

## TRI-CORN GEOLOGY

### The Geology - History - and Environmental Problems of the Upper Hudson Champlain Valley

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#### Introduction

The region of the upper Hudson-Champlain valleys provides an excellent locale for the teaching of introductory geology courses. In addition to the desired examples of geologic phenomena there are ample opportunities to relate geology and human activities past and present and areas where various field methods may be used to solve very simple problems. It is the purpose of this trip to tour the area from Saratoga Battlefield north to Ticonderoga, view points of geologic, historic and environmental interest and to try to relate them one way or another together.

#### The Geologic Setting

The two valleys form a continual slash through the mountains of Vermont to the east and the Adirondacks to the west. Restricted in part between Ticonderoga and Fort Ann, they resemble an elongated hour-glass. The divide between the St. Lawrence and Hudson-Mohawk basins, however, lies south of this restriction on a line trending, just north of the Hudson, through the Village of Fort Edward and the north edge of the city of Glens Falls. A fact which surprises some and was of serious consequence during the 17th and 18th centuries.

The valley floor, lying between the Taconic overthrusts to the east and the Precambrian complex of the Adirondacks is underlain by lower Paleozoic rocks, primarily of the quartz sandstone-carbonate sequence with occasional klippen of allocthonous shales etc. resting atop them.

Structurally, the area is broken up by extensive faulting and some minor folding. The compressional forces associated with the closing Iapetus Ocean resulted in many overthrusts and folds while the tension occurring at the time of the opening of the early Atlantic produced many normal faults yielding tilted fault blocks and grabens, as at Lake George.

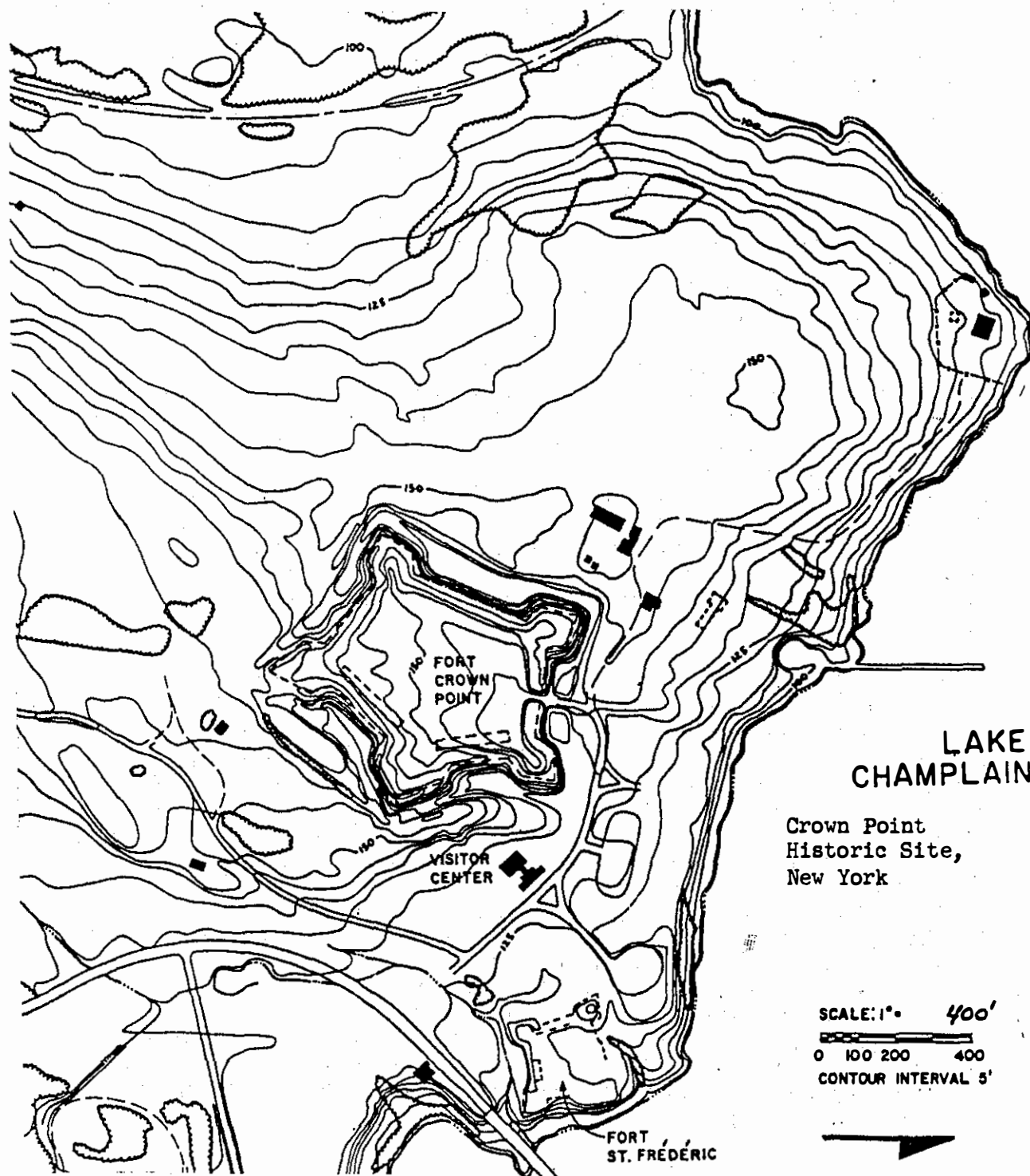
The advance and subsequent retreat of the Pleistocene ice sheets has left a vene of till outwash and lake deposits over most of the bedrock. The till is spread as a thin sheet with thicker deposits formed up, locally, into end moraines, (Gage Hill-Hidden Valley) and drumlins (Pickle Hill). A cluster of drumlins in Kingsbury along with striations record the direction of ice flow of the Whitehall lobe as it merged with those from South Bay (Champlain) and others north-south trending valleys. Meltwater formed a great kame terrace-esker complex which cuts across the south face of the mountains and sweeps down the western side of the valley. The void left by the Lake Albany, Quaker Springs, Coyeville and Ft. Ann, each leaving its own record of strandlines, deltas and lake floor deposits.



The Gallery, Glens Falls, New York Reprint from the London Magazine, 1778

The post glacial drainage systems reflecting the structural control by following joint and fault patterns, deflected by glacial deposits, present varied and occasionally startling patterns.

Ground water is equally varied. Depending on bedrock some water is simply hard, other is rendered almost unpalatable by the "sulfur" content, and then, the intriguing "mineral waters" of the spas. The best water for human consumption appears to be that taken from the glacial sands and gravels.



## Regional History and Development

The opportunity to relate geology and history begins with the initial settlement of the region. The native peoples migrated into the area following the easiest paths through the primordial forest - usually along the waterways. The early people also initiated the "mineral" industries by producing flint, slate, quartzite, mica and clay for implements and pottery. Since the waterways were utilized extensively, it is not surprising that encounters with rival tribal groups occurred along these routes and that these chance meetings led to confrontations and conflict over territorial claims, (a pattern repeated by their European successors). Oral and recorded history relate the native hostilities and how these occasionally led to the involvement of Europeans in support of their local allies. A mistake of this sort by Champlain in 1604 drove the "Mohawks" and subsequently the remainder of the "Iroquois" League into the arms of the Dutch and English.

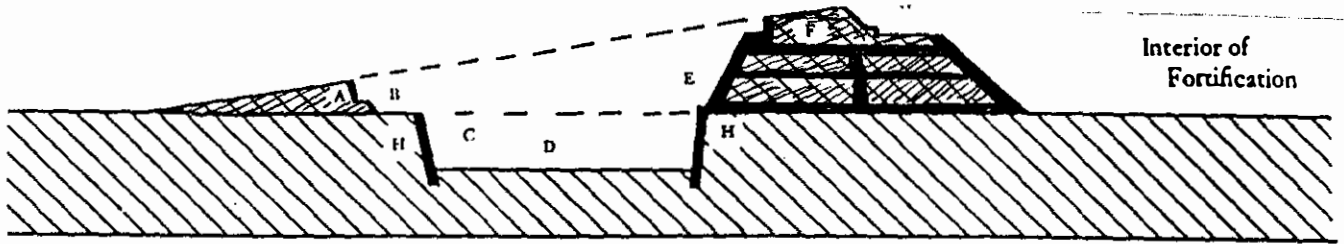
The Europeans similarly utilized the network of rivers, lakes and portages to advance into the interior. The French quickly moved up the St. Lawrence Great Lakes system, laid claim to all the drainage thereof and thence down the Ohio-Mississippi drainage. The Dutch, followed by the English, moved up the Hudson-Mohawk rivers with some claims overlapping the St. Lawrence drainage.

The Europeans brought with them their own methods of waging war: strong forts, sieges and defenses. Field tactics were, to various degrees, adapted to the terrain and circumstances of the forest. The forts were built at strategic points and usually were of the traditional "star-fort" design which had evolved in response to the development of artillery. The high curtain walls and turrets of the castles were sunk down into the moat, the round towers replaced by flanking bastions with thick walls from which enfilading fire could be delivered. The "blind spots" at the corners were eliminated by including them in the angle of the bastion and outworks placed in front of the walls to further protect them.

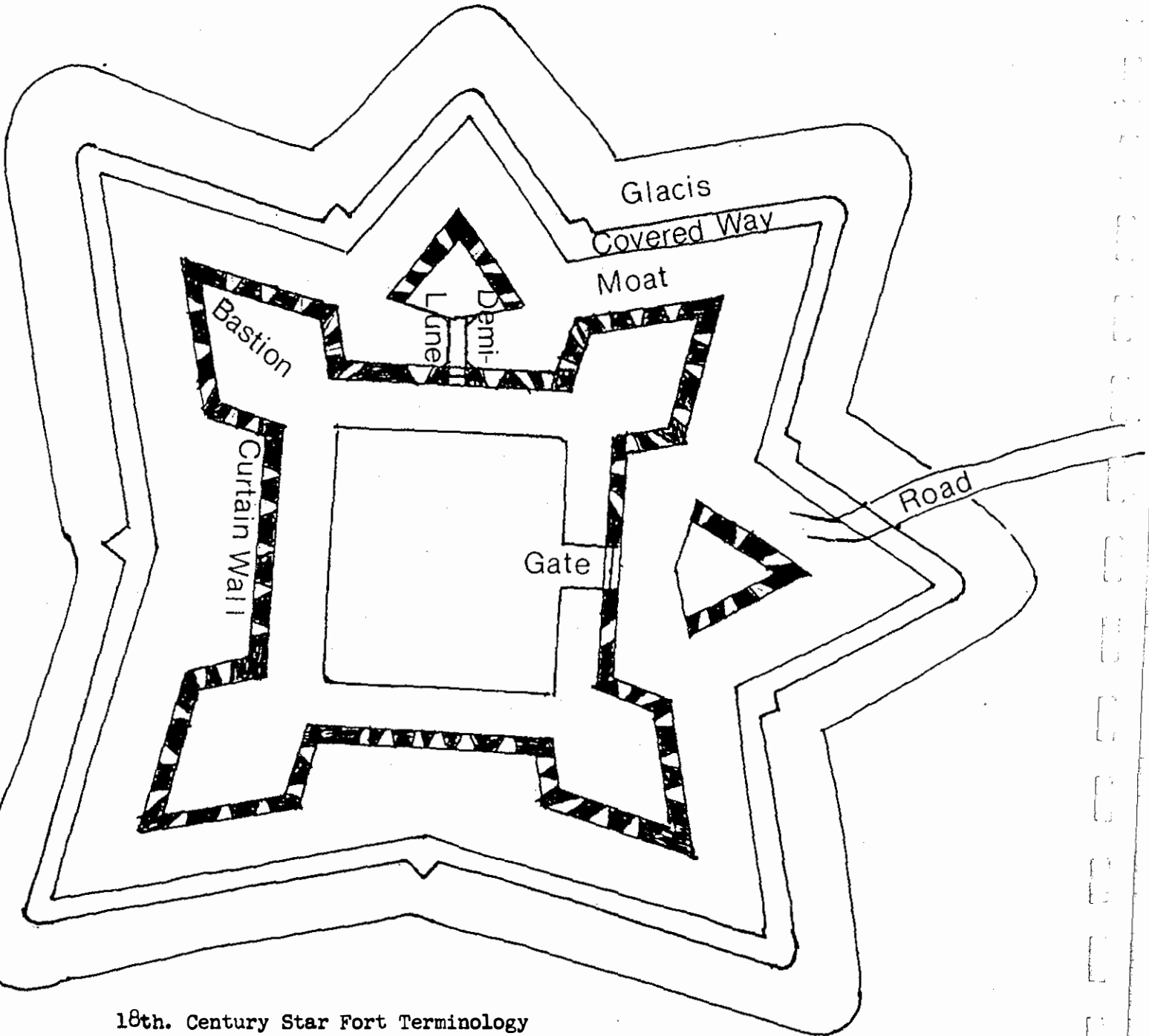
The materials, time, money and labor available determined the type of construction. Local material, either timber or stone masonry, was used for walls and facings which were then filled in with the spoil from the moat. The composition of the spoil affected the durability of the construction. Sand, once the facing of the wall was breached, would stream out. It was well drained and could increase the rate of decay of wood in some cases and reduce it in others. Clay, on the other hand, produced problems of expansion when wet. Wood, from logs as much as three feet in diameter, was squared into timbers usually 15" - 18" on a side and employed either as facings and cribbing or as palisades and blockhouses. It was abundant easily worked by men already familiar with it and inexpensive. While subject to decay within a few years and burned easily, it was considered adequate for the brief periods of use on the rapidly advancing frontier where it would be only subjected to raiding parties armed with light field guns. Fort Edward, William Henry, and Crown Point were examples of the traditional construction and were destroyed by decay, bombardment and fire respectively. Fort Ann was a palisaded blockhouse.

## CHRONOLOGY OF REGIONAL WARS

- 1609-1660 French and Iroquois Wars
- 1618-1648 Thirty Years War -  
S. Champlain taken prisoner
- 1688-1698 War of the Grand Alliance -  
King Phillip's War  
Frontenac's attack on Schenectady  
J. Schuyler's raid on LaPraire
- 1703-1713 War of the Spanish Succession  
- Queen Anne's War  
1709 Nicholson's expedition against Montreal - built  
fort at site of Ft. Edward and road to Wood  
Creek - withdrew to Albany.  
1711 Nicholson tried again, withdrew and burned his forts.
- 1740-1748 War of the Austrian Succession  
King George's War  
1745 Louisbourg besieged and taken.  
Border raids in New York and New England.
- 1748-1755 Period of intense fort building and raids  
Washington's and Braddock's campaign in the west.  
Johnson's and Shirley's campaigns in New York
- 1756-1763 Seven Years War - French and Indian War.
- 1775-1783 American Revolution  
May 10th, 1775 Siezure of Ticonderoga  
September 1775 Invasion of Canada began.  
1776 Retreat from Canada - Battle of Valcour Island.  
1777 Burgoyne Campaign  
1780 Carleton's Raid
- 1812-1815 War of 1812  
September 11, 1814 Battle of Plattsburg



- |                |                      |
|----------------|----------------------|
| A—Glacis       | E—Escarpment (Scarp) |
| B—Covered Way  | F—Parapet            |
| C—Counterscarp | G—Firing Platforms   |
| D—Ditch        | H—Revetments         |



18th. Century Star Fort Terminology

Stone masonry was used more often by the French than the English. This required a local source of limestone for mortar some easily quarried rock which often turned out to be limestone also and skilled stone masons. Construction was slow, so quite often a fort, as at Ticonderoga, was started on a solid stone formation and quickly built up with timber which in turn was replaced by stone work as time permitted. Masonry, while less likely to deteriorate from decay and not flammable, was not necessarily more resistant to bombardment, since smaller blocks would shatter under impact, while ball would often imbed in timbers. The stone walls gave way to the forces of frost heave, expanding clay and solution of the mortar. Besides Ticonderoga, the French Fort St. Frederic and one bastion of Fort George were of stone.

The major works were placed at strategic points, such as major landings and junctures, and provided the bases for the operations of the opposing armies. Fort Edward and Fort Carillon (Ticonderoga) were typical. The former was placed at the northern end of the navigable Hudson to guard the southern juncture of the two portages from Lake George and Lake Champlain. It was the third fort to be built there and the largest British installation in North America at the time of its construction. Built during the year preceding the seven years war by Sir William Johnson, it served as his base of operations during his pre-war campaign and for all of the campaigns that followed. It was the base of the famous Roger's Rangers.

Ticonderoga, in contrast, was built at the same time and was positioned at the juncture of the portage from Lake George and Lake Champlain. It became the forward base of operations for the French taking over from Fort St. Frederic at Crown Point.

Lesser works such as Fort Ann and Fort Miller, were placed for tactical purposes such as outposts in the first case and to protect portages as in the latter or along military roads as "way stations" as at Fort Amherst.

A network of military roads were cut through the forest, first along the portages and later to connect each military post to its neighbors. Usually these paralleled the waterways and were little more than "jeep trails" or "logging roads". They followed as level a route as possible, skirted swamps when they could or corduroyed through them. They were slow and tedious to travel, at the best, and required constant maintainance. Many of our modern highways still follow in part these routes.

It is said that the fabric of our nation was held together by the string of forts which stretched north through this valley from New York City to Canada. During the interval of 1610 to 1815, seven wars were fought, six of them (plus the years of non-peace between some) involved fighting along this valley. The chronology of two intervals are outlined in Table II the Seven Years War (French and Indian) and able III the American Revolution.

During the years that followed the area developed rapidly. Following the French and Indian Wars, settlements sprang up around the military posts along the Hudson and at Skenesborough (Whitehall) with numerous

farms scattered throughout the area. The military roads were utilized and extended by the settlers coming in. The area was still heavily forested and agricultural at the time of the Revolution.

During the years of peace preceding and following the Revolution the military roads were improved somewhat and extended as settlements grew, usually around the sites of the old forts. The falls and rapids which necessitated their construction, became the source of energy for their water powered grist and saw mills. The 19th century saw the scattered farms and towns better linked and the valley floor eventually lumbered off. The exploitation of the Adirondacks began for lumber and tanning bark. To bring out the timber the Hudson River was again utilized - log drives down the river from the Schroon began in 1813 and continued until 1951. By the 1840's 100 million board-feet of lumber was moving down stream each year. By 1890 the paper industry began to supplant lumber and the saw mills in the Glens Falls area were gradually replaced by pulp mills and their satellite industries.

The "mineral" industries expanded with the demand for building materials. Stone was quarried for blocks, slate for roofing and limestone for mortar and cement. Iron ore (magnetite) was discovered and produced at West Fort Ann and Mt. Hope. The product was shipped down river along the waterways which had been improved by the Hudson-Champlain canal. The plates from which the USS Monitor was made were forged in Troy from iron produced, in part, from here.

The conversion from water power to hydroelectric led to the influx of new industries in the 20th century and a subsequent population growth. The utilization of the rivers for water supplies, transportation, waste disposal, and energy production has produced a series of environmental problems, while the careless dumping of wastes into the landfills or just onto the ground, has produced serious groundwater pollution.

#### CHRONOLOGY OF FRENCH AND INDIAN CAMPAIGNS

##### Table II. Pre War

August 8, 1755	Johnson left Albany for site of old Fort Lydius
14th	Johnson joined Lyman at Fort Lydius where Fort Edward was under construction
26-28	Johnson moved bulk of forces to Lake George building road enroute
August 28-Sept. 7	Johnson laid out camp for 5000 men, started building batteaus, sent out scouts
September 3rd	Baron Dieskau left Crown Point (Fort St. Frederic) to attack Fort Edward. 216 regulars, 684 Canadian, and about 6-700 Indians



CHRONOLOGY OF FRENCH AND INDIAN CAMPAIGNS

Table II cont.

7th	Dieskau intersected Johnson's road - abandoned attack on Fort Edward because of cannons, moved against Johnson
8th	<u>Midnight</u> - Johnson alerted to Dieskau's presence <u>Dawn</u> - Council of War dispatched a 1200 man scouting party - relief column to Fort Edward, command of Col. E. Williams and "King" Hendrick. - Head of column ambushed and Hendrick killed, Whiting's men covered withdrawal to Bloody Pond where with 300 reinforcements under Col. Cole a stand was made. - Withdrew to Lake George camp - partially fortified - French assault on camp repulsed - Johnson and Dieskau wounded - the latter captured. - French fled to Bloody Pond where they were scattered by a relief column from Fort Edward.
Fall of '55	Campaign against Crown Point abandoned. Construction of Fort William Henry and Ticonderoga begun and Fort Edward continued.
1756 May 17th	War declared. Construction continued on Forts. Montcalm takes over in Canada Raids continue
Aug. 10-14	Montcalm takes Oswego
1757	Continued Raids
August 3-9	Montcalm took Fort William Henry - massacre followed.
1758 June 26	Amherst takes Louisburg.
July 5-8	Abercrombie Expedition and disaster at Ticonderoga
1759 July 21-26	Amherst moves on Ticonderoga French abandoned and exploded magazines there and at St. Frederic
Sept. 13-14	Quebec fell to British
1760 May 16	Levi's forced to withdraw from beseiging Quebec
Sept. 7	Montreal surrendered.

## Environmental Problems

The environmental problems, in this area, center around water pollution and, to a much lesser extent, mass movements, spring flooding and the remote but never the less possibility of earthquake damage.

Foremost among the problems are those which have been produced by industrial wastes and among these PCB's (polychlorinated biphenols) and TCE (trichlorethalene) are the foremost. Both of these chemicals are widespread but in this area they seem to be especially significant.

PCB's were first used locally during the 1930's in the production of electrical transformers and capacitors. In all fairness it must be said that their use seriously reduced the number of fires started in transformers and saved many lives by doing so. Since they were considered "safe" they were handled very carelessly and disposed of in a carefree manner, often just dumped on to the ground or into the river, sprayed on roads to settle dust or to kill vegetation. This practice has led to widespread ground water and stream pollution.

TCE, an industrial degreaser and solvent, has been used extensively to prepare material and to clean up PCB spills. It too, has gone into the dumps, rivers, and ground.

There are several main points of concentration of these two chemicals: first the Hudson River sediments, which prior to its removal, were trapped behind a Niagara Mohawk Corporation dam at Ft. Edward. Second, around the General Electric Plants, and last, the dumpsites in Ft. Edward, Kingsbury, and Moreau (Caputo). There are many other point sources (some of which are not known) where individuals have disposed of varying quantities of the waste. The wide distribution of the sources makes it difficult to accurately map the movement of the materials in the sub-surface.

Another type of chemical wastes are the heavy metals which have been produced in the manufacture of paint pigments. These include lead chromate which was produced at the Ciba-Geigy Plant. Previously this was included in waste water entering the Hudson River at the plant. It is now separated at a multimillion dollar waste water treatment plant and disposed of in a monitored waste disposal site.

Additional stream pollution came from the dyes, "black liquor" and escaped fiber from the several paper mills. Most of this has stopped since the clean waters act. An incinerator at one plant burns much of the waste, more or less, cleanly.

The local cement company previously allowed great amounts of fine powder to escape from its stack, the distribution of which was well mapped in a study by Adirondack Community College students. The replacement of the old stack with a new static precipitator has greatly reduced this source of air pollution.

The use of pesticides and herbicides in agriculture along with fertilizers has lead to some ground water pollution near certain local distributors where trucks and tanks are washed out and occassional spills have occurred.

Petroleum spills and leaks have been rather limited locally and usually involve service stations or accidental spills from trucks.

The problem of leachates from now abandoned dumps is still around and one local municipality is still dumping raw sewage into the Hudson and another into the Champlain Canal.

The multiplicity of these problems points out the importance of educating the every day citizen...as to the nature of the problems and getting a positive response to the moves to protect and clean up the environment. Although most of the local industrial waste production is now under control, the problem of dealing with the old sources is extremely complex. Should the Hudson be dredged to remove the PCB laden sediment? If so, where do we put it? Can the PCB's be confined indefinitely in the existing dump-sites? What about existing plumes which are presently polluting water supplies? Many of these questions are of great concern to the local people who are faced with the cost of cleaning up while at the same time feeling that they were not responsible for the mess.

**Table III - CHRONOLOGY OF BURGOYNE'S CAMPAIGN**

6 May 1777	Burgoyne arrives in Canada
13 July	Burgoyne leaves St. Jean
1 July	Siege of Ticonderoga begins
5 July	Ticonderoga evacuated
6 July	British occupy Ticonderoga and Skenesborough (Whitehall)
7 July	Battle of Hibbardton Road
8 July	Battle of Fort Anne
27 July	Killing of Jane McCrea
30 July	Burgoyne at Fort Edward
6 August	Battle of Oriskany
9 August	British at the Battenkill
16 August	Battle of Bennington
23 August	Stanwix relieved
13 September	Burgoyne crosses to West bank of the Hudson at Saratoga
18 September	Lincoln raid on Ticonderoga
19 September	Battle of Freeman's Farm
6 October	Clinton captures Hudson highland forts
7 October	Battle of Bemis Heights
9 October	Burgoyne falls back on Saratoga
17 October	Burgoyne Surrenders
8 November	British destroy and abandon Ticonderoga

ROAD LOG FOR TRI-CORN GEOLOGY TRIP

HISTORY - GEOLOGY & ENVIRONMENTAL PROBLEMS

CUMULATIVE MILAGE	MILES FROM LAST POINT	ROUTE DESCRIPTION
00.0	00.	Starting Point
STOP 1. SARATOGA NATIONAL PARK VISITORS CENTER		
<p>The battles fought here were, collectively, one of the most decisive actions during the course of North American history. They represented the climax of a complex, three-pronged campaign, which, had it succeeded, would have cut the rebelling colonies in two, probably winning the war for the British. The American victory assured recognition by France and subsequently to the alliance.</p> <p>The choice of ground was made by the Americans, who drew up their lines overlooking a narrow defile along the Hudson. Entrenchments were dug along Bemis Heights under the direction of Col. Kosciusko. The area was sparsely settled, with farms in scattered clearings, connected by wagon roads through the forest. Where the roads traversed sand, they were difficult to move over with heavy loads. Where they traversed clay, they were impossible when wet, and if rutted, nearly the same until beaten down. Burgoyne, with his heavy train of baggage and artillery, was forced to descend the river using batteaus for his supplies while his men trooped along the parallel road. He had crossed to the western side just north of present day Schuylerville (Saratoga). The American defenses, therefore, commanded his route along the river and extended westward to prevent his flanking them.</p> <p>Leave the Visitors Center and follow the access road eastward to Route 4</p>		
.5	.5	This is the "280 ft." level of proglacial Lake Quaker Springs.
.9	.4	The "250 ft." level of Lake Coveville.
2.3	1.4	INTERSECTION with Route 4 Turn left (North)
6.5	4.2	Coveville Plunge Basin. Drainage from the Ballston Channel combined with waters of the Kayderosseras dropped into the almost river-like Lake Fort Ann.
9.8	3.3	INTERSECTION Rt. 29, Village of Schuylerville, Site of Ft. Hardy, Where British grounded arms, is on the flood plain to the right.

- |      |     |   |
|------|-----|---|
| 10.2 | .4  | Burgoyne's final positions.   |
| 11.4 | 1.2 | <p>Stop #2 Stark's Knob. Pull off road and park. Hike up road leading west past the knob. THE EXACT OWNERSHIP OF THIS SITE IS, AT THE TIME OF PUBLICATION, UNKNOWN, BUT IT IS NO LONGER THE PROPERTY OF THE STATE OF NEW YORK, HAVING BEEN DEEDED TO THE TOWN OF NORTHUMBERLAND. THE TOWN IS THOUGHT TO HAVE DISPOSED OF IT TO A PRIVATE INDIVIDUAL, WHO DENIES THAT IT IS HIS. AS THE RESULT OF REPEATED INTRUSION ONTO HIS ADJOINING LAND, HE HAS MADE IT KNOWN THAT HE WILL HAVE ALL PERSONS WHO STRAY ON TO HIS PROPERTY ARRESTED. IT IS THEREFORE IMPORTANT THAT VISITORS STAY ON THE TWO ACCESS PATHS TO THE SITE AND AVOID CROSSING THE OLD FENCE LINES.</p> |

STOP # 2 STARK'S KNOB

The Knob is named for General Stark, who placed his artillery atop of it in the final days of the campaign, thus blocking the withdrawal of the British up the Hudson River and along its western bank. The knob has been formed by the differential erosion of the soft black shale from around the more resistant basalt of the pillow lava. Both the shale and the pillow lava are part of an overthrust block of Ordovician rock displaced a considerable distance from the east during the Taconic events.

The material between the pillows contains fragments of the carbonates through which the lava appears to have passed on the way to the surface. The pillows themselves, have a chilled surface and are laced with quartz and calcited filled fractures. Several small faults cut down through the quarry face and water moving along these has formed a small spring at the base near the large pine tree. The basalt was quarried for "road metal" prior to its acquisition by the state.

Return to vehicles and continue north on Rr. 4

- |      |     |   |
|------|-----|---|
| 12.1 | .7  | Northumberland & intersection with Rt. 32. Bear right on Rt. 4 over bridge.   |
| 16.0 | 3.9 | <p>Fort Miller<br/>The fort was built on the opposite side of the river, to protect the portage around rapids or a small falls on the river. It was a wood stockaded "star fort".</p> |

- 17.3 1.3 The old Champlain Canal on the right. This old canal wanders along, following the contours in order to reduce the number of locks. Rt. 4 crosses its path.
- 19.1 1.8 Exposure of black shale and sandstone in a near vertical attitude. A few graptolites have been collected here dating it as part of the Taconic over-thrust.
- 23.0 3.9 Bridge over the Champlain Canal. The Hudson River is seen below the locks. This water barrier was non-existent during the 18th century so that it was easier to build the military road down this side of the river.
- 23.2 .2 The Fort Hours Museum.  
(Time permitting, a brief stop.) This house was built prior to the revolution of materials said to have been scavenged from the buildings at the fort. There is an old, but never-the-less good, model of Fort Edward - a typical earth and timber fort.
- 23.4 .2 Bridge over Fort Edward Creek with an old canal aquaduct over it to the right.
- 23.5 .1 Site of Fort Edward.  
All that remains of this, the largest British military installation in North America prior to 1800, is a small portion of the moat. It was essentially a three bastioned earth and timber fort, built over a period of two years on the site of earlier Fort Nickolson. Additional works were built on "Roger's Island" the home base of Roger's Rangers. The fort was never besieged or defended except against small raiding parties. It was placed here at a position of great strategic importance, but like Ticonderoga, it was overlooked by high ground making it indefensible. Seven blockhouses were placed around it to cover the weaknesses in its approaches. This point is the furthest extent of the navigatable

waters of the Hudson and the southern end of the portages to Lakes George and Champlain.

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|------|-----|---|
| 23.7 | .25 | INTERSECTION of Rt. 4 and 197<br>Traffic Light - Turn left over the Hudson River. This canal was completely plugged following the removal of the power dam. |
| 23.8 | .1  | ROGER'S ISLAND - turn right just after leaving bridge. Continue to north end of island.   |
| 24.0 | .2  | STOP #3 - ROGER'S ISLAND  |

In the early 1970's, the Niagara-Mohawk Power Corp. received clearance to remove a small power dam located just north of the island. The volume of sediment entrapped behind the dam was greatly underestimated and the P.C.B. content was not recognized as a hazard and ignored. When the spring flood occurred, a huge volume of P.C.B. laden sediment washed down stream, leaving the north channel plugged and the south channel nearly so. This resulted in three major problems: the navigational channels were plugged here and downstream, P.C.B.'s entrapped in the sediment were distributed with them and raw sewage from the Village of Fort Edward was piled up atop of the plugged channel.

The New York State Department of Transportation dredged out the channels and stored the material at the DOT sites on Roger's Island and on the Town of Moreau side of the river. It was an annual event for several years until the bulk of the sediment was washed out and the nature of the P.C.B. problem "surfaced". During the last dredging, the P.C.B. threat, having been recognized, workers were required to wear dust masks and the material was encapsulated, the previous dumpsites were covered with a temporary cap of clay. An unexcavated archeological site was buried in the process.

Continue around the road to Rt. 197

- |      |    |  |
|------|----|--|
| 24.1 | .1 | Turn right on Rt. 197 over bridge          |
| 24.7 | .6 | INTERSECTION -WEST RIVER ROAD<br>Turn Left |
| 24.9 | .2 | STOP # 4 D.O.T. SITE                       |

This is an encapsulated dump site for the P.C.B. laden sediments dredged from the Hudson River at Roger's Island. The debris was placed in a clay lined pit and then covered again with clay. It is a temporary disposal site.

Turn around and return to Rt 197.

- |      |    |  |
|------|----|--|
| 25.5 | .6 | INTERSECTION Rt. 197<br>Turn right toward Ft. Edward |
|------|----|--|

- 26.3 .8 INTERSECTION Rt. 4 Village of Fort Edward. TRAFFIC LIGHT Turn Left  
After making turn note marker on left for the McCrae House where Jane McCrae was taken by Indians. Rt. 4 approximately follows the military road to Lakes George and Champlain.
- 26.9 .6 The approximate site of the killing of Jane McCrae. A blockhouse was situated about where the school atheletic field is.  
The road is climbing up onto the sand delta deposited into Lake Coveville.
- 27.7 .8 STOP #5 - Pull off road to right.

STOP # 5 - FORT EDWARD GENERAL ELECTRIC PLANT & UNION CEMETERY

This is one of two General Electric plants locally which manufacture electrical components (capacitors chiefly) previously using P.C.B.'s. To the right rear, next to the Grand Union Store, is an Agway Farm Store, which sells pesticides and herbicides to local farmers. Union Cemetery, located to right, is the burial place of several persons of note, including Jane McCrae, Duncan Campbell and Tobert Cochran.

The location is atop a sand delta (Lake Coveville) some 15 to 20 feet thick overlying a shale which crests under the General Electric Plant and slopes away toward the river to the soughwest and the Champlain Canal to the northeast.

Two groundwater problems have developed here, the first involving agricultural chemicals and the second, P.C.B.'s and T.C.E.. Most of the local dwellings have their own waterwells, some of which have become polluted by either or both types of chemicals. The pesticides and herbicides have shown up in wells on Putnam Avenue and Ethan Allen Street southeast of the Agway Store and extend as far as Burgoyne Avenue. The seemingly harmless act of washing trucks appears to have been the cause of this problem. One more good example of why ordinary people need a better education in geology. The P.C.B. T.C.E. problem is more complex. Both chemicals were uses extensively at the General Electric Plant and the deliberate and accidental spills over many years have gradually polluted the groundwater about the buildings. In addition, some individuals have dumped the industrial chemicals at their homes where they have been salvaging materials or using T.C.E. on their own projects. Wells along adjoining streets have been abandoned and these homes have been connected to municipal water systems, the cost being borne by G.E. There is very extensive litigation involved in these cases and little information can be gained from the parties involved.

CONTINUE NORTH ON ROUTE 4



28.4	.75	John St. Intersection & Traffic Light. continue straight on Rt. 4
28.9	.5	HUDSON FALLS VILLAGE PARK Traffic Circle - Leave Rt. 4 continue around park (left turn) and down the River Street hill.
30.3	1.4	INTERSECTION - Traffic light, Quaker Road. Turn right.

NOTE: Ciba-Geigy Plant and wastewater treatment plant.

Prior to the construction of the treatment plant, waste water containing heavy metals was discharged into the Hudson adding to the pollution from the paper mills upstream. Following the imposition of environmental controls, this installation was built to separate the toxic components from the water which is returned to the river cleaner (supposedly) than when it is taken out. The solids are then hauled to the Queensbury Landfill where they are placed in a disposal basin.

The road climbs up onto another sand deposit, this one is probably related to Lake Quaker Springs.

Across the river to your rear, is the Glens Falls Cement Quarry showing the thickness of the sand overlying the carbonates. The cement plant was the center of an air pollution study done by Adirondack Community College students many years ago. The study pinpointed the plant as a major source of particulate matter in the air and with the passage of clean air regulations, the old stack was replaced with one containing "scrubbers" and the problem was essentially solved. The Glens Falls Limestone quarried here was previously produced from tunnels underlying the Village of South Glens Falls.

30.6	.3	Intersection Traffic Light Dix Avenue. Dix Avenue is following the route of the old military road to Lake George. It skirted the low area through which we have just passed, and swung west and then north to avoid the swamp through which Quaker Road passes.
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31.8	1.2	Prospective PEAT FARM. Peat deposits have formed in swamps which developed on Lake Albany clay which sealed the underlying limestone. The development is stalled pending a decision related to the Wetlands Protection Act.
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CONTINUE ON QUAKER ROAD THROUGH THE RIDGE ROAD INTERSECTION.

- 33.3 1.5 INTERSECTION AND TRAFFIC LIGHT BAY ROAD - TURN RIGHT. You are now entering "New France" as you cross Halfway Brook and enter the St. Lawrence drainage basin.
- 34.8 1.5 BRIEF PAUSE - ADIRONDACK COMMUNITY COLLEGE QUARRY.

This exposure of Ordovician, Beekmantown Carbonates, contains a breccia, (fault or collapse ?) some small cephalopods and burrows of a sort. The campus is located on a downfaulted block (a graben) with a fault running approximately across Bay Road and another somewhere between the rear of the buildings and the next ridge to the east. Other structures are suspected because of the change in the attitude of the rocks in the several outcrops on campus. A small fault with a 2 inch displacement has been found. In addition, there is an exposure with enlarged solution joints, perhaps formed during the post-glacial interval while Lake Albany was draining. The soils on campus are lake clays (some varves were found in the building excavations) and to the west and north, is the kame and esker complex.

CONTINUE NORTH ON BAY ROAD.

- 35.1 .3 INTERSECTION - BLIND ROCK ROAD  
TURN LEFT  
The road climbs up onto the kame and esker complex. Blind Rock was a locality where native warparties often took prisoners for torture.
- 36.4 1.3 Round Pond and Paradise Beach.  
A kettle lake with an esker on each side at the far end. The one extending along the north side continues along the right side of the road.
- 37.1 .7 INTERSECTION - Rt. 9 - Turn right.  
This is near the epicenter of a number of very small 'quakes (.5 Richter or less) which were detected during a study done by the N.Y.S.G.S. Rt. 9 passes over 5 Mile Run, the site of several ambushes, just in front of the Great Escape Amusement Park! The low area on the right, past the park is an extension of Glen Lake, an iceblock lake.
- 37.9 .8 Kame terrace capped by Lake Albany sands.

39.7

1.8

STOP #6 COL. WILLIAM'S AMBUSH  
PARK ALONG ROAD SIDES WHERE IT  
IS SAFE. THIS IS A DANGEROUS SITE.

STOP # 6

The outcrop is on the west side of the road and is extremely hazardous because of traffic. The bedrock is Precambrian (Grenville) Gneiss and is cut by several nearly strike-slip faults running parallel to the road. At one point a small dike is cut into three sections by the faulting. Prior to the widening of the road, there was a fine, fluted, slicken-sided surface exposed. French Mt. opposite, is a horst.

The military road passed below the present road and this was the site of the French ambush of the Provincials and Iroquois, known as "The Bloody Morning Scout". Col. Ephraim Williams, whose estate founded Williams College, was killed standing on a glacial boulder, while old "King" Hendrick toppled from his horse and was bayoneted. The colonials and Mohawks successfully withdrew from "Rocky Gulch" to Lake George, leaving about 100 casualties behind.

CONTINUE NORTH ON RT. 9

40.5	.75	Bloody Pond, a kettle lake and the scene of two skirmishes.
42.	1.5	INTERSECTION - TURN RIGHT
42.4	.4	STOP #7 FORT GEORGE AND BATTLE-FIELD

STOP #7

Here is another exposure of Ordovician, Beekmantown carbonates, dipping about 5° northeast and lying between two mountains of Precambrian rock. This presents an opportunity for solving a very simple structural problem. Three responses are usually evoked from beginning students when asked to explain it:

1. The rocks were derived from the older rocks and deposited here.
2. They were downfolded into the valley form.
3. They were downfaulted.

The first choice is eliminated by the character of the sediment, and the others require further information to be gained at the next stop.

The carbonates were first used to build the stone bastion of Fort George, which was built following the Battle of Lake George. The rocks provided both the building stones and the mortar to hold them in place. The present structure has been partially restored.

The battle here followed the Bloody Morning Scout. Dieskau, the French commander, launched a series of assaults on Johnson's camp and was repulsed with heavy losses. Both officers were wounded and Dieskau taken prisoner. The French and their allies fled to Bloody Pond to loot the packs of the men killed there earlier, where a relief column of over 600 men from Fort Edward caught them disorganized and scattered the survivors.

After the battle, Fort William Henry was finished on the sand terrace overlooking the lake. The fort was built of timbercribs filled with sand from the moat. The main gate was on the south side, and a stockaded area on the north. The choice was poor in the sense that the sand, being easy to dig, allowed Montcalm to advance his saps and parallels very quickly when he laid seige two years later in 1757. His artillery quickly reduced one bastion. The sand pouring out through broken timbers caused it to collapse and the fort surrendered. The attack on the unarmed British prisoners following the surrender is a matter of historic record.

CONTINUE NORTH TOWARD LAKE GEORGE.

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|------|----|--|
| 42.7 | .3 | INTERSECTION - BEACH ROAD TURN LEFT. Note: Fort William Henry reconstruction..         |
| 43.1 | .4 | INTERSECTION - RT 9 - Turn right.  |
| 43.7 | .6 | INTERSECTION - RT 9 & RT 9-N Bear right on Rt. 9-N                                     |
| 44.1 | .4 | INTERSECTION - NORTHWAY I-87<br>ACCESS TRAFFIC LIGHT - TURN LEFT<br>AND PARK - STOP #8 |

STOP #8

This exposure of the upper Cambrian Ticonderoga Formation dips gently toward the northeast and consists of mostly sandstone which places it in the upper third of the formation but not at the top which contains some chert. There are ripples and stromatolites present, the latter being in the reddish-brown dolomitic layer at the top of the ledge. The upper surface has been planed smooth by glaciation and the direction of movement has been recorded in striations found there. Visible to the west is an exposure of precambrian rock at the bend in the road. These observations tend to support the hypothesis that the valley floor is a downfaulted block or graben. Further support to the idea comes from the existance of two magnetic anomalies between the two outcrops. (Personal communication from John Mead) A similiar relationship between the Precambrian and the carbonates can be seen along the east side of the valley. (Along Rt. 9-L near Crosbyside)

There are two courses open to the trip: 1st double back to Rt. 9, turn right and proceed toward Warrensburg, or continue on to the NORTH BOUND LAND OF I-87. THE LOG WILL DESCRIBE THE FIRST.

HEAD SOUTH TOWARD LAKE GEORGE VILLAGE ON RT. 9-N

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|------|-----|---|
| 44.5 | .4  | INTERSECTION RT. 9 & TRAFFIC LIGHT<br>TURN RIGHT TOWARD WARRENSBURG.<br>The road follows the trace of the<br>English Brook Fault. |
| 46.5 | 2.0 | BRIEF PAUSE - THE ENGLISH BROOK<br>SAPROLITH  |

Note: This exposure of deeply weathered rock has been known since the 1930's and has miraculously survived repeated road improvements. Originally, the exposure was topped with two layers of glacial boulders separated by a lake sand. Each spring these came rolling down - some three feet in diameter - to the dismay of the highway department. Their recent removal and the gradual covering of the face in its own debris has greatly altered the appearance of the site. The preservation of the saprolith is thought to be the result of deep weathering along the plane of the fault and the transverse orientation of the fault to the direction of ice movement. This is one of the few such exposures which can be easily seen in New York State.

CONTINUE NORTH ON TR. 9

49.1	2.6	INTERSECTION AND TRAFFIC LIGHT E. SCHROON RIVER ROAD. TURN RIGHT OVER BRIDGE.
49.4	.3	EXIT 23 - I-87 TAKE NORTHBOUND LANE TO EXIT 25
<p>Note enroute: This valley was occupied by Glacial Lake Warrensburg, evidence for which is seen in the numerous sand deposits along its floor. Just short of Milepost 63, the road cuts show Precambrian rocks on one side and layered sediments on the other, the road straddling a fault.</p>		
59.2	9.8	EXIT 25 LEAVE I-87 TURN RIGHT (EAST) ON N.Y. RT. 8 TOWARD BRANT LAKE AND HAGUE
73.4	3.9	HAGUE - INTERSECTION - RT.9 TURN LEFT (NORTH) Toward Ticonderoga
79.1	1.7	ROGER'S ROCK STATE PARK AND CAMP- SITE. Named for Roger's Slide - thought to be the fault scarp forming the east side of the Lake George graben and the scene of Major Roger's escape from the French and Indians, March 13, 1758.
84.3	5.2	IN TICONDEROGA - INTERSECTION LEAVE RT's 9-N & NY 8, CONTINUE STRAIGHT ON NY RT. 73
84.7	.4	Ticonderoga Creek - The outlet from Lake George flowing into Champlain
86.0	1.3	INTERSECTION - LEAVE RT. 73 GO STRAIGHT THROUGH TO FORT TICON- DEROGA
87.0	1.0	STOP #9 FORT TICONDEROGA

STOP #9 FORT TICONDEROGA (CARILLON)

This fort is built near if not on the site of Champlain's skirmish with the Iroquois in 1609. Construction was started in 1755 and essentially completed by 1758. Modifications, repairs and improvements continued until the end of the American Revolution, when it was allowed to fall into total disrepair.

The original construction was of earth and timber, later on improved by stone facints. The fort was designed for a small permanent garrison with extensive outworks for a larger "summer" army. The location was poorly chosen, since the works are well within range of seige guns placed on the heights of Mt. Defiance.

The stone fort was built from Ordovician limestone, quarried on the site, and was in total ruin prior to reconstruction. The stone work, weakened by solution and frost action, had collapsed into the moat, and hauled off to build "celler walls" by the post war settlers. The original foundations can be recognized in the walls by their weathered appearance.

Mt. Independence, on the opposite shore, was linked to the fort by a bridge consisting of 22 sunken piers connected by 12' X 50' "pontoons" chained together. The piers still survive in the muddy floor of the lake and are currently being salvaged (?) along with numerous other artifacts of the Revolutionary War.

RETURN TO RT. 73

88.1	1.0	RT. 73 CONTINUE STRAIGHT ON 73
88.8	.7	INTERSECTION - RT. 22 TURN LEFT (SOUTH) ON RT. 22
112.4	23.6	South Bay, Lake Champlain
113.3	.9	Note Rock Falls along road cuts.
114.5	1.2	IN WHITEHALL - INTERSECTION & TRAFFIC LIGHT, TURN LEFT AND TAKE FIRST RIGHT, BEAR LEFT AT FORK TO PARK AREA.
114.8	.3	STOP # 10

STOP # 10 - THE HUDSON-CHAMPLAIN CANAL

The canal follows the general path of wood creek which rises near Fort Edward. During the spring of 1984 this area was badly flooded when water backed up behind a coffer dam following a heavy rain. The dam, installed to permit repairs on the canal, was not designed to accommodate the sudden rise of waters and considerable damage was done to the small museum here and other structures.

Historically, the locality was called Skenesborough, after Philip Skene, a prominent Tory. The claim to be the "birthplace of the United States Navy", stems from the fact that Benedict Arnold's fleet was built here, the first continental squadron. Although it was defeated at Valcour Island, the fleet delayed the Burgoyne campaign until the next year. The hull on display here is a survivor of the Battle of Plattsburg Bay, during the War of 1812. A military road was built from here to Fort Edward and later improved by Burgoyne.

115.1	.3	INTERSECTION - RT. 4 TURN RIGHT
115.2	.1	INTERSECTION - TRAFFIC LIGHT BEAR LEFT ON RT. 4, SOUTH. This road will follow closely the old military road parallel to Wood Creek. It travels over the floor of Lake Fort Ann.
121.2	6.0	LAKE CLAYS ON RIGHT - NOTE SLUMPING Champlain Canal Locks on left.
121.7	.5	Note: ROCKFALLS IN ROAD CUT.
123.1	1.4	BRIEF PAUSE - ROAD CUT IN PRE-CAMBRIAN GNEISS.

The foliation and some joints in the gneiss dip toward the east so that the road cut intersects or "daylights" them along the west side of the road. In order to reduce the chance of failure along these planes, the threatening blocks have been bolted into place with heavy threaded rods which penetrate into "solid" bedrock.

123.3	.2	SLUMPING IN LAKE CLAYS. This area was "corrected" in 1984 by reducing the slope angle. Slumping reoccurred in the spring of 1985
123.8	.5	Additional slumping
124.9	1.1	STOP # 11 UNCONFORMITY

STOP # 11

The base of the Potsdam Sandstone is exposed here in contact with the precambrian gneiss. The basal conglomerate above the unconformity contains many large quartz pebbles here. Additional exposures of the Potsdam may be found by walking down the side road to the left and just past the small valley, climb down over some old concrete slabs to a flat exposure. Graded bedding, crossbedding and ripples can be found here and in the railroad cut. Glacial striations, chatter marks and quarrying faces may also be seen. A commercial building stone quarry across the canal was previously operated and many local houses are built of this rock.

125.6 .7 BATTLE MT. A rear guard action was fought here by the Americans fleeing Burgoyne's army. This was one of the first times that the "Stars and Stripes" were flown in battle.

127.7 1.6 ENTERING FORT ANN VILLAGE

The reconstructed blockhouse (bank) was originally intended for a museum. It is fairly accurately constructed and very close to the actual site of the fort which guarded the crossing of Halfway Brook where it entered Wood Creek. There was a stockade surrounding the blockhouse. Note the use of Potsdam sandstone in several of the older buildings.

127.3 .1 Intersection and Traffic Light Junction with Rt. 149W  
CONTINUE SOUTH ON RT. 4

Burgoyne's line of march probably followed Route 4, but it is also possible that he did follow this lower route.

131.3 2.0 SMITH'S BASIN. INTERSECTION WITH NOTRE DAME EXTENSION. BEAR RIGHT UP THE HILL.  
On the farside of the canal is an excellent section of Cambrian and Ordovician carbonates described by Donald Fisher in the N.E.I.G.C. Guidebook 61st mtg. 1969. An old limestone quarry and kiln was operated just across the bridge in an exotic block or thrust slice of Orwell and Glens Falls limestone. The basin was an old canal basin and at one time was a fairly large settlement.

136.1 4.8 INTERSECTION - BURGOYNE AVENUE  
TRAFFIC LIGHT - TURN LEFT.

137.0 .6 KINGSBURY LANDFILL (Closed)

Note also, the Feeder Canal, five "combines" Locks and small house at right of intersection beyond canal.

The Kingsbury Landfill is now probably the chief source of P.C.B.'s entering the Hudson River. Many capacitors were disposed of here and on hot summer days, their sweet odor can be detected. The P.C.B.'s are leaching out of the site, into the canal and into the Hudson River. Another path is into the groundwater and the lowlands below the site to the river. Current plans call for the capping of the site hopefully sealing it. General Electric has made a major contribution toward the cost, but the remainder must be borne by the local taxpayers.



The feeder canal served two purposes: to move barges to Hudson Falls and Glens Falls and to maintain the water level of the lower section of the canal.

The small house may have been Burgoyne's Headquarters when his army camped here. In any event, it is thought to be one of only two buildings not burned down during Carleton's Raid in 1780.

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| 137.7 | .7 | INTERSECTION - JOHN STREET - RED<br>FLASHER - TURN RIGHT<br>Continue on John Street through the<br>intersections at Oak, Wright,<br>Popular, and Main Street, where<br>there is a traffic light. |
| 138.6 | .9 | GENERAL ELECTRIC PLANT. TURN<br>RIGHT AT INTERSECTION  |
| 138.9 | .3 | INTERSECTION - TURN LEFT OVER<br>BRIDGE.   |

This is Baker's Falls, the highest falls on the Hudson. While it is capped by a dam to increase its generating capacity, it is probably due to a fault. The river has cut a deep gorge through the softer shales below the falls.

It was the presence of this falls which caused Fort Edward to be built and the settlement of "Sandy Hill" to develop into the Village of Hudson Falls. The falls and dams upstream provided the water power for the early mills and later the hydroelectric generating plants, ultimately leading to the locating of the General Electric plants and the P.C.B. problem. It was also found that some P.C.B. was used to produce carbon paper upstream at a paper mill.

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|-------|-----|--|
| 139.6 | .7  | INTERSECTION - BLUEBIRD ROAD<br>TURN LEFT. |
| 141.3 | 1.7 | CAPUTO DUMPSITE.                           |

This site which is located along the right side of the road, in back of the houses was used to dispose of industrial wastes from the General Electric Company from about 1958 to 1970. It was an open pit into which barrels were placed, filled with waste P.C.B.'s and T.C.E. The sub-surface consists of glacial sands and lake clays overlying bedrock. The watertable is about 25 feet down. ENCON. well information indicates the following:

0 - 70 feet	Medium to fine sand
70 - 95 feet	Fine to very fine sand with silt lenses 1/8 to 1/2 " thick.
95 - 100 feet	Fine sand - clay lenses with brown varves.
100 feet +	Gray clay and silt lenses over bedrock.

The site has been enclosed by 1600' slurry wall 100 feet deep and three feet thick in an attempt to contain the leakage. The slurry consists of 70% soil, 28% native clay and 2% bentonite. The whole is capped to shed water. The P.C.B.'s appear to be more or less contained and saturate the soil above the watertable. The T.C.E.'s on the other-hand appear to have sunk down rapidly to about 70 feet. A plume has formed between 45 and 70 feet, spread out about one mile down gradient in 2-2½ years. The water at the watertable appears clean as does the water below 70 feet, thus the plume appears to be moving toward the southeast in a sheet about 25 feet thick at a present rate of eight feet per day.

Many residential waterwells have already been polluted and some properties in close proximity are claiming unsafe levels of vapors within the structures. Because of pending litigation, it is difficult to obtain specific and valid information from some parties. The plume which is moving toward the Fort Edward water supply has shown up in a stream feeding it. A system of aeriating the water has been installed which allows the T.C.E. to dissipate. Additional P.C.B.'s were sprayed along the Fort Edward road to settle dust and this has recently been removed by scooping up the contaminated soil and placing it at the Caputo Site where it is to be encapsulated.

CONTINUE TO ROUTE 9

142.7

1.4

INTERSECTION WITH ROUTE 9 - Turn  
left toward I-87 - Exit 17

TO SARATOGA TAKE SOUTHBOUND LANE

TO GLENS FALLS AND NORTH TAKE NORTHBOUND LANE