Donated by Carol Heubusch
Curator of Geology
Buffalo Museum of Science
11/10/59.

GUIDEBOOK

NEW YORK STATE GEOLOGICAL ASSOCIATION

24TH ANNUAL MEETING

BUFFALO, N.Y.

MAY 1-3, 1952

SPONSORED BY THE BUFFALO MUSEUM OF NATURAL SCIENCE AND THE UNIVERSITY OF BUFFALO

PREPARED UNDER THE SUPERVISION OF
EDWARD J. BUEHLER
ASSISTANT PROFESSOR OF GEOLOGY
UNIVERSITY OF BUFFALO

INSTRUCTIONS

IMPORTANT NOTICE! The Saturday field trip will include a trip to Canada. All foreign born citizens must bring the necessary papers for crossing the border in both directions. E4 students must bring a statement from their school stating that they are enrolled at that institution. All cameras and expensive equipment that you expect to bring into Canada must be registered at the time of registration.

WARNING! BUFFALO can be nasty at this time of year so come prepared for cold, wetweather and hope for the best. Also be prepared for wading through mud and water.

ACKNOWLEDGEMENTS

This field guide pamphlet has been compiled through the combined efforts of Prof. Edward Buehler, Dr. Reginald Pegrum, John Sargent, Virginia Cummings, Donald Wisnet, Paul Blackmon, Jim Cadwell, Gerald Hagen, and Mr. and Mrs. James Hunt.

SCHEDULE OF EVENTS

Register in the Main Lobby of the Buffalo Museum of Science, Humboldt Park, Buffalo, New York, May 1, 2, 3.

THURSDAY MAY 1, 1952

Specialized Field Trips - Private Cars - Gather at the Museum

Paleontology - Fossil collecting in the Hamilton group
led by Donald Fisher 1 P.M.

Mineralogy - Mineral collecting in the Lockport dolomite
led by Larner Peak 1 P.M.

Economic Geology - Industrial trip through the gypsum plant at Clarence, N.Y.
led by Dr. R.H. Pegrum Leaves Museum at 1 P.M.

Upper Devonian Stratigraphy and Paleontology
led by Irving H. Tesmer 10 A.M.

Vertebrate Paleontology and Paleobotany
led by Altck Carter 1 P.M.

Guided tours through the Buffalo Museum of Science 7 P.M. - 10 P.M.

FRIDAY MAY 2, 1952

8:30 A.M. - 5:30 P.M. All day Field Trip. Middle Devonian Stratigraphy and Paleontology. Mineral collecting at Lockport. Busses leave Museum promptly at 8:30 A.M.

7:30 P.M. Banquet and Illustrated Lectures. Hotel Markeen, Main St. at East Utica, Buffalo, N.Y. Turkey or fish.

Stratigraphy and Paleontology of the Niagara Gorge
by Prof. Edward Beuhler

The Carving of the Gorge by John Sargent

Power Development of the Niagara River by Dr. R.H. Pegrum

SATURDAY MAY 3, 1952

8:30 A.M. - 5:30 P.M. All day Field Trip. Niagara Gorge and Niagara Falls. IMPORTANT This trip will be in Canada SEE INSTRUCTIONS.

7:30 P.M. - 11:30 P.M. Informal gatherings at the homes of Max Kopf, 750 Elmwood Avenue, Buffalo; Dr. Wilbur Hoff, 191 Huxley Drive, Snyder; and R.R. Hibbard, 219 Bissel, Buffalo.

Itinerary - May 2

Leave Museum: 8:30

The topography in the vicinity of Buffalo is generally flat. The bed rock is covered by red clay, silt, and sand of glacial Lake Warren. These deposits extend to the south and east as far as the beach line of former Lake Warren near the town of Springbrook, N.Y.

Arrive Federal Crushed Stone Quarry: 8:50

This quarry is in the upper beds of the Onondaga limestone. The contact with the overlying Marcellus shale is less than a mile to the south. The lower beds of the Onondaga limestone will be examined in the afternoon in the Williamsville and Clarence quarries.

The upper portion of the Onondaga is is fine grained, light gray to dark gray limestone. The fauna consists largely of brachiopods (the genus Leptaena is especially common). Excellent specimens of fenestellid bryozoans are common and an occasional large nautiloid of the genus Rytiœras is found.

Note the excellent example of glacial pavement where the advancing glacial ice swept clean the top of the Onondaga limestone. The striations clearly indicate the direction of local ice movement. This glacial pavement is so smooth that it is utilized as a roadway by the quarry vehicles. On the far side of the quarry the limestone is covered by an excellent section of varved clay, representing annual deposition of clay and silt in a glacial lake.

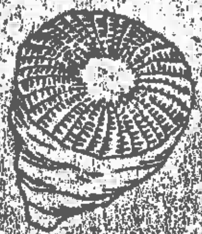
Leave Federal Crushed Stone Quarry: 9:20

Arrive Buffalo Creek: 9:40

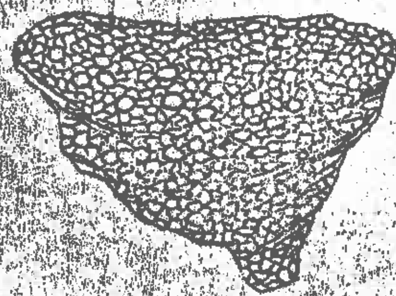
The busses will leave the group at the point where Girdle Road crosses Buffalo Creek and meet the group later at the bridge where Bullis Road crosses Buffalo Creek. An outcrop of the Ludlowville and Moscow formations will be examined at this stop. The traverse along Buffalo Creek is approximately in the direction of dip of the formations. The crumbly gray shale is the Wanakah member of the Ludlowville formation. Brachiopods, corals, and bryozoans are very abundant, especially in the upper beds. The base of the Wanakah shale is marked by beds in which the brachiopod genus Strophalosia and the tabute coral Pleurodictyum are abundant. The underlying Ledyard member has the same lithology as the Wanakah shale but fossils are not as abundant. The Wanakah shale is succeeded vertically by 3 feet of massive limestone, the Tichenor limestone member of the Ludlowville formation. This too is richly fossiliferous with tetracorals and tabulate corals especially conspicuous. The soft calcareous shale of the Windom shale member of the Moscow formation overlies the Tichenor limestone. The Windom shale also has a rich "Hamilton" fauna. Especially abundant is the small productid brachiopod Ambocoelia umbonata.

Buffalo Creek is crossed by a series of sandy ridges which were deposited at the shore line of Lake Warren. The Lake Whittlesey shore line further south is generally indicated by a single ridge of sandy material whereas the Lake Warren shoreline for most of its length in this area is represented by multiple sandy ridges, usually two or three. Lake Whittlesey deposits can be seen here as gravel deposits brought into the lake by Buffalo Creek and Little Buffalo Creek and covered by the sands of the Lake Warren shoreline, when the water receded to the Warren level.

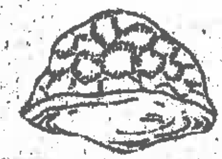
THE MOST COMMON HAMILTON FOSSILS



Heliophyllum halli



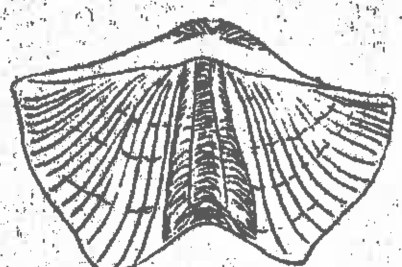
Favosites



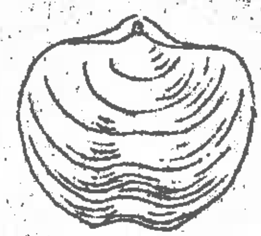
Pleurodictyum

Fenestella

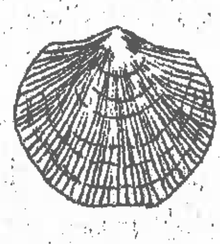
Mucrospirifer mucronatus



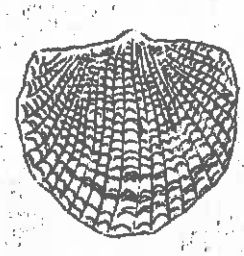
Spinocyrtia granulosa



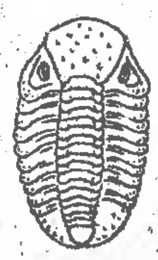
Athyris spiriferoides



Atrypa reticularis



Atrypa spinosa



Phacops rana

Leave Buffalo Creek: 12:00

Arrive Como Lake Park for lunch: 12:20

Leave Como Lake Park: 1:10

Arrive Louisville Cement Co. Quarry (Clarence): 1:40

The formations exposed in this quarry are from top to bottom 1) The lower portion of the Onondaga limestone, characterized by abundant irregular-shaped nodules of chert. 2) The Cobbleskill dolomite, about 8 feet thick

Note the unconformity representing the Lower Devonian between the Cobbleskill dolomite and the Onondaga limestone.
3) The Bertie dolomite (upper beds only) gray, more even in texture and exhibiting conchoidal fracture. The Bertie and Cobbleskill formations are both of Late Silurian age (Cayugan series)

Leave Louisville Cement Co. Quarry: 2:10

The Moraine designated by Taylor the Niagara Falls Moraine crosses Transit Road (Route 78) approximately one mile north of Sheridan Drive. This marks the approximate southern limit of Lake Tonawanda, a lake some 50 miles long by 10 miles wide which occupied the depression between the Onondaga and Niagara escarpments. The deposits consist of yellow or gray clay and silt. Vestiges of Lake Tonawanda remain today as swamps in the vicinity of Batavia and Bergen. Near the city of Lockport, N.Y., about 14 miles north the Niagara Falls moraine is the cluster of moraines known as the Barre moraine.

Arrive Frontier Crushed Stone Quarry: 3:00

The rock quarried here is the Lockport dolomite of Middle Silurian age (Niagaran series). The quarry is located on the outskirts of the city of Lockport, N.Y., the type locality for this formation. Only a portion of this formation is exposed here. A more complete section including the lower members will be studied Saturday on the Niagara Gorge trip. Fossils are scarce in this formation but some excellent minerals are to be found lining vugs in the rock. The minerals which can be collected here include:

- Dolomite (salmon pink rhombohedrons)
- Calcite (yellowish scalenohedrons)
- Gypsum (massive, granular
(Selenite variety, transparent, one way cleavage
- Galena
- Sphalerite
- Celestite

Leave Frontier Crushed Stone Quarry: 3:50

Arrive Williamsville Quarry: 4:20

The Williamsville quarry is very near the edge of the Onondaga escarpment. This quarry is in the basal portion of the Onondaga limestone. The upper beds were studied this morning in the Federal Crushed Stone Co. Quarry. At

Williamsville a coral layer at the base of the Onondaga ls. is swollen into a reef approximately 20 feet thick as contrasted to its usual thickness of less than one foot. The reef consists of closely packed coralla of a large variety of tetracorals and tabulate corals in a matrix of crinoidal limestone. Notice how the upper beds arch over the reef.

Leave Williamsville Quarry: 4:50

Arrive Museum: 5:30

Itinerary Saturday May 3

Leave Buffalo Museum of Science: 8:30

To facilitate customs clearance a list of all cameras, Brunton compasses, etc. will be prepared in advance for each bus. Aliens and foreign students must have passports and other necessary papers for crossing the border.

Arrive Lewiston Bridge: 9:30

There will be an unavoidable delay here for customs clearance. Please be patient. Observe the Niagara escarpment over which the bus just drove, the flat plain to the north, and the broad, quiet lower Niagara River.

The major event of this trip is a hike along a road which was cut into the Canadian side of Niagara Gorge by the Hydro Electric Power Commission of Canada. The hike will begin at Queenston, Ontario at the base of the Niagara escarpment and will end at Niagara Glen where busses will be waiting.

This road cut exposes the complete Niagara Gorge section from Queenston shale to Lockport dolomite inclusive, although the complete thickness of the two formations named is not exposed. For details see the stratigraphic column and description of Paleozoic formations of Western New York in the guide book. The excavations for the power plant provide a rare opportunity to see this complete section at one view and in freshly exposed rock.

Arrive Niagara Glen for lunch: 12:00

This projecting shelf of Lockport dolomite marks a former lip of the falls. There will be enough time during the lunch stop to inspect the boulders and pot holes at the base of the cliff.

Leave Niagara Glen: 1:00

Arrive Whirlpool: 1:05

The cliff on the northwestern side of the Whirlpool basin is composed of unconsolidated material. This marks the filled in pre-glacial St. Davids gorge which extends northwestward to St. Davids, Ontario.

Leave Whirlpool: 1:20

Arrive Whirlpool Rapids elevator: 1:25

This elevator trip to the bottom of the gorge affords an interesting and spectacular view of the whirlpool rapids.

Leave Whirlpool Rapids elevator: 2:15

Arrive at Falls: 2:30

Leave Falls: 3:00

Arrive Burning Springs: 3:05

Leave Burning Springs: 3:20

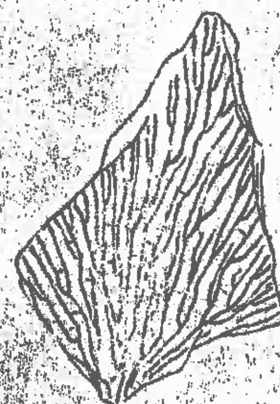
Arrive Goat Island: 3:50

Leave Goat Island: 4:10

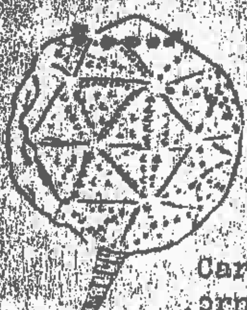
Arrive Museum: 5:00

THE MOST COMMON SILURIAN FOSSILS

Arthrophycus alleghaniensis



Dictyonema

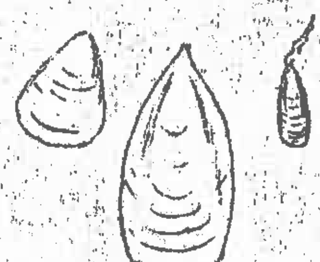


Caryocrinites ornatus

Stephanocrinus angulatus

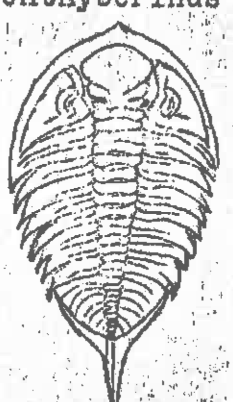
Eucalyptocrinites

Ichthyocrinus

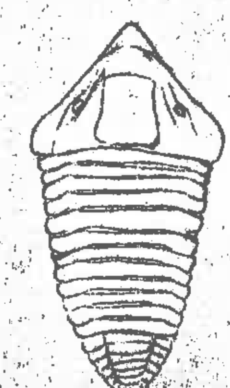


Lingula

Whitfieldella



Dalmanites



Trimerus

Physiography

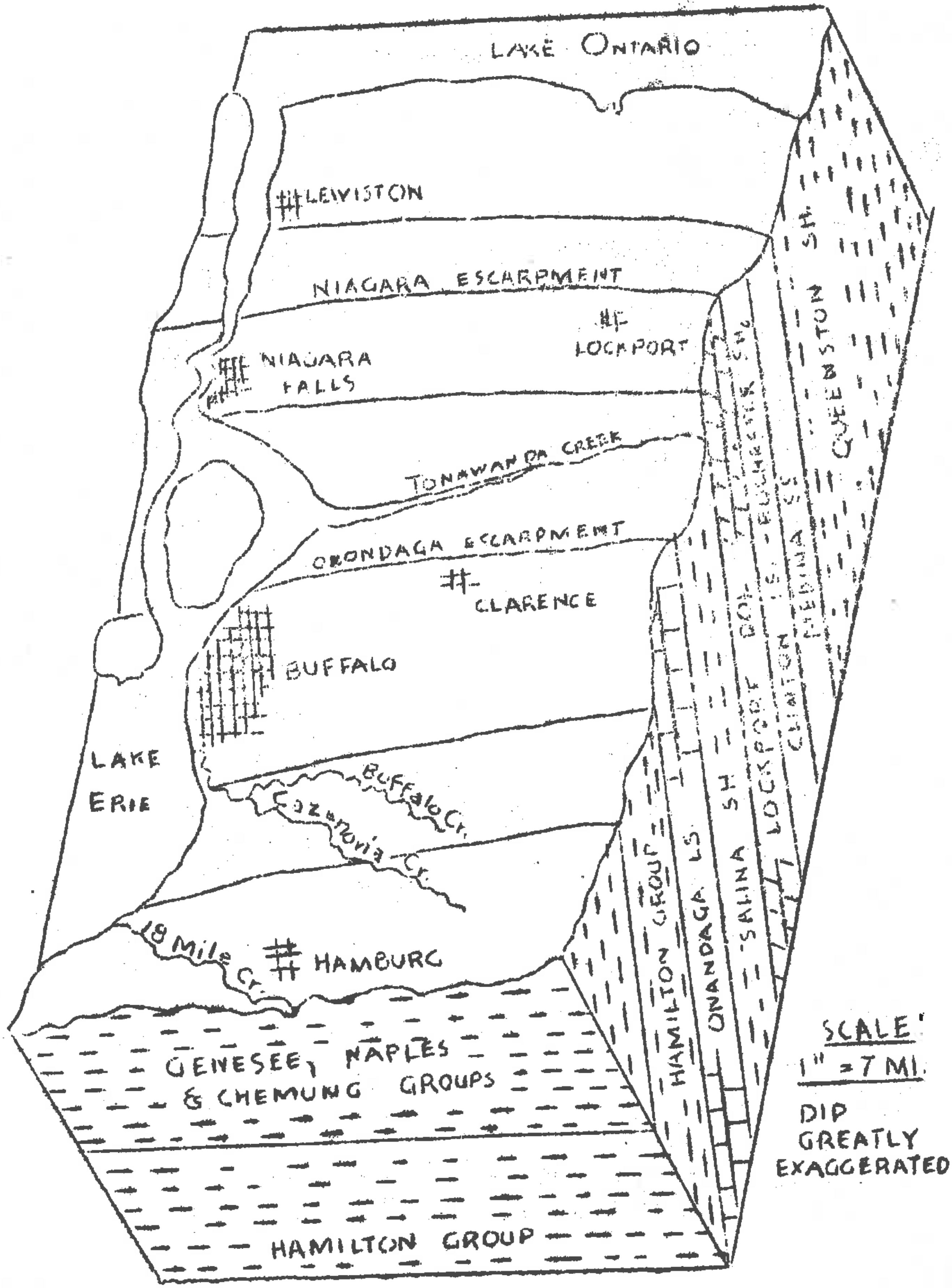
Except for Niagara Falls, Western New York has little to offer in spectacular scenery. To the south of Buffalo the level topography changes to one of modest hills which gradually become more rugged in the direction of the Alleghany Mountains. To the north and east of Buffalo the topography is essentially a plain which slopes northward from an elevation of 700 feet at the northern city limits to 240 feet at Lake Ontario. The flatness of this plain is broken by several features. The most conspicuous of these are two east-west trending escarpments, the Onondaga escarpment and the Niagara escarpment. The latter of these attains a height of 350 feet at Lewiston, N.Y. and is much the more prominent of the two. It passes through the city of Lockport, N.Y. and gradually declines in prominence toward the east. The Onondaga escarpment is only about 50 feet high. It follows a course slightly north of and parallel to Route #5 (Main St., Buffalo-Batavia). Both of these features are more correctly referred to as cuestas, with the steep side facing north and the other side sloping gently to the south. They were formed by differential erosion removing soft shales faster than the more resistant, massive, bedded calcareous formations.

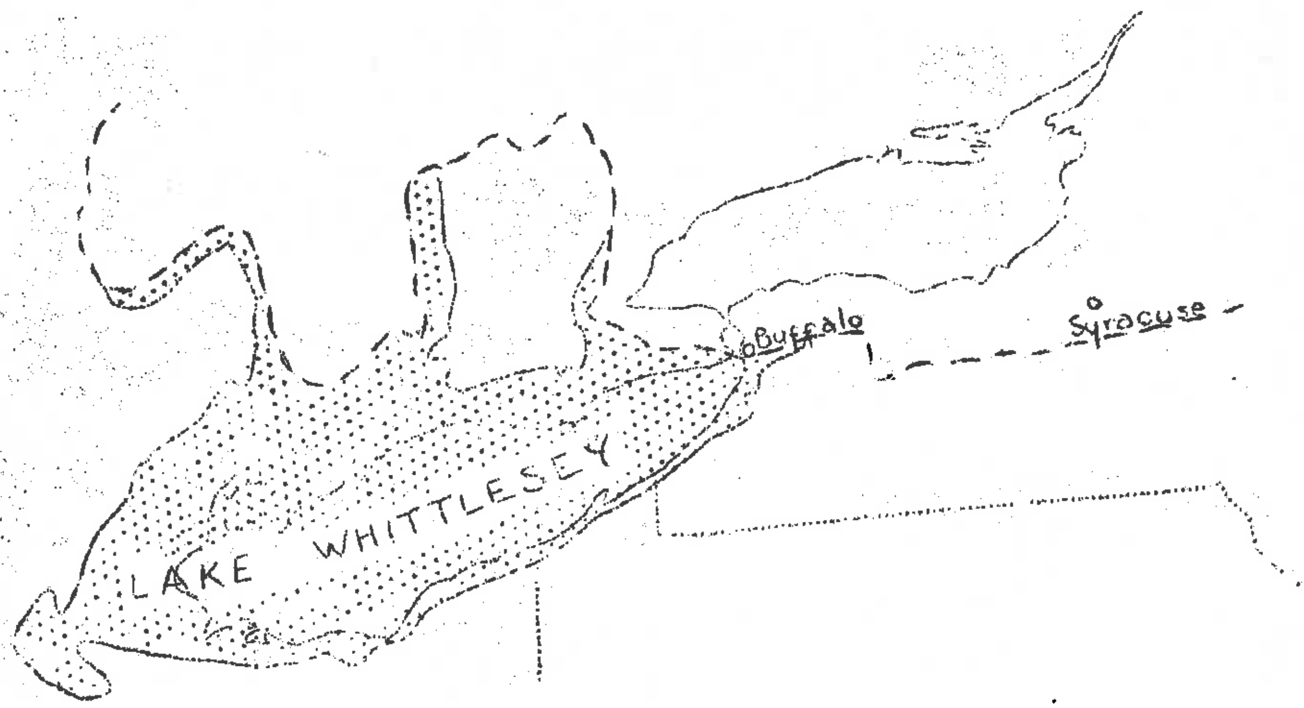
Structurally, Western New York is a gentle homocline. The formations strike E.-W. and dip approximately $\frac{1}{2}^{\circ}$ to the south. Erosion has bevelled them off so that the outcrop pattern consists of parallel bands extending east-west.

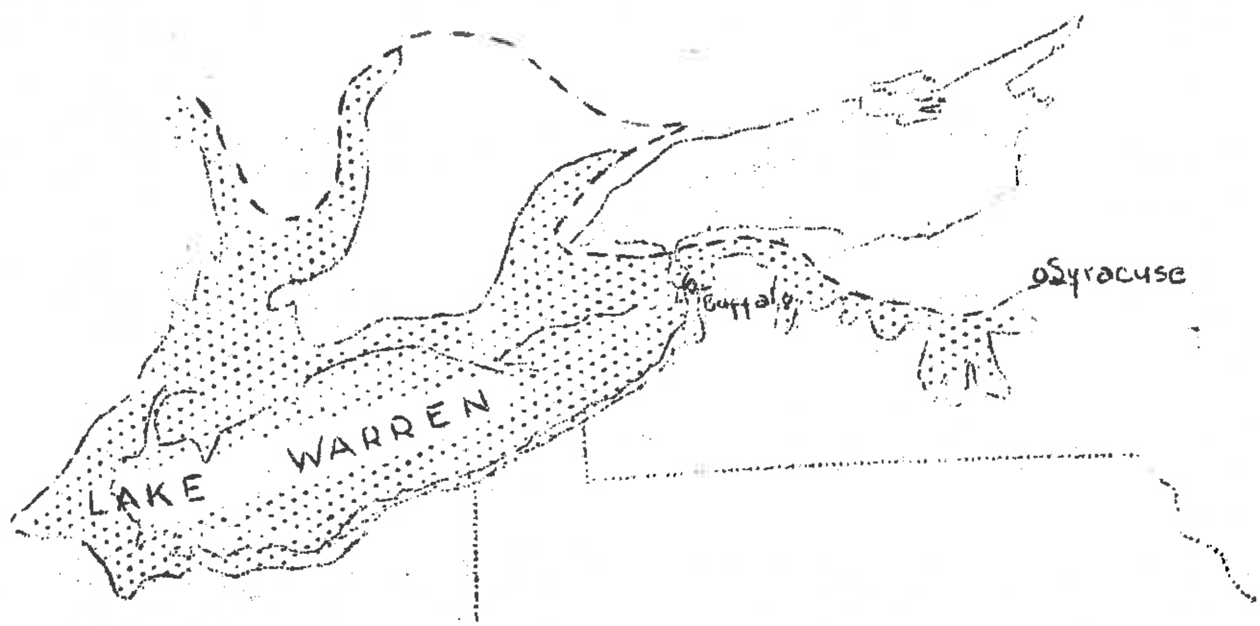
The Onondaga and Niagara escarpments have strongly influenced the Quaternary geology of this region. During the Lake Iroquois stage of the development of Lake Ontario the water extended to the Niagara escarpment at the base of which it formed sandy beach deposits. The plain between the Niagara escarpment and Lake Ontario is drained by northward flowing streams, some of which have cut notches in the escarpment as at Lockport and Gasport and, more spectacularly at Niagara Gorge.

The soft, easily eroded shale of the Salina formation caused a lowland to develop between the Niagara and Onondaga escarpments. This was filled with lake sediment. The red clay which is visible in ditches and excavations was deposited in glacial lakes Dana-Lundy and upon this is the gray or yellowish clay, marl, and sand of Lake Tonawanda, a small lake which is represented today by swamps in the vicinity of Batavia and Bergen. This section is now drained by Tonawanda Creek which flows westward into Niagara River.

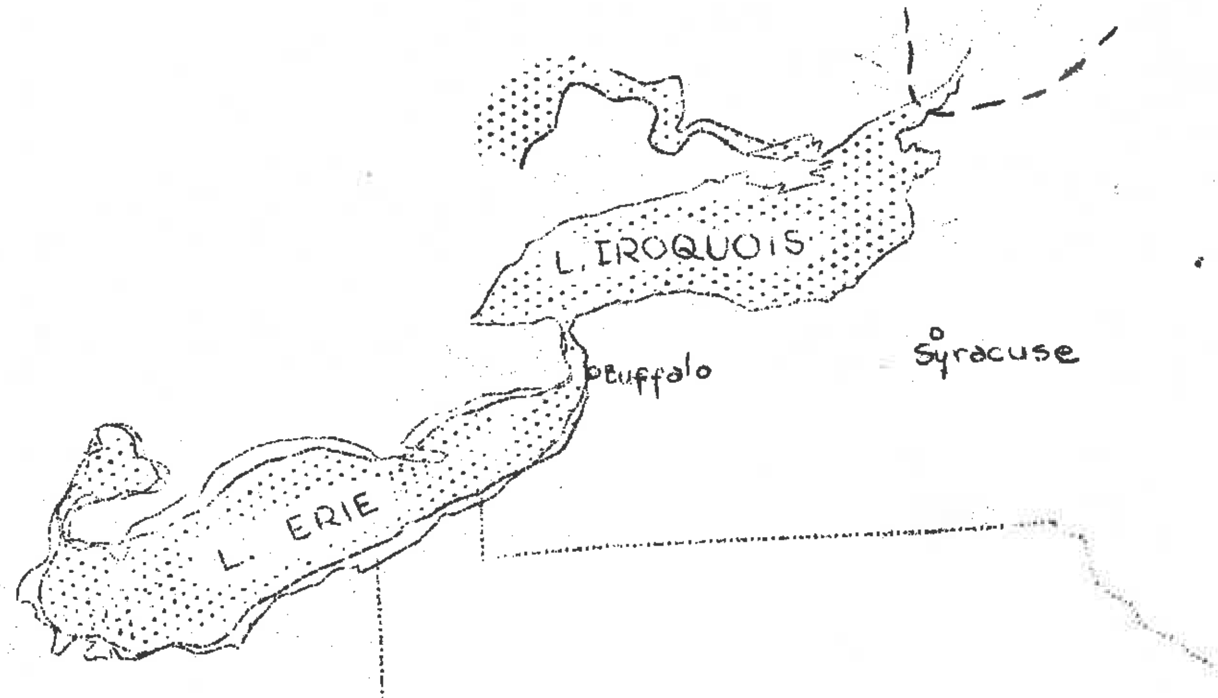
South of the Onondaga escarpment the surface geology consists of moraine deposits and of lake and beach deposits of Glacial Lakes Whittlesey and Warren. The drainage is via several streams which flow north or north west through wide glacial valleys and upon reaching the vicinity of Buffalo turn west and empty into Lake Erie. Buffalo Creek and Cazenovia Creek typify this drainage pattern.


LAKE ONTARIO
LEWISTON
NIAGARA ESCARPMENT
LOCKPORT
NIAGARA FALLS
TONAWANDA CREEK
ONONDAGA ESCARPMENT
CLARENCE
BUFFALO
LAKE ERIE
Buffalo Cr.
Cazenovia Cr.
18 Mile Cr.
HAMBURG
GENESEE, NAPLES & CHEMUNG GROUPS
HAMILTON GROUP
HAMILTON GROUP
ONANDAGA LS.
SALINA SH.
LOCKPORT DOL.
CLINTON
MEDINA SS.
QUEENSTON SH.
SCALE: 1" = 7 MI.
DIP GREATLY EXAGGERATED

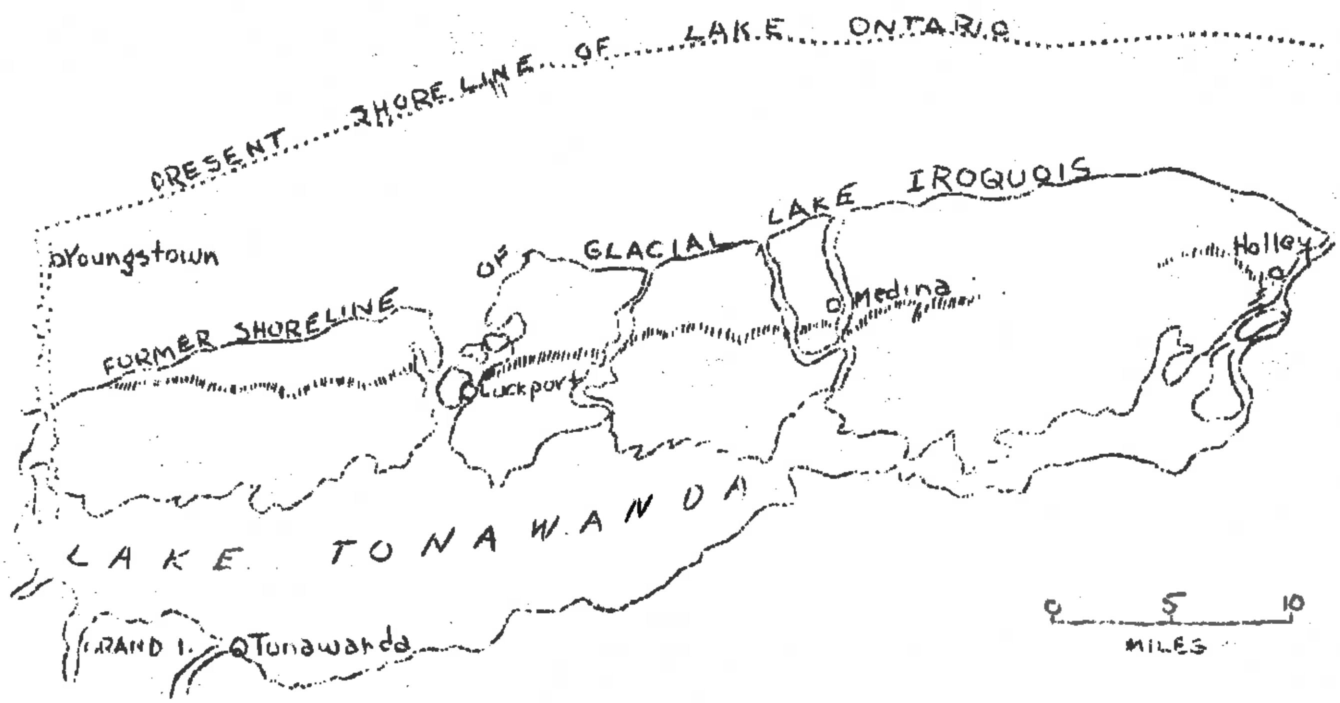




The Lake Erie basin at the time of glacial Lake Whittlesey and glacial Lake Warren. The dashed line shows the southern edge of the ice sheet. (after Leverett and Taylor)

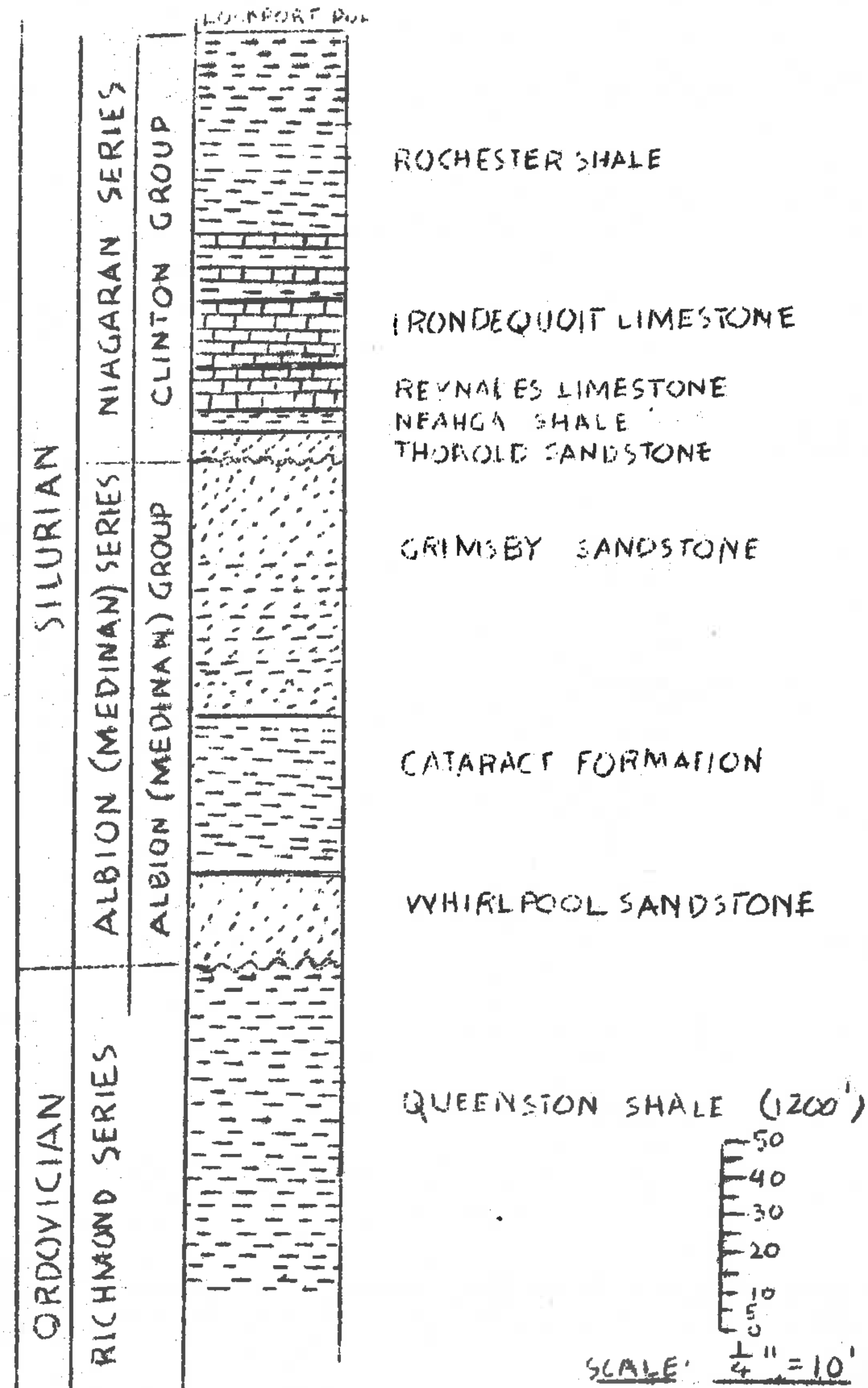


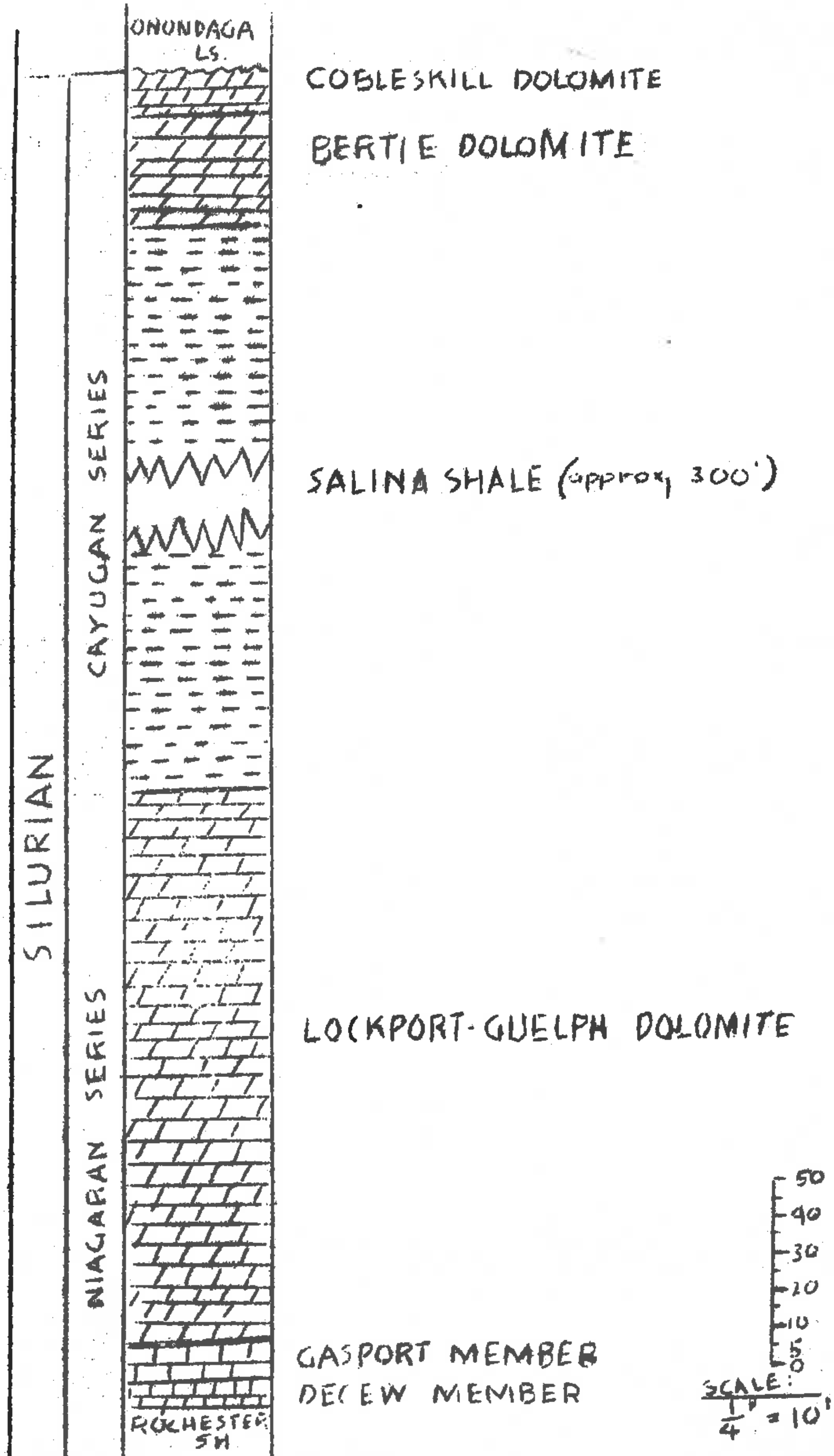
The Lake Erie basin and Lake Ontario basin during the Lake Algonquin stage of the evolution of the Great Lakes.

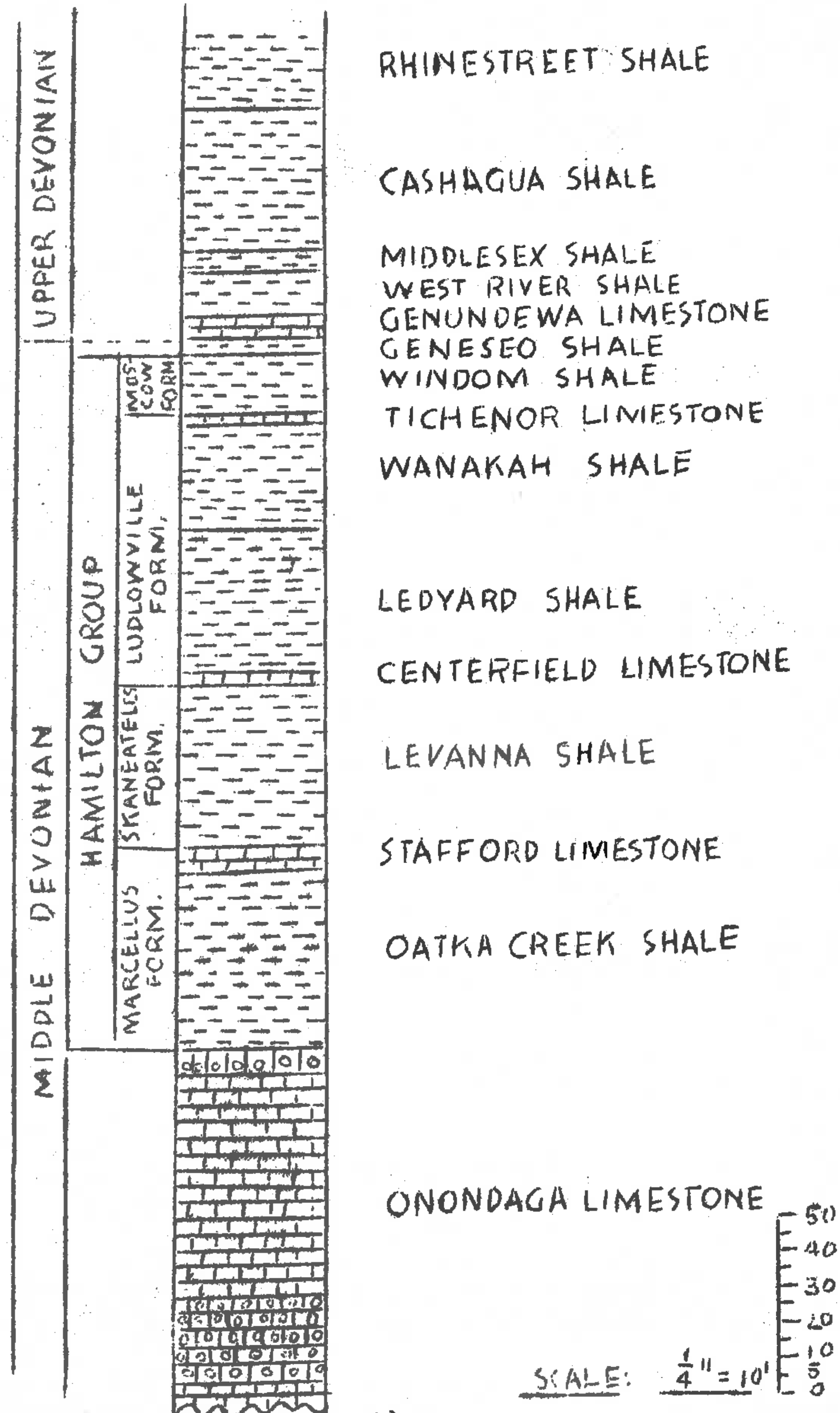


Outline of Lake Tonawanda and spillways
(from U. S. G. S. Atlas, Folio no. 190)

TRATIGRAPHIC COLUMN FOR WESTERN NEW YORK




ONONDAGA LS.
COBLESKILL DOLOMITE
BERTIE DOLOMITE
SALINA SHALE (approx 300')
LOCKPORT-GUELPH DOLOMITE
GASPORT MEMBER
DECEW MEMBER
ROCHESTER SH
SILURIAN
CAYUGAN SERIES
NIAGARAN SERIES
50
40
30
20
10
5
0
SCALE:
1/4" = 10'


UPPER DEVONIAN
MIDDLE DEVONIAN
HAMILTON GROUP
MOSCOW FORM
LUDLOWVILLE FORM.
SKANEATELES FORM.
MARCELLUS FORM.
RHINESTREET SHALE
CASHAGUA SHALE
MIDDLESEX SHALE
WEST RIVER SHALE
GENUNDEWA LIMESTONE
GENESEO SHALE
WINDOM SHALE
TICHENOR LIMESTONE
WANAKAH SHALE
LEDYARD SHALE
CENTERFIELD LIMESTONE
LEVANNA SHALE
STAFFORD LIMESTONE
OATKA CREEK SHALE
ONONDAGA LIMESTONE
50
40
30
20
10
5
0
SCALE: 1/4" = 10'

The Paleozoic Stratigraphy of Western New York

Queenston shale

Type description: Grabau 1908

Age: Late Ordovician, Richmond stage. Basal Silurian according to Ulrich and Bassler (1923) and the N.Y. State Geological Survey.

Terminology: The Medina of Vanuxem and Hall included the Queenston shale. Sometimes referred to as Lower Medina.

Thickness: 1200 feet. Approximately 100 feet of uppermost beds exposed in Niagara Gorge.

Lithology: Soft, brick red shale with thin bands of green shale. Weathers to a sticky red mud. Regarded as a thick delta deposit.

Fossils: Barren of fossils

Correlation: Richmond shale and ls. to the north and west; Juniata to the south.

Unconformity-shown by mud cracks on contact surface of Queenston shale

Whirlpool sandstone

Type description: Grabau 1909

Age: Early Silurian, Albion series

Thickness: 25 feet

Terminology: Sometimes referred to as "White Medina ss."

Lithology: White sandstone, grains rounded, frosted, strongly cemented by silica. Contains small chunks of green shale. Cross bedded. Shows feature referred to as "giant ripple marks."

Fossils: Barren of fossils

Correlation: Lower part of Tuscarora sh. of Pennsylvania

Cataract formation

Type description: Schuchert 1913

Age: Early Silurian (Albion series)

Terminology: Used for gray ss. and sh. between Whirlpool ss. and red Grimsby formation. Regarded as preferable to the term Cabot Head.

Thickness: 30-40 feet

Lithology: Gray shale with thin beds of greenish-gray sandstone.

Fossils: Mostly barren but has yielded some fossils. Fauna needs study.

Correlation: Manitoulin limestone and dolomite of Ontario

Grimsby sandstone

Type description: N.Y. Williams 1914

Age: Early Silurian, Albion series

Terminology: Refers to the uppermost red beds of the original Medina formation.

Thickness: Approximately 55 feet

Lithology: Sandstone and shale with some light yellow and green beds. Shows ripple marks, channeling, cross bedding and large concretions.

Fossils: Has a small fauna. Arthrophycus and Lingula cuneata are common in certain beds near the base. "Fucoides" (unidentifiable objects) are abundant.

Unconformity: an erosion surface between the Grimsby and Thorold is visible in Niagara Gorge.

Thorold sandstone

Type description: Grabau 1913

Age: Gillette (1947), following Ulrich and Bassler and others considers the Thorold ss. to be the initial deposit of the Clinton group. The U.S.G.S. still refers it to the top of Albion series.

Terminology: The "gray band" of Eaton.

Thickness: Approximately 8 feet

Lithology: White sandstone, massive bedded

Fossils: Barren except for some "worm burrows."

Correlation: Oneida conglomerate and sandstone of Central N.Y. Regarded by some as equal to Kodak sandstone of Chadwick.

Neahga shale

Type description: Sanford 1933

Age: Middle Silurian, Niagaran series, Clinton group

Thickness: 6 feet

Lithology: Olive green shale

Fossils: Not fossiliferous

Correlation: Occupies the same stratigraphic position as the Maplewood shale and is of the same lithology.

Reynales limestone

Type description: Chadwick 1918

Age: Middle Silurian, Niagaran series, Clinton group

Thickness: 12 feet

Lithology: Compact gray limestone. Beds thinner than overlying Irondequoit limestone.

Fossils: Has a small fauna characterized by Hyattidina congesta. Includes the Zygobolba excavata microfossil zone.

Correlation: Lower portion (Brewer Dock member) of Reynales at Rochester.

Irondequoit limestone

Type description: Clarke 1906

Thickness: 18 feet

Lithology: Massive bedded gray limestone, crinoidal in portions.

Fossils: Fossiliferous, includes Whitfieldella nitida and many bryozoans. Falls within Mastigobolbina typus microfossil zone.

Rochester shale

Type description: Conrad 1839

Age: Middle Silurian, Niagara series, Clinton group

Thickness: 70 feet

Lithology: Gray, crumbly shale with several thin limestone beds. Contains nodules of gypsum.

Fossils: Contains fauna of over 120 species chiefly brachiopods, bryozoans, some trilobites and echinoderms. Yields fine specimens of the cystoid Caryocrinus ornatus. Fossils confined to lower portion. Upper beds barren.

Decew limestone

Type description: Kindle 1914

Age: Middle Silurian, Niagaran series, Referred to top of Clinton group by some authors and base of Lockport-Guelph group by others.

Thickness: 9 feet

Lithology: Fine grained limestone or dolomite limestone

Fossils: Contains a sparse fauna

Gasport limestone member

Type description: Kindle 1913

Age: Middle Silurian, Niagaran series, Lockport-Guelph group.

Terminology: This name is used for the encrinal portion of the Lockport-Guelph.

Thickness: 15-20 feet

Lithology: Crinoidal limestone, massive bedded, vuggy.

Fossils: Small fauna similar to that of Rochester shale

Lockport dolomite

Type description: Hall 1839

Age: Middle Silurian, Niagaran series

Terminology: The U.S.G.S. follows Hall in including the overlying Guelph dol. in the Lockport dol. The N.Y. State Survey excludes the Guelph dol. from the Lockport dol. The Decew and Gasport are generally treated as members of the Lockport dol. Other members that have been named are : Eramosa beds (Williams 1919), Upper and Lower Shelby dolomite (Clarke and Ruedemann 1903), Suspension Bridge dol. (G.S.A. Com.Chart 1942). These members are difficult to demonstrate.

Thickness: Total thickness difficult to determine because upper contact is not exposed. Approximately 150 feet

Lithology: Dolomite, gray, buff or brown. Bedding variable, a few inches to several feet in thickness. Vuggy, especially near top. Vugs contain crystals of calcite, dolomite, galena, sphalerite. Some chert present.

Fossils: Present but not abundant, usually poorly preserved. A stromatoporoid, Stromatopora concentrica, and tabulate corals are especially abundant. Relationships of Lockport fauna to Guelph fauna needs study.

Correlation: Engadine and Racine dolomite to north and west

Salina shale

Type description: Vanuxem 1839

Age: Late Silurian (Cayugan series)

Thickness: Approximately 300 feet

Lithology: Shale and evaporites. Easily eroded and does not form outcrops. Mined for gypsum and salt.

Bertie dolomite (waterlime)

Type description: Chapman 1864

Age: Late Silurian, Cayugan series

Terminology: The term dolomite is substituted for "waterlime" commonly used in the literature. The Bertie was divided into several formations by Chadwick (1917)

Thickness: 10-60 feet

Lithology: Massive bedded dolomite, some shaly layers. Conchoidal fracture. Contains salt-hopper casts.

Fossils: Includes famous Eurypterid beds. Otherwise sparingly fossiliferous.

Cobbleskill dolomite

Type description: Hartnagel 1903

Age: Late Silurian, Cayugan series

Terminology: The name Akron dol. (Sherzer-Grabau 1909) is preferable but seldom used.

Thickness: 8 feet

Lithology: Massive, bedded, buff-colored dolomite. Vuggy.

Fossils: Small fauna, most conspicuous are Leperditia scalaris, Chonetes jerseyensis and molds of the tetracoral Cyathophyllum hydraulicum.

Unconformity: A pronounced erosional surface separates the Cobbleskill dol. from the overlying Onondaga ls. The unconformity represents the Helderberg and Deerpark stages of the Lower Devonian.

Onondaga limestone

Type description: Conrad 1837, Emmons 1846

Age: There is no uniform agreement as to whether this formation should be referred to the Lower Devonian or Middle Devonian.

Terminology: Conrad used this name as a group term and included part of the Silurian system. Present usage follows that of Emmons 1846. The lower chert beds have been called "corniferous."

Thickness: Approximately 100'

Lithology: A coral limestone layer at base, commonly less than 1 foot thick swells locally into reefs 20 feet thick. This is followed by 20-30 feet of limestone with abundant irregularly shaped chert nodules. Upper portions massive bedded light gray to dark gray, fine grained limestone.

Fossils: The coral reef beds contain a rich fauna of tetracorals and tabulate corals set in a matrix of crinoidal limestone. Tetracorals include Siphonophrentis gigantea and several species of Heliophyllum and Cystiphyllum. The Onondaga ls. also contains brachiopods, bryozoans, some trilobites and cephalopods. There is some indication of giantism in the Onondaga fauna.

Correlation: Columbus ls. of Ohio, Jeffersonville ls. of southern Indiana and northern Kentucky.

Oatka Creek shale

Type description: Cooper 1930

Age: Middle Devonian, Hamilton group, Marcellus formation

Terminology: Some authors have referred the Marcellus formation to the Onondaga ls. rather than to the Hamilton group. See Clarke 1901

Thickness: 30-50 feet

Lithology: Fissile black shale. Several feet of hard calcareous gray shale at base may be a tongue of the Cherry Valley ls.

Fossils: Leiorhynchus fauna present in some beds, especially near top. Other beds barren

Correlation: Cardiff shale of Central N.Y.

Stafford limestone

Type description: Clarke 1894

Age: Middle Devonian, Hamilton group. Usually referred to Marcellus formation but regarded as base of Skaneateles formation by Cooper (1930)

Thickness: 8½ feet

Lithology: Gray limestone, weathering to chocolate brown. Outcrops scarce

Fossils: Has a fauna of about 75 species.

Correlation: Mottville member of Central New York

Levanna shale

Type description: Cooper 1930

Age: Middle Devonian, Hamilton group, Skaneateles formation

Thickness: 45 feet

Lithology: Gray shale and some hard calcarous beds with abundant Tentaculites.

Fossils: Sparse fauna of "Marcellus facies"

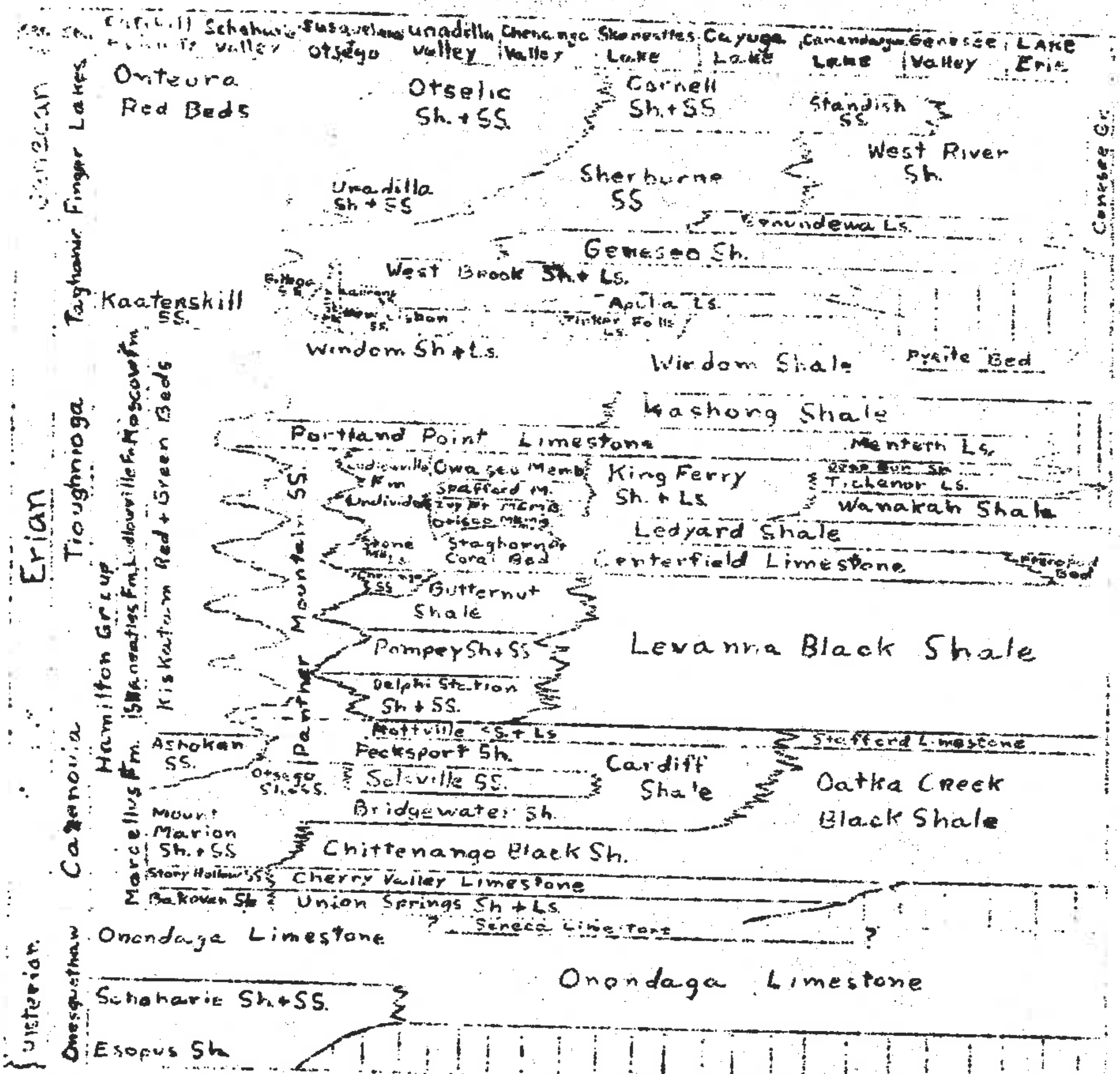
Centerfield limestone
Type description: Clarke 1903
Age: Middle Devonian, Hamilton group, base of Ludlowville formation.
Thickness: 3 feet
Lithology: Compact gray limestone, crinoidal
Fossils: Richly fossiliferous. Well preserved corals are numerous. Brachiopods include Spirifer divaricatus and Pustulina pustulosa.

Ledyard shale
Type description: Cooper 1930
Age: Middle Devonian, Hamilton group, Ludlowville formation
Thickness : 30 feet
Lithology: Featureless gray shale, some thin limestone beds.
Fossils: Unfossiliferous

Wanakah shale
Type description: Grabau 1917
Age: Middle Devonian, Hamilton group, Ludlowville formation
Thickness: 30 feet
Lithology: Soft, blue-gray calcareous shales with some thin beds of limestone. Some concretionary layers with septaria. Very similar to Ledyard.
Fossils: Richly fossiliferous with a brachiopod coral-bryozoan fauna. Common species include Athyris spiriferoides, Mucrospirifer mucronatus, Stropheodonta demissa, Tropidoleptus carinatus, Rhipidomella penelope, and the tetracoral Heliophyllum halli. Several calcareous beds have abundant specimens of the trilobite Phacops rana. The Wanakah is separated from the underlying Ledyard member by beds in which the tabulate coral Pleurodictyum is abundant.

Tichenor limestone
Type description: Clarke 1903
Age: Middle Devonian, Hamilton group, Ludlowville formation
Thickness: 2-3 feet
Terminology: Called Encrinal limestone in some older papers
Lithology: Massive bedded, gray, crinoidal limestone. Slightly petroliferous.
Fossils: Richly fossiliferous, a recurrence of the Centerfield fauna. Has large Favosites colonies.

Windom shale
Type description: Grabau 1917
Age: Middle Devonian, Hamilton group, Moscow formation
Thickness: 17-50 feet
Lithology: Soft, gray, calcareous shale, weathers to a sticky clay.
Fossils: Very fossiliferous with a wide variety of marine invertebrates. The small productid brachiopod Ambocoelia umbonata is abundant in the basal beds.



Schoharie Valley
Otsego
Unadilla Valley
Chenango Valley
Skaneateles Lake
Cayuga Lake
Canandaigua Lake
Genesee Valley
LAKE Erie
Finger Lakes
Taghanic
Onteora Red Beds
Otselic Sh.+SS.
Cornell Sh.+SS.
Standish SS.
West River Sh.
Genesee Gr.
Unadilla Sh+SS
Sherburne SS
Genundewa Ls.
Geneseo Sh.
West Brook Sh.+Ls.
Kaaterskill SS.
Apulia Ls.
Tinker Falls Ls.
Windom Sh+Ls.
Windom Shale
Pyrite Bed
Erian
Tioughnioga
Kashong Shale
Portland Point Limestone
Menteth Ls.
Owasco Memb.
King Ferry Sh.+Ls.
Tichenor Ls.
Wanakah Shale
Spafford M.
Ledyard Shale
Staghorn Coral Bed
Centerfield Limestone
Butternut Shale
Hamilton Group
Kiskatom Red + Green Beds
Panther Mountain SS.
Pompey Sh+SS
Levanna Black Shale
Delphi Station Sh.+SS.
Mottville S.+Ls.
Stafford Limestone
Cazenovia
Ashokan SS.
Marcellus Fm.
Pecksport Sh.
Cardiff Shale
Oatka Creek Black Shale
Otsego Sh.+SS.
Solsville SS.
Bridgewater Sh.
Mount Marion Sh.+SS
Chittenango Black Sh.
Stony Hollow SS
Cherry Valley Limestone
Bakoven Sh.
Union Springs Sh+Ls.
Onesquethaw
Onondaga Limestone
Seneca Limestone
Onondaga Limestone
Ulsterian
Schoharie Sh+SS.
Esopus Sh.

Economic Geology of Western New York

By James Cadwell

The Niagara Frontier and adjoining parts of western New York are not well known for the exploitation of mineral resources. Despite this, local mineral industries and their products are extremely important in the industrial and economic life of the community. This region produced very significant quantities of salt, gypsum, crushed stone, shale for cement, and sand and gravel. Of lesser importance is the production of building stone, shale for brick and small amounts of natural gas and oil.

Gypsum

One of the two minerals that are shaft mined in western New York is gypsum. It has a high percentage of purity here than in other parts of the state and is used mainly for the manufacture of building board and plaster and also as a retarder in cement. The factories producing these products are usually situated at the mines to eliminate the difficulty and cost of transporting the raw gypsum. Gypsum beds in this area are four to six feet thick and occur in the Salina formation of Silurian age. The mines are opened by vertical shafts usually less than 100 feet deep. The locations of these operations may be seen on the accompanying map.

Several of the largest gypsum products companies in the United States have mines and factories here. Included are The Certainteed Products Corp., The U.S. Gypsum Co., The National Gypsum Co. whose headquarters are at Buffalo, and three other companies.

Salt

Of the two most important non-metallic minerals required for basic chemical industries, salt and sulphur, western New York is fortunate in having one in abundance. Salt is obtained both in the form of brine and rock salt. The latter maintains a NaCl content in excess of 95%. Rock salt forms the basis for many of the large chemical industries of the Niagara Frontier.

The salt is found in the Salina formation generally at depths of 1000 feet and over, depending upon the locality. Variation in depth is coused by a southerly dip of the formation averaging about 45 feet per mile. Rock salt is mined at Retsof by the International Salt Co. and brine is pumped at Silver Springs and Attica as well as points further east. Table salt is manufactured at Silver Springs by the Worcester Salt Company.

Other Products

Crushed stone, mainly from the Onondaga ls. and Lockport dol. is widely used in this area for road metal, driveways, concrete aggregate, agricultural lime, and other uses. In former years building stone was extensively quarried for foundations in Buffalo and its environs and many of the buildings on the University of Buffalo campus are constructed of this local stone. Large quarries have been worked at Buffalo, Williamsville and Akron for this purpose. There are still a number of these quarries in full scale operation but the output now is large crushed stone.

Local clay and shale is used in great quantity for the manufacture of Portland cement by the Federal Portland Cement Co. and the Lehigh Portland Cement Co. These are obtained near Woodlawn and Wanakah, a few miles southwest of Buffalo.

Near Angola and Jewetteville in southern Erie county shale is used and has been used for some time for making bricks.

Sand and gravel are necessities in any metropolitan area. Buffalo gets its supply both from glacial till deposits and from sand sucking operations in Lake Erie.

Natural gas has been available from numerous wells for many years. In fact, in 1821 the street lights of Fredonia N.Y., 45 miles southwest of Buffalo, were lit with gas from the first natural gas well drilled in the United States. The gas for laboratory use at the University of Buffalo is supplied by a well near Foster Hall. At present the most important use of nearby gas fields is by the Iroquois Gas Co. for the storage of tremendous footages of Texas natural gas in the exhausted fields of southwestern Erie county. This gas is stored in summer and drawn out during peak winter consumption periods.

The first oil found in North America was discovered in 1627 near Cuba, N.Y., 50 miles southeast of Buffalo, by a French missionary priest, Alleghany and Cattaraugus counties, the two counties just to the south of Erie county, today produce almost all the petroleum of the state with an annual value (1948) of $22,966,370.

On the following page is a map showing the location of economic mineral workings of this immediate area.

Key for Map:

1. Gypsum mines
2. Salt works
3. Crushed stone quarries
4. Shale for cement
5. Gravel pit
6. Gas storage fields
7. Oil wells

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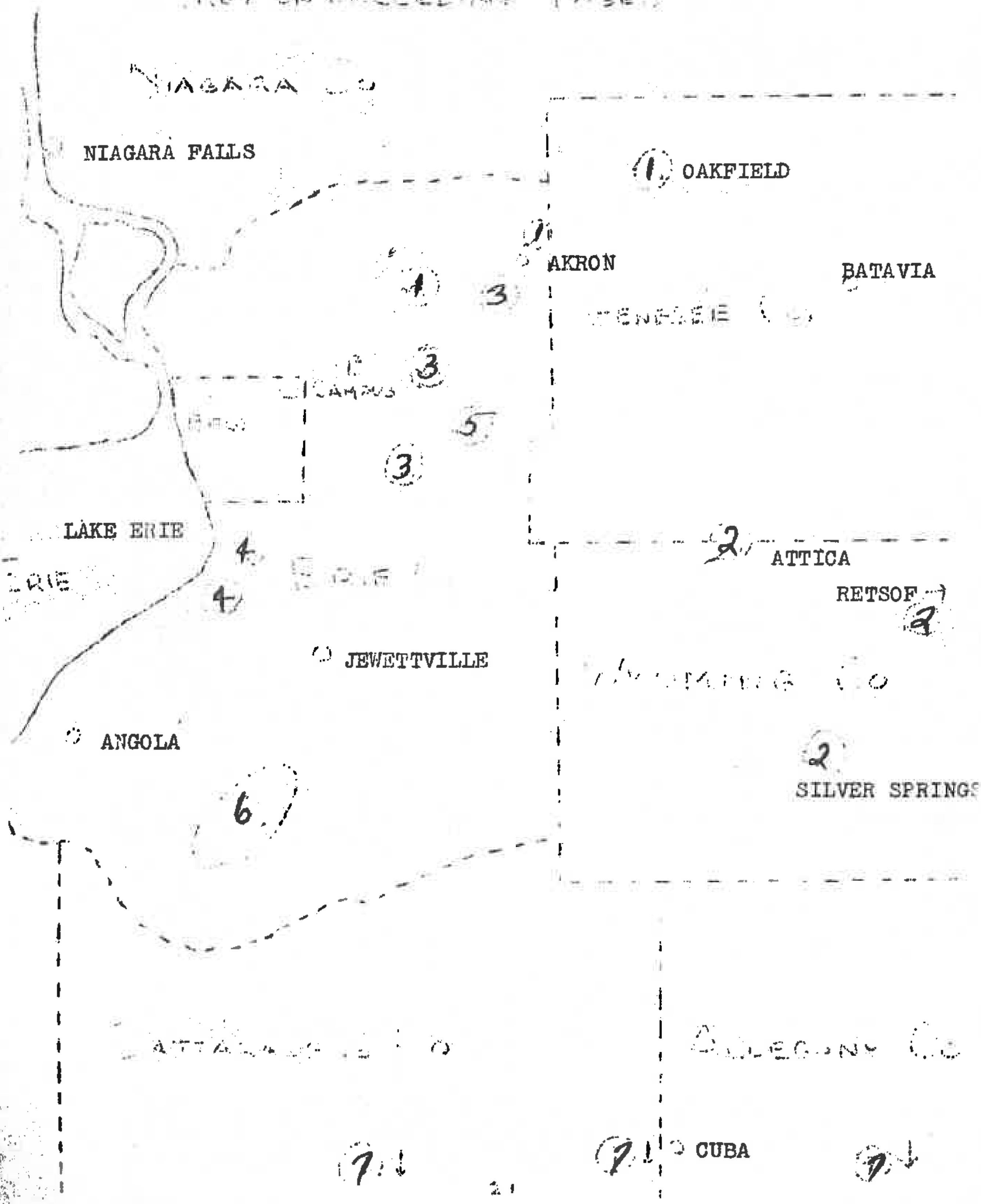
[illegible] Mineral Workings

(Key on preceding page)



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