆ. [AMARANTHACEÆ.]

326. *AMARANTUS* Tourn. [AMARANTHUS L.] AMARANTH.

777. A. HYPOCHONDRIACUS L. [*Amaranthus hybridus* L.]
Railroad yard eastern part of Rochester, *Dr. C. M. Booth*, 1896.

781. A. BLITOIDES Watson. [*Amaranthus blitoides* S. Watson.]
Railroad yard, 1895, common from North avenue to Brighton, and perhaps beyond. August, 1896, in one place, just west of Prince street, for a distance of 150 feet, it was so abundant as to exclude nearly everything else. Frequent from Brighton to Penfield and from Rochester to Coldwater, though less frequent west than east of Rochester, September, 1896, *J. B. Fuller.*

CHENOPODIACEÆ.

326a. *CYCLOLOMA* Moquin. WINGED PIGWEED.

1544. C. PLATYPHYLLUM Moquin. [*C. atriplicifolium* (Spreng.) Coulter.]
Railroad yard, eastern part of Rochester, 1895, *C. M. Booth.* Vincent street flats, Rochester, *M. S. Baxter.*

326b. *KOCHIA* Roth.

1545. K. SCOPARIA Schrad. [*K. scoparia* (L.) Roth.]
Established on Garson avenue, Rochester, 1895, *Dr. C. M. Booth.*

327. *CHENOPODIUM.* Tourn. [L.] GOOSEFOOT. PIGWEED.

1546. C. FOETIDUM Lamk.
Canandaigua, *Mrs. E. O. Cartwright*, 1897.

1547. C. GLAUCUM L. OAK-LEAVED GOOSEFOOT.
Plentiful in railroad yards, Rochester. Scattered along tracks from Coldwater to Penfield. Plentiful in railroad yard at Le Roy, and frequent in dry bed of Oatka creek below Le Roy, *J. B. Fuller*, 1896.

785. C. BONUS-HENRICUS L. MERCURY.
Waste field, Lyndhurst street, Rochester, *J. B. Fuller.*

787. C. BOTRYS L. JERUSALEM OAK.
Common in railroad yard from Scio street to Brighton, and occasional along N. Y. C. R. R. west of the city, *J. B. Fuller.*

1548. C. AMBROSIOIDES L. MEXICAN TEA.
Corner Scio and Syracuse streets, Rochester, *J. B. Fuller*, 1896. Railroad yard, *Dr. C. M. Booth*, 1896. Vacant lot, Canal street, Rochester, *M. S. Baxter*, 1907.

328a. *MONOLEPIS* Schrad.

1549. M. NUTTALLIANA (R. & S.) Wats.
Reservoir avenue, 1909, *Florence Beckwith.* Specimen in Herbarium of State Botanist.

328b. *SALSOLA* L.

1550. S. KALI L. var. TENUIFOLIA G. F. W. Mey. RUSSIAN THISTLE.
Railroad yard eastern part of Rochester, *Dr. C. M. Booth*, 1896. River flats, Vincent street bridge, *M. S. Baxter*, 1898. Despatch and railroad yard, Lincoln Park, 1899, *Miss Beckwith.* Common now along railroads in various parts of the county.

POLYGONACEÆ.

330. *RUMEX* L. DOCK.

1551. **R. altissimus** Wood. TALL OR PEACH-LEAVED DOCK.
Bank of Honeoye creek, Rush, 1899, *Earl H. Clapp.* Lyndhurst street, *J. B. Fuller.* Lincoln Park, 1909, *M. S. Baxter.*

1552. R. CRISPUS L. x R. PATIENTIA L.
Lyndhurst street, Rochester, *J. B. Fuller.*

331. *POLYGONUM* Tourn. [L.] KNOTWEED.

1553. **P. lapathifolium** L.
Old canal near Genesee Valley Park, *M. S. Baxter* and *V. Dewing.*

1554. **P. punctatum** Ell. var. **robustius** Small.
Monroe county, *Botanical Section.*

ARISTOLOCHIACEÆ.

334a. *ARISTOLOCHIA* Tourn. BIRTHWORT.

1555. A. TOMENTOSA Sims.
Naturalized near Pinnacle Hill, Rochester, *John Dunbar.*

EUPHORBIACEÆ.

343a. *MERCURIALIS* L. MERCURY.

1556. M. ANNUA L.
West Brighton, and river road near Rochester, *C. Vollertsen.*

URTICACEÆ.

350. *URTICA* Tourn. [L] NETTLE.

844. U. DIOICA L.
Waste places, Rochester, *C. Vollertsen.*

1557. U. URENS L.
Adventitious. Avon, *C. Vollertsen.*

MYRICACEÆ.

357. *MYRICA* L.

1558. **M. asplenifolia** Endl. SWEET FERN.
Rare. Vosburgh's woods, Forest Lawn, *Mrs. H. G. Pierce,* 1890. Between Sea Breeze and Summerville, *Lewis S. Gannett.* Forest Lawn, *M. O. Stone, Miss H. F. Jacobs.*

CUPULIFERÆ.

363. *QUERCUS* L. OAK.

Q. alba x bicolor.
One large tree in Maplewood Park. *John Dunbar.*

SALICACEÆ.

366. *SALIX* Tourn. [L.] WILLOW.

886. **S. serissima** Fern.

Bergen Swamp. This is the late-fruiting plant noted in Plants of Monroe County, New York, as S. lucida Muhl. var. ————? It has since been raised to specific rank.

1559. **S. alba** L.

Forest Lawn, *Mrs. H. G. Pierce.*

898. **S. petiolaris** J. E. Smith.

Seneca Park, east, *J. B. Fuller.*

903. **S. myrtilloides** L. MYRTLE WILLOW.

Despatch, *M. S. Baxter.*

367. *POPULUS* Tourn. [L.]

907. **P. balsamifera** L. BALSAM POPLAR.

Along the shore of Lake Ontario, in Hamlin, *M. S. Baxter.*

MONOCOTYLEDONES.

ORCHIDACEÆ.

381. *EPIPACTIS* Haller [R. Br.]

931. **E. Helleborine** Gray, Man., not Crantz. [*E. viridiflora* (Hoffm.) Reichb.]
Webster, *M. S. Baxter*; Forest Lawn, *Mrs. H. G. Pierce*; North Rush and Henrietta, one in each town, near town line, on a dry knoll, *Earl H. Clapp*. Oak Orchard Creek, *Prof. W. H. Lennon*.

383 *CALOPOGON* R. Br. [LIMODORUM L.]

933. **C. pulchellus** R. Br. [*Limodorum tuberosum* L.]
Powder Mill, Perinton, *M. S. Baxter*.

386. *HABENARIA* Willd.

939. **H. bracteata** R. Br. (*H. viridis* var. *bracteata* Reichenb.) [*H. bracteata* (Willd.) R. Br.]
Big Woods, Forest Lawn, *Mrs. H. G. Pierce*. Pinnacle Hill, *Mrs. V. Dewing*.

947. **H. lacera** R. Br. [*H. lacera* (Mich.) R. Br.]
Chili, *Mrs. J. H. McGuire*.

IRIDACEÆ.

388. *IRIS* Tourn. [L.]

1560. I. PSEUDACORUS L. EUROPEAN YELLOW IRIS.
Well established near Shortsville, Ontario county, *Mrs. E. O. Cartwright*.

LILIACEÆ.

406. *TRILLIUM* L.

986. **T. cernuum** L. NODDING TRILLIUM.
Rare. Coldwater Station, Chili, *Prof. E. H. Eaton*, *M. S. Baxter* and *W. Streeter*. Orleans county, *Prof. W. H. Lennon*.

987. **T. erythrocarpum** Mx. [*T. undulatum* Willd.] PAINTED TRILLIUM.
Barnards, *Mrs. F. W. Ross*.

1561. **T. declinatum** (Gray) Gleason.
Abundant at West Rush, the only known station in our territory, *M. S. Baxter* and *W. Streeter*.

409. *VERATRUM* Tourn. [L.]

990. **V. viride** Ait. INDIAN POKE.
Greece, *Miss Mary E. Macauley*.

JUNCACEÆ.

413. *JUNCUS* Tourn. [L.] RUSH.

1562. **J. brachycephalus** (Engelm.) Buchenau.
Bergen swamp, Genesee county, *M. S. Baxter*.

TYPHACEÆ.

416. *SPARGANIUM* Tourn. [L.] BUR-REED.

1563. **S. simplex** Huds. var. *androcladum* Engelm.
Shore of Lake Ontario, Greece, *Florence Beckwith.*

ARACEÆ.

417. *ARISÆMA* Martius.

1017. **A. Dracontium** Schott. [*A. Dracontium* (L.) Schott.] GREEN DRAGON.
Red Creek, Henrietta, *Dr. C. M. Booth.* Black Creek, *M. S. Baxter.*

LEMNACEÆ.

424. *WOLFFIA* Horkel.

1564. **W. brasiliensis** Weddell.
Abundant in Irondequoit Bay, *J. B. Fuller.*

NAIADACEÆ.

429. *POTAMOGETON* Tourn. [L.] PONDWEED.

1565. **P. perfoliatus** L. var. **lanceolatus** Robbins.
Frequent. *J. B. Fuller.*

CYPERACEÆ.

432. *CYPERUS* Tourn. [L.] GALINGALE.

1053. **C. filiculmis** Vahl.
Abundant in barren, sandy fields between Point Pleasant and Sea Breeze. Near Riverside Cemetery, Greece, *Mary E. Macauley* and *Florence Beckwith.*

434. *ELEOCHARIS* R. Br. SPIKE-RUSH.

1059. **E. olivacea** Torr.
Mendon, *M. S. Baxter.*

440. *CAREX* Ruppius. [L.] SEDGE.

1091. **C. Grayii** Carey. [*C. Asa-Grayi Bailey.*]
Glen Haven, *Dr. C. M. Booth.*

1566. **C. Schweinitzii** Dewey.
Rare. Wayne county, *E. L. Hankenson.*

1567. **C. formosa** Dewey.
Rare. Seneca Park, Rochester, *Dr. Charles H. Peck*, 1904.

1568. **C. laxiflora** Lam var. **varians** Bailey.
Pavilion, Genesee county, *E. J. Hill.*

1145. **C. Careyana** Torr.
Mendon, *M. S. Baxter.*

1569. **C. tetanica** Schk. var. **Woodii** Bailey.
Pavilion, Genesee county, *E. J. Hill.*

1177 **C. interior** Bailey, *Bull. Torr Club, 20: 426 (1893).*
Mendon, *M. S. Baxter*; Riga, *Miss Beckwith.*

1570. **C. tribuloides** Wahl. var. **reducta** Bailey.
In woods, Penfield, *M. S. Baxter* and *V. Dewing.*

GRAMINEÆ.

443. *PANICUM* L.

1571. P. MILIACEUM L. EUROPEAN MILLET.
Grand avenue, *Dr. C. M. Booth.* Dumping ground near Culver street bridge, *J. B. Fuller* and *C. M. Booth.* Dumping ground, Augusta street, *J. B. Fuller.*

1195. **P. proliferum** Lam.
Railroad yard eastern part of Rochester, *Dr. C. M. Booth*, 1895.

1572. **P. macrocarpon** Le Conte.
Banks of streams, *J. B. Fuller.*

1573. **P. commutatum** Schultes.
Woods, Irondequoit, *J. B. Fuller.*

1574. **P. pubescens** Lam.
Border of woods, Irondequoit, *J. B. Fuller.*

444. *SETARIA* Beauv. FOXTAIL.

1575. S. VERTICILLATA Beauv.
Garden weed, Joslyn Park, Rochester, 1899, *J. B. Fuller.* Alexander street, *Miss Beckwith*, 1899. Boulevard, near Charlotte, *Rev. John Walton.*

445. *CENCHRUS* L. BUR-GRASS.

1208. C. TRIBULOIDES L.
Common from North avenue, Rochester, to beyond Brighton. Abundant at Penfield, whole fields being full of it.

458a. *MIBORA* Adans.

1576. M. MINIMA Desv.
Hodges' nursery, Brighton. Has been growing there at least three years, *Oscar Edson.*

459. *SPOROBOLUS* R. Br. RUSH-GRASS.

1233. S. VAGINÆFLORUS Vasey. (*Vilfa vaginæflora* Torr.) [*Sporobolus vaginæflorus* (Torr.) Wood.]
Railroad yard eastern part of Rochester, *Dr. C. M. Booth*, 1896. Railroad track, Gates, 1896, *J. B. Fuller.* Sparingly in both places.

466. DESCHAMPSIA Beauv. HAIR-GRASS.

1245. **D. flexuosa** Trinius. (*Aira flexuosa* L.) [D. *caespitosa* (L.) Beauv.] Sodus Point, *A. J. Perkins.*

468. AVENA Tourn. [L.] OAT.

1249. **A. striata** Michx.
Mendon, *J. B. Fuller.*

474. ERAGROSTIS Beauv.

1257. E. MAJOR Host. (E. *poæoides* var. *megastachya* Gray.)
Plentiful corner Scio and Syracuse streets, Rochester, *J. B. Fuller.* Powder Mills, Perinton, *M. S. Baxter.* Scottsville, *Miss Beckwith.*

1258. E. PURSHII Schrader.
Plentiful at Scio street and University avenue crossings, and scattered along railroad track from Coldwater to Penfield, *J. B. Fuller.*

479. BROMUS L.

1286. B. TECTORUM L.
Penfield, *Dr. C. M. Booth.* East Main street, Rochester, *J. B. Fuller.* Brighton, *J. B. Fuller.*

480. LOLIUM L. DARNEL.

1289. L. TEMULENTUM L. BEARDED DARNEL.
Near Morton, Monroe county, *Florence Beckwith.*

GYMNOSPERMÆ.

CONIFERÆ.

486. *PICEA.* Link.

1300. **P. nigra** Link. (*Abies nigra* Poir.) [*Picea Mariana* (Mill.) B. S. P.] BLACK SPRUCE.
Despatch, *M. S. Baxter.*

488. *ABIES* Link. [Juss.]

1302. **A. balsamea** Mill. [*A. Balsamea* (L.) Mill.] BALSAM FIR.
Springwater, Livingston county, *M. S. Baxter* and *V. Dewing.*

CRYPTOGAMIA.

VASCULAR ACROGENS. [PTERIDOPHYTA.]

EQUISETACEÆ.

493. *EQUISETUM* L. HORSETAIL. SCOURING RUSH.

1312. **E. palustre** L.
Glen Haven, *Miss Mary E. Macauley.*

1316. **E. scirpoides** Michx.
In fruit, April 27, 1897, Zarges Mills, *M. S. Baxter.*

FILICES. FERNS.

496a. *PELLÆA.* Link. CLIFF-BRAKE.

1577. **P. atropurpurea** Link. [*P. atropurpurea* (L.) Link.]
Rare. Both sides of the ravine at The Gulf, Genesee county, *M. S. Baxter*, July, 1896.

498. *ASPLENIUM* L. SPLEENWORT.

1321. **A. Trichomanes** L.
Brighton, *M. S. Baxter.*

1322. **A. ebeneum** Ait. [*A platyneuron* (L.) Oakes.]
Abundant at the Gulf, Genesee county, *M. S. Baxter.*

499. *CAMPTOSORUS* Link. WALKING-LEAF. WALKING-FERN.

1326. **C. rhizophyllus** Link. [*C. rhyzophyllus* (L.) Link.]
Abundant in rocky woods, Penfield, *M. S. Baxter.*

500. *PHEGOPTERIS* Fee. BEECH FERN.

1327. **P. polypodioides** Fee. [*P. Phegopteris* (L.) Underw.]
Big Woods, Forest Lawn, *Mrs. H. G. Pierce.* Stony Brook Glen, near Dansville, *Florence Beckwith.*

501. *ASPIDIUM* Swartz. [DRYOPTERIS Adans.] SHIELD FERN.

1578. **A. goldianum** x **intermedium** Dowell (comb. nov.) (*Dryopteris goldiana* x *intermedia* Dowell, Bull. Tor. Bot. Club, 35, 1908.)
Wet woods lower Genesee river. Scarce. *M. S. Baxter.*

1579. **A. cristatum** Swartz x **marginale** Davenport.
Riverside woods, bank of Genesee river, *M. S. Baxter.* Specimen in Davenport Herb.

1580. **A. Clintonianum** x **goldianum** Dowell (comb. nov.) *Dryopteris clintoniana* x *goldiana* Dowell, Bull. Tor. Bot. Club, 35, 1908.) (*A. goldianum* var. *celsum* (Palmer) Robinson.)
Occasional. Arbor vitæ swamp, Chili and wet woods lower Genesee, *M. S. Baxter.*

1581. **A. Clintonianum** x **spinulosum** (Benedict) Dowell (comb. nov.) (*Dryopteris Clintoniana* x *spinulosa* (Benedict)) Dowell, Torreya.
Scarce. Arbor vitæ swamp, Chili, *M. S. Baxter.*

1582. **A. Clintonianum** x **intermedium** Dowell (comb. nov.) (*Dryopteris Clintoniana* x *intermedia* Dowell, Bull. Tor. Bot. Club, 35, 1908.)
Frequent, Arbor vitæ swamp, Chili, and wet woods lower Genesee, *M. S. Baxter.*

1334. **A. spinulosum** Swartz var. **dilatatum** Hooker. [*Dryopteris spinulosa dilatata* (Hoffm.) Underw.]
Big Woods, Forest Lawn, *Mrs. H. G. Pierce.*

1583. **A. spinulosum** var. **concordianum** (Davenport) Eastman.
Rare. Arbor vitæ swamp, Henrietta, *M. S. Baxter.*

OPHIOGLOSSACEÆ.

506. *BOTRYCHIUM* Swartz. MOONWORT.

1351. **B. ternatum** Swartz var **dissectum** *Sprenger.*
Henrietta, *M. S. Baxter* and *V. Dewing.*

507. *OPHIOGLOSSUM* L. ADDER'S TONGUE.

1353. **O. vulgatum** L.
Near Coldwater and at Mendon Ponds, *M. S. Baxter.* Forest Lawn, *James Bishop.*

SELAGINELLACEÆ.

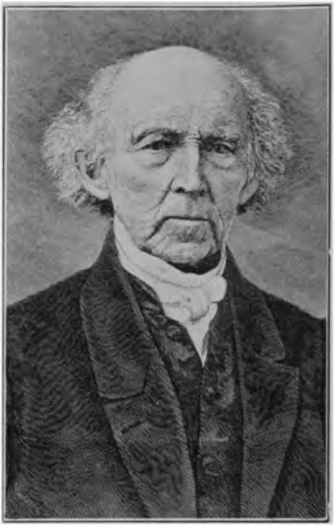
509. *SELAGINELLA* Beauv.

1358. **S. rupestris** Spring. [*S. rupestris* (L.) Spring.]
Dry sandy barrens, Penfield. Apparently the only station, except in the far west, where this plant does not grow on rocks, *M. S. Baxter* and *W. Streeter.*

1584. **S. apus** Spring.
Rare. Blue Pond, Wheatland, near Clifton, *M. S. Baxter.*

INDEX TO ORDERS, GENERA AND COMMON NAMES.

SAMUEL BEACH BRADLEY



CHESTER DEWEY

LAWRENCE HOLZER

EDWARD L. HANKENSON

EARLY BOTANISTS OF ROCHESTER AND VICINITY.

PROCEEDINGS OF THE ROCHESTER ACADEMY OF SCIENCE
VOL. 5, PP. 39-58, PLATES 1, 2. FEBRUARY, 1912

EARLY BOTANISTS OF ROCHESTER AND VICINITY AND THE BOTANICAL SECTION.

BY FLORENCE BECKWITH.*

The systematic study of the flora of Rochester and vicinity dates back many years. There were individual workers in the field almost a century ago of whose labors, fortunately, the records have been preserved, and of whose lives we have more or less knowledge.

With the exception of Dr. Dewey, who was a teacher of botany, these early explorers pursued the study of this science from pure love of it and of nature, and with an earnest desire to thoroughly acquaint themselves with the flora of the region. Their energy and enthusiasm have been a great incentive to later explorers, and rendered it possible to make a comparatively complete list of the plants of this region up to the present time.

While the memory of the work and of the individual personalities of these early botanists is still fresh in our minds, the Botanical Section wishes to show its appreciation of their labors by giving the following brief sketches of their lives.

SAMUEL BEACH BRADLEY.

Dr. Samuel Beach Bradley was one of the earliest, if not the earliest botanist of this section of the country. The period of his work is covered by the years of his residence in Monroe County, from 1825 to 1880. His work along the shore of Lake Ontario and the

*When the Botanical Section decided to prepare sketches of the early botanists and prominent members of the Section, a committee consisting of Miss Mary E. Macauley, Mr. M. S. Baxter and the author was appointed to do the work. Through the hearty co-operation of all the members of the committee the following paper has been prepared. Miss Macauley contributed the sketch of Mrs. Streeter, and Mr. Baxter rendered valuable assistance in procuring material for the sketches of Father Holzer and Mr. Hankenson. The committee congratulates itself that through the kind assistance of various friends, it has been able to obtain pictures of all the botanists of whom sketches are given.

inlets and ponds adjoining was particularly thorough. Some of the plants which he found in that vicinity have since become extinct, and many others are extremely rare, but occasionally one is rediscovered by our later explorers.

As a botanist, Dr. Bradley had more than a local reputation. He is given as authority in the Fifth Edition of Gray's Botany and is often quoted in catalogues of plants. In "Paine's Catalogue of Plants of Oneida County and Vicinity," published in 1865, Dr. Bradley is given as the sole authority for twenty-one species of plants found in this vicinity, and in the List of Plants of Monroe County, New York, and Adjacent Territory, published by this Society in 1896, he was credited with eleven species which had not been reported by any other local botanist.

Dr. Bradley was not only an enthusiastic and capable botanist, but he was noted as a scholar, being well versed in seven different languages and having a great love for books. His extensive knowledge, however, did not prevent him from taking an interest in even the most humble and common-place person who claimed his attention, and he was always ready to help any student.

One of our present-day botanists says that when he first became interested in the study of plants, he heard of Dr. Bradley as being a great authority in botany and as having a fine herbarium, so he determined to make him a visit. This necessitated a drive of several miles, for the young botanist lived in the western part of the county. He met with a very cordial reception, Dr. Bradley making particular inquiry as to what plants the young student was specially interested in, and taking great pains in showing him his herbarium, treating him with all the consideration he would have shown a grown-up person. It was a memorable afternoon for the young visitor, and it goes without saying that he drove home to Adams Basin a very proud and happy youth, more than ever interested in botany.

In person Dr. Bradley is described as being rather stout with broad shoulders and a fine head. His forehead was broad and high and his eyes dark and brilliant, lighting up as he became interested in conversation. His manners were cordial and his hospitality unbounded. Cheerfulness, love of humor, ready wit and quick repartee were among his prominent characteristics.

He retained his interest in botany as long as he lived, and the last few months of his life were devoted to naming and rearranging the plants in his herbarium. The greater part of his herbarium was given to the Northwestern University, at Evanston, Illinois, but a portion of it was donated to us by Dr. Daniel G. Hastings, of this city. Dr. Bradley died at his home in West Greece in 1880, at the age of 84 years. A more complete sketch of his life was published by this Society in 1894. (*Proc. Roch. Acad. of Sci., Vol. 2, pp. 261-263.*)

CHESTER DEWEY.

In 1836 Dr. Chester Dewey came to reside in Rochester. For many years he had been deeply interested in botany, and his "History of the Herbaceous Plants of Massachusetts" had been published by that State. He had also begun a Monograph of the Carices, his studies of which extended back to 1824.

In a sketch of Dr. Dewey, published after his death, President Anderson of the University of Rochester said: "He early became an enthusiastic student of botany and contributed very largely to the scientific knowledge of the Carices," and Dr. Asa Gray spoke of his writings on Caricography as "an elaborate monograph patiently prosecuted through more than forty years." Dr. Gray further said that in connection with the eminent botanists Schweinitz and Torrey, Dr. Dewey laid the foundations and insured the popularity of the study of the sedges in this country.

As a professor in the University of Rochester, Dr. Dewey interested many students in the study of botany, and the flora of the vicinity of the city was very thoroughly collected and examined many times. The Fifty-fifth Annual Report of the Regents of the University of the State of New York contained a paper by Dr. Dewey entitled: "Catalogue of Plants and Time of Flowering in and about the City of Rochester for 1841," but, unfortunately, he did not publish a complete record of his work in this region. In an admirable biographical sketch published by the Academy in 1900, (*Proc. Roch. Acad. Sci., Vol. 3, pp. 182-185*) Mr. Charles W. Seelye pays a warm tribute to Dr. Dewey as a man, as an instructor, and as a botanist, saying the influence which he exerted by his enthusiasm in his study of plants had passed onward and outward over a great region, and that some of the botanists of the present time owe indirectly to him their interest in botanical studies. Dr. Dewey's botanical work in Rochester extended from 1836 until 1866 or 1867, for up to the last of his life his mind retained the vigor and enthusiasm of his early years, and he was constantly writing on scientific topics.

LAWRENCE HOLZER.

The Reverend Lawrence Holzer was another of the early botanists and collectors of this region. He was born at Ratisbon, Bavaria, September, 1819, and graduated at the head of his class from the university of that city. He took Holy Orders in 1845, joining the order of Redemptorists, and two years afterwards came to this country as a missionary. In that capacity he was eminently successful, his eloquence winning many to religion who were deaf to less persuasive preachers.

Father Holzer was at St. Joseph's Church in this city from January, 1847, to July, 1848; from May, 1862, to August, 1865; and from May, 1875, to December, 1876, the time of his death. In the years 1862 to 1865 he was Rector of St. Joseph's, and endeared himself to the congregation by all of the ties which unite pastor and people.

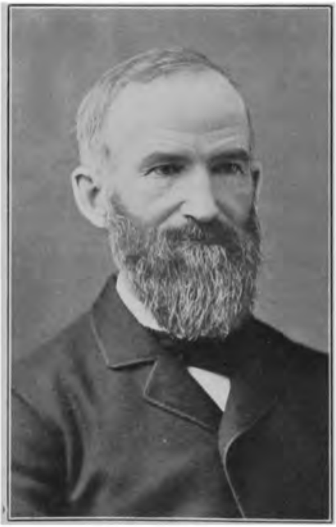
As a missionary he traveled extensively in this country, and was well-known from New Orleans to St. Paul, and from the east to the west of the continent.

Father Holzer was well known to many persons not of his religious faith. With Dr. Chester Dewey he had formed an intimate friendship through their mutual love for plants and interest in botany, and Dr. Booth and Mr. J. B. Fuller were also personally acquainted with him.

He was an enthusiastic botanist, and the garden at the pastoral residence was adorned with many rare plants of his collecting. As a collector, he was indefatigable, and he explored the city and vicinity very thoroughly. His check list shows that he had collected 766 species and varieties of plants in and around the city.

MARY E. STREETER

CHARLES W. SEELYE



CHARLES M. BOOTH

JOSEPH B. FULLER

EARLY BOTANISTS OF ROCHESTER AND VICINITY.

When collecting he gathered quantities of specimens which he sent to societies and institutions in Europe. Once in speaking of this he said: "I gather for all Europe,—all Europe." His large and valuable herbarium is deposited at Mt. St. Alphonsus, Esopus, N. Y.

Those of our members who were acquainted with Father Holzer, have spoken of him as being of very genial manners and particularly good company when on botanical excursions. Like all our collectors, he especially enjoyed excursions to Bergen swamp, that Mecca of western New York botanists, and his rapturous exclamations over the rare specimens found there still linger in the minds of those who heard them nearly forty years ago.

One of Father Holzer's personal possessions, which was kindly loaned our committee by the present Rector of St. Joseph's Church, shows how interested he was in botany and how his love for plants was interwoven with his daily life. In a little leather-covered memorandum book he had copied in his fine German hand the whole of some botany. Pocket editions of botanies were not then obtainable, and it was evident that he had made this copy in order to have it with him at all times for ready reference in field work. In the back part of the book were descriptions of plants which were useful in medicine.

Father Holzer's command of English, judging from the contents of this memorandum book, was quite equal to his knowledge of his own language, for he sometimes used one and sometimes the other with equal facility.

Father Holzer's death was universally regretted by the citizens of Rochester. It was felt that the church had lost a zealous and faithful priest, society a valued member, and science an energetic and learned disciple.

MARY E. STREETER.

Although there had been for so many years such an interest in the flora of this vicinity, there was no regularly organized botanical society in Rochester until in 1881.

April 13, 1881, Mrs. Mary E. Streeter called a meeting of those interested in botany, at her home on Scio Street. Eleven persons responded to the invitation, and then and there the Botanical Section of the Rochester Academy of Science was formed Mr. George T. Fish was President the first year and Mrs. Streeter Secretary. In February of the next year, Mrs. Streeter was elected President, which office she retained until her too early death

The aim of the Section was the systematic study of botany and the collection and identification of the plants indigenous to Rochester and its vicinity, with the design of publishing a complete list of the flora of Monroe County.

After the organization of the Botanical Section, the principal workers in our botanical field became members of it. A number of them have passed away, and it is fitting that the Section should make acknowledgment of its indebtedness to them and should give brief sketches of their lives and their work.

Among the Berkshire Hills, in the quiet little town of West Otis, Mass., Mary Elizabeth Bosworth was born, January 1st, 1842. At an early age her dying mother committed her to the care of an elder brother, Henry W. Bosworth, a well-known judge in Springfield, Mass. As a sacred charge he inspired and directed the little sister, and with this unusual guidance, among the breezy hills, she imbibed a love of nature in all its forms, and acquired a breadth and independence of thought and action not uncommon among those who "lift up their eyes unto the hills," instead of narrowing their vision by the limitations of city walls.

An apt, enthusiastic scholar of bright mind, she easily succeeded in whatever she undertook. She attended the High School in Hartford, Conn., when it stood well in the lead among the educational institutions of New England, and afterward attended the State Normal School at Westfield, Mass.

She taught in a private school in Belvidere, New Jersey, where she was greatly beloved and very successful in awakening and stimulating her pupils. With pronounced executive ability, she later took charge of a Young Ladies' Seminary, at Chester, Penna.

After three years of teaching, she married on February 24th, 1865, a gallant young officer just returning from the Civil War, Major William Streeter, who had also been bred among the hills and had kindred tastes. They located in Rochester in 1868.

By over-zeal in her profession, Mrs. Streeter's health, which was never robust, had become somewhat impaired, and after a happy wedded life of twenty years, during which every care had been bestowed upon her, she was called home June 14th, 1885.

Of Mrs. Streeter's zeal and enthusiasm in carrying on the work of the Botanical Section, many members still live to give their testimony. From the beginning, she felt that the first work of the Section should be the collection and preservation of the plants growing in the vicinity, before a catalogue could be published. During the four remaining years of her life, she labored, and inspired others to labor with her in the same cause, so that before her death she had the pleasure of seeing many of the plants of Monroe and adjacent counties mounted and placed in cabinets for the use of the Society. She also secured gifts of plants from other botanists with whom she corresponded.

But Mrs. Streeter's ambition went beyond the accumulation of a herbarium. With her eager thirst for knowledge, she longed to push out into unknown fields, and unquestionably, had her life been spared she would have attempted, at least, the solution of some of the unsolved problems of plant life. The writer well remembers the statement once made by Mrs. Streeter that she was willing to devote all her time of study to the vegetable kingdom. The turmoil and strife of historical narratives wearied her. In the peace and quiet of the plant world she found the rest and satisfaction she craved, for she ever looked "through Nature up to Nature's God."

Among the papers contributed by Mrs. Streeter to the meetings of the Botanical Section were: "Cross Fertilization of Plants," "On the Order Compositæ," "Ferns of Rochester and Vicinity," "On the Order Ranunculaceæ," and "Plant Histology." Besides the formal papers, she gave many talks on various topics relating to Botany.

While not caring to take time from her beloved botany to study with intensity the animal kingdom, Mrs. Streeter felt great kindness for animals. She saw the necessity of training children to look upon the lower animals with sympathy, and she was instrumental in having Bands of Mercy formed in many of the Rochester schools. And here, perhaps, it will not be inappropriate to mention a companion without whose assistance much of the labor of collecting plants could not have been accomplished in her frail state of health. This companion was her gentle horse, Bonny, who would wait with utmost patience while her mistress wandered into the woods or stopped by roadsides, and yet would push on briskly whenever speed was necessary. Those who had the pleasure of accompanying Mrs. Streeter on these excursions—and she loved to take her friends with her—all felt that Bonny was an ideal horse for a botanist. Nor would it be quite just to omit the mention of Gypsy, her dog, who was usually a guard on the botanical trips.

Mrs. Streeter was a lover of good literature, in which she was well versed. She often gave her friends great pleasure by reading aloud some excellent story or fine poem. Her retentive memory held in its keeping many passages from which she would add to her conversation in a most delightful way. Her sense of humor was strong, and she thoroughly enjoyed Lowell's Bigelow Papers. Whittier, too, was a favorite author.

Mrs. Streeter's death was a great loss to her family, her friends, the Botanical Section, and the community. Her memory is still precious, although years have passed away.

Charles W Seelye.

Mr. Charles W. Seelye, one of the charter members of the Botanical Section, was born at Greenwich, Saratoga County, N. Y., in 1829, and came to this city with his parents in 1835. Rochester was his home until his death, which occurred March 10, 1907.

In his youth Mr. Seelye studied dentistry, but not being robust he abandoned that profession and taught school. He afterward became associated with the late James Vick on the editorial staff of the *Genesee Farmer*. In 1844 he established the Rochester Central Nurseries, the firm being composed of C. W. Seelye and Hiram Sibley, with office located at East Main and Union streets. Later he became associated with James Vick, his brother-in-law, in editing Vick's Quarterly, which was superseded by Vick's Magazine. After the death of Mr. Vick, he continued to edit the Magazine for many years.

As a writer Mr. Seelye had few equals. His information on horticultural and botanical subjects was far-reaching and thorough, and his style elegant, polished and forceful. The diversity of his knowledge was remarkable, but he was particularly well-read on horticultural subjects and his information on all newly discovered or recently introduced plants was always up-to-date and reliable.

He was a landscape artist of more than local repute, being frequently called upon to plan and lay out grounds and cemeteries. He drew the plans for one of Rochester's most beautifully planted streets, Portsmouth Terrace, which was opened after the death of James Vick, nearly thirty years ago. The late George Ellwanger regarded the collection of trees and shrubs planted in this street as particularly choice for such a purpose, and the scheme has been largely copied in other cities.

Mr. Seelye was a charter member of the Western New York Horticultural Society, established in 1857. His reports as chairman of the Committee on Flowers and Bedding Plants were always of interest and profit. An arrangement had been made with him for a series of sketches of the men who were prominent in the history of horticulture during the past fifty years, but failing health prevented him from carrying out this project. He was greatly interested in the culture of grapes and for a number of years owned a fine vineyard at Vine Valley on Canandaigua Lake. He is credited with having originated several varieties of this fruit.

As a writer on horticultural subjects Mr. Seelye had an extensive experience, not only being editor of Vick's Magazine for many years, but also of "How to Grow Flowers," published at West Grove, Pa. He was the author of "The Language of Flowers," "How to Make a Lawn," the "Farmer's Handbook," and a game of cards designed to teach botany. He was a fine French scholar and took pleasure in gathering around him a coterie of young people with whom he read and discussed the literature of France.

Mr. Seelye was an ardent lover of flowers and early began the study of botany. He was a pupil of Dr. Chester Dewey and in June, 1895, contributed a memorial sketch of him for a meeting of the Academy of Science. In this sketch Mr. Seelye paid a warm tribute to Dr. Dewey and the influence which his interest in botany exerted over his pupils, and, indirectly, on succeeding generations. (*Proc. Roch. Acad. Science, Vol. 3, pp. 182-185.*)

Mr. Seelye was from the beginning one of the most interested members of the Botanical Section, contributing material for study and examination, and reading papers on various botanical subjects. At one time he was Corresponding Secretary for the Section. Though the infirmities of his later years prevented attendance at the meetings, he retained his interest in the work of the Section up to the very close of his long life. He was a fine general botanist, but for many years he devoted the most of his attention to collecting and studying ferns. In 1891 he contributed a very able article entitled : "A List of the Indigenous Ferns of the Vicinity of Rochester, with Notes," to the proceedings of the Academy (*Proc. Roch. Acad. Science, Vol. 1, pp. 186-197*).

In 1895 he made a gift of his large collection of ferns to the Academy. This collection contained most of the ferns of Australia and the Sandwich Islands, and many specimens from various other parts of the world, including New Zealand, South Africa, India, Ceylon, South America, Jamaica and others of the West India islands, as well as Great Britain and North America, in all numbering about 1,500 specimens. Nearly all the specimens were mounted and all were encased in a black walnut cabinet made expressly for them. He also presented to the Academy a number of books and publications relating to the filices, some of them very rare and costly, the whole making an exceedingly valuable gift.

In the letter which accompanied the gift, Mr. Seelye said that "the collection, examination, study and preparation of these specimens had been for many years an unfailing source of interest and information" to him, and he wished them to pass into the possession of the Academy for the use of its members. This collection, with the rest of our herbarium, is on deposit at the University of Rochester, and is open for inspection by those interested. In appreciation of this valuable gift, the Academy of Science made Mr. Seelye a Life Member of the Society, November 11, 1895.

Mr. Seelye was a warm friend, always ready to give advice and counsel when consulted, particularly on botanical subjects, and was esteemed by all for his courtesy, his kindness of heart and his quiet and unassuming disposition. His memory should always be cherished by the Botanical Section, not alone for his valuable gift of ferns, but for his warm interest in its affairs and its progress.

Joseph B. Fuller.

Mr. Joseph B. Fuller was born in Brooklyn, N. Y., October 31, 1827, and died in Rochester, February 16th, 1910.

When he was only three years old his family moved to Rochester, coming by way of the Erie canal and stopping on their arrival at the old Rochester House, on the corner of Exchange and Spring streets, then one of the prominent hostelries of the city.

At the age of fourteen, Mr. Fuller was apprenticed to the late Henry O'Reilly to learn the printer's trade. Later he was with the *Genesee Farmer*, published by the late James Vick and edited by the late Patrick Barry.

Being for years in close relationship with Mr. Vick in the printing office, and the two being drawn together by a mutual love of flowers, it did not require much persuasion to induce him to go into the seed business. In 1863 he entered the employ of Mr. Vick, and continued almost uninterruptedly with the Vick firm from that time until failing health, about a year before his death, necessitated his giving up active work.

Mr. Fuller's influence in the development of the business was scarcely second to that of Mr. Vick. His whole life was bound up in the work and his whole energy devoted to it. He was a thorough seedsman, far-seeing, conscientious and accurate. His knowledge of stocks was extensive and thorough ; his judgment and accuracy were without equal ; and his honesty unimpeachable. To his perfect integrity and absolute reliability the success of the Vick seed business was in no small degree due.

Mr. Fuller's geniality was one of his most prominent characteristics. He had a good story apropos to every occasion. His reminiscences of the early days of Rochester, and of the volunteer fire department, of which he was a member for many years, were particularly enjoyable. With his fellow workers in the seed business he was always pleasant, kind, patient and forbearing, with the old-time courtesy of manner. He will always be remembered in the seed house as "the grand old man."

On entering the seed business, Mr. Fuller soon realized that a knowledge of botany and especially of the local flora would be of great assistance to him in his work, and he entered enthusiastically into the study of systematic botany. He devoted himself so thoroughly to field work, that in a few years he reached a point far beyond the practical requirements of his business. He had, however, become so thoroughly in love with field study that he never lost interest in it, and even in his later years, after he had become too feeble to make excursions, he was always eager to examine the results of the explorations of other workers. Mr. Fuller's work as a botanist extended back to 1851. He was an ardent collector, a most faithful, painstaking, conservative and conscientious botanist.

When he began collecting, a great portion of what is now within the limits of the city was covered by the forest. He used to speak of jumping over the fence at Union street and botanizing in the thick woods all over the ground now occupied by the University buildings. The banks of the river on both sides from the upper falls down, afforded a rich field for botanizing, and Mr. Fuller probably explored it more thoroughly than any other collector. In the territory between Vincent street bridge and the old Hanford's Landing, a distance of two and a half miles, he found five hundred different species and varieties of plants. It is doubtful if a better record can be shown anywhere for the area covered. So thoroughly did he explore and collect in that vicinity, that very few plants were left to be reported by later botanists. The growth of the city has destroyed many of the species and the local names of the stations have passed from the memory of all except the oldest inhabitants, so the record of Mr. Fuller's work is all the more valuable.

Mr. Fuller was Curator in Botany to the Academy of Science for many years, and a devoted member of the Botanical Section, contributing much material to the meetings, and, by common consent, acting as supreme authority in the determination of specimens. His exact, critical knowledge often resulted in amusing disappointment on the part of less experienced members, who had brought in plants thinking them to be something entirely new, only to be told that they were some well-known species.

For several years Mr. Fuller devoted all his time to classifying, naming and arranging the plants in the herbarium of the Academy, generously donating to it his own large collection, numbering over 2,500 specimens, and also a fine collection of Syrian plants.

In recognition of these valuable gifts, the Academy made Mr. Fuller a Life Member of the Society and in 1899, in accepting his annual report as Curator, it was moved and unanimously carried that the Academy extend a vote of thanks to him for the exceeding interest he had manifested in the herbarium of the Society, for the great amount of work he had done, and the time he had spent in classifying and arranging the specimens. (*Proc. Roch. Acad. Sci., Vol. 3, p. 273*).

When the List of Plants of Monroe County and Adjacent Territory was published, Mr. Fuller did much arduous and painstaking work in its preparation. In fact, to his untiring labors, his accuracy and his zeal, the completeness of the list was largely due. He was so conservative that unless he was absolutely sure in regard to the determination of a plant, it was denied a place or a number in the list.

Not only did he perform much labor in the preparation of the list, but in the actual printing of it he did still more heroic work. It was difficult to find a compositor sufficiently familiar with botanical terms to set up the list in a satisfactory manner. Mr. Fuller came to the rescue, and, though it was years since he had stood at the case, he set all the type for this work of more than 150 pages. One has but to examine this publication and note the great amount of detail in it, to realize what a remarkable achievement this was for a man of his years, as well as from a typographical standpoint.

The Botanical Section has had many faithful members, but among them all Mr. Fuller stands pre-eminent for untiring service for the good of the Society and generous contributions of his valuable collections of plants.

CHARLES M. BOOTH.

Dr. Charles M. Booth, another of our early and indefatigable botanists, was born in Middlebury, Vermont, in October, 1830. He came to Rochester when he was about twelve years old, and obtained his education in the public schools and High School of this city. He studied medicine with the late Dr. E. M. Moore, and obtained his degree of M. D. from the University of Woodstock, Vermont. For some time after his graduation he was in the office of Dr. Moore.

When about 21 years of age, Dr. Booth, in company with two other Rochester young men, went to Valparaiso, South America, with the intention of engaging in the preparation of quinine, for exportation. Unfortunately, just after the arrival of these young men in South America, the Chilian government forbade the exportation of quinine. Thrown upon his own resources, Dr. Booth engaged in other occupations, practicing his profession, teaching school, conducting a drug store and a book store; he also worked as an engineer, and in the mines. After about ten years in 1861, tiring of the Southern country, he returned to the United States.

After his return to Rochester, Dr. Booth bought some land on the Culver Road, in the town of Irondequoit, and this was his home until his death, January, 1906. His intention in buying the land on which he made his home for so many years, was to engage in the cultivation of fruit, and that he did raise splendid fruit, many of his friends can testify, for his kindness of heart and generosity were proverbial. Though it was several miles from his home to the center of the city, he always walked into town, invariably refusing all neighborly offers of a ride. His inseparable companion on his trips to the city was a covered willow basket, holding, perhaps, about a peck. Many were the gifts of pears, apples, grapes and other fruit which his friends received from him. So inseparably was this basket connected with him, that on his death a friend begged it to hang on his wall as a memento, and many other friends will long remember the basket and its generous owner.

One of the greatest charms of Dr. Booth's home was his garden. It was not a formal garden, nor was it all in one plot. All the dear old-fashioned flowers were there, as well as many more recently introduced ones, and these were scattered around in different parts of his grounds. Many of our native plants had a home in his garden, and these were carefully planted in locations as nearly like their native habitats as possible. Some particularly rare species flourished as well in his garden as in their natural environment. *Rhododendron nudiflora* or *Azalea nudiflora*, the Pinxter Flower, one of the sweetest and most beautiful of our native plants, is difficult to transplant successfully. It may live a year or two in its new home, but it seldom becomes established sufficiently to blossom, and after lingering for a while it generally gives up the struggle for existence. But Dr. Booth had a splendid bush of this Rhododendron which he transplanted thirty years ago from its native woods, and which is still every season covered with its beautiful pink blossoms.

The generous spirit in which he placed everything in his domain at the disposal of his friends added another charm to visits there, and a walk around his grounds was always full of interest and delight. After taking his visitors all around his garden and noting every rare plant and flower, he would invariably say : "And now we will have some practical botany," and this "practical botany" consisted in sampling the choicest fruits of his orchard.

One rare specimen which Dr. Booth raised, and of which he was very proud, is a large tree, a hybrid between the English Walnut and the Butternut. This tree has attracted the attention of many botanists, and Dr. Charles S. Sargent, of the Arnold Arboretum, once paid it a visit.

When quite young, Dr. Booth became interested in botany, and such was his reputation in that study that when it was proposed to found a college at Havana, N. Y., he was offered a position as Professor of Botany. The endowment of Cornell University by Ezra Cornell prevented the building of the proposed college at Havana, and thus Dr. Booth lost a position which he would have filled with honor and credit to himself, and profit to the cause of education.

Dr. Booth was a charter member of the Botanical Section, and for many years a regular attendant at its meetings and a contributor of papers and material for examination. He was a man of wide reading and extended research, a fine general botanist, and exceedingly careful in determining specimens. His explorations around Irondequoit Bay were so thorough that he seemed to know every foot of ground. He was the first botanist in this country to discover the blossoms of *Lemna trisulca*, and is so credited in the Fifth Edition of Gray's Botany. In our List of Plants of this Vicinity, published in 1896, he is credited with many rare plants, and in our Supplementary List, lately published, he is authority for a large number of species.

His studies in later years were mostly among the grasses, mosses and algæ. His large collections of these plants have been given to the Academy, and will take their place in our herbarium. It was hoped that Dr. Booth would make his study of the mosses of this region so complete that it could be published by the Academy, but the infirmities of his later life prevented his accomplishing this.

Dr. Booth and Mr. Joseph B. Fuller were intimate friends and co-workers for many years in the field of botany. Mr. Fuller used to enjoy telling how, in his earlier botanical excursions, he frequently caught sight of another man carrying a tin collecting case, and wondered who he was. After a time their paths crossed, and it did not take long for them to form an acquaintance, which lasted until the close of their lives.

After the publication of our List of Plants of Monroe County, in 1896, the enthusiasm of all the members of the Botanical Section was newly aroused. Dr. Booth and Mr. Fuller were greatly interested, and made frequent trips up and down the railroad tracks, searching for recently introduced weeds, and never returned without securing more or less specimens new to our locality. The advent of the Russian Thistle was confidently expected at that time, for it was reported as on its way east, and many of our botanists were looking out for it, but Dr. Booth was the first to find it. He was remarkably quick to recognize a new plant; sometimes when walking along the street, conversing with a friend, and apparently not particularly interested in his surroundings, he would quietly step one side and gather an entirely new species, one which no one else had thought of looking for. As long as his strength permitted him to roam abroad, he was constantly on the lookout for new introductions, and as constantly finding them. The Botanical Section owes much to the labors and researches, the quick eye and trained mind of Dr. Booth.

In character, Dr. Booth was one of the most unassuming of men, gentle, quiet and retiring, enjoying to the utmost the freedom of his country life, with its flowers and its fruits and its opportunities for doing unostentatious deeds of kindness. His neighbors speak of him lovingly as one of the best of men, and one of them says that to her he was the most like Thoreau of any one she ever knew. To some of us he will ever be an exponent of the simple life.

The garden which he loved is being encroached upon by the busy world, on whose borders it lay for so long a time, but something of its charm is still left and we hope will exist for many years to come. It will be a great loss to the lovers of nature when Dr. Booth's garden is entirely blotted out.

EDWARD L. HANKENSON.

Mr. Edward L. Hankenson, a Corresponding Member of the Academy, was born in Newark, N. Y., March, 1845, and died in the same town in February, 1910. His education was obtained in the Newark High School, and at an early age he entered his father's business, developing it, as years went on, into the well known establishment of Hankenson & Son, and continuing in it until his death.

When about seventeen, Mr. Hankenson began a careful study of botany, and devoted years to this most congenial pursuit. It was not only his great recreation, but he had the ambition to make a complete collection of the flora of Wayne County, and most thoroughly did he explore every portion of that territory. He became an authority on the plants of the region, and for a time conducted a class in botany in the Newark High School. For years he was in personal correspondence with the most eminent botanists of this country, including Asa Gray, Alphonso Wood, Dr. John Torrey, Dr. J. W. Robins, Mrs. Lincoln Phelps, and many others.

Upon the organization of the Botanical Section, Mr. Hankenson became much interested in its work, frequently attending the meetings and contributing many specimens for the herbarium, representing not only the flora of Wayne County and our own neighborhood, but other parts of the country as well. When the List of Plants of Monroe County and Adjacent Territory was published, Mr. Hankenson was authority for hundreds of specimens from Wayne County. After his death, through the kindness of Mrs. Hankenson, his large herbarium, comprising a complete collection of the plants of Wayne County, also many foreign specimens, became the property of the Academy and is incorporated with our other possessions.

One marked characteristic of Mr. Hankenson's work in connection with the flora of Wayne County, was his demand for absolute accuracy. Before making a record, he insisted on seeing the actual plant. One of the most noteworthy plants in his list, *Cypripedium arietinum*, when reported in Wayne County, was far from any other recorded station. This specimen, a single plant, was collected by other botanists, but Mr. Hankenson, by an exchange, succeeded in obtaining it, and it is now in our herbarium, the only specimen known to have been found within the limits of our territory.

One who knew him well has said: "In character, Mr. Hankenson was singularly reserved, though warmly expansive to those of kindred mind. Gifted with a remarkable memory, by constant reading he stored his mind with the best to be obtained from literature, thus adding to his native inborn culture. Clear and clean-minded, most Christian in his judgments, unselfish, unfailing, uncomplaining,—to those who knew him best his life will ever be an illustration of the Christ example, and the memory of his home life will be a lasting memorial of his beautiful, consistent character."

Work of the Botanical Section.

In a report of the Botanical Section made June 11, 1881, Mrs. Streeter, its founder and first Secretary, said: "The work of making a collection of the flora of the vicinity of Rochester is thus fairly commenced, and we believe the work is in the hands of those who will not rest from their labors as long as there is one herb, shrub, or tree in our neighborhood that has not yielded up at least one of its secrets."

The founder of the Section and many other members have passed away, but the work is still being carried on. Looking back over the thirty years of its existence, the members of the Section can see that some of the dreams of its founder have been realized, and we can only regret that she was not longer permitted to share in the work and in the measure of success obtained in making a collection of the flora of this vicinity. A brief history of what has been accomplished is of interest in this connection.

Ever since its organization, the Section has met regularly, with varying attendance as to numbers, but during that period there has been no suspension of meetings except occasionally for brief summer vacations.

During the early years of the Section, the meetings were held at the rooms of the Academy, then located in the Reynolds Arcade. When the Society changed its headquarters to the University of Rochester, in 1889, on invitation of Mr. Streeter, the Botanical Section met at his residence, and ever since that time his house has been generously and hospitably opened to us. The Section has greatly appreciated the privilege which has been so cordially and generously accorded it for twenty-two years. There is no doubt that this hospitality of Mr. and Mrs. Streeter has had much to do with the continued life of the Section, as well as with the successful work done, for Mr. Streeter's extensive library and microscopical resources have always been at the service of its members, and having a permanent meeting place has added to the feeling of stability, which is essential to the success of any society.

In 1896 the Academy published a List of Plants of Monroe County and Adjacent Territory, prepared by a committee of the Botanical Section. This list comprised 1208 species and varieties of plants found growing without cultivation in Monroe County, and 106 in adjoining counties, in all, 1314 species and varieties. In 1910, a committee of the Section prepared a Supplementary List, which was published by the Academy. In this list the number of plants reported in Monroe County (including the list of 1896) is 1387, the total number for Monroe County and vicinity being 1584.

And the work has not ceased. The members of the Section are still collecting and studying. We still have among our number as enthusiastic and indefatigable workers as those who have passed away. Already 40 or more additional species have been reported since the Supplementary List was published in May, 1911. The recent work of prominent botanists on the Cratægus, Violets, Ferns, Grasses and other groups has revealed many unsuspected species, and has opened a field for renewed efforts among the flowering plants of this vicinity, and in the cryptogams there is a wide opportunity. The work on the mosses which Dr. Booth began should be carried on to completion.

Our herbarium now comprises more than 15,000 specimens. We have been given the large collections of Mr. Fuller, Mr. Seelye, Dr. Booth, Mrs. Streeter, and Mr. Hankenson. Other members of the Section have been generous, and have contributed specimens from

Colorado, Florida, Massachusetts, Montana, New Hampshire, Vermont, and other parts of the United States, so our herbarium is not limited to the plants of this region, and it is not only of goodly size, but of great working value.

The Section is open to all members of the Academy, and it cordially welcomes to its meetings those who take an interest in the plants of this vicinity.

PROCEEDINGS OF THE ROCHESTER ACADEMY OF SCIENCE
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PLANTS OF MONROE COUNTY, NEW YORK, AND ADJACENT TERRITORY.

SECOND SUPPLEMENTARY LIST.

BY FLORENCE BECKWITH, MARY E. MACAULEY AND MILTON S. BAXTER,

Committee of the Botanical Section.

CONTENTS.

EXPLANATION.

In 1896 the Botanical Section of the Rochester Academy of Science published its first list of the "Plants of Monroe County, New York, and Adjacent Territory," the result of labors extending over many years.

In May, 1910, a "Supplementary List" was published covering the same territory, adding 225 new species and giving about one hundred new stations for plants which were considered rare or scarce. Since the issuing of the second list so many new species have been discovered by the members of the Section, and so many new stations for rare and scarce plants disclosed, that the publication of another Supplementary List has been deemed advisable. This list has been compiled from the records of the Section, and only such plants are included as have been identified by experts, and of which specimens are available for verification in the collections of the Academy and of the Park Commission at Rochester, in the State Herbarium at Albany, the National Herbarium at Washington, or in private collections of the members. Our acknowledgments are due to the State Botanist and to several members of the staff of the National Herbarium for their kindness in the identification of species.

In Rochester and vicinity many trees remarkable for size, beauty of form or rarity are to be found. Mr. John Dunbar, Assistant Superintendent of Parks, whose knowledge of the trees of the region is widespread and thorough, kindly consented to describe some of the most noteworthy specimens and give their locations.

Mr. Fred S. Boughton, a member of the Botanical Section, has devoted several years of study to the Hymenomyceteæ of Rochester and some of the adjoining towns, and the results of his labors are given in a list following that of the flowering plants. Mr. Boughton is a close and indefatigable student, and his labors have been recognized by having his name given to two new species which he discovered, one in the Adirondacks and the other in Monroe county: *Lactarius Boughtonii* Pk. and *Hypholoma Boughtonii* Pk.

Territory Included.

The territory included covers the same area as the lists of 1896 and 1910, comprising the whole of Monroe county and parts of Genesee, Livingston, Ontario, Orleans and Wayne counties, being in general the lower drainage basin of the Genesee river, with that of Irondequoit creek and smaller streams upon the lake border. Localities in Ontario county which had not been thoroughly explored previously, have within the last two years been visited many times by our members, and, in consequence, a number of new species and several new stations for rare and scarce plants have been added to our list.

Introduction of Species.

The number of introduced species is increasing rapidly every year. Many of these introductions are western plants and are found along the railroad tracks, which have been quite regularly patrolled by some of our members every season.

In the summer of 1909 several species of plants foreign to our flora were found at Highland Park, in the southern part of the city. These plants were growing on newly seeded portions of the park. The grass seed used in sowing these places had been purchased from several different dealers and then mixed, so it was impossible to trace its origin, but the new species were mostly western plants.

The same stock of grass seed was used for seeding the slopes of the Cobb's Hill reservoir, then lately completed, and the following year a large number of new species of plants were found thriving vigorously in this new home. Through the kindness of Mr. C. C. Laney, Superintendent of Parks, these new plants were allowed to grow unmolested, and they increased in number and variety until 36 species foreign to our district had been found around the reservoir and at Highland Park.

After a few years it became impracticable to allow the grass on the slopes of the reservoir to remain uncut. For at least three or four years mowers have been regularly run over the ground and the plants have had to try to hold their own and make their way as best they could. It speaks well for their sturdiness and persistence that the majority of them have retained their hold and still survive. During the summer of 1916 representatives of nearly all the new species were found growing in more or less vigor, although, as a result of their being so frequently decapitated, many of them have not been allowed to blossom and so have not increased in abundance. Occasionally some in a favored location, close to a protecting tree or shrub, or on the steep sides of the reservoir where they have escaped the sharp teeth of the mowers, still not only survive but bloom quite freely. As it seems unlikely that any of them will ever become pernicious weeds, it is hoped that no particular pains will be taken to eradicate them, and that they will be allowed to live and thrive, for it adds interest to our flora to have these far western plants domesticated here.

The following list gives the names of these foreign species, all of them determined by the State Botanist, and all represented in the herbarium of the Academy, or the State herbarium, or in the collections of the members of the Botanical Section:

Stipa comata Trin. & Rup.
Bouteloua oligostachya (Nutt.) Torr.
Hordeum jubatum L.
Atriplex rosea L.
Chrysothamnus pinifolius Greene
Oenothera pallida Lindl.
Verbena bracteosa Michx.
Grindelia squarrosa (Pursh) Dunal
" " var. *nuda* A. Gray
Chrysothamnus pinifolius Greene
Gutierrezia Sarothrae Britton & Rusby
Sideranthus gracilis (Nutt.) Rydb.
Aster multiflorus Ait.
Machaeranthera tanacetifolia (H. B. K.) Nees
" *pulverulenta* (Nutt.) Greene
Gymnolomia multiflora (Nutt.) Benth. & Hook.
Helianthus petiolaris Nutt.
Lychnis alba Mill.
Lobularia maritima (L.) Desv.
Sisymbrium Sophia L.
Anthyllis vulneraria L.
Erodium cicutarium L.
Bidens tenuisecta A. Gray
Chaenactis stevioides Hook. & Arn.
Dyssodia papposa (Vent.) Hitch.
Artemisia dracunculoides Pursh
" *glauca* Pall.
" *filifolia* Torr.
" *frigida* Willd.
" *biennis* Willd.
" *gnaphaloides* Nutt.
" *trifida* Nutt.
" *carruthi* Wood
Senecio eremophilus Rich.
Carduus crispus L.
Lygodesmia exigua A. Gray

Epilobium hirsutum L. was first found on the tracks of the New York Central railroad near Bergen in 1913. In 1914 it was found in a swamp two or three miles north of Scottsville; in 1915 in the southern part of the village of Scottsville; in 1916 in Rochester, Mendon and various other places, showing how rapidly new plants are disseminated.

A number of plants which were noted as rare or scarce in our previous lists, are now reported from various stations. Notably among these is *Serapias Helleborine* L. [*Epipactis Helleborine* Gray.] In our list of 1896 one station was given for it, the third reported in the State. In the Supplementary List, published in 1910, five new stations were reported, but it was still considered scarce. In the present list four more stations are given, and, in fact, it is being found in so many places that we are beginning to consider it almost common.

Sisymbrium altissimum L., first given in our list of 1910, has become so plentiful as to be considered pestiferous.

New Species.

In the Seventh Edition of Gray's Botany many genera have been entirely revised, resulting in the addition of numerous species. This has afforded an opportunity for the critical study of several of our common genera, and has shown that in our territory a large percentage of the new species are present. This is notably the case in the genus Viola, to which 11 new species have been added, and to the genus Antennaria, which now includes 8 species, instead of the single one of our former list. Other genera, to a less degree, have also been studied with like results, and it is believed that continued investigation will show the presence of many species not yet included in our lists.

The studies on Crataegus, Carya and Malus have been continued by Messrs. Dunbar, Slavin, Brown, Baxter and Dewing, and many species from this locality have been described by Dr. Sargent. References to the original publications are given with the species. Twenty-three new species of Crataegus and nine new Carya are given in the present list.

Rediscovery of Species.

In our list of 1896 a number of species were noted which had not been reported for several years. Some of these have since been rediscovered. *Gentiana puberula* Michx. was found at Bushnell's Basin in 1914, only to have the station entirely destroyed before another year. *Buchnera Americana* L. has been found in two localities. *Spiraea tomentosa* L. has been discovered in Simpson's woods. *Abies balsamea* Mill. was found at Springwater and Gulick, Ontario county. Although these are not in all cases the original stations, it shows that the species noted are still to be found within our territory, and it is possible that others which have not been reported of late years will be brought to light by the persistent search of our botanists.

Noteworthy Trees in Rochester and Vicinity.

By John Dunbar.

During the past sixty to seventy years the city of Rochester has been an important nursery center. A number of progressive nurserymen introduced many trees from various foreign sources to be tested in their grounds and sold to customers if they proved to be sufficiently hardy. The firm of Ellwanger & Barry did a great deal of work, at great expense, in introducing, testing and distributing many interesting trees from various parts of the world, and many of these are now to be seen in the City of Rochester and vicinity.

The Valley of the Genesee in the vicinity of Rochester is particularly adapted, through favorable climatic conditions, for growing many of the hardy trees of the north temperate zone. For example, the Chinese Magnolias, and hybrids derived from these Magnolias, grow with remarkable success in Rochester and vicinity. Perhaps there is no other city in the northeastern United States where these Magnolias grow any more freely. *Paulownia imperialis,* Sieb. & Zucc., from China and Japan, is well known to be a tender tree and fails in many parts of the northern United States, but it succeeds very well in Rochester.

The purpose of this paper is to record some of the most notable foreign trees in Rochester and vicinity, and a few of the most prominent of the native trees. The circumference of the trees has been ascertained four feet from the base, unless otherwise stated. The heights of all the trees has been estimated, and as this is a matter of judgment, without correct measurement, these heights are to be taken as approximately correct.

Ginkgo biloba Linn., the Maidenhair Tree, has been planted liberally throughout the city. The largest individual grows at No. 455 Lake Avenue. This is the old home of the late James Whitney. The circumference is 8.1 feet, and the height is 60 feet. Judging by its appearance, it might have been planted sixty years since. On the Ellwanger & Barry grounds near the office, on Mt. Hope Avenue, there is a Maidenhair Tree with a circumference at three feet above the base of 6.5 feet, and the height is 55 feet. On what used to be the nursery grounds of the late T. B. Yale & Son at the Winton Road near the canal bridge a Maidenhair Tree with a girth of 5.2 feet, and a height of 65 feet, shows a greater height than the other two on account of proximity, perhaps, to other trees. The Maidenhair Tree has not been found in a wild state but has been planted extensively in Japan and China for hundreds of years.

Pinus excelsa Wall, the Bhotan Pine from the Himalayas, grows on the grounds of Mrs. Gilman Perkins, No. 421 East Avenue. This is a handsome species of white pine. The drooping leaves are six to eight inches long. It is 4.2 feet in circumference and 40 feet high, and is the largest individual in Rochester and vicinity.

Pinus ponderosa Dougl. the Bull Pine, native from British Columbia to Mexico, Nebraska and Texas, attains considerable size in this city. In the Ellwanger & Barry nursery grounds, on Mt. Hope Avenue near the office there are two trees which measure respectively in circumference 6.9 and 5.8 feet; the larger is 65 feet and the smaller 60 feet in height. At No. 455 Lake Avenue a healthy individual of *Pinus ponderosa* measures 6.5 feet in circumference and is 55 feet tall.

Abies Nordmaniana Spach. from the Black sea regions is one of the noblest of the firs and it does remarkably well in Rochester. One of the best examples grows on the grounds of the Ellwanger &

Barry vineyard, Highland Avenue at the bottom of the south slope. It measures 4.9 feet in circumference, and is 75 feet in height. As far as can be ascertained it was planted with a number of other trees by the late George Ellwanger about sixty years ago.

Abies Picea Lindl. (*A. pectinata* DC.) the Silver Fir from the mountains of central and southern Europe, is a fir with a somewhat tender reputation. A fine individual grows on the east side of the Winton Road near the canal bridge, and south of the bridge. The circumference is 6.5 feet, and the height is 75 feet. The adjoining land where this tree stands was at one time an important nursery owned by T. B. Yale & Son. It has been abandoned for many years and is now built up. This fir and a number of other important trees were planted by T. B. Yale & Son about 1858 to 1860 as nearly as can be ascertained.

Sequoia Wellingtonia Seem., the famous Big Tree of California, was introduced by Ellwanger & Barry from California in 1864. The seed came across the continent by pony express in a snuff box Thousands of seedlings were raised by Ellwanger & Barry, and mostly sold in Europe. A group of five trees, from these seedlings, now stands near the office on Mt. Hope Avenue. They vary considerably in size. The largest is 7.9 feet in circumference, and the height is 55 feet. What is probably one of the same group of seedlings stands on the old T. B. Yale & Son nursery grounds on the Winton Road, but it shows signs of failing health. It is 6.5 feet in circumference, and 50 feet in height.

It is surprising to see on the old T. B. Yale & Son nursery grounds a healthy individual of *Libocedrus decurrens* Torr., the Incense Cedar of the Pacific Coast. It is 2.5 feet in circumference, and is 35 feet tall. It is the only individual of any considerable size in Rochester and vicinity.

Chamaecyparis Lawsoniana Parl., commonly known as Lawson's Cypress, is represented by a good healthy individual on the grounds of the Ellwanger & Barry vineyard, at the bottom of the south slope of the hill. It shows a peculiarly swollen base. The circumference is 4.9 feet and the height 40 feet. As far as can be ascertained this is the only individual growing in Rochester and vicinity, with the exception of a few small plants growing in the conifer collection in the public parks. It is a matter of much surprise for many horticulturists to see this beautiful tree doing so well so far north. It is native from Oregon to California.

Juglans regia Linn., the Persian Walnut, commonly known under the name of English Walnut, has been considerably planted in the city and vicinity, and it bears crops of nuts quite freely. The largest individual tree in Rochester and vicinity grows in the village of Greece, on the Ridge Road, and on the side of the road. The circumference is 7.6 feet, and the height 45 feet. An interesting hybrid walnut grows at No. 1210 Culver Road, at the home of Miss Mary A. Booth. Her father, the late Dr. C. M. Booth, procured a nut from a Persian Walnut tree, growing at that time at the east end of Garson Avenue, and planted it at the rear of his house, about forty years ago. When this tree began to bear nuts it was observed they differed from the parent considerably. It was further noticed that the leaves, buds and bark of the tree were intermediate between the Butternut and English Walnut, and it consequently proved to be a hybrid between the two. This was explained by the proximity of a Butternut to the Persian Walnut from which Dr. Booth procured the nut. By a mere accident Dr. Booth happened to take the nut in which the pistil of the flower had been cross pollinated by the Butternut. The girth is 8.5 feet, the height 50 feet, and the spread of branches 75 feet. An orchard of Persian Walnuts, consisting of about eight acres, has been established on the farm of L. S. Thompson, East Avon, and was planted thirty-one years since. This orchard has received considerable attention from the Bureau of Plant Industry, Washington, D. C.

Populus nigra variety *betulifolia* Torr. is a poplar of much interest. Michaux found this poplar growing on the banks of the Hudson River and believing it to be a native American poplar, gave it the name of *Populus Hudsonica.* Pursh again found it growing in 1814 somewhere on the shores of Lake Ontario, and named it *Populus betulifolia.* The date of its introduction from Europe is unknown, but it is known to be a form of *Populus nigra* Linn. It does not seem to have perpetuated itself to any extent in this country, and the large individual in front of the Rochester Trade School at Exposition Park is the only one known in Rochester and vicinity. It is a large well shaped individual, and has a girth of 9.4 feet and is 80 feet in height.

Quercus cerris Linn., the Turkey Oak, is represented by a good sized individual on the east side of the Rochester Trade School and on the opposite side of the road at Exposition Park. It is the largest specimen in the city or vicinity. The circumference is 5 feet, and the height 40 feet. It is a native of Southeast Europe and West Asia. An interesting hybrid oak grows in Maplewood Park on Maplewood Avenue on the west side of the road and a short distance from Driving Park Avenue. It is a cross between *Quercus alba* Linn. and *Quercus platanoides* Sudw. The girth is 10.6 feet, and the height 70 feet. There are many splendid examples of the native oaks in the vicinity of Rochester, but there does not seem to be any sufficiently notable to indicate in this paper.

The European elms are well represented in the city of Rochester, where they have been extensively planted. On what used to be the estate of the late Samuel Wilder at the corner of East Avenue and Oxford Street, an immense individual of *Ulmus campestris* Smith, is in perfect health. This is the common elm of the roadsides in England, and is known as the English Elm. Its circumference is 14.3 feet, and the height by actual measurement is 101.72 feet. This tree was planted in 1850. Another good sized English Elm stands at No. 219 Alexander Street. The girth is 9.9 feet, and the height is 75 feet. *Ulmus Hollandica* variety *vegeta* Rehdr., always known under the name of Huntington Elm, has been planted to some extent in the city. There are four good examples at the southeast corner of Goodman Street and Highland Avenue. Their girths are respectively 9.1, 8.1, 7.1 and 7.1 feet. Two of the tallest are 80 feet in height. The Huntington Elm was first known at Huntington, England, in the middle of the 18th century. It is believed to be a hybrid between *Ulmus glabra* Huds. and *Ulmus nitens* Monch. *Ulmus nitens* Monch. sometimes known under the name of the Smooth Elm, is represented by a good individual at the east end of Avenue B about one hundred feet from the bank of the river, and on the south side of the Avenue. The girth is 7.2 feet, and the height 60 feet. *Ulmus nitens* is a common tree in the south of England and ranges from Central Europe to northeastern Asia. *Ulmus Hollandica* variety *superba* Rehdr. is a very graceful elm, and a very large example grows on the edge of the lawn in front of the Ellwanger & Barry office on Mt. Hope Avenue. The circumference is 18.35 feet, and the height is 70 feet. It is said to have been planted not over sixty years since. This is an extraordinary girth for a tree to attain in that time. At five feet from the ground it breaks into seven large boles, and has an enormous spread.

There are numerous splendid examples of the American Elm, *Ulmus Americana* Linn., in the vicinity of Rochester, and throughout the Genesee Valley. We will call attention to four individuals that are somewhat notable. In the grove in Genesee Valley Park there is a very large American Elm with a wide spreading head, and in perfect health. The circumference is 16.8 feet, and the height is perhaps 100 feet. A good example of the vase form of the American Elm grows on the Latta Road about one mile west of Charlotte. The girth is 12.3 feet, and the height is 90 feet. A fine individual of the umbrella type of American Elm grows on the state highway about two miles east of the village of Avon. The circumference is 16.2 feet, and the estimated height is 110 feet. On the farm of Mr. W. G. Markham, two miles north of Avon there is now the lingering remnant of the "Markham Elm" This was a landmark in its day. All that remains of the tree is a large limb from the north side of the base and this is supported by a stout brace. This elm was first seen and attracted the attention in 1764 of William Markham who was a soldier in the colonial army and the great grandfather of the present William G. Markham. It was at that time a tree of extraordinary size. It is stated that during this known period of its history in four Markham generations no perceptible change was observed in its size. In the spring of 1893 the north side of the tree was blown down. Mr. Markham had this sawed across, and he counted three hundred and seventy-five rings. From the portion beyond which he counted, there was a large decayed area towards the center of the tree which he estimated proportionately, and he felt confident this elm had lived about six hundred years. The trunk was 45 feet in circumference three feet above the base, and at noon the shade of the branches extended over one acre. From all reliable accounts this tree was a most phenomenal elm. It is said to have been of a distinctly pendulous form, with the branches drooping like a Babylonian Willow.

Toxylon pomiferum Raf., the Osage Orange, which before the advent of wire fences, was an extremely popular hedge plant, is a native of Kansas and Texas. It is quite hardy as far north as Massachusetts. An individual grows at the corner of Merchants Road and Culver Road, on the south side, and this appears to be the only tree of any size in the city and vicinity. The circumference is 7 feet, and the height 45 feet.

Magnolia acuminata Linn., the Cucumber Tree, grows native from Western New York to Alabama. It is found growing in a wild state in the town of Parma, at Fishers, Ontario county, and at Portage Falls, on the Genesee River. At No. 455 Lake Avenue, a good individual stands, of which the girth is 6.6 feet, and the height 55 feet. On the grounds of H. B. Graves, No. 344 West Avenue there is a well developed Cucumber Tree with a circumference of 6.2 feet and a height of 55 feet. A number of interesting trees were planted at the home now owned by H. B. Graves, and adjoining lots, by the late Captain Giles Kitts, between forty to fifty years since, as nearly as can be ascertained, including the magnolia referred to. Near the Ellwanger & Barry office on Mt. Hope Avenue there is a healthy individual of *Magnolia macrophylla* Michx. the Large-leaved Cucumber Tree. At the base of the stem the girth is four feet, and the height is 25 feet. This magnolia is mostly confined to the southern states in a native condition. The Chinese species and hybrid magnolias are abundantly planted throughout the city. The most notable example is the line of Chinese hybrid Magnolias along the center line of Oxford Street, south of Park Avenue. The oldest of these magnolias were planted over forty years since, by the late H. E. Hooker, who had an important nursery business on these lands at this time. The hybrid known under the name of speciosa was the one mostly planted. At the south end, additional plantings have been made since that time. These Magnolias attract the attention of many horticulturists who visit the city.

There are good examples of *Liriodendron tulipifera* Linn., the Tulip Tree, around the city. Some remarkably good individuals are found growing in Livingston Park. The largest grows at No. 5 Livingston Park. The girth is 8.3 feet, and the height is 80 feet.

Asimina triloba Adans., the Papaw, is a rare native shrub or small tree. The only known station in the vicinity of Rochester where it grows wild is on the Budlong farm in the town of Greece north of the Ridge Road. There is a thick colony of arborescent shrubs, which annually bear quantities of fruit. There is a similar native colony of the Papaw growing near Brockport.

A great deal of work has been done by members of the Park Department, and the Botanical Section of the Academy of Science during the past seventeen years in studying and investigating the genus Crataegus (American Hawthorn) in the vicinity of Rochester, Western New York and elsewhere, in collaboration with Dr. C. S. Sargent, the Director of the Arnold Arboretum, Harvard University. Many new species were discovered. One of the most interesting of the new arborescent species was named after the late George Ellwanger: *Crataegus Ellwangeriana* Sargent. The type plant stands at the west end of the grass walk in the Ellwanger & Barry Nurseries on Mt. Hope Avenue. Mr. Ellwanger said a few years before his death that he remembered this hawthorn very well fifty years ago, and he did not observe any perceptible increase in its size during that time. If no increase was noticed in this hawthorn in a period extending over sixty years, it surely must be of considerable age, and must have started on its life history long before it was seen by a white man. The circumference is 3.7 feet and the height 25 feet.

Gymnocladus Canadensis K. Koch., the Kentucky Coffee Tree, has been planted to some extent in the city. A well balanced tree grows on the grounds of H. B. Graves with a girth of 4 feet, and a height of 40 feet. At the corner of Bay Street and Culver Road on the grounds of the old McGonegal home there is a Kentucky Coffee Tree with a remarkably wide spreading head. The girth is 4.6 feet, and the height 38 feet. A large Kentucky Coffee Tree grows at No. 174 South Goodman Street in front of the house. The circumference is 5.5 feet, and the height 50 feet. Another large Kentucky Coffee Tree grows on the grounds of the Homeopathic Hospital on Alexander Street, the girth is 5.5 feet, and the height 55.8 feet.

Sophora Japonica Linn., the Japanese Pagoda Tree, is a native of China, and is planted considerably in this country. A tree of considerable size grows inside the fence at No. 88 University Avenue. The circumference is 7.4 feet, and the height 45 feet.

Cladrastis lutea K. Koch., the Yellow Wood, is a native of Kentucky, Tennessee, Alabama, and North Carolina. It has been planted sparingly around the city. The largest individual grows on the grounds of Ellwanger & Barry near the office. It branches at the base into five large boles, and the largest bole measures 6.5 feet in girth. It is 60 feet in height.

Acer campestre Linn., the English Field Maple, is not a rare tree in Rochester. Perhaps the largest individual grows at No. 360 West Avenue and is one of the trees planted by the late Captain Giles Kitts. The branches spread from the ground and it perhaps has a spread of forty feet. The circumference was not ascertained but it may be 9 feet in circumference at the base; the height is forty feet. *Acer cappadocicum* Gled. (*Acer lactum* C. A. Mey) a very beautiful maple native from the Orient to the Himalayas, is represented by a fine healthy individual in front of the home of A. M. Lindsay, No. 973 East Avenue. At three feet from the base it measures 7.2 feet. At this point it branches into a wide spreading head. It is 50.36 feet in height by actual measurement. This seems to be the only tree of any considerable size in the city and vicinity. *Acer opalus Mill.* (*Acer Italum* Lauth.) is native from the Orient to the Himalayas. There is a good sized individual growing on Mt. Hope Avenue on the land added to Highland Park, on what used to be the Warner estate. This tree is about two hundred feet northeast of the stone cottage. The circumference is 6.2 feet, the height is 35 feet. This is the only known example of this species in the city of Rochester. *Acer macrophyllum* Pursh, the Large-leaved Maple from Oregon and adjoining regions, is unquestionably a tender tree in the north. A splendid individual with a wide spreading head grew on the old nursery grounds of T. B. Yale & Son on the Winton Road, and was one of the group of interesting trees planted by this firm previously alluded to. Most unfortunately it was cut down three or four years since to make room for a dwelling house. No measurements were ever taken of this maple, but it probably was 9 feet in circumference and had a height of at least 45 feet. This perhaps was the only example of the Large-leaved Maple in Western New York of any size. The only large individual the writer has seen in the northeastern United States, is on the estate of Paul Dana, Glen Cove, Long Island.

Aesculus turbinata Blume., a handsome Horse-Chestnut from North China and Japan, is represented by a healthy individual in the Ellwanger & Barry nurseries, at the east end of the grass walk which runs directly east from the office on Mt. Hope Avenue towards South Avenue. This is said to be the largest tree of this species known in cultivation in this country. The circumference is 5.5 feet two feet above the base and the height 35 feet. As an ornamental tree this species is handsomer than *Aesculus hippocastanum* Linn. in its foliage. There is an interesting collection of trees of the hybrids and varieties of the Pavia section of Aesculus adjacent to, and east of *Aesculus turbinata.* Perhaps no better can be seen in this country.

Tilia petiolaris DC., usually known as the Weeping Linden is a singularly handsome tree. A number of trees have been planted through the city. The largest appears to be at No. 7 Livingston Park. The circumference is 8.3 feet, the height is 60 feet. It is believed to have been planted over fifty years. This Linden is said to have been first observed on the streets of Odessa, Russia, and all the trees in cultivation are said to have originated from this tree. All the trees in cultivation are budded or grafted. The writer at one time sowed a large quantity of the seeds of this linden and out of several thousand seeds only a few germinated. These seedlings showed great diversity, and none of them was the same as the parent. This seems to prove it to be a hybrid.

There are a few trees of *Paulownia imperialis* Sieb. & Zucc. in the city. What seems to be the best individual grows at the home of John M. Thayer, No. 66 James Street. It was planted twenty-seven years ago. The girth is 6.7 feet, and the height by actual measurement 55 feet. It is a native of China and possibly of Japan.

Catalpa speciosa Engelm., the Western Catalpa, has become noted of late years as a timber tree, useful for different purposes. It has been planted considerably in the city and vicinity. It does not appear to have been much planted fifty or sixty years ago. There are two large trees in front of the home of Mrs. Charles T. Depuy, No. 1075 East Avenue. The girth of the larger is 8.3 feet and the smaller 7.6 feet. The height by actual measurement is 64 feet. A well balanced Western Catalpa stands on Highland Avenue in front of the Ellwanger & Barry vineyard, and is one of the numerous trees planted there by the late George Ellwanger at least sixty years since. The circumference is 8.1 feet and the height is 60 feet.

Statistics.

There have been added to our list since 1910, the following:

Species and varieties native to the Monroe Flora,	121
Species and varieties introduced to the Monroe Flora,	56
Total number of species and varieties,	177

New localities are given for 132 species and varieties noted as rare or scarce in the lists of 1896 and 1910.

The total number of species and varieties reported in the Plants of Monroe County and Adjacent Territory, including the lists of 1896, 1910 and the present one is 1761.

The Catalogue.

EXPLANATION OF THE PLAN.

Authorities.—In arrangement and nomenclature this list follows the seventh edition of Gray's Manual of Botany, except for the Crataegus, in which Dr. Charles S. Sargent, Director of the Arnold Arboretum, is accepted as authority.

Typography and Reference Marks.—Each species, variety or marked form regarded as an established member of our flora is given a catalogue number. Those without number are not considered as fully established.

Heavy-faced type indicates species believed to be indigenous. Names of introduced species are printed in capitals, as are also the common or popular names.

The name of a discoverer of a plant new to our district, or of a new locality for a rare or scarce plant, is given in Italics.

In the present list the genera are given the same number as in the previous lists. New genera are inserted in their proper order, and, to prevent confusion, are lettered, as 34a, etc. Where new stations are given for rare or scarce plants, the number given in the previous lists is retained.

The list of 1910 closed with the number 1584. All numbers beyond that in this Second Supplementary List denote new species and varieties.

PTERIDOPHYTA.

POLYPODIACEÆ.

500. *PHEGOPTERIS* Fee. BEECH FERN.

1327. **P. polypodioides** Fee.
Brigg's Gully, Reynold's Gulf, Hemlock Lake, Honeoye Lake, *M. S. Baxter* and *J. Laird.*

499. *CAMPTOSORUS* Link.

1326. **C. rhizophyllus** Link. WALKING FERN.
Five Corners, Rush, *M. S. Baxter;* Penfield, *W. Streeter, M. S. Baxter.*

501. *ASPIDIUM* Swartz.

1585. **A. marginale x goldianum** Dowell. (comb. nov.)
Perinton, *M. S. Baxter.* A single plant.

1335. **A. Boottii** Tuckerm.
Sullivans, *E. P Killip.*

503. *ONOCLEA* L.

1586. **O. sensibilis** L. var. OBTUSILOBATA (Schkuhr.) Torr.
Moist pastures, Greece, *D. M. White.*

LYCOPODIACEÆ.

508. *LYCOPODIUM* L. CLUB MOSS.

1587. **L. annotinum** L.
Gulick, *J. Laird.*

SELAGINELLACEÆ.

509. *SELAGINELLA* Beauv.

1584. **S. apus** (L) Spring.
Morganville, Genesee Co., *M. S. Baxter.*

SPERMATOPHYTA.

PINACEÆ.

488. *ABIES* Link.

1302. **A. balsamea** Mill. BALSAM FIR.
Gulick, Ontario Co., *M. S. Baxter, J. Laird.* Common.

NAJADACEÆ.

431. *NAJAS* L.

1588. **N. marina** L.
Held's Cove, Irondequoit Bay, *E. P. Killip.*

ALISMACEÆ.

426. *SAGITTARIA* L. ARROW-HEAD.

1589. **S. arifolia** Nutt.
Held's Cove, Irondequoit Bay, *M. S. Baxter.*

GRAMINEÆ.

442. *PASPALUM* L.

1590. **P. Muhlenbergii** Nash.
Bushnells Basin, Fishers and Victor, *M. S. Baxter.* Occasional.

443. *PANICUM* L.

1591. **P. boreale** Nash.
Irondequoit, *M. S. Baxter.* Scarce.

1592. **P. spretum** Schultes.
Irondequoit, *M. S. Baxter.* Rare.

1593. **P. Lindheimeri** Nash.
Bergen swamp, *Dr. C. H. Peck.*

1594. **P. implicatum** Scribn.
Irondequoit, *M. S. Baxter;* Mendon, *E. P. Killip.* Scarce.

1595. **P. Scribnerianum** Nash.
Irondequoit, *M. S. Baxter;* Mendon, *E. P. Killip.* Scarce.

1596. **P. Boscii** Poir.
Canandaigua, *Mrs. E. P. Gardner.*

444. *SETARIA* Beauv.

1207. **S. italica** (L.) Beauv.
Along railroad, Golah, *E. P. Killip.*

1597. **S. virescens.**
Mendon, *E. P. Killip.*

450. *PHALARIS* L. CANARY GRASS.

1215. **P. arundinacea** L.
Adams Basin, *E. P. Killip.*

451. *ANTHOXANTHUM* L. SWEET VERNAL GRASS.

1217. A. ODORATUM L.
Bog near Round Pond, Manitou, *E. P. Killip.*

452. *HIEROCHLOE* R. Br. HOLY GRASS.

1218. **H. odorata** Wahl. [*H. borealis* R. & S.]
Sullivans, *M. S. Baxter;* Mendon, *M. E. Woodams* & *W. A. Matthews.* Local.

453a. *STIPA* L. FEATHER GRASS.

1598. **S. comata** Trin. & Rup.
Cobbs Hill Reservoir, *M. S. Baxter.*

453b. *ARISTIDA* L.

1599. **A. oligantha** Michx.
Along Penn. R. R., near Avon, *M. S. Baxter.*

455. *MUHLENBERGIA* Schreb.

1600. **M. foliosa** Trin.
Railroad tracks, Charlotte Dock, *M. S. Baxter.*

1224. **M. racemosa** (Michx.) BSP. [*M. glomerata* Trin.]
Woolstons swamp, *M. S. Baxter.*

459. *SPOROBOLUS* R. Br. DROP-SEED.

1234. **S. cryptandrus** Gray.
Forest Lawn, *John Dunbar.*

465. *HOLCUS* L.

1244. H. LANATUS L. VELVET GRASS.
Meadows, East Avenue, Rochester, *C. Vollertsen.*

470. *BOUTELOUA* Lag. GRAMA GRASS.

1601. **B. oligostachya** (Nutt.) Torr.
Cobbs Hill Reservoir, *Florence Beckwith.*

472. *PHRAGMITES* Trin. REED.

1253. **P. communis** Trin.
Round Pond, Manitou, *E. P. Killip.*

472a. *TRIDENS* R. & S.

1602. **T. flavus** Hitch.
Bushnells Basin, *M. S. Baxter;* Atlantic Ave. Dugway, *G. H. Chadwick.*

474. *ERAGROSTIS* Beauv.

1258. **E. Purshii** Schrad.
Waste lots, Rochester, *D. M. White.*

475a. *CYNOSURUS* L. DOG'S-TAIL GRASS.

1603. C. CRISTATUS L.
Lawns, East Ave., *C. Vollertsen.* Apparently well established.

476. *POA* L. MEADOW GRASS.

1267. **P. debilis** Torr.
Mendon, *M. S. Baxter.*

477. *GLYCERIA* R. Br. MANNA GRASS.

1604. **G. canadensis** Trin.
Bushnells Basin, *M. S. Baxter.* Rare.

1271. **G. pallida** Trin.
Irondequoit, *M. S. Baxter.*

478. *FESTUCA* L. FESCUE GRASS.

1605. F. ELATIOR ARUNDINACEÆ Celak.
Wet meadow, Brighton, *John Dunbar, M. S. Baxter.*

479. *BROMUS* L.

1286. B. TECTORUM L.
Fields, East Rochester, *E. P. Killip.*

1280. **B. Kalmii** Gray
Sullivans, *E. P. Killip.*

482. *HORDEUM* L. BARLEY.

1292. **H. jubatum** L.
Pittsford, *F. S. Boughton;* N. Y. C. R. R. tracks, Penfield, *M. S. Baxter;* Cobbs Hill Reservoir, *Florence Beckwith;* Braddocks Bay, *E. P. Killip.*

CYPERACEÆ.

432. *CYPERUS* L.

1606. **C. Engelmanni** Steud.
Bushnells Basin, *M. S. Baxter.* Rare.

434. *ELEOCHARIS* R. Br. SPIKE RUSH.

1061. **E. rostellata** Torr.
Sullivans, *M. S. Baxter;* Mendon, *E. P. Killip.*

435. *SCIRPUS* L. BULRUSH.

1607. **S. planifolius** Muhl.
Sullivans, *M. S. Baxter.* Rare.

1067. **S. caespitosus** L.
Sullivans, *M. S. Baxter.*

1608. **S. occidentalis** Chase.
Canandaigua, *Miss E. C. Webster;* Manitou, *E. P. Killip.*

1609. **S. atrocinctus** Fernald.
Adams Basin, *E. P. Killip.*

436. *ERIOPHORUM* L. COTTON GRASS.

1610. **E. tenellum** Nutt.
Mud Pond, Wayne Co., *E. P. Killip.*

439. *SCLERIA* Berg.

1087. **S. triglomerata** Michx.
Mud Pond, Wayne Co., *E. P. Killip.*

440. *CAREX* L. SEDGE.

1611. **C. atlantica** Bailey.
Bog near Round Pond, Manitou, *E. P. Killip.*

1612. **C. stellulata** Geed. var. **angustata** Carey.
Mendon, *M. S. Baxter.* Scarce.

1613. **C. brunnescens** Poir.
Sullivans, *M. S. Baxter.* Rare.

1180. **C. trisperma** Dewey.
Manitou, *E. P. Killip.*

1614. **C. vulpinoidea** Mich. x **comosa** Boott.
Mendon Ponds, *M. S. Baxter.* One plant.

1615. **C. setacea** Dewey var. **ambigua** (Barratt) Fernald.
Adams Basin, *E. P. Killip.*

1616. **C. pallescens** L.
Woolstons, Penfield, *E. P. Killip.*

1617. **C. laxiflora** Lam. var. **blanda** (Dewey) Boott.
Mendon, *E. P. Killip.*

1618. **C. grisea** Wahl. var. RIGIDA Bailey.
Sullivans, *M. S. Baxter.*

1108. **C. lanuginosa** Michx. [C. *filiformis* L. var. *latifolia* Boeckl.]
Woolstons, Manitou, Mud Pond, *E. P. Killip.*

1619. **C. squarrosa** L.
Golah, *C. Vollertsen.*

1566. **C. Schweinitzii** Dewey.
Sandbar near Forest Lawn, *V. Dewing & M. S. Baxter.*

1098. **C. Tuckermani** Dewey.
Penfield, *M. S. Baxter.*

1620. **C. Leersia.**
Egypt, Mud Pond, *E. P. Killip.*

1621. **C. disperma.**
Bergen swamp, *E. P. Killip.*

PONTEDERIACEÆ.

412. *HETERANTHERA* R. & P. MUD PLANTAIN.

993. **H. dubia** (Jacq.) MacM. [*H. graminea* Vahl.]
Mendon, *W. A. Matthews.*

LILIACEÆ.

410. *ZYGADENUS* Michx.

991. **Z. chloranthus** Richards. [*Z. elegans* Pursh.]
Sullivans, *Miss A. B. Suydam.*

409. *VERATRUM* L.

990. **V. viride** Ait.
Perry, *Florence Beckwith.*

400. *CLINTONIA* Raf.

974. **C. borealis** Raf.
Sullivans, *W. H. Bailey & Dr. W. A. Windell;* Gulick Swamp, *Baxter & Laird.*

399. *DISPORUM* Salisb.

973. **D. lanuginosum** Benth. & Hook.
Lux woods, Pittsford, *F. S. Boughton;* Mendon, *W. A. Matthews.*

391. *SMILAX* L. GREEN BRIAR.

1622. **S. rotundifolia** L. var. QUADRANGULARIS Wood.
Native in Seneca Park, *B. H. Slavin.*

ORCHIDACEÆ.

386. *HABENARIA* Willd.

941. **H. dilatata** Gray.
Mud Pond, Wayne Co., *M. S. Baxter.*

943. **H. orbiculata** Torr.
Honeoye Lake, *W. A. Matthews.*

381. *SERAPIAS* L. (*EPIPACTIS* Haller.)

931. **S. Helleborine** L.
Golah. Common. East Shore, Irondequoit Bay, *Killip & Woodams;* Rattlesnake Point, *D. M. White;* Hamlin, *Miss Beckwith.*

379. *SPIRANTHES* Rich. LADIES' TRESSES.

925. **S. lucida** Ames. [*S. latifolia* Torr.]
Egypt, *Dr. L. R. Cornman;* Greece, *Miss A. B. Suydam.*

926. **S. Romanzoffiana** Cham.
Sullivans, *M. S. Baxter.*

377. *CORALLORRHIZA* R. Br. CORAL ROOT.

920. **C. trifida** Chatelain [*C. innata* R. Br.]
Gulick, *J. Laird.*

921. **C. odontorhiza** Nutt.
Bushnells Basin, *Mrs. Helen Rockwell;* Perinton, *M. S. Baxter;* Springwater, Livingston Co., *Baxter & Laird;* Woolstons, *M. Woodams.*

373. *LIPARIS* Rich. TWAYBLADE.

915. **L. liliifolia** Rich.
Bullhead Pond, Perinton, *Miss A. B. Suydam.*

916. **L. Loeselii** (L). Richard.
Barrett farm, Pittsford, *E. P. Killip.*

376. *APLECTRUM* Torr. PUTTY-ROOT.

919. **A. hyemale** Nutt.
Riga, *Florence Beckwith.*

SALICACEÆ.

366. *SALIX* L. Willow.

886. **S. serissima** Fern.
Spencerport, *M. S. Baxter.*

1623. **S. cordata** var. Myricoides (Muhl) Carey.
Shore of Lake Ontario near Braddocks Point, *E. P. Killip.*

JUGLANDACEÆ.

356. *CARYA* Nutt. Hickory.

1624. **C. ovata** var. **fraxinifolia** Sarg.
Type, Conesus and Mount Morris, *John Dunbar;* Rochester and Macedon, *B. H. Slavin.* Trees and Shrubs, Vol. 2, p. 207.

1625. **C. ovata** var. **Nuttallii** Sarg.
Canandaigua, *B. H. Slavin.* Trees and Shrubs, Vol. 2, p. 207.

1626. **C. Laneyi** Sarg. (A hybrid of **C. ovata** x **C. cordiformis**).
Type, Riverside Cemetery, *H. B. Brown, John Dunbar, C. S. Sargent.* Rare. Trees and Shrubs, Vol. 2, p. 196.

1627. **C. porcina** var. **acuta** Sarg.
Type, Seneca Park, *B. H. Slavin;* Mendon, *C. C. Laney, R. E. Horsey.* Scarce. Trees and Shrubs, Vol. 2, p. 200.

1628. **C. megacarpa** Sarg.
Type, Seneca Park, *B. H. Slavin;* Highland Park, *R. E. Horsey.* Rare. Trees and Shrubs, Vol. 2, p. 201.

1629. **C. ovalis** Sarg.
Mount Morris and Rochester, *John Dunbar* and *R. E. Horsey.* Rare. Trees and Shrubs, Vol. 2, p. 207.

1630. **C. ovalis** var.**obcordata** Sarg.
Maplewood Park, *C. C. Laney.* Frequent. Trees and Shrubs, Vol. 2, p. 208.

1631. **C. ovalis** var. **obovalis** Sarg.
Rochester, *John Dunbar.* Scarce. Trees and Shrubs, Vol. 2, p. 209.

1632. **C. ovalis** var. **odorata** Sarg.
Rochester, *John Dunbar;* Conesus Lake, *B. H. Slavin* and *R. E. Horsey.* Common. Trees and Shrubs, Vol. 2, p. 207.

BETULACEÆ.

359. *ALNUS* Hill. Alder.

865. **A. rugosa** Spreng. [*A. serrulata* Willd.]
Durand Park, *John Dunbar, B. H. Slavin.* Scarce.

URTICACEÆ.

345. *ULMUS* L. ELM.

837. **U. racemosa** Thomas. CORKY ELM.
Bergen, *M. S. Baxter.*

346. *CELTIS* L. HACKBERRY.

838. **C. occidentalis** L.
Reed's Swamp, near Scottsville, *M. S. Baxter.*

350. *URTICA* L. NETTLE.

1633. U. CHAMAEDRYOIDES Pursh.
Lawn, University Ave., *Florence Beckwith.*

CHENOPODIACEÆ.

326b. *KOCHIA* Roth.

1545. K. SCOPARIA Schrad.
Becoming common throughout the city.

327. *CHENOPODIUM* L. PIGWEED.

1548. C. AMBROSIOIDES L.
South Clinton Street, *C. Vollertsen;* Lake Ave., *F. Beckwith.*

1546. C. VULVARIA L. [*C. foetidum Lamk.*]
South Avenue, *M. S. Baxter.*

783. C. URBICUM L.
Railroad weed, East Rochester, *M. S. Baxter.*

328. *ATRIPLEX* L.

1634. A. ROSEA L. Cobbs Hill Reservoir, *Florence Beckwith.*

AMARANTHACEÆ.

326. *AMARANTHUS* [Tourn.] L.

781. **A. blitoides** Wats.
Wendt farm, Barnards, *E. P. Killip.*

ILLECEBRACEÆ.

325b. *SCLERANTHUS* L.

1543. S. ANNUUS L.
Shore of Lake Ontario, Town of Hamlin, *Florence Beckwith.*

325c. *ANYCHIA* Michx. FORKED CHICKWEED.

1635. **A. canadensis** (L.) BSP.
Dry ravines, Naples, *M. S. Baxter;* Seneca Point, Canandaigua Lake, *Mrs. E. P. Gardner;* Scottsville, *Florence Beckwith.*

CARYOPHYLLACEÆ.

60. *SPERGULA* L. PEARLWORT.

130. S. ARVENSIS L.
Hamlin, *Miss Beckwith;* Barnards, *E. P. Killip.*

56. *ARENARIA* L. SANDWORT.

122. **A. lateriflora** L.
Sullivans, *Mrs. L. R. Cornman.*

55. *LYCHNIS* L.

119. L. CORONARIA Desv. MULLEIN PINK.
Canandaigua, *Mrs. E. P. Gardner.*

†636. L. FLOS-CUCULI L. RAGGED ROBIN.
Meadows, East Ave., *C. Vollertsen.*

1378. L. ALBA Mill. [*L. vespertina* Sibth.]
Cobbs Hill Reservoir, *Miss Beckwith.*

54. *SILENE* L. CATCHFLY.

1377. S. DICHOTOMA Ehrh.
Wheatland, near Scottsville, *Florence Beckwith.*

113. S. LATIFOLIA Britton & Rendle [*S. cucubalus* Weible.] BLADDER CAMPION.
Becoming common.

116. S. ARMERIA L. SWEET WILLIAM CATCHFLY.
Vacant lots, Rochester, *D. M. White.*

RANUNCULACEÆ.

6. *RANUNCULUS* L. BUTTERCUP.

13. **R. delphinifolius** Torr. [*R. multifidus* Pursh.]
Golah, *M. S. Baxter,* and *M. Woodams.*

15. **R. Flammula** L. var. **reptans** (L.) Mey.
Long Point, Sodus Bay, *E. P Killip.*

8. *TROLLIUS* L. GLOBEFLOWER.

27. **T. laxus** Salisb.
Gulick Swamp, *Baxter & Laird.*

12. *ACTAEA* L. BANEBERRY.

1637. **A. rubra** (Ait) Willd. forma NEGLECTA Robinson, with white berries on long slender green pedicels.
Woolstons, *E. P. Killip.*

13. *HYDRASTIS* Ellis.

33. **H. canadensis** L. GOLDEN SEAL.
Allens Creek, Brighton, *Lewis S. Gannett;* Golah, *M. S. Baxter;* Sullivans, *F. Boughton.*

BERBERIDACEÆ.

20. *JEFFERSONIA* B. S. Barton. TWINLEAF.

40. **J. diphylla** Pers.
Culvert 79a, near Fishers, *J. Laird;* Riga, *M. S. Baxter;* The Gulf, Genesee Co., *Mrs. John Dennis;* Mendon, *W. A. Matthews.*

PAPAVERACEÆ.

28a. *ARGEMONE* L. PRICKLY POPPY.

1638. A. MEXICANA L.
Vacant lot, *C. Vollertsen.*

FUMARIACEÆ.

29. *ADLUMIA* Raf. CLIMBING FUMITORY.

53. **A. fungosa** (Ait.) Greene. [*A. cirrhosa* Raf.]
Lake shore about one mile east of Devil's Nose, *Florence Beckwith;* one mile east of mouth of Sandy Creek, *M. S. Baxter;* Mumford, *Miss Nellie Hynes.*

CRUCIFERÆ.

34b. *LOBULARIA* Desv.

1639. L. MARITIMA (L.) Desv. SWEET ALYSSUM.
Cobbs Hill Reservoir, *Florence Beckwith;* Highland Ave., *E. P. Killip.*

35. *ALYSSUM* L.

68. A. ALYSSOIDES L. [*A. calycinum* L.]
Charlotte, *J. Laird.*

44. *THLASPI* L. PENNY CRESS.

85. T. ARVENSE L.
Pittsford, *F. Boughton;* Float Bridge, *Mrs. Helen Rockwell;* vacant lots, *D. M. White.*

45. *LEPIDIUM* [Tourn.] L.

89. L. CAMPESTRE (L.) R. Br.
West Bergen, *E. P. Killip.*

36. *CAMELINA* Crantz. FALSE FLAX.

69. C. SATIVA Crantz.
City streets, *C. Vollertsen.*

1640. C. MICROCARPA Andrz.
Canandaigua, *Miss E. C. Webster.*

36a. *NESLIA* Desv. BALL MUSTARD.

1641. N. PANICULATA Desv.
Greece, *George Arnold.*

42. *BRASSICA* L. MUSTARD.

1642. B. CAMPESTRIS L.
Scottsville, *Florence Beckwith.*

42b. *CONRINGIA* Link. HARE'S-EAR MUSTARD.

1366. C. ORIENTALIS Link.
West Shore railroad tracks, Pittsford, *F. Boughton.*

42c. *ALLIARIA* Adans. GARLIC MUSTARD.

1643. **A. officinalis** Andrz.
Highland Ave., Rochester, *E. P. Killip.*

41. *SISYMBRIUM* L. HEDGE MUSTARD.

1364. S. ALTISSIMUM L. TUMBLE MUSTARD.
Has become common throughout the city and vicinity.

81. S. THALIANUM (L.) J. Gay.
Vacant lots, Rochester, *F. Beckwith.*

39. *HESPERIS* L. ROCKET.

78. H. MATRONALIS L.
Brighton, *J. Laird.*

37. *RADICULA* [Dill.] Hill. [NASTURTIUM R. Br.]

74. **R. aquatica** (Eat.) Robinson. [*Nasturtium lacustre* Gray.]
Sodus Bay, *E. P. Killip.*

33. *CARDAMINE* [Tourn.] L.

62. **C. pratensis** L.
Mendon, *W. A. Matthews.*

34. *ARABIS* L.

1361. **A. Drummondi** Gray. [*A. confinis* Wats.]
Canandaigua Lake, *Mrs. E. P. Gardner.*

64. **A. hirsuta** Scop.
Ravine at Buttermilk Falls, *M. S. Baxter.*

SARRACENIACEÆ.

26. *SARRACENIA* L. PITCHER-PLANT.

50. **S. purpurea** L.
Rochester Junction; Sullivans, *Botanical Section.*

SAXIFRAGACEÆ.

127. *MITELLA* L. BISHOP'S CAP.

316. **M. nuda** L.
Sullivans, *Miss A. B. Suydam.*

130. *RIBES* L.

320. **R. rotundifolium** Michx.
Bergen swamp, *E. P. Killip.*

1644. **R. triste** Pall. var. ALBINERVUM Fernald.
Bergen, *M. S. Baxter.*

ROSACEÆ.

111. *SPIRAEA* L.

260. **S. tomentosa** L. HARDHACK.
Simpson's Woods, *Killip & Woodams, Mrs. John Dennis, Miss A. B. Suydam.*

122. *MALUS* S. F. Gray. APPLE.

1645. **M. glaucescens** Rehdr. (Described in Trees and Shrubs 2, 139.)
Type in Maplewood Park, Rochester, *John Dunbar.* Frequent.

1646. **M. fragrans** var. **elongata** Rehdr. (Trees and Shrubs 2, 229.)
Type at Chapinville, Ontario Co., *John Dunbar* and *B. H. Slavin.*

124. *AMELANCHIER* Medic. JUNEBERRY. SHADBUSH.

1647. **A. humilis** Wiegand (Described in Rhodora 14, 141.)
Frequent along banks of Genesee River and elsewhere, *John Dunbar*

1648. **A. stolonifera** Wiegand. (Rhodora 14, 141.)
Occasional, Mendon, *M. S. Baxter.*

123. *CRATAEGUS* L. HAWTHORN. WHITE THORN.

1649. **C. eastmaniana** Sarg. (N. Y. State Mus. Bul. 167, 141. 1912.)
Durand-Eastman Park, *Henry T. Brown.*

1650. **C. pausiaca** Ashe (Trees and Shrubs 1, 105 t 53.)
Chapinville, *John Dunbar.*

1651. **C. brownietta** Sarg. (N. Y. State Mus. Bul. 167, 78, 1912.)
Common around Hemlock Lake, *H. T. Brown.*

1652. **C. obstipa** Sarg. (N. Y. State Mus. Bul. 167, 80, 1912.)
Near Chapinville, *B. H. Slavin.*

1653. **C. prominens** Sarg. (Ont. Nat. Sci. Bul. 4, 23, 1908.)
Hemlock Lake, *H. T. Brown.*

1654. **C. latiflora** Sarg. (N. Y. State Mus. Bul. 167, 83, 1912.)
Richmond, Livingston Co., *H. T. Brown.*

1655. **C. scitula** Sarg. (N. Y. State Mus. Bul. 167, 84, 1912.)
Chapinville, *B. H. Slavin.*

1656. **C. placiva** Sarg. (N. Y. State Mus. Bul. 122, 46, 1908.)
Belfast, *M. S. Baxter* and *V. Dewing.*

1657. **C. pulchra** Sarg. (N. Y. State Mus. Bul. 122, 42, 1908.)
Chapinville, *B. H. Slavin.*

1658. **C. seclusa** Sarg. (N. Y. State Mus. Bul. 167, 89, 1912.)
Richmond, *H. T. Brown.*

1659. **C. promissa** Sarg. (N. Y. State Mus. Bul. 122, 30, 1908.)
Hemlock Lake, *H. T. Brown.*

1660. **C. congestiflora** Sarg. (N. Y. State Mus. Bul 122, 144, 1908.)
Castile and Belfast, *Baxter & Dewing;* Palmyra, *B. H. Slavin.*

1661. **C. cruda** Sarg. (N. Y. State Mus. Bul. 122, 54, 1908.)
Hemlock Lake, *H. T. Brown.*

1662. **C. suavis** *Sarg.* (N. Y. State Mus. Bul. 122, 59, 1908.)
Hemlock Lake, *H. T. Brown.*

1663. **C. conferta** Sarg. (N. Y. State Mus. Bul. 122, 62, 1908.)
Rochester, *John Dunbar.*

1664. **C. vivida** Sarg. (Ont. Nat. Sci. Bul. 4, 47, 1908.)
Chapinville, *B. H. Slavin.*

1665. **C. dayana** Sarg. (N. Y. State Mus. Bul. 122, 66, 1908.)
Hemlock Lake, *H. T. Brown.*

1666. **C. perrara** Sarg. (N. Y. State Mus. Bul. 167, 103, 1912.)
Chapinville, *B. H. Slavin;* Honeoye Lake, *H. T. Brown.*

1667. **C. misella** Sarg. (N. Y. State Mus. Bul. 167, 115, 1912.)
Belfast, *Baxter & Dewing.*

1668. **C. spinifera** Sarg. (N. Y. State Mus. Bul. 122, 118, 1908.)
Canandaigua, *B. H. Slavin;* Hemlock Lake, *H. T. Brown.*

1470. **C. structilis** Ashe (N. Y. State Mus. Bul. 122, 77, 1908.)
Chapinville, Rochester, Hemlock Lake, *John Dunbar.*

1669. **C. truculenta** Sarg. (N. Y. State Mus. Bul. 167, 118, 1912.)
Belfast, *Baxter & Dewing.*

1670. **C. balkwillii** Sarg. (Ont. Nat. Sci. Bul. 4, 80, 1908.)
Chapinville, *B. H. Slavin.*

1671. **C. sonnenbergensis** Sarg. (N. Y. State Mus. Bul. 167, 120, 1912.)
Canandaigua, *B. H. Slavin.*

118. *POTENTILLA* L. CINQUEFOIL.

279. **P. paradoxa** Nutt. [*P. supina* Gray.]
Long Pond, Braddocks Bay, *Killip & Woodams.*

115. *GEUM* L.

1672. **G. flavum** Bick.
Canandaigua, *Mrs. E. P. Gardner.*

114. *DALIBARDA* Kalm.

269. **D. repens** L.
Gulick Swamp, *Baxter & Laird.*

119. *AGRIMONIA* [Tourn.] L.

1673. **A. striata** Michx.
Mendon, *W. A. Matthews.*

LEGUMINOSÆ.

94a. *ANTHYLLIS* L.

1674. A. VULNERARIA L.
Cobbs Hill Reservoir, *Miss M. E. Macauley* and *Miss F. Beckwith.*

96. *TEPHROSIA* Pers.

212. **T. virginiana** Pers.
Sullivans, *Mrs. John Dennis.*

101. *DESMODIUM* Desv.

230. **D. marilandicum** (L.) DC.
Greece, *E. P. Killip.*

102. *LESPEDEZA* Michx. BUSH CLOVER.

235. **L. capitata** Michx.
Banks of Irondequoit Bay, also S. Goodman St., Rochester, *E. P. Killip.*

103. *VICIA* L. VETCH.

1675. V. VILLOSA Roth.
Vacant lot near South Ave., *Mrs. John Dennis.*

OXALIDACEÆ.

72. *OXALIS* L. WOOD SOREL.

1384. **O. Acetosella** L.
Reynolds Gulf, Hemlock Lake, *Baxter & Laird.*

GERANIACEÆ.

70. *GERANIUM* [Tourn.] L.

153. **G. carolinianum** L.
Mendon, *W. A. Matthews.*

EUPHORBIACEÆ.

343. *EUPHORBIA* L.

1676. **E. glyptosperma** Engelm.
Dry sand hills, Point Pleasant, Irondequoit, *Killip & Woodams.*

830. **E. corollata** L.
Bushnells Basin, *M. S. Baxter.* Rare.

CISTACEÆ.

49. *LECHEA* L.

93. **L. villosa** Ell. [*L. major* Michx.]
Victor and Perinton, *M. S. Baxter.* Frequent

94. **L. intermedia** Leg. [*L. minor* L.]
Victor and Perinton, *M. S. Baxter*. Frequent.

VIOLACEÆ.

51. *HYBANTHUS* Jacq. GREEN VIOLET.

109. **H. concolor** (Forster) Spreng. [*Solea concolor* Ging.]
Powder Mills, *F. Boughton*.

50. *VIOLA* L.

1677. **V. nephrophylla** Greene (*V. vagula* Greene.)
West Bergen, *Dr. H. D. House*. Occasional.

1678. **V. latiuscula** Greene.
Swamp road, Victor, *W. A. Matthews*.

1373. **V. incognita** Brainerd.
Sullivans, *E. P. Killip*.

101. **V. rotundifolia** Michx.
Palmers Glen, Rochester, *F. Boughton;* Densmore Creek, *M. S. Baxter;* Springwater, Livingston Co., *Baxter & Laird*.

LYTHRACEÆ.

138. *LYTHRUM* L.

341. L. SALICARIA L.
Palmers Glen, *E. P. Killip*.

ONAGRACEÆ.

141. *EPILOBIUM* L.

1679. E. HIRSUTUM L.
Reeds swamp, north of Scottsville, *M. S. Baxter;* Scottsville, *Florence Beckwith;* Bergen, *Killip & Woodams;* Mendon, *W. A. Matthews*.

1680. **E. densum** Raf.
Golah, *E. P. Killip*.

1483. **E. adenocaulon** Haussk.
Sullivans, *E. P. Killip*.

142. *OENOTHERA* L. EVENING PRIMROSE.

1681. **O. oakesiana** Robins.
Canandaigua, *Mrs. E. P. Gardner*.

1682. **O. muricata** L.
Canandaigua, *Mrs. E. P. Gardner*.

1683. **O. muricata** var. CANESCENS Torr. & Gray.
Canandaigua, *Mrs. E. P. Gardner*.

1684. **O. pallida** Lindl. [*Anogra albicaulis* Britton.]
Cobbs Hill Reservoir, *Florence Beckwith*.

349. **O. pumila** L.
Coldwater, *J. Laird.*

143. *GAURA* L.

351. **G. biennis** L.
Golah, *E. P. Killip.*

UMBELLIFERÆ.

164. *SANICULA* L.

1685. **S. canadensis** L.
Canandaigua Lake, *Mrs. E. P. Gardner.*

CORNACEÆ.

166. *CORNUS* L. DOGWOOD.

1686. **C. Slavini** Rehder.
Type plant in Seneca Park, Rochester, *B. H. Slavin.*

ERICACEÆ.

239. *CHIMAPHILA* Pursh.

606. **C. maculata** Pursh.
Perinton, *Miss A. B. Suydam.*

241. *PYROLA* [Tourn.] L.

1687. **P. incarnata** (Fisch.) Fernald. [*P. uliginosa* Torr.]
Mendon, *W. A. Matthews.*

229. *VACCINIUM* L.

1688. **V. pennsylvanicum** Lam. var. ANGUSTIFOLIUM (Ait.) Gray.
Rocky ledges, Leroy, *M. S. Baxter.*

1525. **V. atrococcum** (Gray) Heller.
Bushnells Basin, *E. P. Killip.*

PRIMULACEÆ.

247. *ANAGALLIS* [Tourn.] L. PIMPERNEL.

1689. A. ARVENSIS L. var. CAERULEA (Schreb.) Ledeb.
Canandaigua, *Mrs. E. O. Cartwright.*

GENTIANACEÆ.

255. *GENTIANA* L.

642. **G. puberula** Michx.
Bushnells Basin, *F. Boughton* and *Florence Beckwith.* This station has since been destroyed.

257. *BARTONIA* Muhl.

646. **B. virginica** (L.) BSP. [*B. tenella* Muhl.]
Simpson's Woods, *James Bishop.*

ASCLEPIADACEÆ.

253a. *CYNANCHUM* L.

1690. C. VINCETOXICUM (L.) Pers.
Dry fields, Highland Ave., *D. M. White.*

CONVOLVULACEÆ.

270. *CONVOLVULUS* L. BINDWEED.

1691. **C. sepium** L. var. **pubescens** (Gray.) Fernald.
Canandaigua, *Mrs. E. P. Gardner.*

271. *CUSCUTA* L. DODDER.

1692. C. EPITHYMUM Murr.
Caledonia, *Florence Beckwith.*

POLEMONIACEÆ.

259a. *POLEMONIUM* L.

1693. **P. reptans** L.
Near Log Pond, Caledonia, *C. Vollertsen* and *Florence Beckwith.*

BORAGINACEÆ.

261. *CYNOGLOSSUM* (Tourn.) L.

654. **C. virginicum** L. WILD COMFREY.
Springwater, Livingston Co., *Matthews & White.*

265a. *ONOSMODIUM* Michx.

1694. **O. hispidissimum** Mack.
Dugan Creek, Livingston Co., *M. S. Baxter.*

VERBENACEÆ.

301. *VERBENA* L.

1695. **V. stricta** Vent.
Irondequoit, *James Bishop;* Pittsford, *F. Boughton.*

1537. **V. bracteosa** Michx.
Highland Park and Cobbs Hill Reservoir, *Florence Beckwith.*

LABIATÆ.

302a. *AJUGA* L. BUGLE WEED.

1696. A. REPTANS L.
Canandaigua, *Mrs. E. O. Cartwright.*

303. *TEUCRIUM* L.

1697. **T. occidentale** Gray.
Canandaigua, *Mrs. E. P. Gardner;* Pittsford, *F. Boughton.*

323. *GALEOPSIS* L. Hemp Nettle.

1698. G. Ladanum L. var. latifolia Wallr.
Along West Shore railroad, Pittsford, *F. Boughton.*

322. *LAMIUM* L. Dead Nettle.

1699. L. purpureum L.
W. A. Matthews. Common.

324a. *SALVIA* L.

1700. S. nutans L.
Caledonia, *F. Beckwith.* Adventive.

314. *MONARDA* L.

755. **M. clinopodia** L.
The Gulf, *Mrs. John Dennis;* Mendon, *W. A. Matthews.*

315. *BLEPHILIA* Raf.

1701. **B. hirsuta** (Pursh) Benth.
Buttermilk Falls, *D. M. White.*

308. *PYCNANTHEMUM* Michx.

1539. **P. flexuosum** (Walt.) BSP. [*P. linifolium* Pursh.]
Mendon, *W. A. Matthews;* Forest Lawn, *Mrs. H. C. Pierce.*

745. **P. virginianum** (L.) Durand & Jackson [*P. lanceolatum* Pursh.]
Woolstons, *Mrs. L. R. Cornman, E. P. Killip.*

SOLANACEÆ.

272. *SOLANUM* [Tourn.] L. Nightshade.

675. **S. carolinense** L.
Two miles south of Sodus, *E. P. Killip.*

277. *HYOSCYAMUS* L.

683. H. niger L.
Waste places around Rochester, *C. Vollertsen.*

SCROPHULARIACEÆ.

281. *LINARIA* [Tourn.] Hill.

689. **L. canadensis** (L.) Dumont.
Golah, *E. P. Killip.*

1702. L. minor (L.) Desf.
North Bergen, *Killip & Woodams,* 1913; Stanley, *Baxter & Laird,* 1914.

283. *SCROPHULARIA* L. Figwort.

1703. **S. leporella** Bick.
Dugan Creek, Caledonia, *M. S. Baxter;* east side Irondequoit Bay, *D. M. White.*

285. *PENTSTEMON* Mitch.

695. **P. laevigatus** Solander.
West Shore railroad tracks, near Bergen, *Killip & Woodams.*

289. *VERONICA* L. SPEEDWELL.

702. **V. virginica** L.
West Rush, *M. S. Baxter;* Scottsville, *Florence Beckwith.*

293. *PEDICULARIS* L.

720. **P. lanceolata** Michx.
Turk's Hill, *Lewis S. Gannett.*

PLANTAGINACEÆ.

325. *PLANTAGO* L. PLANTAIN.

1704. P. MEDIA L.
Canandaigua, *Miss E. C. Webster.*

1541. **P. aristata** Michx. [*P. patagonica* var. *aristata* Gray.]
Woolston road, Perinton, *M. S. Baxter.*

1705. **P. virginica** L.
On dry hillsides, Sullivans, *M. S. Baxter.* Rare.

RUBIACEÆ.

178. *GALIUM* L. BEDSTRAW.

421. **G. pilosum** Ait.
Pittsford, *C. Vollertsen.*

1706. G. SYLVATICUM L.
Pittsford, *E. P. Killip.*

1707. **G. labradoricum** Wiegand.
Mud Pond, Wayne Co., *E. P. Killip.*

175. *HOUSTONIA* L.

413. **H. caerulea** L.
Gulick, *Miss A. B. Suydam;* Springwater, Livingston Co., *Matthews & White.*

CAPRIFOLIACEÆ.

170. *TRIOSTEUM* L.

1708. **T. aurantiacum** Bick.
Canandaigua Lake, *Mrs. E. P. Gardner.*

VALERIANACEÆ.

179. *VALERIANA* [Tourn.] L.

430. **V. uliginosa** (T. & G.) Rydb. [*V. sylvatica* Man. ed. 6.]
Swamp road, Victor, *W. A. Matthews.*

DIPSACACEÆ.

181a. *KNAUTIA* L.

1709. K. ARVENSIS (L.) T. Coulter.
Meadows, East Ave., Rochester, *C. Vollertsen.*

COMPOSITÆ.

183. *EUPATORIUM* [Tourn.] L.

1710. **E. purpureum** L. var. **maculatum** (L.) Darl.
Swamps, Mendon, *E. P. Killip.*

1711. **E. purpureum** L. var. **foliosum** Fernald.
Swamps, Sullivans, *M. S. Baxter.*

1712. **E. perfoliatum** L. var. TRUNCATUM Gray.
Greece, *E. P. Killip;* Irondequoit, *D. M. White.*

183a. *GRINDELIA* Willd.

1713. **G. squarrosa** Dunal.
Cobbs Hill Reservoir, *Florence Beckwith.*

1714. **G. squarrosa** Dunal. var. NUDA Gray.
Cobbs Hill Reservoir, *Florence Beckwith.*

183b. *CHRYSOTHAMNUS* Nutt.

1715. **C. pinifolia** Greene.
Cobbs Hill Reservoir, *M. S. Baxter.*

183c. *GUTIERREZIA* Lag.

1716. **G. Sarothrae** Britton & Rusby.
Cobbs Hill Reservoir, *Florence Beckwith.*

184. *SOLIDAGO* L.

1717. **S. caesia** L. var. AXILLARIS (Pursh) Gray.
M. S. Baxter. Frequent.

1718. **S. caesia** L. var. PANICULATA Gray.
M. S. Baxter. Occasional.

1719. **S. hispida** Muhl. Branched form.
Greece, *D. M. White.*

1720. **S. juncea** Ait. var. SCABRELLA (T. & G.) Gray.
M. S. Baxter. Occasional.

1721. **S. uniligulata** (DC.) Porter var. *levipes* Fernald (Rhodora 17, 7.)
Bergen swamp, *Dr. C. H. Peck,* 1880.

1722. **S. aspera** Ait.
M. S. Baxter. Common.

184a. *SIDERANTHUS* Sweet.

1723. **S. gracilis** Rydb.
Cobbs Hill Reservoir, *M. S. Baxter, Florence Beckwith.*

186. *ASTER* L.

467. **A. laevis** L.
A peculiar form of this species with elongated leaves and long narrow panicle, blooming in late October and November, has been found for several years in succession on the Pinnacle Hills by *C. H. Vollertsen.*

1724. **A. Schreberi** Nees.
Seneca Park, *B. H. Slavin.* Occasional.

469. **A. multiflorus** Ait.
Cobbs Hill Reservoir, *Florence Beckwith.*

1725. **A. longifolius** Lam.
Greece, *D. M. White.*

1726. **A. novi-Belgii** L.
Canandaigua, *Mrs. E. P. Gardner.*

1727. **A. tardiflorus** L.
Simpson's woods, *Mrs. John Dennis.*

186a. *MACHAERANTHERA* Nees.

1728. **M. tanacetifolia** Nees.
Cobbs Hill Reservoir, *M. S. Baxter.*

1729. **M. pulverulenta** Greene.
Cobbs Hill Reservoir, *F. Beckwith.*

188. *ANTENNARIA* Gaertner. Everlasting.

1730. **A. Parlinii** Fernald var. *arnoglossa* Greene.
Ogden and Lime Rock, *M. S. Baxter.* Scarce.

1731. **A. canadensis** Greene.
Dry hills, *M. S. Baxter.* Common.

1732. **A. fallax** Greene.
M. S. Baxter. Common.

1733. **A. occidentalis** Greene.
M. S. Baxter. Common.

1734. **A. neodioica** Greene.
Penfield, *M. S. Baxter.* Common.

1735. **A. grandis** (Fernald) House.
M. S. Baxter. Common.

1736. **A. neglecta** Greene.
Penfield, *M. S. Baxter.* Occasional.

1737. **A. petaloidea** Fernald.
M. S. Baxter. Common.

190. *GNAPHALIUM* L.

1738. **G. purpureum** L.
Sullivans, *M. S. Baxter.* Rare.

192. *POLYMNIA* L.

496. **P. canadensis** L.
Caledonia, *F. Beckwith;* The Gulf, *Botanical Section.*

195. *HELIOPSIS* Pers.

504. **H. scabra** Dunal.
Canandaigua, *Mrs. E. P. Gardner.*

195a. *GYMNOLOMIA* H.B.K.

1739. **G. multiflora** B. & H.
Cobbs Hill Reservoir, *F. Beckwith.*

198. *HELIANTHUS* L.

1507. **H. petiolaris** Nutt.
Railroad weed, East Rochester, *M. S. Baxter;* Cobbs Hill Reservoir, *Florence Beckwith;* The Gulf, *Dr. L. R. Cornman.*

201a. *DYSSODIA* Cav.

1740. **D. papposa** (Vent.) Hitchc.
Cobbs Hill Reservoir, *M. S. Baxter.*

203a. *MATRICARIA* L. WILD CHAMOMILE.

1741. M. CHAMOMILLA L.
Waste places around city, *C. Vollertsen.*

1742. M. SUAVEOLENS Buch.
Canandaigua, *Mrs. E. O. Cartwright.*

206. *ARTEMISIA* L.

529. **A. caudata** Michx.
Lake Shore, *D. M. White.*

530. **A. canadensis** Michx.
Waste lot, Rochester, *D. M. White.*

1743. **A. dracunculoides** Pursh.
Cobbs Hill Reservoir, *F. Beckwith.*

1744. **A. glauca** Pall.
Cobbs Hill Reservoir, *M. S. Baxter.*

1745. **A. filifolia** Torr.
Cobbs Hill Reservoir, *F. Beckwith.*

1746. **A. frigida** Willd.
Cobbs Hill Reservoir, *F. Beckwith.*

532. **A. biennis** Willd.
Cobbs Hill Reservoir, *M. S. Baxter;* Highland Park, *F. Beckwith;* Exchange street, *F. Boughton.*

1747. **A. gnaphaloides** Nutt.
Cobbs Hill Reservoir, *F. Beckwith.*

1748. **A. trifida** Nutt.
Cobbs Hill Reservoir, *F. Beckwith.*

1749. **A. carruthi** Wood.
Cobbs Hill Reservoir, *M. S. Baxter.*

209. *SENECIO* L.

1750. **S. eremophilus** Rich.
Cobbs Hill Reservoir, *F. Beckwith.*

212. *ARCTIUM* L.

542. **A. minus** Bernh. [*A. lappa* L. var. *minus* Gray.]
Several plants with pure white flowers at Garbutt, *F. Beckwith.*

212a. *CARDUUS* L.

1751. C. CRISPUS L.
Cobbs Hill Reservoir, *Miss M. E. Macauley.*

215. *CENTAUREA* L.

1752. C. NIGRA L.
West Shore Railroad tracks at Pittsford, *F. Boughton.*

1753. **C. americana** Nutt.
Long Pond, *Killip & Woodams.*

1754. C. MACULOSA Lam.
Winton road, Brighton, *C. C. Laney.*

216. *LAPSANA* L. [LAMPSANA HILL.]

552. L. COMMUNIS L.
Canandaigua, *Mrs. E. O. Cartwright.*

218d. *HYPOCHAERIS* L.

1522. H. RADICATA L.
Waste places around city, *C. Vollertsen;* Alexander St., near Prince, *F. Beckwith.*

218b. *LEONTODON* Banks.

1755. L. NUDICAULIS (L.) Banks.
Eastern part of city, *C. Vollertsen.*

218c. *PICRIS* L.

1756. P. HIERACIOIDES L.
Cultivated field, Westfall road, Brighton, *C. Vollertsen.*

223. *LACTUCA* L.

1757. L. SCARIOLA L. var. INTEGRATA Gren. & Godry.
Vacant lots, *M. E. Macauley.* Becoming common.

1758. **L. canadensis** L. var. MONTANA Britton.
B. R. & P. R. R. near Riverside, *D. M. White.*

220. *CREPIS* L.

1759. C. CAPILLARIS (L.) Wallr.
Lawns, Rochester, *M. S. Baxter.*

562. **C. biennis** L.
Canandaigua, *Mrs. E. P. Gardner.*

219. *HIERACIUM* L.

1760. H. FLORENTINUM All.
Springwater, *Matthews & White;* Gulick, *M. S. Baxter.*

1761. H. MURORUM L.
Canandaigua, *Miss E. C. Webster.*

HYMENOMYCETEAE OF ROCHESTER, N. Y., AND VICINITY.

By Fred S. Boughton.

The following Hymenomyceteæ, or fleshy fungi, numbering 319 species and varieties, were collected by the writer in Rochester, Pittsford, Perinton, Mendon and vicinity. References to the reports of Dr. C. H. Peck are given in parentheses.

CLASS FUNGI.

Sub-class Basidiomycetes.

Cohort Hymenomycetes. *Gr.*—a membrane, a fruit-bearing surface; *Gr.*—a mushroom.

Family I.—Agaricaceæ.

Series I.—Leucosporæ. *Gr.*—white; *Gr.*—seed. White spored.

Amanita.

(A name given to some esculent fungi by Galen, perhaps from Mount Amanus.)

1. **Amanita phalloides** Fr. (Pk. 1895)—phallus-like Amanita. Woods, Rochester, Bushnells Basin and vicinity, common, deadly poisonous.
2. **A. phalloides,** gray var., same habitat as the last, not common, deadly poisonous.
3. **A. verna** Bull. (Pk. 1895.) A variety of A. phalloides, not common, deadly poisonous.
4. **A. spreta** Pk.—hated. Woods, Pittsford, not common, poisonous.
5. **A. muscaria** Linn. (Pk. 1895)—Fly Amanita. Poisonous, common throughout the county. The Germans use the caps, immersed in milk, to kill flies.
6. **A. Caesarea** Scop. (Pk. 1895)—King-like Caesars mushroom. Pittsford. Not common, edible.
7. **A. rubescens** Pers. (Pk. 1895)—reddish Amanita. Seneca Park, Pittsford, Bushnells Basin, common, edible.
8. **A. Frostiana** Pk. Pittsford, not common, poisonous.
9. **A. sp.**—A species new to me. Gray in color, with pileus covered with warts. Woods, Pittsford.
10. **A. pantherina** DC.—Bushnells Basin, not tested.
11. **A. radicata** Pk.—Rochester, not tested.
12. **A. strobiliformis** Vitt.—*Strobilis,* a pine cone. Rochester, edible.

AMANITOPSIS Roze.

Amanita, opsis, resembling.

13. **Amanitopsis vaginata** Roze.—*vagina,* a sheath. Pittsford, not common, edible. Common in the Adirondacks.

14. **A. strangulata** (Fr.) Roze.—choked, from the stuffed stem. Rochester, Pittsford, not common, edible.

15. **A. velosa** Pk.—*velosus,* fleecy. Rochester, Pittsford. Not common; common in the Adirondacks, edible.

16. **A. volvata** Pk.—possessing a volva. Pittsford, not common, edible.

17. **A. nivalis** Grev.—snowy. Rochester, too bitter to eat.

LEPIOTA Fr.

Lepis, a scale.

18. **Lepiota naucinoides** Pk. (Pk. 1895). Woods, fields, roadsides, edible.

19. **L. procera** Scop. (Pk. 1895).—Parasol mushroom. Woods, orchards, common, edible.

20. **L. Americana** Pk. (Pk. 1895). Pittsford, not common, edible.

21. **L. clypeolaria** (Bull.) Fr. (Pk. 1900). Woods, fields and lawns, common, edible.

22. **L. acutesquamosa** Wein.—*acutus,* sharp; *squama,* a scale. Rochester, not common, edible.

23. **L. granulosa** Batsch.—*granosus,* full of grains. Rochester, not common, edible.

24. **L. aspera** Murrill. Mendon, not common, not tested.

25 **L. cepaestipes** Sow.—onion-stemmed Lepiota. Pittsford, not common, edible.

ARMILLARIA Fr.

Armilla, a ring.

26. **Armillaria mellea** Vahl. (Pk. 1895).—honey-colored Armillaria. Around old stumps, common everywhere, edible.

27. **A. mellea** var. **glabra**.—smooth. Bushnells Basin, edible.

TRICHOLOMA Fr.

Gr.—a hair; a fringe.

28. **Tricholoma personatum** Fr. (Pk. 1895)—wearing a mask, (from its many varieties of colors). Called in England "Blue hats" Woods, common everywhere, edible.

29. **T. russula** Schaeff. (Pk. 1901).—reddish. Seneca Park, Pittsford, Mendon, Bushnells Basin, edible.

30. **T. gambosum** Fr.—*gambosus,* swelling near the hoof. Woods, Monroe Co., edible.

31. **T. vaccinum** Pers.—*vacca,* a cow. Woods, Monroe Co., edible.

32. **T. album** Schaeff. Pittsford, Bushnells Basin, edible.

33. **T. aurantia** Schaeff. Fr. Pk. Pittsford, edible.

34. **T. transmutans** Pk.—changing. Woods, Pittsford, edible.

35. **T. fumidellum** Pk.—smoky Tricholoma. Woods, Pittsford, edible.

36. **T. columbetta** Fr.—*columba,* a pigeon, (from the color). Woods, Pittsford, edible.

37. **T. subcinereum** Pk.—a new species discovered by the writer in a cellar in Pittsford. Pileus about 2½ inches broad of an ash color, smooth and flat, with broad rounding gills making the pileus look like the half of a ball. Stem three inches high, a little larger than a lead pencil, of the same color as the pileus. Edible, qualities not tested.

38. **T. subsejunctum** Pk.—partly separated, (from the peculiar manner in which the gills separate from the stem.) Monroe Co., edible.

39. **T. imbricatum** Fr.—covered with tiles. Rochester, edible.

40. **T. subpulverulentum** Pers.—slightly dusty. Rochester, edible.

41. **T. subpurpurea**—somewhat purple. Rochester, not tested.

42. **T. sejunctum** Sow.—separated; (from the peculiar manner in which the gills separate from the stem.) Monroe Co., edible.

43. **T. terreum** Schaeff.—the earth, (from the color). Pittsford, Mendon, Bushnells Basin, quality fair.

44. **T. albo-flavidum** Pk.—yellow-disced. Pittsford, Bushnells Basin, edible.

Clitocybe Fr.

Gr.—sloping (from the depression of the pileus).

45. **Clitocybe odora** Bull.—*odorus,* fragrant. Woods, Pittsford, edible.

46. **C. multiceps** Pk. (Pk. 1909).—*multus,* many; *caput,* a head, (from growing in clusters). Open places, Pittsford.

47. **C. illudens** Schw. (Pk. 1895).—deceiving. Pittsford, Churchville, Golah. Unwholesome. Phosphorescent, giving out light at night.

48. **C. infundibuliformis** Schaeff. (Pk. 1895).—funnel-formed. Common throughout the county, edible.

49. **C. cyathiformis** Bull.—cup-shaped. Pittsford, edible.

50. **C. (laccaria) ochropurpurea** Berk. (Pk. 1906). Woods, Pittsford, edible.

51. **C. (laccaria) laccata** Scop. (Pk. 1895).—made of lac. Woods, Pittsford, Mendon, edible.

52. **C. (laccaria) laccata,** var. **pallida** Pk. Bushnells Basin, edible.

53. **C. (laccaria) amethystina** Bolt.—color of an amethyst. Mendon, not common, edible.

54. **C. dealbata** Sow. On lawn, Pittsford, not edible. This mushroom has the property of making the person who eats of it sweat profusely.

55. **C. eccentrica** Pk. Woods, Monroe Co., not tested.

56. **C. albissima** Pk. Woods, Pittsford, not tested.

57. **C. gilva** Pers.—*gilvus,* pale brownish yellow. Rochester, edible.

58. **C. monadelpha** Mor.—*monas,* single; *adelphos,* a brother, from its growing in clusters. Rochester, Pittsford, edible.

59. **C. nebularis** Batsch.—*nebula,* a cloud. Rochester, edible.

60. **C. robusta** Pk.—*robustus,* stout. Mendon, edible.

61. **C. tuba** (Fries) Gill. Pittsford, Bushnells Basin, not tested.

62. **C. candicans** Pers.—*candico,* to be shining white. Pittsford, edible.

63. **C. sp.** species not named. Mendon, Murrill.

64. **C. Adirondackensis** Pk. (Pk. 1900). Rochester, edible.

Collybia Fr.

65. **Collybia radicata** Relh. (Pk. 1895).—*radix,* a root. Woods, fields, lawns, common. Not poisonous, not edible.

66. **C. platyphylla** Fr. (Pk. 1895).—*Gr.*—broad; a leaf. Pittsford, Bushnells Basin, edible.

67. **C. velutipes** Curt. (Pk. 1895).—*velutum,* velvet; *pes,* a foot. On old logs and stumps, common, edible.

68. **C. butyracea** Bull.—*butyrum,* butter; buttery to the touch. Bushnells Basin, edible.

69. **C. dryophila** Bull. (Pk. 1907).—*Gr.*—oak-loving. Woods, common, edible.

70. **C. acervata** Fr. (Pk. 1908).—*acervus,* a heap. Bushnells Basin, edible.

Mycena Fr.

Gr.—a fungus.

71. **Mycena pura** Pk. Woods, Pittsford, not tested.

72. **M. cohaerens** Fries.—adhering together. Rochester, not tested.

OMPHALIA.

Gr.—belonging to an umbilicus.

73. **Omphalia oniscus** Fr. *Gr.*—a wood louse, (from the ashy color). Woods, Pittsford, not common, edible.

74. **O. caespitosa** (Bolton) Sacc.—growing in clusters. Rochester, édible.

PLEUROTUS.

Gr.—a side; *Gr.*—an ear.

75. **Pleurotus ostreatus** Jacq. (Pk. 1895).—*ostrea,* an oyster. Rochester, Pittsford, Bushnells Basin, common, edible.

76. **P. serotinus** Fr.—late, from its late appearance. Woods, Pittsford, Bushnells Basin, edible.

77. **P. ulmarius** Bull. (Pk. 1895).—elm Pleurotus. On logs and stumps. Pittsford, Bushnells Basin, edible.

78. **P. sapidus** Kalch. (Pk. 1895).—savory. On stumps and partly decayed trees, Pittsford, Bushnells Basin, edible.

79. **P. subareolatus** Pk.—somewhat cracking. On living maple tree, Pittsford. Rare, edible.

80. **P. petaloides** Bull.—petal of a flower. Rochester, not common, edible.

HYGROPHORUS Fr.

Gr.—moist; *Gr.*—to bear.

81. **Hygrophorus pratensis** Fr. (Pk. 1895).—*pratum* a meadow. Pittsford, Bushnells Basin, edible.

82. **H. pratensis** white var., same habitat, edible.

83. **H. cantharellus** Schw. *Gr.*—a small vase. Bushnells Basin, edible.

84. **H. cantharellus** var. **flava.** Bushnells Basin, not common, edible.

85. **H. ceraceus** Fr.—*cera,* was. Monroe Co., edible.

86. **H. chrysodon** Fr. *Gr.*—gold, a tooth, (from tooth-like squamules). Monroe Co., edible.

87. **H. flavo-discus** Frost (Pk. 1895).—*flavus,* yellow; *discus,* disk. Woods, Palmer's Glen, Rochester, Pittsford, edible. The Boston Mycological Club makes a trip every fall for the express purpose of gathering this species and having it cooked by an expert, a member of the society.

88. **H. miniatus** Fr. (Pk. 1895).—*minium,* red lead, (from the color). Woods, Pittsford, Bushnells Basin, edible.

89. **H. eburneus** Bull. Fr.—*ebur,* ivory. Woods, Mendon, edible.

90. **H. coccineus** Schaeff.—scarlet. Bushnells Basin, edible.

LACTARIUS Fr.

Giving *lac* (milk).

91. **Lactarius piperatus** Fr.—*piper,* pepper. Rochester, Pittsford, Bushnells Basin; edible but not of first rate quality.

92. **L. vellereus** Fr.—*vellus,* fleece. Pittsford, edible.

93. **L. deliciosus** Fr. (Pk. 1895). Pittsford, edible.

94. **L. indigo** Schw. Woods, Pittsford, Bushnells Basin, edible.

95. **L. luteolus** Pk. (Pk. 1902).—yellowish. Pittsford, edible.

96. **L. Gerardii** Pk. (Pk. 1895). Woods, Pittsford, edible.

97. **L. volemus** Fr. (Pk. 1895). Woods. Common; one of the best of fungi.

98. **L. trivialis** Fr.—common. Rochester, Pittsford, Bushnells Basin. Too peppery to eat.

99. **L. hygrophoroides** B. and C. (Pk. 1895). Seneca Park, Pittsford, edible.

100. **L. torminosus** Fr.—*tormina,* gripes. Pittsford, on a lawn, poisonous.

101. **L. chelidonium** Pk. Rochester, edible.

102. **L. crocea** Burlingham. Rochester, not tested.

103. **L. insulsus** Fr.—tasteless. Rochester, edible.

104. **L. atro-viridis** Pk.—black green. Woods, Pittsford, not tested.

105. **L. fuliginosus** Fr.—*fuligo,* soot. Rochester, Pittsford, Bushnells Basin, poisonous.

106. **L. theiogalus** Fr. *Gr.*—brimstone; milk. Rochester, Pittsford, Bushnells Basin, edible.

107. **L. pergamenus** Fr.—parchment. Rochester, edible.

108. **L. griseus** Pk.—gray, Pittsford, not tested.

109. **L. lignyotus** Fr.—*lignum,* wood. Rochester, edible.

110. **L. subpurpureus** Pk.—somewhat purple. Rochester, Pittsford, not tested.

RUSSULA Pers.

Reddish.

111. **Russula purpurina** Quel. and Schulz.—purple. Woods, Pittsford, edible.

112. **R. sordida** Pk. (Pk. 1905).—dingy. Rochester, Pittsford, Bushnells Basin, edible.

113. **R. ochrophylla** Pk. (Pk. 1895). Seneca Park, Pittsford, Bushnells Basin, edible.

114. **R. virescens** Fr. (Pk. 1895).—*viresco,* to be green. Common but not as plentiful as one could wish. Edible, one of the best.

115. **R. citrina** Gillet.—citron colored. Pittsford, edible.

116. **R. cyanoxantha** (Schaeff.) Fr. *Gr.*—blue; *Gr.*—yellow, from the color. Bushnells Basin, Adirondack Mts., not common, edible.

117. **R. foetens** Fr.—stinking. Woods, common, not edible, not poisonous.

118. **R. emetica** Fr.—an emetic. Pittsford, edible, though reputed to be poisonous by some.

119. **R. atro-purpurea** Pk.—*atre,* black; *purpureus,* purple. Pittsford. Edible, must be eaten as soon as gathered.

120. **R. aurata** Fr.—*aurum,* gold. Pittsford, Bushnells Basin, edible.

121. **R. alutacea** Fr.—*aluta,* tanned leather. Bushnells Basin, edible.

122. **R. rosiepes** (Secr.) Bres.—*rosa,* rose; *pes,* a foot, (from the color of the stem). Seneca Park, Pittsford, Bushnells Basin, edible.

123. **R. compacta** Frost. (Pk. 1906).—compact, firm. Seneca Park, Pittsford, Bushnells Basin, edible.

124. **R. obscura** Pk. Bushnells Basin, Adirondack Mts., edible.

125. **R. variata** Banning (Pk. 1905).—variable. Seneca Park, Bushnells Basin, Pittsford, edible.

126. **R. crustosa** Pk. (Pk. 1902). Bushnells Basin, edible, rare.

127. **R. sp.** new species, not named, found in Mendon. Has a very viscid pileus. Murrill.

128. **R. bicolor** Burlingham.—two colored. Rochester, edible.

129. **R. lactea** Fr.—*lac,* milk. Rochester, edible.

130. **R. rubra** Fr.—*ruber,* red. Rochester, Pittsford, Bushnells Basin, edible.

131. **R. pectinata** Fr.—*pecten,* a comb, (from comb-like furrows on the margin). Edible but not very good.

132. **R. decolorans** Fr.—*de* and *coloro,* to color. Bushnells Basin, edible.

133. **R. albella** Pk.—whitish. Pittsford, edible.

134. **R. furcata** Fr.—*furca,* a fork, (from the forked gills). Pittsford. edible.

135. **R. pinophila** Pk.—pine loving. Rochester, Adirondack Mts., edible.

CANTHARELLUS Adans.

Gr.—a vase; a cup.

136. **Cantharellus cibarius** Fr.—*cibaria,* food. Seneca Park, Pittsford, Bushnells Basin, Adirondack Mts., common. One of the highest-priced mushrooms sold in the English markets.

137. **C. aurantiacus** Fr.—orange yellow. Bushnells Basin, Adirondack Mts., edible.

138. **C. cinnabarino** Pk.—cinnabar red. Rochester, Pittsford, Bushnells Basin, edible.

139. **C. brevipes** Pk.—*brevis,* short; *pes,* a foot. Rochester, edible.

MARASMIUS Fr.

Gr.—to wither or shrivel.

140. **Marasmius oreades** Fr. (Pk. 1895). Fairy Ring, Mountain Nymphs, Scotch Bonnet. Common in fields and orchards. A very valuable edible species which should be better known. Can be dried for winter use.

141. **M. Wynnei** B. & Br. Woods, Pittsford, edible, not common.

142. **M. siccus** (Schw.) Fries. Rochester, not tested.

LENTINUS Fr.

Lentus, tough or pliant.

143. **Lentinus lepideus** Fr.—*Gr.*—scaly. Railroad ties, Pittsford, edible.

PANUS Fr.

A name given to a tree-growing fungus by Pliny.

144. **Panus torulosus** Fr.—a tuft of hair, (from its hairy pileus). Rochester, Pittsford, edible.

145. **P. stypticus** Fr.—*stypticus,* astringent. Bushnells Basin, poisonous.

SCHIZOPHYLLUM Fr.

Gr.—to split; *Gr.*—a leaf.

146. **Schizophyllum commune** Fr. On decaying wood, not edible.

SERIES II.—RHODOSPORÆ. *Gr.*—rose; *Gr.*—a seed. Spores pink or salmon color.

VOLVARIA Fr.

Volva, a wrapper.

147. **Volvaria volvacea** Bull.—*volva,* a wrapper. Rochester, edible.

148. **V. volvacea** white variety found by the writer, edible, rare.

149. **V. bombycina** Schaeff.—*bombyx*, silk. On three living trees in Pittsford; edible, not common. A large and very conspicuous object with immense white pileus and pink gills and long silky white hairs on the pileus, making it look not unlike a Tam O'Shanter cap.

PLUTEUS Fr.

Pluteus, a shed (from the conical shape of the pileus).

150. **Pluteus cervinus** Schaeff.—*cervus*, a deer, from the color. Stumps in woods and old sawdust piles, Pittsford, edible.

151. **P. granularis** Pk.—sprinkled with grains. Rochester, edible.

152. **P. admirabilis** Pk. Rochester, edible.

ENTOLOMA Fr.

Gr.—within; *Gr.*—a fringe.

Probably referring to the innate character of the pseudo-veil.

153. **Entoloma grande** Pk. Bushnells Basin, edible.

154. **E. sinuatum** Fr.—waved. Pittsford, poisonous.

CLITOPILUS Fr.

Gr.—a declivity; *Gr.*—a cap.

155. **Clitopilus prunullus** Scop. (Pk. 1895).—*prunus*, plum. Rochester, Pittsford, Mendon, edible.

156. **C. orcella** Bull. (Pk. 1895). Woods, Pittsford, edible.

157. **C. noveboracensis** Pk.—New York Clitopilus. Woods, Pittsford, edible.

158. **C. noveboracensis** var. **tomentosipes** Pk.—hairy stemmed. Pittsford, edible.

159. **C. caespitosus** Pk.—tufted. Rochester, edible.

CLAUDOPUS *Smith.*

Claudus, lame; *pous*, a foot.

160. **Claudopus nidulans** Pers.—*nidus*, a nest. Bushnells Basin, edible.

Series III.—OCHROSPORÆ. Spores brown.

PHOLIOTA Fr.

Gr.—a scale.

161. **Pholiota praecox** Pers. (Pk. 1895).—early. Fields, lawns, roadsides. Rochester, Pittsford, edible.

162. **P. squarrosa** Mull. (Pk. 1901).—*squarrosus*, scurfy. On logs, Pittsford, edible.

163. **P. comosa** Pk. Pittsford, not tested.

164. **P. vermiflua** Pk. (Pk. 1903).—wormy. Under an apple tree, Pittsford, not tested.

165. **P. durus** Bolt.—*durus,* hard. Rochester, edible.

Inocybe.

Gr.—a fiber; *Gr.*—a head.

166. **Inocybe modesta** Pk. A new species discovered by the writer in the Pittsford cemetery, with small modest brown pileus and stem. Not edible.

167. **I. geophylla** (Sow.) Fr. Rochester, not edible.

168. **I. geophylla** var. **purpurea,** not edible. A pretty purple variety found by the writer in woods, Pittsford.

169. **I. Lorillardiana** Murrill. Rochester, not edible.

Hebeloma Fr.

Hebe, youth; *loma,* a fringe.

170. **Hebeloma fastibile** Fr.—*fastidibilis,* loathsome, (from the smell). Rochester, Pittsford, not edible.

171. **H. crustiliniforme** Bull.—*crustulum,* a small pie; *forma,* form. Rochester, not edible.

172. **H. sp.**—a species found by the writer in Mendon, said by Dr. Murrill to be new.

Flammula Fr.

Flamma, a flame (In reference to the bright colors of many of the species).

173. **Flammula alnicola** Fr.—*alnus,* alder; *colo,* to inhabit. Near a hedge, Pittsford, edible.

174. **F. decurrens** Pk. Monroe Co. Not tested.

175. **F. sulphurea** Pk. (Pk. 1911) Monroe Co. Not tested.

Naucoria Fr.

Naucum, a nut shell.

176. **Naucoria semi-orbicularis** Bull.—half round. Lawns, Rochester, Pittsford, common, edible.

177. **N. platysperma** *Pk.—platys,* broad; *sperma,* a seed. Lawns, Pittsford, edible.

178. **N. pediades** Fr. *Gr.*—a plain. Rochester, edible.

GALERA Fr.

Galerus, a cap.

179. **Galera tenera** Schaeff.—*tener,* tender. Lawns, Pitsford, edible.

180. **G. flava** Pk.—*flavus,* yellow. Pittsford, edible.

181. **G. reticulata** Pk. Pittsford, rare, not tested.

CREPIDOTUS Fr.

Gr.—a slipper.

182. **Crepidotus versutus** Pk. Rochester, not tested.

CORTINARIUS Fr.

Cortina, a veil or curtain.

183. **Cortinarius albo-violaceus** Pers. Seneca Park, Pittsford, edible.

184. **C. sanguineus** Fr.—sanguis, blood. Woods, Pittsford, Bushnells Basin, edible.

185. **C. cinnamomeus** Fr. (Pk. 1895). Woods, common, edible.

186. **C. rubripes** Pk.—red stemmed. A new species discovered by the writer in what is now Lombs woods, Pittsford. Pileus pale tan color, gills rich purple, stem swollen at the base like a radish and of a brick red color. Not common and not tested.

187. **C. semi-sanguineus** Pk. (Pk. 1895).—partly red. Bushnells Basin, edible.

188. **C. sebaceus** Fr.—*sebum,* tallow, from the color. Bushnells Basin, edible.

189. **C. napus** Fr. Pittsford, not tested.

190. **C. distans** Pk. Woods, Bushnells Basin, not desirable.

191. **C. infractus** (Pers.) Fries. Pittsford, not tested.

192. **C. purpurascens** Fr. Bushnells Basin, edible.

193. **C. turbinatus** Fr.—*turbo,* a top. Pittsford, edible.

PAXILLUS Fr.

Paxillus, a small stake.

194. **Paxillus involutus** (Batsch) Fr.—rolled inward. Seneca Park, Bushnells Basin, edible.

195. **P. atro-tomentosus** (Batsch) Fr.—*ater,* black; *tomentum,* down. Forest Lawn, edible.

196. **P. rhodoxanthus** Pk. Rochester, not tested.

SERIES IV.—PORPHYROSPORÆ (Pratelli). *Gr.*—purple.

AGARICUS.

Agaricon, a Greek name for fungi, said to be derived from the name of a town, Agara.

197. **Agaricus campester** Linn.—*campus*, a field. The common pasture mushroom; fields, orchards, roadsides, edible.

198. **A. diminutivus** Pk. (Pk. 1900). Pittsford, Adirondack Mts., edible.

199. **A. Rodmani** Pk. (Pk. 1895). Roadsides, Pittsford, common, edible.

200. **A. magnificus** Pk. Roadsides, Pittsford, edible, not common.

201. **A. silvicola** Vitt. (Pk. 1895).—*silva*, a wood; *colo*, to inhabit. Woods, Pittsford, edible.

202. **A. placomyces** Pk. (Pk. 1895). Woods, orchards, lawns, common, edible.

203. **A. sylvaticus** Schaeff. Woods, Forest Lawn; orchards, Sodus, edible.

204. **A. abruptibulbus** Pk. (Pk. 1895). (*A. silvicola* Vitt. *A. arvensis* var. *abruptus* Pk.) This being the wood cousin of the field mushroom is worth notice. It grows very tall with a large bulb at the base of the stem and a large pileus, and from a distance looks like Amanita phalloides. It has the true mushroom flavor. Found in woods in Pittsford, not common.

STROPHARIA.

Gr.—a sword belt (referring to the ring).

205. **Stropharia aeruginosa** Curt.—*aerugo*, verdigris, from the color. Not edible.

HYPHOLOMA.

Gr.—a web; *Gr.*—a fringe.

206. **Hypholoma incertum** Pk. (Pk. 1895). Lawns, roadsides, common, edible.

207. **H. aggregatum sericeum** Pk. Same habitat as the last and like it, but larger, edible.

208. **H. Perplexum** Pk. (Pk. 1895). Around old stumps, common everywhere, edible.

209. **H. sublateritium** Schaeff.—*sub* and *later*, a brick, from the color. Same habitat as the last, edible.

210. **H. Boughtoni** Pk. (Pk. 1909). A new species discovered by the writer in woods at Bushnells Basin. Pileus from two to four inches broad often areolately cracking, pale reddish brown, lamellae unequal purplish brown, seal brown or blackish—stem equal, white or whitish, two to three inches long. Not tested, but Dr. Peck says probably edible.

211. **H. appendiculatum** Bull.—a small appendage (from fragments of the veil adhering to the pileus). Rochester, Pittsford, edible.

212. **H. Candolleanum** Fr. Rochester, edible.

213. **H. rigidipes** Pk.—rigid stemmed. Rochester, Pittsford, not tested, probably edible.

PSILOCYBE Fr.

Gr.—naked; head.

214. **Psilocybe atomatoides** Pk. Pittsford, not tested.

Series V.—MELANOSPORÆ (spores black). *Gr.*—black; *Gr.*—seed.

COPRINUS Pers.

Gr.—dung.

215. **Coprinus micaceus** (Bull) Fr.—*mica,* grain, granular. Glistening Coprinus or brownie mushroom; common everywhere, edible.

216. **C. comatus** Fr.—*coma,* hair. Shaggy mane mushroom. Lawns, waste places, common everywhere, edible.

217. **C. atramentarius** (Bull) Fr.—*atramentum,* ink. Inky Coprinus. Same habitat as the last; one of the best.

218. **C. virgineus** Banning. Rochester, edible.

PANÆOLUS Fr.

Gr.—all; *Gr.*—variegated.

219. **Panaeolus solidipes** Pk.—solid stemmed. Rochester, Pittsford, edible.

220. **Panaeolus epymices** Pk. Monroe Co., not tested.

PSATHYRELLA.

Gr.—fragile.

221. **Psathyrella disseminata** Pers.—dissemino, to scatter. Rochester, Pittsford, common, edible.

Family II.—POLYPORACEÆ.

BOLETINUS Kalch.

222. **Boletinus pictus** Pk.—spotted. Sullivans, edible.

223. **B. porosus** (Berk) Pk. Rochester, Pittsford, edible.

224. **B. grisellus** Pk. Pittsford, not tested.

BOLETUS Dill.

Gr.—a clod.

225. **Boletus gracilis** Pk. Bushnells Basin, edible.

226. **B. Americanus** Pk. Monroe Co., edible.

227. **B. subluteus** Pk. (Pk. 1895).—somewhat yellow. Bushnells Basin, edible.

228. **B. subtomentosus** L.—somewhat hairy. Monroe Co., edible.

229. **B. bicolor** Pk.—two colored. Woods and open places, Pittsford, edible.

230. **B. Russelli** Frost. Bushnells Basin, not common, edible.

231. **B. edulis** Bull. (Pk. 1895). Woods, Rochester, Pittsford, Bushnells Basin, edible.

232. **B. edulis** var. **clavipes** Pk.—club footed. Rochester, Pittsford, edible.

233. **B. luridus** Schaeff. Woods, Pittsford. Should be carefully tested.

234. **B. versipellis** Fr. (Pk. 1895). Bushnells Basin, Bergen Swamp, edible.

235. **B. felleus** Bull. (Pk. 1895). Rochester, Pittsford, unwholesome.

236. **B. griseus** Frost.—gray. Bushnells Basin, edible.

237. **B. chromapes** Frost. Monroe Co., edible.

238. **B. communis** Bull. Monroe Co., not tested.

239. **B. retipes** B. and C.—reticulate stem. Bushnells Basin, edible.

240. **B. castaneus** Bull.—chestnut. Rochester, Adirondack Mts., edible.

241. **B. impolitus** Fr.—unpolished. Rochester, edible.

242. **B. vermiculosus** Pk.—wormy. Rochester, not tested.

243. **B. subaureus** Pk. var. **rubro-scriptus** Pk. Rochester, edible.

244. **B. subtomentosus** L.—somewhat downy. Rochester, edible.

245. **B. sp.**—a new species found by the writer in Bushnells Basin. Small peach yellow pileus with red cheek. Dr. Peck said that it was new but on account of not finding any more specimens he would not give it a name.

246. **B. Sullivantii** B. and M. Rochester, not tested.

Strobilomyces Berk.

Gr.—a pine cone; a fungus.

247. **Strobilomyces strobilaceus** *Gr.*—cone like. Rochester, Pittsford, Bushnells Basin, edible.

Fistulina *Bull.*

Fistula, a pipe.

248. **Fistulina hepatica** (Huds.) Fr.—resembling the liver. Beefsteak mushroom. On chestnut stumps. Rochester, Pittsford, edible.

249. **F. pallida** B. and Rav.—*pallidus*, pale. Rare, not tested.

Polyporus Fr.

Gr.—many; a passage, a pore.

250. **Polyporus squamosus** Fr.—*squamma*, a scale. On partly decayed trees, Pittsford, edible but tough.

251. **P. umbellatus** Fr.—*umbella,* a sun shade. Woods, Pittsford, edible.

252. **P. sulphureus** Fr. (Pk. 1895).—sulphury Polyporus, chicken mushroom. Rochester, Pittsford, Mendon, Perinton.

253. **P. picipes** Fr.—*pix,* pitch; *pes,* a foot. Monroe Co., edible.

254. **P. poripes** Fr.—porus-stemmed. Woods, Pittsford, edible.

255. **P. anax** Berk. Woods, Pittsford, edible.

256. **P. lucidus** Fr. Monroe Co. Not tested.

257. **P. frondosus** Fr.—*frons,* a leafy branch. Pittsford, edible.

Family III—HYDNACEÆ.

HYDNUM.

Gr.—name for some edible fungus.

258. **Hydnum repandum** L. (Pk. 1895).—spreading. Seneca Park, Pittsford, edible, common but not plentiful.

259. **H. albidum** Pk. (Pk. 1895). Woods, Pittsford, edible.

260. **H. coralloides** Scop. (Pk. 1895). Pittsford, Fairport, Adirondack Mountains. A handsome plant, edible.

261. **H. caput-ursi** Fr. (Pk. 1895).—bears head Hydnum. Pittsford, Adirondack Mts., edible. This can be truly called a wonderful plant with its resemblance to the head of a polar bear.

262. **H. caput-Medusae** Bull.—Medusa's head Hydnum. Mendon, Adirondack Mts., edible. This with its long spines is a handsome plant.

263. **H. erinaceum** Bull.—*erinaceus,* a hedgehog. Pittsford, edible.

264. **H. scabrosum** Fr.—*scabrosus,* rough. Rochester, edible.

265. **H. imbricatum** L.—*imbrex,* a tile. Woods, Pittsford, edible.

Family IV.—THELEPHORACEÆ Fr.

Gr.—a teat; *Gr.*—to bear.

CRATERELLUS Fr.

Crater, a bowl.

266. **Craterellus cornucopoides** Pers. (Pk. 1895).—cornucopia shaped. Pittsford, Bushnells Basin, edible. A remarkable mushroom, looking not unlike a small ruffled-edge morning glory blossom, of a pinkish brown color.

267. **C. cantharellus** Schw.—a small vase or cup. Rochester, edible. In looks somewhat like a chantarelle.

Family V.—CLAVARIACEÆ.

SPARASSIS Fr.

Gr.—to tear in pieces.

268. **Sparassis crispa** Fr.—*crispus,* curly. Pittsford, edible. A very remarkable mushroom looking not unlike a coil of two to four inch wide brown ribbon set on edge and somewhat crimped. It is not common.

CLAVARIA L.

Clava, a club.

269. **Clavaria flava** Schaeff.—yellow. Seneca Park, Pittsford, Bushnells Basin, edible.

270. **C. botrytes** Pers. (Pk. 1895).—a cluster of grapes (from shape). Bushnells Basin, edible.

271. **C. amethystina** Bull.—amethyst color. Pittsford, edible.

272. **C. cristata** *Pers.* (Pk. 1895). Seneca Park, Pittsford, edible.

273. **C. coralloides** L.—coral like. Pittsford, edible.

274. **C. formosa** Pers.—neat, handsome. Pittsford, edible.

275. **C. stricta** Pers.—*stringo,* to draw tight. Bushnells Basin, edible.

276. **C. aurantio-cinnabarino** Schw.—orange, vermillion. Bushnells Basin, edible. This is the handsomest of this family, looking like a branch of red coral.

277. **C. vermicularis** Scop.—*vermis,* a worm. Bushnells Basin, Sullivans, rare, edible. First found by the writer in the Adirondacks.

278. **C. fusiformis** Sow.—*fusus,* a spindle. Pittsford, Adirondack Mountains, edible.

279. **C. pistillaris** L. (Pk. 1904).—pistillum. Woods, Pittsford, edible.

280. **C. pyxidata** Pers.—*pyxis,* a small box. Bushnells Basin, edible.

281. **C. densa** Pk. Bushnells Basin, edible.

282. **C. pinophila** Pk.—pine-loving. Pittsford, not tested.

283. **C. mucida** Pers.—moss like. Rochester, Pittsford, not tested.

Family VI.—TREMELLACEÆ Fr.

Sub-family TREMELLINEÆ.

TREMELLA Dill.

Tremo, to tremble.

284. **Tremella mycetophila** Pk. Bushnells Basin. Parasitic on Collybia dryophila; edible. It is sometimes so heavy as to weigh the caps to the ground.

285. **T. fuciformis** Berk. Monroe Co., not tested.

TREMELLODON Pers.

Tremo, to tremble.

286. **Tremellodon gelatinosum** Pers.—jelly. Monroe Co., edible.

Sub-class.—Ascomycetes.

Cohort Discomycetes *Gr.*—a sac; *Gr.*—a fungus.

Family Helvellaceæ.

HELVELLA Linn.

287. **Helvella crispa** Fr.—curled. Bushnells Basin, edible.

LEOTIA Hill.

288. **Leotia lubrica** Pers.—slippery. Bushnells Basin, edible.

MORCHELLA Dill.

Gr.—a mushroom.

289. **Morchella conica** Pers. (Pk. 1895). Pittsford, Bushnells Basin, edible.

290. **M. esculenta** Pers. Pittsford, Bushnells Basin, edible. Sold in stores of some of the Western states.

291. **M. deliciosa** Fr. Pittsford, edible.

292. **M. semilibera** DC.—half free from the stem. Bushnells Basin, edible.

GYROMITRA *Fr.*

293. **Gyromitra esculenta** Fr. Rochester. Edible for some, unwholesome for others; use with caution.

294. **G. brunnea** Underwood.—*brunneus,* brown. Pittsford, edible.

SPATHULARIA Pers.

A Spatula.

295. **Spathularia clavata** (Schaeff.) Sacc.—club shaped. Bushnells Basin, Adirondack Mts., edible.

GEOGLOSSUM Pers.

(Emended)

296. **Geoglossum glutinosum** Pers. Rochester, edible.

Family.—PEZIZÆ.

PEZIZA Linn.

297. **Peziza badia** Pers.—bay or brown. Rochester, Pittsford, edible.

298. **P. aurantia** Pers.—orange-colored. Rochester, Pittsford, edible.

299. **P. coccinea** Jacq.—scarlet. On fallen branches in woods, Pittsford, edible. A bright scarlet mushroom coming with the early wild flowers and looking much like one.

300. **P. sp.** A species found by the writer in woods, Pittsford, growing in clusters with stem long and pileus two inches across of a beautiful orange color on top and white underneath. This was sent to Dr. Peck but he could not identify it and no more having since been found it remains unnamed.

301. **P. unicisa** Pk.—implying one incision. A single plant found by the writer in the Catskill mountains. About four inches high of a yellow color tinged with pink and split down one side. I afterwards found one in Mendon. Edible.

Urnula Fr.

Gr.—burned.

302. **Urnula craterium** (Schw.) Fr.—a small crater. Pittsford, Sullivans. This is a very remarkable plant of the shape and size of an old fashioned wine-glass. Pileus dull black inside, ash white outside. Found but twice by the writer.

Bulgaria Fr.

Found first in Bulgaria.

303. **Bulgaria inquinans** Pers.—befouling or polluting; so called because of the blackish gelatinous coating of the pileus. This is a small cup-shaped fungus black inside and dark brown or chocolate colored outside. Pittsford, not very common. Not tested.

Cohort.—Pyrenomycetes.

Family.—Hypocreaceæ.

Hypomyces Fr.

Gr.—under; *Gr.*—fungus.

304. **Hypomyces lactifluorum** (Schw.) Tulasne.—*lac*, milk; *fluorum*, flowing. This is a remarkable parasite on Lactarius piperatus, changing that mushroom from white to orange scarlet color, removing the gills, adding to the weight and from being a second rate mushroom making it one of the best.

305. **H. purpureus** Pk. Bushnells Basin, edible.

306. **H. lateritius** Pk. Parasitic on Lactarius indigo. Bushnells Basin, rare, edible.

307. **H. hyalinus** (Schw.) Tul. Monroe Co., not tested.

PECKIELLA Sacc.

308. **P. Banningiae** (Peck) Sacc. Bushnells Basin, rare, not tested.

Sub-class BASIDIOMYCETES.

Cohort GASTROMYCETES.—*Gr.*—gasteron, a sac.

Family I.—PHALLOIDEÆ.

PHALLUS Mich.

309. **Phallus Ravenelii** B. and C. Rochester, Pittsford, edible when in the egg state. Has a very bad odor when full grown.

MUTINUS Fr.

310. **Mutinus caninus** Fr. (*Phallus caninus* Berk.; *P. inodorus* Sow.) Rochester, Pittsford, edible in the egg state.

Family II.—LYCOPERDACEÆ.

GEASTER Mich.

Gr.—the earth; *Gr.*—a star.

311. **Geaster hygrometricus** Pers. Pittsford, edible when young. This fungus is known as being a natural barometer, spreading its stellate covering on the ground when moisture is in the air, and closing it around its puffy body when humidity is absent.

TYLOSTOMA Pers.

Gr.—a knob.

312. **Tylostoma myenianum** Kl. Rochester, Pittsford, edible. This species is noted for having the entire peridium mounted on the apex of the stem.

CALVATIA Fr.

313. **Calvatia gigantea** Batsch. (*Lycoperdon bovista* Linn; *L maximum* Schaeff; *L giganteum* Batsch.) Rochester, Pittsford, edible. One weighing 58 lbs. was found in Rochester a few years ago.

314. **C. cyathiformis** Bosc.—cup shaped. Pastures, orchards, Pittsford, Bushnells Basin, common, edible.

LYCOPERDON Tourn.

315. **Lycoperdon Frostii** Pk. Woods, Pittsford, edible. This fungus reminds one of a chestnut burr when ripe and brown, edible.

316. **L. pyriforme** Schaeff.—pear formed. Pittsford, Adirondack Mts., edible.

317. **L. pedicellatum** Pk.—*pediculus*, a little foot. Bushnells Basin, edible.

318. **L. gemmatum** Batsch.—gemmed. Rochester, edible.

Family III.—Sclerodermaceæ.

Scleroderma Pers.

Scleros, hard; *dermos*, skin.

319. **Scleroderma vulgare** Fr.—*vulgaris*, common. Common everywhere, edible when young and white.

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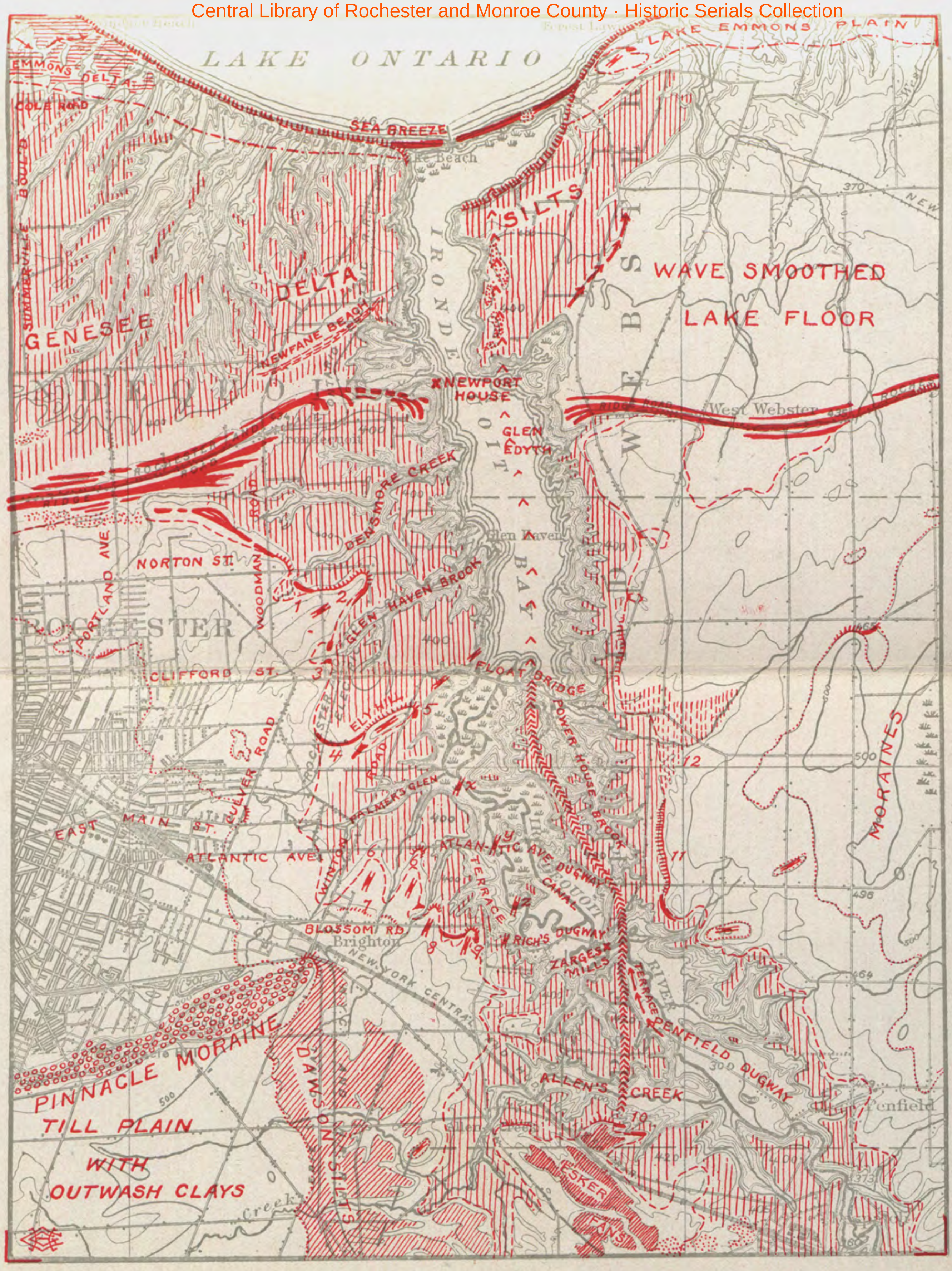

- Kame moraine
- Drumlin or drumloid
- Meander controls; *see page 143.*
- Supposed buried esker
- Esker fan in Lake Dawson
- 480 contour (approximate Dawson shoreline)
- Silts of Lake Dawson
- Sand dunes
- Newfane beach
- Lake Iroquois shoreline
- Special features on Iroquois shore; *see pages 132 and 133.*
- Beaches, bars, spits
- Wave-cut cliffs
- Lake Iroquois silts
- Subaerial deltas
- Lake Emmons shore (approximate)
- Lake Emmons delta
- Abandoned channels

Plate III.
Physiographic Features
of the
Lower Irondequoit Valley.

The base map for this plate, printed in gray, is from a plate prepared to illustrate Professor Fairchild's paper on "The Geology of Irondequoit Bay" and is Plate 3 of volume 3 of the Proceedings. It was photographed with slight reduction from the familiar government topographic sheets, on sale in the book stores.

The overprint in red is intended to suggest the physiographic interpretation of the surface features, together with the field evidence upon which the succeeding outline maps (Plates IV to X) are constructed.

PROCEEDINGS OF THE ROCHESTER ACADEMY OF SCIENCE
VOL. 5, PP. 123-160, PLATES 3-10. JULY, 1917.

THE LAKE DEPOSITS AND EVOLUTION OF THE LOWER IRONDEQUOIT VALLEY.

BY GEORGE H. CHADWICK.

Presented for publication and read by title before the Academy, June 7, 1915.

CONTENTS.

INTRODUCTORY.

The Irondequoit Valley lies just to the east of the city of Rochester, to whose people it is familiar as a recreation ground. The main elements in its geological history have already been presented in these proceedings[1] and elsewhere by Professor Fairchild. The present paper is an outgrowth of studies upon the rock floor of this valley presently to be published in which it became necessary to show what features are superficial and not dominated by rock forms beneath. This lateral investigation soon assumed such proportions as to merit separate treatment, especially since its content may appeal to a different company of students. Though prepared in 1909, the manuscript has been laid aside awaiting the solution

1. The Geology of Irondequoit Bay, H. L. Fairchild. Vol. 3: pp. 236-239.

of broader problems involved;[2] much of the results having meanwhile become public through use in the classroom, and parts having been duplicated or corroborated by advanced students in the college.

Physiographic Divisions.

As a physiographic unit, the valley of the Irondequoit heads at Fisher's, fifteen miles by rail southeast from Rochester, where the stream itself enters it from the side *(see Key Map, Fig. 1)*. From Fisher's down to Lake Ontario it is divisible into four equal sections of four and a quarter miles each. The first section, from the entry of the headwaters to Bushnell's Basin, is heavily obstructed by kame and esker fillings which divide it more or less continuously into a double depression; this is the Upper Valley. The second section, from the Erie Canal at Bushnell's Basin to Penfield village, is filled nearly to the brim by a broad silt plain across whose level surface the canal and railroads find favorable passage; this is the Middle Valley. The third is the "dugway" section,[3] deeply trenched in these same silt plains and affording picturesque submountainous scenery; this section extends from Penfield to the Float Bridge *(see Plate III, facing front page)*. The fourth or "bay" section combines the steep silt bluffs with a lake-like sheet of water laving their base, uninvaded by commerce, that has no peer in our inland waters. This section extends from the Float Bridge to Sea Breeze (Lake Beach of the map), and together with the preceding "dugway" portion constitutes the Lower Valley, the subject of this paper.

It is this lower half of the valley, eight and a half miles in length from Penfield to Lake Ontario, that is shown upon our maps. Allen's Creek, the most important Irondequoit tributary, enters at its upper end, issuing from a well-marked minor valley on the southwest. Otherwise the lateral drainage of this Lower Valley is exceedingly local.

Glacial Lake Succession.

It has been shown by Prof. Fairchild[4] that the present surface depression of the Irondequoit is but the shadow of a greater rock-

2. See references beyond to papers on Lakes Vermont and Emmons.

3. The name "dugway" is locally applied to the three roads carved across this section of the valley. See Plate III.

4. See the paper just cited on preceding page.

valley beneath, whose partial effacement is due to glacial and post-glacial agencies, including stream-fillings in bodies of standing water. With these last mentioned deposits of the glacio-postglacial lakes we are specially concerned, since they have played the major

Fig. 1. Key Map of the Region around Rochester, (former city limits in dot and dash), showing the four sections (numbered) of the Irondequoit Valley separated by dash lines, and the relation of the area of our maps (shaded quadrangle) to the Genesee River and the belts of rock outcrop. The strata (dotted boundaries) dip gently toward the south (base of map) passing under the Onondaga limestone escarpment, north of which the belt of weak Salina shales is deeply drift buried, especially by huge kames between Mendon and Henrietta and from Victor to Fairport. Somewhere beneath the former area lies the preglacial rock channel of the Genesee, as suggested by the broken arrows.

part in determining the final topographic expression of the middle and lower valley, whereas the ice-made features control in the upper valley.

Always, during its waning over western New York, the receding margin of the ice-sheet abutting against the north-sloping land surfaces of this region held impounded waters whose points of escape lay to south or west or east. Some of these waters were small and local lakes, but others were truly inland seas, greater than the existing Great Lakes their descendants. The broader history of these lakes, so far as it had been unravelled, has been told by Fairchild.[5] Of the lakes described by him, the earlier ones, Hall, Vanuxem, and Warren, involved more or less of the Upper Irondequoit Valley but probably did not enter the area immediately under discussion because it was still ice-covered. At least the ice reached into the upper valley during the existence of the succeeding Lake Dana for there is an ice-margin deposit (esker fan) built in Dana waters at Railroad Mills (715 feet A. T.). At some time, however, during or subsequent to Lake Dana the kame deposits of the Pinnacle Range just south of Rochester *(see Plate III)* were being constructed at the margin of the Genesee ice-lobe; and it is interesting to note that their highest summit at 750 feet accords with the rising Dana plane on this parallel. It is possible, therefore, that before its extinction Lake Dana was admitted into the southwest corner of our map-area.

After Dana came a brief pause at about 540 feet that has left faint marks on the south face of Cobb's Hill and the Pinnacle and on the north end of certain drumlins south of Fairport; then Lake Dawson at 480 feet, whose more conspicuous effects are described beyond, and next Lake Iroquois at 435 feet, whose work occupies the bulk of this paper. Iroquois was by far the most important and most enduring of these water bodies. Its outlet was through the Mohawk Valley at Rome, N. Y., and at its zenith it filled the Ontario-Saint Lawrence Valley to the northmost bounds of our State.

Two stages in the lowering of Lake Iroquois waters have been recently [as of 1909] discerned by the writer[6] in northern New York, and since traced and mapped by Fairchild into the Champlain and Hudson Valleys.[6] The higher of these had already been noted by me at about 320 feet in the Rochester district; the other probably

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5. Bulletin 127 N. Y. State Museum: Glacial Waters in Central New York. This work was just going through the press when the present paper was written.

6. Bulletin 145 N. Y. State Museum, p. 139 footnote; and Bull. 149, p. 18.

passes under Lake Ontario in this region at about 240 feet, though there is some reason to think that its higher and weaker beaches may reach up to 260 feet. Indeed some of the wavework herein attributed to Ontario may have been initiated by this its predecessor. Finally the evacuation of the St. Lawrence Valley by the glacier let in the salt (or brackish) waters of Gilbert Gulf, whose levels "fell" steadily through land uplift until the Thousand Islands emerged from the waters. Then and thus came Lake Ontario into existence

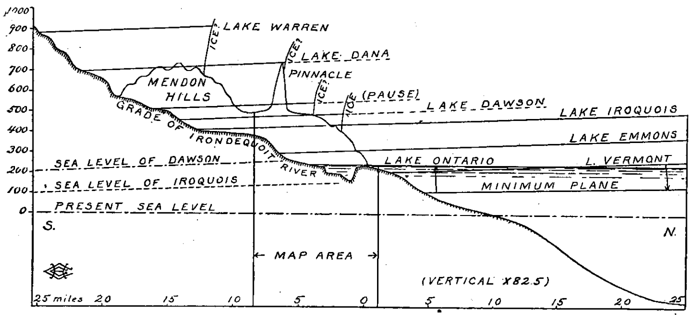


Fig. 2. Vertical Diagram of Glacial Lake Levels in the Rochester Region, showing deformation (tilting) by land uplift. Exaggeration of vertical scale 82.5 times.

but not in its present dimensions, since by the same land uplift still in progress its surface has been steadily *rising* on the south shore until it has reached its present point. There are no published estimates for the altitudes of initial Gilbert Gulf or of minimum (transition) Gilbert Gulf-Lake Ontario off the Irondequoit outlet. Rough calculations suggest about 175 feet A. T. for the highest Gilbert beach and 110 feet A. T. for the point of farthest retreat. These are respectively 72 and 137 feet below the present stand of the lake, but they are merely approximations. The fact they stand for is, however, that for a time immediately before the present the base level of our region (represented by the lake) was considerably lower, perhaps by hundreds of feet, than at present, the shore lines were farther out by some miles, and the erosional capacity of the Irondequoit River was greater than to-day. Lake Ontario is readvancing upon its south side, and all the streams entering it here are "drowned" in their lower reaches, none illustrating this better than the Irondequoit and the Genesee. Figure 2 represents these lake levels, which may be summarized thus:—

Lake Dana - - -	750	feet above present sea-level
Pause at - - - -	540	" " " " "
Lake Dawson (final) - -	480	" " " " "
Lake Iroquois (final) -	435	" " " " "
Lake Emmons - - -	320	" " " " "
Lake Vermont[7] - -	250 (?)	" " " " "
Gilbert Gulf, initial, falling -	175 (?)	" " " " "
" " transition -	110 (?)	" " " " "
Lake Ontario, rising to -	247	" " " " "

The Lake Deposits.

Earlier lakes. Lake Dana and its 540 foot successor made no distinctive deposits in the lower valley proper, although the influence of the former is very conspicuous in the upper valley from Railroad Mills to Fisher's.[8] Lake Dawson, however, with its outlet via the splendid channel from Fairport to Lyons, left more indelible traces on our map. Its wavework was here too cramped to build strong spits and bars, but it ate away the declining east end of the Pinnacle kame as far as where the Erie Canal swings around it at Brighton, thus leaving only trains of bare boulders to mark the former extension of that moraine into the re-entrant angle between the Genesee and Irondequoit lobes. From Brighton to Fairport the Dawson shoreline is followed approximately by the Canal, and on the north and east of this shore in the Allen's Creek valley our map shows extensive, but dissected, surfaces at the Dawson wave-

7. Vermont-New York of Fairchild; now regarded by him as a sea-level water body higher and earlier than the Gilbert stage. For the names of this lake and its predecessor Emmons see Bulletin 158 N. Y. State Museum: pp. 33-35; for the later interpretations, Bulletin 164: pp. 22-24, also the Bulletin of the Geological Society of America, Vol. 24: pp. 157-160 and Vol. 25: pp. 220, 233-242. (All by H. L. Fairchild).
The question of the nature of Lake Vermont, or even of the higher Emmons and Iroquois, whether sea-level or glacial, in no way affects the conclusions set forth in this paper.

8. See map, Pl. 2, Bulletin 127 N. Y. State Museum.

base level. The region southeast of "Allen Creek" along either fork of East Avenue and northward to the railway is a sand desert whose summits are mostly within the 480′ contour—only one small knoll near Pittsford (not on our map) going above 500′. The original form and extent of these deposits have been obscured by windwork still in progress, to which their irregularity of surface is palpably due, but standing as they do isolated in the midst of the valley, approximately in line with the buried esker described beyond *(see page 143)*, it seems reasonable to view them as the pro-glacial delta sands (esker fans) of the Dawson stage. The excess of fine materials is remarkable, yet coarse gravels and even cobble beds occur in the heart of the mass and it is to be noted in this connection that fine sand predominates in the great Turk Hill kame-area only six miles southeast from here up the same valley. The above interpretation requires that the ice front be deeply lobed into this valley, since it must escape the Pinnacle Range at Brighton, but this arrangement, which is to be expected a priori, is strongly suggested by the attitude of the deposits themselves. Finally there is a possibility that some of these sand heaps were built upon an ephemeral foundation of stagnant ice to which they owe some of their present irregularity. Lake Dawson wavework appears again in the low bluff east of Culver Road at East Main St., just north of the new athletic field. The rest of its shore line through the city shows but weak vestiges of wave action.

Outer bar or "Ridge Road" of Iroquois. That feature of the Iroquois shore that has attracted the widest attention hitherto is the outer bar or barrier beach known throughout its length as the "Ridge" (or "Little Ridge" in contrast with the adjacent Niagara scarp) and everywhere threaded by a "ridge road" On our map it is bounded by the 440 contour east of the bay and by the 420 contour on the west. Beyond the Genesee it again exceeds 440 feet. The section north of the city is boldly divorced from the mainland and is often a multiple bar with minor flanking swells, as specially noticeable east and west of Portland Avenue. But the "ridge" is not always independent of the (former) mainland; at times it gives place to low wave-cut bluffs, as for example at the east edge of our map and again toward the western limit of the Rochester quadrangle (off our area). The material of the ridge is mostly gravel, with typical beach structures, well shown where the Sea Breeze trolley line cuts through the bar (or long spit) east of Irondequoit, in the gravel pits of the Sodus railway above Glen Edyth, at the deep pits east of Portland Avenue, where the gravels rest on the bedrock with no intervening till, and finally in the Heffer pits west of Portland Avenue where dune sands overlie the gravels.

The size and strength of these gravel bars and embankments indicate that they are the finished product of wavework in a long-lived water body. They are far larger and stronger than the corresponding features of Lake Ontario, a few miles away, for which two explanations have been suggested,—first that here Iroquois was practically stationary at one level throughout most of its long life time, whereas Ontario has constantly advanced upon newly submerged land surface; and second that Iroquois found a much larger amount of glacial gravels and other incoherent debris ready to handle, while Ontario is cutting chiefly into stiff delta clays or compact till robbed of its loose surface materials by former lowering waters and subsequent land drainage. The value of the former suggestion is now somewhat open to doubt *(see page 150)* and Prof. Fairchild now considers the latter as the real reason.

The freshness of these beaches in spite of the time that has elapsed since the waves last caressed them is indeed astonishing. With one exception erosion has been impotent against them. This exception is a quarter mile strip between the Sea Breeze trolley line and the road to the Newport House, where the "ridge" has been undermined and carried away by the encroachment of a huge gully working back from the Bay. The terminus of the long spit was not at the trolley, as the contours would suggest, but in the vineyard overlooking the Newport House,—a point that commands the entire Bay. Here the gravel ridges curve around to the south and decline to their final termination. It is evident that neither they nor the silts upon which they were pushed out ever went further at this particular point or connected across the chasm with the companion spit on the east shore, with which they are in line.

Newfane beach at Rochester. Westward of our meridian, in the Niagara district, there has been recognized a lower, earlier stand of Iroquois which its waters afterward overrode and partially subdued. This is called[9] the Newfane beach. While seeking anew in 1914 an explanation of the great northerly deflection of the "ridge" as it approaches the Irondequoit embayment from the west, the Newfane bars were found at the road crossing on the Sea Breeze trolley a mile and a quarter south of Lake Beach (Sea Breeze) at the "Birds and Worms" station, just north of which (between the two cross roads) the trolley grade cuts through the beach. The trend here is southwest, according with the curvature of the ridge proper; but just east of the trolley the beach ends in an acute angle from which another limb or spit runs a short distance south to the margin of the big gully. This Λ-shaped cusp apparently represents the destruction of a small kame island with the distribution of its materials backward in two unequal "streamers" This is a kind of work that might even have been done with the Iroquois waters at their full height, in the process of razing a small island or a shoal that stood above wave base. But in any case the trend of the western limb of the cusp is significant as showing the presence in that direction of other land masses to which it could tie.[10] These must have lain somewhat to the north of the present ridge in the wave-planed area between the 400 and 420 foot contours. Their contents were undoubtedly pounded slowly backward into the finished ridge. The essential thing for us is the suggestion they convey of a line of kames, concentric with the Pinnacle series and probably the later product of that same ice lobe, acting as the backbone for the outstanding Iroquois bar through Irondequoit. Lying but little north of the Dawson shoreline, they may be referred to the same ice pause as the supposed esker fans at Allen Creek above noted. *(Compare Plate IV.)*

Inner beaches of Iroquois. Back (i. e. south) from the Ridge Road bar lies the modified "initial shore" of full-height Iroquois with the associated inner bars and cliffings. This strandline reaches far south around the Irondequoit depression, limning a great bay, to which the name "Pittsford embayment" has become attached

9. See U. S. Geol. Survey Niagara Folio No. 190: p. 12 seq.
10. See Johnson's studies on Nantasket beach in Journal of Geology Vol. 18: p. 162.

although precisely speaking Pittsford village does not lie therein and but the margin only of the town of Pittsford.

Not everywhere along this inner shore can unequivocal marks of water action be made out, but the silt plains soon to be described serve as a valuable index in its exploration. At the west edge of our map the initial shore is against the attenuated Niagara escarpment, with rock exposures due to the surf. Coming east, to and across Portland Avenue, the shore is masked by the dunes of the Heffer sand-pits. When it emerges from these it begins to bear away southeastwardly, diverging from the Ridge until it lies a mile back from it at Woodman Road. In this short stretch are developed the best of the inner beaches, either because this was an exposed shore in the earlier stages of Iroquois before the completion of the sheltering Ridge, or else since even afterward it was the least protected portion within the Pittsford embayment. The beaches here are not only strong but at one point they become complicated and multiple.

East and south from Woodman Road the work of Iroquois waters has been recognized at the following points: (1) On Densmore Creek just south of Norton Street where a small bar built from the southeast has deflected the stream on the 420 contour; a delta fills the space behind; (2) Extending from the preceding to the end of Norton Street the shore cliff is finely concaved, terminating with a deep notch in the sandy promontory; on the east side small pits have been opened in the beach deposits; (3) Next southwest, where a road crosses the Glen Haven brook, are other gravel patches partly obstructing the Iroquois mouth of that stream; (4) Half a mile south of Clifford Street a semicircular bar, concave northward, swings across the Glen Haven (Sodus) railway to a drumlin island (Ely hill) on the east and ties it to the mainland; the blind road of the map is the chord of its arc, permitting several houses and barns to stand upon it or its flanks; this was the first bit of the inner shore to be discovered by the writer. (5) The north end of the same drumlin, along Winton Road, is sharply notched, with traces of a small spit on the east slope; (6) On Atlantic Avenue east of Winton Road two successive drumloid ridges show wave action; the second one, just above the "dugway" hill, baring the limestone in the roadway;

(7) There is a notable straightening of the 440 contour south of the preceding, with some cliffings north of Blossom Road, Brighton, that seem to be the storm cuttings of Iroquois; (8) Just east of these the second brook makes a twist around a rather shapeless gravel mass north of the road, while the two drumloid promontories next east are plainly notched, with another semicircular bar between them, south of the road; the triangular lagoon inclosed by it has been drained by an artificial ditch cut through the barrier; (9) Tracing the wave scarp eastward around the point of the hill at the end of Blossom Road a wide gravel spit is found in its lee, facing Kelley Road; the elevation of this spit has been determined by Professor Fairchild to be 427.30 feet, and that of the bar at Clover Street on the west of the same hill as 431 feet, which indicates an approximate deformation of the Iroquois shoreline of two and a half feet per mile in a north-south direction between here and the Ridge at West Webster.

The embayment becomes constricted at this point, where Rich's Dugway road crosses the valley, and is still further blocked by an island-like mass on the Penfield road next south, thus hampering wave-work in its upper section. But Ira Edwards reports (1914) that Iroquois beaches do exist (10) on the north end of the great sand mass east of Allen Creek which we have taken for an esker fan in Lake Dawson. This is the spot where such phenomena had the best opportunity to impress themselves.

On the east side of the embayment the beaches recommence opposite where we left them, i. e. at Rich's Dugway; thence are plainly traceable for a mile northward (11) as a sloping strip of gravel following the smooth contours of the hillside. A considerable delta, (12) with curiously lobate front, fills the re-entrant angle of the brook then crossed; this extends to the Float Bridge road, beyond which the shore again follows the steep hillside to the Ridge.

The silt plains. If to the eye the inner shore is often elusive, the silt plains are everywhere contrastingly conspicuous. They represent an astonishing amount of infilling of this great gulf during the life of Iroquois. One has only to go down any of the "dugways" and gaze upward at the enormous banks of sand exposed on all sides by man or stream cutting, to wonder whence all this stuff could have come. Though deeply dissected by numerous gullies on every side the upper surface of these plains still presents to the eye a perfectly straight and horizontal line of great beauty. Yet the relation of these flats to the Iroquois lake plane would appear to vary at different points. In the open northern portion of the Pittsford embayment they evidently mark "wave base" but as each successive narrowing of the bay diminished the wave force the depth of wave base below water-level must have correspondingly decreased. A critical observation bearing on this was possible in 1909 in the fresh cuttings for the state road on Atlantic Avenue, where, along the east ascent from the valley, the upper ten feet or so of the silts showed a conspicuous flow-and-plunge structure, sharply separated from the uniformly horizontal laminæ below. This seems to indicate that the silts were here able to accumulate above the original wave base and by their own slow encroachment to retard the wave activity. We may safely assert that the surface of the silt filling rose slowly southward as in the present Bay (which, however, from its smaller size and deep implantation, is a comparatively placid body of water) until it surmounted the lake level and became, first a marsh and then a grade-plain (flood plain) of the river. Fairchild has shown[11] that the original grade of this plain had some six feet per mile of southward rise in the most exposed portion and one is tempted to compare this figure with the exactly similar gradient of the submarine silt plain for one hundred miles off New York harbor. But these figures of Fairchild take no account of the subsidence that these soft silts underwent when the sustaining and permeating lake waters were withdrawn. *(See discussion of this farther on.)* As shown later there are many evidences, especially the course of Allen's Creek after it enters the main valley, that point to sub-aerial construction of the silt plain as far north at least as the Rich's Dugway (Zarges Mill), though possibly this was true only of the final stages when the waters of Iroquois had already commenced to lower.

These silt plains are now in the process of removal, a process that has been going on uninterruptedly since Iroquois was drained

11. Proc. Roch. Acad. Sci. 3: 238.

away. Their present is therefore but a partial index to their former extent. But the latter item is so vital to an understanding of the subsequent history of the lower valley as to demand a careful inspection of the evidence. The widest continuous plains to-day are found along the west side of the Bay (south of the Ridge), where there was and is copious land drainage. Though trenched and dissected again by the same streams that furnished their materials, these particular plains preserve a lobate front for each of the major brooks, with the development of minor gullies in the intervening notches. There is none of the concave scalloping of their front slopes such as in other portions of the valley signifies under-cutting by stream meander; on the contrary the scallops are all convex as is normal in a delta margin, from which we conclude that here at least we have a true measure of the original filling, and that it failed to encroach farther upon the great depression now occupied by the southern half of the Bay. On the east side, between the Float Bridge and the Ridge Road, the conditions are very different; the land drainage is exceedingly weak, with no mappable brooks, and the silt plain is but a narrow wave-built platform constructed into deep water against a steep declevity. But here again meander-cut concavities are lacking, the nearly straight face being instead quite regularly corrugated by rain wash, except where complicated by slipping of the silts down the till slope to which they cling. With so much stuff necessarily expended in vertical construction alone, the meager supply at this point prevented the plain from advancing far into the basin, and once more the present limits appear to mirror quite closely the former proportions of the deposit. In our belief, this section of the bay was never filled by the silts.

Southward from the Float Bridge the evidence is quite the opposite. All the slopes are clearly erosional, with meander carved walls throughout the re-excavated valley of the main stream and many flat-topped "mesa" remnants and "sugar-loaves" in the heart of the valley as pointed out by Fairchild.[12] The freshly cut edges of the silt strata are visible at many points in the steep banks. All observers from the time of Gilbert have agreed that in this section of the valley the filling was continuous from wall to wall across the

12. Vol. 3 of these Proceedings, p. 237.

ancient depression. These central fillings terminate, however, to-day at the Float Bridge to be replaced immediately by the open waters of the Bay. The protruding point of the silt mesa just east of the bridge, in the mid line of the valley, is not unlike the protruding marshy delta of the present river at its foot; moreover, the excavations for sand in its northern face reveal a sloping stratification conforming to the surface slope of the hill itself. These facts seem to warrant the inference that this central filling of silts, or subaqueous Iroquois delta of the Irondequoit river, did not extend north of this point but ended here with the usual lobate front. This conclusion is the same as that derived just above from the study of the lateral deposits on the north. The contrast between the filled and unfilled areas is marked and the dividing line between them is abrupt.

On their landward side, the margins of the silt plains blend, as might be expected, with wave eroded benches in the till, and in proportion as the beaches weaken toward the upper (south) end of the embayment the limits of the plains grow more and more obscure, partly through subsequent rainwash. Thus both criteria fail together, the Iroquois plains merging upward with those of Dawson in the region between Fairport and Bushnell's Basin, south of our map.

Iro-Genesee subaqueous delta. Similar in origin to the silt plains, and consisting like them of the same detrital material, is the great subaqueous Iroquois delta of the Genesee river, which constitutes a large share of the town of Irondequoit. The embouchure of the Genesee into Lake Iroquois lay about a mile to the west of our map limits at the end of Norton Street. But its silts cover all the district east and north as far as Lake Ontario and the Bay; nor are they, apparently, terminated by the latter, for, if our interpretation is correct, they also give shape to the remarkable angular platform that narrows the bay on the east shore to less than half its normal width from opposite the Newport House northward to near its mouth. While this great mesa, with its excessively steep bluffs and its surmounting sand dunes, may have as its core a gravelly esker-fan of early Iroquois age *(see Pl. V and compare Figure 8, A)* yet the mass as a whole bears every evidence of being a now sundered continuation of the Genesee silts, extending east as far as the main road (next east of the Bay) from the Float Bridge to Forest Lawn. In fact no other source can be found for the fine silts composing it. The peculiar acute angle between this mass and the main east margin of the Bay depression (just north of the Ridge Road) thus finds explanation as being the unfilled space between two different areas of deposition, while the steep and straightened backslope of the delta thus thrown laterally across a great chasm is just what we would expect in such a case. Furthermore, the whole structure lines up well with the Ridge Road spit across the Bay in Irondequoit village. No other competent cause can be invoked for this great obstruction blockading the ancient rock-valley for more than two-thirds of its width, and for over a mile of its length. The mode in which it was cut off from the main mass on the west will be considered later.

This main mass, in the town of Irondequoit, has been subjected to a very pretty and perfect dissection by a group of closely spaced "consequent" brooks that furnish as compact a little field for detailed study as could be selected anywhere in the world. Digging down through the silts at a point where these were spread somewhat deeply over a broad hollow in the underlying rock and till surfaces (see the accompanying paper on the rock topography) these brooks have in most cases come to rest not far from the actual contact of the silts upon the till. Here they find their downward progress almost wholly checked by the firm stony "hard-pan", but here they find also their greatest alimentation of ground water; and so they push their little valleys headward along the till surface by means of the feeding springs, and develop lateral tributaries by the same means. The new Durand-Eastman Park now includes a considerable portion of this area.

Between this park and the bay lies a flat ridge of undissected plain followed by the road and trolley to Sea Breeze (Lake Beach). This ridge, though essentially a part of the delta surface, has become so largely through the smoothing down of the glacial kames and earlier (Newfane) beaches already described. Across the surface thus levelled must have been swept or carried in suspension the silts that compose the detached mass east of the bay. The glacial core of this ridge, which partakes of the nature of an interlobate moraine, declines rapidly northward from the 380 contour and passes under a thick cover of silts at the Sea Breeze end. In the road cutting there the silts are seen to be much contorted, a phenomenon noticed also at Summerville and other points along or near the delta edge by Prof. Fairchild, and attributed by him to a spreading flow or "creep" of the basal layers of the delta deposit under the increasing superincumbent load, or as the waters withdrew.

The remarkable triune amphitheater southeast of this ridge, encompassed by the trolley, will be considered under the erosional history.

Lake Emmons delta and terraces. We now pass from the deposits of Lake Iroquois to those of the first conspicuous halt in the lowering of its waters probably identical with that which Fairchild has elsewhere called Lake Emmons, but the nature of which he has more recently doubted. The matter of interpretation need not concern us here, if the fact of a recognizable and continuous strand is established; nor is a new name necessary, since in any case the sole communication of the Emmons waters with the sea must have been through the narrow strait at Whitehall, with the flow all in one direction.

The Emmons delta of the Genesee is at Windsor Beach, with an inshore elevation of below 320 feet (probably about 310). A portion of it appears in the extreme northwest corner of our map, showing traces of the old distributary channels on its surface. The "White City" stands on this plain, whereas "Elm Beach" occupies the beach level of Lake Ontario. (These not on map). The Emmons shore is everywhere weak and this delta is further disguised by being built against the lower slopes of the much larger Iroquois delta, from which it was therefore not discriminated at first. But while the Iroquois plain extends northward on the Summerville Boulevard to "Cole Road" *(see west edge of map)* with a nearly level surface, it then begins to decline noticeably. This slope continues halfway to the next turn in the road, where it ceases and the Emmons plain commences. Faint wave work and notchings are visible just above the inner margin of that plain at about the 320 contour, with some pebbles and gravel ice-rafted along the beach in winter. The shore bears thence nearly due east, discernible chiefly as a change in gradient, until it is interrupted by the receding bluffs of Lake Ontario. These bluffs also truncate the delta itself abruptly, especially on the northeast, indicating that a large part of the original deposit has been redistributed by the waves of the present lake.

It should be noted that the Emmons plain is traceable farther east than the map contours show, since the latter prove to be somewhat at fault. By Locke level the land is only 40 feet above the Ontario water-surface of July, 1909, or approximately 290 feet A. T., at the western corner of Durand-Eastman Park, while the map contour here (under "AND" in name of railway on Plate III) is 320. The second promontory east of this, (under "N" of Ogdensburg), also contoured 320, measures 55 feet above lake or only 305 A. T. Extensive grading of the park property has now obscured some of these levels.

The Emmons shore reappears east of the Bay, at Forest Lawn, with a conspicuous plain above 300 feet eastward of that place, as shown on the map.

One of the most striking features connected with the Emmons base-level is the great meander cut of the Genesee in its Iroquois delta at the Rifle Range (west of our map) with a similar though less remarkable cutting on the opposite bank. The full consideration of these and of the complex of old channels in Seneca Park must be reserved to another paper, but they are noteworthy here as independent evidence of a pause in the lowering waters at a point slightly above 300 feet present altitude. While Lake Emmons was receiving the Genesee outwash at approximately the Charlotte coal-trestles, a mile farther south the river was swinging laterally in its own soft silts of an earlier stage and snaking itself about on a floor of Medina sandstone as far upstream as that floor did not surmount the base-level,—above which it was engaged in gorge making. The material for the Windsor Beach delta was thus derived ready comminuted from this convenient supply and with great rapidity, which explains why this delta deposit is so disproportionate to the wave work of the evanescent Emmons waters.

With the Emmons base-level we would associate also an erosional terrace in the silts of the Irondequoit valley at the 320 contour. This is represented by a lateral bench at two localities in the "dugway" section, both on the west side of the present valley, and in the summits of two tiny sugarloaves that margin one of these benches. This terrace extends practically continuously from Atlantic Avenue to beyond the Rich's Dugway, at the latter point being especially well developed but containing some kame-like gravels that need explanation. The second bench may be traced from the narrow portal just above Zarges Mill south to the Penfield road, halfway to which it rises above the 340 contour. This section retains an abandoned channel of the stream on its inner margin. These two stretches totaling over two miles in length and having a maximum width of about forty rods apparently bespeak a distinct pause in the erosion of the modern valley, such as one would most naturally link with the base-level furnished by the Emmons waters. That this interpretation may be too simple is suggested, however, by the absence of any Emmons delta at the Float Bridge. See map D (Plate VII) in which they have nevertheless been given this interpretation.

Soundings in Irondequoit Bay. Some very significant facts regarding the underwater topography of the present bay are revealed *(see Figure 3)* by the U. S. Lake Survey large scale manuscript map of 1875, of which Professor Fairchild possesses a blueprint. The scale is 1:10,000, or 6.336 inches per mile. In the mile section (D of Fig. 3) from the Float Bridge to Glen Haven there are 90 soundings whose total average is not quite five feet, nearly a third (28) of them being two feet or less while over two-thirds are under one fathom. The four deepest soundings recorded are respectively 11, 12, 14, and 16 feet, but this is exclusive of 14 soundings in the delta channel of the Irondequoit river ranging from six to eighteen feet with an average of nearly twelve feet. It also excludes 15 others in an abandoned (or artificial?) channel close to the west shore which average eight and a third feet. Apart from these the area under one fathom is localized on the east side farthest from the river, where the filling would naturally be deficient.

Northward of a concave line the soundings deepen abruptly and in the middle broad section (C) of the Bay there are, exclusive of the marginal platform due to recent wavework, 125 soundings, 104 of which fall between the limits 35 and 40 feet inclusive. Only eight exceed 45 feet (maximum 54) and these are all in the extreme northwest corner in the notch leading down the deep section beyond. Thirteen range between 19 and 28 feet but are either at the extreme south end or else fall upon the marginal slopes. The average of the remaining 104 is 38½ feet. Just one-quarter of these (26) are under 35 feet, located mostly near the south end, while over a half (54) are

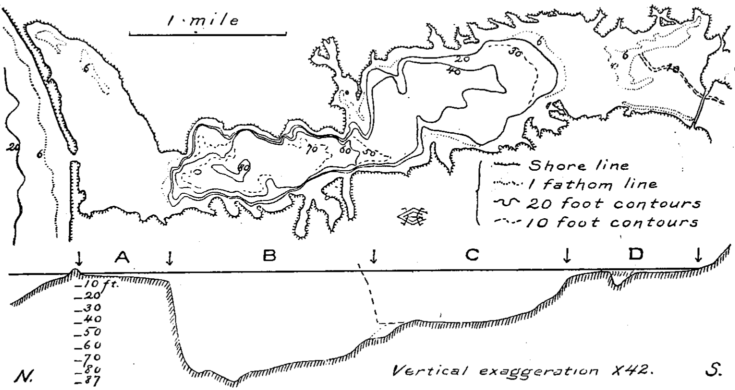


Fig. 3. Underwater Contours and Longitudinal Profile of Irondequoit Bay, constructed from blueprint of U. S. Army map of 1875 and reduced to one-sixth. The absence of meander cuts in the broad section (C-D) and their abundance in the deep section (B) is strikingly brought out by the contours, as also the narrow submerged wave-platform surrounding the entire deep basin, showing how rapidly the silt bluffs are being eaten back.

either 39, 40 or 42 (41 feet being nowhere shown). This section possesses therefore a remarkable flat floor, extending a mile and a half north from the preceding section.

Opposite the Newport House, however, the Bay deepens again as suddenly as it narrows, and 127 soundings in this deep section (B) show only nine under 42 feet all of which are distinctly marginal, while 91 are sixty feet or more, four being 81 feet and one 84 feet. The remaining 27, ranging between 42 and 57 feet, are restricted to two very definite small platforms on mid-west and northeast, perhaps contemporaneous in origin with the preceding flat-bottomed section. The form of the under-water contours in this section B is that distinctive of a gorge-like valley widened slightly by meander sweep, contrasting strongly with the absence of any such meander-cuspings in the preceding sections C and D.

The maximum depth of 84 feet anywhere in the Bay is in this narrow section and about opposite Point Pleasant. With the widening of the Bay towards its mouth the soundings jump abruptly from 60 feet up to barely six (one fathom). 109 soundings in this shallow northerly section (A) include only eleven over six feet all of which are in the northeast corner farthest from the inlet. Over half (52) of the remaining 98 are either 3 or 4 feet, and these are distributed on the western half which thus constitutes a typical inlet delta.

The longitudinal profile of the Bay, as shown in Figure 3, therefore contains four sharply distinguished segments,—three of them (A, C, D) approximately flat platforms and the fourth (B) a gorge-like trench. The principal platform is in the middle and widest portion of the Bay, with an average depth of about 40 feet but declining quite steadily though gently from south to north. The other two flats are the shoal portions at each end of the Bay. In the very deep, gorge-like segment the depths increase pretty steadily from the Newport House to Point Pleasant, and thence shallow again about one fathom. Each of these four sections is separated from the adjoining ones by abrupt vertical transitions of 25 to 50 feet. In attempting to interpret their testimony it is obvious that the shoals at either end are the work of the present waterplane, but the broad flat bottom of the middle bay and the deep channel through the narrow section originated in episodes when the waters in the Ontario Basin stood much lower than to-day. Our conception of their meaning is recited on a later page, in the paragraphs on the re-excavation of the valley.

Course and character of the "dugway" valley. The erosional forms assumed by the silts in the "dugway" portion of the valley look at first sight exceedingly complicated, but on more minute analysis their peculiarities and irregularities are found to be highly instructive. At Zarges Mills the present course of the river bends sharply and crosses abruptly from the east to the west side of the old silt-filled rock valley. The narrow portal through which it passes is exactly midway of this "dugway" section. From this point north to the Bay, at the Sodus railway powerhouse, the east half of the old valley is being redeveloped by a companion stream parallel to the Irondequoit, while to the south of it the opposite half of the old valley is less plainly delineated by a small gully and then by Allen's creek flowing in a reversed direction to find the main stream. These facts suggest a resistant central core to the valley fillings that might serve as an axis for the great tongue-like remnant of the silt plain extending north down the middle of the valley from Zarges Mills to Float Bridge and in the other direction well toward Despatch. For an analogous case we need go no farther than the upper Irondequoit valley from Bushnell's Basin to Fisher's, which is similarly bifid by a great esker up the middle. A ruler laid along the general course of that esker, which must indicate pretty closely the direction of local ice-flow while the esker was building, coincides almost perfectly with this hypothetical axis in the lower valley. A visit in 1914 to the narrow portal above Zarges Mills revealed there as had been anticipated a cross section of this buried esker, and further exploration has located other exposures of its gravels where it crosses Allen's creek. Presumably this is the same esker whose delta sands in Lake Dawson lie between Allen's Creek and East Rochester (formerly Despatch) as referred to on a previous page *(129)*. Its supposed course is represented on map A (Plate IV), and on Plate III.

In the section of the Irondequoit river from Zarges Mills north to the mouth of Palmer's Glen the present excavation in the silts has three widenings and three constrictions (*x, y, z* on Plate III). In each of these constrictions the river is against the west bank and is apparently unable to make much lateral progress into it, whereas the expanded sections are developed on the opposite or right bank and portray plainly old meander swings into soft silts. now being slowly drowned as the Ontario level rises. It would seem that these meander loops so nearly closed in behind the intervening spurs as to leave only insignificant necks capable of being overtopped by the rising waters; and through those narrow necks was later cut by man the canal that made Rich's Landing (now Zarges) the port of entry for sailing boats in the days of the early settlement. It is this artificial channel beside which the name "Irondequoit River" is engraved on the topographic map, but the Brighton-Penfield townline follows the natural tortuous stream which still carries the main flow.

The question confronts us, why should the river have been held so rigidly in its place at the three pivotal point, x, y and z, just as it is at Zarges Mills, while permitted to freely meander into the soft silts elsewhere between. Some efficient obstruction must have served as the vise, for this is not the normal behavior of streams engaged in valley-widening, in which the meanders pursue each other steadily down the valley and widen all parts alike. Here then is evidence that at these three points the stream encountered barricades in the days when it was more actively corrading. These barricades are now effectually concealed by the return of Ontario waters raising the level of the marshes, but it is easy to ascribe them to the buried northward continuations or declining ends of the drumloidal flutings of the till whose summits are seen not far to the south, along Blossom Road. For the easternmost one this relation was demonstrated by intervening till exposures at the State Road, now grassed over. It is unnecessary at this time to go further into the details of meander work of an intricate and somewhat exceptional nature to be found in this two mile stretch, since our general conclusions are not involved. The scale of the map is too small to show them well.

The section below Palmer's Glen requires no special analysis. That to the south of Zarges presents many instances of meander work, but nothing of particular moment save the long tongue projecting obliquely into the valley from just northwest of Penfield. This has not been visited and its message is unknown, but it cannot be a rock rib.

Work of the Ontario waters. The waters of the present Bay are those of Lake Ontario. The shallows at its two ends are constructional platforms in this water-level, the one a delta-filling of the Irondequoit continuous with its marshes, the other a barrier-beach accessory as explained beyond. About its shores minor wave work keeps the silt fresh-cliffed at many points *(see explanation of Figure 3)*, while small deltas form at the mouths of the brooks, especially Densmore's and at Glen Haven. Since its re-entry into the Bay, Ontario has not been idle. On its main shoreline also it has done a notable work, though some of this may have been roughed out for it by its predecessor "Vermont" as already suggested. The smooth curvature of that bit of its shore that appears upon our map, and the great bar completed across the mouth of the Bay, are indices of maturity in this particular arc, which, it should be noted, spans the space between two rock exposures, at Windsor Beach and just west of Forest Lawn.

The height of the silt bluffs west of "Lake Beach" denotes that Ontario has here transgressed shoreward at least a mile into the delta plains of Iroquois and Emmons. To-day its waves are opposed at many points by the more resistant till, and progress is slower, though sufficiently vigorous to arouse at times the apprehension of property owners and to have compelled the railway to dump huge masses of rock along the frontage of its tracks.

Besides the contributions of its own wave work, this recess of the lake receives also the detritus of the present Genesee. The lake currents here set easterly; a yellow streak in the blue waters trails away eastward for several miles from the mouth of the Genesee river. Though this is now kept a mile or more offshore by the long breakwaters confining the outflow at Charlotte, its burden is still borne inward toward the beach by the waves, and in the past it must have added no small increment to the material that has been piled into the mouth of the Bay. The soundings testify that the Ontario-Genesee delta extends widely eastward and completely masks any northern continuation of the Irondequoit valley beneath the water of Lake Ontario.

One other item remains. This is the long concave silt-bluff on the east shore of the Bay at its north end, facing out toward the lake and paralleled by the barrier beach. The shaping of this is plainly the work of waves from the open lake, but the bulk of this cutting must have preceded the construction of the barrier. Some of the shoaling of this north end of the Bay is evidently due to the material derived thus close at hand, while at the east the shallow platform is really a wave-cut terrace, not a refilling.

Evolution of the Valley.

In the endeavor to reincarnate the sequence of events in the lower Irondequoit valley, these fall readily into three principal stages, which, without forcing the simile, may be conveniently designated as follows:—

I. *Pre-natal period,* during which the conditions were being made ready for the birth of the valley;

II. *Life-span* of the valley as the product of a great river, brought to an untimely close by the glacial occupation;

III. *Post-mortem period,* in which the valley is not merely dead but buried, as we have been considering, under a pall of Pleistocene weaving in which the modern Irondequoit river has made a big rent.

Perhaps to these we should append its possible *resurrection* in time to come.

Early history. The story of the "pre-natal" period is the story of Paleozoic sedimentation, whose details are not germane to this paper, and of the slow uplift of those sediments into a coastal plain whose inner margin lapped along the Canadian-Adirondack old-land on the north and northeast while its outer edge disappeared southward and southwestward under the slowly retiring Mississippian Sea. Across this foreland the rivers of Canada, draining the old-land, prolonged themselves in roughly parallel courses to the sea. Thus was begun the process of valley-making on the surface of this plain.[13]

The story of the "life-span" of the valley thus born is the story of the development of that great trench in the underlying strata which is the subject of our forthcoming paper on the rock topography, wherein its character and proportions are visualized. Complete unanimity as to the significance and history of this rock trench does not obtain, but the following sketch may be considered as harmonizing most of the interpretations. The original rivers of this

13. See Dr. A. W. Grabau: Bulletin 45 N. Y. S. Museum, pp. 87-47.

coastal plain flowed upon a now-vanished land surface hundreds of feet above the present one and upon rock strata long since removed by erosion,—they themselves being active agents in that erosional process. Nevertheless in the long course of this denudation few if any of these valleys could ever have entirely disappeared, since even when stream-capture shifted their main flow elsewhere they would still serve to collect and carry some run-off and thus continue to be deepened at least as rapidly as the surrounding slopes until they reached base-level. But there is scant evidence that our region was ever base-levelled. The rock valley of the Irondequoit must therefore be regarded as such an inheritance from the remote past, for it is not explicable as a subsequent adjustment to the rock structures which it crosses nor as the escapement for glacially coerced waters. Its location was determined by one of those through-flowing rivers of the coastal plain running southward to the Mississippian Sea. In course of time this river was decapitated somewhere to the north of Rochester by the headwaters of another stream working in from the west along the belt of weak Ordovician shales; and as this invading stream grew by successive conquests and opened out the great valley of present Lake Ontario it sent a small tributary headward into the amputated end of the older valley to eat off the head of the latter's river little by little. Thus by a slow but ceaseless shifting of the divide southward down the old consequent valley the original flow was progressively reversed. Successive uplifts of the land, acting from the north, merely gave to the Ontario river greater capacity to excavate its basin, thereby imparting greater vigor to this its Irondequoit tributary. Apparently there was a revival of this invigoration not long before the end came, a rather immature inner canyon through the Niagara escarpment east of Rochester being the resultant as will be described in a subsequent paper. Before it could be widened to full maturity the advance of the ice-sheet put an end to further river work and inaugurated a stage of glacial modification and erosion, of which the particulars are narrated in another paper.

Glacial occupation. So Irondequoit died, by a frigid fate, and the glaciers came and went over its grave. Inasmuch as the main ice movement was in a southwesterly direction diagonally across the rock valley, they proceeded to "putty up" that valley, at least its deeper part, with their ground-moraine or till; but some of the later movement, being more nearly lengthwise of the depression, may have partially cleaned out this earlier filling, though the flow was still somewhat oblique to the valley as late as the formation of the Winton Road drumlin. Whatever the explanation, in the end the glacial putty fell considerably short of obliterating the valley on the parallel of Rochester, as is shown in Figure 4.

Figures 4 to 7 Longitudinal Profiles showing Stages of Filling and Re-excavation of the Lower Irondequoit Valley.

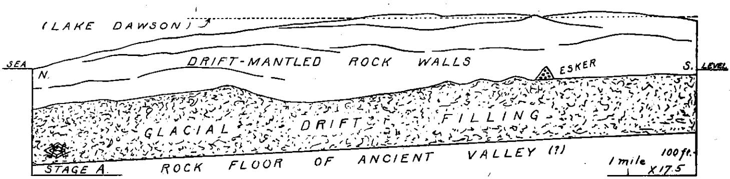


Fig. 4. Glacial Filling. Longitudinal profile of the lower Irondequoit valley showing approximate surface of the glacial drift as left by the ice. Vertical exaggeration 17.5. The position assigned to the rock floor of the valley is purely hypothetical; it is probably deeper than shown rather than less. Lake Dawson waters nearly overtop the valley rim. Compare Map A (Plate IV) and succeeding figures.

More important, therefore, than these local glacial deposits, as concerns the subsequent history, were those made farther south, around Fisher's and Mendon, in the form of huge kame-moraines built at the ice margin; for these determined the actual eviction from this valley of the drainage that formerly followed it. Save for these barriers the Genesee would to-day pass out the Irondequoit portal and little would have been spared of the present silt plains or similar fillings under the onset of so mighty a stream. Nor could we write "obit" of the valley, but "etiam vivens".

So familiar are these facts from the writings of others that we may pass them over thus lightly and return now to the serious contemplation of the aftermath,—the "post mortem" period of our schema. The series of maps (Plates IV to X, *see explanation on page 160)* which have been prepared to portray the salient stages of this evolution, as the writer conceives them, may henceforward serve as the warp upon which our narrative may be woven.

Dawson and Iroquois sedimentation. As the ice burden was melting back from this region, the waters of the pro-glacial lakes took up the work of burying the valley which the ice had left incomplete. The waters of Dawson and Iroquois practically overtopped the already concealed rock rim of the ancient valley, permitting their sediments to level it up almost perfectly. Our first map (A; Plate IV) reproduces the broader lines of the probable geography during the active period of Lake Dawson. The stagnant ice, weighted with accumulated debris, lingers in the narrow trough as a long slender tongue, beneath which courses an esker stream that spreads its delta sands about the tip. The waters, agitated perhaps by "iceberg calving" in a small way as well as by the winds, hurl their waves upon exposed bits of the coast and keep the inwashed silts beaten down to a wavebase plain.

The stagnant tongue of ice naturally builds no important marginal moraines except the esker fan, and surface drainage upon it is inconsequential. But the ice edge to the west is more favorably situated for the discharge of many surface rivers from the melting ice, just as formerly when the Pinnacle Hills were built. A series of kames is therefore in construction, the position of which later influenced the shaping of the Ridge Road. But so far as the valley itself is concerned the deposits of this stage are localized in or beyond the southern part of our map. Its outlet is just over the line at the southeast, through the Fairport channel. Though its shorelines are now 480 feet above the sea, the level of the lake in its own lifetime may not have been much over 200 feet above the then ocean.

The discharge from Lake Dawson entered a small lake in the Syracuse-Rome region that was the beginning of Lake Iroquois. But with the recession of the ice front from the drumlin hills of northern Wayne county, the Dawson waters were no longer constrained to use the Fairport outlet. By flowing around north of these hills they soon lowered themselves to the Iroquois level on the east, merging with and becoming a part of that lake. More than doubled in size by this annexation, Iroquois now became the successor of Dawson in the Irondequoit region and continued its labors, at a slightly lower level.

Our map B (Plate V) of the early phase of Iroquois was drafted under the former supposition that the Iroquois plane remained practically stationary hereabouts during its long lifetime. But it is now evident that this would necessitate the upward land movement at the Mohawk outlet being always exactly compensated

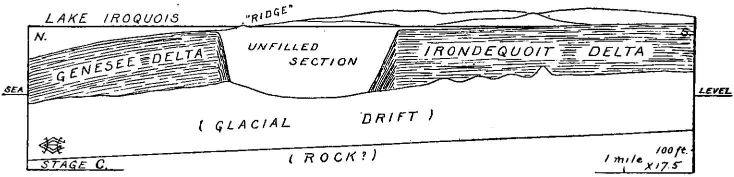


Fig. 5. Lake Iroquois Filling. Longitudinal profile of the lower Irondequoit valley showing the great silt fillings during Lake Iroquois. The convention used is not intended to accurately represent the real stratification. Vertical exaggeration 17.5. Compare Map C (Plate VI) and Figures 4 to 8.

for us by downcutting in the Little Falls gorge. It is more likely that cataract recession at Little Falls would have terminated in a rather sudden lowering of the lake surface. The Little Falls outlet, moreover, carried prolonged and copious glacial drainage long prior to Iroquois, and the latter has no high-level beaches in that region. Therefore we must now believe that Iroquois entered our district at a much lower level, after which its waters crept slowly back upon us here as the land at Rome continued to rise. The recent discovery of the Newfane beaches, already referred to, confirms this view. It is far from certain, however, where (on a map) the first stand of Iroquois was taken in our region since those first beaches are buried deeply under silt. The map B is accordingly retained but must be considered to depict only such a shore line as initial Iroquois would have possessed *if* it had stood somewhere near the Ridge Road level it later assumed. Its chief value, then, is for comparison with the next map, to show the contour of the final shore line before its modification had begun, thus giving a more graphic conception of the sum total of that modification.

In map C (Plate VI) we have the climax of the sedimentary cycle, at or just after the full height stage of Iroquois. All that remains of the ancient valley is the small but remarkable unfilled area in the center, surrounded on every side by heavy masses of silt with steep borders. In these the deposits made by the several streams are comparable to their respective watersheds; the Genesee river, on the west (just off our map), furnishing the largest body of sediment. The small distributaries ramifying over the delta of the Irondequoit have mostly some echo to-day in the courses of the brooklets that are now carving these silts; but they never all functioned at once in the way the map has to picture them. In general, however, everything expressed on this map has a significance relative to the later development, and in general it must come pretty near to being an actual reconstruction of the true geography of those days. With it should be compared the longitudinal section of this stage given in figure 5.

Re-excavation—Lake Irondequoit. The phase of the later history to which we now pass is signalized by a succession of falling water-levels, in which the individual stages are of less interest than the general fact that sedimentation in the large has ceased and re-excavation commenced. After a venerably long life Iroquois became a memory, and its plane was lowered rapidly to the Emmons pause, map D (Plate VII). By this drop of a little over one hundred feet our map becomes mostly land instead of mostly water. The main shore line falls back two miles or more to the north, and it no longer has an embayment into the Irondequoit valley. All that remains of the latter is the water held in the unfilled central space to which attention has just been called; and this was isolated from the main water body before its level had fallen thirty feet. To the steeply walled lake or pond thus produced, unique in type and with a very real and rather long existence albeit at no fixed level, the name Irondequoit adheres spontaneously and as "Lake Irondequoit" it stands upon our map. To its history we shall return after considering what was happening to the sediments thus newly exposed.

By comparing maps C and D it is seen that nearly all of the newly added land surface consists of Iroquois silts, that is, of fine sandy material. Unless vegetation were able to clothe this surface as rapidly as the water laid it bare, it became temporarily the prey of the winds. The dunes that rise so prominently above the 400 foot plain just atop the east rim of the Bay at its north end *(see Plate III)* may have originated at this period. In their situaton on the very edge of an abyss they remind one of the "Hogback" dune on the great Iroquois delta at the Pine Plains encampment near Carthage, bordering the Black River entrenchment. Besides wind-work, many little streams set themselves the task of carving the reclaimed land, while the larger streams either bisected their former deltas or deployed into the conveniently low ground at one side of the delta. Densmore Creek and the Glen Haven Brook are examples of the former; the Irondequoit and more particularly Allen's Creek exemplify the latter case.

As for the sediments themselves, left far above the falling waters, they must have settled considerably, even though not perceptibly. In approaching this question of the behavior of sediments when the waters of their deposition are withdrawn, we need to recall that sand, with a specific gravity of 2.65, weighs 60% more out of water than in. Such moisture as remains in it temporarily during the draining process merely swells this percentage, though it may however retard the resultant compression or settling of the mass. It is evident that the amount of this response, even if not great, will be everywhere proportional to the vertical thickness of the deposit; thus if an irregular surface has been levelled up with sediment, the settling will develop a faint apparition or bas-relief of the underlying topography. A shallow surface valley will appear, to mark the position of a deeply buried anterior valley. A vanished knoll will cause a slight eminence on the silt surface above. Elevation or hollow, each will have its counterpart on the resulting surface, sufficient to determine the drainage lines though perhaps unobtrusive to the eye. If, therefore, we find any notable departure from this result, indicated by the rearranged drainage, some original inequality of deposition will need be looked for, such for example as the familiar case of a delta higher in the middle than at either side so that its stream eventually skirts one of its lateral margins as we have observed in Allen's Creek and the Irondequoit. Possibly another modifying factor is to be acknowledged if the squeezing out and plication of the deeper portion of the silts *(see page 138)* took place chiefly in consequence of the augmentation of load as the waters lowered, yet the areas that so slumped would credibly be governed by subjacent depressions in the till and such movements would therefore merely accentuate the effects of the normal settling.

Now the Genesee silts, heaped across the Irondequoit chasm, were pounded down to wave base and accurately levelled by the surf of Iroquois. But with the withdrawal of that lake the results of settling must have been conspicuous here if anywhere and we should expect to find the outlet of Lake Irondequoit superposed over the axis of the buried canyon beneath. Its actual position lies slightly to the west of this, but that is after all in keeping with our experience in other portions of the valley,—where an esker core pre-empts the midline and the drainage channels are displaced laterally. There is no good reason to suppose that the esker was confined to the southern section where its presence is visible, and there is some evidence, as yet unsifted, that an esker fan of early Iroquois times is incorporated in the silt mesa. What determined on which side of it the new flow should go remains an open question. Certain features suggest that in the primary outflow, just as the Iroquois waters were sundered from those of the Irondequoit lagoon and before the silts had had opportunity to settle, a temporary escape was actually afforded around the east margin of the Genesee delta, across the narrow neck of the 400 foot contour on the map, where a weak and shallow channel appears to have been partially refilled by wind work.

The Irondequoit outlet as finally adopted passed over soft silts its entire length. Into these it must have notched itself almost as rapidly as the lake levels lowered. Thus the decline of Lake Irondequoit kept pace with that of the larger body, and as the former in turn controlled its affluents on the south and west they in their turn became free to intrench themselves in equally soft materials. By the time of the Emmons pause their grades were lowered so far as to enable them to commence lateral swing or meander, and they completed a good bit of valley-widening during that brief episode. (*See map D*). The detritus so derived perforce found lodgment in the unfilled basin of Lake Irondequoit, which thus tardily became a locus of sedimentation. (*Compare figure 6.*)

The further withdrawal of the waters after the Emmons episode, had its next interruption during the "Vermont" stage. In Northern New York this stage is marked by a series of beaches distributed through about a hundred feet of vertical range, instead of by a single plane. The higher beaches are weak, however, whereas

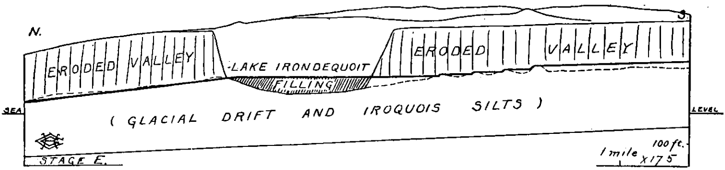


Fig. 6. Lake Iroquois Filling. Longitudinal profile of the lower Irondequoit valley showing valleys newly channeled through the silts by the Irondequoit river upon the draining away of the glacial waters, and the tardy flooring up with silts of the unfilled section. The stream supposedly encountered drift obstacles at the five points indicated. Vertical scale 17.5 times the horizontal. Compare Map E (Plate VIII) and Figures 4 to 8.

the lower ones and especially the deltas are conspicuous. This lower phase, marking the most prolonged stillstand, is calculated at approximately 205 feet present altitude for Rochester, or forty feet below the existing level of Lake Ontario. Referring back to page 141 it will be seen that this is precisely the average depth of the remarkably flat floor of the Bay in its widest portion,—between Glen Haven and the Newport House.

Since we are unable to-day to trace the shorelines of Lake Vermont beneath the enveloping waters of Ontario and so prove beyond a doubt that our figuring is correct, it would be unsafe to assert that this coincidence is more than casual. It is equally thinkable that the downcutting of the Lake Irondequoit outlet in pace with the lowering master lake, was checked at this point by encountering an obstruction of some more resistant nature than the silt, perhaps firm till or moraine, perhaps hard rock even. Such an obstruction is indeed demanded by the subsequent events in this vicinity, therefore we would not lay too much stress upon the possible relation subsisting between the Vermont level and that of this resubmerged plain, but would look upon the latter as marking the natural end of Lake Irondequoit, upsilted in its shallow senescence and converted into a swampy meadow, persisting henceforth as such until drowned long afterward by the returning flood of Lake Ontario. This meadow, then, composed of the materials swept out from the upclogged area on the south by the rejuvenated Irondequoit River, established automatically the permanent minimum base-level of the latter's activities, a base to which the river speedily adjusted itself from Penfield northward and by its subsequent meanderings evolved the characteristic scenery of the "dugway" section. Meantime, however, the master lake without, now naught but an arm of the ocean, was still "falling" as the land was lifted out of it, and thus the channel continued to be deepened north of the meadows, through what is now the deepest, narrowest part of the Bay.

Our map E (Plate VIII) shows all these details at a time when the waters of the Ontario basin had withdrawn beyond the northern limits of our map area. The depth of 137 feet (23 fathoms) corresponding to our local estimate of 110 feet above present sea level for the minimum stage or transition from Gilbert Gulf to inchoative Lake Ontario by emergence of the Thousand Islands above the sea, is shown by the soundings three miles north of the present shore line, but allowance must be made for subsequent fillings and the actual shore was probably somewhat nearer than that. Allowing four miles from the 14 fathom sounding in the Bay to this assumed outlet at 23 fathoms, and with no correction for land tilting since, a gradient of 13.5 feet per mile is indicated for the bottom of the channel then cut. This is not heavy for a stream in drift, as may be seen by comparison with the Irondequoit above Penfield (on the map) where the present gradient, even following the meanders, is over 20 feet per mile. On the other hand, the jump from 84 feet up to 45 in one mile, from this deepest sounding to the submerged meadows just south, is excessive, and affords the proof of an efficient obstruction already adverted to. Without some barrier here capable of producing strong rapids the channel must have been notched back far more deeply into the silts of the meadow and a great hole rent in these by meander swinging. Of the latter the soundings give no inkling, and since it is unlikely that it could have been refilled later so accurately it may be denied that it ever existed. The question of the nature of this barrier, whether rock or only heavy moraine, need not be attacked here as it pertains rather to the companion investigation on the rock valley. The longitudinal profile of this stage (figure 6) renders the problem clearer.

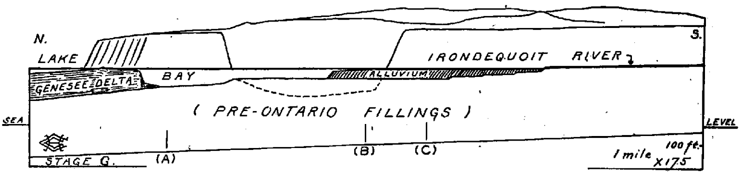


Fig. 7. Lake Ontario Filling. Longitudinal profile of the lower Irondequoit valley showing renewed silting on the return of Ontario waters, producing the shallows at each end of the Bay and alluvial marshes up the valley to Zarges Mills. Vertical exaggeration 17.5. Compare Map G (Plate X) and Figures 4 to 8; and observe how the sea-level has been steadily "dropping" as the land rose.

We come back at this juncture to the remarkable triple depression on the west wall of the Bay opposite its deep section, whose three ravines (one of which breaches the "ridge" bar, *see page 130*) show by their embayment that they were cut at this stage. The form of this amphitheatre suggests that a meander loop of the Lake Irondequoit outlet may have insinuated itself here during the Emmons stage. But this suggestion alone is inadequate to explain the later history, and so does not help much if at all. The circ-like heads of these three gullies, and the brooks mapped in two of them, indicate that they are powerfully spring fed. Their position between the Ridge Road and Newfane beaches of Iroquois may have something to do with this, nevertheless they await explication. A comparison is suggested with the great re-entrant that lies so nearly opposite them on the east side of the Bay. While we have ascribed this primarily to the junction of the two silt areas, its rounded head again denotes spring erosion; and it, also, is deeply embayed.

Return of Ontario waters. The remainder of our story is soon told. The returning waters of Ontario ate their way into the front of the Emmons and Iroquois deltas, and entering the Irondequoit outlet channel filled and leveled up its outer portion as they came. They interrupted its cutting prematurely while there was yet a heavy gradient through the present narrows of the bay, then having accomplished this long climb they flooded back over the meadow plain

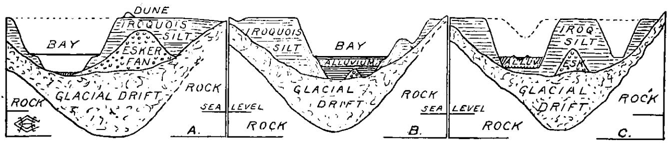


Fig. 8. Typical Cross Sections. Three transverse diagrams of the lower Irondequoit valley showing (9 times vertically exaggerated) the form and character of the various fillings in their mutual relations. All concealed structures necessarily theoretical. Compare Map G and, for location of sections, Figure 7.

and the river plain south of it more rapidly than sedimentation could counterbalance. By this resubmergence of the meadows the present Irondequoit Bay was initiated as is outlined in map F (Plate IX), and once more the formerly unfilled basin begins to receive sediment. Placing beside this map that of the modern stage (map G, Plate X) as untouched by man, a measure is obtained of the recent alluviation and of the wave work now in progress, shown also in Figure 7.

The Irondequoit has to-day either reclaimed or held its own in the "dugway" section, by means of a refilling that may have a depth of from twenty-five to forty feet for the lower two miles of its course *(see Figures 7 and 8, C).* Through this same portion its banks are strongly leveed, until finally these levees push out into the open waters of the Bay at its mouth in truly Mississippi fashion. Beyond this the filling still continues northward just under water for a mile to Glen Haven.

A heavy bar at the north end of the Bay closes what would otherwise be a splendid natural harbor. This bar has been built from both ends, with sand from the west derived from the silt bluffs, but from the east of rolled red sandstone pebbles from where the surf is attacking the rocks beneath the bluff at Forest Lawn. Lakeward from this bar extends the broad subaqueous platform of the Genesee silts; bayward of it the same or a similar shoaling reaches far in, until it drops suddenly from 6 to 60 feet of water. The long concavity of the main shore line on our map, and probably also the minor concavity behind the bar, has been shaped by deep and prolonged wave erosion of the contorted silts along the ancient delta margins, a process to which wind work contributes in no small degree.

Man's contribution to the present stage. In the face of the great operations here recorded man's efforts have been weak indeed. He has reinforced the outer bar of the Bay with a railway embankment built up especially at the two ends. He has cut a "ship canal" (in the early days and long since abandoned) for small craft, through the Irondequoit floodplain swamps, to make Zarges Mills (then Rich's Landing) his harbor. He has dipped in here and there for gravel and sand, has graded his roads and built his bridges. But neither white man nor aborigine has been more than a passive spectator in the making of those topographic features by which we have been unravelling the past. Yet the time is approaching when this may no longer be true,—when with the growth of the city and the accrescence of man's ingenuity many of the landmarks we have been recording will be blotted from existence, the present forces harnessed to new tasks of man's own devising and the face of nature stamped more indelibly with the brand of his artifice. It is time therefore that these studies should be printed before such changes come about, both as a permanent record of the present phenomena and their interpretation, and even more as an incentive to a larger general interest in the acquisition and preservation of the further data that the future with its greater undertakings may make more abundantly available.

SUMMARY.

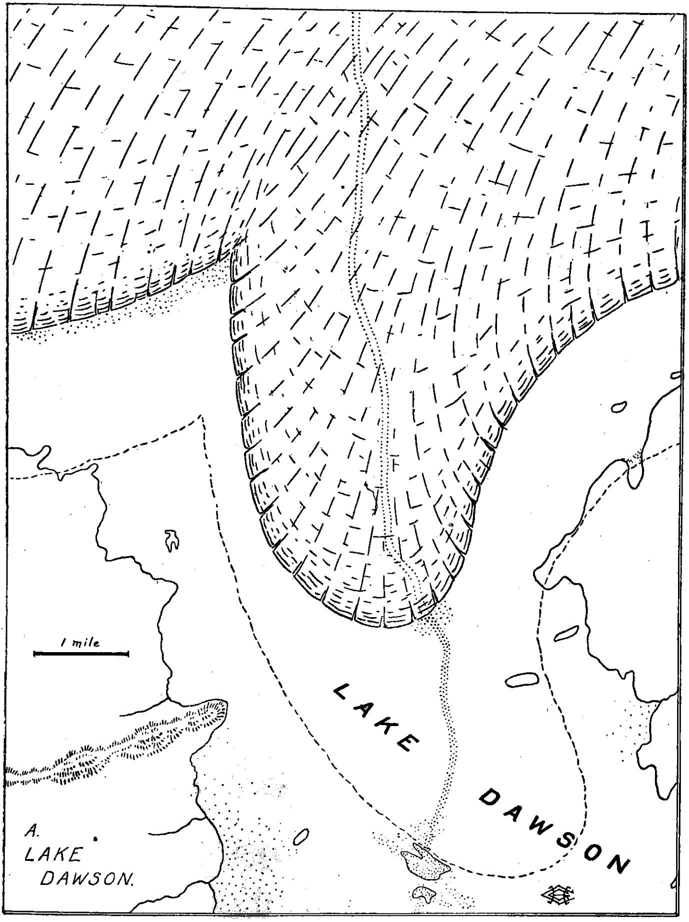
The writer's aim has been to show (1) that the land forms of this picturesque area, so close at hand and accessible for our city schools and their teachers, are not fortuitous but explicable in every detail and eloquent with the story of a marvellously entertaining past, intelligible to all; and (2) that the irregularities in the form of the present Irondequoit valley are entirely a matter of the post-glacial fillings and their subsequent erosion, in no case to be advanced as an index of similar irregularities in the deeply buried rock valley below. It must not be supposed that this paper exhausts the subject. It is but the first raking of a field seeded by Gilbert and mowed by Fairchild, from which much remains to be gleaned. Nor may it close without an acknowledgment to the latter, the writer's godfather in science and the regenerator of this society, to whom he owes a measure of gratitude and appreciation not to be counted in words.

Explanation of the Outline Maps (Plates IV to X) Illustrating the Later Geographic History of the Lower Irondequoit Valley.

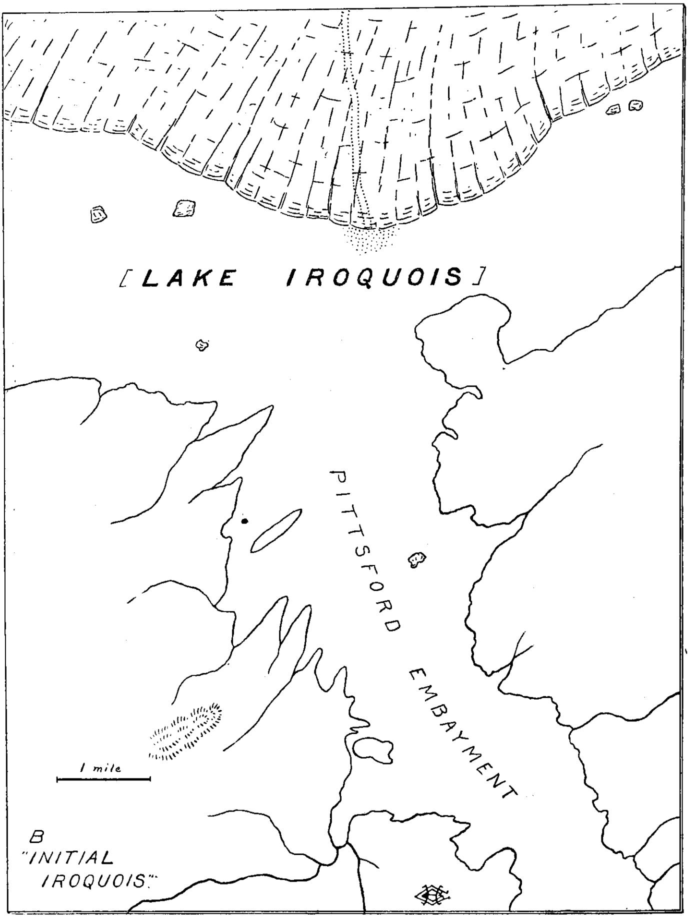
All the maps cover exactly the same area, identical with that of the preceding Plate III, with which they are meant to be compared directly although for convenience reduced in size. Enough only of the geography of each stage is shown to reveal the more important or significant changes that have occurred. In all the maps open stippling means deposits forming under water and close stippling those above water level.

For description see pages 149 to 158.

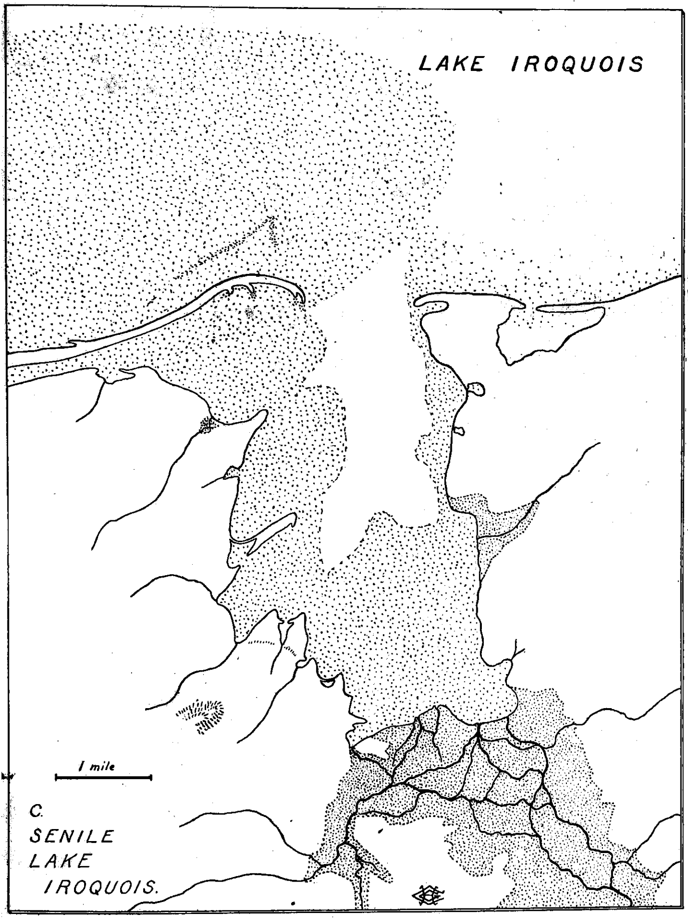
Map A. Lake Dawson stage
Map B. Hyper-Iroquois ("initial Iroquois") stage
Map C. Lake Iroquois stage at close
Map D. Lake Emmons stage: Lake Irondequoit
Map E. Gilbert Gulf stage: Irondequoit Meadows
Map F Returning Lake Ontario: early Irondequoit Bay
Map G. Present Lake Ontario and Irondequoit Bay.



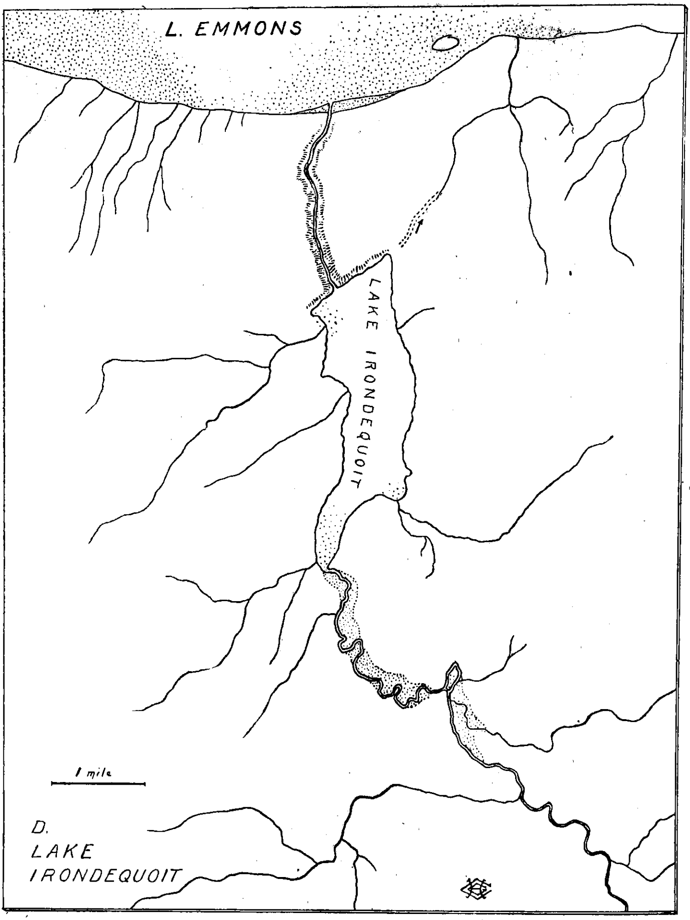
Map A. Lake Dawson stage, showing the waning glacier and the subglacial esker-river constructing a "fan" at the ice margin; also the "fan" previously built in primitive Dawson when the ice front was at the broken line. Still earlier the ice had stood at and constructed the Pinnacle Range of hills. Outlet of lake is to southeast.



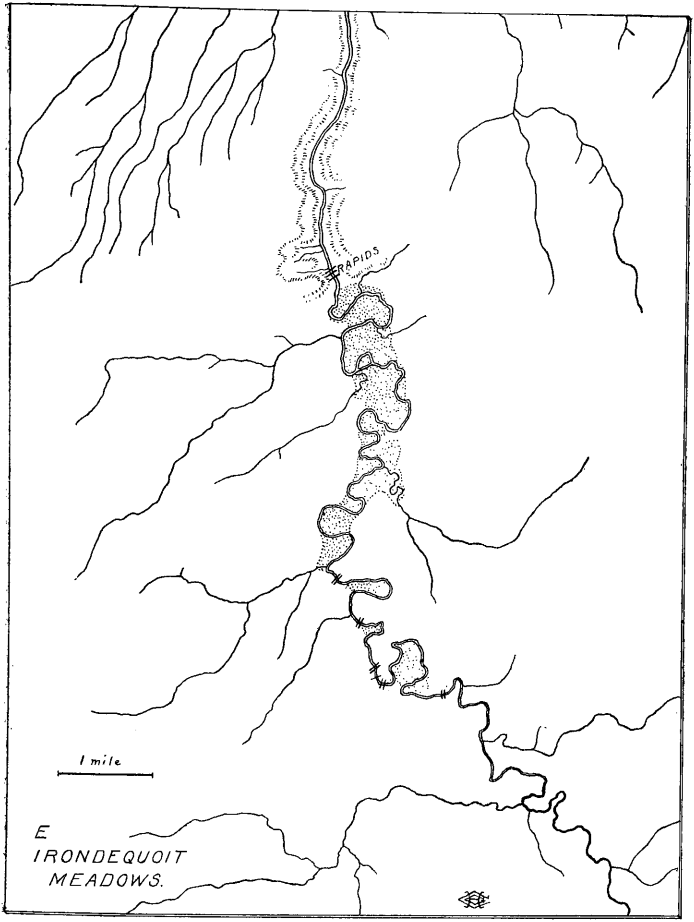
Map B. A stage in the lowering waters (sub-Dawson) when they reached approximately the level assumed later by final, full-height Iroquois. Lake Iroquois was actually initiated 70 feet lower *(see page 150)*. This map is for comparison with the next and the preceding. The esker-river builds still another "fan" Small icebergs float in the lake.



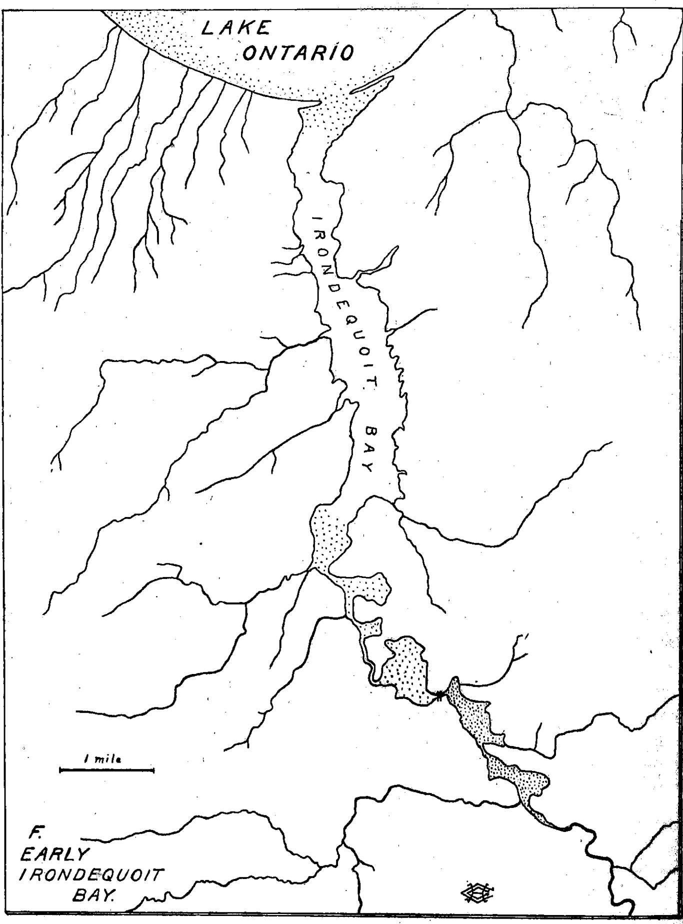
Map C. Closing phase of the Lake Iroquois stage, showing the extent of sedimentation and wave-work accomplished in that long-lived water-body, yet their failure to fill the central section of the Irondequoit depression. The ice front, withdrawing toward Montreal, presently unblocks lower escape north of the Adirondacks and extinguishes Iroquois.



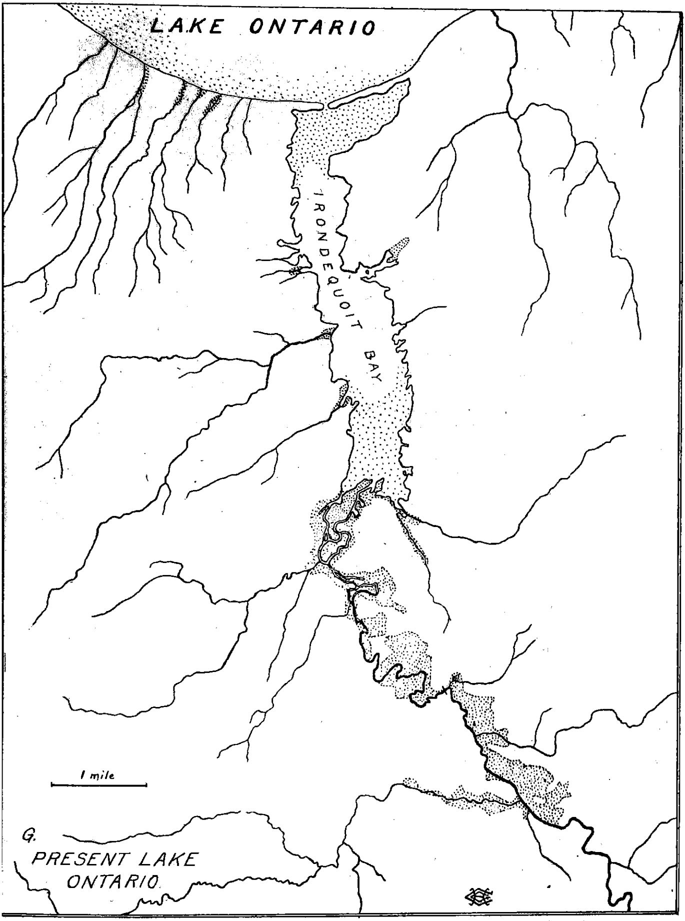
Map D. Lake Emmons stage of the subsiding waters, showing Lake Irondequoit occupying the previously unfilled depression and carving its outlet through the Genesee delta silts. A shallow early escape is indicated around the east edge of these silts. At the south the Irondequoit river is cutting, in its own former deposits, the "320 foot terrace"



Map E. Gilbert Gulf stage. The ice has left the Saint Lawrence Valley with the Thousand Islands depressed below sea level so that marine waters occupy the Ontario basin,—their shore line being several miles beyond our map limit. Lake Irondequoit is silted up into a meadow, the present flat floor of the middle Bay, south of which meanders develop.



Map F. Lake Ontario stage at a late phase with greatest extension of Irondequoit Bay. Lifting of the Thousand Islands floods the Ontario waters back on our region and inundates the lower Irondequoit valley as far south as Zarges Mills, thus initiating the present Bay. Bar building is in progress already at its mouth.



Map G. Present phase of Lake Ontario stage, disentangled from the work of man and presented as a physiographic study of the sedimentation and wave-work accomplished, or in progress, in Lake Ontario and its subsidiaries. Especially conspicuous is the process of silting up of the Bay from both ends in spite of rising water level.

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VOL. 5, PP. 161-240, PLATES 11-16. JUNE, 1918.

ESKERS IN THE VICINITY OF ROCHESTER, NEW YORK

By Albert W. Giles

Presented for publication and read by title before the Academy, January 14, 1918

CONTENTS.

ILLUSTRATIONS.

INTRODUCTION.

During the spring of 1910 the writer made a study of several eskers in territory adjacent to Rochester, New York, in connection with graduate work for the degree of Master of Science at the University of Rochester. The results of this study were incorporated in a paper which was submitted as a Master's thesis. The matter was then dropped until the winter of 1916-17, when the general discussion of the paper was revised and rewritten. During the past summer (1917) the eskers described in the early paper were revisited, and several additional occurrences not originally examined were studied. The results are incorporated in the following paper.* It is hoped that it will make some contribution to the subject of eskers and to the general subject of glacial geology. The bibliography at the end of the paper the writer has tried to make as complete as possible.

Eskers represent an interesting type of glacial phenomena. Their peculiar form and trend excite interest even in the casual and superficial observer, and a great deal has been written regarding them.

Definition. Eskers may be defined as long, winding ridges of gravel and sand, commonly stratified, with steep slopes and narrow crests, trending in the general direction of former ice movement. They may strikingly resemble artificial railway embankments.

Popular names of eskers. People familiar with these interesting ridges have accorded them a great variety of names, some of them indicative of their supposed origin, such as, horsebacks, hogbacks, serpent kames, serpentine kames, whalebacks, ridges, windrows, turnpikes, back furrows, ridge furrows, morriners, Indian roads (99).

Technical nomenclature. Esker is the technical name now long used in this country for this class of glacial phenomena. The term is of Irish origin (44). The Swedish word "os", plural "osar", sometimes written "as (asar)", has priority, but has never come into use in America. In Scotland the term "kame" has been used to designate these ridges, the word being probably derived from the Teutonic "kam", meaning ridge (44) By general agreement the term "kam", is now restricted to mounds and short ridges, features developed perpendicular to the direction of ice movement, while the word "esker" is applied to ridges extending in the general direction of ice movement (10).

History. In the early part of the last century, when attention was first directed to these singular esker ridges, various explanations

* I wish to express my appreciation of assistance by Professor Fairchild in connection with this paper. He first suggested the subject to the writer as one worthy of study; he has made many suggestions during the progress of the work; and has placed the facilities of the Geological Laboratory of the University of Rochester at the disposal of the writer. Finally he has contributed of his experience and time in the immediate preparation of the paper for the press.

were advanced to account for them. By some they were explained as ancient sea shores (Hisinger, Martins (69), Chambers (15), Erdman (33), Torell, etc.). Ramsay refers to them as "those marine gravelly mounds, called kames or eskers" (78). Another idea was that a "vast deposit of sand and mud covering the country which had been cut thru by rivers, whose beds were gradually filled with stones and gravel. Later the sand and mud were washed away, leaving the stone and gravel deposits of the rivers in the shape of ridges" (109). They were also regarded as being due to a great diluvial flood (91). Again they were thought to have been formed by marine currents during the submergence of the land (117). Another very early idea compared them to the submarine banks formed in the pathway of tidal currents near the shore. Under the old idea of the aqueous origin of the drift they were referred to iceberg action (73). Jamieson explained both kames and eskers as moraines of gravelly debris deposited at the edge of an oscillating icesheet; the ridge-like form he considered due partially to the ice on its advance pushing the material before it (58). In certain localities in this country they are popularly believed to represent the work of the aborigines, hence the name "Indian roads" applied to them.

Hummel of the Geological Survey of Sweden seems to have been the first one to recognize the fact that the existence of an inland ice sheet must be presupposed as the indispensable agent in forming such ridges. He regarded them as being formed beneath the ice in tunnels excavated by percolating waters (1874) (57). In 1876 Holst, another Scandinavian, published his theory of their origin in the beds of supra-glacial rivers (56). The same view was advocated by Upham in 1878 in this country (115,117). Dana regarded eskers as being subglacial moraines. The idea of glacio-fluvial origin of this type of glacial phenomena has long been entertained, and there is general agreement on this point by all glacialists.

Geologists in this country who have made notable contributions to the subject are N. H. Winchell, I. C. Russell, Warren Upham, G. H. Stone, W. O. Crosby, T. C. Chamberlin, R. D. Salisbury, W. M. Davis, Frank Leverett and J. B. Woodworth.

Occurrence of Eskers. General Occurrence. Eskers occur only in glaciated regions and are limited to areas that were covered by the ice, they never occur beyond the terminal moraine in the marginal zone of outwash. They occur at all elevations above sea level.

Eskers find their best development in Sweden, where they were first recognized as being a distinct phase of the glacial drift. However in south Sweden, Germany, and Denmark, they are almost entirely absent. They are wanting or rare in many regions where other glacial phenomena are strongly developed, as in Switzerland, Norway, and southern Greenland. They are especially numerous in central Ireland, and occur also in Scotland, Finland, and northwest Russia.

In the United States they are best developed in Maine (99). They are common in New England, but rare over the interior states (61, 62, 63).

Occurrence in the New York area. In New York they are infrequent in occurrence, widely distributed, and are low short ridges. They occur in much the same way as over the whole glaciated area to the west.

General Description.

Dimensions. Eskers vary greatly in dimensions. In height they may be from 3 feet to 150 or even 200 feet. One in the Connecticut river valley has been described as being 250 feet high (117). In most cases they are less than 50 feet in height.

Eskers vary in length from a fraction of a mile to 100 miles or more. Several of the esker systems of Maine attain a length of 130 to 140 miles (99).

In breadth at the base they are in most cases only a score or a few score of feet, less than 75 or 100 feet, but locally they may broaden to 500 feet, and a basal width of over a mile has been recorded. The height exceeds one-eighth, and may reach one-fourth or one-third the width of the base. Width may increase as height diminishes or vice versa. They are neither constant in width nor uniform in height. One esker has been described as one-eighth of a mile wide throughout its whole length (63, p. 203). Eskers tend to be small near their point of origin, becoming larger toward their termination.

Segmentation and intervals. Eskers tend to occur in segments, separated by intervals of varying width. Discontinuity is the rule, not the exception. No esker ridge may be traced for 100 miles, or even 10 miles without interruption, the individual segments being but a few miles long, rarely greater than 5 miles, and in many cases only a fraction of a mile in length. In fact segments may be so short as to be mistaken for elongated kames. Stone has stated that in the long esker systems of Maine the eskers are seldom continuous for more than 10 miles without a break (99). The segments may or may not be in alignment.

The intervals between segments are in many cases less than a mile in length, but they may be 2 or 3 miles or even more in extent. These intervals are apt to be occupied by scourways or drainage creases (122). Again gravels more or less spread out and kames are found in these stretches.

Tributaries. Tributaries are an uncommon feature and, where they occur, they are apt to enter the main course at a high angle. They are in the vast majority of cases inferior in development to the main ridge.

Direction. In direction eskers trend with the general direction of ice movement for the general locality in which they occur. Hence their courses tend to parallel the striae, boulder trains and drumlins of the surrounding region. There are however some notable departures from this direction, in fact some have been observed to extend for miles in a direction transverse to the direction of ice flow. Some have their entire course in a direction at nearly right angles to the direction of local ice movement, again part of the course will be transverse and a part conformable to the direction of the ice movement. Some ridges have been observed that apparently extended nearly to the edge of the ice, then turned abruptly through a large angle and ran for miles parallel to the ice edge.

Relations at point of origin. Esker ridges rise abruptly from the general surface. This is true not only at the point of origin of the esker, but also at the beginning of each segment. As a rule the ridges attain their full height within a few rods. They may arise in a kame area, they may continue outward from a recessional moraine, again they may originate in a bouldery field of irregularly heaped till, or from a swampy area of thin till. They exhibit a tendency to originate in places favorable to a large accumulation of water, as level plains, broad basins, and near the top of low divides. They may arise from the lee end of a drumlin.

Character of course. The course, as already indicated, pursues commonly a sinuous direction; rarely is an esker straight for any distance. It meanders, the long deflections, sometimes a mile or several miles in length, appear to obey the topography, the short deflections, only a few feet to a fraction of a mile long, resemble stream meanders. Further, esker courses are unsymmetrical, abrupt turns and sharp angles being a not uncommon feature. Maxima changes in the course may be accompanied by maxima changes in the elevation of the crest line (122).

The crest may remain as narrow as a wagon road, again it may spread out into terrace-like flats, in conformity with a similar increase in the breadth of the base, and become higher than the rest of the esker. In the case of the eskers of the interior these flat areas are rarely more than 500 feet wide, in the case of the Maine eskers they may be exceptionally a mile or more in width. These broad "plains" may contain kettle holes, variously known as basins, sinks, funnels, hoppers, punch bowls, and Roman theaters (99). These kettles may be as deep as the esker is high, and may contain water indicating an impervious bottom. These broad places may show evidences of stream erosion, and boiling springs may occur along their flanks.

The esker ridge may divide, and two parallel ridges may unite to form one ridge. The main ridge may break up to form several distributary ridges, every one of which exhibits the same height and width as the main ridge. These distributary ridges may interlace complexly, enclosing numerous kettle holes, which may have outlets; again they may contain water, and may be floored with till. Such a system of meandering and anastomosing ridges may be connected by lateral and transverse branches enclosing large areas of the country. The width of such complexes may be as great as 5 miles, and the length 10 to 20 miles, the whole often representing a jumble of heaps, mounds, cones and ridges. Such reticulated eskers find their best development in this country in southwest Maine, where they lie in broad valleys (99). They are most liable to development near the terminus of the individual eskers.

Eskers find their fullest development on a long gentle slope. In crossing divides they are apt to be low and their materials coarse (92). They may be represented in such situations merely by scattered pebbles or they may be absent with ridges on both the up and down slopes on either side of the divide. On long gentle up slopes there is a slight tendency toward increase in size, while on short slopes there is no material change in size. On long steep down slopes there may be no deposit, or only a string of large boulders, while at the base of the slope large ridges or, in some places, "plains" are formed.

They may be conspicuously developed in valleys, and then passing onto plains become so faint as to be difficultly traced. The ridges are apt to broaden in the direction of their termination. In Maine they may broaden southward to plains one-half a mile in width. These very broad eskers behave as do the narrow ridges and may change back again to the narrow ridge type (99). Their sides tend to become pitted with small hollows, branches may diverge from them, and the adjacent lowlands become covered with small kames (99). These broad esker plains may constitute valley filling for a distance, or even a narrow marine delta (99).

"Buttress-like deposits" may lie against the base of an esker ridge; sometimes a fan-like spreading of debris from a similar position has been observed (88).

Relation to surroundings. Eskers show no particular regard for topography, they tend however to follow valleys, especilaly if such valleys parallel the direction of ice movement. Rarely they may follow the axis of a valley transverse to the direction of ice movement, and in such cases are likely to lie along the side of the valley toward which the ice moved. They may cross valleys and pursue their direction across neighboring divides. Rarely do they cross ridges more than 200 feet high that lie athwart their courses; in the case of higher ridges the eskers pass through gaps which are not always the lowest or the most direct. One may turn aside to avoid a hill 100 feet high and in another part of its course cross a hill of greater height.

Eskers may follow the bottom of a valley; in the majority of cases however they lie along the sides of the valley and above its bottom. They may cross from one side of the valley to the other, often they trend toward the bordering hills on the one side or the other. If the latter are more than 200 feet high the eskers never leave the valley; if less, after following the valley for some distance they may break across the low divide and wind across areas of considerable relief. An esker may divide, one ridge maintaining its position in the axis of the valley, or along the side and above the valley bottom, the other ridge paralleling the first along the opposite side. A single ridge may break up into several ridges that follow along the valley, especially if it is a broad valley. If the valley lies in the general direction of ice movement, eskers will not leave it even if adjoining divides are considerably less than 200 feet in height. They often enter and leave valleys of other trend. They are more strongly developed throughout their courses in the valley than when crossing the neighboring uplands.

They show discordance in most cases with existing drainage. They may pass through lakes and their courses be traced beneath the water; they may pass from the land surface to beneath the level of the ocean (99).

They are more common in rough regions than in regions of slight relief, more numerous in Maine than over the upper Mississippi plains.

Leverett has noted the frequent occurrence of eskers in river-like channels cut into the till sheets (61, 62, 63). These troughs may be almost as narrow as the esker ridge at its base, commonly they are several times as broad, the individual trough may not be occupied by the esker throughout its whole length.

In Western New York they lie in narrow valleys between the drumlins. Instances have been recorded when they are known to pass over drumlins (125). They are bordered on either side by wet-swampy places. In fact lakes, ponds or swamps bordering eskers on one side or both sides, elongated in the direction of the esker are common features (29, 122).

Large eskers are apt to be found in large drainage basins, and to be composed of coarser material.

At higher altitudes eskers are confined to valleys chiefly, thus in Sweden at elevations greater than 300 feet they lie in valleys.

Relations at termination. Eskers frequently terminate in kame areas. They may also end in marine and lacustrine deltas and outwash plains. The esker ridges widen as they approach these, and merge with them gradually. Their termination may also be very abrupt without regard to the character of the surroundings. This may take place in an uneven bouldery field, or in a morainal surface. When eskers terminate in recessional or terminal moraines, they tend to advance toward them at nearly right angles.

Eskers may split up near their southern termini into several distinct branches or distributaries, like the mouths of a stream in a delta. These distributaries may be connected by cross-ridges giving a decidedly complex, reticulated appearance.

In case a single ridge has broken up into a number of ridges some distance from its termination the latter ridges are often found to converge and unite just above the termination. Again these diverging ridges may terminate miles from each other in separate deltas, kame areas, fans, etc.

The burial of the lower ends of esker ridges by lacustrine silts, marine sediments, outwash and delta materials, has been observed repeatedly.

Association with moraines. There is no denying the fact that many eskers, possibly most eskers, are associated with either terminal or recessional moraines. Their courses lie north of these moraines in which they terminate. This intimate relationship seems to indicate a close connection in the formation of the two types of glacial deposits.

Composition. Eskers are composed chiefly of sand and gravel. The sand is coarse for the greater part. Gravel is considerably the more abundant material and may be very coarse. It probably makes up the greater part of most eskers, while some eskers are composed entirely of gravel (38, 99,). Very fine material, such as "rock flour", is absent and clay is rare, and when present occurs only in thin beds. Boulders several feet in diameter may be present, embedded in the sand and gravel, some with a diameter of over 5 feet have been observed (99). The pebbles of the gravel are well rounded, rarely are striae preserved upon their surfaces, if once present water action has completely removed their traces. They are rounded not like those of ordinary stream beds, but like those of pot holes or beach shingle (99). The boulders are for the most part subangular, and many preserve striae upon their surfaces. However at times boulders 2 to 4 feet in diameter occur that are well rounded.

The ridges are entirely unfossiliferous, the waters in which they were formed being apparently destitute of life. However the individual component rock fragments may carry fossils indicative of the time which they were formed.

The material may be compact, even firmly cemented into a true conglomerate, again it may be so loose as to be readily dislodged by a stroke of the hammer. Davis has described the esker material as "open work gravels" (27). In certain places fine material has all been carried out from between the gravels, however, adjoining layers may contain plenty of fine material, such as sand.

A few ridges have been described that are composed entirely of till (29, 126, 62, 88, 63). The till has been more or less washed apparently, for the fine material is largely removed, and the coarser material locally shows some degree of water action. The famous Bird's Hill esker contains till incorporated within its mass (112). This will probably be found to be true of a large number of eskers when sufficient exposures are available to examine their interiors fully. Till interbedded with the sand and gravel may be considered then a rather common feature in many eskers.

Near the point of origin of eskers the materials are coarser, and less rounded. Proceeding toward their termination the materials became finer, and well rounded. In the longer Maine eskers Stone states that their north ends are composed of material barely water-worn, the finer material having been entirely removed (99). Toward the crest of the esker the materials are apt to be less rounded than in the lower portion.

One part of an esker may be composed of sand, another part of the ridge may be gravel. Steeper sided ridges are composed of coarse gravel, possibly blocks, angular and subanguler debris mixed with sand and earthy grit (40). The size and distribution of material are influenced by several factors, the nature of the underlying rock, the supply of water in which the esker material was deposited, and chiefly the slope on which the esker lies. Where the slope is steep all of the fine material seems to have been washed out, where gentle only the finer material was transported (102).

In the broad places, the "plains" of the esker courses, the central portion is of coarser material and more water worn. The lateral portions are chiefly sand, in fact most of the sand and finest materials are located in the wide flat-topped portions of the esker. Clay in a few instances makes up the lateral portions, but in most cases it is apparent that the water possessed sufficient current to carry out the very fine materials. Coarser materials are also apt to be near the top and the finer near the bottom in these broad areas.

Reticulated ridges show little change in composition throughout their length, on a whole their materials are coarser and not so well rounded as in the single ridges. The material becomes finer where the ridges grow broader and where they finally become coalescent in a rolling plain (99).

The gravel and sand, the materials of the esker, do not spread out laterally over the adjacent lowland, but are strictly confined to the ridge itself.

Source of materials. The materials composing eskers are largely local in origin, that is, they have been derived for the most part from formations immediately beyond the point of origin of the esker in the direction from which the ice came. The material has been transported somewhat farther than the till adjacent to the esker, but still it is largely local in origin. Hershey states that in the case of the eskers he studied 90 per cent. of the materials have come from less than 60 miles from the eskers themselves (48). The larger material, such as boulders, is more apt to be far-traveled than the smaller, yet a large proportion of these has been transported only a short distance from the place of origin. It is safe to say that in many eskers 90 per cent. of the materials have come from within a few miles to the north of the esker in question, in a majority of eskers 75 per cent. or more of the material is of similar local derivation.

Stratification. The materials of eskers,, being water-lain, are stratified almost without exception. This stratification is rude, chaotic, with cross-bedding common, the cross-bedding planes dipping toward the side or toward the lee end of the esker. The beds may dip from 5° to 60° or more.

There is a tendency toward an anticlinal arched arrangement of the beds, a feature exhibited in most eskers to a notable degree when viewed in cross-section. The layers may be curved, twisted, or distorted markedly. The beds not only tend to dip outward from the center toward the sides, giving the anticlinal appearance, but they are also inclined in the direction of the trend of the esker, they dip away from the point of origin toward the place of termination of the ridge or segment. A single bed may be of fine material, adjacent beds of very coarse material, and vice versa. The larger materials may show an imbricated arrangement observable often among the stones and coarse shingle of streams and rivers.

One part of a ridge may show good stratification, another part poor, obscure stratification. A few eskers exhibit no stratification, they have a "pell-mell" structure, as it has been described, a confused arrangement of materials all of which are rounded. An esker may exhibit stratification in one part of its course, and a "pell-mell" structure in another part. "Pell-mell" structure is characteristic of those eskers especially that are more irregular and hummocky in external form.

In the broad "plains" characteristic of many esker courses the strata are nearly horizontal, or gently dipping toward the southern termination of the esker.

Slopes. The lateral slopes of eskers are as steep as the materials will lie, being the angle of rest for the material of which the esker is composed. This slope varies from 25° to 35° from the horizontal. In cross-section the narrow crest and steep slopes give the appearance of an isosceles triangle, with the cross-sections in any section of a ridge tending to uniformity. The steepness of the slope is an indication of the character of the esker material, the steeper slopes indicating coarser material. Often where the high knolls, characteristic of many esker crests, appear, the declivity is very pronounced, and where the cols appear the angle of slope is somewhat less. Sometimes the slopes of both the cols and the knolls remain the same, the width of the base changing so as to maintain the usual degree of slope.

The ends of esker ridges and of the individual segments are, like the sides, as steep as the materials will lie. In few cases do the ends tend to trail out with a gentle slope and blend with the ground moraine.

Surface characters. Many eskers preserve a uniform crest line throughout their whole length or a greater part of their length. This is in many instances remarkably level, similar to a railroad grade, however such long stretches are in truth slightly curved. Again the crest may be very uneven, thrown into a series of alternating knobs and depressions. This type of crest may characterize the entire course of the esker. Again eskers may have a uniform crest for part of their length, and an uneven crest characteristic of the remaining part. Also the two types may alternate throughout the esker course, each type persisting for some little distance. Knobs above the crest are particularly apt to occur at termini and at ridge intersections (88). The knobs vary in height from 3 or 4 feet to 10 or 20 feet and rarely may be 50 feet above the general level of the crest. They may be so high and pronounced that the esker resembles a series of kames more or less connected. Where they occur the esker ridge tends to broaden.

The materials on the surface are of the same nature as the materials of the esker—sand and gravel, with gravel more common by far. While most eskers have no till on their surfaces, yet its occurrence on a part of the surface or over the whole surface of a number of eskers has been noted. Scheffel describes eskers mantled with till to the depth of 5 or 6 feet (88), and Leverett describes a number of eskers from the interior with till present upon their surfaces (62, 63).

Boulders with a diameter of several feet may be present upon the surfaces of eskers, their occurrence here however is not common. They may be sparingly distributed over the surface, they may be confined to certain restricted areas, again they may cover the surfaces of certain eskers quite profusely (117).

River silt may bury eskers that lie in valleys, as is the case with the series of eskers of the Connecticut valley. They may be buried by outwash carried out by streams from the front of the receding ice edge (28). Along the coast of Maine marine sediments cover the surfaces of eskers (99). Upham has described eskers in New Hampshire covered with alluvium (115). Valley terraces and delta materials may bury them also (21).

Till, as well as large boulders, is very rare over the surfaces of the broad places, the "plains", of esker courses.

Relation to the rock surface beneath. The relation of the esker to the surface upon which it rests is an unknown quantity in most cases, the lack of knowledge being due to the paucity of sections that reveal the bases of the eskers. Where examination is possible it has been found that in the case of a large number of eskers the gravels either penetrate to the bed rock beneath, or below the surface of the till on either hand. However, a number of eskers rest on the till directly with little or no evidence of erosion of the till beneath. Geikie states that eskers rest often on boulder clay, but more often perhaps on solid rock (40). Leverett has mentioned a number of examples of till erosion beneath eskers in the glaciated portion of the interior (62, 63).

Time of Formation.

It is universally conceded that eskers were formed during the waning stage of the continental ice mass. It is probable that the eskers were formed for the most part after the formation of the drumlins.

Condition of the ice at the time of esker formation. The ice at the time of esker formation was thin, having a thickness of but 300 feet or even less (99). High hills, ridges and divides probably projected above the ice as nunataks. Movement was slight or lacking altogether, surface ablation was rapid with the consequent formation of considerable volumes of water (45, 46), a "general recession of a nearly stagnant sheet of ice" was taking place (61).

Rate of Growth.

It is generally admitted that the rate of esker growth was rapid, very rapid. The streams in which the eskers were formed while torrential in character deposited the gravels and sands rapidly. The character of the stratification, the cross-bedding and irregular bedding, the rapid changes in dip and steep dips, all point to conditions of rapid sedimentation. The "open work" gravels, the coarse angular materials near the point of origin, point to rapid growth. Further the nature of the deposits indicate a more rapid flow of water in some parts than in other parts of the stream's course.

Theories of Origin.

The manner of formation of eskers has long been a matter of dispute. That streams associated with the melting glacial ice were responsible for the origin of the typical esker is beyond question, but just what that association was has been the "bone of contention." There have been two opposing ideas advanced, one maintains that eskers originated in streams beneath the ice, the subglacial view, the other idea maintains that eskers were deposited in streams on the surface of the ice, the superglacial view. Students of glacial geology have been advocates of the one or the other idea. Recently there has been another view advanced that has gained a few adherents. This holds that eskers were made at the edge of the ice or in reentrants back from the edge. Again some have entertained the idea of esker formation in ice-walled, earth-bottomed canyons open to the sky. Further, some eskers have undoubtedly been formed in ways in which the active agency of water has been lacking. The large question hinges upon what was the predominant method. These various theories will next be considered.

Subglacial Hypothesis. Statement. This view, advanced at an early date, and followed to-day by the majority of glacialists, attempts to explain the origin of eskers by the activity of subglacial streams. These streams flowed in tunnels beneath the ice mass. The water was under considerable pressure or "head," due to the crowding of the ice, if it possessed movement, against the stream, and due to the height of the tributary waters of the stream at their point of origin on top of the rapidly melting ice miles back from the place of deposition of the esker ridge. The water, derived by surface ablation, flowed along the glacier surface until it plunged into a crevasse or moulin where its course became englacial for a distance or subglacial. These subglacial waters, closely pent, followed a crevasse or a series of crevasses, or some other line of least resistance. The course once established was maintained, even if the ice possessed some movement, and the tunnel gradually enlarged by the melting of the ice adjacent to the stream and by mechanical erosion, Tributary tunnels were developed and maintained in the same way as the main course. The subglacial streams issued from beneath the ice into ponded glacial waters, in some cases as along the New England coast; beneath marine waters, or onto surfaces sloping away from the ice front. In any case there resulted decrease in velocity at the edge of the ice, through loss of "head," and consequent deposition from the waters heavily charged with debris. This clogged the mouth of the tunnel and caused the water to flow at a higher level in the tunnel, eroding and melting the upper surface of the tunnel. As the tunnel got larger and the mouth more and more clogged with debris the main current of the subglacial stream would vary in position and in load leading to aggradation. At first the deposition would be only local, here and there in the channel, but as the tunnel enlarged the deposition would be more frequent to a perfect or nearly perfect ridge development. By reason of the velocity the coarser materials would be left, the finer carried out into the deltas, outwash plains, kames, etc., that were forming at the edge of the ice. Subglacial streams issuing into standing water would have had their velocities checked some distance back from the edge of the ice without regard to aggradation at the mouth of the tunnels, thus leading to deposition in the tunnels.

The supply of debris was obtained from the surface, from englacial material, from the basal portion of the ice heavily laden with material, from tributaries, from the flow of the ice in case it possessed movement, by the erosion of any till in the upper reaches of the stream's course and in the tributary courses that already had been deposited beneath the ice.

These subglacial streams were for the most part short lived. They maintained their courses for brief periods only. They may have been diverted in part or wholly by the closing of the tunnel through ice movement, by the collapse of the tunnel, by the opening of an easier passage for the escape of the waters, possibly by finding exit to the surface or to an englacial position, and flowing there for some distance before plunging into another crevasse.

Some subglacial streams may have formed no deposits in their channels before diversion of their waters, in some cases apparently a low ridge or only a partially completed ridge was formed, again a ridge fully developed may have been formed before the waters were diverted. Such a ridge by clogging the channel and making great "head" necessary to continue the flow may have led to the diversion of the waters. Again the stream may have maintained its course along the crest of the esker until the tunnel became roofless, and even subsequently if the front of the ice was bathed in waters, the presence of which caused the tributary stream to flow sluggishly, thus preventing erosion of the ridge. With the recession of the front of the ice the ridge became a subaqueous embankment. This may have been covered by delta deposits or by a sand plain built into the glacial lake as in the case of the Auburndale esker, Mass. (28). It is evident that if the ice possessed vigorous movement tunnels could not exist, or if it was very thick tunnels would be closed by its weight.

Eskers were doubtlessly formed near the ice edge, within a few miles at most of the receding ice front. The most favorable position for esker development was under the stagnant front of the glacier, or beneath a detached ice block, conditions that were common along the front of the receding ice sheets. "Doubtless also esker development was favored along the margin of valley glaciers, or glacier lobes, when the ice was thin, the motion slight and the volume of water great. It is from such places that glacier torrents issue from living glaciers, and doubtless eskers are forming in some of them, as, for example, in Alaska, where small eskers are found on ground from which the glaciers have receded within a century" (105).

Such were the conditions under which typical eskers were formed according to the subglacial view. In the argument that follows the attempt is made to explain the peculiarities exhibited by eskers in terms of this hypothesis. Following this argument there is a list of all the objections that have been raised against this manner of esker origin. Most of these objections will be found to have been adequately answered in the argument.

Argument. The length of many esker systems has been urged as an objection to the subglacial hypothesis, it being maintained that correspondingly long tunnels could not exist beneath a mass of moving glacial ice. However, in the case of the longest eskers, eskers 100 miles or more in length, no part of the esker ridge was formed until the ice front had receded to within a few miles of that part, in most cases 2 or 3 miles at most, the part already formed extending beyond the ice edge to its leeward termination. In the case of segmentation, characteristic of practically all eskers of any length, the ice may have stood at or near the end of each segment as it was forming, see Fig. I.

As already indicated patches of gravel and sand are very characteristic of intervals between segments, and were carried out by the subglacial stream in which the segments were forming beyond the edge of the ice and spread out.

Thus an esker 100 miles long doesn't mean that deposition was going on in a subglacial channel beneath the ice for 100 miles back from the ice edge, but instead it means that conditions were favorable for fairly continuous deposition near the edge of the ice while the ice front was receding for a distance of 100 miles.

Eskers are especially apt to be developed in rough, hilly, rugged regions, such as Maine, for here the ice would be crevassed affording initial passage ways for the subglacial waters. Here also the ice flow would be likely to cease sooner while the ice was still thick, the melting of which would afford a large body of water to be contributed to the subglacial streams and its thickness furnish the requisite "head" for such streams. On peneplain tracts crevasses might develop as a result of tension thus giving opportunity of exit for subglacial waters. However this point is not of prime importance, since the pent-up subglacial waters must find exit, crevasses or no crevasses.

That till beneath the ice was eroded by subglacial waters has been repeatedly observed. Hershey has described the erosion of till and water laid drift within a short distance of a glacial lake, where the erosion must have taken place beneath the ice (48). Lack of evidence of erosion of till between esker segments and back of the point of origin of the esker by the subglacial waters may be expected, for subsequent deposition of till would tend to obliterate all such evidence. The above observer describes the erosion of rock ridges, more or less broken by the ice probably, that existed just behind the

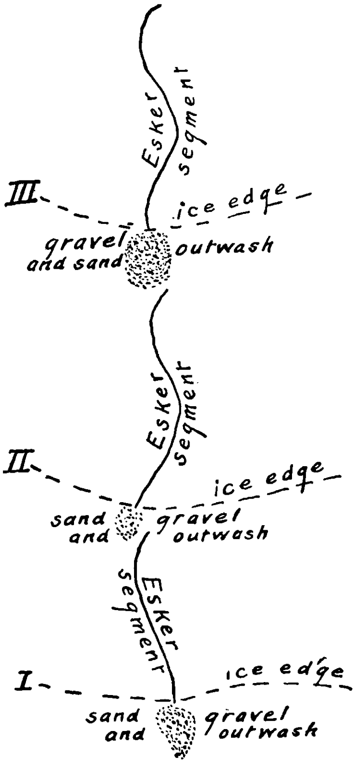

Fig. 1. Relation of the segments of an esker system to the ice front at the time of their formation. I, II, III indicate successive positions of the ice front, the segment just north being formed when the ice front was stationary in each one of these positions.

growing eskers which are composed largely of their fragments. The streams must have been subglacial to get at these ridges, and further, materials from the neighboring hills are absent from the eskers showing that the esker streams did not have access to those hills and did not get possession of drift they may have contributed to the englacial and surface portions of the ice. This hypothesis also accounts for the occurrence of eskers in troughs, so frequently noted by Leverett. These troughs were eroded by the same subglacial streams in which the esker ridges were deposited.

Tributaries to eskers are rare, for if the ice possessed movement it would obliterate such features inasmuch as they would be for the most part transverse to the direction of ice flow.

Double ridges may be accounted for by the formation of a broad arch which, unable to support itself, bent downward dividing the tunnel into two parts in each of which deposition took place, or locally a deposit was formed in a superglacial or englacial channel which, protecting the ice beneath from melting, slid down both sides of the resulting ridge.

Accordant levels of delta and feeding esker are significant. Eskers are never greater in height, and rarely of less altitude than the delta to which they are tributary. This is to be expected under this hypothesis for aggradation would cease in the subglacial tunnel when the upper level of the material clogging its mouth was attained, the upper level of the delta (27, 28).

Gaps in esker courses may be accounted for by subsequent erosion, by glacial erosion of the once continuous ridge, by lack of deposition resulting from lack of confinement of the subglacial stream to a definite channel where the gap occurs, by an ice-block falling into channel with deposition behind and in front of it, but the water possessing too great velocity in passing around it or not definitely confined to channels resulting in no deposition. Stone suggests that the ratio of the volume of water and the size of the tunnel varies in such a way that deposition takes place where the stream is small and the tunnel large and the velocity is therefore low, and that deposition fails where the ratio is reversed and the velocity high (98).

The fact that the stream was under high pressure accounts for esker courses across divides, across valleys, over rough topography, etc., as shown in the courses of existing eskers. The absence or poor development of eskers on divides and on steep downslopes is due to the greater velocity of the subglacial streams in those situations. Yet velocity on downslopes was not excessive, we have here to deal with something analogous to a tube of flow. Hence some deposition may have taken place on downslopes, the water not possessing sufficient velocity to carry the heavier material and excessive load to the front of the ice. Further, streams with sharpest gradient did not develop the highest esker ridges. The low ridges as well as the ridges having low, lateral slopes have the higher gradient as a rule (7). On long gentle slopes and across plains the eskers have their strongest development.

Courses transverse to the direction of ice movement may be accounted for by the formation of eskers after ice movement had ceased, or by assuming a change in the direction of ice flow near the closing stage of the ice epoch, the movement being in the general direction of the esker trend and not being recorded on the till coated surface beneath the ice, or by the stream maintaining its course against the ice flow. This theory accounts for the tendency of the esker ridge to bend in the direction of ice movement as when crossing a valley in which the motion of the ice was obviously down the valley axis (7).

Eskers are also strongly developed beyond localities where the ice had crossed easily eroded rocks, thus getting a large basal load to be contributed to the subglacial waters.

This method of origin accounts for the character of the stratification, its chaotic arrangement of layers, its cross-bedding, the tendency to dip toward the terminus of the eskers, the anticlinal structure due to sliding and slipping of the beds as the restraining ice walls on either hand were removed. "Pell-mell" structure may be explained by the excessive slipping and irregular sliding of the materials coming to rest, by ice push subsequent to the formation of the esker (102), or by collapse of the subglacial tunnel in which the esker ridge was deposited (40). Variations in supply of water from day to day, and from season to season would account for many modifications in bedding (40).

This theory also accounts satisfactorily for the character of the materials, their subangularity near the origin of many eskers when they had been transported but a short distance, their rotundity in the lower part of esker courses, the rounding of large boulders, 2 to 4 feet in diameter, indicating rapid, violent flow under great "head" of a stream acting upon subangular glacial materials. The presence of large boulders in the gravels may be explained as being derived from the basal ice, in which they were occluded, either by lateral melting revealing the boulders, or by being crowded in by ice push or by overriding ice, possibly some fell from the roof as the level of the stream rose in the growing subglacial channel. Large boulders on esker surfaces may be accounted for in these several ways. The presence of till on the surface and distributed through the esker mass may likewise be explained.

The absence of till from the surface of many eskers may be accounted for by subsequent erosion, especially during the time just following ice retreat when the surfaces of the easily eroded materials were unprotected by vegetation or other covering, or by the subglacial tunnel becoming roofless by surface ablation before the esker-forming stream was diverted, or by the esker becoming so high that it rose above or nearly above the upper limit of the zone of till in the basal part of the ice. Subsequent sliding may have concealed till present upon the fresh esker surface. Also the surface of the ice may have been kept free of debris by its washing toward the ice edge or into moulins continuously till the ice surface was lowered to the top of the esker leaving little to be deposited on it from the ice surface. Absence of outwash on surface may be accounted for in similar ways: Removal by subsequent erosion, never deposited if subglacial stream flowed along crest of esker deposit till the channel was open to the sky, or if the stream was diverted after the esker formation, outwash would not have been likely to have been carried out onto the esker surface, at the edge of the ice.

The knolls characteristic of the crests of eskers may be explained by local enlargements in the roof of the tunnel in which deposition took place, or by superglacial material falling through holes in the ice onto the partially uncovered ridge, or by being added by superglacial or englacial streams cascading downward from the surface. Also they may be explained by irregularities in the surface on which the esker rests, or by irregular sliding of the esker material on removal of the ice walls, or by subsequent erosion, or by melting out of occluded ice masses in the esker gravels, or by slight difference in the velocity of the subglacial stream leading to difference in the amount of deposition. Woodworth has advanced another explanation to account for irregularities in the crest (122). He says, "if in a channel at the base of a stagnant and disappearing ice sheet, detritus be laid down with a constructional surface relatively even, but with a width varying within short distances, so that at one point the width is less than the thickness, and at another point greater than the thickness of the deposit, the ultimate crest line of the deposit, when the ice melts away, will vary. The caving of the sides will produce slopes whose intersection will take place above the constructional surface when the deposit is wider than it is high in the ratio of one to one and one-half (about). When this ratio or a greater one obtains, the constructional surface along its median line will not be lowered. When the thickness is equal to or exceeds the width of the deposit, then the slopes will intersect below the constructional surface and bring down the crestline beneath the original surface. Where this readjustment has taken place, it follows that an esker channel was originally narrow where the esker is now low, and wide where the esker is high. This gravitative arrangement of the crestline would not be produced in deposits whose thickness did not equal or exceed the width of the channel. The application of this prin-

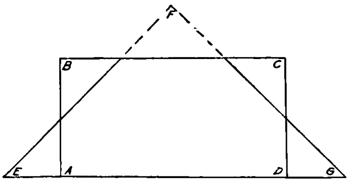

Fig. 2.

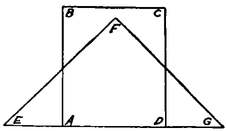

Fig. 3.

Diagrams illustrating one method by means of which an uneven crestline originates. Where the constructional width is greater than the thickness (Figure 2), the readjustment upon the melting of the ice will not result in the lowering of the crest; when the width is less than the thickness (Figure 3) the readjustment will bring down the crestline beneath the original surface (After Woodworth).

cipal to variations of the crest-line is made possible by the uniform limitation of eskers to a cross-section within the range of this action." See figures 2 and 3. Woodworth also has stated that maxima changes in the width of the channel occur at points of maxima change in direction.

"In these figures ABCD represents the assumed cross-section of the gravels and sands deposited in a tunnel of varying width before the ice has melted from the sides. EFG represents the cross-section after the sides of the original deposit have slidden down. In Fig. 2 F is above the constructional height, and the crest line is there unchanged; in Fig. 3, F is below the constructional height and the crest is lowered." After Woodworth.

Inasmuch as an ice arch more than 200 feet wide cannot support itself, wide places, so-called "plains," in eskers may be cited as in objection to this hypothesis. They may be explained variously: (1) The ice arch bent downward in the center and rested upon the surface of the accumulated deposit, however, the evidence of this in existing eskers has rarely been noted; (2) in such places in the subglacial stream courses the tunnel may have become roofless and the ice melted back to afford the required width, there being first the narrow ridge, and as the channel widened this central ridge was more or less spread out and finer material characteristic of these broad areas was brought in; (3) they may have been formed at the edge of the ice beyond the subglacial tunnel; (4) they may represent pools in the ice at the bottom of large moulins (99); (5) or possibly the ice floated on slack water above the deposit.

This theory accounts for the lateral projections from the sides of eskers. "These irregularities probably mark the entrance to the major line of small tributary streams, or as an alternative, the opposite condition, leakage from the major lines" (88). They may also represent alcoves in the ice bordering the stream (99).

Reticulated ridges may also be explained under this hypothesis. They may be considered as distinct ridges formed in branching, interlacing subglacial tunnels. Rapid melting of the ice yielded an excess of water heavily charged with sediment, especially in regions of easily eroded rocks, which choked the subglacial channels faster than the water could erode them, this and the excess of water formed many new channels, particularly on long gentle slopes where this type is apt to occur. "In this way large numbers of narrow channels were formed, connected at frequent intervals with one another by transverse channels". (Stone). They may represent ridges formed where streams debouched into open standing water from the ice front (97). Here they would be comparable to the distributaries of modern deltas, enclosing basins, kettles, etc. Lacustrine deltas formed in glacial lakes have been observed to be more or less reticulated toward their landward extremity. This feature may also have been formed as a lacustrine delta in a local enlargement of a subglacial stream, possibly roofless. Every stream flowing into the lake would build its lateral ridges, kettles would be enclosed by these growing ridges, and ice block inclusion would form others. On the north side of divides uncovered by ice ablation lakes might form and its numerous more or less connected subglacial tributaries northward give rise to reticulated ridges. As a result of clogged subglacial channels, the water might become superglacial and the resulting superglacial deposits become a jumble of ridges, cones and hollows on the melting of the ice beneath, these would constitute a narrow area of reticulation. They also may have been formed in an excessively crevassed ice front not bathed in glacial lake waters. Such crevasses might be produced by tension.

Ice movement probably destroyed eskers. Their almost universal absence from the glaciated interior and from other glaciated regions, with possibly here and there an isolated occurrence, except in especially favored localities such as Maine, may be explained not so much from lack of deposition in subglacial channels, or absence of subglacial drainage, but by the fact that subsequent or persistent ice movement destroyed the majority of those already formed. Ice advance might destroy eskers already uncovered by ice retreat as well as those formed or partially formed still beneath the ice. Vigorous drainage at the ice front may also have been a contributing factor in esker destruction as soon as they were uncovered. Stone explains the absence of glacial gravels near the coast of Maine as a result of "a small acceleration in the ice flow near the coast and limited enlargement of the subglacial tunnels over the area whose basal ice was submerged in the sea"(99). Eskers may have been destroyed as a result of subsequent erosion by the same stream that built them.

Objections. Various objections have been urged against this hypothesis of esker origin. They are indicated below:

(1) The enormous thickness of the ice, measured in terms of hundreds, even thousands, of feet would not permit of tunnels beneath itself (111).

(2) Swift streams do not deposit under ordinary conditions, much less deposit sand, gravel and boulders altogether (111).

(3) Eskers and kames are composed of the same materials. Kames are deposited at the edge of the ice where the issuing waters have lost their "head." If this be true it is reasonable to suppose that eskers should be composed of coarser materials than kames (111).

(4) Eskers could hardly escape destruction by the ice constantly moving over them, especially those 50 to 100 miles long extending far back from the ice border (111).

(5) This theory does not adequately explain the discontinuity of eskers. They cannot be due to irregular glacial erosion of an originally continuous ridge for the ends of segments are depositional rather than erosional. Further, breaks are common where the trend of the ridge was parallel to the direction of ice movement and glacial erosion at a minimum therefore. Also the absence of stratified materials in the intervals, and the abruptness with which the ridges pick up on either side of a break seem to militate against the idea that these discontinuities are due to lack of confinement of the stream to a definite channel where these breaks occur. It is urged that a stream so separated as not to be able to transport a load could hardly build a ridge 100 feet high and of proportionate breadth just beyond the point where the stream had had no definite channel to which it had been confined, and further what was the source of supply of the materials if the stream had not been definitely organized as a transporting stream above this ridge. If the suggestion by Stone (99) be valid the appearance of the esker ridge below the interval must represent a sudden change in the character of the tunnel (from small to large), and that large tunnels carrying water of low velocity can exist beneath ice masses 100 miles back from their terminals (111).

(6) Eskers are not found between the Malaspina glacier and the shore across which the ice has recently receded, although num-

erous subglacial streams issue from the ice along its margin here and present conditions apparently favorable for esker formation (111, 80, 81).

(7) Eskers should show drift covered surfaces frequently, they do not however.

(8) Eskers trend in the direction of ice movement. There is no reason why streams should flow in that direction, especially as topography is often adverse. Crevasses would not be in that direction often (21, 111).

(9) Why did subglacial streams follow rough topography and parallel valleys both broad and deep? Also the presence of eskers in a lateral position on the sides of valleys is inconsistent, the subglacial waters would tend to work toward the axis of the valley.

transverse (10) Deposits should be swept away as fast as formed when ~~parallel~~ to ice movement.

(11) It is difficult to account for broad areas, "plains", because requisite arch would be too broad to support itself. Also heat of water and erosion would be inadequate to form the broad channels except late in ice epoch when there was no movement, and then the whole channel would be worn to uniform width.

(12) It is difficult to account for knobs along the crest-line. The crest should be even, uniform, sloping upward from the terminal plain.

(13) Branches can be accounted for only with difficulty. They would be erased by glacial movement. They often make oblique angles with the major ridge, they should make large angles.

(14) Double and reticulated ridges are likewise difficult to account for under this hypothesis.

(15) As soon as the channel became partially filled with a deposit there would be a strong tendency for the waters to be drawn off through a side crevasse.

(16) Eskers should be composed of coarse material and be stronger and more perfectly aggraded on up slopes.

(17) Mountain topography is apparently not favorable for the development of eskers, yet it is rough leading to extensive crevassing with opportunities for subglacial flow. On the other hand dissected peneplain tracts are favorable (111).

(18) More frequent trenching of the ground moraine, and the more frequent occurrence of eskers in troughs in the ground moraine would be expected under this hypothesis. Stone found little evidence of subglacial stream work except near the coast in his study of Maine eskers (101).

(19) In order to preserve the esker the subglacial stream had to be diverted when the ridge was completed. How was it diverted, and why was no esker formed in the new channel? Also erosion channels of such streams after their diversion are very rare (21).

(20) The trend of the subglacial stream demands ice control and a long life, its deposits demand a short and intensely active life, followed by a sudden disappearance from the scene of its labors (21). The two ideas are inconsistent.

(21) Deltas and outwash plains should show more tributary eskers than they do. They have not been ice removed, for ice contact slopes of the sand plains are intact, there is no evidence of disturbance due to ice push.

(22) Eskers should be well-stratified if subglacial, yet there is found extremely chaotic stratification with "pell-mell" structure.

(23) Absence of an adequate supply of material since the ice sheet protected till already deposited from erosion except where the subglacial tunnels were located constitutes an objection. All of the material must come from subglacial stream erosion of till, from debris in the basal portion of the ice and a little englacial and superglacial material, this must form eskers miles in length and extensive outwash plains. This source seems inadequate entirely.

(24) Crevasses are too few after cessation or near the time of cessation of ice movement to afford new subglacial tunnels, and those already existing are too few to accommodate sudden floods formed by melting during the warm summer season, this excess of water must therefore pass off in superglacial streams, hence few eskers would be formed subglacially.

(25) Eskers should tend to show a more uniform cross-section than they do, for with a given thickness and weight of ice any enlargement of tunnel would be precluded by creep of ice inward.

(26) Under this theory one would expect to find more large boulders on the surfaces of eskers.

(27) Eskers should be located in large preglacial valleys, instead they cross valleys repeatedly.

(28) Eskers pass along plains where there is little chance for crevassing, zigzag across valleys without regard to the direction that crevasses (29) would naturally follow. There is little or no evidence of erosion of till back of the point of origin of the esker.

Conclusion. Most of these objections have already been answered in the argument given above. Objections 5, 11, 14 are the most vital and important, and apparently can be answered only in part as yet, or in a manner not thoroughly satisfactory.

Superglacial hypothesis. The superglacial hypothesis of the origin of eskers has been most ably advanced by Crosby (21). Stone was an early exponent but later was converted to the subglacial idea. Holst has already been mentioned in connection with the early advocacy of this theory of esker origin. The hypothesis has found few supporters in this country.

Statement. Crosby states "this explanation of eskers assumes a stagnant marginal zone of the ice sheet at least 100 miles in maximum width, practically free from crevasses, sufficiently wasted by ablation to be more or less abundantly covered by englacial drift which has become superglacial, with a general southward slope, and toward the southern border at least, thin enough to reflect in its surface contours, in some degree, the underlying topography" (21). Crevasses, if present, would be sealed in the final stages of movement, or filled with debris; it is significant in this connection to note the rarity or lack of crevasses in the Greenland glacier except near the margin. Water divides on the ice must be sufficiently far apart so that the water supply may be great enough to form large rivers, hence over broad valleys and lowlands of the pre-existing topography are places favorable to the formation of eskers (66).

At the margin of the ice the superglacial stream's elevation is controlled by the level of a glacial lake, bank of till, or detrital cone (21). The stream grades itself with reference to this control. It may have tributaries—in fact a river system upon the surface of the ice, comparable to a river system on a land surface. At first the streams of the system will possess such high velocities that no material will accumulate in their channels, but as grade approaches corrasion will gradually cease, and aggradation will take its place, building an esker ridge in the stream channel. The stream will derive its supply of debris from subglacial or englacial drift that has become superglacial by shearing, by the overriding of the sedentary ice cap that had accumulated previous to the invasion by the ice from the center of ice dispersion, the latter carrying upward its basal load, by the upturning of layers, phenomena observed especially along the front of the Greenland glacier, by surface ablation revealing the englacial and basal material in the ice, and by erosion of nunataks projecting through the ice and of ledges projecting into the ice. Upham has thought that much drift has become englacial even in a short distance from the point of origin on a relatively flat surface. Stone formerly entertained the idea that much of the drift of the Maine eskers was englacial in source.

With the cessation of corrasion the esker channels may be 50, 100 or more feet above the ground. The question now arises as to how to get the esker down on the ground without the destruction of its ridge-like character. It is necessary that the banks of the channel—the retaining ice walls—be preserved if the esker form is to be maintained. Hence the bottom of the channel must be lowered as rapidly as surface ablation lowers the neighboring ice surface. Corrasion has ceased so recourse must be had to the melting of the ice at the bottom of the channel by the sluggish waters of the stream percolating downward through the porous gravels. Russell has described lakelets on the moraine-covered marginal zone of the Malaspina glacier, 50 to 100 feet deep, rarely more than 100 feet in diameter, with bottoms covered with drift constantly augmented by the addition of fresh material from top and sides. These lakelets are deepened as fast or faster than the surface of the ice is melted, by convection, the warmer, denser (near 39° F.) waters of the surface sinking and percolating through the porous materials covering the bottom displacing the colder lighter water, near the freezing point, at the bottom. Thus the lake bottom is lowered, and the walls of ice undercut even below the water surface. In a similar manner the bottom of the esker channel is lowered by the melting of the ice as the warmer surface waters percolate through the esker deposit, and the ridge finally comes to rest upon the ground. This is in brief the mechanics of the process of esker formation according to the superglacial view.

Argument: The esker having come to rest upon the ground will show the normal disregard for topography, its course being that of the superglacial stream.

Tributaries will be rare for aggradation will be confined to the main channel for the most part by reason of the high gradient of tributary channels.

The general absence of eskers in mountain regions may be explained because of excessive crevassing of ice not permitting the extensive development of superglacial streams (66). Thus Holst explains their absence in south Greenland (66). In regions of plains they are also apt to be absent because of the absence of large drainage basins (66).

Knolls are explained by the dumping of material into the main superglacial valleys from hanging tributary valleys, by unevenness in the surface upon which the esker ridge is deposited, and by irregularities induced by the gradual lowering of the esker deposit to the base of the ice due to the unequal melting of the ice beneath the esker.

The widening of eskers toward their terminations is due to the normal widening of the ice valley as it approaches a body of standing water in which its walls are bathed. Wide places in the esker course, the "plains", are due to the development of wide places in the superglacial valley.

In case the esker channel is drained before subsidence is completed, the debris so left will protect the ice beneath from melting and, becoming elevated on an ice ridge, will slide down both sides thus forming a double esker.

The trend of eskers is in general conformity with the direction of ice movements; the slope of the upper surface of the ice is in that direction so the esker streams naturally flowed in that direction.

Reticulated eskers represent delta-like branching in broad places in the superglacial channels, or a broad deposit split up into a network of ridges while being let down upon the ground.

The esker deposits may protect vast bodies of ice beneath from melting after being aggregated into ridges by the superglacial streams. From the ice ridges so formed material may slide down irregularly to form kames.

This manner of formation would explain the general absence ot till from esker surfaces. Large boulders on esker surfaces and within the gravels may have been floated in on icebergs, may have fallen from the steep ice walls at the side of the deposit, or may have been incorporated in the base of the gravels from the basal ice as the deposit was slowly being let down to the ground.

The chaotic stratification, evidences of sliding, and "pell mell" structure are explained by the irregularities induced in getting the ridges down upon the ground.

Segmentation is due to the occurrence of rapids in the superglacial stream with consequent lack of deposition, or to distribution of that portion of the ridge in being let down upon the ground.

This method of origin also accounts for eskers resting directly upon the till, and the absence of till erosion beneath the esker and back of the point of origin of the esker.

Objections. (1) Insuperable difficulties stand in the way of getting the ridge down on the ground according to the method postulated. Porosity of ice would drain off the water from the sluggish stream's course before the esker deposit could be let down on the ground. Russell's observations on the lakelets of the Malaspina glacier show that they are frequently drained even on stagnant ice, their deposits becoming cones due to the protection afforded to the ice beneath from melting. There is no instance recorded of the material on the bottom of these lakes getting down to the ground by this process.

(2) Eskers occur that are 100 miles long or more, it is doubtful if that expanse of glacial ice can exist without crevasses which would limit length of esker ridges. The extensive crevassing of the margin of the Greenland glacier in the zone of esker formation reinforces this point. Further streams of the length required here would be apt to have their upper courses in the region of névé and not on debris covered ice. These long eskers probably could not be formed close to the ice margin during its retreat for the rapidly melting ice would not permit of the stream coming to grade, a condition essential for aggradation.

(3) Glacial debris is almost entirely confined to the base of the ice. Little of it is englacial or superglacial. By far the greater amount of material is located within 50 feet of the base of the ice (9). This would leave little accessible to superglacial streams.

(4) Existing glaciers show that the drainage of ice sheets is almost entirely subglacial, streams flow but a short distance on the surface before they plunge into a crevasse or moulin. The presence of pot holes in glaciated regions shows that moulins were as characteristic of former ice sheets as present ones.

(5) The rapidity of currents of superglacial streams and the smoothness of their channels are directly opposed to the lodgment of materials in them.

(6) The materials of eskers are essentially local in character. Davis has shown that the materials of the Newtonville and Auburndale eskers have only come from two to four miles to the northward (27). To oppose this fact it has been suggested that the upturning of the layers of ice as noted in Greenland would bring up basal materials within a short distance of their source, however, this upturning of ice layers is merely a terminal phenomena and cannot find application here. Further this material would have to rise to a height of 50 to 100 feet in the case of high eskers, too great a rise especially on level ground. If the ice moved over a sedentary ice cap some of the surface debris at the time of esker formation must have been far traveled material, yet even the large boulders of eskers are local in origin for the most part.

(7) If eskers are let down from a superglacial position across divides they should show evidences of stretching—relation of chord to the arc—however they do not exhibit evidences of stretching in these situations but exhibit uniform preservation throughout the length of the segment (122).

(8) Ice is so easily eroded that deposits would not be restrained to definite narrow channels, especially after the stream had become graded, hence narrow ridges could not be formed with characteristic uniform cross-sections.

(9) Ponds and swamps bordering esker courses point to ice block inclusion and show that the ice lingered there longest. If the esker ridges were superglacial they would tend to slide off the surfaces of these blocks to either side.

(10) Numerous large boulders on esker surfaces and in the upper part of esker ridges are difficult to explain under this hypothesis (125).

(11) Eskers are often observed to lie in shallow troughs excavated in the till apparently by the same streams in which the eskers were formed (61, 62).

(12) Chadwick has noted several eskers in the vicinity of Ogdensburg, N. Y. If these eskers are superglacial in origin it is difficult to see how they were preserved with the vigorous waves and currents of the glacial lake Iroquois laving the ice edge, and the waters advancing into the superglacial channels with the recession of the ice front. In his study of the glacial features in the Thousand Islands district Professor Fairchild has reinforced this argument (34A; 34B. p. 149).

(13) Eskers exhibit a tendency to pass through gaps in crossing divides, a feature not easily accounted for under this hypothesis, since they should show little relation to these smaller features of the underlying topography.

(14) If eskers are superglacial in origin they are not likely to exhibit accordant relations with delta and outwash surfaces, as they usually do.

(15) No large lakes are known to form on ice sheets, comparable to such lakes as those in which esker "plains" are supposed to have been formed.

(16) This theory of esker origin is inconsistent with the "open work" structure observed so commonly in esker gravels (27), for where the stream became graded and the current sluggish the spaces within the gravels would have been filled by the slowly percolating waters.

(17) If eskers had been let down from a superglacial position to their present attitude, the bedding would have been much more greatly disturbed than the present sections indicate (27).

(18) Also if eskers had been let down from a superglacial position the material should slip outward more or less, the downthrow should always be toward the margins. Eskers exhibit displacements with downthrow toward the crest line, as well as dislocations with downthrow in the opposite direction.

(19) Amount of material on the Malaspina glacier cannot be taken as an index of the surface conditions of continental glaciers, for much of the superglacial material of the Malaspina is due to avalanching.

(20) Not enough debris would be brought in after the superglacial stream had reached the graded condition necessary to deposition to build eskers possessing such large dimensions as are frequently observed.

(21) Warm waters would have to penetrate deposits 50 or more feet thick and warm the ice beneath sufficiently to melt it, and in the case of broad eskers and "plains" penetrate a deposit of 500 feet or more wide and 25 to 100 feet or more thick, apparently an impossibility.

(22) Superglacial streams must always have had an obstruction at their mouth to permit aggradation, otherwise they would not have reached grade till the stream bottom rested upon the ground.

23) Shearing is little effective in getting material up into the ice, it is opposed by basal drag of the ice and the resulting more rapid movement of the upper portions of the ice.

Conclusion. Of the numerous objections noted several appear to be absolutely fatal to the theory and preclude the possibility of the majority of eskers having been formed in this manner. The local character of the esker materials, the confinement of debris to the basal portion of ice masses, the swiftness of superglacial streams, their smooth channels and short lengths, and the difficulty of getting ridges so formed down upon the ground without their destruction, are perhaps the most serious difficulties in the way of acceptance of the theory. A well known glacialist once remarked in the presence of the writer, "no one who has ever visited an ice sheet would entertain for a minute the idea of superglacial origin of eskers."

Hypothesis of origin at the edge of the ice. Baron De Geer of Sweden early stated his conviction that eskers were laid down where a glacial river emerged from the ice sheet and deposited its material as a fluvio-glacial fan. As the ice front receded the deposits of successive years formed a continuous gravel ridge, which followed the retreating mouth of the river.

Hershey in his study of Illinois eskers seems to have come to a similar conclusion regarding their origin (48). He thinks that the drainage was largely subglacial, and that the tunnels, being small, could not carry the amount of water provided by the rapid melting of the ice, the excess being ponded in the crevasses of the ice adjacent to the subglacial streams for considerable distances back from the border of the ice. This ponded water created great "head" in the subglacial streams, which therefore eroded rock ridges beneath the ice, and other deposits encountered, sweeping the materials forward and suddenly dropping them at or near the mouth of the tunnel, where the pressure was removed (48).

Gregory says that an esker is a "fluvioglacial ridge formed of sand and gravel which has been laid down along the course of a glacial river. The deposition has taken place mainly where the river emerged from the glacier, and the course of the esker is usually at a high angle to the edge of the glacier." "They have been built up into long ridges by the overlapping of successive delta fans" (44).

Still more recently Trowbridge has advocated essentially the same idea that of esker formation at the edge of the ice or within a re-entrant back from the edge (111). In the following statement the important details in this method of esker formation have been taken from a recent paper by the latter writer (111).

Statement. Trowbridge believes "that most eskers are simply kames drawn out into long lines by the slow retreat of the edge of the ice while kame deposition is in progress. If a kame is being formed at the edge of an ice sheet, and the edge retreats slowly, deposition will continue so long as the re-entrant remains and the stream continues to issue there, and the kame will be drawn out into a long ridge or esker." Discontinuities would result if "during the recession of the edge of the ice the re-entrant ceased to exist, or the stream ceased to issue there; when a re-entrant and the mouth of a subglacial stream again coincided deposition would begin again. This would make a break in the esker whose length would be determined by the rate of recession of the ice and the length of time during which deposition was not in progress. Such changes as these would take place suddenly," and would account for the abrupt termination of esker ridges. A slowly retreating ice edge would form a high, thick esker, rapid retreat would form a "thinner, lower one; rapidly changing rates of recession would cause an esker of varying thickness and of considerable surface relief." The esker knobs would result from a temporary halt in the ice recession. "Crooked re-entrants or shifting stream mouths would result in crooked ridges. Where there was one re-entrant, or one stream, there would be one ridge formed; where the ice edge was badly broken up and streams ran through all the cracks, the result would be a kame area drawn out into an intricate series of ridges, rather than a single ridge. Converging cracks would result in converging ridges, diverging cracks in diverging ridges, and crossing and recrossing cracks in intricate reticulated ridges. Where the ice edge retreated uphill, the ridges would be extended uphill. Where the ice receded across valleys and divides, the esker would be made to follow a course across a surface of high relief. The rougher the region, the more likely the presence of cracks in the edge of the ice, which explains the greater abundance of eskers in rough than in smooth regions" (111).

Hershey regards the "plains," areas of "special development" in esker courses, as formed at the terminus of the ice when it has remained stationary for some time (48). It is also suggested that they may be due to the overlapping of several individual deposits. He further states that esker deposits are not generally overriden but exhibit some evidence of ice push.

Objections. (1) Many eskers and most of the New York eskers do not show an uneven crestline but rather a uniform crest. To produce this condition by this method of origin it would seem essential that the recession of the ice front be very regular, and that the volume and velocity and load of the esker making streams remain constant, a series of conditions that would not be likely to obtain along the borders of receding ice sheets.

(2) An interval in the course of an esker should be represented by a ridge, or at least by gravels, elsewhere, which is not the case usually.

(3) Many eskers have till on their surfaces, a fact difficult to explain if the esker was built at the edge and not beneath the ice. The presence of large boulders on the surface encounters a similar difficulty in explanation under this idea.

(4) If eskers were formed in re-entrants in the ice front, such re-entrants would have to maintain their position while the ice front was receding for 100 miles or more in the case of the longer eskers, such as those of Maine, a condition not likely to occur.

(5) If eskers had been deposited in re-entrants into the ice their sides would be expected to show evidences of erosion in many cases by the stream which contributed to their formation. Eskers do not generally exhibit such erosional features, even on steep down slopes.

(6) Eskers occur where it would be impossible for a re-entrant to exist, situations in which the ice is wedged against a high cliff, the pressure on which would close the re-entrant (122).

Fig. 4. Outline map, showing the eskers of Finland, trending south-easterly toward the terminal moraines that were built at the margin of the ice. The segmented character of eskers and the intimate relations they display to terminal moraines are excellently displayed (After J. J. Sederholm).

(7) This theory does not explain adequately or satisfactorily the derivation of reticulated ridges, also the derivation of eskers whose direction was transverse to the direction of ice movement, or the meanders often quite symmetrical that are frequently exhibited by eskers.

(8) Esker ridges formed in this way should be banded in structure. The coarse wash deposited by spring floods should be followed by layers of finer material as the volume of the river diminished in the summer, thus there should result a passage from cannon shot gravel through fine gravel to sand. Eskers do not show this feature (44).

(9) The constant association of eskers with terminal and recessional moraines indicates their formation at a time when the ice front was nearly or quite stationary building the moraine, not at a time when it was in rapid retreat. See figure 4.

Conclusion. Of these several objections 1, 3, 4, 7, 8 and 9 are the most weighty, and especially the last, 9. This one alone would seem to preclude the possibility of the theory as applied to the formation of the vast majority of eskers.

Englacial hypothesis. This hypothesis has never been seriously entertained or advocated. It is subject to essentially the same objections as the superglacial hypothesis, and while it is possible that nearly stagnant ice may be traversed by tunnels above its base, as indicated by observation (80), yet it is improbable that any deposits of significance have ever accumulated in such tunnels.

Ice canyon hypothesis. The ice canyon theory has been elaborated particularly by Upham. N. H. Winchell seems to have entertained similar views earlier than Upham (120).

Statement. It is maintained that superglacial melting was rapid during summer but subglacial melting was slow both winter and summer. During the warm season the subglacial courses were inadequate for the transportation of all the water derived by ablation, and further tended to be "obstructed and closed by the transportation and deposition of modified drift." The melting ice border then became deeply incised by superglacial streams for a distance of 50 to 200 miles back from the ice edge. These numerous streams had steep gradients and, corrading rapidly, soon came to flow in deep canyons cut back from the ice front. These may have been ice floored or again cut entirely through the ice sheet with bottoms on the terrane beneath. In these ice-walled channels deposition of the esker gravels took place, the materials being derived from the surface of the ice, from the basal and englacial debris, and from the stream's floor.

Objections. The greatest objection to the theory is the disregard that the normal esker manifests for the topography. The appearance of an esker first on one side of a valley then on the other, the courses of eskers up long gentle slopes, could only be explained under this idea by the canyons being ice floored and sloping upward from the edge of the ice. In this case the theory meets the same objections as the superglacial hypothesis.

Conclusion. An occasional esker may have been deposited in an ice canyon, but the majority of eskers have arisen in other ways. Tarr has stated that "it is by no means impossible that in favorable situations, rapidly moving, heavily laden marginal streams may have flowed in valleys or tunnels cut in the ice, making deposits which, on the melting of the ice, took the esker form" (107).

Other views. Eskers may have arisen in other ways. Wright has described the formation of an esker ridge of the Muir glacier as follows: "The formation of kames, and of the knobs and kettle holes characteristic both of kames and terminal moraines, is illustrated in various places about the mouth of the Muir glacier, but especially near the southwest corner just above the shoulder of the mountain where the last lateral branch comes in from the west. This branch is retreating, and has already begun to separate from the main glacier at its lower side, where the subglacial stream passing the buried forest emerges. Here a vast amount of water-worn debris covers the ice extending up the glacier in the line of motion for a long distance. It is evident from the situation, that when the ice stream was a little fuller than now, and the subglacial stream emerged considerably farther down, a great mass of debris was spread out on the ice at an elevation considerably above the bottom. Now that the front is retreating, this subglacial stream occupies a long tunnel, 25 or 30 feet high, in a stratum of ice that is overlaid to a depth in some places, of 15 or 20 feet of water-worn glacial debris. In numerous places the roof of this tunnel has broken in and the tunnel itself is now deserted for some distance by the stream, so that the debris is caving down into the bed of the old tunnel as the edges of the ice melt away, thus forming a tortuous ridge, with projecting knolls where the funnels into the tunnel are oldest and largest. At the same time, the ice on the sides at some distance from the tunnel, where the superficial debris was thinner, has melted down much below the level of that which was protected by the thicker deposits; and so the debris is sliding down the sides as well as into the tunnel through the center. Thus three ridges approximately parallel are simultaneously forming—one in the middle of the tunnel and one on each side. When the ice has fully melted away, this debris will present all the complications of interlacing ridges with numerous kettle holes and knobs characterizing the kames; and these will be approximately parallel with the line of glacial motion. The same condition of things exists about the head of the subglacial stream on the east side, also near the junction of the first branch glacier on the east with the main stream, as also about the mouth of the independent glacier shown on the map lower down on the west side of the inlet" (126, pp. 65-66).

Eskers may have been formed between hill slopes and the steep edge of the ice. Upon the melting of the ice such deposits would tend to slide down and in some places be preserved with decidedly esker form.

An esker near Polmont in the south of Scotland, described as glacio-fluvial by Gregory, is unstratified, made up of angular materials, contains no bands of sand and appears to have been formed as a bank of wash quietly deposited along the margin of a melting glacier at one stage of its retreat.

Ridges may also be formed subaerially as natural levees, the current being bordered by slacker water. Likewise when streams enter standing water they tend to build up ridges at either side. Subaqueous ridges may be formed at the mouth of streams, and also in the lee of islands or other obstructions in the midst of sediment bearing streams (99).

Testimony of Existing Glaciers.

Existing glaciers do not throw a great deal of light on the problem of esker origin. The remoteness of continental ice masses and the paucity of observations on them have been unfavorable factors in this connection. The continent of Antarctica is covered by a continental glacier that approaches most nearly the great continental ice sheets of past time. Unfortunately it is not well known, and furthermore it does not furnish the requisite conditions necessary for the study of esker formation, its edge being nearly everywhere buried beneath sea waters.

Chamberlin has made a study of the Greenland glacier (9). He states that the drainage was largely confined to streams running along the sides of the glacial lobes, sometimes tunneling under the ice, or buried beneath snow drifts. On the disappearance of the snow and ice, deposits in such streams will resemble the terraces and eskers of our drift, but nothing typical in the way of esker formation was noted. However, it was observed, and this has repeatedly been confirmed, that the debris of the ice was confined to its lowest portion, with few exceptions at heights not greater than the heights of kames and eskers, a fact directly antagonistic to the superglacial method of esker origin, as already pointed out.

Holst found on the ice in south Greenland a stream 5 feet wide and 5 feet deep flowing on the surface for some distance, separating into two branches in one place enclosing an island of ice, before plunging into a moulin (66).

A. Kornerup in the published report of his travels, 1879, published 1881, states that he found in the Ausalik valley of Holsteinborg, "a typical gravel-ose about 4 miles long, parallel to the present direction of the motion of the inland ice, and having a roof-shaped top, and even sides, inclined 20° to 25° to the plane of the valley over which it extended in a meandering course." Further he states that the valley is "an unusually large plain, bounded by even, gently-sloping foot hills."

Alpine glaciers afford evidence of little significance in this connection. Their high gradients and paucity of materials are not favorable for the development of eskers. Materials are insufficient in amount to clog the subglacial channels at their lower ends thus leading to aggradation. Furthermore the high gradient of the valleys cause such rapid flow that only small deposition occurs, the outwash being carried on down the valley.

A deposit of the nature of an esker is described as occurring on a small glacier on Mt. St. Helena, Washington. "It was perfectly straight and regular in form, about 300 feet long, 20 feet wide at the base, 5 feet high and with a slightly convex crown of about 4 feet." Its materials were like those of the moraines associated with the glacier, "but worn, rounded and all of much smaller and more uniform size." At the foot of the side slopes the demarcation was clear and well defined, at its upper end it terminated against a lateral moraine into which it appeared to grade. Its lower end was abrupt, with no gradation and no dump. Russell suggests that it appears to have been formed in a tunnel by an englacial stream and afterwards brought to the surface by the melting of the ice (77). Tarr and Martin as a result of their Alaskan studies in the Yakutat Bay region state that eskers are subglacial deposits mainly, if not entirely, associated with stagnant ice conditions. However, in the bases of stagnant moraine-covered glaciers of this region, no eskers were observed in the process of formation on account of the dearth of streams. Some eskers buried by outwash were observed (106). Tarr has noted small eskers in Alaska on ground from which the glaciers have receded within a century (105).

Russell's study of the Malaspina glacier constitutes a classic in geology (80, 81, 82, 83). He states that the drainage of the Malaspina glacier is almost entirely interglacial or subglacial. There is no surface drainage except very locally, here the streams are short and soon plunge into a crevasse or moulin. On the Alpine glaciers tributary to the Malaspina there are a few short streams confined to their lower portions, but they soon disappear from view.

He further states that the lakes on the moraine-covered portion of the glacier "last from year to year," but are finally drained, usually through a crevasse or opening of some sort at the bottom, and the basins are left with a deep filling of boulders and stones. They protect the ice beneath from melting and eventually come to stand out on pedestals as a result of the ablation of the surrounding surface (83).

Russell also observes that the three principal streams along the eastern margin of the Malaspina glacier in 1891 issued from beneath the ice as subglacial streams. Each flows for some distance between walls of ice and is actively aggrading its channel. One, the Osar, has a ridge of gravel running parallel with it which was deposited on the ice during a former stage when the water flowed about 100 feet higher. No other instance of esker formation was directly observed (80).

"The formation of osars seems fully explained by the subglacial drainage of the Malaspina ice sheet." Streams flowing into the tunnels on the north side of the glacier are carrying already large quantities of sand, gravel and mud, and on emerging from the eastern and southern sides bring out large quantities of water-worn material. A part of the overload is dropped here. These cones obstruct the mouth of the tunnels and thus slackening the flow of water within the tunnel may lead to deposition. The water is consequently forced to a higher level in the tunnel, eroding the ice roof as it slowly rises and leading to further deposition on the gravel deposit beneath. When the ice melts, the supporting walls being removed, the gravel will slide down to a position of stability giving the arched, anticlinal structure of eskers. The process would go on in a stagnant ice mass till the waters found new channels (80).

Russell notes that in the case of the Muir glacier where debris is abundant and of large size, the channel frequently becomes clogged, and the subglacial waters are forced to find a new outlet. Some subglacial streams have formed re-entrants, others not, the condition of formation seeming to depend on volume and swiftness of stream and on amount and size of debris on the ice (79).

General Conclusion Regarding Origin.

The testimony of existing glaciers, while probably insufficient to warrant a firm and definite conclusion, yet unquestionably points to the subglacial origin for the typical esker and for the vast majority of eskers. A critical study of eskers themselves results in this same conclusion. Objections may be urged against this theory, but they are fewer in number, less vital, and more satisfactorily answered than is the case with any other theory so far formulated. It is significant that those geologists most familiar with existing ice fields, with Pleistocene phenomena and with the particular type of glacial deposits under discussion here, are in accord in the acceptance of the subglacial hypothesis for the origin of the vast majority of eskers. Such men as Chamberlin, Salisbury, Russell, Leverett, Davis, Woodworth, Tarr, Fairchild, Stone and others, all agree that the subglacial hypothesis best explains the facts.

Economic Importance of Eskers.

The sand and gravel these ridges afford are of economic importance and there is scarcely an esker that does not show one or more excavations for these materials. In some cases a large part of the esker has been removed, its materials being utilized for building purposes, road construction, and ballast, manufacture of concrete blocks, filling, etc. From a scientific standpoint this is unfortunate, and yet as a resource their materials should be utilized.

The ridges themselves may be used as roads to cross swampy ground, to afford suitable grade, and to save to the agriculturist arable land by utilizing that least arable. Such roads are level and dry.

Their surfaces are unsuited to agriculture, and are in most cases untilled, usually being forested.

Description of Western New York Eskers.

General statement. The description of the individual eskers that are readily accessible around Rochester follows. In every case the descriptions are in detail and it is hoped that they will serve as a guide for students and others interested in glacial geology who may visit the eskers in the future. The descriptions are followed in each case by a brief summary of the characteristics which tend to throw light upon the origin of the esker in question.

A contour map of each esker studied was made and this accompanies the descriptions. The contour interval was purposely made small, 5 feet, in order to bring out the details of the surface configuration. The linear scale and direction (magnetic) are indicated on each map. A larger scale was used for the width, approximately twice that of the linear scale. This is the first time that eskers have been mapped in so great detail, but it is felt that the results obtained amply repay the greater effort required.

Rush esker. Figure 5, plate XI. On going by train from Rochester to Rochester Junction on the Lehigh Valley railroad, one passes close beside this esker throughout its entire length, it being distinctly visible from the car windows. The esker makes its appearance one and one-half miles south of Henrietta on the west side of the railroad and continues in a more or less interrupted course until its termination is reached where the railroad turns southeast for the straight stretch into Rochester Junction.

The direction of the esker is nearly north and south in conformity with the direction of ice movement in this locality.

It varies in height from 5 to 25 feet, the greater part of its course being below 20 feet in elevation so that its representation on the Rochester quadrangle fails to portray its true linear proportions.

It rises from swampy ground at its origin and pursues a course southward along the swampy forested bottom of a narrow valley that is flanked on either side by drumlins. The northern portion of the esker from its point of origin to the small station called Cedar Swamp is composed of isolated mounds not more than 2 or 3 rods long or more than 10 feet high. From Cedar Swamp southward the ridge is fairly continuous for a distance of about 1¼ miles. There are interruptions in its course, creeks wind across, in places it fades out and disappears, however, the places of discontinuity are few and widely separated. Throughout this distance the crest is comparatively even, interrupted in but few places by low knolls. Its course is of the winding, serpentine character peculiar to eskers.

This part of the esker terminates in a kame area. From these kames a well defined ridge trends southward a short distance and then divides to form a complex of interlacing ridges, with steep slopes and stony surfaces, enclosing numerous kettles. The accompanying figure illustrates these conditions and indicates further that streams have succeeded in crossing this complex in two places. The terminal portion of the esker south of the reticulated complex consists of three distinct ridges, the one toward the west having a large kame extending from its western flank. These three ridges end in a kame topography which ceases abruptly southward at the margin of the deep east-west valley through which the Buffalo branch of the Lehigh Valley railroad passes.

Three-fourths of a mile south of Cedar Swamp there occurs a low but well-defined esker which may be regarded as a tributary. It is on the east side of the railroad and extends at almost right angles to the course of the main esker. It is several rods long but nowhere more than 10 feet in vertical section with uniform gentle slopes. There is no evidence of its continuation west of the railroad track where it might be expected to join the main esker ridge.

An excavation near the southern terminus of the esker reveals something regarding its internal character. Here boulders rounded and of all sizes occur in profusion. The gravel is for the most part of poor quality by reason of the large quantity of coarse materials, that of better grade being located in the center of the pit extending from the base of the excavation to the crest of the esker. On each side of this coarse materials predominate. At least 50 per cent. of the material is Medina, while 15 to 20 per cent. is crystalline. Stratification is not apparent. The base of the pit does not go below the adjoining surface so that it is impossible to tell how deeply the esker characters penetrate.

Origin. There are few features of this esker that shed light upon the manner of origin, the steep slopes and gravelly surfaces are characteristic of practically all eskers, the composition and character of course are likewise typical of the majority of eskers. The long interruptions at the north end of the esker may be due to subsequent erosion or to lack of deposition in the glacial stream. The short tributary is likewise noncommittal as to origin, the absence of till from the esker surface may be due to subsequent erosion or lack of deposition at the time of esker formation, or possibly to other causes. Its trend along the axis of a narrow valley in the direction of ice movement would seem to indicate its formation in a subglacial stream following the lowest part of the valley during or just after the accumulation of the heavy drumlin masses on either side.

Cartersville esker. Figure 6. The best known and one of the most magnificent eskers in Western New York lies nearly opposite Cartersville and north of Bushnells Basin. It has been briefly mentioned by Dr. Dryer (30), and more recently more fully described

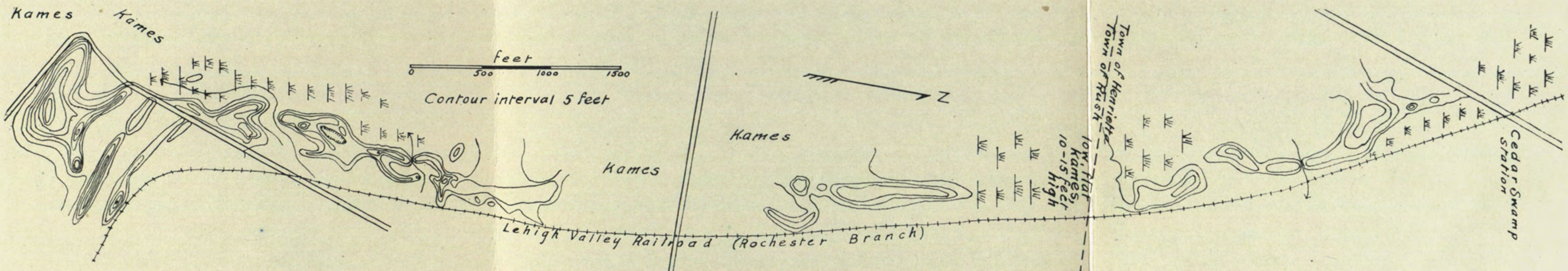

Fig. 5. Rush esker. This esker extends in an interrupted course from Henrietta to within one mile of Rochester Junction, closely paralleling the Lehigh Valley railway on the west.

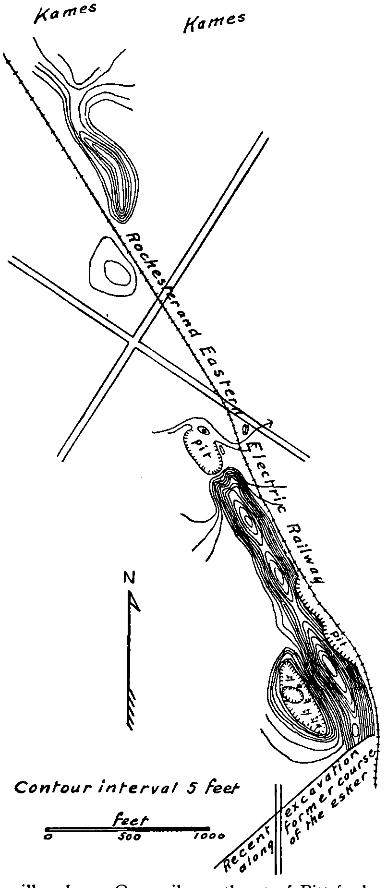

Fig. 6. Cartersville esker. One mile southeast of Pittsford, situated by the side of the Rochester & Eastern Electric Railway, and readily observed from the State road, occurs this magnificent esker.

by Professor Fairchild (34). It is particularly interesting because of its fine development, and the splendid opportunities offered for the study of its structure by reason of the numerous excavations made to obtain gravel. It is readily accessible, the Rochester and Eastern Electric Railway passing along its foot, first on the southwest, then on the northeast side. A regular stop is made within a few rods of its best developed portion, at the Palmyra road.

This esker lies amid the sands of the Irondequoit kame area. The fields in the neighborhood present a sandy surface with moraine developments of the kame type. Through such surroundings the esker trends in a north-northwest and south-southeast direction in a meandering course.

It is only about a half mile in length but it preserves in altitude what it lacks in length, its highest part being nearly 80 feet above the surrounding surface.

The esker first appears on the north as a distinct ridge emerging from a confused piling of moraine drift of a silty nature and extends nearly southeast. Upon entering on the ridge one is appraised immediately of its character; water-worn stones of all sizes marking its crest and its slopes in marked contrast to the neighboring area, where the stones are very small and rarely encountered. The second distinguishing feature is the steep slopes (about 30 degrees), quite different from the gentle slopes of the morainic drift.

For the first 200 feet the surface of the ridge is cultivated but beyond that the slopes are wooded, their steepness and stony character not favoring agriculture. For one-fifth of a mile these characters continue, then this portion of the esker terminates abruptly with a slope as steep as the sides.

Within a few feet of this abrupt termination, it is again resumed in a cultivated field. The gap thus left has been utilized for the line of the Rochester and Eastern railway. The length of this portion is but a few rods and its trend is in a more southerly direction than the segment described above. It has very gentle slopes here and is of low altitude only 10 or 12 feet above its surroundings. At the southern portion of this section of the esker there is a decided increase in width with a shallow depression in its surface, which slopes toward the west, the eastern side of the ridge acting as its rim. This segment terminates just north of the crossing of the two roads (see figure 6).

About 1,000 feet southeast of this portion of the esker it is again resumed, sloping upward from the plain until a height of 50 feet is attained. Here occurs a large gravel pit, the whole end of the esker being cut away, affording a fine exposure of the internal structure. From here the ridge continues southeastward for 1/3 of a mile with a crest showing frequent knolls and saddles and with a width of 15 or 20 feet. The base of the esker here is 100 to 200 feet in width, this width together with the narrow crest and lofty height give steep slopes that become gentler where the knolls occur along the crest line. Sand seems to be common in the saddles, gravel comprises the knolls along this crest line. It is in this segment that the highest knoll occurs, its top rising 80 feet above the surrounding country. Twenty-five rods beyond this knoll the ridge curves abruptly westward. Its course may be traced as far as the Erie Canal 1,000 feet or more to the west, however, this portion of the course has been almost entirely cut away for its gravel. This excavation affords the finest exposure of the internal structure and materials of an esker that is to be found in Western New York. Originally this portion of the ridge was of insignificant development, being but about 15 feet high and 25 to 30 feet wide at the base.

Beyond the canal the continuation of the esker has not been found if it exists. It is possible that it is buried beneath the well-defined kames that are excellently developed here. However, the topography has been much altered due to extensive excavations for the kame sands.

The internal structure of the esker is well displayed by the numerous gravel excavations already mentioned. The gravel pit at the north end of the southern segment presents the structure in a most satisfactory way. It exhibits the rude anticlinal structure so common in eskers. The stratification is indistinct. The materials vary greatly in size, Medina sandstone making up the larger proportion of both the fine and the coarser materials. Perhaps 90 per cent. of the mass is of local origin. Boulders 1 foot in diameter occur distributed through the gravels; boulders larger than this are rare. All of the materials are well rounded by water action.

At the bottom of the pit the gravel is of the finest character of the whole esker. Much of it is but little coarser than coarse sand.

Here the stratification is scarcely discernible, being best brought out by layers of small well rounded pebbles occurring in the fine gravel deposit. The stratification is most irregular, now dipping one way, again in another direction. At each side of the pit the dip is outward at an angle of about 10 degrees. The gravel here extends considerably below the general surface on either side of the esker.

At about 10 feet above the floor of the pit there is a peculiar development decidedly unusual in eskers so far observed. This consists of a layer of almost uniform thickness, of about 3 feet, which extends across the whole esker in a horizontal plane. It is composed almost entirely of small pebbles of uniform size, with few larger stones or boulders. The whole mass is so firmly cemented that it is almost impossible to break it with a sledge. It is necessary to dislodge it with dynamite to get at the gravel underneath. Great masses of this layer have been left strewn about the floor of the pit and in the adjoining field. This cemented layer lies in the plane of the latest and highest Iroquois waters. It is suggested that the calcareous cement was carried down by leaching atmospheric waters and was deposited when the zone of the standing waters was reached. The layer is the most striking feature of the excavation and immediately attracts attention.

At the southeast end of this excavation, of which this peculiar layer forms the floor, is found much the same features. Here the stratification is indistinct and appears frequently to be entirely wanting. The materials are unassorted, the coarser being mingled in profusion with the finer. This is especially true near the extreme top of the ridge. Here coarse boulders, 8 to 10 inches in diameter, occur in profusion.

On either flank of the ridge, as revealed in this excavation, a layer of fine sand occurs, 4 to 8 feet in thickness, extending from a line 15 feet from the crest half way down the slopes. This probably represents wind blown accumulations subsequent to the formation of the esker.

Southeast of this extensive excavation along the railway track there is another gravel pit which affords a good quality of gravel of uniform size. The exposure exhibits distinct stratification, the strata dipping outward.

As already indicated the finest exposure is found at the southern end of the esker. Here the whole ridge has been practically cut away for more than 1,000 feet. At the east end of the excavation the material is coarse at the top grading into fine gravel below. The bedding is horizontal. Southwest 60 feet from here a layer of sand 6 feet thick occurs upon the remnant of the western flang of the esker, which probably represents sand blown upon the esker subsequent to its formation. Four hundred feet farther southwest this sand layer has disappeared entirely, the surface layers being coarse gravel and rounded boulders, with finer gravel and some coarse sand below, cross-bedding being very characteristic here. Southwest of the north and south road the remnant of the esker remaining is composed of coarse gravel chiefly. Sand occurs here again on the surface of the slopes, and cross-bedding is excellently exhibited. A study of the material throughout this whole excavation reveals the fact that it is largely local in origin.

It seems probable from recent study that the esker described above represents only a portion of a very much longer esker system. Chadwick in a recent paper, "Lake Deposits and Evolution of the Lower Irondequoit Valley," describes a gravel ridge lying in the Irondequoit valley that may well be a part of this esker. This ridge divides the valley into two parts and extends southward to East Rochester where extensive sand plains occur, probably representing an esker fan. Three miles southeast of this fan lies the esker that is described in this paper. Two or three miles beyond Bushnells Basin southeast of Cartersville occurs another typical esker fan which is probably associated with this esker system. The continuation of the portion of the esker studied to this outwash plain has not been traced as yet. It is further possible that this esker system may continue north of Irondequoit Bay and lie concealed beneath the waters of Lake Ontario. At any rate if all these features are to be considered as a single esker system, which seems to be the correct interpretation, then the Cartersville esker is the longest esker system in Western New York.

Origin. Some features exhibited by this esker throw light upon its origin. The depression of the esker gravels below the general surface on either hand, the preponderance of local material, and the depression in the middle segment signifying the weight of an ice arch upon its surface, all point to the subglacial origin of the ridge. Likewise the kettles that parallel its course are evidence of the weight of ice masses bordering the esker (122). One gap in the course of the esker has been due to stream erosion and is now occupied by a vigorous stream. The other gaps may be due to stream erosion but more probably they represent lack of deposition in the subglacial tunnel.

Palmyra eskers. Figures 7-9, plate XII. Near Palmyra occur several eskers lying in the valleys between the drumlins. Three of these gravel ridges may be seen in going from Palmyra to Marion, closely paralleling on the west the road that connects the two villages; the fourth lies one and one-half miles northwest of Marion. All are of sufficient height to be indicated on the Palmyra topographic quadrangle. In length the ridges are short, each being from one-half to three-fourths of a mile long. Their north-south alignment would seem to indicate that they represent the activity of a single glacial stream flowing southward in a course parallel to the drumlins and to the direction of ice movement. In figures 7-9, plate XII, the ridges are designated A, B, C and D. A being the one nearest Palmyra, D being the one farthest north, lying northwest of Marion. A distance of about six miles separates the ridge near Palmyra from the one near Marion.

Ridge A. This esker, or esker segment, is of average height, being about 25 or 30 feet for the greater part of its course. It has a rather broad crest with relatively gentle slopes, which locally are exceedingly stony and elsewhere quite free from stones. Its crest supports no knolls, being thrown into a series of gentle grades. Its course is not characterized by meanders which were found to be a pronounced feature in a number of eskers studied that are shorter than this. Near the northern portion of the esker several gaps occur, one of which is traversed by a stream, the largest gap being occupied by a number of low kames. In the course of this esker excavations have been made in one place only. But little was gained in the examination of this excavation. It had not been worked for a long time, and the action of the weather had obscured its features. In the accumulated debris at this point coarser stones appeared to be lacking entirely.

The greater portion of this esker is under cultivation, in fact its surface is better suited to cultivation than the adjoining wet swampy ground, with its small ponds containing stagnant water. The ridge terminates northward in a comparatively flat swampy area, southward it gradually fades out and blends with the ground moraine.

East of the southern half of the esker and between it and the highway occurs a series of knolls resembling kames. The topographic sheet indicates several of them. They are joined by low intervening ridges except in one or two instances where deposition between the knolls apparently was lacking. The northernmost of these knobs is separated from the rest by a swamp and is attached to the eastern slope of the esker. Its surface is under cultivation as in the case of the knolls, and it is not excessively stony. This series of knolls may be regarded as a parallel esker or as a series of kames originating as a result of the deposition of detritus (formed by a superficial or subglacial stream) at the edge of the ice or in a reentrance of the ice, the localization of accumulation being due to the wavering retreat of the ice.

Ridge B. About one mile north of Ridge A occurs another esker segment closely paralleling the base of a lofty drumlin, to which it is joined in two places. For the most part it is low, being less than 20 feet high. Several gaps occur in its course, one or two of which are probably due to stream erosion. Near the northern portion of the ridge a shallow kettle occurs in its highest part; here the ridge is about 50 feet wide across its crest.

The southern portion of this ridge exhibits a notable tendency to meander. It terminates southward in a kame area, the surface of which is very stony. Some of these stones may have been derived from the erosion of the esker itself.

The northern portion of Ridge B is its highest part. Here a detached segment 500 feet long and 25 to 30 feet high rests upon an elevated surface which is apparently of till, possibly being a broad flat drumlin.

This segment is densely wooded, its crest is unusually level and rather broad, its termination on the south is very abrupt and its initiation northward is of equal abruptness. It is succeeded northward by a kame area that is bounded on the east by a steep slope about 20 feet high.

Ridge B is bordered on the east for a considerable part of its course by a long parallel ridge of about 25 feet in height.

Ridge C. One-fourth to one-half of a mile north of Ridge B occurs the third part of the esker. It proceeds northward from the kame area that terminates Ridge B on the north, the steep eastern edge of the kame area forming the eastern side of Ridge C.

This portion of the esker system trends northward for one-fourth of a mile or more as a well-defined ridge 15 to 25 feet high with steep slopes and a meandering course through swampy ground. Knolls along its crest are common. The excavations for gravel here show material of uniform grade and medium size. Sand is lacking, and few large boulders occur.

In the northern part of the esker two shallow kettles are depressed into the ridge. Where these kettles occur the ridge exhibits a tendency to become low and broad, while on either side the esker rises abruptly to the normal height. The slopes leading into the kettles and outward from their rims are very gentle.

Northward the esker terminates rather abruptly in a swamp.

Ridge D. This northermost segment of the esker system lies between two high drumlins bordered by swampy land with small ponds on either side. It is short, only about one-quarter of a mile long, with a meandering course throughout its entire length. Nowhere is its height greater than 30 feet.

The southern portion of the ridge is of low altitude with uneven crest, the northern part reaches a height of nearly 30 feet and has a remarkably even level crest with steep and stony slopes that are under cultivation. Northward this level-crested ridge terminates abruptly in a flat field, southward the esker blends with the high drumlin that parallels its course on the west.

Where the stream cuts through the esker there is an old excavation which reveals a rude indistinct stratification. At least three-fourths of the materials are from local formations. There is some sand here on the eastern side of the excavation in which are embedded numerous rounded stones. On the opposite side of the excavation occurs sand near the surface, with numerous embedded rounded stones.

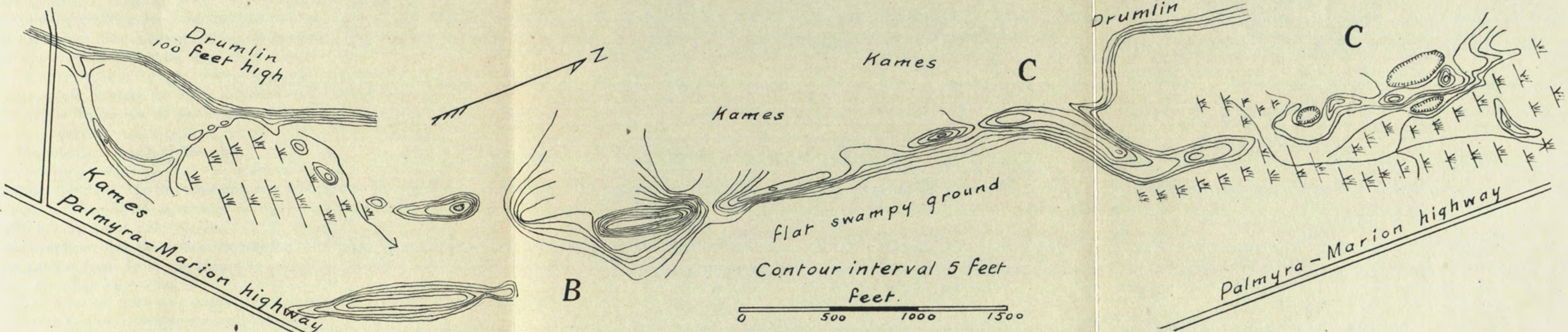

Fig. 8. Palmyra esker, Ridges B and C. This portion of the Palmyra esker lies one mile north of the northern termination of Ridge A.

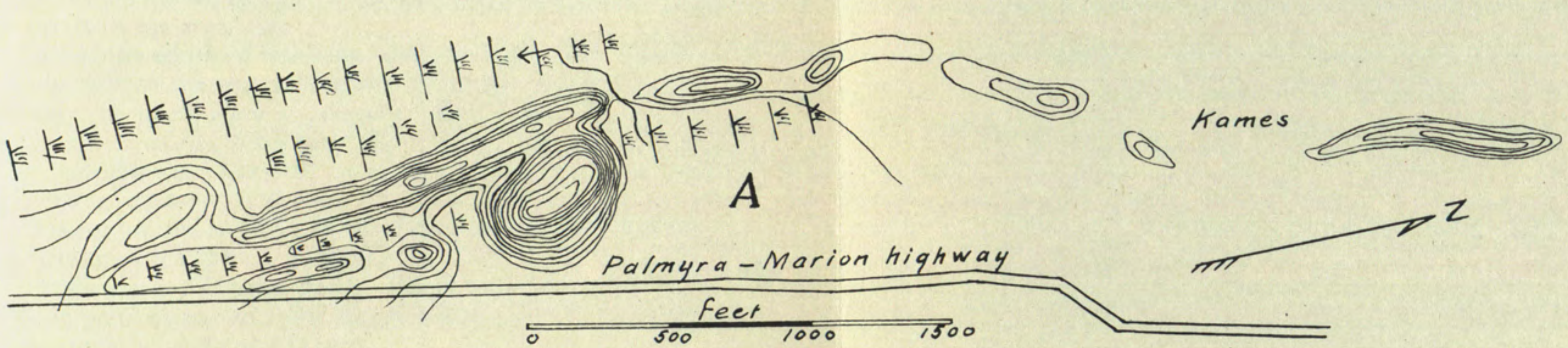

Fig. 7. Palmyra esker, Ridge A. This esker lies one mile north of Palmyra paralleling the Palmyra-Marion highway on the west.

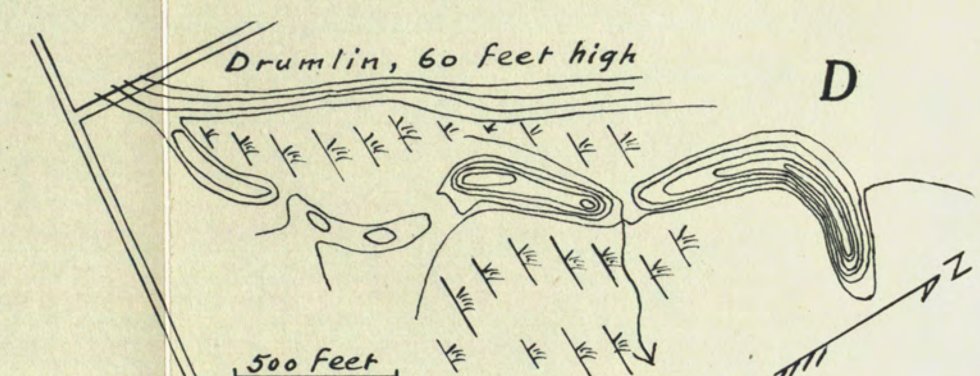

Fig. 9. Palmyra esker, Ridge D. This short segment of the Palmyra esker occurs about one and one-half miles northwest of Marion.

Origin. There was little developed in the study of these Palmyra esker segments that throws light on the precise manner of origin. If the broad elevation on which the northern and highest part of Ridge B is located is to be interpreted as till and possibly as a drumlin then the esker was deposited after the deposition of this till. However, that does not necessarily mean that the esker stream was superglacial even in this part of its course.

The presence of several kettles depressed into the crest of the eskers would indicate ice block inclusion with subsequent melting leaving the depression, or possibly the places of rest of the sagging ice arch over the broad subglacial tunnel, either interpretation favoring the subglacial origin of the esker.

Probably each ridge was built when the ice front stood near its southern terminus. In each case this was followed by ice recession and the building of the next ridge northward followed. The presence of kame areas near the ends of the individual ridges would seem to indicate this, the kames representing the outwash beyond the stagnant ice front from the stream in which the individual esker ridges were being deposited.

The trend of this esker system along the axis of a valley reinforces the idea of its origin in a subglacial stream.

Eskers of the Mendon kame area. Figures 10-11, plates XIII, XIV. The Mendon kame area lies about 12 miles south of Rochester. It has been described by Prof. Fairchild (34), who mentions briefly the eskers of the area.

All of the eskers of this kame area are excellently developed, in fact the one on the east side of the area east of Mendon pond is probably the finest esker in Western New York. The Rochester topographic quadrangle indicates the eskers of this region, although very inadequately. They all trend north and south and pursue meandering courses. They are of historic interest because their crests were utilized as trails by the Indians in passing northward to the vicinity of the present village of Pittsford.

Esker west of Mendon pond. Figure 10, plate XIII. West of Mendon pond occurs an esker that is nearly two miles long and in places attains a height of 100 feet.

On the north it rises from a low swampy tract and passes westward for about 600 feet with a height of less than 5 feet. Turning toward the southwest it broadens and gradually attains a height of 25 feet and then rapidly decreases in height until it is nearly lost again in the swampy ground. Pursuing its meandering course farther southwestward it gradually broadens and rises to a height of 45 feet, then drops off slightly with hummocky, narrow, meandering crest, to be continued onward in an abrupt rise of more than 40 feet followed by a level stretch and then a further gradual rise of 50 feet to a high elevation that rises about 125 feet above the swamp on either side of the esker. This elevation has a very stony surface, all of the stones being small, and well rounded. The slope toward the west from this elevation is gradual into rolling farm land. The elevation itself is under cultivation, although the esker from the point of origin to this elevation is wooded and bordered by swamps on either hand.

Southward from this high elevation the esker is very broad and indefinite. On the west is located a large deep kettle, on the east a steep slope leads from the esker crest to the swamp.

After crossing the road the esker rapidly narrows southwestward to its typical form, with hummocky crest, meandering course, and steep sides 60 to 75 feet high. A long deep kettle borders the esker on the west throughout this portion of its course.

At the second road crossing the esker turns abruptly southward making a right angle with its former course. For the next half mile its course is toward the southeast with narrow hummocky crest, meandering course and sides as steep as the materials will lie. All of this southern portion is wooded and bordered by swamps on both sides. About 1,000 feet south of the road just mentioned a ridge extends eastward from the esker that may possibly be interpreted as a tributary. It has a broad crest, with slopes more gentle than those of the main esker, and is under cultivation. Its surface is less stony than the surface of the main esker and apparently is composed largely of till.

South of this tributary 600 feet, the steep east slope of the esker is succeeded by a gentle slope that passes down to the edge of Mendon pond, the base of this portion of the esker being 500 to 600 feet in width.

One thousand feet south of this broad place occurs a conical elevation 100 feet high, one of the most conspicuous elevations of

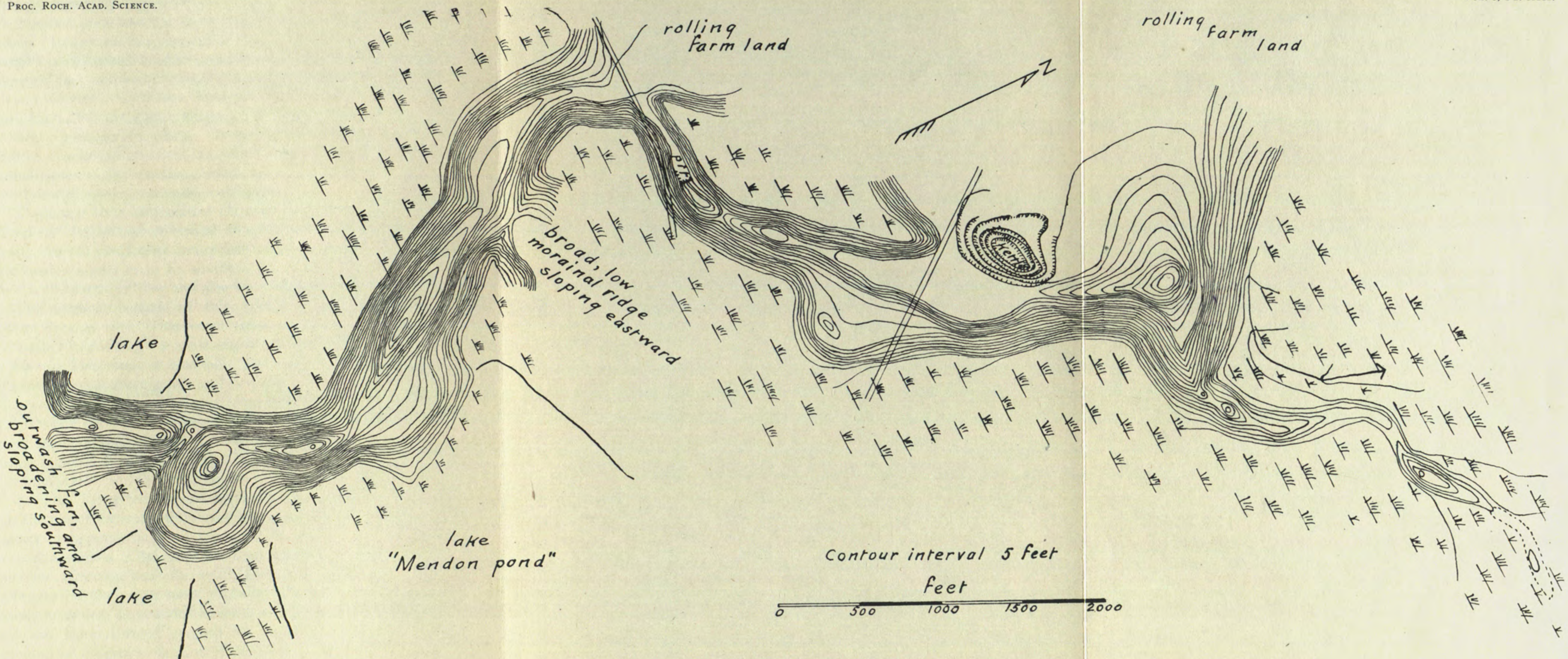

Fig. 10. Esker west of Mendon Pond in the Mendon kame area.

the Mendon kame area. It is east of the main course of the esker although intimately connected with the esker itself and overlooks both Mendon pond and the small pond to the south, lying between the two. Its surface is composed of sand and fine gravel. Near its summit a partly buried boulder occurs with an edge exposed that will measure 8 feet, and another edge that will measure 6 feet in length. It is not wooded. Southwest from this high mound the esker continues for 1,000 feet with a height of 75 feet or more, and with a hummocky meandering course. It then abruptly broadens into an excellent example of an esker fan, which slopes with uneven surface gradually toward the southeast, south and west, and is covered with small rounded stones and under cultivation.

There was little information obtained as to the composition of this esker. Its surface is typical of eskers in being mantled with gravel. An old excavation occurs north of the road that crosses the esker nearly a mile from its southern termination, which discloses gravel both coarse and fine and also some sand on its north side.

The northern portion of this esker is paralleled by another ridge on its south side. This second ridge is of about the same height as the esker itself, with the same degree of slope on the flank facing the esker. This slope is wooded. The opposite side toward the southeast is much more gentle and is under cultivation. This ridge is separated by a narrow swamp from the esker described above. Its northward termination is more abrupt and its northern portion is higher than the esker mapped. Otherwise it possesses the same general features as the one studied in detail. These two ridges are to be interpreted probably as a double or reticulated esker.

Origin. Little can be said regarding the origin of this esker. Near the top of the excavation mentioned above a large boulder was observed lying partly buried in the sand. It could hardly have gotten into such a position if the esker had been superglacial in origin. The prominent elevation near the south end of the esker was formed at the edge of the ice or more probably in a slight re-entrance, or possibly in an area surrounded by ice at a time when the esker northward was being formed beneath the ice and probably after the formation of the greater portion of the esker to the south of it. The eminence near the north end of the esker was formed in a similar manner, but after the esker to the south of it had been built and uncovered by the melting of the ice. During its formation the portion of the esker to the northeast of it was being formed beneath the ice. The elevation itself and the gentle slope westward from it represent outwash at the time this northern portion of the esker was forming, and the kettle to the south probably represents ice block inclusion, the block remaining while the elevation itself was being formed.

Esker east of Mendon pond. Figure 11, plate XIV. On the east side of Mendon pond is found the finest esker of the Mendon kame area. In many respects it is the finest example of this type of glacial development that was studied. For a distance of 2½ miles it continues its course through the eastern half of the kame area bordered by kames on either hand. It meanders freely, possesses an uneven hummocky crestline, and on either side at its base occurs a succession of kettles formed by ridges passing off from the side of the esker and connecting with the adjacent kames. These kettles may contain water forming small ponds and swamps. In altitude it equals or surpasses the other eskers studied, in places rising 100 to 125 feet above its base, with very steep slopes and narrow crest.

The esker begins on the north in one of the highest elevations in Monroe county. This elevation is well shown on the Rochester topographic sheet lying about 1 mile northeast of Mendon pond, with an altitude of 850 feet above sea level. The accompanying figure exhibits only the higher portion of this eminence from the upper surface of which there is a gentle rolling slope outward in all directions except where the esker joins on the south.

The surface of this elevation is thickly mantled with waterworn stones of all sizes and apparently the greater part of the whole hill is water lain material. Southward from this elevation the esker pursues its meandering course toward the southwest with hummocky crest and steep lateral slopes. About one mile south the ridge terminates in a high knoll bordered by a long deep kettle on the east side. Southwest of this knoll and joined to it occurs another higher knob that forms one of the most conspicuous elevations along the whole esker course. A short distance south of this high elevation the esker turns abruptly toward the west and continues nearly a half mile in that direction. The best view of the esker from the Pitts-

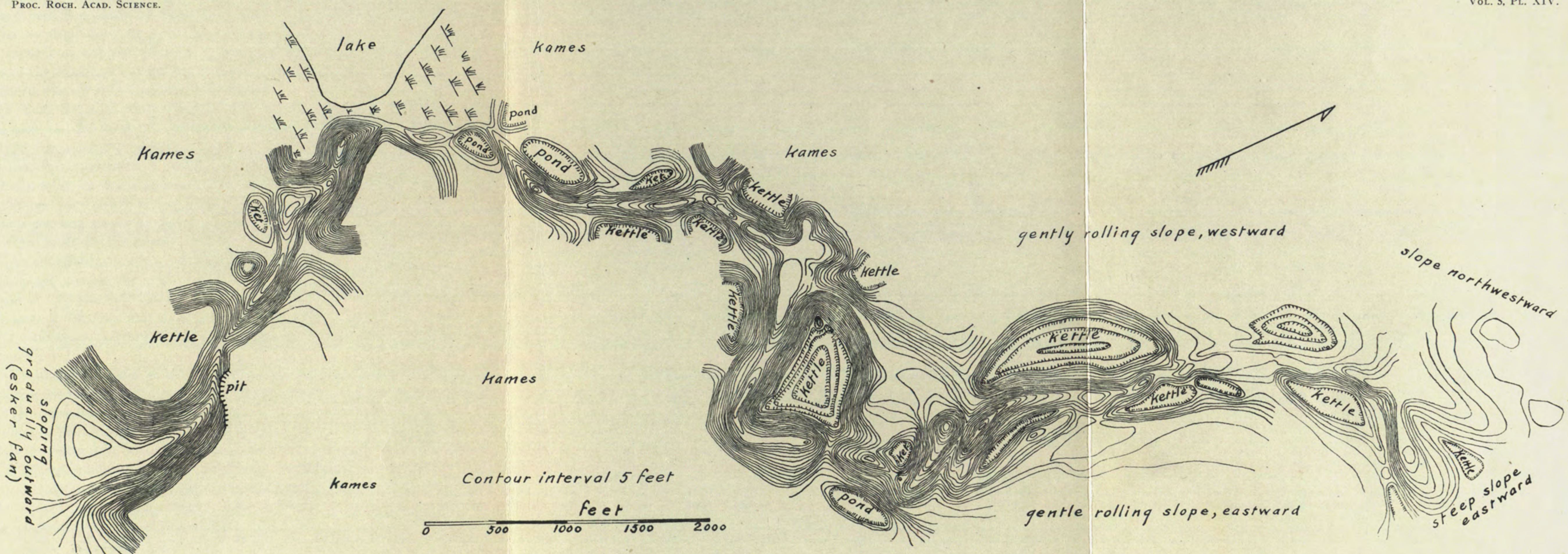

Fig. 11. Esker east of Mendon Pond in the Mendon kame area.

ford road may be obtained at the point where it makes this turn, its base being but about 250 feet distant from the road.

Swinging toward the southwest again from its westerly course the esker pursues its meandering course for another half mile, its narrow, hummocky crest, steep slopes, with numerous kettles on either flank, being its distinguishing features. In one portion of its course here it appears as if three or four kames had been tied together by short low ridges to form a part of the main ridge. From the summit of any one of these a fine view may be had of a large part of the esker and of practically the whole kame area. Near the southern end of this southwesterly trending part of the esker the ridge itself becomes inconspicuous and is bordered by a beautiful little lake on the west. Turning toward the southeast it continues onward for more than one-half a mile, preserving the same characters that distinguish the northern part of its course. As is the case with the esker on the west side of the Mendon kame area this esker terminates southward in an excellently developed esker fan that spreads out and slopes southward gently with a rolling surface well sprinkled with small rounded stones.

An interesting feature in connection with this esker is that it is in no place completely discontinuous throughout its whole course. In one or two places it is only 5 feet above the adjacent swamp, yet even here it does not lose its character as a distinct ridge.

Its northern portion is nearly all forested, its southern portion is entirely so.

Excavations occur in two places in the course of the esker. Both are small and have not been worked recently. One about a mile from the north end exhibits coarse gravel and many good sized boulders. The stratification is poorly preserved. Near the south end of the esker on its east slope occurs an old gravel pit. The material is considerably finer than that found in the excavation near the north end of the esker. In both excavations the material is almost entirely local in character having been derived from formations between the north end of the esker and Lake Ontario.

Origin. Very few features observed in the study of this esker throw light upon the way in which it originated. That part of its course which appeared to be a succession of kames tied to each other by connecting ridges may represent formation at the ice front or within a re-entrance into the ice, the point where the kame occurs representing a halt in the withdrawal of the ice front, the connecting ridge representing a time of slow, steady retreat of the ice edge. The high knob described above that is located about a mile from the north end of the esker was probably formed at the ice edge, after the formation and uncovering of the esker south of it and while the portion of the esker to the north of it was being built beneath the ice. The numerous kettles that parallel the course of the esker may represent the melting out of ice blocks that lingered adjacent to the sides of the esker, or unequal deposition at the ice front.

The high elevation occurring at the north end of the esker probably represents deposition at the ice edge or within a broad re-entrance back into the ice by a powerful stream pouring from the ice and carrying a large quantity of material with it. It was this same stream that built the esker extending southward from the elevation, the one just described. The formation of the elevation itself was not begun until after the building of the esker had been completed. Why there should not be an esker continuing northward from this elevation and built beneath the ice at the time the elevation was forming is an interesting question. Apparently all the material was carried out and dropped to make up the large mass of the elevation itself.

The local character of the materials of these Mendon eskers constitute a strong argument in favor of the subglacial hypothesis. It would seem impossible for this material to have gotten up on top of the ice in such a short distance especially when this ice was advancing over a level plain.

Further the occurrence of the high knolls in the course of these eskers is antagonistic to the idea of esker origin at the edge of the ice or in re-entrants from the edge; the knolls themselves represent the deposits forming in these situations, while the eskers stretching northward from them were being deposited in the subglacial streams at the same time the materials were being contributed by these streams to form the knolls. The latter doubtlessly clogged the exits of the tunnels leading to erosion of the roof of the tunnel and deposition in the slacker water in the lower part of the stream. The resulting strong development of the esker ridges north of the knolls and the upward trend of their crests toward these knolls are in line with this idea.

Esker south of Mendon kame area. A third esker occurs beyond the southern extremity of the Mendon kame area, shown on the Honeoye topographic quadrangle.. It has been described by Professor Fairchild (34). He says: "One mile south of the kame area occurs a singular group of knolls that must be regarded as an esker. This lies one-half mile south of Mud pond and three-fourths of a mile west of Mendon center. The north end of the esker is cut by the east and west highway. This esker consists of four connected knolls, in a north and south line, making altogether a length of about one-eighth of a mile. The local name of the knolls is the 'Dumpling Hills.' The summit and slopes of the ridge and the road cutting show only a fine, stiff or silty sand, similar to much of the surface of the region southward. A few stones were observed in the sand. The esker is thirty to fifty feet high but surmounting a ridge probably drumloid, it is conspicuous over a considerable area. Its altitude is 762 feet (aneroid). The sides of the esker are very steep and ridges of sand stretch away from it at right angles" (34).

Origin. These knolls probably represent deposition at the edge of the ice or within a re-entrant by a heavily laden stream flowing from the ice. They may best be interpreted as a series of kames that have been connected by deposition, the individual kames representing successive halts in the ice retreat with resulting localization of deposition, the connecting ridges indicating slow continuous retreat of the ice front between the periods of halting.

Le Roy esker. Figure 12. The LeRoy esker lies in Genesee County, situated partly in the town of LeRoy and partly in the town of Stafford. It is about one-half mile north of the main or State road that connects the village of LeRoy with the city of Batavia, and is crossed by the north and south highway forming the boundary between the two towns mentioned. It parallels in a general way both the New York Central Railroad (Batavia and Canandaigua Branch) and the Erie (Attica Branch), and lies about half way between the two. The northeastern part of the Batavia topographic

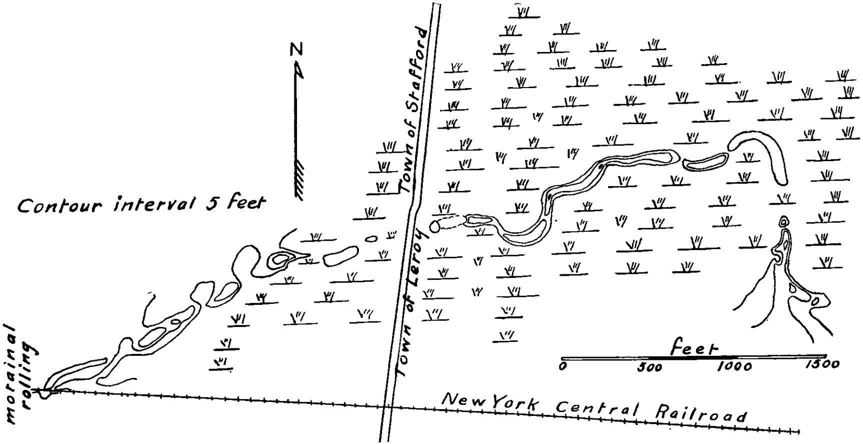

Fig. 12. Leroy esker. This esker crosses the township line between Stafford and Leroy, 2 miles west of the village of Leroy.

quadrangle indicates the character of the general area, the esker itself being too inferior to find expression on the map. This esker has already been described (20).

It is not a large type of its class, being less than a mile long and rarely reaching a height of 15 feet. The most striking feature observed in its study was its direction, this being not far from east to west, or at nearly right angles to the direction of ice movement in this region. However the striae locally do not indicate such a disparity between the direction of the ice movement and the trend of the esker. Apparently at least during the closing stages of the ice invasion the local ice movement was toward the southwest.

The esker begins on the east in a cultivated field with characteristic rolling morainal topography. The distinctly ridge form is scarcely assumed before it is abruptly terminated and succeeded by swampy ground, and then 500 feet farther north it picks up as abruptly and continues onward curving rather sharply toward the westward. Two short breaks, each but a few feet wide, follow in rapid succession and then its course is continuous, till the north-south highway is reached. West of the highway it is much more discontinuous and segmented (see figure) until finally it blends with the heavy morainal features just beyond the railroad.

It traverses swampy ground throughout its entire course, east of the road the adjacent swamp being wooded, west of the road it being sufficiently dry to be under cultivation. It is quite possible that the breaks are due to stream erosion, although the sluggishness of the illy-defined drainage lines through the swamp would seem to antagonize that idea.

Several excavations have been made at various places in the esker, though none are recent. Just east of the road such an excavation occurs and also one about 600 feet west of the road, and near the eastern termination of the ridge three excavations are found which exhibit the materials and structure to best advantage. Here the material is very fine for the most part, although little sand is present, with bedding indistinct. Just east of the north-south road the excavation is old and so thoroughly washed down as to be of little value. However, there is some sand here, and the fact that the excavation was continued below the level of the surrounding surface seems to indicate that the stratified materials continue below the general till surface. This excavation is now occupied in its deeper part by a pond. The excavation west of the road exhibits fine gravel only.

The slopes of the esker are gentle and the gravelly surface has developed sufficient soil to support vegetation. Its base rarely reaches a width of 50 feet.

About one-half mile west of the termination of the esker and just north of the railroad a ridge starts abruptly from the level surface and rapidly gains in height until an altitude of 50 feet is attained. This ridge continues northwestward for more than 1,000 feet and then turns northward and ceases rather abruptly. Its surface is of gravel with an excavation near its summit in fine gravel, these features together with its steep sides and change in direction give this ridge a decidedly esker appearance.

Northeastward this ridge is succeeded within a few hundred feet by another ridge that abruptly rises to a height equal to that of the first and as abruptly declines nearly to the level of the adjacent topography where it is succeeded by a low broad ridge. This last ridge is nowhere more than 20 or 30 feet above the adjacent surface, and continues for a half mile or more toward the northeast. Possibly these developments may be interpreted as the main esker, the one mapped and described above being considered a small tributary to it. This may help to explain the unusual direction of the latter. Further study will be necessary to bring out the relationships and to determine if the high disconnected ridges are really a part of an esker system. The topographic map very imperfectly exhibits these features.

Origin. The manner of origin of the ridge shown on the accompanying map (Fig. 12) is not demonstrated by the field study. The fact that the gravels continue below the general surrounding surface where one of the excavations occurs (see above) would seem to indicate that the esker materials were deposited not later than the deposition of the till which would favor the subglacial method of origin.

Eagle Harbor esker. Figures 13-14, plates XV, XVI. Three miles south of Eagle Harbor, a small station on the Falls branch of the New York Central railroad, occurs an esker several miles in

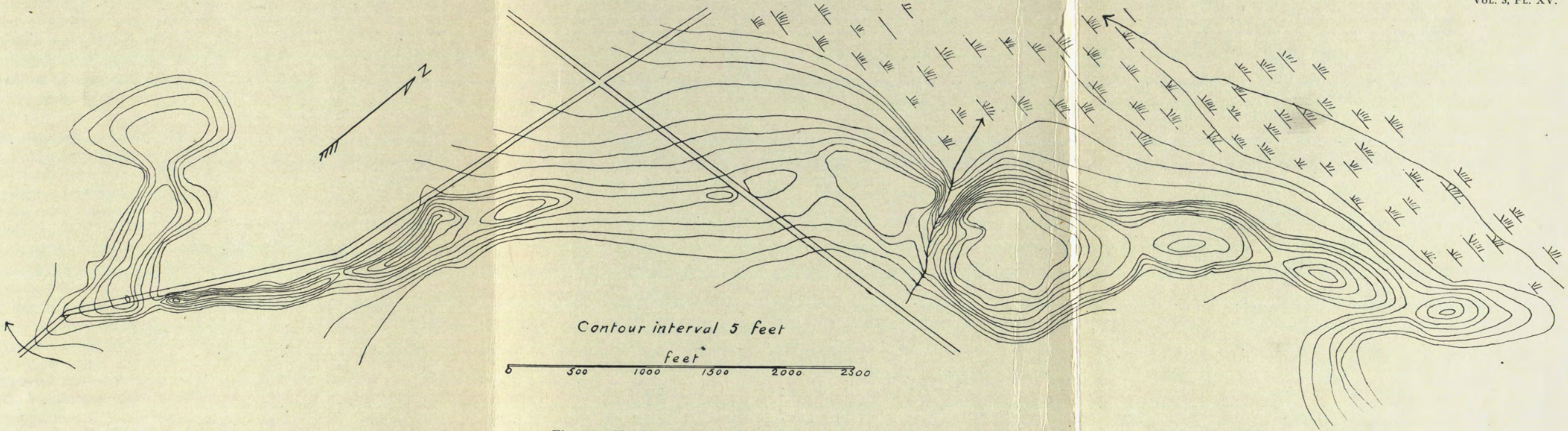

Fig. 13. Northern half of the Eagle Harbor esker. This esker originates about 3 miles south of Eagle Harbor and continues in an almost uninterrupted course for 4 miles southward nearly to West Barre. This map joins Figure 14.

length. Its northern portion is indicated on the Albion topographic quadrangle, the remaining part lying in the territory covered by the Medina quadrangle. The esker is associated with the Barre moraine, its southern end being about 1 mile north of the main east-west ridge of the moraine. The country through this section is rolling. In the midst of this rolling plain, occupying a rather low swampy stretch, the esker pursues its course. Its trend is nearly north and south, although both its northern and southern extremities depart appreciably from this general direction. Its height is nowhere excessive, for the greater part of its course only 15 to 30 feet, but its length is notable, being about four miles, with but one or two short gaps in this entire distance.

Leverett has mapped and described briefly this esker (62), the northern part of the ridge shown in the accompanying figure (Fig. 13), he apparently regards as moraine, and has so mapped it (62, plate III).

On the north the esker sets in as a very broad low ridge, the width of the base being several times the height. Arising from swampy land it continues southwestward for more than a mile, its gentle slopes and broad crest not revealing its true character to the casual observer. In places in this portion of the course the esker may broaden until its base is nearly one-quarter of a mile in width. This part of the esker lies banked against the Niagara escarpment, the trend of which has probably influenced its direction.

One or two exposures occur here. Very little sand is present, chiefly fine to coarse gravel, Medina sandstone pebbles comprising by far the greater part of the material.

The surface of the esker everywhere in this northern portion is exceedingly stony, the stones being small, about the coarseness of fine gravel, and mantling the surface everywhere. Notwithstanding this feature the esker is under cultivation and its slopes are fairly productive.

Near the southern terminus of this northern portion a distinct ridge joins it from the northwest. This is probably to be interpreted as a tributary to the main ridge. It is a broad, level-topped, gentle-sided elongation, about 700 to 800 feet in length and terminates northwestward in a broad flat-topped elevation with very gentle slopes.

From the point where this tributary joins the main ridge a road follows the broad crest of the esker until the latter ceases at a stream crossing 600 feet or more beyond this point of junction. The portion from this interruption to the southern terminus of the esker may be regarded as the southern part of the esker. (Figure 14, plate XVI). This southern portion possesses typical esker characters, much more so than the northern portion. Here the esker has a narrow, hummocky crest, steep sides, as steep as the materials will lie, and a meandering course.

In places the esker reaches a height of 50 to 60 feet, however, for the greater part of its course it is but 20 to 30 feet in height. It is continuous, but one short gap occurring and that near its northern terminus. Swamps occur on both sides throughout its whole extent, the ground being much too wet for cultivation; kames rise from these swampy tracts in several places.

This portion of the esker has a short low eastern prolongation just south of the east-west road. It continues eastward for 500 or 600 feet before gradually disappearing. It is very possibly a small tributary.

This part of the esker is further characterized by a very broad place in its course. It is flat-topped, several hundred feet across and rises 50 to 60 feet above the base of the esker. The sides have gentle slopes which are scarred by numerous gullies. In the southeast section of this elevated level space occur three large blocks of weathered Medina, the largest of which will measure 10 or 12 feet on its edges, the other two being but little smaller. Other large boulders are lacking on the surface, but gravel occurs everywhere.

After pursuing a meandering course for nearly a quarter of a mile beyond this broad portion the esker terminates abruptly in a level-topped loaf-shaped hill whose surface is covered by stones of all sizes. All are well-rounded, with crystalline material forming a conspicuous but minor portion, the greater part being Medina. Its sides are as steep as those of the esker ridge proper except the side on the west which slopes more gently toward the road.

East of the terminal loaf-shaped hill occurs another larger hill with gentle slopes. Its slopes are comparatively free from stones and apparently are of till. It is probably morainal in origin.

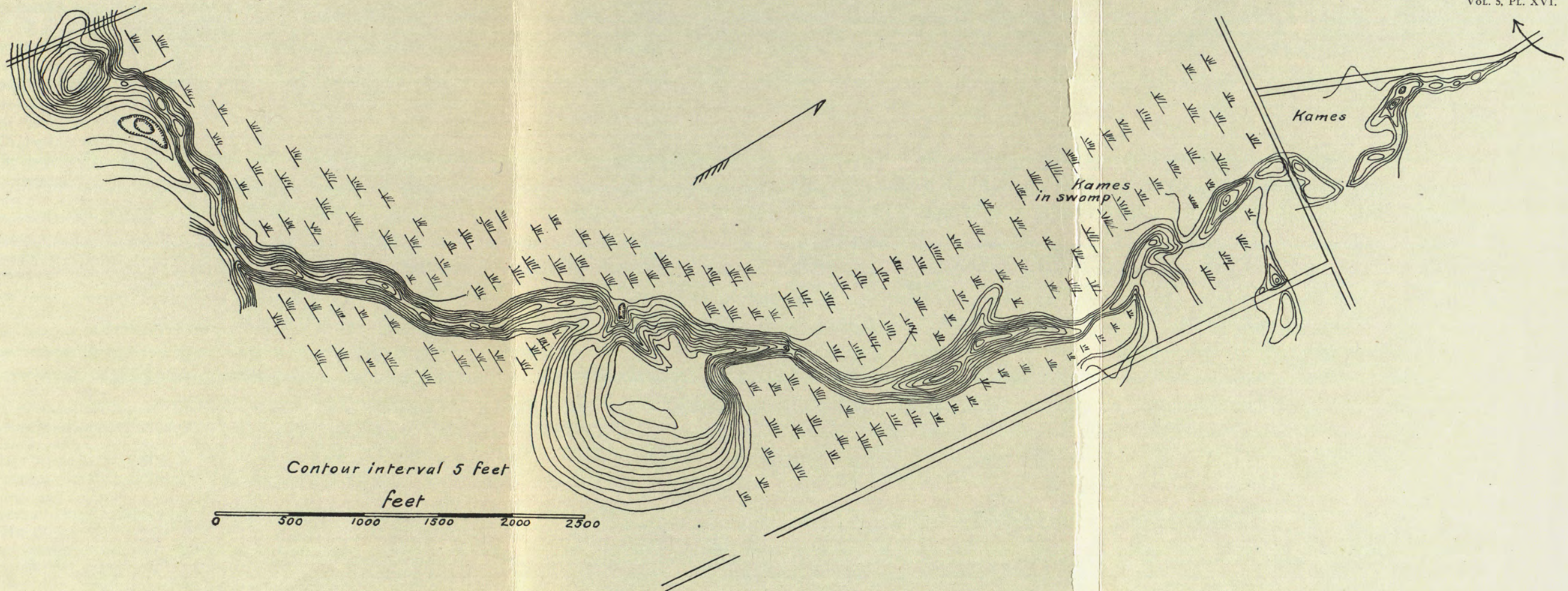

Fig. 14. Southern half of the Eagle Harbor esker. This map joins Figure 13.

Leverett has mapped two eskers as terminating in this loaf-shaped hill (62, plate III). The second one he indicates as paralleling on the west the one figured and described in this paper. Elevated ground occurs beyond the swamp that borders this esker on the west but its breadth and its other characters are not at all like those of eskers. It is half a mile wide, irregular in form, 20 to 60 feet above the swampy ground on the east and extensively dissected by drainage lines. Everywhere it is under cultivation. Its surface is rolling and not excessively stony, and is largely composed of till. It is undoubtedly to be regarded as morainic, and a northward continuation of the Barre moraine.

Origin. Several features in connection with this esker throw light upon its origin. Its position north of the Barre moraine would seem to suggest that it was forming beneath the ice while the Barre moraine was being built at the ice front. The large blocks of Medina on the surface of the wide portion of the esker near its southern terminus could not have gotten there if the esker was being built in a superglacial stream, and could with difficulty be accounted for in that position, if the esker was being built in a re-entrance back from the ice front. The influence of the Lockport escarpment on the trend of the northern portion of the esker shows that the esker stream must have been subglacial in this portion of its course at least to have been affected by this feature whose relief was certainly not great enough to extend through the ice and affect a superglacial stream. The swampy strips on either side of the esker bordered by higher ground farther away indicate the pressure of the ice blocks immediately adjacent to the subglacial stream on either side.

Holley esker. Figure 15. This esker is situated between Holley and Clarendon. It originates about a mile southwest of Holley and continues southwestward to within one-half mile of Clarendon. The improved highway that connects the two villages passes along the crest of the esker over the northern part of its course.

The ridge is over a mile long, it is very broad and near its southern extremity it reaches its greatest height, being 80 feet above the marshy flat ground that borders the whole length of the esker on either side. From the summit of this knoll, "Indian Hill", an excellent view is to be had of the entire surrounding country and particularly over Clarendon and to the southward.

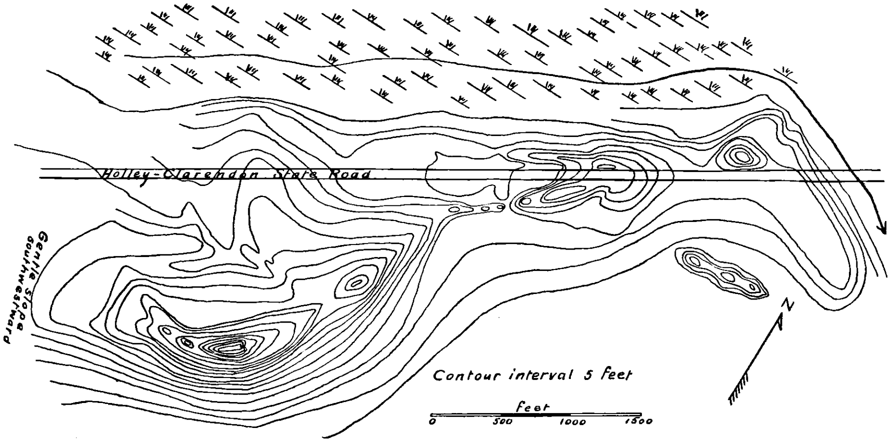

Fig. 15. Holley esker. This esker is situated between the villages of Holley and Clarendon and is traversed for the larger part of its course by the Holley-Clarendon improved highway.

It is associated with the Albion moraine, lying to the north of it, the moraine making a jog southward from its regular trend and passing through Clarendon beyond the southend of the esker (62). The Albion topographic map exhibits the esker and associated features clearly.

The esker ridge rises rather abruptly at its north end, the country north of its place of origin being uneven with gravelly knolls abounding. In fact these knolls parallel its course on either side and are especially numerous beyond its southern termination around Clarendon.

Its course is of the meandering type, the meanders being long and conspicuous. The ridge is unusually broad at its base, a feature not characteristic of Western New York eskers, and its crest is likewise unusually broad. Its lateral slopes are gentle, much more so than those of the ordinary esker. They are stony yet yield a fairly good soil consequently the ridge is under cultivation its entire length, part of it being in orchard. The crest-line is uneven or hummocky, the highest one being "Indian Hill" which rises 45 feet above the adjoining portion of the ridge on the north.

From the point of origin to the place of termination no interruptions occur in the course of the esker, it being continuous throughout its entire length.

Its termination is gradual. From "Indian Hill" it slopes southwestward, first rapidly and then more gently until it has ceased to appear as a distinct ridge among the irregularities of the ground moraine on either hand.

At least two gravel pits occur in its course. Neither has been worked recently so that their features are obscured by weathering. The bedding is imperfect and indistinct near the surface, becoming more distinct with rude anticlinal structure with depth. The materials are fine, chiefly gravel of good grade. This is composed almost entirely of Medina sandstone, a formation that is extensively worked at Holley for building stone. Leverett states that Medina makes up 90 per cent. of the pebbles by actual count (62).

One small tributary esker occurs just east of the north end of the main ridge. It is about 800 feet long with a hummocky crest, the hummocks rising to a height of 20 feet above the surface on either side of the tributary.

Origin. Little can be said as to the origin of this esker. The abundance of local material in its composition is antagonistic to the idea of superglacial origin. The small amount of sand observed in its course is certainly unfavorable to the idea of origin at the ice-front or within a re-entrance into the ice, for under these conditions a composition comparable to that of kames might be expected. Further it was apparently formed at a time when the Albion moraine with its associated kames was forming at the ice front around Clarendon south of the southern terminus of the esker. Its width seems to be the only feature opposed to the idea of subglacial origin. "Indian Hill" at the terminus of the esker may very likely represent a kame that was forming at the edge of the ice when the esker was being deposited beneath the ice toward the north in the subglacial feeding stream.

Ogden esker. Three miles south of Adams Basin and one-half mile east of Ogden occur several glacial features that Leverett has interpreted as constituting an esker (62). These features are well exhibited on the Brockport topographic quadrangle. An inspection of this part of the map discloses a broad interrupted ridge trending southwestward, 40 to 60 feet above the general level of the surrounding country, with low wet ground on either side. On the quadrangle this ridge is represented as about one mile in length, however it is in reality twice that length, fully half of it being too low to find representation with the contour interval used.

The ridge begins on the north as a low broad quite inconspicuous feature just south of the first east-west road north of Ogden. For one-fourth of a mile it preserves this character, then rises gradually to a height sufficient to take its first 20 foot contour. Just east of Ogden on the cross road the ridge is 50 feet high and one-quarter of a mile wide. It diminishes in height southward from this locality and nearly ceases. Again it increases in height and turning more to the southwest continues to the east-west road one mile south of Ogden. The highest part of this portion of the ridge is 60 feet above the surrounding country. It is broad, being nearly one-half a mile in width at this highest point with very gentle slopes.

Throughout the entire course the ridge is under cultivation. Its surface is sandy, here and there gravel occurs mixed with the sand. Large boulders are rare. Till occurs locally. Excavations have been made in several places, the most recent of which exhibit fine gravel, poorly stratified, covered by till to a depth of four feet. This excavation occurs along the north-south road at the north end of the southern half of the esker.

This ridge lies north of the Barre moraine which is very indefinite through this portion of Monroe County and the adjacent part of Orleans county, consisting chiefly of low, irregularly distributed mounds and short ridges.

Origin. It is quite possible that this ridge may be interpreted in another way rather than as constituting an esker. Its width, its very gentle slopes and its material are not typical of eskers. In fact the southern segment resembles a drumlin as seen from the north and from the sides. It has the same trend as the drumlins of this area. The topographic map exhibits this similarity very strikingly, however, its composition of sand with some gravel is opposed to this interpretation of its origin.

Again this feature may be considered as a morainic spur extending northward from the Barre moraine.

Finally it may be interpreted as an esker built in a very broad subglacial stream at the time of the deposition of the Barre moraine, or, less likely, the filling by a powerful stream of a broad re-entrant of the ice extending back from the Barre moraine.

Conclusion.

The study of the eskers in the vicinity of Rochester has developed few new facts and the observations recorded exhibit few new features. Each esker possesses its individual peculiarities which are largely a matter of detail. The relations at the point of origin, the relation at the termination, the character of the course, the relation to surroundings, the composition, are essentially the same with the New York eskers as characterize eskers in other regions.

The features exhibited by the western New York eskers seem to indicate in a vast majority of instances an origin in a tunnel beneath the ice. It is true that the characteristics of some eskers do not throw much light upon the manner of their origin, yet in the case of most eskers, if they are studied carefully, there will be revealed, very often in their minor details, the way in which they were formed. The relation they bear to moraines, their relations at the point of origin, their occurrence between the drumlins, the presence of lakes or swamps on either side, their composition largely of gravel, their relation to kames, the local character of their materials, the presence of till and large boulders on their surfaces, and of kettles depressed into their crests, their occurrence in trenches in the till sheet, their chaotic stratification, all seem to indicate a subglacial origin for the Rochester eskers.

While the preceding descriptions aim to include all of the eskers near Rochester, New York, very possibly some occurrences have been overlooked. Eskers of inferior dimensions are very likely to be missed. One such occurs two miles northwest of Scottsville. It is but a few hundred yards in length, 10 to 15 feet high, and lies between two high drumlins, with swampy ground on either hand. The topographic map (Rochester quadrangle) gives no indication of it and as it occurs some distance from the highway it might be very readily overlooked. Probably there are a number of such isolated examples of eskers in the area under consideration which are not high enough to be indicated on the topographic maps and the occurrence of which is not known to the scientific public.

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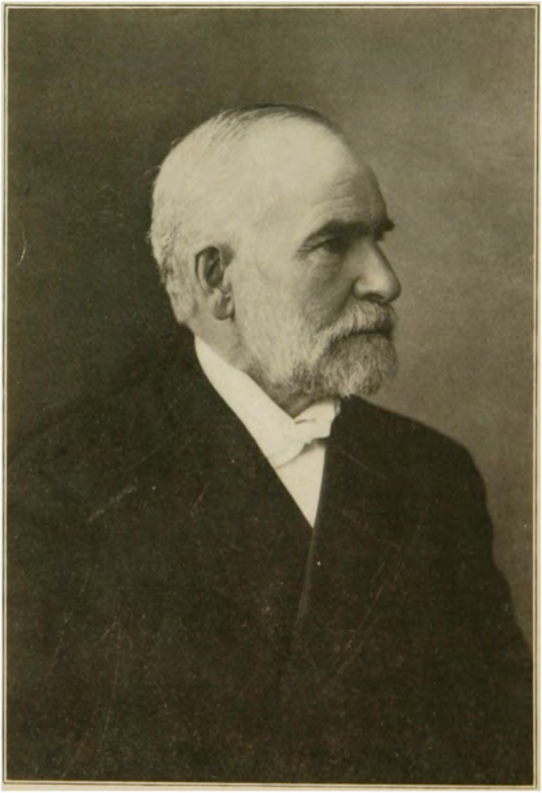

HENRY AUGUSTUS WARD

1834–1906

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BIOGRAPHIC MEMOIRS OF DECEASED FELLOWS

HENRY AUGUSTUS WARD

(Read before the Academy, December 9, 1918.)

A small pebble in the rock collection of the University of Rochester may be considered the germ of not only the University Museum but of most of the museums of America. It is a rounded fragment of hornblende gneiss crossed by series of black lines so regular as to resemble a bit of dark Scotch plaid. The description, dictated to the writer by Professor Ward, reads: "Found in a stone pile in corner of zigzag rail fence, surrounding his home, site of the Jewish temple, corner of Grove and Gibbs Street, about 1837. The first specimen I ever collected."

He evidently began his life work at an early age. He told the writer how as a lad he climbed to the platform of Corinthian Hall, just at the beginning of some exercises, to show this specimen to Chester Dewey, who waved him away, it being an unsuitable time. This incident illustrates his remarkable fearlessness in search of information and material, in striking contrast to his singular modesty and timidity in personal relations.

Ward was born March 9, 1834, and died by automobile accident in Buffalo, July 4, 1906. The biographical facts concerning him and his family may be found in editions of "Who's Who in America" previous to 1907.

The life and work of this remarkable man has been so felicitously told by one of his former assistants, William T. Hornaday, that extended extracts from his writing will form the larger part of this memoir.

THE KING OF MUSEUM BUILDERS

(By W. T. Hornaday in The Commercial Travellers Home Magazine of February, 1896.)

"The king of museum-builders is an American; and the greatest scientific emporium in the world is at beautiful Rochester, fairly in the shadow of her University. As patriotic Americans we have good reason to be proud of

Professor Ward and his work, and there are some millions of us who should also think of him with feelings of gratitude. In my opinion he has done more toward the creation and expansion of the scientific museums of the world than any other twenty men I could name, and the value of his work as a scientific educator can never be estimated in dollars and cents.

I knew him well; and having quarreled with him frequently in the ardent and aggressive days of my youth, I feel that I can now judge dispassionately both his character and his work, and write his story exactly as it is.

It is said by some that familiarity breeds contempt, and that no man is a hero to his valet. It may be so, especially when the party of the second part is a fool; but, at all events, after seven years of service with him, after months of his society as a travelling companion, and twelve years more of personal correspondence, I still can say that Henry A. Ward is the most remarkable scientific genius I ever knew. . . .

In this country, in England, Germany and France there are other men who make a business of gathering and distributing scientific specimens for museums; but this man towers above them all like a colossus standing on a plain. Where other men are able to supply the specimens for one small department of a new scientific museum, his vast establishment can fill the entire museum, from the lowest depths of geology up to man himself, with every department reasonably complete. The whole of the Lewis Brooks Museum, of the University of Virginia, except the building, was taken bodily and at once out of the Rochester establishment, and scarcely made a hole in it. When Marshall Field, of Chicago, gave his check for $100,000 in exchange for the entire Ward Collection at the World's Fair, a whole museum was bought and 'located' in one day.

In these days, the times require that every man shall have his special work, bounded, limited and confined. In science no man now dares to attempt to know it all. He must specialize within the fence that bounds his particular bailiwick. . . .

Know that Professor Ward belongs to neither of these classes of naturalists. With a fine scientific education, the inborn habit of investigation, and a command of language—or I had better say languages—of which any teacher might well be proud, he elected to carve out for himself a special niche in the world and fill it all alone.

. . . His life work began in carrying an old trunk filled with fossils from the Paris Basin, across the English Channel, and selling its contents to the London museums for a good round sum. Now, however, it requires twenty-one freight cars, jammed to the roof, to transport such a collection as that which constituted the 'Ward Exhibit' at the World's Fair of glorious memory.

. . . I have before me a list, closely printed, exactly the length of my arm, of one hundred American museums, to each of which Professor Ward has supplied collections. It is a roll of honor well worthy of being carved, figures and all, on his monument. In reality it is a complete list of all the scientific museums in the United States worthy of being mentioned anywhere. The cost of the natural history collections purchased of Ward's Natural Science Establishment by this group of museums alone foots up a grand total of $730,223. . . . There are only a few civilized, educated countries on the globe to which the Ward establishment has not sent natural history collections. . . . In 1879, when wandering through Tokio, Japan, an utter stranger in a strange land, I visited the Educational Museum; and there, in a large collection 'from Ward,' I beheld with the joy of an old acquaintance the stuffed and mounted figure of the very puma that I shot on the Essequibo River, South America, in 1876."

Hornaday's very happy description of the gathering of scientific material from all parts of the globe, and the great work of the Ward establishment, is here omitted.

"Professor Ward's history and personality are as strange as his profession. The next time you are traveling by rail—not in the smoking car, however, for he never uses tobacco—and see a studious, preoccupied man with a closely trimmed gray beard, rather scanty gray hair, keen, piercing gray eyes, old-fashioned gold spectacles, a big leather satchel, and a seat full of letters, pamphlets and books, it will surely be Henry A. Ward, A. M., F. G. S., etc.

His height is five feet eight, and at present his weight is 172 pounds. If one could examine him analytically it would be found that internally he is composed of raw-hide, whale-bone and asbestos; for surely no ordinary human materials could for forty-five years so successfully withstand bad cooks, bad food and bad drinks that have necessarily been encountered by any one who has, so recklessly of self, traveled all over creation.

. . . At ten years of age master Henry failed to harmonize with his parental environment. Having provided himself with a little brass pistol, at a total cost of seventy-five cents, he ran away from home, boldly struck out for Chicago and after long weeks of walking and riding actually reached his goal. It was his plan to build for himself a wickiup on the edge of the prairie near the city, shoot prairie chickens, and sell them in open market for cash. During his first day's experience on the Chicago prairie he encountered a good Samaritan, who chanced to be the gentleman after whom Clark Street was subsequently named. Mr. Clark kindly extracted the lad's story, took the embryo market hunter to his own home 'and grossly betrayed my confidence,' said Professor Ward, 'by writing to my uncle Moses, who sent one of his clerks after me, who ignominously took me back to Rochester.. . . .'

I doubt if any boy ever wrestled harder with circumstances to win an education than did young Ward during the two and a half years he spent at the Middlebury Academy at Wyoming, N. Y. By virtue of his official position (as janitor), he lived in the top of the Academy building, and supported himself by doing more kinds of work than many a boy of to-day has even seen done. As opportunity offered, he did carpentry, shoemaking, gardening, painting, and livery stable work. One of his specialties was cleaning out wells. In September, 1848, while the late well-known agricultural publisher, Orange Judd, tramped the road between Warsaw and LeRoy repairing clocks, Ward and his partner went over the same route, cleaning out wells on a very profitable basis.

After the Academy he went to Williams College . . . where he was a fellow student of Senator Ingalls and Hon. Charles E. Fitch. There, also, he supported himself by hard work in hours filched from periods that should have been devoted to study and recreation. His best friend was Professor Emmons, the geologist, who showed him the path that afterwards led to geology and mineralogy, and started him therein."

It would be interesting to know why young Ward went to Williams instead of studying at his home college, which had opened in 1850, a year before he entered Williams. It is believed that his interest in earth science was awakened by Professor Chester Dewey; and it may be that he went to Williams on account of Professor Emmons.

"In speaking of that period of his life, Professor Ward admits that he was a bad student in all his studies except geology, mineralogy and the languages, in which he always stood high. . . .

In 1853 Professor Louis Agassiz came to Pittsfield, Mass., 28 miles from Williamstown, to deliver a lecture. The college boys hired a band wagon and drove over. The fare was seventy-five cents, and being without money, young Ward walked the 28 miles to the lecture. . . .

After the lecture Ward was introduced to Professor Agassiz, and invited to visit him at his hotel. The direct result of the fifty-six mile walk to hear one lecture was that the walker went at once to Cambridge, and became a pupil of the great Swiss naturalist. . . .

At Cambridge young Ward and 'Charlie' Wadsworth became such fast friends that General Wadsworth took the two boys to Paris with him, gave Ward a year's course of special instruction in the School of Mines, and to crown all, afterward gave the lucky boys a glorious trip to Egypt, up the Nile to the third cataract, winding up with Suez. Thus began the long series of delightful journeys over the face of the earth so dear to the heart of Henry A. Ward, from which he will never rest permanently so long as he can climb the steps of a car, or cross a gangplank without falling off.

After the close of the great Egyptian picnic young Ward resumed his studies in Paris. The only regular feature about his course was running out of money. He would study in the School of Mines until almost penniless, when he would drop his books and hasten to the gypsum and chalk quarries of Montmarte and Meudon. There he would gather a good load of minerals and fossils, pack them in his trunk, cross the channel to London, and sell them to the British Museum, the School of Mines, or wherever a buyer could be found.

He was not long in finding out that British fossils and minerals were also salable in Paris, and forthwith he tapped the mining regions of Cornwall and Cumberland. Often he returned to Paris with quite a large sum of money in his pocket, sometimes amounting, he slyly says, to as much as $40. . . .

At Epernay, sixty miles east of Paris, good Madame Cliquot had a large vineyard which produced the very fine brand of champagne, bearing her name. Certain strata of the Paris Basin, of the oldest Eocene age, cropped out with very fine sections on the estate of Madame Cliquot, and brought to light certain fossils that were then little known, and valuable. If Professor Ward ever sets up a new coat of arms for his posterity, surely it should contain somewhere the figure of a long, trumpet-shaped shell of the genus Cerithium, on a carpet-bag, couchant.

Thanks to the conciliating diplomacy that every collector must possess to be successful, and to the good nature of Madame and her manager, the young American who spoke such excellent French was given a cinch on the fossils underlying a portion of that estate, and told to work his will. He hired workmen at forty cents a day, and for several summers he mined and countermined his concession so successfully that many score of those curious fossils now repose in British and continental museums, each having yielded a benefit to the purveyor of from $5 to $10. Nature kindly made them just small enough to pack successfully in a trunk, and also light enough to carry in a satchel when necessary.

Notwithstanding the noise it makes, Europe is a small country; and in a very short time Ward had extended his field of commercial activity over the whole of it. 'I never traveled third class when I could go fourth,' said the man of many trips, 'but I went all over Europe, selling specimens to museums, and collecting to sell elsewhere. I went to Brussels, Hamburg, Copenhagen, Berlin and Vienna repeatedly, and finally covered Sweden, Russia and Spain. . . .'

Thus was developed the germ of Ward's Natural Science Establishment. The history of that strange and unique institution really dates back to the Paris Basin and the Cerithium quarry in the vineyard of Madame Cliquot. The making of the great Ward cabinet of minerals, and its purchase for $20,000 by means of a popular subscription for the University of Rochester, is merely an important incident in the development of the idea.* A still

* At the time the Ward Collections came into the possession of the University of Rochester, and were displayed on the top floor of Anderson Hall, occupying ten rooms, a pamphlet of 44 pages was printed describing the collections. In this Professor Ward says, that after collecting from American localities he had "spent six years in Europe, studying in the large museums, and travelling very widely through that continent and into Asia and Africa, in executing the detail of a plan which he had formed for a large Mineralogical and Geological Museum. . . . I have collected them, almost from the first, upon a plan which was strictly an educational one, and which contemplated a full and equal illustration of these sciences. . . ."

more moving cause was the appointment of young Mr. Ward, after five years study and work abroad, to the professorship of mineralogy, geology and zoölogy in the University of Rochester. It was during his work as a teacher that he found how seriously every American teacher of science was hampered and handicapped by the lack of tangible representatives of the beasts, birds and reptiles that abounded in geologic times, and are now extinct. Therefore, for several years in succession, he spent his vacations in the royal museums of Europe, making plaster-of-paris moulds of their rarer and more striking fossils, from which he was afterwards enabled to make perfect plaster copies of the originals for his beloved cabinet in the University of Rochester.

The outcome might easily have been foreseen by a blind man. No sooner were those wonderful casts brought forward than other institutions of learning sought copies from the same mould and 'Ward's Casts of Celebrated Fossils' was the final result. American teachers and students, to whom the originals were inaccessible, were delighted with them. Illustrated catalogues were issued, the largest of which we used in my *alma mater* as a textbook. The casts became exceedingly popular, and were an important factor in the final upbuilding of what is now the Ward Establishment. . . . in 1869 he gave up his professorship in the University of Rochester.* Embowered in the stately elms and spreading maples that overarch College Avenue, almost in the shadow of the main building of the University, there now stands a group of sixteen buildings of about twelve different sizes, each with a gilded totem at its peak to show the place in nature of its contents. Over the wide gateway to the courtyard the lower jaws of an immense right whale form a gothic arch. As you enter, a conspicuous placard informs you in the most business-like way 'This is not a museum but a working establishment, where all are very busy.'

His ambition was fully realized at 27 years of age. The collections were placed on exhibition in a large hall at the corner of Main Street and Plymouth Avenue; and attracted wide attention. The descriptive pamphlet quotes Dr. James Hall, Dr. John Torrey and Professors Dana, Silliman, Edward Hitchcock, Doremus, James Orton and others, to the effect that the collection as a whole was the finest and most complete in America, if not in the world. But it was beyond the appreciated needs of the institutions of that day, and was a "white elephant." Then President Anderson and the friends of Ward decided that it must remain in Rochester, and a fund of $20,000 was raised by subscription, headed by Lewis Brooks for $5,000, Levi A. Ward for $1,500, and Freeman Clarke and William A. Reynolds for $1,000 each. This list, along with the bill of sale and a brief description of the collection in Ward's own writing, is preserved.

The price paid was little more than the amount of Ward's debt to his uncle, Levi A. Ward, who had generously financed him.

The Ward's Natural Science Establishment was subsequent to, and an outgrowth of, the making of the University collections. H. L. F.

* The instinct of the collector and the desire for travel was so compelling that Ward could not be held to the routine work of the college instructor, and he was not active in the college after about 1865; but his name was carried as "Professor" in the University Catalogue until 1875. In 1896 the University gave him the degree LL. D.

The University Museum contains many of the smaller fossils which were the "originals" in the series of casts.

Adjoining all these buildings on the north is a spacious and well-lighted square house, in the upper right hand corner of which is 'the study,'—dear to the memory of I cannot tell how many naturalists, both young and old. In the front right hand corner of the big study which is walled with books, barricaded with maps and eternally littered with scientific papers and pamphlets and photographs and drawings and small specimens, there sits the presiding genius of this unique world. No man is more busy than he, yet Abraham Lincoln himself was not more approachable, nor more kind toward everyone desiring to see him.

Twenty-one years ago, when I was . . . a college student, no sooner did I hear of this strange man than I fired a letter at him, modestly stating that I would like to have him teach me everything I most desired to know. When Professor Bessey read his kind, and even fatherly reply, he remarked with vigor, 'Well, that man is no churl, that's plain.' And truly he was not, as many an American naturalist can testify."

Here follows a list of eminent men in the scientific world, with their positions and work, who were started in the Ward establishment. Hornaday names G. K. Gilbert, James Orton, Frederic A. Lucas, Walter B. Barrows, E. W. Staebner, Edwin E. Howell, Charles H. Townsend, J. W. Schollick, and the two sons, Charles H. Ward and Henry L. Ward.

Other names that now should be given are: William M. Wheeler, Frank C. Baker, R. H. Pettit, Carl Akeley, Henry L. Preston, George H. Chadwick, A. B. Baker, and Charles Bull.

"Scores of other men have been trained here in various branches of scientific work, and have gone forth to fill positions of responsibility. The Society of American Taxidermists, which in five years' time wrought a complete revolution in taxidermic work in America, was founded here in 1880 by Professor Ward's taxidermists, and in all its work always received from him hearty sympathy as well as active support and co-operation. It is my firm conviction that no man living has done as much toward the promotion of the art of taxidermy as has been done by Henry A. Ward and the influences created by him. . . .

Of all the travellers I have ever known, aye, or ever heard of, Professor Ward is the most persistent, and I may still say, unsatisfied. . . . I, too, love to travel; but it makes me feel both tired and homesick to think of all the trips abroad he has taken. There is hardly a nook or corner in the United States that he has not been to or through, and the same is true of Europe. Egypt, Nubia, Arabia and Somaliland are merely nice winter playgrounds for him, and Zanzibar, Abyssinia, Mozambique, Zululand, Natal, Cape Colony and Griqualand, 800 miles in the interior of South Africa, have all been ransacked by him for specimens. So also with Japan, Australia, Patagonia and Brazil."

During the ten years of active life after Dr. Hornaday wrote this appreciation, Ward made many long and arduous journeys. In 1903 he searched every country in Europe except Turkey and Scandinavia for meteorites. In a trip to Persia he faced the Shah, and induced him to cut off a piece of the Viramin siderite. Only a few weeks before his death he made a trip to South America and secured a large piece, 324 pounds, of the famous meteorite which stood on a marble column in the plaza of Santa Rosa, Colombia. The quest for meteorites for the great Ward-Coonley Collection had started another series of world trips.

"When still a beardless young man he went up the river Niger, in time to tell David Livingstone all about that country, in Sir Roderick Murchison's London drawing room. On the African Island of Fernando Po he was put down on the sand to die comfortably of African fever, but was rescued and nursed back to life by a negro woman. . . .

Thousands of people there are, also, who know Professor Ward only by correspondence, all written by his own hand, and the cords of letters he has written since I first knew him remind me of his handwriting. It is peculiar, and once seen is never forgotten. It is so heavy, so run together and so peculiar that it caused one of his western correspondents to protest as follows: 'If you should ever try to get up a writing school in this vicinity, I will do all I can against you. Why will you persist in writing with a sharp stick, when pens are so cheap?' . . .

Naturally one is curious to know the religious belief of this strange cosmopolitan, who has hobnobbed with American puritans, French infidels, Mohammedan Arabs, Chinese Buddhists, and goodness only knows what else. While going down the Red Sea with him bound for the great hot-bed of Mohammedan fanaticism, Jedda, I put the question.

'I am an agnostic,' was the answer; 'but I would like to be called a Christian agnostic. I would like to be spoken of as one possessing the high hopes and ideals of Christianity, except that mine are based on data entirely distinct from those on which Christians base theirs. . . .'

I have often wondered how Professor Ward will start on his last journey; whether it will be by accident, or sudden and violent illness in some foreign hotel or steamer. . . . One thing only about this causes him great concern. He is really haunted by a fear that he may chance to die so far from Buffalo that he cannot be scientifically and esthetically cremated, and will be compelled to undergo the ignominy of interment and slow decomposition in mother earth! . . ."

Singularly, his death occurred in Buffalo; but it seems a pity that after escaping all the dangers of foreign travel for more than half a century he should perish by street accident at home. If a meteorite from the celestial spaces had struck him it would have been fitting. His remains were cremated, as he wished, and rest in an urn in a niche of the great glacial bowlder of jasper conglomerate which he had brought from Algoma district, Canada, and placed in Mount Hope.

". . . In speaking of the advance made by American institutions in natural science equipments, Dr. Goode says: 'In this connection should be mentioned the very important influence of Professor Henry A. Ward, who in the conduct of the Natural History Establishment at Rochester, was always evidently actuated quite as much by a love for natural history and the ambition to supply good material to museums, as by hope of profit, which was always by him subordinated to higher ideals in a manner not very usual to commercial establishments."

A GREAT MUSEUM BUILDER

(By W. T. Hornaday, in The Nation, July 12, 1906.)

"Henry Augustus Ward, . . . to whom the scientific museums of America owe more than to any other man, was killed by an automobile at Buffalo, July 4. The world has its professors of zoölogy, its doctors of science and its curators, but it has only one maker of museums in the class of this remarkable man. He was a unique personage, and, viewed to-day in the perspective which a third of a century can give, his genius and his works bulk large.

In the ordinary sense Professor Ward was neither a scientific investigator nor a college professor. In these lines he did not aspire to distinction; but his formal title he acquired properly during the five-year period when he was a member of the faculty of Rochester University, and there taught the natural sciences. His life was devoted to culling scientifically and accumulating the choicest objects for illustration of the processes of nature; to converting them into museum specimens, and finally to building museums. With him the idea of educating the masses in the natural sciences by means of object-lessons became an absorbing passion. He cared for money only to spend it in wider travel and more collections. And while he found purchasers for great collections as no other man ever did, the huge checks which he received he always joyously scattered to the ends of the earth in the purchase of more 'museum material.' . . .

Professor Ward's most notable achievement as a scientist and educator was, in my estimation, the colossal task which culminated in the Ward Collection of Casts of Celebrated Fossils. . . . Poor indeed is the college or university museum which does not contain a series of 'Ward Casts.' About two hundred sets of them have, I think, found lodgment in the museums and higher institutions of learning in this country. The most noteworthy objects are the great Megatherium, the Dinotherium, Glyptodon, Colossochelys, Mastodon, and Elephas ganesa. . . .

Henry A. Ward was the first American to take up the making of museums in a systematic and scientific manner. The collection which he finished about 1862 and placed for the citizens of Rochester in the museum of the University of Rochester, may justly be regarded as having set the pace. Even after the lapse of [44] years it is a good object lesson to aspiring museum builders, a collection to study and admire. . . . As early as 1873 when the best of our scientific museums were in their swaddling clothes, and skilled museum preparators were a negligible quantity, Professor Ward assembled at Rochester a corps of the best French, German, and American taxidermists, osteologists, moulders, and modellers, that high wages could procure. In 1876 I was astonished at finding that Rochester afforded better facilities for the study of museum making than Paris, London or Berlin.

About eight years ago Professor Ward . . . relinquished the detailed management of the Rochester establishment. After that he devoted much time to completing his collection of meteorites, which for nearly twenty years has been a favorite interest. He brought it to a remarkable state of perfection (the largest in the world). His last literary work was the publication of an elaborate annotated catalogue of the collection; a model of its kind."

Ward wrote little for scientific journals until late in life, but the many illustrated catalogues of the Establishment were witness to his scientific knowledge. The Catalogue of Casts was probably the best general work on Paleontology of its time in America. Two very interesting articles were printed in the Democrat & Chronicle of November 17, 24, 1889, written at Punta Arena, Patagonia, relating his experiences in an extensive trip in South America.

In the last years of his life he published many interesting descriptions of new meteorites. Seven articles were in the American Journal of Science; one in volume 49 (1895), one in vol. 5 (1898), two in vol. 15 (1903), and one each in vol. 17 (1904) vol. 19 (1905) and vol. 23 (1907). The Mineral Collector for September, 1904, contained an interesting article by him on the values of meteorites. His best meteorite articles were published in the Proceedings of this society; one in volume 2, and seven in volume 4, with 23 full-page plates. Two of these papers were the first descriptions, with photographic illustrations, of two of the most remarkable meteorites ever found. One is the Bacubirito iron, in Sinaloa, Mexico; the other, the Willamette, from Oregon. The

Willamette has the most remarkable form among meteorites, and the two are exceeded in size only by the Anighito iron brought by Peary from Cape York, Greenland. The latter and the Willamette are now in the American Museum of Natural History.

Professor Ward was a Councillor of the Academy in 1892. When in the city he was usually present at Academy meetings, and the Proceedings record many addresses and exhibitions of material, always to the great pleasure of his audience. He was a charming raconteur. Some of his living associates tell with gusto how the programs of meetings were ignored when Ward was induced to talk. Yet he was modest, even timid, and the request for an address or paper would cause dismay. It is very unfortunate that he was not induced to dictate his memoirs. The story of his wanderings, told by himself, would have made the most readable book of travel.

"At the age of seventy Professor Ward went to Canada, and selected a particularly fine rock 'specimen' to mark his last resting place. A massive and shapely bowlder of jasper conglomerate was brought to Rochester, erected on a prominent knoll in Mount Hope Cemetery, and his name was sculptured upon its face. Except for the chiseled inscription the rock is as it came from nature's workshop. This last task of the always-forehanded man of science was not completed a day too soon. Thus passes from life a man whose services to science, and also to unscientific millions, were great, but understood and appreciated by those only who knew him best and longest.

From 1870 to 1895 he was the man for the hour, the birth hour of many new museums, the renaissance of old ones. He wrought with high purpose; he lived to see the fruits of his genius and his labors; and in his peculiar field he leaves no understudy."

H. L. Fairchild.

GROVE KARL GILBERT

(Read before the Academy, June 24, 1918.)

Dr. Gilbert was one of the most eminent geologists of the world, and as he was a native of Rochester and an honorary member of this society the Rochester Academy of Science has special pride in his life and work.

Dr. Gilbert was born in Rochester, May 6, 1843. His father was the well-known portrait painter, Grove Shelden Gilbert. An older brother, H. Roy Gilbert, remained in the city as manager of a milling business until his death in 1902; and a sister, Mrs. Peter Loomis, is yet living in Jackson, Michigan. During Gilbert's boyhood the family lived at the junction of Exchange and Clarissa streets, but about 1861 land was purchased and a cottage built at the intersection of Culver Road and Merchants Road.

Karl, as he was always called by his family and intimates, was a studious boy, graduating at the Rochester High School at the age of 15, and from the University at 19. He was tall, slender, thin-chested and rather delicate, being overgrown for his years. As a condition of going to college he was required to take out-of-door exercise, and spent much time rowing on the Genesee River, and in later years on Irondequoit Bay.

He is remembered as a quiet, modest boy, with pleasant manners, very kindly disposition, and of very even temper. He was a good student, apparently indifferent to college honors and prizes. He was strong in mathematics, which explains his facility in the handling of geologic problems involving mathematics and physics. He had a keen sense of humor, and Rossiter Johnson, a classmate, says that he wrote skits for the college paper. The following passage in a letter from him in November, 1917, illustrates his happy temperament. After saying that he hand-printed thousands of the labels in the Ward Collections of the University Museum he adds: "Your inquiry calls to memory an embellishment that proved to be only temporary. In a collection installed for the Buffalo Academy of Sciences was a cast of an impression, on Connecticut sandstone, of a saurian who rested on feet, tarsals and tail; and I added in the margin of the label a quotation from King Richard—'all places yield to him; here sits he down.' This struck Ward as an exhibition of undue levity, and a new label was written."

It is said that he was sometimes absent-minded, but took the jokes about it in good nature. His boyhood playmate, Mr. Robert Bell, writes: "I would judge that Karl was of too kindly disposition to make a successful teacher of youngsters; they would take advantage of him."

In 1862 young Gilbert graduated at the University of Rochester. He had no decision as to vocation, but did not wish to enter any of the so-called learned professions. In one year of teaching, as principal of schools at Jackson, Mich., he paid his debt incurred at college, and returned to Rochester. Until 1868 he was assistant to Henry A. Ward in the preparation of natural science material, and the installation of museums. Whether he had any offer from Ward before he returned to Rochester we do not know. He could not previously have been associated with Ward, who was nine years his senior and was in Europe until Karl was a Sophomore or a Junior. Chester Dewey was the teacher of chemistry and natural sciences until 1861, when Ward took the latter subjects. Ward's wonderful collections were on exhibition in the city in 1861, and were purchased for the college in 1862; but there is no intimation that Gilbert had any connection with Ward and the museum until 1863.

As noted above, many thousands of the labels in the University Geological Museum, which contains the famous Ward Collection, carry the pen-work of young Gilbert. His work on the zoölogic and geologic material of Ward's Natural Science Establishment probably determined his future scientific career. There is no suggestion that he previously had any particular interest in natural history or earth science.

During the five years with Ward's Natural Science Establishment Gilbert's work in the handling of geologic material and the installation of museums was a fine experience. In an appreciation of E. E. Howell (in volume 23, Bulletin of the Geological Society of America), Gilbert says that Ward's Establishment was Howell's real school; and after naming some of the men eminent in science who had received their early training at Ward's he adds: "And in addition to these the writer, who ranks himself somewhat proudly as senior alumnus." He had immediate charge of the mounting of the Cohoes Mastodon, in the State Museum at Albany, and his first publication related to the conditions of the entombment of the animal. In this article (in the 21st Annual Report on the New York State Cabinet, 1871, pages 129–148), after describing the geologic features, he made an estimate of the time subsequent to the burial of the Mastodon, based on the recession of the walls of the Mohawk channel under atmospheric erosion; using as a chronometer the slow growth of stunted cedars that were clinging to the steep cliffs of the river gorge. Dr. John M. Clarke has referred to this work of Gilbert (in Science, volume 10, 1899, page 695) as the first attempt of the kind ever made. The field work was done in 1866, when Gilbert was only 23 years of age, although the paper may have been completed a couple of years later. It is a fine example of Gilbert's philosophic method and of his ability.

In 1869 he began, on the Ohio Geological Survey, under Professor J. S. Newberry, his geologic work. That this work was deliberate choice appears from the "Historical Sketch" by Newberry, in the report for 1869 (page 9), where we read:

"Of the other members of the corps, Messrs. Gilbert and Sherwood were geologists who had devoted much time to practical geology in New York and Pennsylvania, and who, for the purpose of adding to their experience, volunteered their services for no other compensation than their traveling expenses."

In the report for 1870 Dr. Newberry writes:

"The fossil fishes and fossil plants found in the state have been described by myself. They have been drawn by Mr. T. Y. Garner and Mr. G. K. Gilbert in a style that has not been surpassed in this country, and some of their work is equal to any of a similar character done by the best European draughtsmen" (page 8).

This volume contains a short report by Gilbert on three counties in the northwestern part of the state. A fuller report on the same district is attached to a report on the surface geology of the Maumee Valley, found in Volume 1, of the final reports of the Newberry survey. This writing, published in 1873, contains six maps, evidently all his own work. The first two maps show the beaches of the ancient glacial waters in the Maumee Valley, and the correlation of the highest shore with the pass at Fort Wayne.

These fine maps are the first ever made in delineation of ancient lake beaches and correlation with the controlling outlet. The field work for this report was done in 1869 and 1870, when he was only twenty-seven years of age. At this time Gilbert did not recognize the receding ice sheet as the dam that held up the ancient waters, but he did clearly postulate deformation of the earth's surface as one cause of the variation of levels. He says (page 551):

"The more general conclusion that the system of raised beaches signify a succession of flexures of the earth's surface, rather than successive stages of subsidence due to the gradual removal of a barrier of tide water, or the gradual wear of a barrier of stone, does not rest on this single fact."

Even then he knew something of the change of levels in the Ontario basin, for he immediately says, in citing other similar facts: "There is evidence that Lake Ontario, at Rochester, N. Y., has stood 70 feet lower than it does now" (page 552). Some sentences in the same connection illustrate his capacity for generalization.

"While these facts abundantly prove that a simple theory of gradual drainage, by the elevation en masse of the lake regions, is entirely inadequate, they are too fragmentary to define clearly the general synchronism and sequence of the local movements to which they testify. Nevertheless, it is something to have learned that the writhing of the surface of the earth, which has in the ages so many times remapped the continents, has also been the great immediate cause of the transformations of the great lakes, and that, continuing through the latest distinguishable geological epoch and its prolongation the historical, it has not now ceased."

Dr. Newberry was the first geologist to recognize the ice barrier as the cause of the high-level waters in the Laurentian basin, and it is interesting to find a footnote over his initials, at the bottom of the same page (552), reading as follows:

"In the discussion of these facts cited by Mr. Gilbert, and others of similar character, it should be remembered that the retreating glacier must have, for ages, constituted an ice dam that obstructed the natural lines of drainage, and may have maintained a high surface level in the water-basin which succeeded it."

The substance of Gilbert's report in the 1873 volume of the Ohio Survey had previous publication by permission in the *American Journal of Science* in 1871. An abstract was also printed in the proceedings of the New York Academy of Sciences of February 20, 1871 (pp. 175–178).

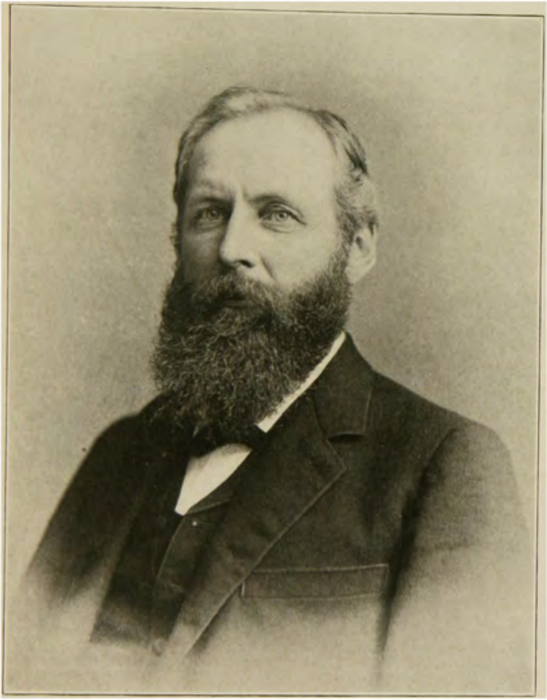
In 1871 Gilbert joined the Wheeler survey of the western territories and began the many years of work in the far west. From 1875 he was on the survey under Major Powell. The United States Geological survey was organized in 1879, with Clarence King as director, and young Gilbert became a member. From that time to his death, May 1, 1918, he was continuously on the national survey.

Gilbert was not a prolific writer, as compared with others and judged by his work and ability. Down to 1891 the bibliographic list carries 70 titles, four of which have associated authors. His initial publication, in recognized geologic mediums, was in 1871, on the Cohoes Mastodon in the twenty-first annual report of the New York State Cabinet of Natural History. His next three articles have been noted above, relating to Ohio geology and the ancient beaches. From 1871 his papers are mostly in description of features of the western country. The most important of his earlier papers is the report on the Henry Mountains, published 1877. In this classic paper he described a new type of mountains, now fully recognized. These were originally domes, or areas of sedimentary strata lifted by the injection of lava from beneath. Quoting his own description, page 19:

> "The lava of the Henry Mountains behaved differently. Instead of rising through all the beds of the earth's crust, it stopped at a lower horizon, insinuated itself between two strata, and opened for itself a chamber by lifting all the superior beds. In this chamber it congealed, forming a massive body of trap. For this body the name laccolite (cistern-stone) will be used."

In later years the name has been changed to laccolith. Subsequent erosion of these uplifts by doming has often destroyed the arching form or obscured the primitive shape and exposed the injected igneous heart. The latter part of this book is a discussion of land sculpture. In this statement of the principles of erosion and the origin of topographic forms he shares with Newberry and Powell the honor of a pioneer.

Probably his most famous writing is the work on Lake Bonneville. This is the initial volume of the series of quarto monographs published by the National Survey, and bears the date 1890. This describes the wide expanded predecessor of the present Great Salt Lake, which existed in glacial time when humidity and rainfall of the Great Basin produced the vast lake which overflowed northward to the Columbia River. Great Salt Lake is only the saline remnant of that dessicated fresh-water body.



GROVE KARL GILBERT

1843–1918

This handsome quarto volume contains a chapter on "Topographic Features of Lake Shores" which is the classic writing on shore-line topography.

It is interesting to note that he published no articles relating to the Rochester region until after his long period of western exploration. His best publication in reference to the Ontario basin was in 1885, on the Iroquois shoreline; although he then called it simply the old shore-line of Ontario. Between then and 1891 he published six papers on the Pleistocene features or glacial history of the Ontario basin; and one on the sink ridges near Caledonia.

From 1892 to 1900, eight years, his list of writings is forty; covering a wide range of subjects in geology. Of these eight related to western New York. From 1901 to 1905 twenty-five titles are on record, of which only two concern western New York. During 1906 and 1907 he published nine articles, one being on Niagara. In 1908 only four articles, including another on Niagara, are recorded in the bibliography. Since 1908 only five titles are credited. Altogether this makes 156 titles, of which 18 relate to the geology of western New York or the Ontario basin.

The few papers published in later years is explained by his poor health, due to a slight stroke of apoplexy. After this time by very careful living he was able to do some work in a deliberate way. His latest study was the transportation of detritus by streams, with reference to hydraulic mining in California. This work, spread over several years, was published last year, being his last publication. It is entitled "Hydraulic-mining Debris in the Sierra Nevada," and is Professional Paper 105 of the Survey list, forming a quarto of 154 pages, with numerous maps and reproduction of photographs.

Dr. Gilbert's only writing for school textbooks in his "Introduction to Physical Geography," in collaboration with Professor A. P. Brigham. This was published in 1892 by D. Appleton and Company.

Geology is so broad and comprehensive and so inviting in many directions that some men with active minds and lively interest scatter their studies over diverse fields. Dr. Gilbert more wisely confined his work to physical geology, especially geodynamics, in which he was recognized as a master. He published practically nothing in biologic geology or paleontology; and almost nothing in stratigraphy and petrology.

His geologic interest in his home region was mainly in glacial problems, especially the glacial lake Iroquois and the deformation of the Ontario basin. He was the first geologist to appreciate the complexity of the Pleistocene history of the valley. As early as 1885 he recognized the three controlling factors: (*a*) the damming effect of the waning glacier and the glacial nature of the earlier waters; (*b*) the succession of water levels due to opening of different outlets or places of escape for the impounded waters, by the recession of the glacier front; and (*c*) the dislocation and canting of the water planes by the tilting uplift of the land. His accurate conclusions regarding the complex history are embodied in a number of short papers, and especially in a chapter in the "Sixth Annual Report of the Commissioners of the State Reservation at Niagara for the year 1890." The title of this important but little-known paper is "The History of Niagara."

Dr. Gilbert's mind was of the reflective, philosophic type. He sought for the explanation and relationship of phenomena. His calm judgment and clear discrimination joined to a spirit of fairness and with gentle manners caused him to be much sought as a critic and helper. He was a sort of father-adviser to the members of the Survey. Doubtless much of his thought has found expression in the writings of the younger men who revered and loved him. The writer of this appreciation never heard him say a harsh word of anyone. He was reserved in personal matters, but it is known that the death of a young daughter affected and saddened his life. His wife, who was Fannie L. Porter, died over twenty years ago. Two sons are living. The eldest, Archibald Marvin Gilbert, is a successful civil engineer, in reclamation and irrigation work in the west; and had charge of the construction of the great Salmon River dam.

Dr. Gilbert received many honors. The University of Rochester gave him the master's degree in 1872, and the LL.D. degree in 1898. The latter degree was also conferred by the University of Wisconsin in 1894, and by the University of Pennsylvania in 1897. He gave special courses of lectures at Cornell, Columbia and Johns Hopkins universities. He was the fourth president of the Geological Society of America, in 1892, and was again president in 1909, the only man honored by a second term. In 1899 he was president of the American Association for the Advancement of Science, probably the highest honor in the gift of American science. Naturally he was active and prominent in the scientific societies of the national capitol, and was a member of the National Academy of Sciences. He was a Foreign Fellow of the Geological Society of London, and received its Wollaston Medal in 1899. He was President of the American Society of Naturalists, 1885–1886; Philosophical Society of Washington, 1895; Association of American Geographers, 1908. He received the Walker Grand Prize from the Boston Society of Natural History in 1908. He was a member of the Delta Upsilon college fraternity.

H. L. FAIRCHILD.

EDWIN EUGENE HOWELL

(Read before the Academy, December 9, 1918.)

Howell was one of the interesting group of men who have won distinction in science and received their early training in Ward's Natural Science Establishment.

He was born in Genesee County, March 12, 1845, and died in Washington, D. C., April 16, 1911. His youth was passed on a farm with early education in the country schools. His sister was Henry A. Ward's first wife, which relation doubtless explains his entrance to Wards' establishment in 1865, at the age of 20, where he remained until 1872, when he joined the government surveys in the far west. G. K. Gilbert was at Ward's for three years after Howell arrived, and left the Ohio Survey for the Wheeler Survey in 1871, and it is surmised that it was through Gilbert that Howell also joined the Wheeler party. On this survey, the U. S. Geographical Survey West of the 100th Meridian, Lieutenant George M. Wheeler in charge, he remained two years, and in 1874 became a geologist on the Powell Survey of the Rocky Mountain region. In these surveys he made reconnaissance in Utah, Nevada, Arizona and New Mexico. There is a suggestion in Gilbert's memoir* that Howell left the Survey with the conviction that it

* Bulletin Geological Society of America, volume 23, pages 30–32.

was not the vocation for which he was best fitted. At any rate he returned to Rochester, and at a time of financial stress in the Ward establishment he purchased one-half interest in the mineralogic and geologic material of the institution, and until 1892 the geological branch of the business was in the firm name of Ward & Howell.

In 1875 he constructed a relief map of the Grand Canyon of the Colorado, for the United States Government exhibit at the Centennial Fair at Philadelphia in 1876. He claimed that his relief map of the island of San Domingo, made in 1870, was the first relief map made in the United States. In 1892, on the reorganization of the Ward establishment, he disposed of his interest and removed to Washington, D. C., where he organized his own establishment, which he called "The Microcosm," somewhat after Ward's original building called "Cosmos Hall," but restricted to geologic materials and relief maps. Of this work Gilbert wrote:

> "The modeling of relief maps, in which work he was a pioneer,—if not *the* pioneer—for the United States, soon became a specialty; and his monument for a generation at least will consist in the plastic representations of physiography, topography, and geologic structure which adorn the halls and walls of museums and school-rooms throughout the continent.
>
> Personally, Howell was quiet, unassuming and sincere. He recognized that integrity was an important factor in his business success. If he had enemies or detractors, I have not met them. . . . His clients found him ever clamorous for facts and anxious to revise work at any stage if it could thus be made more truthful; and his clients, who were numerous among the investigators and teachers of geology and geography, were also his friends."

The University of Rochester recognized some special studies and conferred on him the degree Master of Arts (Honorary) in 1880.

After the reorganization of the Academy in 1888 Howell became active in the Society, being Chairman of the Section of Geology, 1889–1891; and Treasurer of the Academy, 1890–1891.

The bibliography of the U. S. Geological Survey credits Howell with five titles of reports for 1874–1877, three being in collaboration with Gilbert and others. The first volume of the Academy Proceedings contains two articles by him in 1890, 1891, describing nine new meteorites. Other papers on meteorites were printed in the American Journal of Science for 1887, 1888, 1892 and 1895.

Mrs. Howell, who was Annie H. Williams, died in 1893. A son and daughter are living.

H. L. FAIRCHILD.

SAMUEL ALLAN LATTIMORE

(Read to the Academy, February 24, 1913.)

In the death of Dr. S. A. Lattimore, the Rochester Academy of Science loses one of its oldest members, and it is fitting that the Society should make acknowledgment of its appreciation of his character and his work as a scientist, and give expression to its deep sense of loss.

Professor Lattimore was born in Union County, Indiana, May 31, 1828, and died February 13, 1913. He graduated at DePauw University in 1850, and remained there as classical tutor two years and as Professor of Greek until 1860. He then went to Genesee College, at Lima, N. Y. as Professor of Chemistry, and in 1867 was called to the similar chair in the University of Rochester, where he remained until his retitrement in 1908. He received the A. M. degree in 1853 from DePauw, and the Ph.D. from both DePauw and Iowa Wesleyan University in 1873; and the same year the LL.D. degree from Hamilton College.

In 1896–1898 he was acting President of the University of Rochester. After 1881 he was chemist to the New York State Board of Health, and to the New York Dairy Commission after 1886.

The Rochester Microscopical Society, from which the Academy of Science sprang, was organized in January, 1879. The first meeting, as a conference, was held in Professor Lattimore's lecture room in chemistry, the southeast room on the first floor of Anderson Hall. On the formal organization of the Society Professor Lattimore was elected President, continuing in office one year.

The Microscopical Society was started at a time when there was popular interest in the use of the microscope and its accessories, and the enthusiasm of its members soon made it a great success. In 1881 it had become the largest organization of the kind in America, and its annual public exhibitions, or Soirees, were occasions of great popular interest and largely attended.

The Microscopical Society having been so successful and the desire for a society that should cover a larger field being increasingly manifest, in two years an expansion of the organization was made, and the Rochester Academy of Science was incorporated May 14, 1881. The names of the incorporators were Myron Adams. H. F. Atwood, C. E. Rider, H. C. Maine, Adelbert Cronise, S. A. Lattimore, William Streeter and Cyrus F. Paine. The Microscopical Society was merged in the Academy as the Section of Microscopy.

From the first, Dr. Lattimore was an interested and leading member of the Academy, always willing to give the benefit of his wide scientific knowledge for the good of the organization. In later years, on account of his services, he was made an Honorary Member of the Society.

Dr. Lattimore did not present many formal papers to the Academy, but he was a frequent speaker in an informal way at the meetings. His special interest was, of course, in chemistry, but he was one of the old-time school of scientists whose knowledge extended over a broad field, and he was able to discuss almost any scientific subject with intelligence and true appreciation of its merits. His remarks were always so interesting, his illustrations so apt, his examinations so clear and his manner of presenting a subject so simple and lucid that he was always a welcome speaker. His dignified but pleasant manner, of the old-school courtliness, made him an ideal presiding officer when called upon to fill that position.

Such was Dr. Lattimore's reputation as an expert chemist, that he was frequently called upon by industrial corporations, municipal authorities, and courts of law for analyses, investigations, and expert testimony. As a chemist in the State Agricultural Department for many years he rendered important assistance, and twice he served as a member of the national commission of chemists to test the gold and silver coinage of the United States.

In 1872 he was employed by the Rochester water commissioners to test the water of all streams and lakes which were supposed to be available for the city water supply, and it was on the basis of his analyses and advice that the city purchased Hemlock lake, and later, Canadice lake.

In 1889, on account of an epidemic of typhoid fever at Springwater, which is within the drainage area of Hemlock lake, an analysis of the water of this lake was made by Professor Lattimore. The results of this examination were published in the proceedings of the Academy in connection with a paper given by George W. Rafter and Dr. M. L. Mallory on the subject of this epidemic.

On May 14, 1894, Dr. Lattimore read an able paper before the Academy on "The Recent Epidemic of Typhoid Fever in Buffalo," drawing particular attention to the imperative necessity of a close attention to the water supply of a city, and congratulating Rochester on the fact that its supply was drawn from Hemlock lake instead of Lake Ontario. This was printed in volume 2, of the Proceedings, pages 270–278.

Dr. Lattimore was ever progressive and kept fully posted on all matters of scientific interest. At a meeting of the Academy held October 28, 1895, he described the newly discovered element Argon and discussed its nature, its utility, and the manner in which it was discovered. In October, 1898, he described in a very interesting manner the geological formations and natural beauties of Mount Desert Island, on the coast of Maine, where he had spent his vacation.

Dr. Lattimore was always deeply interested in all that pertained to the welfare of Rochester, and was specially anxious that the city should do everything possible to preserve its beautiful natural features. In April, 1895, at the conclusion of a lecture by Professor H. L. Fairchild on the Geology of the Pinnacle Hills he presented the resolutions, unanimously adopted by the Academy, and printed in the Proceedings, volume 3, pages 178–179.

Dr. Lattimore's latest appearance before the Academy was last October, when, at a meeting devoted to a Retrospect of Science in Rochester, he spoke informally, in his usual pleasant manner, of the work of Professor Lewis Swift in astronomy, and supplemented Professor Fairchild's remarks on the work of Professor Henry A. Ward by a number of interesting personal reminiscences of that distinguished scientist and traveler.

FLORENCE BECKWITH.

WILLIAM STREETER

(Read before the Academy, December 18, 1916.)

In the death of Major William Streeter the Academy of Science lost its oldest member, both in years and in length of service, and one to whom the Society owes a great debt of gratitude.

Major Streeter was born at Whitingham, Vermont, October 11, 1834. His early life was spent on a farm. At the outbreak of the civil war he enlisted in the ranks, and belonged to the Tenth Massachusetts, a fighting regiment. He participated in eighteen engagements but escaped with only one wound. His rank as Major came by successive promotions, and it is said that he declined the promotion to Colonel, in favor of another officer.

Of the years following the civil war we have no record. Coming to Rochester in 1868 he engaged in business as a lock manufacturer, but soon entered the employ of the Sargent & Greenleaf Company as Superintendent; which position he held for almost 50 years. His unusual mental and physical vigor was shown by his ability to carry on his work until within four months of his death.

He was one of the original members of the Rochester Microscopical Society, organized in 1879, from which developed the Rochester Academy of Science. He was one of the incorporators of the Academy, in 1881, of whom only four are now living, H. F. Atwood, Adelbert Cronise, H. C. Maine and Cyrus F. Paine.

In the section of Astronomy, in the early days of the Academy, he was a very active member, having a fine telescope mounted in an observatory on the roof of his house. He was also an active member in the Section of Microscopy, and always retained his interest in microscopic work. His collection of microscopic objects and appliances was probably the largest and best in Rochester. He was always most generous in his services to all who needed expert help in study or identification of microscopic forms.

Major Streeter retained his membership in the Academy from its beginning until his death, in December, 1916. But his diffidence and modesty prevented him from taking an active part in the general meetings. The only offices which he ever consented to accept were those of Councillor, from 1889 to 1892; and Vice-Chairman of the Botanical Section from 1889 to 1915.

In 1899 he was made a Life Member of the Academy, on account of his having been a charter member; a man eminent for scientific accomplishments, and one who through the whole life of the Academy had worked for its success. But Major Streeter's special service to the Academy was as host and helper to the Botanical Section, to whose meetings he freely and cordially opened his house for more than twenty-six years; with the additional privilege of the use of his extensive library and microscopical resources. The continued life of the Section, as well as the successful work which it has accomplished, are largely owing to Mr. Streeter's kindness and hospitality in affording it a permanent meeting place. In the study of algae, mosses and lichens he was deeply interested, and did very fine microscopical work in connection with them, arousing much enthusiasm in the members of the Section.

Mr. Streeter was a man of refined tastes, with a keen appreciation of the best in literature, music and art; a close observer; well versed in several branches of science, and an ardent lover of nature. Those who had the privilege of taking strolls with him through forests and along streams will never forget his delightful companionship.

Personally he was a man of strong traits of character and positive convictions, yet ever genial and courteous in his intercourse with friends and associates.

The members of the Academy, and particularly of the Botanical Section, desire to express their appreciation of the life and worth of Mr. Streeter, their gratitude for his great assistance, their deep sense of loss, and their sympathy for the members of his family.

FLORENCE BECKWITH,
MARY E. MACAULEY,
M. S. BAXTER,
H. L. FAIRCHILD,
Committee.

MAJOR ALBERT VEEDER, M. D.

(Read before the Academy, December 9, 1918.)

During the years 1889 to 1899 Dr. M. A. Veeder was the Academy's mentor in matters of meteorology and solar physics. Living at Lyons and doing the work of a country physician and local health officer he took the time to attend our meetings and brought the results of his intensive studies in a subject foreign to his medical work. He was a remarkable man in his capacity for patient collection and tabulation of numerical data, his grasp of their significance, his prevision of the elusive relation between terrestrial phenomena and solar conditions, and his fearless persistency and confidence in urging his own conclusions. For in his study of electro-magnetic phenomena he was in advance of his day and his work was not appreciated. His appeals to the government bureaus were politely waived, and his writings neglected. How could a doctor in a country village discover any worth-while new truth in the difficult subject of solar influence?

But Dr. Veeder's work is coming into recognition. The eminent geographer and meteorologist, Professor Ellsworth Huntington, has published an appreciation of Veeder's work and writings in the Geographical Review of April, 1917 (Vol. 3, pages 188–211; 303–316). He says (page 188), "I can say with confidence, however, that in the study of meteorology I have come upon no writings which have stimulated me more than those of Dr. M. A. Veeder. His hypotheses may prove wrong, but that will not destroy the stimulating character of his broad and original ideas."

When Dr. Veeder joined the reorganized Academy, in 1889, he had published a 4-page article on the Aurora in the Siderial Messenger, and had privately printed an 8-page pamphlet. The writer of this memoir urged him to prepare fuller statements of his studies and theories for publication in the Proceedings of the Academy; with the result that six papers of his were printed in the first two volumes. These articles were on the Aurora, Storms, Zodiacal Light, and Solar Electrical Energy. No one in the Academy nor in Rochester was able to judge and correctly value these writings. They were technical, advanced physics, and objections were made to giving so much space to abstruse solar physics, and perhaps erroneous theories. But the money of the Academy was well spent in giving him a hearing and placing his work on record. That kind of mental activity deserves cultivation; and the correctness of the conclusions are of less importance. Mental geniuses are the hope of the race; and we may entertain angels unawares. Professor Huntington expresses this thought in the first paragraph of his article.

"To-day the poets and reformers seem to make their voices heard in almost every village. The careful, unostentatious scientist is the man most apt to do his work unheralded and unrewarded. There is perhaps no greater economic waste than that which condemns a man of great originality to spend his time in the ordinary round of common duties rather than in carrying on the so-called impractical investigations which are the essential foundation of all the so-called practical advances."

Dr. Veeder was born at Ashtabula, Ohio, November 2, 1848. He graduated at Union College in 1870. From 1875 he was Principal of Ives Seminary, at Antwerp, N. Y. In 1878–1879 he studied at Leipzig, Germany. He graduated in medicine at the University of Buffalo in 1883. To his death, November 16, 1915, he lived in Lyons. His devotion to thought beyond the common range and his interest in many things outside his medical practice were the cause of suspicion and criticism from people who could not understand and appreciate the unusual man. But he was a skillful physician and alert in medical science. On October 25, 1898, he read a paper before the Adacemy on "The spread of typhoid fever and kindred diseases by flies." His paper on that subjected printed in the Medical Record a month previous is believed to have been the first recognition of the fact.

Dr. Veeder was interested in the geologic features of his district, and wrote fugitive papers on this and other subjects. That his views on subjects apart from his specialties were sometimes more original than correct, was to be expected of a man with such active mind and fearless expression.

Professor Huntington's article discusses Dr. Veeder's work and his conclusions, and includes some writings that Veeder left in manuscript. A portrait is given. The following quotation is from the paper:

". . . In connection with Peary's polar expeditions he distributed over 5,000 blanks to observers in all the continents, in order to have simultaneous records from as wide a region as possible. It was always a pleasure to Dr. Veeder that people in many lands took such interest in recording and reporting auroras for him. These aurora studies led him to consider the relation between the activities of the sun and the earth. The result was that by 1895 he had framed an hypothesis which may possibly prove to be one of the most important contributions not only to meteorology but to astronomy."

"This modest, unassuming, but highly gifted man should never have been obliged to get a living by practicing medicine. He ought to have been connected with some great scientific institution where he would have been free to carry on his researches untrammelled by anxiety about the support of his family. His mind was extraordinarily fertile in ideas, not only in respect to his own profession but along other scientific lines. He appears to have been the first to publish an article clearly setting forth the now well-accepted idea that typhoid germs are carried by flies, and it was upon his advice that the medical department of the United States Government adopted its successful policy of preventing the spread of typhoid fever in Cuba and in the southern camps of our soldiers during the Spanish War. He was also a pioneer in advocating the open-air treatment of tuberculosis, and was perhaps the first adequately to explain it. . . ."

H. L. FAIRCHILD.

JOHN MASON DAVISON

(Read before the Academy, February 12, 1917.)

The subject of this sketch was born in Albany, N. Y., December 18, 1840, of New England ancestry. His father, bearing the same name, was Registrar in Chancery of the State of New York from 1839 to 1848. Mr. Davison senior became President of the Saratoga and Whitehall Railroad Company, and also of the Adirondack Railroad Company. His mother, Sarah S. Walworth, was the daughter of Reuben Hyde Walworth, who was for many years Chancellor of the State. In 1848 the family removed to Saratoga Springs.

Mr. Davison's early education was in the academies of Saratoga Springs and Ballston Spa, and in the Canandaigua Academy. The Principal of the latter school, Noah T. Clarke, was his cousin. He entered Williams College in 1858 and graduated in 1862 with the degree Bachelor of Arts.

After leaving college he studied law for a short time in the office of an uncle in New York City. Early in 1864 he took employment in the Second National Bank of Detroit, Mich., and became Assistant Cashier in 1873. On account of poor health he retired from business in 1882 and returned to his former home in Saratoga Springs. In 1887 he came to Rochester and remained here until his marriage, in 1911, to Miss Emma O. Decker of Evansville, Ind. The next two years were spent in Europe and then he settled in Detroit, Mich. He died at Santa Barbara, Cal., on April 30, 1915, at the age of 74.

Mr. Davison joined the Rochester Academy of Science in 1889, and was elected a Fellow in 1890. He was a member of the Council of the Society during the years 1890–1892 and 1899–1904, a service of nine years. He was also First Vice-President for the years 1893–1898, but declined more responsible official position.

It is not known if Mr. Davison had more than a casual or general interest in mineralogy and chemistry before coming to Rochester, but during the 24 years of his residence in the City or suburbs his chief occupation was chemical study and analysis in the University Laboratory, a matter of intellectual pleasure and scientific curiosity. He declined to accept pay for analyses made for others, and would not undertake the examination of material in which he was not personally interested. His name was carried in the Catalogue of the University of Rochester during all the years from 1888 to 1911 as a special or graduate student, not a candidate for degree. This standing in the student body of the College assured him the required laboratory facilities, and all his mornings and many afternoons were spent in the laboratory. His analytic work was specially on meteorites, in which study he became an expert and a recognized authority. The attached list of 12 titles of papers is the permanent record of his scientific work.

Of rather slender figure, gray hair and beard, with refined and quiet though somewhat reserved manners, gentle in speech and immaculate in dress even when at work, standing day after day at his table Mr. Davison was for over 20 years a familiar figure to the chemistry students and an interesting and admirable personality. Here was a man of advanced age, with financial means and independence, able in every way to follow his pleasure, and yet finding it in continuous study amid the fumes and odors of the chemical laboratory, instead of seeking diversion or working to amass money or gratify selfish ambition. To the students he was a fine example of unselfish devotion to the search for truth.

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H. L. FAIRCHILD.

GEORGE W. RAFTER

(Read to the Academy, December 9, 1918.)

This eminent hydraulic and sanitary engineer was born in Orleans, N. Y., December 9, 1856, and died at Karlsbad, Germany, December 29, 1907.

As a boy he attended the public schools, and spent three years at the Canandaigua Academy. In 1872 he was an optional student at Cornell University.

During the years 1889–1900 Mr. Rafter was active in the work of the Academy, being Corresponding Secretary in 1890–1891, and recorder of the Section of Zoölogy in 1890. He was a pioneer in the application of biological and microscopical analysis to the water supplies of cities. His paper published in the Academy Proceedings, volume 1, pages 34–44, on the Biological Examination of Potable Water marked a notable advance in sanitation, and his method there described, with illustrations, is the one still in use. In conjunction with Dr. M. L. Mallory he also published in volume 1 a paper on the Springwater typhoid epidemic. His collection of Algae he presented to the Academy in 1896.

The city of Rochester is greatly indebted to Rafter for the devotion of his knowledge and ability to the city's engineering problems. In 1876, and again in 1883–1887 he was Assistant Engineer of the Rochester Water Works, and was Acting Chief Engineer in 1890. From June, 1888 to October, 1890 he was in charge of the work giving additional water supply to the city from Hemlock lake. He was widely employed in constructional work and as expert adviser, and his most important engineering work was in the employ of New York State, in water-supply investigation, control of river flow and plans for water storage. Of special interest to Rochester was his survey for Genesee River storage by a dam at Portage. He was a member of the Water Storage Commission. In 1894 he was sent abroad by the State Engineer to investigate bridges and dams. His work on the "Hydrology of the State of New York," forming the State Museum Bulletin No. 85, of 902 pages, is a monument to his ability and industry. Five papers in the Water-Supply Papers of the U. S. Geological Survey were written by him. His comprehensive work on sewage disposal, with Mr. M. N. Baker, has been a standard textbook. He was a prolific writer, but his bibliography has not been compiled.

An interesting account of Mr. Rafter's work and of his personality, written by Mr. J. Y. McClintock, is published in the Transactions of the American Society of Civil Engineers, volume 62, to which the writer is indebted for some items here given.

H. L. FAIRCHILD.

EMIL KUICHLING

(Read before the Academy, December 9, 1918.)

Rochester owes a heavy debt to Emil Kuichling for the devotion of his high abilities and honest purpose to the engineering work of the city, and the Academy of Science is honored by his connection.

He was born at Kehl, Germany, January 20, 1848. His father, Louis Kuichling, a graduate in medicine of Gottingen and Freiburg, was sentenced to death for participation in the revolution of 1848, but escaped to America and settled in Rochester. Emil studied at private schools, and at the age of 14 was apprenticed to a master builder. Later he was employed in the office of the City Surveyor, and worked winters in the local office of the Erie Canal engineer. In 1868 he graduated at the University of Rochester in the Arts course, and in 1869 received the degree of Civil Engineer. Then in two years he covered the three years course at the Polytechnic School of Carlsruhe, Germany, obtaining another C. E. degree in 1872. All his vacations were used in practical work or in examination of engineering works in America or Europe. From 1873 to 1885 he was Assistant Engineer of the Rochester waterworks, and then was elected to the Executive Board of the city. This latter position he resigned in 1887 in order to superintend the construction of the East Side sewer. During trips to Europe he studied the details of European sanitary engineering and was recognized as a leading American authority in that branch of engineering, and his services as an expert were in demand. In 1890 he became chief engineer of the Rochester waterworks, resigning about 1900 to devote himself to his large private practice. He had much to do with the planning of the new conduit from Hemlock Lake and with the sewage disposal system that removes the sewage from the Genesee River. He was consulting engineer on the State canal work; was called as an expert in many important litigations; and was consulted by many cities in the United States and Canada on matters of water supply and sewage disposal. He was a member and officer of many engineering organizations and public health associations. His contributions to scientific literature were many and valuable.

During the early years of this Academy Mr. Kuichling was an active Fellow. In 1895 and 1898 he described to the society the plans and the construction of the Hemlock conduit. The Rochester Engineering Society had its beginning as a Section of the Academy, with Kuichling as Chairman and J. Y. McClintock as Recorder.

He married Sarah L. Caldwell in 1879. He died in New York City November 9, 1914. "He was a true and faithful citizen and an able, fearless and kindly man, who left the impress of his work on the city of his adoption and the impress of his rich personality on all who were intimately associated with him."

H. L. FAIRCHILD.

JOHN WALTON

(Read before the Academy, December 9, 1918.)

Rev. John Walton was born in England, at Newcastle-on-Tyne, January 14, 1834. The name Walton came through his adoption in childhood by an uncle. At the age of 12 he attended for two years a Government School of Design and Art, and then was apprenticed to a house painter for the term of seven years. In 1860 he came to America with his family and goods, and to Rochester, by way of Canada, in 1863. For some years he worked for Frank VanDorn, the sign painter, and it was by Walton's work that the picture sign became popular.

His art work for James Vick began in 1870, but was interrupted by three years of ministerial work outside the city, 1874–1877. From lettering cases and designing labels he became the artist of the Vick Catalogue and the floral chromos, then in vogue. In 1879 Mr. Vick began the publication of Vick's Magazine, and Walton supplied the artistic illustrations for over ten years. He painted not only the colored plates of flowers and fruits but drew the black-and-white sketches and the charming head and tail pieces. He was also employed by the leading physicians of the city to make colored drawings of surgical cases; and in the later years he was employed by the Park Board in preparation of botanical pictures.

For years he was also the color artist at Ward's Natural Science Establishment.

Before leaving England Walton had been a Local Preacher in the Primitive Methodist Church, and at different times from 1864 to 1886 he was in charge of churches of the Methodist denominations, in and outside of Rochester; even as far as Tamaqua, Penn.

It is said that from childhood Walton was fond of the out-of-doors, and it was but natural that such a skillful artist of plant life should be interested in the associated animal life. He became an authority on the molluscan fauna. Two papers by him were published in the Academy Proceedings; one on the occurrence of Mesodon Sayii, in volume 1; and an extended paper on the Mollusca of Monroe County, in volume 2. The latter paper is beautifully illustrated by eight plates of outline drawings by his own hand. His collection of shells was presented to the Academy in 1891, on which account he was later elected a Life Member. For many years he was the Curator in Conchology. He was especially active in the Botanical Section, and the records of the public meetings have many references to his participation. In 1897 he read a paper on the fertilization of Orchids, which was not published.

Apart from Mr. Walton's work in the ministry his most serious occupation was his floral artistry. He had the ambitious plan of publishing a work on the wild flowers of the Rochester district, illustrated by his own colored sketches, and he painted a great number of flowers from life, in the woods and fields. The plan did not mature, but many of his charming pictures are in possession of members of the Botanical Section, and most highly prized.

John Walton was a man of unusual artistic ability and a true scientific spirit; in character unselfish, in manners gentle and refined; a lovely spirit. He was married three times. His later years were enfeebled, and he died May 13, 1914, at the age of 80.

H. L. Fairchild.

RICHARD MOTT MOORE, M. D.

(Read to the Academy, December 9, 1916.)

Dr. Moore was the strongest representative of the Academy in the serious study of entomology since the death of Mr. Robert

Bunker, in 1892. He was born November 23, 1856. His early education was in private schools, with some work in 1873–1875 at the University of Rochester. He graduated at the Buffalo Medical College in 1878, and very soon began medical work with his father, the eminent physician and surgeon, Edward Mott Moore, senior, and he continued in medical practice to his death, September 23, 1916. For a time he was an instructor in the Buffalo college. In 1893 he was appointed a member of the Rochester Board of Health. He was a member of several medical and health associations, and was President of the Rochester Academy of Medicine in 1910–11.

From his childhood Dr. Moore was interested in insects, and in his mature life the pursuit of entomology was his avocation and recreation. His special branch was the coleoptera (beetles), but he had intimate knowledge of other insect orders.

In the Proceedings of the Academy he published no papers, but made contributions to American entomological journals and issued a paper on "Habits of the Cicindela" and "Observations on Mayflies." He had in preparation a book on beetles, but was anticipated by Blatchley. When his fatal illness came he was collecting material for a paper on the carrion beetles.

The Section of Entomology of the Academy was organized by the group of young men that Dr. Moore had attracted about him for the study of insect life, and he was made the Chairman. His valuable library and his collection in entomology were bequeathed to the University of Rochester.

H. L. FAIRCHILD.

HARRY L. PRESTON

(Read before the Academy, December 9, 1918.)

For many years Mr. Preston was the Academy's expert and authority in mineralogy and petrography. He was born in Philadelphia in 1856, and spent his early life there. He graduated at the Newton School, in West Philadelphia; and for a time attended the University of Pennsylvania. His work in mineralogy began with his employment by Dr. A. E. Foote, the well-known dealer in minerals. Preston had charge of Foote's exhibit at the Centennial Exposition. About two years later he met Professor Henry A. Ward, who appreciating his skill, induced him to come to Rochester; and until his death, June 15, 1904, he was continuously in the Ward's Establishment. Professor Ward is quoted by Charles H. Ward as saying that Preston was the most proficient man he had ever known in the instant identification of minerals and rocks.

Preston was active in the Academy from 1889 until near the time of his death. He was Secretary of the short-lived Section of Geology in 1889–1891; and was one of the Council in 1891 and 1893.

Preston's published writings related to meteorites. Volumes 2, 3 and 4 of the Academy Proceedings contain four papers; one being the description of a new and excellent method for etching iron meteorites so as to display their crystalline structure. The two later papers were also printed in the Journal of Geology, Volume 4. Five papers were published in the American Journal of Science, volumes 5 and 9, between 1898 and 1900. A tenth paper, his last, on a meteorite from Niagara, North Dakota, was printed in the Journal of Geology, volume 10, 1902.

H. L. FAIRCHILD.

LIST OF PAPERS READ BEFORE THE ACADEMY

DATE	AUTHOR	TITLE
1910.		
Oct. 24,	Harrison E. Howe,	The chemical composition of optical glass.
Nov. 14,	Richard M. Moore,	Dragon-flies.
Nov. 28,	Charles C. Zoller,	Photographs in colors of nature, by the Lumiere process.
Dec. 12,	William F. Devendorf,	The telephone, its inventors, successive forms and operation.
1911.		
Jan. 9,	Charles Wright Dodge,	Demonstration of anatomy with the projection microscope.
Feb. 13,	Roland Cole,	Modern office systems.
Mar. 13,	George W. Kellogg,	Customs of the Indians on the Tonawanda Reservation.
Mar. 27,	Charles E. Lee,	Mines and miners of Mexico.
Apr. 10,	Committee of the Botanical Section,	Early botanists of Rochester. (Printed as pages 39–56 of this volume.)
Apr. 10,	William D. Merrell,	Algae of the vicinity of Rochester.
Apr. 24,	Reuben A. Punnett,	Occult phenomena and psychological marvels.
May 28,	George E. Fell,	The currents at the east end of Lake Erie, and their influence on the sanitation of Buffalo.
Nov. 27,	John R. Williams,	The modern conception of the physiology of digestion.
Dec. 11,	J. L. Roseboom,	Esperanza as the universal language of science.
1912.		
Jan. 8,	John F. Skinner,	The Panama Canal, and life on the Isthmus.
Jan. 22,	Victor J. Chambers,	The chemistry of coal.
Feb. 12,	A. L. Benedict,	The life of western New York Indians.
Mar. 1,	Carl E. Akeley,	Hunting big game in Africa.
Mar. 11,	Harrison E. Howe,	Manufacture of beet sugar.
Mar. 11,	Charles C. Zoller,	Rochester beautiful in the colors of nature.
Mar. 25,	John M. Swan,	Biology of the malarial parasites.
Apr. 8,	Charles W. Dodge,	Sensory activity of plants.

DATE	AUTHOR	TITLE
Apr. 22,	Herman L. Fairchild,	The history of the removal of the ice sheet from New York State.
May 13,	C. W. Hennington,	Poisonous snakes.
May 27,	Elon H. Eaton and Florence Beckwith,	Bergen swamp, etc.
Oct. 14,	H. L. Fairchild, Florence Beckwith, S. A. Lattimore, C. W. Hennington,	Retrospect of science in Rochester.
Oct. 28,	William S. Magill,	Antitoxines and vaccines.
Nov. 25,	Howard D. Minchin,	Absorption values of glass.
Dec. 9,	A. L. Benedict,	Food values; physiologic and economic.
1913.		
Jan. 13,	W. D. Bancroft,	The theory of dyeing (joint meeting with the Rochester Section of the American Chemical Society).
Jan. 27,	Herman L. Fairchild,	Maps of New York State under the latest ice sheet.
Feb. 10,	Harrison E. Howe,	Chemical experiments with the aid of projection.
Feb. 10,	Charles C. Zoller,	Views of Rochester in colors of nature.
Feb. 24,	Chester F. Stiles,	Mountain climbing of Mt. Washington in winter.
Mar. 10,	Victor J. Chambers,	The preparation in the chemical laboratory of valuable substances.
Mar. 24,	Frederic W. Hinrichs,	The testing of materials.
Apr. 7,	H. S. Miner,	The history of the development of gas lighting (joint meeting with the Chemical Society).
Apr. 28,	E. A. Rumball,	Housing conditions in Rochester.
May 12,	D. D. Scott,	The mining region of Lake Superior.
May 26,	George W. Kellogg,	Photographs of flowers with a hand camera.
Oct. 13,	William M. Davis,	The lessons of the Colorado Canyon, and how we determine the age of the earth.
Nov. 10,	J. E. Woodland,	Experiments with liquids, gases and thermit.
1914.		
Jan. 12,	W. H. White,	Under what conditions is concrete a safe building material?
Jan. 26,	Arthur L. Schoen,	An electrical process for separating smoke from chimney gas.

DATE	AUTHOR	TITLE
Feb. 9,	Herman L. Fairchild,	Views of Mexico.
Feb. 23,	Herman L. Fairchild,	Earthquakes.
Mar. 9,	Charles C. Zoller,	See your own country first, then a bit of Europe.
Mar. 23,	Herman L. Fairchild,	Snow crystals as illustration of mineral crystallization.
Apr. 3,	Victor J. Chambers,	Dyes and dyeing.
Apr. 27,	Chester F. Stiles,	Interesting applications of photography.
May 11,	John M. Swan,	The newer methods of studying diseases of the heart.
May 25,	Elon H. Eaton,	The birds of western New York.
Oct. 12,	Several speakers,	Reports on summer experiences.
Oct. 26,	Herman L. Fairchild,	The geologic why of Rochester.
Nov. 9,	P. F. Trowbridge,	Some problems of nutrition (joint meeting with the Chemical Society).
Nov. 30,	Howard Rhode,	Manufacture of Portland cement.
Dec. 17,	Charles F. Binns,	The history and art of clay working.
1915.		
Jan. 4,	Arthur L. Day,	The volcano Kilauea in action (joint meeting with the Chemical Society).
Jan. 7,	William M. Davis,	The origin of coral reefs (meeting in participation with the University of Rochester).
Feb. 8,	Charles C. Zoller,	Europe by color photography.
Feb. 22,	Victor J. Chambers,	The utilization of waste materials.
Mar. 8,	Howard D. Minchin,	Illumination and vision.
Mar. 29,	Douglas W. Johnson,	Surface features of western Europe as a factor in the war.
Apr. 26,	Hugh P. Baker,	Forests and forestry in New York.
May 10,	Herman L. Fairchild,	Meteor Crater, Arizona.
May 24,	Schuyler Bull,	The structure of the atom and the cause of color.
June 7,	George H. Chadwick,	Post-glacial history of the lower Irondequoit Valley (read by title and printed as pages 123–159 of this volume).
June 7,	William L. Bray,	The development of the vegetation of New York State.
Oct. 11,	Several speakers,	Reports on summer experiences.
Nov. 22,	Arthur P. Coleman,	Ice ages in Africa, Australia and India.
Nov. 29,	Charles A. Dewey,	A sketch of the life of Lewis Henry Morgan.

DATE	AUTHOR	TITLE
Nov. 29,	Algernon S. Crapsey,	Lewis Henry Morgan, scientist, philosopher and humanist (joint meeting with the Rochester Historical Society).
Dec. 13,	Thomas C. Hopkins,	Physiographic and structural features of the Rocky Mountains.
1916.		
Jan. 10,	George H. Chadwick,	The land of Rip Van Winkle.
Jan. 24,	Several speakers,	Symposium on the public health.
Feb. 14,	Merton Y. Williams,	Interesting phases of the Silurian of Ontario, Canada.
Feb. 28,	Charles H. Richardson,	Coal mining with a camera.
Mar. 27,	Victor J. Chambers,	The purification of potable water.
Apr. 10,	Charles C. Zoller,	Autumn and winter views in the colors of nature.
Apr. 24,	Herman L. Fairchild,	A trip to Cuba and Panama.
May 8,	H. L. Fairchild, Ellsworth P. Killip, Charles W. Dodge,	Symposium on Jamaica.
May 22,	Guy H. Bailey,	The call of the out-doors.
Oct. 9,	Several speakers,	Reports on summer experiences.
Nov. 13,	Milroy N. Stewart,	Observations in meteorology.
Nov. 27,	Cogswell Bentley,	Canoeing and camping in Timagami.
Dec. 18,	Ira S. Wile,	The scientific bases of modern medicine.
1917.		
Jan. 8,	Schuyler Bull,	Color harmony.
Jan. 22,	Charles P. Berkey,	Geological problems and discoveries of the Catskill Aqueduct.
Feb. 12,	Charles C. Zoller,	The Adirondacks and Thousand Islands in color.
Feb. 26,	George A. Frank,	Shade trees and their insect enemies.
Mar. 12,	Several speakers,	The geology of western New York.
Mar. 26,	Homer D. House,	Botanizing with a camera.
Apr. 9,	George L. English,	The wonders and beauties of calcite.
Apr. 23,	Elon H. Eaton,	Some rare birds of western New York.
May 28,	Joseph G. Taylor,	Among the pines of southern New Jersey.
Oct. 22,	Dhan Gopal Mukerji,	India under British rule.
Nov. 2,	Robert S. Breed,	The milk question.
Nov. 26,	Heinrich Ries,	Scandinavia, the land of ice and iron.
Dec. 10,	Charles H. Richardson,	Picturesque Vermont.

DATE	AUTHOR	TITLE
1918.		
Jan. 14,	ALBERT W. GILES,	Eskers in the vicinity of Rochester, New York (read by title, and printed as pages 161–240 of this volume).
Jan. 28,	E. P. FELT,	Gall-insects and their relation to plants.
Feb. 11,	R. M. RICHTER,	The Indiana limestone industry.
Feb. 25,	GUY A. BAILEY,	Close-ups with the birds.
Mar. 11,	F. C. HAMILTON,	Modern warfare.
Mar. 25,	ROBERT G. COOK,	Aircraft in war.
Apr. 8,	FRANK H. HAMLIN,	Argentina.
Apr. 22,	LATIMER J. WILSON,	Mars and Jupiter through the telescope.
Apr. 29,	WILLIAM A. PARKS,	The northland of Ontario.
May 13,	HERMAN L. FAIRCHILD,	Post-glacial land uplift and the story of the Rochester canyon.
May 27,	JOHN DUNBAR,	Interesting fruits, economic plants and remarkable trees of the world.
June 10,	HERMAN L. FAIRCHILD,	Drumlins, kames and eskers of western New York.
June 24,	FLORENCE BECKWITH,	A botanical visit to Stonewall Gap, Colorado.
June 24,	HERMAN L. FAIRCHILD,	Memoir of Grove Karl Gilbert. (Printed as pages 251–259 of this volume.)
Nov. 11,	Several speakers,	Reports on summer experiences.
Nov. 25,	W. H. JORDAN,	Government aid to agriculture.
Dec. 9,	HERMAN L. FAIRCHILD,	Memoirs of Henry A. Ward and other deceased Fellows of the Academy. (Printed as pages 241–276 of this volume.)
Dec. 9,	GEORGE H. CHADWICK,	Portage stratigraphy of western New York. (To be published in the Bulletin of the Geological Society of America.)

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of the

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Miss Mary E. Macauley*†....................................19 Pinnacle road
Charles W. Markus....................................Eastman Kodak Co.
Mrs. Clara B. Marsh....................................42 Savannah street
Herbert Marth....................................107 Delevan street
W. A. Matson....................................23 Lake avenue
Warren A. Matthews*....................................56 Lansdale street
C. E. K. Mees*....................................Eastman Kodak Co.
John L. Merrell....................................106 Edgerton street
William D. Merrell*....................................University of Rochester
Carl W. Meyer....................................523 Averill avenue
Miss Minnie C. Michel....................................67 Saranac street
Mortimer E. Milburn....................................15 Kensington street
G. W. Moffet....................................118 Gorsline street
Charles S. Moon, D.D. S....................................126 Sibley Block
Fred C. Morgan....................................189 Clinton avenue north
Mrs. John W. Oothout....................................1063 East avenue
Charles H. Palmer....................................Genesee Valley Trust Co.
Louis A. Pechstein*....................................University of Rochester
Herman K. Phinney*....................................University of Rochester
Mrs. Horace G. Pierce....................................58 Albemarle street
C. E. Pratt....................................938 Granite Building
Miss Stella E. Prongay....................................305 Garson avenue
Milton B. Punnett*....................................Pittsford, N. Y.
Mrs. Della B. Renwick....................................2 Livingston park
G. Willard Rich....................................711 Wilder Building
J. L. Roseboom, M. D.*....................................672 Main street east
Fred W. Ross*....................................1990 Dewey avenue
Dunbar B. Scott....................................27 Carthage road
Harry H. Servis....................................21 Riverside street
Jacob Schuler....................................733 Monroe avenue
Mrs. Mabel Sherry-Hall....................................71 Clinton avenue south
Miss Esther Smith....................................68 Melville street
Mrs. G. A. Spear....................................37 Washington street south

Miss Julia B. Spencer................................11 Greenwood street
Nelson E. Spencer................................809 Wilder Building
Edwin Allen Stebbins................................Clover Street, Brighton
Miss Ida H. Stebbins................................52 Albemarle street
Miss Eleanor Stewart................................126 Plymouth avenue south
Milroy N. Stewart................................Taylor Instrument Companies
Miss Jennie E. Strowger................................855 Main street
Charles R. Sumner, M. D.*................................20 Sibley place
Miss Anna B. Suydam*................................47 Caroline street
John W. Then................................3 Vienna street
Mrs. George T. Thompson................................Canandaigua, N. Y.
Miss Arelyn C. Thurston................................15 Westgate terrace
Miss Marinette E. Thurston................................15 Westgate terrace
Miss Anna Van Aalst................................69 Prince street
Robert C. Vance................................16 Florence street
Mrs. Ethel M. Vanderbergen................................70 Melrose street
Albert J. Walcott................................Bausch & Lomb Optical Co.
Frank A. Ward*................................Ward's Nat. Science Establishment
J. Foster Warner*................................5 Prince street
Herbert A. Weiss................................University of Rochester
George Wendt*................................Mechanics Savings Bank
Mrs. Gertrude Wendt................................Stone road, Barnard
Miss Frances G. West*................................89 Meigs street
Lansing G. Wetmore................................Scrantom, Wetmore & Co.
Douglas M. White*................................1195 North street
Milton E. Woodams................................783 South avenue
Philip H. Yawman................................322 University avenue
Charles C. Zoller*................................100 Delevan street

* Indicates a Fellow.

† Indicates a Life Member

INDEX, VOLUME V.

The papers on plants of Monroe County and Rochester carry their own indexes, and the plant names in the systematic lists are not repeated here. The indexes are on pages 37–38; 120–121.