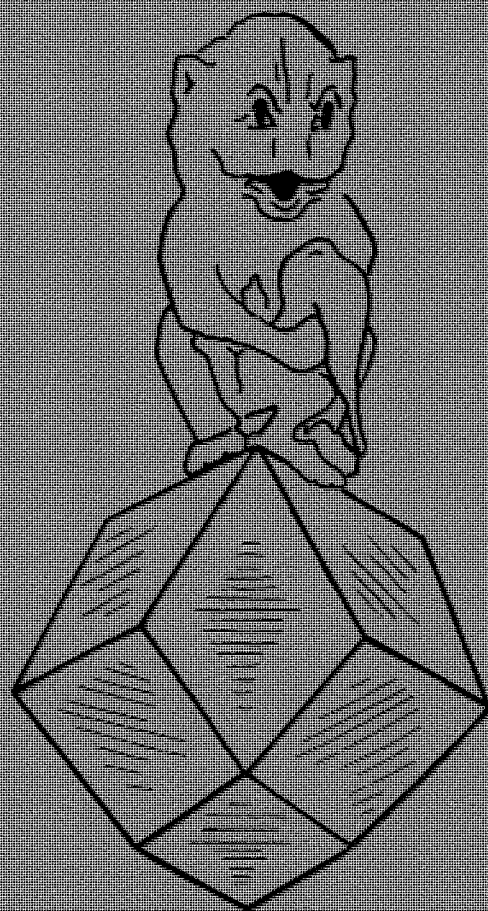


GUIDE BOOK

FIELD TRIPS IN THE SCHENECTADY AREA



NEW YORK STATE GEOLOGICAL ASSOCIATION
37th ANNUAL MEETING
UNION COLLEGE
SCHENECTADY, NEW YORK

APRIL 30 - MAY 2, 1965

GUIDEBOOK TO FIELD TRIPS

NEW YORK STATE GEOLOGICAL ASSOCIATION

37th Annual Meeting

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UNION COLLEGE

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Preface

The area surrounding Schenectady provides a wealth of material for the student of geology. Lying in an area of sedimentary rock containing plentiful fossils, it is also possible to study metamorphic and igneous rock within a very short distance of Schenectady. Structure, stratigraphy, sedimentation, paleontology, in all aspects the region is classic ground in the field of geology. The Adirondacks, Taconics, Helderbergs, and the Mohawk and Hudson Valleys each provide wonderful sites of interest to the student and of great use to the teacher.

In planning a series of field trips such as those for this 37th Annual Meeting of the New York State Geological Association, it is difficult to decide just which of these areas to cover. Since the Taconic area has been visited recently by the Association and the Lower Devonian was so well treated at the 36th Annual Meeting at Syracuse, it was decided that totally different trips should be presented. Therefore, the lower Mohawk Valley (a region of prime interest) and the southeastern Adirondacks (a critical area in the early history of eastern North America) were decided upon as being of sufficient distinction to provide a new phase of the geology of this part of New York State. In addition, much new data have been found regarding the glaciation of the area. A glacial trip was considered to be essential, for this information should be presented. One other factor was considered. In any area there are phenomena which are of interest though they may not be fully solved problems and not related to the total geologic picture. Often certain of these are excellent teaching outcrops of great interest for the student who may never have seen the features available. It is for this reason that a field trip of this type was planned.

So many individuals have helped to make this meeting possible that it is difficult to acknowledge the help of them all. In addition to the authors of the text (and, therefore, field trip leaders) many individuals are assisting as bus leaders. These include Lawrence V. Rickard, James F. Davis, R. Lynn Moxham and Roger L. Borst. Thanks are also due to John Broughton of the New York State Geological Survey of the State Museum and Science Service who helped in planning and in making his staff available as leaders and as authors.

Union College is pleased to welcome you all to the area. We hope you will enjoy your study of the region.

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TRIP A

MOHAWK VALLEY STRATA AND STRUCTURE

Saratoga to Canajoharie*

by

Donald W. Fisher

State Paleontologist
New York State Museum & Science Service

"The crust of our earth is a great cemetery, where the rocks are tombstones, on which the buried dead have written their own epitaphs".

---- Agassiz

INTRODUCTION

Seldom can professors, teachers, or students locate a compact area where many phases of geology have their pertinent features displayed or their principles and processes demonstrated in a relatively short period of time. Seldom, too, can they examine rocks and fossils that encompass a broad expanse of time or many segments of time. Fortunate, indeed, are the universities, colleges, and schools who possess so much geology at their "front door", and doubly fortunate are those who make maximum use of such an "outdoor textbook". We regard ourselves in this category for the Mohawk Valley, in the broad sense, is precisely such an area. Permit us to show you its geologic wealth.


Whatever may be your geological specialty, be it igneous and metamorphic geology, stratigraphy, structural geology, sedimentation, glacial geology, engineering geology, ground-water geology, mineralogy, petrology, geology of economic mineral deposits, or that of geobiology - paleontology -, there is something of interest for you in the Mohawk Valley. Obviously, one day is hardly adequate to examine features representative of these many facets of geology. But one day is all we are allotted and therefore we shall merely introduce you to a few basic concepts together with some teasing problems which, to date, have defied solution. In so doing, we shall

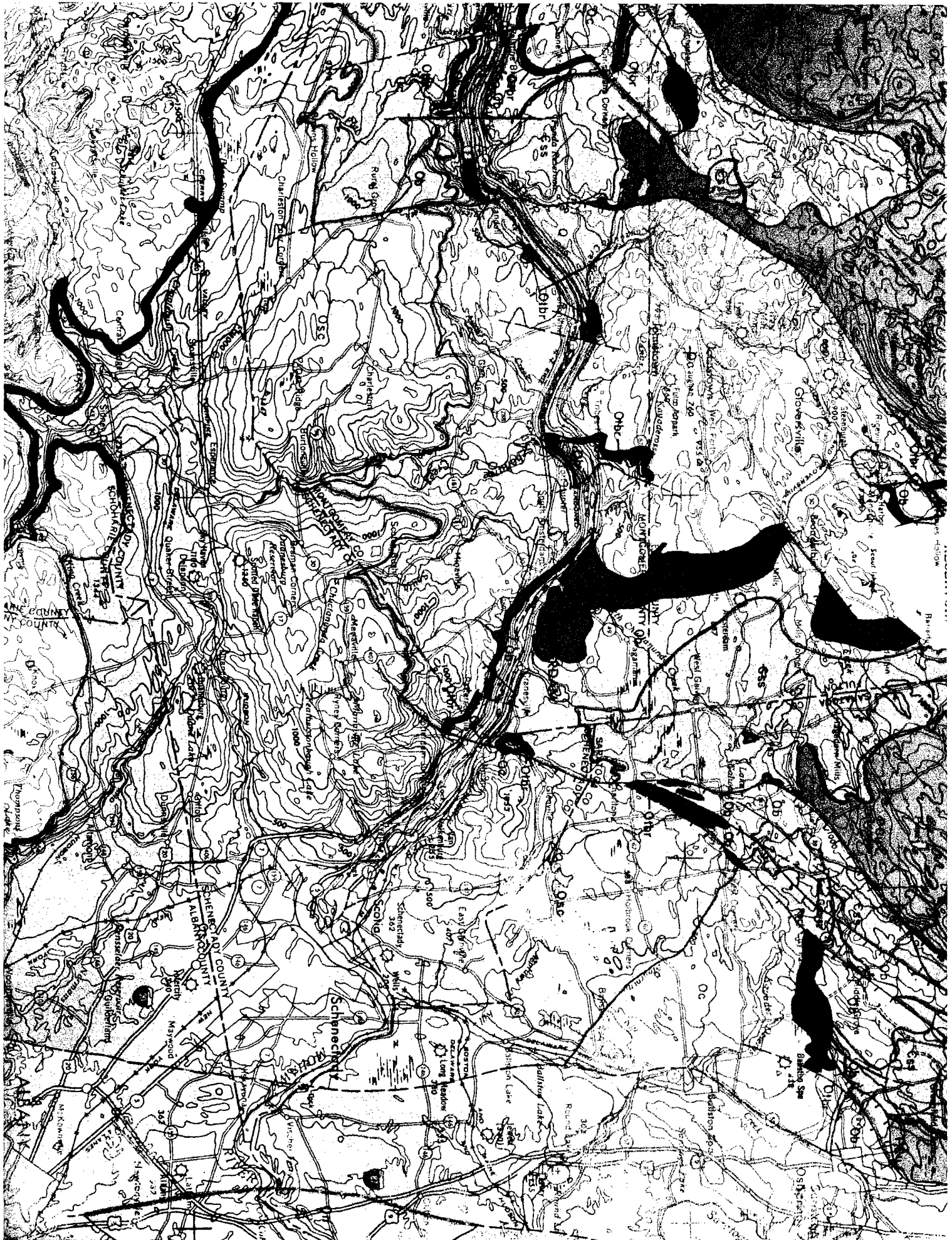
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LEGEND

- Q Glacial & alluvial deposits. Underlying geology unknown
- D DEVONIAN, UNDIFFERENTIATED
 Hamilton Group - siltstone and shale
 Onondaga Limestone, Schoharie Sandstone, Carlisle
 Center Formation, Esopus Shale, Oriskany Sandstone

 Helderberg Limestones
- S SILURIAN
 Cobleskill Limestone
 Brayman Shale
- Osc, On MIDDLE ORDOVICIAN
 Osc: Schenectady Formation- graywacke, siltstone, shale
 (grades into Frankfort Shale, west of the Noses
 fault)
 On: Normanskill Formation- graywacke, siltstone, shale
 (in extreme east only)
- Otbr Trenton Group- "Shoreham" & Larrabee Limestones
 Black River Group- Amsterdam & Lowville Limestones
- Ob LOWER ORDOVICIAN (BEEKMANTOWN GROUP)
 Chuctanunda Creek Dolostone (cherty)
 Tribes Hill Formation- dolomitic limestone, dolomitic
 shale, calcitic dolostone
- Gss UPPER CAMBRIAN (SARATOGA SPRINGS GROUP)
 Little Falls Dolostone (cherty)
 Hoyt Limestone, dolostone- algal reefs, oolites
 Theresa Formation- dolostone, sandstone
- PGu PRECAMBRIAN
 Undifferentiated gneisses, quartzite

 Fault; hachures on downthrown side, dashed where inferred



examine both the ordinary and extraordinary features of the sedimentary rocks, the fractures disrupting them, and the "you are there" approach to a reconstruction of past geologic settings and events.

Our clues will be sought in Upper Cambrian, Lower Ordovician, and Middle Ordovician rocks (of Late Cambrian, Early Ordovician, and Medial Ordovician ages) which were deposited from about 520 million years ago to about 435 million years ago. This 85-million year "chapter" of our geological "book" is superbly illustrated and can be deciphered no better than in the Mohawk Valley. Because of this completeness of the sedimentary record, the Medial Ordovician is termed the "Mohawkian".

Bounded by the Adirondack Mountains on the north and the foothills of the Catskill Mountains on the south, the Mohawk Lowland has an east-west extent of slightly over 100 miles and a maximum north-south extent of about 35 miles. Only the eastern or Lower Mohawk Valley is treated in this article. This area includes portions of six 15-minute (1:62,500) U.S. Geological Survey topographic quadrangles (Canajoharie, Fonda, Amsterdam, Broadalbin, Saratoga, Schenectady, Albany). Except for the Saratoga quadrangle, all are also available on 7 1/2-minute (1:24,000) base. The Valley is moderately well populated, industrialized, with much open farmland and excellent road coverage. Coupled with splendid long stratigraphic sections along the tributaries to the Mohawk, the field geologist's work is made easier. But this was not always so.

For better understanding of this guidebook and the fundamentals of physical geology, stratigraphy, and paleontology, the user should have prior knowledge of these subjects or refer to elementary texts in these fields.

- Physical Geology - "The Earth Beneath Us" (1964) by Kirtley F. Mather
 "Principles of Geology" (1959) by Gilluly Waters
 & Woodford
- Stratigraphy - "Stratigraphic Principles and Practices" by J. Marvin
 Weller
 "Principles of Stratigraphy" (1957) by C. O. Dunbar &
 John Rodgers
- Paleontology - "Search for the Past" (1960) by James Beerbower
 "Invertebrate Fossils" by R. C. Moore, C. Lalicker, &
 A. G. Fischer
 "The Fossil Book" by C. L. Fenton & M. A. Fenton (1958)

ACKNOWLEDGEMENTS

Much appreciation is extended to the N. Y. State Conservation Department for their willingness to make Lester Park presentable by removing underbrush and repairing the descriptive plaque. Mr. Stan Farmer and Morgan Smith of that Department are especially thanked for the role they played in this endeavor.

Thanks, also, to Mr. Francis Harrington, General Manager, Cottrell Paper Co., Rock City Falls, for permission to examine the strata in their quarry and along Kayaderrosseras Creek.

HISTORY, -- GEOLOGIC AND HUMAN

"Not to know the events which happened before
one was born, that is to remain always a boy".

---- Cicero

Synoptic geologic history of the Mohawk Valley and environs:

- | | |
|--|--|
| <p>Precambrian
[2000 - 600 million
years (my) ago]</p> | <p>- <u>Ancestral Canadian Shield received sediments:</u> sand, silt, clay, calcium carbonate. Successive cycles of sedimentation produced a geosynclinal prism which <u>buckled</u>, was subjected to elevated temperatures and tectonic pressures resulting in metamorphism of the sedimentary rocks into quartzites, marbles, and gneisses. This <u>mountain-making event</u> (Grenville Orogeny) has been <u>radiometrically</u> determined to have taken place about 1100 million years ago. A lengthy period of <u>erosion</u>, accompanied by small intrusions of <u>mafic dikes</u>, ensued.</p> |
| <p>Early
Cambrian
[600 - 560 my ago]</p> | <p>- <u>Sediments were deposited</u> in eastern New York and western New England which we see today as the graywackes, micaceous siltstones and shales of the Cossayuna Group.</p> |
| <p>Medial
Cambrian
[560 - 530 my ago]</p> | <p>- <u>Peneplantation</u> of Adirondacks and its southern periphery with some sedimentation atop the Early Cambrian rocks east of the present Hudson River.</p> |
| <p>Late
Cambrian
[530 - 500 my ago]</p> | <p>- <u>Flooding</u> by shallow epeiric seas transgressing from southeast and east toward the northwest. Quartz sand and dolomite <u>deposited</u> in varying intermixed quantities with localized algal reefs fringing the southern Adirondack shore (Saratoga Spring Group).</p> |
| <p>Early
Ordovician
[500 - 470 my ago]</p> | <p>- Extensive <u>carbonate deposition</u> (Beekmantown Group) in widespread, shallow, continental shelf environments. <u>Local uplifts</u>, of brief duration, temporarily expose the shelves.</p> |

Waters were probably temperate to cool, as evidenced by great development of thin-shelled mollusks. Continental emergence at close of the Canadian of long duration in some areas. This marked break is, probably, but a slight manifestation of an intense orogeny in New England, now masked by subsequent periods of folding, faulting, and metamorphism.

- Medial Ordovician
[470-435 my ago]
- Thick carbonate deposition in Champlain Valley (Chazy Group); lack of contemporaneous record in Black River and Mohawk Valleys. Warm Chazy seas exhibited variety of environments; one type was host to lush reef development of stromatoporoids, algae, and bryozoans. Later, more widespread environments of carbonate deposition inundated most of New York State (Black River and Trenton Groups). These reefless seas supported immense numbers and varied types of brachiopods and mollusks. Thick terrigenous deposits were dumped in eastern New York reflecting the initial phases of the Taconian Orogeny. Folding and thrust faulting of these and older strata occurred with eventual westward emplacement of the Taconic Allochthone. Earthquake and volcanic activity further demonstrates crustal instability. A southern prolongation of the Adirondacks, the Adirondack Axis, exerts influence on Medial Ordovician sedimentation and faunal distribution.
- Late Ordovician
[435-425 my ago]
- Adirondack Mountains domed; extensive block faulting in Mohawk and Champlain Valleys and throughout eastern Adirondacks possibly culminating in localized intrusions of basic dikes. Period of vigorous erosion with thick wedge of sediments deposited to the west of the Adirondack Axis. This Queenston
- Early & Medial Silurian
[425-410 my ago]
- Delta, together with lesser thicknesses of coarse Early and Medial Silurian clastics (Medina and Clinton Groups) is the debris from the uplifted Adirondack Mountains, Adirondack Axis, and Taconic Mountains. It is unlikely that the Mohawk Valley region proper was peneplaned sufficiently to permit Early and Medial Silurian seas to inundate it.
- Late Silurian
[410-405 my ago]
- Once again the Mohawk Valley region was submerged under marine seas but this time the transgression came from the west - the pattern of flooding during the entire Silurian in

- New York. A thick delta or coastal plain clay deposit (Vernon "Delta") along the west flank of the Adirondack Axis, is the product of further washing away of residual soil derived from the older eroded rocks. Nearly land-locked hypersaline seas appeared; within these isolated environments, dolomite and evaporites (chiefly halite and anhydrite) were precipitated with land-derived clays (Salina and Bertie Groups). These muddy supersaline waters with unstable sea floors were not conducive to the usual marine animals; typically marine invertebrates such as brachiopods and echinoderms are absent whereas the bizarre eurypterids are fairly abundant. The closing stages of the Late Silurian - deposition of quartz and clay-free carbonates -
- Early Devonian [405-385 my ago] - herald the oncoming of warm, shallow, clear seas, with a prolific bottom fauna, which persisted into the Early Devonian. These carbonates (Helderberg Group) represent several types of lime environments (supra-tidal, inter-tidal, lagoon, reef, off-reef, shelf, etc.). Uplift and erosion followed (no orogenic episode in New York) and a thin quartz-sand veneer (Oriskany) was spread (wind blown?) over a broad area. Quartz-silt and clay (Esopus-Carlisle Center) with some lime, continued to accumulate for the remainder of the Early Devonian. Uplift and erosion
- Medial & Late Devonian [385-355 my ago] - brought a halt to this clastic cycle. Shallow seas with a prolific marine fauna, including coral reefs, blanketed the southern half of New York. The resultant record of this period is a limestone (Onondaga). We have no knowledge of how much, if any, of the younger Devonian seas covered the Mohawk Valley region. The former northward extent of these rocks (Hamilton Group, etc.) must fall within the realm of speculation. Effect of the Acadian Orogeny in the Mohawk Valley is unknown.
- Late Paleozoic & Mesozoic Eras [355-60 my ago] - No record of sedimentation; Mohawk area presumably undergoing regional uplift and erosion.
- Tertiary [60 - 1 my ago] - Regional upbowing in New York producing renewed vigorous erosion. Major topographic features and drainage patterns created. Detritus carried to the continental shelf where it now constitutes a thick wedge of the shelf. Mohawk River came into existence; course dotted with waterfalls where water cascaded over fault-line scarps (examples: Little Falls, St. Johnsville, Noses, Tribes Hill, Hoffmans). At least three large

rivers entered Mohawk River from the north (Sacandaga River between Fonda and the Noses, "Cranesville" River between Cranenville and Toureuna Road, "Niskayuna" River, east of Schenectady).

Pleistocene

[1 - 0.01 my ago]

- Southward advancing continental ice sheet blanketed New York (except for small area in southwestern New York). Extensive removal of residual soils and dumping of heterogenous detritus coupled with glacial sculpturing greatly altered existing topography and drainage patterns. As ice front receded northward, outlet for the newly formed Great Lakes was opened to the east via the Mohawk Valley to the Hudson Valley and ultimately to the Atlantic Ocean. Brief westward re-advance (and/or stagnation) of ice in the Mohawk Valley (Mohawk Lobe) left the Adirondack Mountains as a large rock island surrounded by ice (nunatak). Potentially economic water-laid gravels and sands accumulated at wider parts of the Valley, at eastern side of largest faults. Melted ice produced temporary lakes in which varved clays and silts and sands built up. These lacustrine beds, like those which formed in glacial Lake Albany, are important reservoirs for water, are useful sand and gravel deposits for concrete manufacture, and the clays were once the source of a lucrative brick-making industry.

Recent

[0.01 - 0 my ago]

- Land undergoing erosion, sediments travelling down the Mohawk and Hudson Rivers, some deposited as river alluvium and some reaching the continental shelf or forming turbidity deposits in the Hudson River submarine canyon on the Atlantic sea floor.

Our geological excursion could well be labelled "from the place of herrings" to the "pot that washes itself" for this is the literal translation of Saratoga to Canajoharie in the Mohawk language. Saratoga - from Sa-rag-ho-go - received its name from alewives (cousins of herrings) which formerly migrated up the Hudson River, through Fish Creek into Saratoga Lake, then up Kayaderosseras (Kay-der-oss) Creek to Rock City Falls. Canajoharie was so-called by the Mohawks from the splendid potholes (up to 12 feet across) in the dolostone of Canajoharie Creek at the southern edge of the town. These potholes truly do "wash themselves" for their tools, the pebbles and cobbles, are swirled about by rushing water, like a ball mill.

The Mohawks, the most eastern segment of the Iroquois Nation, are indigenous descendants of the Owasco people which inhabited the Valley almost 1000 years ago. To date, the most ancient human implements discovered within the Mohawk Valley (near Schenectady) are some Clovis fluted points, dated in the southwest U.S. to some 10,000 years ago.

We cannot be sure who was the first white man that ventured into the Mohawk Valley; probably it was one of a small party of French trappers or explorers. At any rate, the Mohawks resented intrusion by any foreigner, Indian or white. Because of their grisly cannibalistic rites, the Mohawks were called the "people eaters". Trespassers were usually brutally killed; occasional captives were atrociously tortured and devoured. French traders, trappers and Jesuits were prime targets. Among those who were martyred were Father Isaac Joques, Rene Goupil, William Couture, and Lalonde, to whom the shrine at Auriesville is dedicated.

The Mohawks were equally inhospitable to their Indian cousins. During the middle of the 17th century, the Mohicans had invaded the Valley from the east but their penetration was thwarted at the Mohawk palisaded village of Kanyeagah on the Fonda sand flats. Smarting under this defeat, the Mohicans retreated to the eastern terminus of the Valley, the high hills near Hoffmans. Like sentinels, the two flanking hills creating an ideal defensible gateway at Hoffmans are, Yantaputchaberg (sleeping lady) on the south and Kinaquarione (place of the last great battle) on the north. To the Mohawks, these high hills symbolized the eastern terminus of the Iroquois "Long House" and they could not tolerate any enemy in so strategic a position. In 1669, a bloody two day battle decided which nation was to remain master of the Valley. The Mohicans were so severely decimated that never again did they pose a threat and they remained, peacefully, in the Hudson Valley until the flood of white colonialism gradually forced them to depart.

In the late 17th and early 18th century Dutch and German colonists emigrated westward from the Hudson Valley. The obvious route was through the Mohawk Valley, the only natural path to the west across the Appalachian Mountains. But this strategic Valley was still controlled by the savage Mohawks and passage seemed virtually unthinkable unless a small-sized army was dispatched for protection. Strangely, the Dutch and Germans never moved very far west. Owing to their small numbers, the Mohawks regarded them as

no serious threat to their "empire". In fact, many of these whites intermarried with the Mohawks. A highly successful barter system was set up whereby the whites were permitted to remain and till the soil in return for supplying the Mohawks with rifles and trinkets. In years to come, this arrangement would be regretted.

Until 1772, all of the Mohawk Valley was included in Albany County. Then, a new county, named Tryon (from the then governor of the region) was separated off as all of the state west of a line trending due north of the Delaware River along the eastern limit of the present counties of Montgomery, Fulton, and Herkimer to the Canadian boundary. In 1838, Montgomery and Fulton Counties were separately distinguished.

One of the greatest personages in the story of the Mohawk Valley was Sir William Johnson (1715-1774), superintendent of Indian affairs for the British government. It was he who welded amicable relations between the inherently hostile Mohawks and the British colonists. This was accomplished primarily because of the Mohawks intense hatred for the French and the fact that the British were proving their dislike for the French by driving them out of much of North America: following Wolfe's victory over Montcalm at Quebec in 1759 which secured Canada for the British, French influence in the New World declined. Johnson was a superb administrator. Evidence of his "era of good feeling" is that the blood of the Mohawks flows in the veins of many valley families today, thereby demonstrating the fraternization between Indian and white. Johnson, himself, took Joseph Brant's sister Molly as mistress of his baronial home at Fort Johnson for many years. It has been said that had Johnson lived, he probably would have sided with the rebels and that his name would have ranked with that of Washington and other heroes of the American Revolution.

However, the Johnson name was blackened by his son, Sir John, an avowed Loyalist, who was responsible for allowing particularly savage massacres of colonists to be conducted by Tory and Indian raiders. The Infamous Cherry Valley massacre, led by Walter Butler, regarded by many as one of the most hated men of the period, but by some as most maligned, was but one of these ghastly acts.

The importance of the Valley was evident again during the American Revolution. British control of the natural artery to the west -- the Mohawk Valley -- was mandatory toward suppressing the rebellion. The British "squeeze plan" was to have General John Burgoyne move south through the Champlain Valley and General Barry St. Leger move south through the Black River Valley and east through the Mohawk. The two expeditions would join forces at Albany and move down the Hudson and secure New York City. But the stalwart patriots of Dutch and German ancestry of the Mohawk had other ideas. Under the command of General Nicholas Herkimer, they stopped St. Leger's combined British, Tory, and Mohawk Indian advance at Oriskany - at the western terminus of the Mohawk Valley - , the turning point of the American Revolution. With General Horatio Gates and General Philip Schuyler's victory over Burgoyne at Saratoga in 1777, the French joined the Americans against their arch foe, the British. The British command could see the "handwriting on the wall" and Lord

Cornwallis surrendered the British army and navy at Yonkers in October 1781. Unaware of this, the last Mohawk Valley battle of the war occurred at Johnstown. In pursuit by the victorious colonists, Walter Butler was killed. A new country was born and the greatest 18th and 19th century "trunk line" to the west was safe for colonization. Like all adolescents, the Mohawk Valley has experienced its "ups and downs". Reid's (1901) treatment is a fascinating expose of Mohawk Valley history.

* * * * *

Geological investigation in the Mohawk Valley commenced relatively early in our nation's history. When in the early 1880's the astute DeWitt Clinton envisioned a canal connecting the Hudson River with the Great Lakes, it was necessary that a geological survey be made to ascertain the kind of rocks that would be encountered in excavating for the "Big Ditch". Amos Eaton, ransomed from a debtor's prison, was chosen for the job because of his earlier areal survey of Rensselaer County. The survey of the Erie Canal (Eaton, 1824) served not only to establish geological investigations as an integral part of engineering projects but it set up a sequence of geological formations which stood as the framework for subsequent geologic studies.

With the establishment, in 1836, of a Geological Survey of New York by Governor Marcy, attention was again focused on the geology of the Mohawk Valley. The State was divided into four Geological Districts, with a geologist in charge of each. Portions of two Districts extended into the Mohawk Valley; W.W. Mather's First District included Albany, Schenectady and Saratoga Counties and Lardner Vanuxem's Third District included Montgomery, Fulton, Herkimer and Oneida Counties. Out of this endeavor a state geologic map and four large District Reports were prepared. These District Reports form the basis for all subsequent work on New York's strata. So comprehensive were these reports that half a century elapsed before additional studies were required. The new work was prompted by the need for an up-to-date state geologic map. Nelson H. Darton was assigned the counties which lay astride the Valley. His chief contributions (1895) were the mapping of many normal faults and refinement of bedrock mapping.

Figure 2

Summary of Stratigraphic Nomenclature in the Lower Mohawk Valley

Eaton 1824 Mohawk Valley		Conrad 1837-1839 Mohawk Valley		Vanuxem 1842 Mohawk Valley		Prosser and Cumings 1900 Amsterdam Saratoga		Cushing 1905 Little Falls		Miller 1911 Broad-albin		Ruede-mann 1912 Mohawk Valley		Cushing 1914 Saratoga		Ruede-mann 1930 Capital District		Kay 1937 Mohawk Valley		Fisher and Hanson 1951 Saratoga		Fisher 1957-1965 Mohawk Valley	
Metalliferous Graywacke	Second Graywacke	Green Slate		Frankfort Slate and Rubblestone		Hudson River Shale		ERODED		Frankfort Shale Utica Shale Canajoharie Shale		Schenectady Sandstone & Shale Canajoharie		Schenectady		Schenectady		ERODED		Schenectady Grayw. Shale		Schenectady Group	
	Transition Graywacke	Trenton Limestone and Slate		Utica Slate		Utica Shale		Utica Shale		Trenton Limestone		Trenton "age" Trenton		Canajoharie = Snake Hill		Canajoharie		Fairfield Minaville		Canajoharie		Trenton Group	
Metalliferous Limerock				Trenton Limestone		Trenton Limestone		Trenton Limestone & Shale		Trenton Limestone		Basal Trenton		Glens Falls Limestone		Glens Falls		Shoreham Limestone Larrabee Limestone		Trenton Limestone		"Shoreham" Limestone & Shale Larrabee	
"Sparry Limerock"		Mohawk Limestone		Base of the Trenton		Black River		Black River		Amsterdam Limestone		Amsterdam		black Lowville		Not Discussed		Amsterdam		Amsterdam		Black River	
		Gray Limestone with sparry veins		Black River Limestone		Birdseye Limestone		Lowville Limestone		Black River		Lowville		Lowville				Lowville		Lowville		Black River	
Calciferous Sandrock		Bastard Limestone		Mohawk Limestone (1840)		Fucoidal Layers of Calciferous Sandrock		Beekmantown Formation		Tribes Hill Limestone, Dolomite		Not Discussed		Considered Absent		Not Discussed		Tribes Hill Limestone, Dolomite		Gailor Dolomite		Chuctanunda Cr. Dolostone	
		Gray Limestone with sparry veins (1837)								Fucoidal Layers								Little Falls Dolomite Theresa Sandstone Dolomite Potsdam Sandstone		Little Falls Hoyt Limestone Theresa Potsdam		Ritchie Limestone	
		Calciferous Sandstone of Mohawk Valley		Calciferous Sandrock		Calciferous Sandrock												Little Falls		Hoyt Galway Potsdam		Saratoga Springs Little Falls Theresa Potsdam	
Primary		Gneiss (1837) Primary (1839)		Gneiss (1838) Primary		Not Discussed		Precambrian		Precambrian				Precambrian				Precambrian		Precambrian		Precambrian	

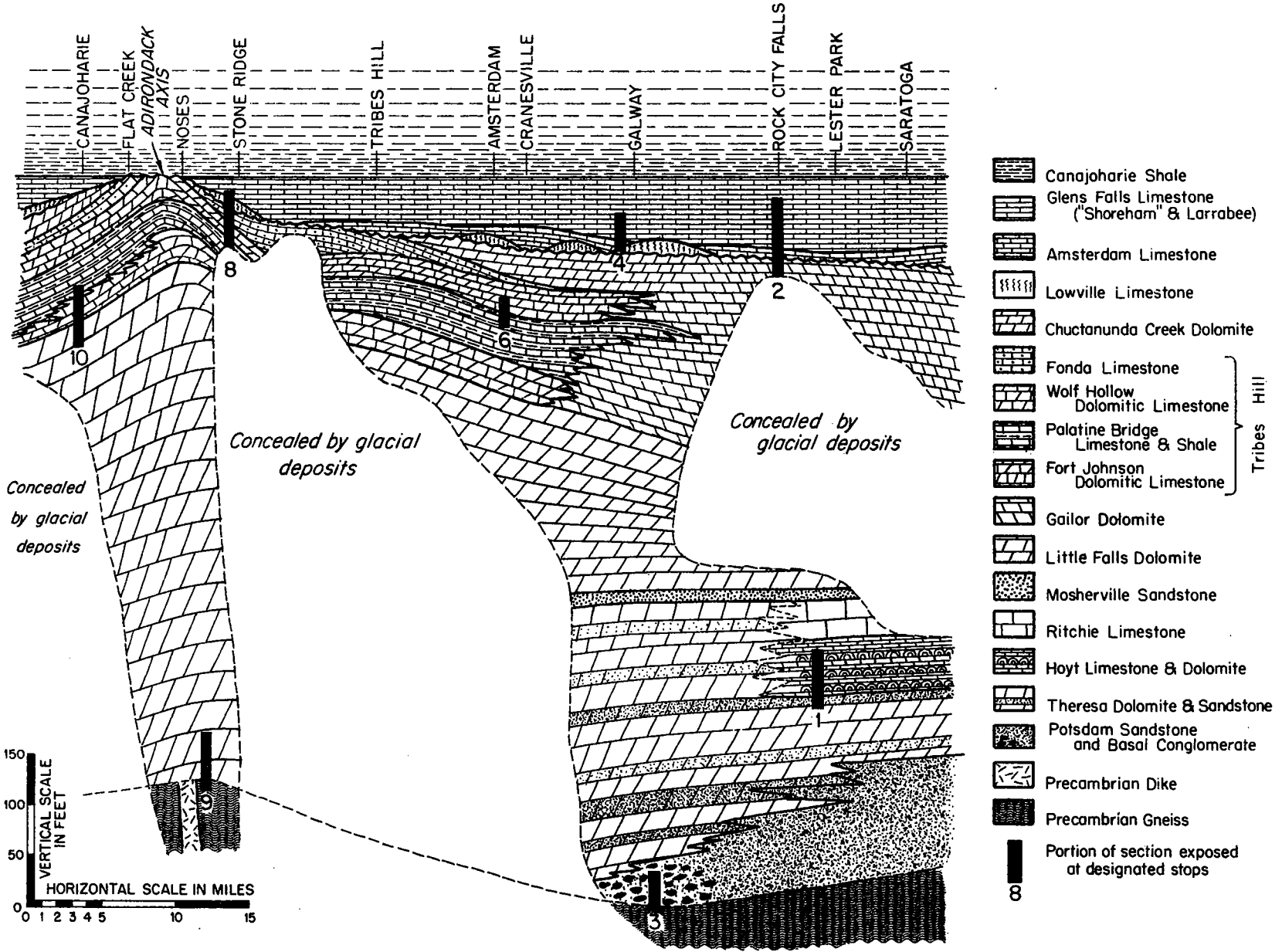
In general, the fossils of the Mohawk Valley have suffered from inattention. Following Hall's initial volume (1847) of his monumental "Paleontology of New York", half a century passed before application was made of the fossil wealth of the Valley. Charles Smith Prosser (first professor of geology at Union College) and Edgar R. Cumings (later to enjoy many years as Professor of Geology at Indiana University) demonstrated the stratigraphic usefulness of fossils in their studies of Black River and Trenton limestones (1900). In conjunction with this work, the Amsterdam quadrangle became the first 15-minute topographic quadrangle to be geologically mapped (1897, Prosser, Cumings, and Fisher). Herdman F. Cleland's work (1900, 1903), stemming from a Cornell summer field camp under Professor Gilbert D. Harris, was of taxonomic and correlative importance. He announced a new fauna, older than the Black River and younger than the Potsdam-Hoyt Fauna, described a few years earlier by that great student of the Cambrian, Charles D. Walcott (1884). This Tribes Hill (early Ordovician) fauna stimulated search for fossils in other areas at this stratigraphic level.




















A rash of quadrangle mapping was in vogue in New York State in the period 1905-1930 motivated chiefly by John M. Clarke and Rudolf Ruedemann who were engaged in several ambitious paleontologic endeavors. It was during this acceleration program that the Little Falls (Cushing, 1905), Broadalbin (Miller, 1911) Saratoga-Schuylerville (Cushing and Ruedemann, 1914) and Schenectady and Albany (Ruedemann, 1930) quadrangles were geologically mapped. Similarly, mapping of glacial deposits was undergoing an "explosion". James H. Stoller, second Professor of Geology at Union College (1911, 1916), Albert Perry Brigham (1929) and, probably foremost, Herman Leroy Fairchild (1912, 1919) labored toward the enlightenment of Pleistocene Geology in eastern New York.

Owing to the intensive study of the extinct strange graptolites by Ruedemann (1912, 1925), it was discovered that the great monotonous thickness of Ordovician black shales was capable of faunal subdivision; several biostratigraphic graptolite zones were formulated. Now that the Middle Ordovician shales were shown to be divisible it remained for Marshall Kay to attack the Middle Ordovician limestones with the same purpose. This resulted in the illuminating classic "Stratigraphy of the Trenton Group" (Kay, 1937), undoubtedly more referred to than any other single work on New York Ordovician geology. With the completion of this work, there remained two major segments of Mohawk Valley geology virtually unstudied: the Lower Ordovician-Upper Cambrian strata, and (2) bedrock mapping of the Canajoharie and Fonda quadrangles. These I commenced in the summer of 1947 and since then have worked on them intermittently.

Figure 3

STRATIGRAPHIC PROFILE — CANAJOHARIE TO SARATOGA



-  Canajoharie Shale
-  Glens Falls Limestone ("Shoreham" & Larrabee)
-  Amsterdam Limestone
-  Lowville Limestone
-  Chuctanunda Creek Dolomite
-  Fonda Limestone
-  Wolf Hollow Dolomitic Limestone
-  Palatine Bridge Limestone & Shale
-  Fort Johnson Dolomitic Limestone
-  Gailor Dolomite
-  Little Falls Dolomite
-  Mosherville Sandstone
-  Ritchie Limestone
-  Hoyt Limestone & Dolomite
-  Theresa Dolomite & Sandstone
-  Potsdam Sandstone and Basal Conglomerate
-  Precambrian Dike
-  Precambrian Gneiss
-  Portion of section exposed at designated stops

Tribes Hill

PALEO ENVIRONMENTS, -- AN ENIGMA

"The interest in a science such as geology must consist in the ability of making dead deposits represent living scenes" ----- Hugh Miller

The above quotation together with the opening statement in Derek Ager's recent book on "Principles of Paleocology", -- "Fossils were once animals and plants that lived and breathed, fed and bred, moved and died. Their lives were a continuous battle with their environment. Their story is the essential prelude to the fleeting present and the unknown future" -- succinctly outline what is in store for those who attempt to recreate pictorially the settings which sedimentary rocks can reveal with proper study.

The study of rocks and fossils with the goal of reconstructing ancient environments is termed paleoecology. The approaches utilize many of the methods of paleontology, stratigraphy and ecology, the study of present-day environments, except that the paleoecologist is concerned with another dimension -- time, and another medium -- rocks. He, thus, works with untold numbers of faunas and floras usually imperfectly preserved. Furthermore, he is handicapped by the fact that no past environment is preserved in its original state for the fossils that one finds in a rock are death assemblages; they may represent life that was:

- (1) Native [endemic] to the environment
- (2) Foreign [exotic] to the environment

or, more probably, a

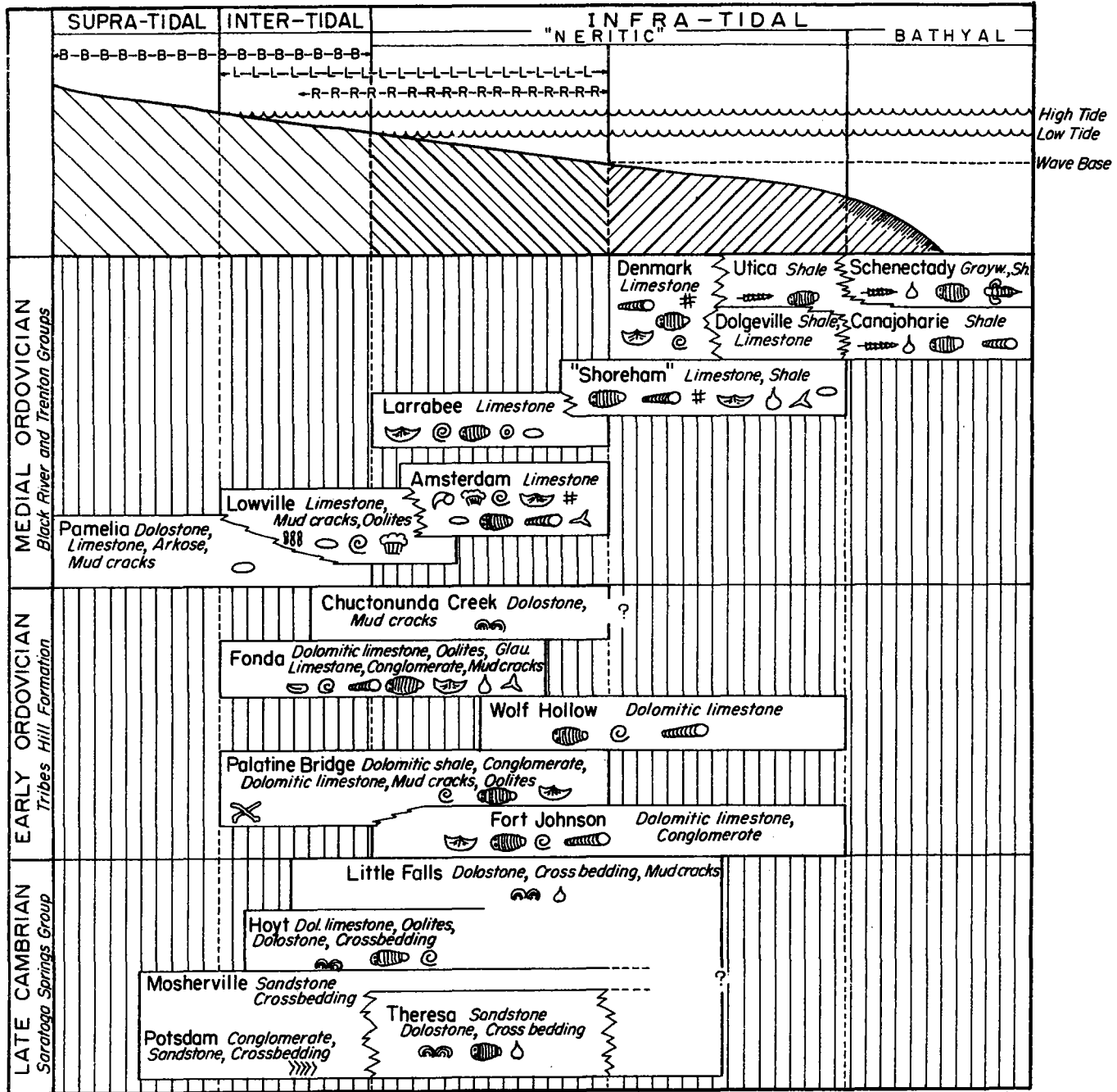
- (3) Mixture. Such assemblages may be
 - (a) Ecologically mixed
 - (b) Chronologically mixed
 - (c) Geographically mixed
 - (d) Combinations of the above

Furthermore, an environment may be divided into physical, chemical, and biological components. Some of these cannot be determined whereas others can be restored only with uncertainty.

In reconstructing past environments, it should be remembered that:

Figure 4

SUMMARY of MARINE PALEO-ENVIRONMENTS in the MOHAWK VALLEY



GYG 4-65

- | | | | | | |
|--|------------------------|--|----------------------------|--|--|
| | Conodonts | | Inarticulate brachiopods | | -B-B-B- Area of potential beach development |
| | Graptolites | | Bryozoans | | -L-L-L- Area of potential lagoon development |
| | Trilobites | | Horn corals | | -R-R-R- Area of potential reef development |
| | Eurypterids | | Tobulate corals | | } Continental Shelf |
| | Ostracodes | | Vertical worm borings | | |
| | Ribeirids | | Worm & unidentified trails | | Continental Slope |
| | Orthoconic cephalopods | | Arthropod trails | | |
| | Snails | | Cryptozoons | | |
| | Articulate brachiopods | | Pelmatzoan columnal | | |

- (1) Not all animals and plants that have lived on this Earth have left a fossil record.
- (2) Those that have left a fossil record may have left
 - (a) only parts of their bodies
 - (b) only an incomplete chronologic record
 - (c) a misleading record as far as abundance is concerned (Ex. animals that molt)
 - (d) as yet, undiscovered remains
- (3) Some environments are less apt to be preserved in the sedimentary record (Ex. rocky shore)
- (4) Habits and habitats of extinct animals are unprovable (We do the best we can with the available evidence)
- (5) The assumption that the Law of Uniformitarianism, -- The Present is the key to the past -- has always been so, may be fallacious. Organisms may have changed their habits and habitats with time.

With all the above qualifications and uncertainties, you may rightly ask, "What paleoecological deductions can one make from the sedimentary rocks?" Utilizing tools from chemistry, physics, and biology, the paleoecologist can arrive at some pretty well substantiated ideas of ancient environments. True, we are still making some educated guesses and there are many questions that, for now, must remain unanswered but paleoecology has come a long way in the past 20 years. The groundwork, however, must remain the tedious descriptive stratigraphy and taxonomic paleontology that will forever be basic to any paleoecological study. Albeit traditional, it appears that the presentation of the description of the stratigraphic units in their proper chronologic sequence is the most feasible manner to examine the past environments of the Mohawk Valley.

PRECAMBRIAN ERA (PCu)

Precambrian rocks do not comprise much of the surface rock in the Mohawk Valley. But these rocks are important toward the understanding of the derivation of the younger strata and the events which preceded the accumulation and lithification of the fossil-bearing rocks of the subsequent Paleozoic Era.

For a more complete discussion of the rock types of the Adirondack Mountains, the reader is referred to Y. W. Isachsen (1965). Within the Mohawk Valley, three kinds of Precambrian rock are exposed at the two inliers or "windows".

- (1) garnet-biotite gneiss (at the Noses Inlier)
- (2) mafic pyroxenite dike (at the Noses Inlier)
- (3) augite-hornblende syenitic-gneiss (at the
Little Falls Inlier)

Only the garnet-biotite gneiss will be examined on this trip

(Stop 9, see Road Log).

P A L E O Z O I C E R A

LATE CAMBRIAN (CROIXIAN) - SARATOGA SPRINGS GROUP

POTSDAM SANDSTONE (€ss)

Typically, the Potsdam is a white to cream colored, clean, quartz sandstone cemented by silica, calcium carbonate, or dolomite. The type locality at Hannawa Falls near Potsdam, St. Lawrence County, N.Y. is, paradoxically, atypical for there it is a red to maroon colored, feldspathic sandstone with cobbles and pebbles of older rock. Elsewhere, the white Potsdam is customarily pebble-free, regular - and cross-bedded with infrequent wave and current ripple marks. Bedding varies from thin - to thick bedded.

Along the southern margin of the Adirondacks, the Potsdam is thin, never exceeding 100 feet, or absent and has failed to yield any diagnostic fossils. Near Fort Ann, 25 miles northeast of Saratoga, the trilobite Komaspidella fixes a Dresbachian (Early Croixian) age.

Ecologically, it is likely that the Potsdam represents a beach deposit (wind-blown and water abraded quartz) on the shore of a westwardly transgressing sea (see Fig. 4). The lack of sedimentary fossils attests to the instability of the sand bottom. Trails, looking like tractor tire-tracks, so common in the Potsdam, would be expected in this environment. Very short wave length ripple marks are, similarly, ubiquitous in our present-day shifting beach sands of the supratidal zone. Localized patches of quartz-boulder or cobble conglomerate atop the Precambrian have, rightly or wrongly, been termed Potsdam. One of these will be examined at Stop 3 (see Road Log).

THERESA FORMATION (€ss)

The Theresa is a facies of alternating dolomitic quartz sandstones and quartzose dolostones interfingering shoreward with the Potsdam sandstone facies and seaward with the Little Falls Dolostone facies (see Figs. 3 and 4). The sandstones in the Theresa vary from the Potsdam-type to one in which the quartz to dolomite ratio is nearly 1:1. The Dolostones are, characteristically, coarsely crystalline with pockets of pink and orange dolomite crystals. Rarely, thin dolomitic shale zones may occur. One of these along the West Galway Road, east of Bunn Corners, has abundant lingulid brachiopods. This zone is very near the summit of the Theresa Formation, here overlain by the Mosherville Sandstone - a local, persistent 5-6 foot bed useful as a stratigraphic marker (see Fig. 3).

Isolated algal stromatolites (Cryptozoon) and the trilobites Elvinia and Camaraspis (indicies of the early Franconian) complete the known fauna in the Saratoga-Mohawk Valley region. Elsewhere in the State, the Theresa has trilobites of late Franconian age and at the type locality at Theresa, Jefferson County, N.Y. the formation is demonstrably Early Ordovician holding the gastropods Helicotoma and Holopea. Thus, the Theresa, like its shoreward facies the Potsdam, is time-transgressive toward the northwest and sedimentation would seem to be continuous from Late Cambrian into Early Ordovician time (Fisher, 1962a). However, the lack of any faunal proof of the middle (Conaspis zone) or upper (Ptychaspis-Prosaukia zone) Franconian in the Saratoga-Mohawk Valley region may signify a cessation of sedimentation and a gap in the stratigraphic record (paraconformity). The Theresa appears to be a deposit in the inter-tidal and inner continental shelf areas (see Fig. 4).

HOYT LIMESTONE (Ess)

This formation, named by Ulrich and Cushing (1910, p. 98), is lithologically variable. Primarily, it is dark to medium gray, coarse - to medium textured quartzose dolomitic limestone. Purer layers of dolostone, oolite-rich beds, and quartz sand-rich beds are frequent. Unique to the Hoyt, in comparison with other stratigraphic units of the region, are the several biostromal reef limestones constructed by colonial algal stromatolites -- the Cryptozoons or "fossil cabbages or brussel sprouts". The Cryptozoon heads were periodically smothered by quartz sand thus halting or inhibiting their growth. Trilobite fragments were distributed haphazardly and, luckily, enable us to rather precisely fix the age of this key unit as late Late Cambrian (Trempealeuan), for the formation has yielded Dikellocephalus, Keithiella, Plethometopus, Plethopeltis, Prosaukia, and Saratogia. Primitive snails like Matharella, Palaeacmaea, and Pelagiella, the monoplacophoran Tryblidium, the lingulid brachiopods Lingulepis and Obolella, and the curious hyolithid-like Mathevia complete the known fauna and flora.

Fortunately, we can assign the Hoyt to its paleoecological niche with some conviction. Recent studies (Logan, 1962) in Shark Bay, Western Australia, demonstrate that living Cryptozoons thrive in an inter-tidal zone in an elongated bay with salinity somewhat higher than the open ocean. The adjacent land, of low relief and slight rainfall, supplies little detritus to the ocean. At Lester Park (Stop 1) the Hoyt Formation is a Late Cambrian portrayal of this modern Australian oceanic environment (see Fig. 4). And like the Shark Bay setting, the Cambrian Hoyt counterpart was seemingly geographically restricted for the Hoyt facies has not been found outside of the Saratoga area. Correlative strata in the Mohawk and Champlain Valleys are dolostones or limestones which lack the reef development of the Hoyt.

LITTLE FALLS DOLOSTONE (css)

J. M. Clarke (1903, p. 16) introduced the name Little Falls for the magnesian limestone underlying the "Birdseye" or Lowville Limestone (Middle Ordovician) and overlying the Greenfield (later named Hoyt because of preoccupation) Limestone. As thus defined, the Little Falls embraced an interval occupied by Lower Ordovician (Tribes Hill - Gailor) strata. And so a common error was perpetrated in selecting the name from one area and defining the unit from an area where the stratigraphic relations are different. In the Saratoga region, Wheeler (1942) had thought that the Hoyt overlay the Little Falls but he overlooked the effect of faulting on the stratigraphic sequence. Fisher and Hanson (1951) showed that the dolostone previously termed Little Falls in the Saratoga vicinity was actually a Lower Ordovician dolostone which they named Gailor and which proved to be a facies of the Tribes Hill Formation of the Mohawk Valley.

In the Mohawk Valley, the Little Falls consists of a thick series (up to 550') of dolostones variable in color and texture, usually admixed with rounded quartz grains and frequently penetrated by light gray and white chert nodules and stringers. Glauconite is occasionally present. Locally, pyrite may be common. Detrital quartz increases in volume stratigraphically downward and geographically northward; the northward increase is of such proportions that a separate facies, the Theresa, is seen to intertongue with the Little Falls (see Figure 3). Interstitial hematite is prevalent in a red zone, 8 to 15 feet thick, at the summit of the Little Falls Dolostone. This zone is riddled with pockets (vugs) of quartz crystals, termed "Herkimer Diamonds", and anthraxolite, a black lustrous carbonaceous mineral with nearly the same chemical composition as coal though it has different physical properties (see Dunn and Fisher, 1954). This anthraxolite became concentrated, as a liquid, in a zone of relatively high porosity and permeability in a manner similar to that of petroleum. Having first saturated the carbonate strata, it underwent subsequent changes which produced a decrease in volume and a corresponding increase in viscosity until it attained its present solid, brittle or sooty condition. These changes occurred, in part, contemporaneously with the introduction of silica. The parent material (proto-anthraxolite) was probably vegetable and derived from the algal biostromal reefs of Cryptozoon, now largely obscured through dolomitization; migration from the Hoyt reefs is also plausible.

Except for the aforementioned dolomitized Cryptozoon, the Little Falls is frustratingly barren of fossils; exceedingly rare and undiagnostic lingulid brachiopods and a trilobite free cheek (Elvinia), not in place, have been found at the Noses. For this reason the age of the Little Falls, unproved by direct fossil evidence, must be ascertained through fixing the ages of its overlying, underlying, and lateral equivalents (see Fig. 3). The first two

provide minimum (Early Canadian= Tremadoc) and maximum (Precambrian) ages; the last signifies an Early Franconian age as illustrated by the trilobites of the Theresa in the Saratoga region. The Little Falls may span a broader interval than Early Franconian but this must await corroboration from discovery of additional key fossils. The "prominent unconformity" mentioned by Ulrich and Cushing (1910) will be seen at Stop 10 (see Road Log); it is more correctly termed a paraconformity (see section on unconformities).

EARLY ORDOVICIAN (CANADIAN) - BEEKMANTOWN GROUP

In 1899, Clarke and Schuchert (p. 876) recognized that the Cambrian and Ordovician portions of the "Calciferosus" should be differentiated. Faunally this seemed plausible owing to Walcott's (1884) study of the Potsdam-Hoyt fauna and Cleland's (1900) study of the "new Tribes Hill" fauna; lithically, such a division was not obvious. Unfortunately, they chose the name Beekmantown for the Ordovician portion although neither the then known Tribes Hill (Early Canadian) nor Fort Cassin (Late Canadian) faunas were known to occur at Beekmantown, N.Y. Only 25 feet of dolomitic limestone and calcitic dolostone crop out at Beekmantown and the fossils (Lecanospira zone) indicate only a Medial Canadian age. Subsequently, Clarke (1903, p. 16) proposed the name Little Falls Dolomite for the Cambrian portion of the "Calciferosus" though no fossils were known by which its age could be established! Strangely, Clarke called it Champlainic or "Lower Siluric", thereby implying an Ordovician age.

Confusion mounted when Cushing (1905) placed all the strata between the Potsdam and Lowville in the Beekmantown Formation (see Fig. 2) automatically relegating the entire "Calciferosus" to the Ordovician. Perplexingly, the name Little Falls Dolomite appears on the geologic map (dated 1901) for the strata in question but the name was not formally proposed in the literature until 1903!

Out of this chaos, the name Beekmantown has come to be employed for all carbonate rock of Early Ordovician (Canadian) age in the eastern and central United States.

TRIBES HILL FORMATION (Ob)

Named by Ulrich and Cushing (1910, p. 99), this unit was initially separated from the Calciferous Sandrock as the Bastard Limestone (see Fig. 2). The Tribes Hill has more calcite and far less quartz than the underlying Little Falls Dolostone; it is also non-cherty. In some places the Tribes Hill is capped by a thin cherty dolostone, the Chuctanunda Creek Dolostone. In my original report (1954) on the Lower Ordovician of the Mohawk Valley, I designated yet another formation - the Cranesville Dolomite - a separation based partly on identification of a gastropod supposedly indicative only of the Upper Canadian. Additional stratigraphic information, not available at

the time of the original study, coupled with the now dubious identification and stratigraphic reliability of this gastropod (Eccyliopterus = Lesueurilla) clearly reveals that Cranesville should be abandoned as a stratigraphic name.

The Tribes Hill Formation is subdivisible into four members (Fisher, 1954). They are, in ascending order:

- Fort Johnson Member: massive, dark gray-black, dolomitic calcilutite (fine grained limestone) grading into calcitic dolostone with the calcite portion weathering white and the dolomite portion weathering buff. A fretwork appearance is produced as the patches of dolomite weather out in relief. Occasional quartz grains are present. The fine-grained, massive character coupled with the molluscan fauna and lack of shallow water features produced by waves implies deposition in the outer shelf zone.
- Palatine Bridge Member: distinguished by its relatively large amount of interbedded shale and persistent thin-beddedness of its quartzitic calcilutite layers. Pyrite, some of which is oolitic, and orange-brown iron staining are common. Glauconite is locally common. Some bedding planes are replete with tracks and trails erroneously alluded to as "fucoids". Trilobite fragments are common in the limestone layers. This unit is interpreted to have been formed in the inter-tidal and inner shelf zone.
- Wolf Hollow Member: massive, dark gray-black, dolomitic calcilutite with a single stratum of dolostone, 2-7' thick, a few feet above the base. The calcite weathers white and the dolomite weathers buff and in relief produces a fretwork appearance. This is a recurrent Fort Johnson facies but with a more varied and abundant fauna. Quartz is virtually absent as is pyrite and glauconite. An outer shelf environment seems a likely site of deposition. This and the Palatine Bridge member will be seen at Stop 6 (see Fig. 4 and Road Log).
- Fonda Member: has the most varied fossil content and lithologic makeup of any part of the Tribes Hill Formation. Calcarenites (coarse grained limestones) with quartz sand and silt and with glauconite and pyrite yield most of the fossils, many of which are abraded. Flat-pebble conglomerates (calcirudites), calcitic dolostone, dark gray oolitic quartzose calcarenite, and gray dolomisiltite complete the lithologies. Stratigraphic breaks are common, probably of diastemic value. Ribeirids and gastropods are most numerous, followed by trilobites, orthoconic and cyrtoconic cephalopods, brachiopods, conodonts, and cystid plates in that order. The Fonda seems unquestionably to be a deposit in the high wave energy inter-tidal and inner shelf zones. The Fonda member will be examined at Stop 8 (see Fig. 4 and Road Log).

Where the basal Tribes Hill (Fort Johnson) grades into purer dolostone, the separation from the underlying Little Falls Dolostone then becomes a problem (see Fig. 3). Similarly, where the Tribes Hill laterally changes to dolostone (Gailor facies), separation from the older strata is difficult. In general, the Gailor is a gray, coarsely crystalline, massive bedded dolostone, somewhat cherty and quartzose. Discovery of the gastropods Ophileta and Lytospira (=Ecculiomphalus) and the ellesmeroceroid cephalopod Ectenoceras at Saratoga confirms the existence of Early Ordovician dolostone above the Hoyt Formation; the Little Falls Dolostone is absent in this region, having passed laterally into the Potsdam and Theresa Formations (see Fig. 3).

CHUCTANUNDA CREEK DOLOSTONE (Ob)

This, the youngest Canadian unit in the Mohawk Valley, has been named from its type locality along the North Chuctanunda Creek within the city of Amsterdam (Fisher, 1954, p. 90). It is entirely dolostone varying in grain size from the dolomilitite (medium grained dolostone) through dolomarenite. The upper portion is so impregnated with silica cement that, in some places, the rock behaves physically like chert. Stringy, hackly and nodular chert may be found. Some quartz silt and sand occur and black interstitial carbonaceous material is also present. Bedding varies from 6" to 2'. The maximum thickness is 40'; usually it is 10-25' thick, where present. The erosional surface atop the Canadian, in some places, reaches as low stratigraphically as the Wolf Hollow Member and the Chuctanunda Creek Dolostone is absent in many sections (see Fig. 3).

The sparse fossils found are some poorly preserved Ophileta and Lytospira, a silicified cyrtoconic cephalopod (Clarkoceras) and some dolomitized Cryptozoon mounds which resemble hippopotami backs when observed in stream beds. The few available environmental criteria point to deposition in the inter-tidal and inner shelf zones.

The Canadian units offlap the Little Falls Dolostone, or its correlatives, to the north and west.

MEDIAL ORDOVICIAN (MOHAWKIAN) - BLACK RIVER GROUP

The Black River Group receives its name from the splendid extensive exposures in the Black River Valley, flanking the western Adirondacks. There, the Group consists of the Pamela, Lowville, and Chaumont Formations; the Chaumont includes the Leray and Watertown Limestones of the older literature. At its base, the Pamela is dolomitic arkose grading upward into greenish, massive bedded, conchoidal fracturing dolostone; rare black calcilutite beds occur. The Pamela facies grades laterally and vertically into the "dove-gray", white weathering calcilutite of the Lowville which, in turn, grades laterally into the Chaumont black, massive, slightly cherty calcilutite. Faunally, the Pamela is barren except for ostracodes, the Lowville has a sparse fauna chiefly characterized in its upper part by coral biostromes of Tetradium, whereas the Chaumont holds

horn and favositid corals, orthid brachiopods, and large orthoconic cephalopods.

In the Champlain Valley, the Pamela is dubiously present and the Lowville facies intertongues with a black, massive, calcilutite termed the Isle la Motte Limestone. In the southern Champlain Valley, the lumpy bedded, black Amsterdam Limestone separates the Lowville and Isle la Motte. This facies concept is not as extreme a view as that proposed by Winder (1960) who considered all the limestones of the Black River and Trenton Groups to be contemporaneous. I believe there is a slight hiatus between the two Groups. Locally, disconformable contacts are visible or Trenton limestones are known to overlap the Black River Group. The faunas, too, though imperfectly known, seem chronologically distinct. Accordingly, I place the Black River Group in the Wilderness Stage and most of the Trenton Group in the Barneveld Stage (see Fig. 6).

LOWVILLE LIMESTONE (Otbr)

Named from its type exposure in Lowville, Lewis County, this rock unit has one of the most distinctive physical appearances of any in the State. An extremely fine grain-size, a conchoidal to sub-conchoidal fracture, chalk-white weathering, coupled with a tan-gray color known as "dove gray", stamps the Lowville as a rock not likely to be confused with any other in the State. Occasional well-rounded quartz grains are thought to have been introduced by wind. Dessication cracks are profusely distributed on the bedding planes. The thin-to medium bedded rock is finely laminated; oolites are sometimes present.

The Lowville's fauna, too, is unique. At least four sub-facies occur: a Phytopsis facies, a Tetradium facies, a gastropod facies, a fossil-free facies. Phytopsis is a vertical worm boring which in some places riddles the rock as though peppered with bullet holes. It is these holes which caused the early geologists to label this the Birdseye limestone. This is a deposit of the inter-tidal zone. Tetradium is a colonial tabulate coral which is so abundant locally as to form reefs -- thus an inner shelf reef deposit. The gastropod-rich beds probably accumulated as off-reef deposits in the inner shelf zone. The fossil-free laminated beds may have formed in lagoons behind the Tetradium reefs. Bean shaped ostracodes are the most abundant organic remains in the Lowville. Rare brachiopods and trilobites complete the fauna.

In the Mohawk Valley, the Lowville is neither continuous nor is it thick; six feet is the maximum observed thickness. Elsewhere in the State it reaches 65' where it interfingers with the supra-tidal Pamela and the infra-tidal Chaumont, Amsterdam, or Isle la Motte calcilutites. In many places, basal Trenton limestones rest on Lowville Limestone without evidence for a time gap. The Lowville will be examined at Stop 4 (see Fig.3 and Road Log).

AMSTERDAM LIMESTONE (Otr)

Cushing (1911, p. 143) applied the name Amsterdam to the Mohawk Limestone of Conrad (1840). Its type exposure was said to be "in the vicinity of Amsterdam". There is much doubt as to what unit Cushing had in mind for he gave no lithic or faunal description nor were the superjacent and subjacent units mentioned. Furthermore, in his description of the Paleozoic rocks of the Saratoga region, Cushing (1914) reports 39 feet of Amsterdam at Rock City Falls. The only limestone there with a thickness of such magnitude is the Trenton, most of it being the gray Larrabee coarse-textured limestone with a typical Trenton fauna. It follows that Cushing, the nomenclator of the Amsterdam, utilized his name for the coarse-textured "base of the Trenton" limestone, referred to by Ruedemann to the lower half of his Glens Falls Limestone. Kay (1937, p. 259) employed the name Amsterdam for approximately 10' of gray-black, rough fracturing limestone with wavy bedding planes above the Lowville and beneath the Glens Falls (Larrabee member). This application seems more in keeping with the usage of Mohawk Limestone of the early geologists of the New York Survey (see Fig. 2).

It would seem that Vanuxem's "Third District" report would shed light on the matter but, on this point, Vanuxem himself wavered. In 1840, he clearly stated that the Mohawk Limestone underlay the Birdseye (Lowville) Limestone; this would place the Mohawk Limestone in the Tribes Hill Formation. Later, (1842) he refers to the Base of the Trenton and Black River Limestone as Mohawk Limestone. In summary, different workers have applied the name Amsterdam to different rock units. Ordinarily, priority would be respected but in this case the main usage has been for a unit not intended to be termed Amsterdam by its nomenclator! It, thus, seems prudent to accept the principal usage -- that the Amsterdam overlies the Lowville and underlies the Larrabee.

As so defined, the Amsterdam is a lumpy bedded, blocky, dark gray to black, calcilutite to calcisiltite which weathers grayish-white and has a hackly or brittle fracture. In commenting on the Black River Limestone of the Amsterdam quadrangle, Cumings (1900, p. 465) stated, "The lumpy structure mentioned by the early New York geologists as a characteristic of the Columnaria horizon at Watertown is its [Amsterdam] most constant lithologic character in the present region [Amsterdam quadrangle]". Its maximum thickness in the Mohawk Valley is about 11 feet but usually it is 4-6 feet; in some places it is absent from its accustomed stratigraphic position. Its fauna is large in numbers and variety but is, as yet, unstudied (Fisher, in progress). Snails, orthid and strophomenid brachiopods, trepostome bryozoans, ostracodes, horn and columnarid corals, trilobites, actinoceroid cephalopods, conodonts, and pelecypods occur in that order of abundance. This is a typical infratidal shelf fauna. The lumpy bedding together with haphazard fossil orientation suggests deposition above wave base and in the inner shelf zone.

Figure 5

COMPARISON OF CLASSIFICATION OF NEW YORK ORDOVICIAN

Kay 1960			RADIOMETRIC DATES IN MILLIONS OF YEARS	Fisher 1962		
SERIES	STAGES	SUBSTAGES		SERIES	STAGES	ROCKS
CINCINNATIAN	Richmondian		425	CINCINNATIAN	Richmond	QUEENSTON FORMATION
	Maysvillian				Maysville	LORRAINE GROUP
TRENTONIAN	Pictonian	Gloucesterian Collingwoodian Cobourgian	435	MOHAWKIAN	Barneveld	TRENTON GROUP <i>including</i> UTICA
	Shermanian		Denmarkian Shorehamian			
	Nealmontian	Kirkfieldian Rocklandian	445		Wilderness	BLACK RIVER GROUP
BLACKRIVERAN	Chaumontian Lowvillian Pamelian		455	UNNAMED	Porterfield	<i>absent in New York</i>
CHAZYAN	Valcourian				Ashby	CHAZY GROUP
	Crownian				Marmor	
	Dayan				Whiterock	<i>absent in New York</i>
CANADIAN	Whiterockian		470	CANADIAN	<i>(Stages not yet established)</i>	BEEKMANTOWN GROUP
	Cassinian	<i>Proposed by Flower (1957) but not used by other Ordovician workers except Kay.</i>				
	Jeffersonian					
	Demingian					
Gasconadian						
			500			

As early as 1900 Prosser (p. 470), in discussing the Ingham's Mills section on East Canada Creek, recognized the interfingering of the Birdseye [Lowville] and Black River Limestone [Amsterdam] lithologies. Such intergradation is demonstrable in several places.

The Amsterdam is not certainly present west of Tribes Hill; a few feet of lumpy-bedded limestone at Stone Ridge are questionably referred to the Amsterdam.

MEDIAL ORDOVICIAN (MOHAWKIAN) - TRENTON GROUP

There has been much ambiguity in the use of the name Trenton. To some it means rocks (Trenton Group, Trenton Formation); to others it denotes time (Trentonian Series, Trenton Stage). In addition, there are varying opinions as to the stratigraphic limits of these rock or time units. My preference is that Trenton be used as a rock term (Group). The type section of the Trenton Group is at Trenton Falls, N.Y. on West Canada Creek. Not all the Trenton rock units are exposed here but most of the typical limestones are well displayed.

Marshall Kay has been the most intensive worker in the New York Trenton. His classic paper (1937), "Stratigraphy of the Trenton Group", was an elaboration for subsequent studies in these rocks in New York and Ontario and a reference for Medial Ordovician stratigraphic studies elsewhere. Because of fundamental differences in our philosophies on a "Formation" and faunal zonation, our respective stratigraphic frameworks are noticeably different. Figure 5 is a comparison of Kay's most recent terminology (1960) with mine (Fisher, 1962b) which is patterned after that adopted by G. A. Cooper (1956).

GLENS FALLS LIMESTONE (Otrbr)

For the limestone intervening between the Amsterdam below and the Canajoharie Shale above, in the Mohawk Valley and in the Saratoga - Glens Falls region, Ruedemann (1912, p. 22) proposed the name Glens Falls Limestone. He recognized that it was older than any limestone at Trenton Falls. Earlier, that perceptive geologist E. R. Cumings (1900, p. 466) reported, "The Trenton substage is composed of two members, a lower, massive, crystalline and an upper, thin-bedded, fine-grained member. The lower member is usually about 8 feet in thickness and the upper probably not far from 30 feet. This, together with Ruedemann's repeated references to a twofold division of the Glens Falls prompted Kay (1937, p. 262-265) to apply formal names to these divisions -- Larrabee for the lower Glens Falls and Shoreham for the upper.

LARRABEE LIMESTONE (Otbr) This is a light to medium gray, thin - to medium bedded dark gray weatherin calcarenite to calcisiltite which typically produces field ledges and has been extensively quarried in the past. Cross-bedding and pebble beds are rarely encountered. Locally, there is a basal, lumpy bedded somewhat conglomeratic argillaceous calcilutite as at Rock City Falls, north of Tribes Hill along NY 67, and at Stone Ridge. It is noteworthy that this subunit, never exceeding 8 feet in thickness occurs only where the subjacent Amsterdam is thin or absent.

The Larrabee's fauna is large with orthid and strophomenid brachiopods being the most numerous. Crinoid debris and snails are common. Among the trilobites, Encrinurus cybeliformis and Bathyrurus ingalli seem to be reliable guides to the Larrabee.

The nomenclatorial confusion surrounding this unit has already been discussed under the Amsterdam Limestone (see Fig. 2). It is debatable whether the name Larrabee should be carried west of the Adirondack Axis.

The paleoecological niche of the Larrabee seems unquestionably to be the inner shelf zone, as the sedimentary evidence clearly points to deposition in a high energy zone but one with a prolific marine bottom fauna (see Fig. 4).

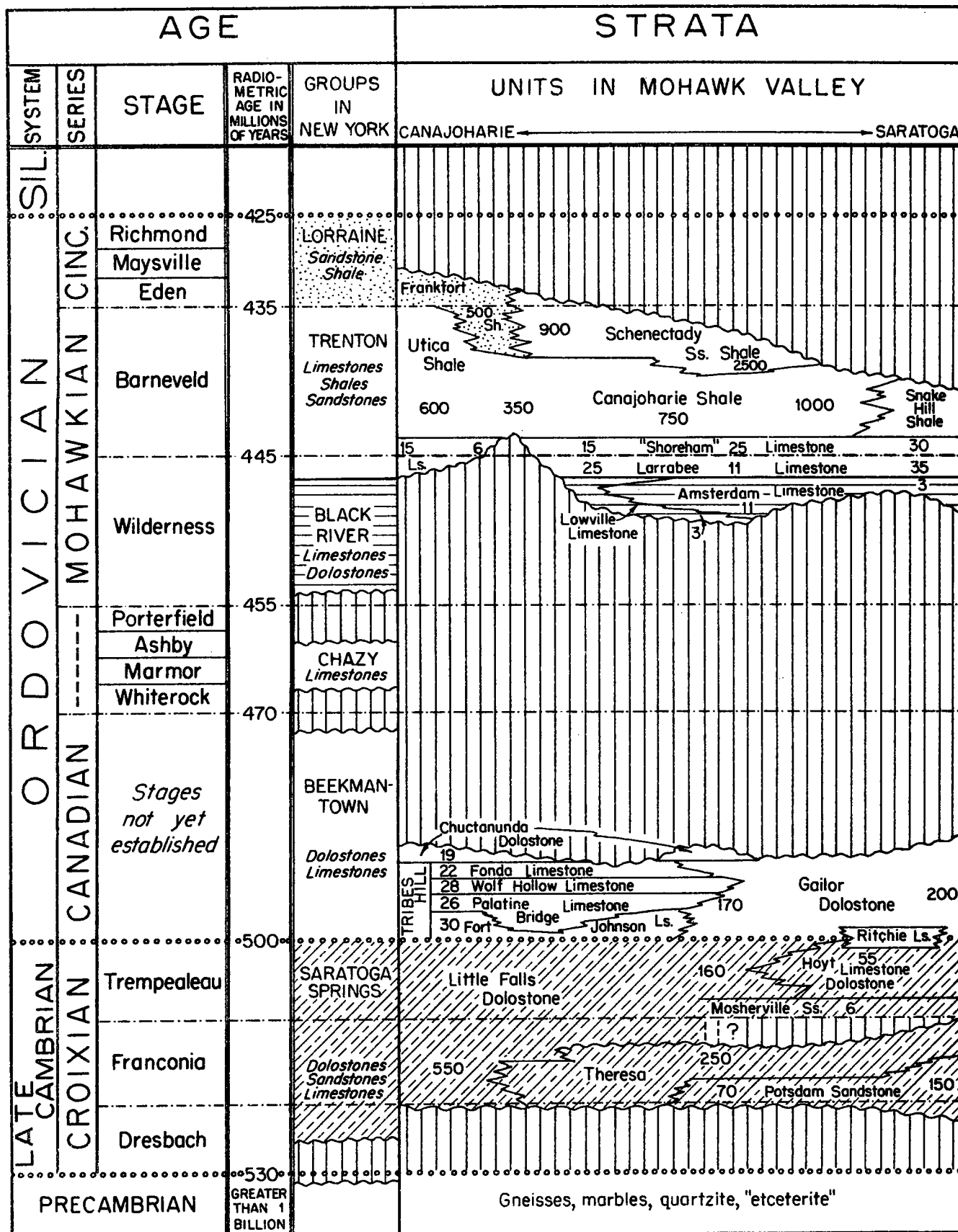
The Larrabee may be seen at Stops 2, 4 and 8 (see Fig. 3 and Road Log).

"SHOREHAM LIMESTONE" (Otbr) Kay defines this unit thusly, "The Shoreham member (Shoreham Township, Addison County, Vermont) constitutes the zone of Cryptolithus tessellatus Green, the limestones of lowest Sherman Fall age". Clearly, the name Shoreham applies to a biostratigraphic unit and not a lithologic one. Since its inception, the name Shoreham has come to be employed for the rock between the Denmark above and the Kirkfield or Larrabee below despite the fact that the lithology varies and the trilobite Cryptolithus tessellatus is not known everywhere from this stratigraphic interval. For example, Kay (1937) places the Shoreham along Flat and Canajoharie Creeks but, after intensive search no Cryptolithus could be found and the rock is coarser textured than the "Shoreham" elsewhere. I would agree with Kay (1960) that the Shoreham may be utilized as a substage (zone of Cryptolithus tessellatus) but I disagree that, in addition, it can be regarded as a rock unit with fixed physical characters.

In the Mohawk Valley and Saratoga-Glens Falls region, the "Shoreham" (upper Glens Falls Limestone) is composed of alternating dark gray to black calcareous shale and thin-bedded dark gray to black argillaceous calcilutite and calcisiltite. Because the upper Glens Falls deserves a new rock name, which ought not to be proposed here, the name Shoreham is provisionally retained in quotes.

Figure 6

CORRELATION CHART - LOWER MOHAWK VALLEY



Note: All thicknesses shown in approximate feet.

Faunally, the "Shoreham" is a trilobite-brachiopod facies and several genera of each occur in immense numbers (see under Faunal Zonation). Bryozoans are next in abundance. Inarticulate brachiopods and orthoconic cephalopods are not uncommon. The site of deposition seems to be the outer shelf zone, below the effective depth of wave base (see Fig.4).

CANAJOHARIE SHALE (Oc)

Named (Ruedemann, 1912, p. 28) from the section along Canajoharie Creek south of the village, the Canajoharie Shale is thicker than the composite thickness of the older Paleozoic strata; it approaches 1100' in the eastern Mohawk Valley thinning westward to 350' over the Adirondack Axis expanding again westward to 650'. It is lithologically remarkably uniform being a slightly calcareous dark gray to black shale. In some places the rock is so dense and compact as to be called an argillite. Pyrite nodules, up to 4", are rarely found.

To the west, the Canajoharie passes through the Dolgeville facies (alternating black shale and thin-bedded black calcilutite) into typical Trenton limestone (Denmark). To the east, the Canajoharie grades into the silty Snake Hill Shale and into the lower Schenectady graywacke and gray shale (see Fig. 6).

In the main, the fauna is a pelagic one consisting chiefly of planktonic graptolites and nektonic orthoconic and gyroconic cephalopods. Epiplanktonic brachiopods, snails, and sponges adhered to floating seaweed. A meager benthonic fauna of scavengers or "garbage collectors" appears in the upper Canajoharie and Utica Shales. Chief among these are the trilobites Triarthrus and Flexicalymene.

The origin of black shales has been the subject of much dispute. Some regard the foul hydrogen-sulfide rich muds as having been deposited in fairly deep waters; others believe the highly reducing conditions to have taken place in virtually land-locked lagoons. Whatever the depositional site, black shales generally lack a normal bottom fauna, lack calcareous fossils and, in the Ordovician, are apt to yield those strange extinct graptolites - excellent devices for correlation.

SCHENECTADY FORMATION (Osc)

For the great thickness of interbedded silty gray and black shales, buff-weathering graywackes, and argillaceous sandstones that form the surface rock throughout virtually all of Schenectady County, Ruedemann (1912, p. 38) applied the name Schenectady beds. Thicker than the whole of the preceding Paleozoic section, the Schenectady's actual thickness is undetermined owing to insufficient long sections and lack of marker beds within the monotonous repetitive lithologies. Well data disclose that 2000' are penetrated before the Canajoharie Shale is reached; the Schenectady may approach 2600'.

The Schenectady's meager fauna indicates a Mohawkian age; graptolites, (orthograptus truncatus) eurypterids, and seaweeds are the chief elements.

The formation is a terrigenous product of vigorous erosion and rapid sedimentation. Much turbidite phenomena exist such as sole markings and flow rolls. Lithologically, the Schenectady is reminiscent of the Chemung beds of the Upper Devonian but the bottom fauna so profuse in the Chemung is almost non-existent in the Schenectady. The Schenectady is a younger extension of the Normanskill. Presumably the Schenectady accumulated in a sinking basin, on the continental slope (see Fig. 4) in front of the rising Taconic Mountains. Its great thickness may be attributed to the shedding of older Cambrian and Ordovician clastics from the recently emplaced Taconic Allochthone in Mohawkian time. In turn, the younger Late Ordovician Pulaski and Oswego facies were derived from the erosion of the Schenectady sediments.

FAUNAL ZONATION

Not only are the fossils of the Cambrian and Ordovician strata in the Saratoga to Canajoharie region useful for reconstructing past environments but they are usable for determining relative ages and for correlating with other areas. Whereas benthonic (bottom dwellers) animals, particularly those that are immobile, are superior indices to environments, nektonic (swimmers) and planktonic (floaters) ones are more valid for zonation and correlation purposes because of quicker and wider dispersal. On the other hand, the factors of abundance and easy identification bear on the matter. For this reason, the Mohawk Valley strata, especially the carbonates, are more easily zoned through the use of mobile or vagrant benthos, specifically the trilobites. It was during the Cambrian and Ordovician Periods that trilobites attained their maximum diversity and numbers -- the zenith or acme of their evolutionary cycle. Because of their profusion and relative ease of identification nine biostratigraphic zones may be distinguished:

<u>Triarthrus</u> , <u>Flexicalmene</u>	-	Lower Schenectady - Upper Canajoharie
<u>Cryptolithus tessellatus</u> , <u>Flexicalmene</u> , <u>Isotelus</u>	-	"Shoreham", Snake Hill
<u>Bathyurus ingalli</u> , <u>Encrinurus cybeliformis</u> , <u>Isotelus</u>	-	Larrabee
<u>Bathyurus spiniger</u> , <u>Bumastus trentonensis</u> , <u>Isotelus</u>	-	Amsterdam
<u>Hystericurus ellipticus</u> , <u>Clelandia parabola</u>	-	Upper Tribes Hill
<u>Asaphellus gyracanthus</u> , <u>Symphysurina</u> , <u>Bellefontia</u>	-	Lower Tribes Hill
<u>Plethopeltis</u> , <u>Keithiella</u>	-	Upper Hoyt
<u>Dikellocephalus</u> , <u>Prosaukia</u> , <u>Plethometopus</u> , <u>Saratogia</u>	-	Lower Hoyt
<u>Elvinia</u> , <u>Camaraspis</u>	-	Theresa (Galway)

In relating strata of one area or continent with another, it is customary to compare fossil assemblages rather than fossil species. The reason for this is that individual species are usually provincial, that is, they are ecologically or geographically controlled and species are more liable to subjective rather than objective refinement. The faunal summary (by series) below is not intended to be comprehensive but it does illustrate the gross composition of the respective faunas.

<u>SERIES</u>	<u>abundant to frequent</u>	<u>scarce to rare</u>
	*graptolites (<u>Orthograptus</u> , <u>Lasiograptus</u> , <u>Glossograptus</u>)	*orthoconic cephalopods (<u>Geisenoceras</u>)
	*trilobites (see earlier tabulation)	*ostracodes (<u>Primitiella</u>)
		*inarticulate brachiopods (<u>Obolus</u> , <u>Trematis</u>)
		*algae
	strophomenid brachiopods (<u>Rafinesquina</u>)	lingulid & obolid brachiopods (<u>Lingula</u> , <u>Trematis</u>)
	orthid brachiopods (<u>Paucicrura</u> , <u>Dinorthis</u> , <u>Zygospira</u> , <u>Sowerbyella</u>)	endoceroid cephalopods
	bryozoans	actinoceroid cephalopods
	trilobites (see above)	conularids
MOHAWKIAN	gastropods (<u>Trochonema</u> , <u>Hormotoma</u> , <u>Liospira</u> , <u>Phragmolites</u>)	pelecypods
	ostracodes (<u>Eoleperditia</u> , <u>Isochilina</u> , <u>Kloedinella</u>)	worm borings receptaculitids
	conodonts	
	crinoid fragments	
	corals (<u>Foerstephyllum</u> , <u>Favistella</u> = <u>Columnaria</u>)	

* items prefixed with asterisk occur in black shale

abundant to
frequent

scarce to
rare

CANADIAN

<p>ribeirids (<u>Ribeiria</u>)</p> <p>gastropods (<u>Ophileta</u>, <u>Bucanella</u>, <u>Liomphalus</u>, <u>Gasconadia</u>)</p> <p>orthoconic cephalopods (<u>Ectenoceras</u>, <u>Walcottoceras</u>)</p> <p>cyrtconic cephalopods (<u>Clarkoceras</u>)</p> <p>trilobites (see earlier tabulation)</p>	<p>lingulid brachiopods (<u>Lingula</u>)</p> <p>orthid brachiopods (<u>Finkelburgia</u>)</p> <p>worm trails</p> <p>cystid plates</p> <p>conodonts</p> <p>tentaculitids</p>
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CROIXIAN

<p>trilobites (see earlier tabulation)</p> <p>algae (<u>Cryptozoon</u>)</p>	<p>gastropods (<u>Matherella</u>, <u>Rhachopea</u>)</p> <p>lingulid brachs. (<u>Lingulepis</u>)</p> <p>matthevids (<u>Matthevia</u>)</p> <p>hyolithids</p> <p>worm borings</p>
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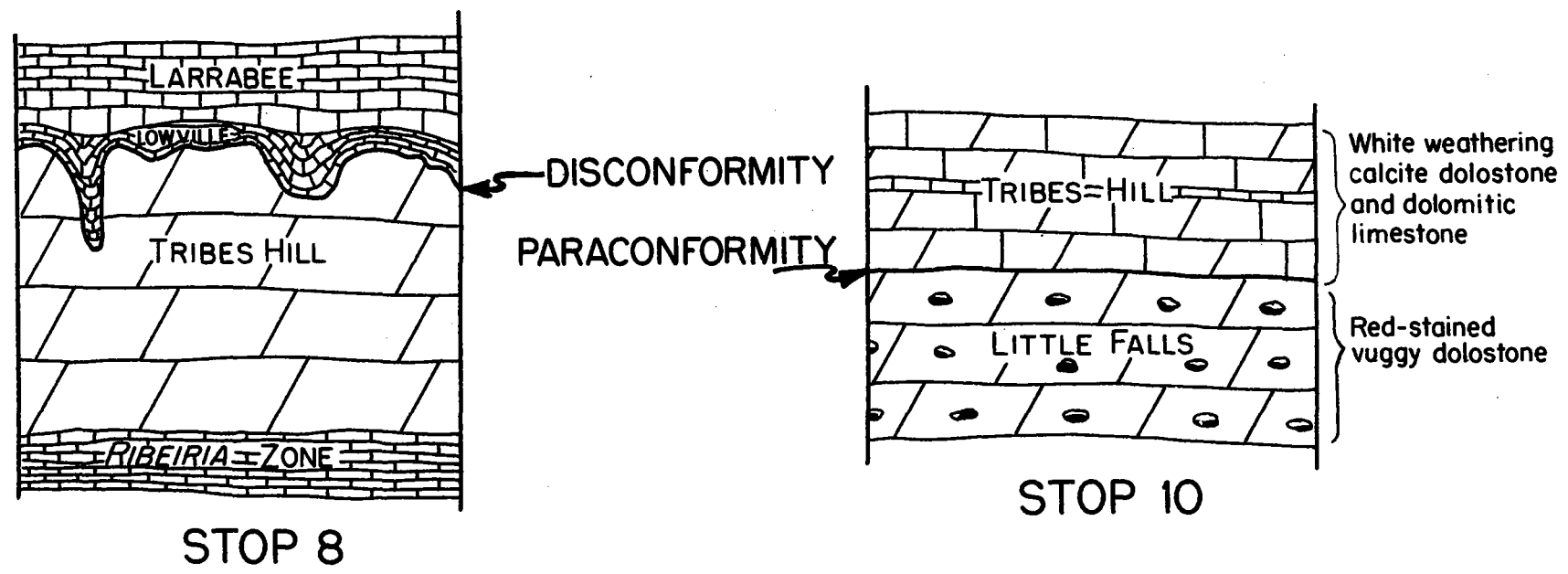
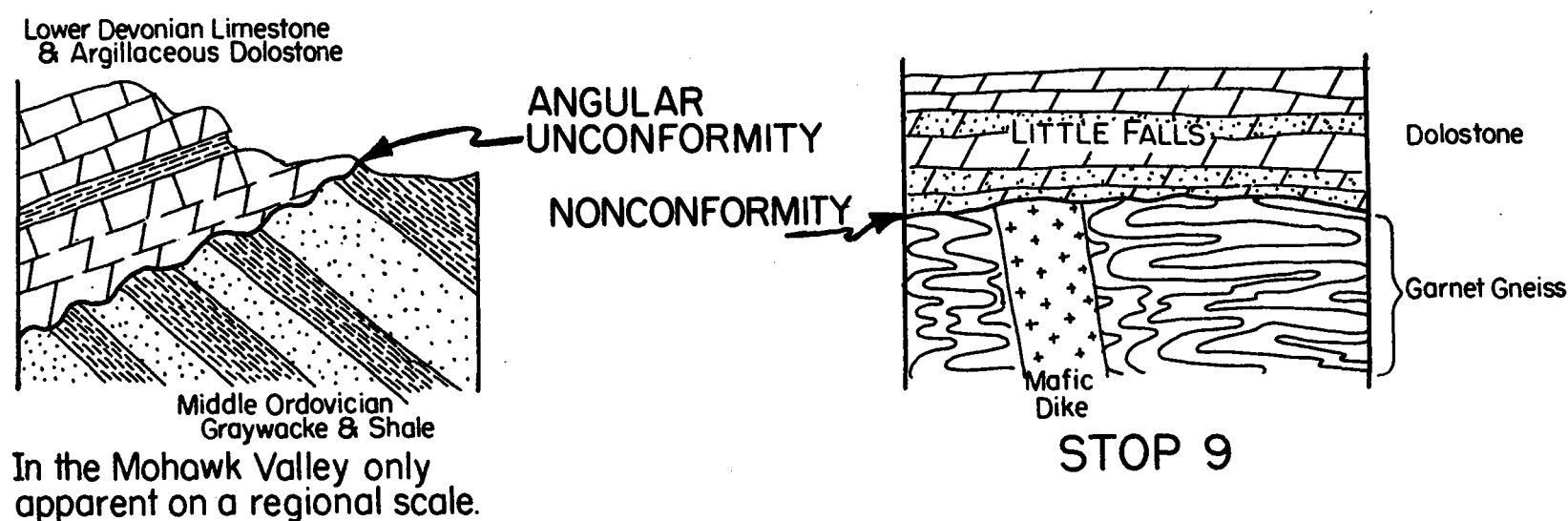


Figure 7 Types of Unconformities

STRUCTURE

UNCONFORMITIES - OBVIOUS AND OBSCURE

Lack of continuity in the sedimentary record has long been recognized. In fact, every bedding plane is an interruption of that continuum. But these gaps in the record are of geologically short duration, perhaps daily, weekly, or yearly cessations of sedimentation; other gaps may span millions of years as, for example, Recent alluvium resting on early Precambrian rocks. Any break in the sedimentary sequence signifies subtraction from the steady supply of stratigraphic data, whether produced by the neutral condition of non-deposition or the negative one of erosion. Stratigraphic gaps are constantly being filled by extension of investigation but, as Darwin once intimated, there is probably more time represented by breaks than by record.

To those concerned with reconstructing geologic history, stratigraphic breaks or unconformities are of the utmost importance. Originally, they were delineated by abrupt changes from basement metamorphic rocks to unmetamorphosed sedimentary rocks. Discordance of bedding between two adjacent units was early recognized as reflecting a diastrophic event in which uplift and folding caused a stoppage of the normal sedimentary cycle prior to the return of sedimentation; the duration of the period of omission of the record was called an hiatus. However, the amassed paleontologic evidence sometimes illustrated great gaps in evolutionary sequences where physical gaps are not apparent. Closer scrutiny of the field relations disclosed no angularity of bedding between two units with fossils of different ages but it did reveal that the contact surface was an irregular one which, when traced over a broad area, proved that the underlying strata had undergone erosion. This disconformable surface was sometimes capable of being traced into an area where an angular bedding relationship could be demonstrated. Still another more baffling situation commonly arose where, within a single lithologic unit, faunas of markedly differing ages occurred.

Few geologic phenomena are of more interest and importance than unconformities for they record emergence, erosion, non-deposition and diastrophism. Four types of unconformities may be distinguished (see Fig. 7). It is apparent that the nonconformity, in which two units of stratified rock and the angular unconformity, in which two units of stratified rocks are discordant are easily detected. Less easily discerned is the disconformity, in which two units of stratified rock are parallel but the surface of unconformity is an old erosion surface of measurable relief, because some bedding planes are undulatory and some intraformational conglomerates produce pseudo-disconformable surfaces. The really obscure unconformity is the paraconformity in which strata, often of identical lithology, are parallel but the contact is a simple bedding plane and the stratigraphic gap must be determined by faunal analysis.

It should be kept in mind that the length of time missing is not necessarily a function of the obviousness of the unconformable surface. Cross-bedded formations show marked angular discordance of bedding but there is little or no break in sedimentation. Conversely, some paraconformable surfaces are of long duration as, for example, Mississippian Redwall Limestone on Middle Cambrian Mauv Limestone in the Grand Canyon.

Bear in mind, too, that an unconformity may appear in more than one guise. When considered on a regional basis it may manifest itself as an angular unconformity but at a single exposure it may appear as a disconformity or even a paraconformity. Breaks of short extent (diastems), when compounded, probably account for more geologic time than more obvious unconformities.

The following is a summation of stratigraphic breaks in the lower Mohawk Valley and Saratoga region presented in order of increasing time:

Pleistocene and Recent deposits

---- angular unconformity (regionally) and
disconformity (locally)----

Trenton Group

---- disconformity (regionally) and
paraconformity (locally) ----

Black River Group

---- angular unconformity (regionally) and
disconformity (locally) ----

Tribes Hill Formation (diastems within unit)

---- paraconformity (locally) ----

Little Falls Dolostone (diastems within unit)

---- nonconformity ----

Precambrian gneiss

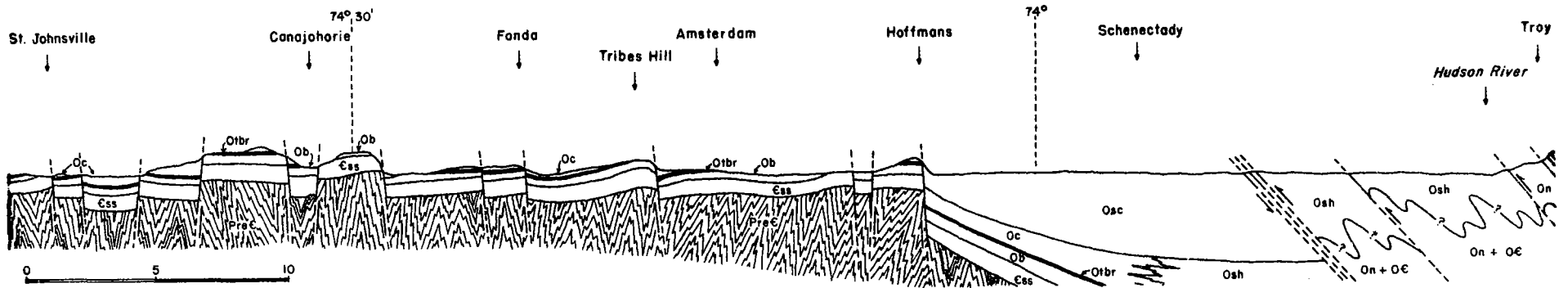


Figure 8 Structural Section of the Mohawk Valley — St. Johnsville to the Hudson River

FAULTS - HORSES, HORSTS, AND GRABEN

Fractures in the Earth's crust along which there has been movement parallel to the fracture surface are known as faults. One type, called normal faults, is well displayed in the Mohawk Valley. Normal faults, in contrast with reverse faults, are those in which the hanging wall has dropped down relative to the foot wall. If parallel faults are downdropped on the same side, a step-like topography may result. If, however, some of the parallel faults are downdropped on the opposite side, a series of troughs and ridges known as graben and horsts are produced (see Fig. 8). This series of upthrown blocks (horsts) and downthrown blocks (graben) extend from the Hoffmans Fault on the east to Little Falls on the west. The faults are all very high angle, the fault planes dipping from 75° to verticality. Occasional dips as low as about 45° are observable, for example, where the Little Falls Fault crosses the N. Y. State Thruway.

In general, the gravity or normal faults with the greatest vertical displacement (throw) are downdropped on the east. This produces a series of staggered steps as one proceeds west, up the Valley (see Fig. 8). Northward these faults extend into the Precambrian gneisses of the Adirondack Mountains (see Fig. 1). The throw increases to the north but whether it continues to increase within the Adirondacks is not determinable owing to the lack of marker beds. Southward, thick glacial debris piled against the foot of the Devonian Helderberg and Onondaga Escarpments and an east-trending drumlin field prohibits tracing the faults with accuracy. The youngest strata cut are of the late Barneveld Schenectady Formation; the oldest strata not cut are those of the Medial Silurian Clinton Group. Either the faults extend beneath the Helderberg Escarpment or else they hinge out in the Ordovician shales prior to reaching the Escarpment.

The cause of the Mohawk Valley faulting is conjectural. At least three hypotheses have been suggested to explain the reason why such block faulting should occur. Chadwick (1917) believed that the faults were crustal readjustments on the shelf due to the tremendous weight exerted by the Taconic Klippe on the crust in the thicker portion of the geosynclinal strata, i.e. isostatic compensation. Megathlin (1935) regarded the faults as tensional responses following a period of compressional stress which gave rise to folds and reverse faults in eastern New York, i.e. relaxation of stresses. Yet another hypothesis may be offered which attributes the gravity faults to differential updoming of the Adirondacks; it is significant that the faults increase in throw to the north.

The age of the faulting is as much a mystery as is the cause. Block faulting is known in the Triassic Period in eastern New York and New England. Regional uplift is known in the Tertiary but no faulting is presumed to have taken place then. Reverse faulting is proved in the Taconian and Acadian Orogenies. In all probability, the Mohawk Valley faults were active early in the Paleozoic and renewed movement took place at subsequent times in geologic history.

Certain it is that the Noses Fault Scarp was a formidable barrier to sedimentation. The whole pattern of Late Ordovician deposition (Lorraine Group and Queenston Shale) shifted to the west indicating that the Mohawk Valley was sufficiently uplifted to prohibit epeiric seas from covering this portion of N.Y.

A structural feature of importance bisects the Mohawk into an Upper and Lower Valley. This Adirondack Axis (or arch) was effective as a barrier as early as Early Ordovician time and continued to be effective until sometime during Canajoharie sedimentation, then again during Schenectady sedimentation. The entire Valley region was uplifted during the Late Ordovician and remained a source area for a greater part of the Silurian Period. Marine seas were unable to inundate the region until Late Silurian (Brayman) time. The stratigraphic sequence from Brayman Shale through the Devonian shows no evidence of an Adirondack Axis. The crest of the Axis seems to have occurred in Late Ordovician time when the thick regressive Queenston Delta deposits changed to Early Silurian transgressive deposits; from the base of the Clinton to the end of the Silurian the pattern is one of eastward transgression except for a regressive period at the close of Herkimer deposition and two minor regressive periods during the formation of the Clinton Group. The most plausible age, then, for the culmination of block faulting in the Mohawk Valley seems to be during the latest Ordovician with minor reactivity perhaps in the earliest Silurian and again prior to the formation of the late Silurian Vernon Delta.

The normal faults with the greatest throw are from east to west, the MacGregor Fault (from Saratoga north), the Hoffmans Fault, the Noses Fault (midway between Fonda and Canajoharie), the St. Johnsville Fault and the Little Falls Fault. The largest graben is that occupied by the Sacandaga Reservoir; the largest horst is that atop the Noses. Many of the faults, especially the largest ones, split into two or more faults when traced north. In contrast, the faults with smaller displacements seem to die out both northward and southward (Tribes Hill Fault, Fonda Fault).

A feature attendant to faulting that is shown to advantage in the Mohawk Valley is a horse, a small block or sliver caught along the fault surface. The strata within the horse are intermediate in age between the older strata of the upthrown side and the younger strata of the downthrown block. Within the horse, the rocks invariably possess a northerly component to their dip, which may be either westerly or easterly. Horses are probably more prevalent than customarily supposed but are infrequently seen because of scarcity of rock exposure. Horses will be observed at Stops 4 and 5. (see Road Log).

Reverse faults are unknown west of Schenectady but they are plentiful in the Taconic region east of the Hudson River where imbricate or shingle blocks have been pushed westward by compressional and gravitational forces.

No special study of joints, fractures in rocks along which there is no movement parallel to the ruptured surface, has been made. We are unsure what relation persistence or non-persistence of joint patterns means with respect to faulting or regional uplift (epeirogeny).

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"Some books are to be tasted, others to be
swallowed, and some few to be chewed and
digested" --- Francis Bacon

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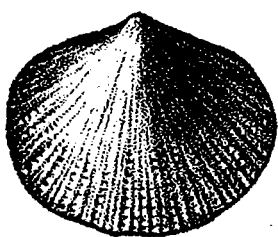
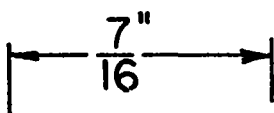
Figure 9

ALGAE

Cryptozoon



Figure 10



Paucicrura

Figure 11

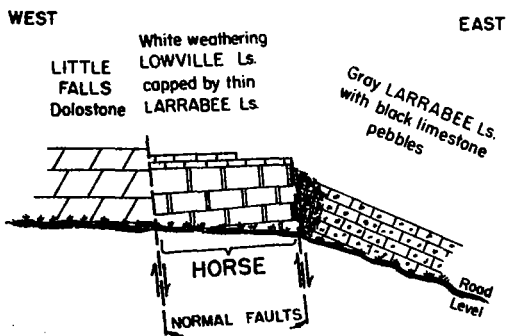
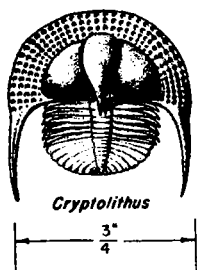


Figure 12



Cryptolithus

GRAPTOLITE
(ORTHOGRAPTUS)

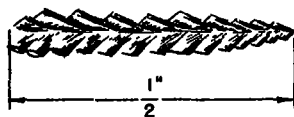


Figure 13

RIBEIRIA

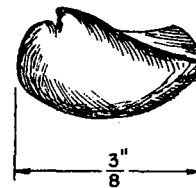


Figure 14

ROAD LOG

TRIP A - Saratoga to Canajoharie (use with Fig. 1)		
<u>Time</u>	<u>Miles</u>	<u>Distance between points</u>
8:15	0	Leave Thruway Motel, proceed west on Washington Ave. to intersection with Northway and Thruway (Interchange #23)
	1.0	<u>Turn right</u> (north on Northway, Interstate 87)
	8.0	7.0 Outcrop of Middle Ordovician Normanskill Graywacke and Shale along east (northbound) lane. This is the westernmost extent of a large area of Normanskill, interpreted as a thrust outlier of the Taconic Allochthone or as a north-trending anticline protruding from beneath a cover of younger rocks.
	8.2	0.2 Crossing Mohawk River. These dual tied-arch bridges won an award in 1958 for their design.
	20.2	12.0 Crossing former channel of the Mohawk River. To the east, Round Lake occupies a portion of this now abandoned channel.
	22.2	2.0 Long exposure in Middle Ordovician Snake Hill Shale, a dark gray silty facies of the Canajoharie Shale of the Mohawk Valley.
	29.2	7.0 <u>Exit</u> from Northway on NY 9P & proceed west.
	29.7	0.5 <u>Turn right</u> after crossing over Northway and take connecting road north to NY 29.
	30.7	1.0 <u>Turn left</u> (west) on NY 29.
	32.7	2.0 Straight thru Saratoga Springs, crossing Main St. where road becomes NY 9N.
	35.7	3.0 <u>Turn left</u> on Middle Grove Rd. (Saratoga County 21).
	36.2	0.5 <u>Turn left</u> on paved road to Lester Park.
9:05	36.6	0.4 STOP 1 (35 minutes). LESTER PARK This is the type section for the Late Cambrian Hoyt Limestone, noted for its biostromal reefs of colonial algae called <u>Cryptozoon</u> (see Fig. 9, Plate 1). The lowest reef

has been planed by glacial erosion revealing the algal heads in horizontal section; a higher reef, in the recently enlarged road cut, exhibits a vertical section of Cryptozoon. A still higher reef in the abandoned Hoyt Quarry displays a reef of algal mats rather than heads. Between the lowest and middle reefs is a coarse-grained dolomitic limestone with oolites and trilobite fragments; the genera Prosaukia, Saratogia, Plethometopus, Plethopeltis, and Dikellocephalus have been collected here, thereby establishing a Trempealeau age.

- 9:40 36.6 LEAVE LESTER PARK, continue south on town road.
- 37.3 0.7 On left (east) is entrance to Petrified Gardens, a privately owned exhibit of the Hoyt Limestone and its Cryptozoon reefs.
- 37.4 0.1 On right is old quarry in the Ritchie Limestone, either a local facies of the Hoyt or a slightly younger unit. Its rare fossils (the gastropod Rhachopea) are not diagnostic. An east-trending normal fault separates this quarry from Lower Ordovician Gailor Dolomite on the downthrown, southern side.
- 37.8 0.4 Turn right on NY 29.
- 41.3 3.5 Turn left at Cottrell Paper Mill in Rock City Falls.
- 9:50 41.5 0.2 Cross Kayaderosseras Creek and park behind Fire House at abandoned quarry. STOP 2 (25 minutes). ROCK CITY FALLS stratigraphic section.
 In addition to studying several rock units here, there is a fine display of the Lower Ordovician-Middle Ordovician unconformity (disconformity) between the older Gailor Dolomite forming the face of the falls and the Amsterdam Limestone. The falls marks a fault-line scarp, upthrown on the west. The downthrown block exhibits Middle Ordovician Larrabee Limestone beneath the road bridge, some 70 feet lower than in the quarry on the upthrown block.
- 10:15 41.5 Leave Rock City Falls quarry, return to NY 29.
- 41.7 0.2 Turn left (west) on NY 29.
- 45.7 4.0 East Galway

- 46.7 1.0 Morainal pond on north side of road; extensive cover of glacial sand and gravel in this region.
- 47.3 0.6 Mosherville
- 10:25 48.5 1.2 STOP 3 (15 minutes). Basal Paleozoic cobble conglomerate consisting of quartz cobbles, derived from a Precambrian quartzite atop the hill to the north, in a siliceous, pyritic matrix. Midway in the exposure is some coarse-textured, bedded, quartzose sandstone. This entire unit has been called Potsdam in the past because of its basal position and sub-jacency to the Theresa Formation, which crops out along the road to the west. Lithologically it is atypical for Potsdam; it seems to be a talus deposit, probably formed at the base of a sea cliff in Late Cambrian time. Precambrian biotite-gneiss may be uncovered by digging beneath this basal Paleozoic conglomerate.
- 10:40 48.5 LEAVE. Continue west.
- 48.7 0.2 Road cut in Theresa Formation, a unit with alternating quartzose dolomites and dolomitic sandstones with occasional golf-ball size quartzite pebbles.
- 48.8 0.1 Turn left (south) on NY 147 at Kimball's Corners. Mohawk Valley to the south in the distance.
- 51.4 2.6 Turn right (west) at signal in Galway on Saratoga County route 45.
- 52.2 0.8 Climb fault-line scarp; this is the northern extension of the Hoffmans Fault, the most easterly of the Mohawk Valley normal or step faults.
- 52.5 0.3 Sharp left curve, remain on County route 45.
- 53.1 0.6 Intersection with West Galway Road, proceed straight ahead. Cliff of Upper Cambrian Little Falls Dolomite on upthrown side of fault parallels road on the right.
- 53.3 0.2 Middle Ordovician Larrabee Limestone along road, on right, opposite old cemetery. This is the eastern downthrown block. Scarp veers southwestward.
- 53.7 0.4 Turn right on recently graded town road.

- 10:55 53.8 0.1 STOP 4 (20 minutes). There are two normal (gravity) faults here, both downthrown on the east with a small fault block (horse) caught between them (see Fig. 11, Plate 1). The eastern block shows steep east-dipping Larrabee Limestone with included round pebbles of a black, fine-grained, limestone (Amsterdam?) dragged against slightly westward dipping fine-grained, tan-gray, white weathering Lowville Limestone. The Lowville within this horse is overlain directly by the gray, coarse-grained Larrabee Limestone; the Amsterdam Limestone is missing from its accustomed position between the two in the Lower Mohawk Valley. Like all other horses observed by me, this one dips north or reverse from the regional dip. The west block exposes nearly horizontal Little Falls Dolomite.
- 11:15 53.8 LEAVE horse, continue west on town road, crossing main branch of Hoffmans Fault.
- 54.2 0.4 Atop hill, good view of Mohawk Valley to the southwest, looking downdip.
- 54.6 0.2 Turn left, south on Jersey Hill Road. This region underlain by Little Falls Dolomite.
- 55.9 1.3 Turn right, west on NY 67.
- 56.3 0.4 Long road cut in Little Falls Dolomite (both sides of road). Quartz crystals and chert are absent here although we are less than 50 feet below the Tribes Hill Fm.
- 56.8 0.5 Road cut in Little Falls Dolomite.
- 56.9 0.1 Turn left on Toureuna Road, parallels electric transmission line. Lower area to west is the course of a pre-glacial valley, tributary to the Mohawk.
- 59.1 2.2 Turn half left at Green Corners on Wolf Hollow Road Extension.
- 60.4 1.3 Straight ahead at intersection with West Glenville Road. Outcropping of thick-bedded, coarse-grained, light gray Larrabee Limestone (with "Shoreham" fossil Cryptolithus) on lumpy-bedded, fine-grained, dark gray to black Amsterdam Limestone on southwest corner. This is the fault-line scarp of the Hoffmans Fault.
- 60.8 0.4 Entering Wolf Hollow, bear right.

- 11:35 61.5 0.7 STOP 5 (60 minutes), WOLF HOLLOW and LUNCH Park on left, horse on right. The road and stream follow the fault trace of the Hoffmans Fault which, here, has a vertical displacement (throw) of at least 1000 feet and very probably as much as 1600 feet (see Figure 8). The downthrown (east) block exposes Middle Ordovician Schenectady Graywacke and Shale in the southern part of the Hollow and Canajoharie black shale in the northern part. The upthrown (west) block shows the Lower Ordovician Gailor Dolomite forming the impressive cliff. A small horse on the west side of the road of "Shoreham" Limestone and Canajoharie Shale dips north. Wolf Hollow well exemplifies the role exerted by faults in controlling drainage.
- 12:35 61.5 LEAVE, proceed south downhill.
- 61.6 0.1 Sharp left curve. Schenectady Graywacke and Shale dragged at a 40° angle, diminishing to less than 5° at eastern limit of exposure, some 500' distant.
- 62.4 0.7 Turn right on NY 5.
- 62.7 0.3 Long high road cut begins where Toureuna Road joins NY 5; lower 40' is Little Falls Dolomite and the remainder of the cliff is Gailor Dolomite. A small hill atop the cliff exhibits Lowville, Amsterdam, Larrabee, and "Shoreham" Limestones and Canajoharie Shale in their normal stratigraphic positions. Thus, the stratigraphic succession can be demonstrated conclusively in this single section.
- 63.5 0.8 Beginning of two-mile stretch of clay and sand deposits.
- 64.4 0.9 Across river, active quarry in Tribes Hill and Chuctanunda Creek Formations.
- 65.6 1.2 Cranesville. Western limit of large pre-glacial valley which entered the Iromohawk from the north. Across river, large active quarry in Tribes Hill and Chuctanunda Creek Formations.
- 66.1 0.5 Across river, Niagara-Mohawk steam generating electric plant (now abandoned).
- 12:45 67.1 1.0 STOP 6 (20 minutes), road cut on NY 5 at railroad overpass. The two middle members of the Tribes Hill Formation are exposed here; the massive Wolf Hollow dolomitic calcilutite (fine-grained limestone) is in contact with the thin bedded Palatine Bridge dolomitic

shale and quartzose calcisiltite (medium-grained limestone) and calcilutite. Note the white and buff fretwork weathering of the Wolf Hollow member with the buff dolomite in relief. The Palatine Bridge member is lighter colored and more quartzose and pyritic. A single dolomite bed, 2 1/2 feet thick, in the lower part of the Wolf Hollow member can be traced throughout the Valley; it is a bluish-gray, medium-textured dolostone with pockets (vugs) of dolomite crystals. Fossils are scarce in both members. The Wolf Hollow member has a molluscan fauna of large, loosely coiled gastropods and straight or gently curved ellesmeroceroid and clarkoceroid cephalopods. In contrast, the Palatine Bridge member has an arthropod (trilobite) and brachiopod fauna. Both faunas indicate an Early Canadian (=Tremadoc) age.

- | | | | |
|------|------|-----|--|
| 1:05 | 67.1 | | LEAVE, continue west on NY 5 through Amsterdam. |
| | 71.5 | 4.4 | Fort Johnson. Intersection with NY 67. Baronial home of Sir William Johnson built in 1749 on northwest corner. |
| | 73.0 | 1.5 | Cross Tribes Hill Fault, upthrown on west. |
| | 73.5 | 0.5 | On north side of NY 5 is a cut in the same portion of the section viewed at the previous stop. Note the change in appearance owing to longer weathering (exposed initially in 1958). When first revealed, there was a two-foot iron-oxide zone at the top of the Palatine Bridge member; this corresponds to the two-foot dolomitic shale zone at the previous stop. |
| | 75.5 | 2.0 | Parking area, splendid view of Mohawk Valley with Schoharie Valley in distance. |
| 1:35 | 76.0 | 0.5 | STOP 7 (20 minutes). On north side of NY 5, Middle Ordovician Canajoharie Shale, here more of a calcareous argillite which is typical of the lowest 200' of the formation, has graptolites (See Figure 13, Plate 1) in the upper few feet of the exposure. These extinct animals, excellent guide fossils for subdividing the Ordovician and Silurian Periods, are thought to have been floaters (plankton) and, thus, achieved wider distribution in a relatively short period of time as compared to bottom dwellers. |
| 1:55 | 76.0 | | LEAVE, continue west on NY 5. |

- 78.1 2.1 Turn left (south) in Fonda on NY 30A (NY 148 on maps)
- 78.4 0.3 Crossing Mohawk River.
- 78.6 0.2 Pass under N.Y. State Thruway in Fultonville.
- 78.7 0.1 Turn right (west) on NY 5-S.
- 79.2 0.5 Beginning of a long series of rock cuts (1.5 miles) in Canajoharie Shale.
- 80.2 1.0 Crossing Stone Ridge Fault, upthrown on west.
- 81.0 0.8 Upper Tribes Hill Formation (Fonda member) and overlying Larrabee Limestone on south side of road.
- 81.6 0.6 Turn left on Borden Road.
- 2:05 81.8 0.2 STOP 8 (20 minutes) STONE RIDGE
 This is a critical section in deciphering structure and Ordovician stratigraphy in the Valley. The three upper members of the Tribes Hill Formation are exposed (upper Palatine Bridge and Wolf Hollow in Van Wie Creek to the west of Borden Road and Fonda member in road ditch and road cut). The Chuctanunda Creek Dolostone is missing due to erosion. This is a superb example of a disconformity (See Figure 7). The older Tribes Hill Formation has been subjected to subaerial erosion and the crevices at its summit are filled, in places, with white-weathering Lowville Limestone with vertical worm borings. Lumpy bedded limestone (Amsterdam or Larrabee ?) occurs above; the fossils are not diagnostic in distinguishing which Middle Ordovician unit crops out in this cut. Further up Van Wie Creek, undoubted Larrabee and "Shoreham" Limestones are overlain by Canajoharie Shale. In the road ditch a coarse grained limestone (calcarenite) with glauconite yields abundant fossils. Most of these are stained with iron oxide and are water-worn. Gastropods are abundant but the unusual pelecypod-like arthropod, Ribeiria, (See Figure 14, Plate 1) exceeds all others in numbers. Trilobites, ellesmeroceroid cephalopods, and brachiopods round out the major faunal elements. Rare calyx plates of cystids and conodonts complete the known fauna.
- 2:25 81.8 LEAVE. Turn around in driveway 500' to the south and return to NY 5-S.

- 82.2 0.4 Turn left (west) on NY 5-S. Note flat-topped Fonda wash plain across river. This is an Ice Age delta consisting of water-laid gravels and sands which extends north for 4 1/2 miles and west for 3.5 miles from Fonda to the Noses Fault.
- 83.8 1.6 Turn left in Randall at church onto Currytown Road.
- 2:30 84.3 0.5 STOP 9 (50 minutes) NOSES FAULT and ANTICLINE ?
NONCONFORMITY or FAULT CONTACT ?

Park next to barn at intersection of Anderson and Currytown Roads, walk across bridge over Yatesville Creek through private property to rock exposures along railroad and old Erie Canal. Precambrian garnet-biotite-gneiss brought to surface along old canal and railroad in upthrown (western) block of Noses Fault. These exposures of the basement could be due to relief of the Precambrian surface or to an anticline being upwarped slightly west of the Noses Fault. The basal Paleozoic rock here is the Late Cambrian Little Falls Dolostone. This Precambrian outcrop (one of five within this inlier) is capped by a one foot shaly zone rich in quartz and pyrite; some traces of gold and silver were reported by Darton (1895). Is the shaly zone fault gouge or is it residual soil atop the Precambrian? One must look to the basal Little Falls breccia to determine whether it is tectonic or sedimentary. You be the judge! Much of the Little Falls Dolostone here is heavily chertified; quartz crystals may be found after careful search. Elsewhere within the inlier, the basal Little Falls is not brecciated but is a dolostone rich in rounded quartz grains. At the Precambrian exposure north of the river along NY 5, a six-foot wide mafic dike (unmetamorphosed) cuts the older garnet-biotite-gneiss. The basal Little Falls is concealed but exposures 20 feet above the Precambrian are not penetrated by the dike. Presumably, the dike was injected during a late Precambrian (Keewanawan) orogenic episode. Very scarce lingulid brachiopods are the sole fossils discovered in place in the lower Little Falls at the Noses Inlier. A loose Elvinia free cheek was found by me along the railroad in 1949. Within the Late Cambrian, this would signify an early Franconian age.

- 3:30 84.3 LEAVE, proceed south (uphill) paralleling Noses Fault. Note that Yatesville Creek's course is largely controlled by the fault.
- 84.1 0.1 Fault scarp on right.
- 84.6 0.2 (and 84.7) Dragged Canajoharie Shale along road on right. Dips up to 75° E.
- 86.7 2.1 Ledge of Wolf Hollow Limestone crosses to the east of the road. Canajoharie Shale in road ditch near house. Upper Tribes Hill (Fonda), Chuctanunda Creek Dolostone and Lowville, Amsterdam, Larrabee, and "Shoreham" Limestones are missing here owing to either non-deposition or, more probably, erosion. The Canajoharie Shale, too, is but 350' thick. This area atop the Noses is considered to be the crest of the Adirondack Axis and was an effective barrier to sedimentation and faunal interchange during the Wilderness and early Barneveld Stages of the Mohawkian Series.
- 87.0 0.3 PAUSE. Looking backward, note Noses scarp extending north toward Precambrian Adirondack Mountains. Land to the east (downthrown block) underlain by Middle Ordovician Schenectady Formation. Throw of the Noses Fault here about 500'.
- 87.6 0.6 Turn right at intersection with NY 162. For the next two miles we are travelling across the top of the largest horst in the Mohawk Valley.
- 87.7 0.1 Note hills to the southwest near Cherry Valley composed of Lower and Middle Devonian strata. At Sharon Springs, 8 miles south of Canajoharie, Late Silurian Brayman Shales are in contact with Medial Ordovician Schenectady shales. A few miles west of Cherry Valley, the Medial Silurian Clinton Group intervenes between the Late Ordovician Frankfort Shale and the Late Silurian Vernon Shale. The Paleozoic section, thus, thickens markedly as one proceeds west from the Adirondack Axis. The section also thickens markedly east of the Axis but the thickening occurs within the Medial Ordovician.
- 90.3 2.6 Dropping off western side of the Noses horst; good view looking up the Mohawk Valley toward Fort Plain and St. Johnsville.
- 91.3 1.0 Turn left (west) in Sprakers on NY 5-S, cross Flat Creek and drive on river alluvium to Canajoharie.
- 93.7 2.4 Sharp reverse left on Sprakers Road at inactive quarry. Park to the left on road paralleling

railroad track.

4:00 93.8 0.1

STOP 10 (25 minutes)

Inactive quarry at eastern limit of Canajoharie on south side of NY 5-S exposes the Cambrian-Ordovician contact, i.e. Little Falls Dolostone-Tribes Hill Formation. The uppermost Little Falls Dolostone is stained red with interstitial hematite and has vugs of quartz and anthraxolite. Anthraxolite is a black mineral with 92-98% carbon with much the same composition as anthracite coal. The physical properties, however, are quite different. For example, anthraxolite does not ignite. Note that anthraxolite occupies the lower half of the vugs; the upper half is usually filled with quartz but sometimes dolomite crystals complete the cavity. Anthraxolite is believed to be a hydrocarbon residue of petroleum and to have been derived from algal reefs in the Late Cambrian seas.

The overlying Fort Johnson member of the Tribes Hill Formation is a calcitic dolostone to dolomitic calcilutite. Its scarce fossils (Ophileta, Finkelburgia, Asaphellus) denote an early Canadian age. Because the uppermost Little Falls Dolostone here has not yielded any fossils (except the non-diagnostic Cryptozoon we cannot be certain whether the Little Falls-Tribes Hill contact here is a paraconformity (surface of erosion but with no relief) indicating a gap in the record or whether the subtle change from relatively pure dolomite below to dolomitic limestone above indicates continuous sedimentation from the Cambrian into the Ordovician Period. The physical clues (zone of hematite, vuggy dolomite with contained minerals) lean toward the paraconformity view (see Figure 7).

The splendid long stratigraphic sections along Flat and Canajoharie Creeks cannot be examined by large groups. They are, however, critical in reconstructing the geologic history of the Valley and are accordingly included in Figure 3.

4:25 93.8

LEAVE, return to NY 5-S and turn left (west).

94.1 0.3

Turn right, enter N.Y. State Thruway (Interstate 90) at Interchange #29. Bear right, proceed east (Albany and New York).

NOTE: NO STOPPING PERMITTED ON THRUWAY

96.4

2.3

Valley narrows to water gap at the "Noses"; valley walls are entirely Little Falls Dolostone.

97.0

0.6

Crossing Flat Creek.

- 98.4 1.4 Entering the water gap and the Precambrian inlier.
- 98.7 0.3 Across river, road cut in Precambrian on NY 5 showing six-foot dike cutting garnet-biotite-gneiss.
- 99.7 1.0 Precambrian gneiss and Little Falls Dolostone on right along old Erie Canal and West Shore branch of N.Y. Central Railroad displaying anticlinal effect.
- 100.5 0.8 Across river, two kames (chocolate-drop-shaped hills) of gravel and sand in shadow of Noses escarpment. Fonda flat-topped wash plain extends from here for 3.5 miles eastward to Fonda.
- 103.3 2.8 Road cut along eastbound lane exposing uppermost Tribes Hill Formation, Amsterdam, Larrabee, and "Shoreham" Limestones.
- 105.0 1.7 Fultonville, Interchange #28. Water-laid gravel and sand overlying boulder till blankets much of the inner valley from here eastward.
- 108.4 3.4 Auriesville Shrine atop hill to the south.
- 109.5 1.1 Schoharie Creek, east side of Schoharie Valley here is boulder till.
- 113.3 3.8 Amsterdam, Interchange #27 with NY 30.
- 118.7 5.4 Across river, large cut in Gailor Dolostone, the dolomitic facies of the Tribes Hill Formation.
- 119.0 0.3 Road cuts along eastbound lane in Lower Ordovician Dolostone.
- 119.3 0.3 Crossing Hoffmans Fault.
- 120.0 0.7 Hills forming Valley walls composed of Schenectady Graywackes and Shales.
- 122.0 2.0 Road cuts on eastbound lane in Schenectady
+ Graywacke
- 122.7 0.7 and Shale.
- 123.3 0.6 Mohawk Valley broadens into Lake Albany Plain. Note gravels along north river bank. These thick gravels and sands are excellent reservoirs for ground water; the entire city of Schenectady and neighboring suburbs obtain their public water supplies from these almost inexhaustible water-bearing glacial deposits.
- 124.0 0.7 Schenectady, NY 5-S, Interchange # 26. Climb over south valley wall out of Mohawk Valley proper.

124.7	0.7	Road cuts in Schenectady Graywacke and Shale.
+ 124.8		
126.5	0.7	Prominent topographic feature straight ahead is the Helderberg Escarpment (not produced by faulting). Note terraces of Lower and Middle Devonian Limestones.
127.4	0.9	Approximate west shore of glacial Lake Albany. Sand plains with profuse growth of pine trees extend from here to Albany. Area of sand dunes atop lacustrine varved clays, the dunes produced by wind whipping the relatively thin veneer of lacustrine sands into north-south trending hills.
129.1	1.7	Crossing N.Y. Central Railroad.
132.0	2.9	Schenectady, NY 7, NY 146, Interstate 890, Interchange 25.
133.3	1.3	Sand dune.
133.5	0.2	Boulder till.
137.2	3.7	Albany (Northway, Washington Ave.), Interchange #24. LEAVE Interstate 90, proceed east on Washington Ave.
5:15	138.2	1.0 Arrive at Thruway Motel. End of excursion.