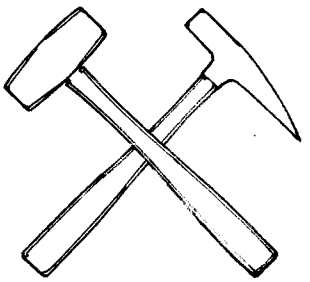
EIGHTH ANNUAL FIELD EXCURSION OF THE MICHIGAN ACADEMY OF SCIENCE, ARTS AND LETTERS SECTION OF GEOLOGY AND MINERALOGY



MAY 28-29, 1938

MICHIGAN ACADEMY OF SCIENCE, ARTS AND LETTERS
SECTION OF GEOLOGY AND MINERALOGY

Eighth Annual Field Excursion, May 28-29, 1938

Itinerary (Saturday)

Stop No.	Place	Time
	Leave Hallett Hotel, Charlevoix. Follow county road south to Ellsworth Drumlin till plain topography - Highway follows the long axes of drumlins in direction of ice movement.	9.00 A.M.
1(Loc.2)	Arrive Ellsworth Quarry 100 ft. green Ellsworth shale. Drumlins with cores of shale	9.30 A.M.
	Leave Ellsworth Quarry Follow county road to Atwood. Note swell and sag topography - cross axes of numerous drumlins. Turn north on U.S. 31, which at Charlevoix County line follows top of long narrow drumlin; turn west on Norwood road to Norwood. Cross Algonquin bluff to Algonquin Beach (El.674); thence turn west on Dock Street, turn south 3/4 mile along Algonquin plain to Stop 2.	9.50 A.M.
2(Loc.1)	Arrive at type locality of Antrim shale Leave locality of Antrim shale	10.20 A.M. 10.50 A.M.
3(67)	Return to Dock Street; thence north on shore road to one mile north of Norwood Traverse-Norwood (Antrim) contact. Return to Norwood and U.S. 31 thence across till plain to Charlevoix Lunch at Charlevoix	11.00 A.M. 11.30 A.M. 12.00 M. 12.00 M.
4(Loc.8)	Leave Charlevoix and take shore drive west to Gravel Point. Note fossils Leave Gravel Point	1.15 P.M. 1.30 P.M.
5(Loc.9)	Arrive old quarries of Charlevoix Rock Products Co. Note small bieherm Leave Charlevoix Rock Products Co. Return to U.S. 31; follow Algonquin sandy lake to Bay Shore	1.45 P.M. 2.15 P.M.
6(Loc.13)	Arrive Bay Shore, Curtis quarry. Note "wavy" beds Leave Curtis quarry	2.30 P.M. 2.50 P.M.
7(Loc.14E)	Arrive Bell or Rose quarry Note contact of upper blue shale (Gravel Point) and Charlevoix limestone. Abundance of fossils and gypsum crystals Leave Rose Quarry	3.00 P.M. 3.15 P.M.

Note: Location No. refers to columnar section and localities of Michigan Geol. Surv., University Museum and E. R. Pohl.

8(Loc.14)	Arrive Petoskey Portland Cement Co. quarry Note contact as above. Note selenite crystals at base of upper blue shale. Leave Petoskey Portland Cement quarry Continue east on U.S. 31	3.30 P.M. 4.00 P.M.
9(Loc.18)	Arrive Northern Lime and Stone Co. quarry, Petoskey Leave quarry	4.15 P.M. 4.30 P.M.
10(Loc.18A)	Arrive Bay View, stopping near Penn. R.R. Sta., on shore of little Traverse Bay. Note contact Gravel Point and Charlevoix limestone Leave Bay View	 5.00 P.M.
11(Loc.21)	Arrive Mud Lake quarry Note great abundance of fossils Leave Mud Lake quarry Arrive Petoskey	5.15 P.M. 5.45 P.M. 6.00 P.M.
	Dinner and special discussion Leaders Dr. S. G. Bergquist and Prof. G. M. Ehlers	

— — — —

Itinerary (Sunday)

	Leave Petoskey, Perry Hotel Follow shore drive M-31 to Cross Village (an Indian village)	8.00 A.M.
	Arrive Cross Village Note Indian mounds and cemetery, morainic topography, Algonquin bluffs below road level. Study glacial geology along route Leave Cross Village Follow county road to Sturgeon Bay-Nipissing Beach east of highway. Follow county road to Carp Lake. (If road condition prohibits above route follow Highway 31 to Mackinaw City. Drive on Algonquin spillway. Algonquin shore lines on either side of highway).	8.50 A.M. 9.25 A.M.
12	Arrive point 1½ miles south of Mackinaw City Biehermal beds, Devonian but undetermined correlation. Note strong Algonquin beach.	10.20 A.M.
	Arrive Mackinaw City Note various beaches visible on Mackinac Island Leave Mackinaw City	10.45 A.M. 11.00 A.M.
13	Turn SE on U.S. 23 two miles. Arrive at Stimpson farm in NE¼ sec. 30, T.39N., R.3W. Breccia ridges Leave Stimpson farm Return to Highway 23, built on Nipissing beach, continue southeast. Note Cheboygan moraine on south side of road	 11.10 A.M. 11.30 A.M.
14	Arrive Dolan farm in SE¼ of NE¼ of sec.29, T.39N., R.3W. Examine long trench in limestone across Devonian limestone beds. Leave Dolan farm	11.40 A.M. 12.00 M.

15	Arrive Mill Creek quarry	12.10 P.M.
	Note high dip of quarry beds	
	Leave Mill Creek quarry	12.25 P.M.
	Note three types of rock structure and deposition in Mackinaw area -	
	1. Road cut U.S.31, 1½ miles south of Mackinaw City - biohermal beds	
	2. Stimpson farm - breccia	
	3. Dolan farm) Mill creek) stratified beds	
	Arrive Cheboygan, lunch	12.40 P.M.
	Leave Cheboygan, Ottawa Hotel	1.45 P.M.
	Follow U.S.23 to Legrand. Enter sandy lake plain of Lake Algonquin one mile south of Cheboygan.	
16	Arrive Legrand	2.10 P.M.
	Turn west to outcrop of Genshaw limestone 2¼ miles west.	
	Leave Genshaw outcrops	2.25 P.M.
17	Arrive outcrop of Killians limestone	2.35 P.M.
	Leave Killians limestone exposures	2.50 P.M.
18	Turn south on Afton road to Campbell's quarry in Alpena limestone. Arrive	3.00 P.M.
	Leave Afton quarry	3.20 P.M.
19	Arrive Genshaw limestone exposures one mile south of Afton in bed of Pigeon River	3.30 P.M.
	Leave Genshaw exposures	3.45 P.M.
20	Continue south two miles and note Alpena limestone along roadside. Turn west at schoolhouse one-half mile to "Antrim" or Norwood shale pit. Arrive	3.55 P.M.
	Note "gray rock" in black shale.	
21	Leave quarry in Norwood shales	

End of excursion

ROUTE MAP

8TH ANNUAL FIELD EXCURSION

MICHIGAN ACADEMY OF SCIENCE, ARTS & LETTERS

SECTION OF GEOLOGY & MINERALOGY

MAY 28-30, 1938

BEAVER ID.

ST. IGNACE

STRAITS OF MACKINAC

MACKINAC ID.

MACKINAC

BOIS BLANC ID

MACKINAW CITY

STURGEON BAY

CROSS VILLAGE

NIPISSING BEACH

LAKE MICHIGAN

INTERLOBATE MORAINE

EMMET

PORT HURON MORAINE SYSTEM

ALGONQUIN MORAINE

LEVERING

DOUGLAS L.

MORAINE

ALGONQUIN HARBOR SPGS. BEACHES

BURT LAKE

MULLETT LAKE

MORAINE

LAKE HURON

WATER

CHEBOYGAN

AREA

MORAINE

CHARLEVOIX

BAYSHORE DRUMLINS

LAKE CHARLEVOIX

PETOSKEY

TILL PLAIN

MORAINE

BLACK LAKE

NORWOOD

CHARLEVOIX DRUMLINS

WALLOON LAKE

BOYNE CITY

LEGRAND

BAFTON

PRESQUE ISLE

ELLSWORTH

DRUMLINS

JORDAN

TORCH L.

ANDREWS DRUMLINS

CHEBOYGAN

WOLVERINE

ONAWAY

U.S. 31 · U.S. 23 · U.S. 27 · M-131 · M-66 · M-33

LEGEND

ROUTE STOPS	(21)
LOCATIONS, U.M., & M.G.S.	L.67 (3)
WINCHELL LOCATIONS	W
HOUGHTON LOCATIONS	H

H. UNDERHILL

MICHIGAN ACADEMY OF SCIENCE FIELD TRIP

Glacial Geology

By S. G. Bergquist

CHARLEVOIX to ELLSWORTH

From Charlevoix to Ellsworth the highway crosses a drumlin - till plain topography. It follows the long axes of the drumlins in the direction of ice movement. The stoss slopes to north, lee slopes to the south.

to ATWOOD

Across the axes of the drumlins - showing characteristic swell and sag topography. Till plain with scattered drumlins.

NORWOOD

Algonquin shore bluff with beach at 674 feet
Nipissing beach at 608 feet marked by a wide bench in front of a shore cliff

to

Till plain with scattered drumlins
Back on Algonquin lake plain - Shore cliff along highway.

CHARLEVOIX to BAY SHORE

Algonquin sandy lake plain.
Nipissing beach at 611 feet.

to PETOSKEY and LITTLE TRAVERSE BAY

Highway follows over Algonquin plain (700 - feet)
Shore cliff to south of main road.

Little Traverse Bay is undoubtedly an indentation scoured out by an ice tongue projecting out from the main mass of ice in the Michigan lobe.

BAY VIEW

The Nipissing beach is obscured by sand dunes at Bay View but the Algonquin shore feature is well defined to the south of the village.

to ALANSON

Algonquin lake plain. The beach is developed along borders of the moraine to east and west in the vicinity of Alanson.

ALGONQUIN ARCHIPELAGO

Crooked, Pickerel, Burt and Douglass lakes lie in a depression which was flooded as an archipelago during Algonquin time and were also connected by a narrow strait during the Nipissing stage. The passage eastward from Little Traverse Bay was not completely closed by the gravels deposited on the bar of Lake Nipissing but was cut off by the dunes that were subsequently heaped up on that beach. The lakes thus became isolated from the main body of the larger lake.

north to PELLSTON

Highway follows along through sandy plain of Lake Algonquin. Shore cliffs of this lake are cut out of the east slope of the Interlobate moraine a half mile to the west of the highway.

The Interlobate moraine fills the area of Emmet County between Little Traverse Bay, Cross Village, and Levering.

to LEVERING

Situated on Algonquin lake plain.
West edge of village is banked against the shore cliff notched out of the Interlobate moraine.

A mile east of Levering is a gravel bar of Lake Algonquin which may be traced for several miles eastward.

Two miles north of Levering the highway crosses a similar bar. Just east of town the upper Algonquin beach is finely developed with a wave cut bluff 30-40 feet high banked up against the north edge of a chain of morainic knolls which run southeast nearly to Munro Lake.

to CARP LAKE — On Algonquin Lake plain which continues north to within two miles of Mackinaw City. A mile north of the rock outcrop the Nipissing beach crosses the highway.

MACKINAW CITY — West of Mackinaw City the Nipissing beach is developed as a strongly cut bench and bluff on the north and west side of McGulpin Point. (Elevation 629 feet) On the east side of Cecil Bay the Nipissing beach runs for a short distance along the base of a limestone cliff. The beach continues as a belt of sandy ridges along the west end of French Lake across to O'Neal Lake and thence nearly to Sturgeon Bay.

A narrow morainic ridge, known as the Cheboygan moraine, may be traced
CHEBOYGAN — from Mackinaw City to Cheboygan. It has an average width of about a quarter of a mile and was formed at a level much below that of Lake Algonquin. This moraine is the youngest in the Southern Peninsula and appears to mark the southern edge of a lobe of ice which came into the Huron basin from the Northern Peninsula.

The Nipissing lake plain lies behind the moraine facing Lake Huron.
At Cheboygan the Nipissing shore extends inland to form a strait which reaches into the basins of Mullett and Burt Lakes and into the Indian River to fill the basins of Pickerel and Crooked lakes, thence into Little Traverse Bay. This strait was cut off by sand dunes which piled up on the Nipissing bars at the entrance to the main body of water.

CHEBOYGAN to LE GRAND — Leaving the Nipissing plain a mile south of Cheboygan the route traverses a broad stretch of sandy clayey plain of Lake Algonquin. The shore cliff of this lake is banked against the north edge of a small morainic fragment $4\frac{1}{2}$ miles north of Legrand.

The town of Legrand lies in a narrow valley which was flooded during Lake Algonquin time. A shore bluff passing through Legrand is sculptured in the till plain which may be followed for a distance of
to AFTON — two miles southward. At this point the till plain merges with a morainic fragment which continues westward to Afton. In the region of Afton the glacial drift is very thin and the topography reflects the character of the underlying rock surface.

DRUMLINS OF THE GRAND TRAVERSE REGION

The best drimlin development in the southern Peninsula is to be found in Antrim and Charlevoix counties between Grand Traverse and Little Traverse Bays. In this area they are developed on a till plain formed after the ice had retreated from the position of the Main Moraine of the Port Huron System. The most characteristic forms lie in the region between Torch Lake and Lake Charlevoix where they form definite linear ridges up to 60 and more feet in height. They range in length from merely a fraction of a mile to 1½ miles and in width from 1/8 to 1/4 mile.

In the area between Torch Lake and Grand Traverse Bay the features are not so well developed and occur more in the form of drumlinoids. The south ends of the drumlins throughout the section seem to merge more or less obscurely into the hummocky morainic topography.

The drumlins between Lake Charlevoix and Petoskey are likewise drumlinoid in character and stand out above the till plain surface in the form of irregular elliptical hills.

The drumlins of the Grand Traverse region trend roughly north to south and mark the direction of ice movement at the time that they were formed. In the vicinity of Lake Charlevoix, however, they extend in a northwest-southeast direction but are not parallel to the long axis of the trough in which the lake is situated. This discordance of trend between the drumlins and the axis of the lake basin would seem to indicate that the trough was sculptured by an ice advance which was independent of the one that shaped the drumlin ridges.

In the region of Ellsworth the drumlins are cored in the Ellsworth shale and are mantled with a thin veneer of glacial till. Along the borders of Torch, Intermediate and Charlevoix lakes the ends of the drumlins have been truncated by wave action of Lakes Algonquin and Nipissing. Due to the sorting action of the waves which were active in cutting the drumlins there is a concentration of lag cobbles along the borders of these lakes. Along some of the lakes these coarse concentrates have been piled up into distinct ramparts by ice activity in the post-Nipissing lakes.

The route from Charlevoix south to Ellsworth will follow along the trends of a number of well developed drumlins. It will be noted that there is very little difference in the steepness of the stoss (north) and lee (south) slopes.

From Ellsworth westward to Atwood the route crosses the short axes of a number of drumlins to display the "sag and swell" topography so characteristic of drumlin areas. The "sags" between the ridges are usually poorly drained and are occupied by swamps and bogs.

FINGER LAKES OF THE GRAND TRAVERSE REGION

In the region extending from Grand Traverse to Little Traverse Bays is a series of border lakes which project inland from Lake Michigan like huge fingers. They seem to occupy extensive troughs running more or less parallel to the direction of the movement of the ice during its latest invasion across the area. At one time they formed a part of the larger lake but were cut off and became isolated by great bay-mouth bars which were thrown across their connections during the Algonquin and Nipissing stages of lake development.

From south to north there finger-like lakes are named Elk, Torch, Intermediate, Six Mile, South Arm, Charlevoix and Walloon, respectively. They were all connected during the Lake Algonquin stage and are bordered by shore features which form more or less continuous bands at various levels along their margins. The old Algonquin shore may be traced around these lakes at elevations above Lake Michigan ranging from 54 feet (635' A.T.) at Elk Rapids on Elk Lake to 85 feet (666' A.T.) at Charlevoix on Lake Charlevoix.

With the recession of the water to the Nipissing level the basins were definitely separated from the main lake by bars which were developed across the headlands. With the single exception of Walloon Lake which stands well above the levels of the post-Algonquin lakes, the Nipissing shore may be traced as a more or less uninterrupted feature around the borders of these lakes at an elevation of 606 feet at Elk Rapids to 611 feet at Charlevoix.

LAKES OF THE CHEBOYGAN RIVER BASIN

From the vicinity of Petoskey on Little Traverse Bay eastward to Cheboygan is a chain of lakes commonly referred to as the "Inland Route". These lakes, including Crooked, Burt, Douglass and Mullet, lie in an interlobate area of morainic country formed by the Michigan and Huron lobes respectively.

It is thought that the depressions occupied by these lakes may have been formed prior to the last retreat of the glacier by the action of pre-glacial rivers, by scour of the ice in its advance or by the two processes together. Little Traverse Bay occupies a depression which was undoubtedly formed by the invasion of a small tongue of ice which pushed out from the main mass of the Michigan lobe into a pre-glacial trough.

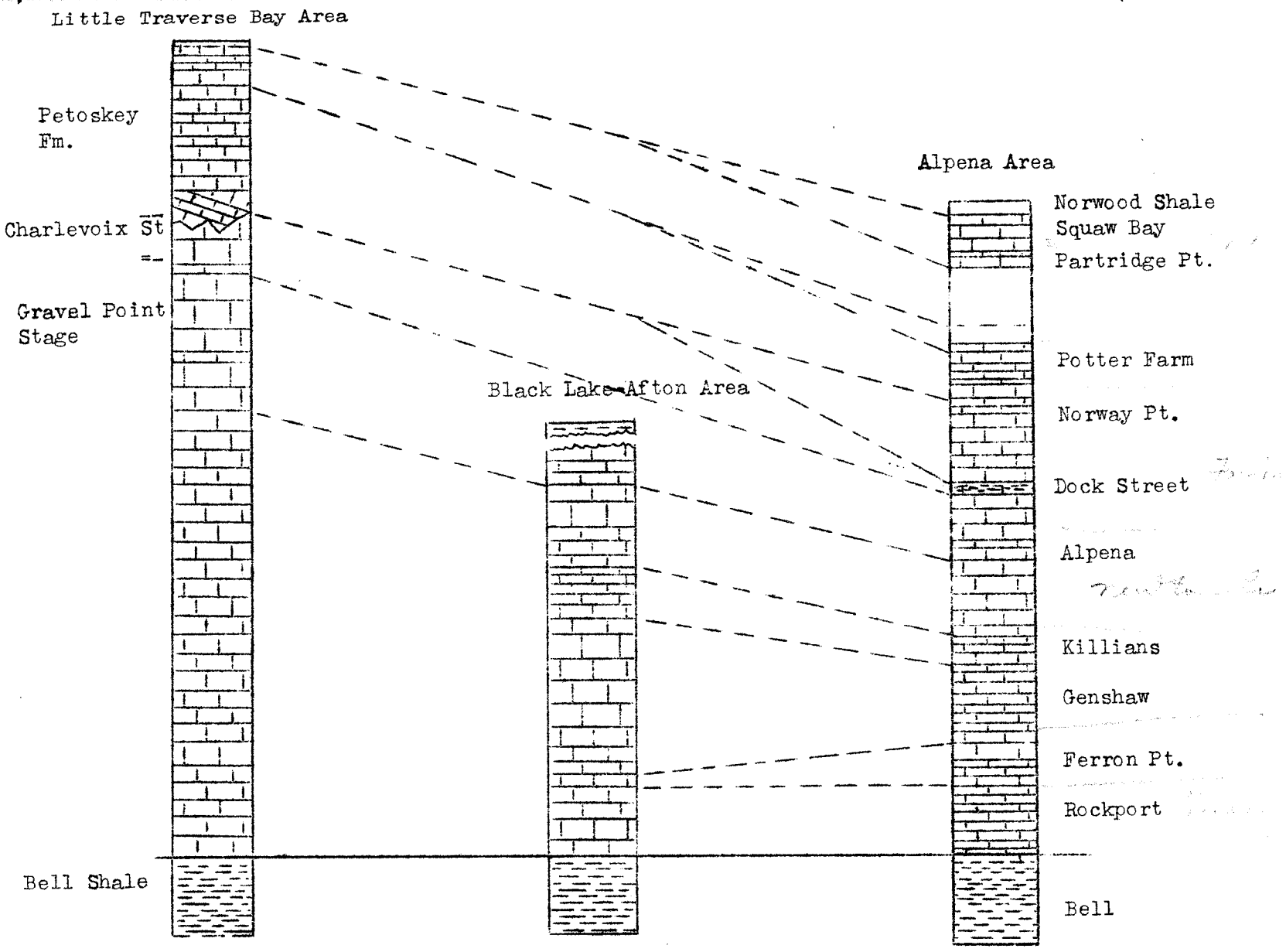
Upon final retreat of the ice from the region these depressions were doubtlessly filled with blocks of ice which naturally melted more slowly than the main mass of the ice thus preventing them from becoming filled with glacial debris.

During Algonquin times this region was an Archipelago which covered all of the present lakes of the chain as well as large areas of the adjacent lowlands. Algonquin shore features may be traced almost continuously along the margins of the lakes at an elevation of 85 to 90 feet above the level of Lake Michigan.

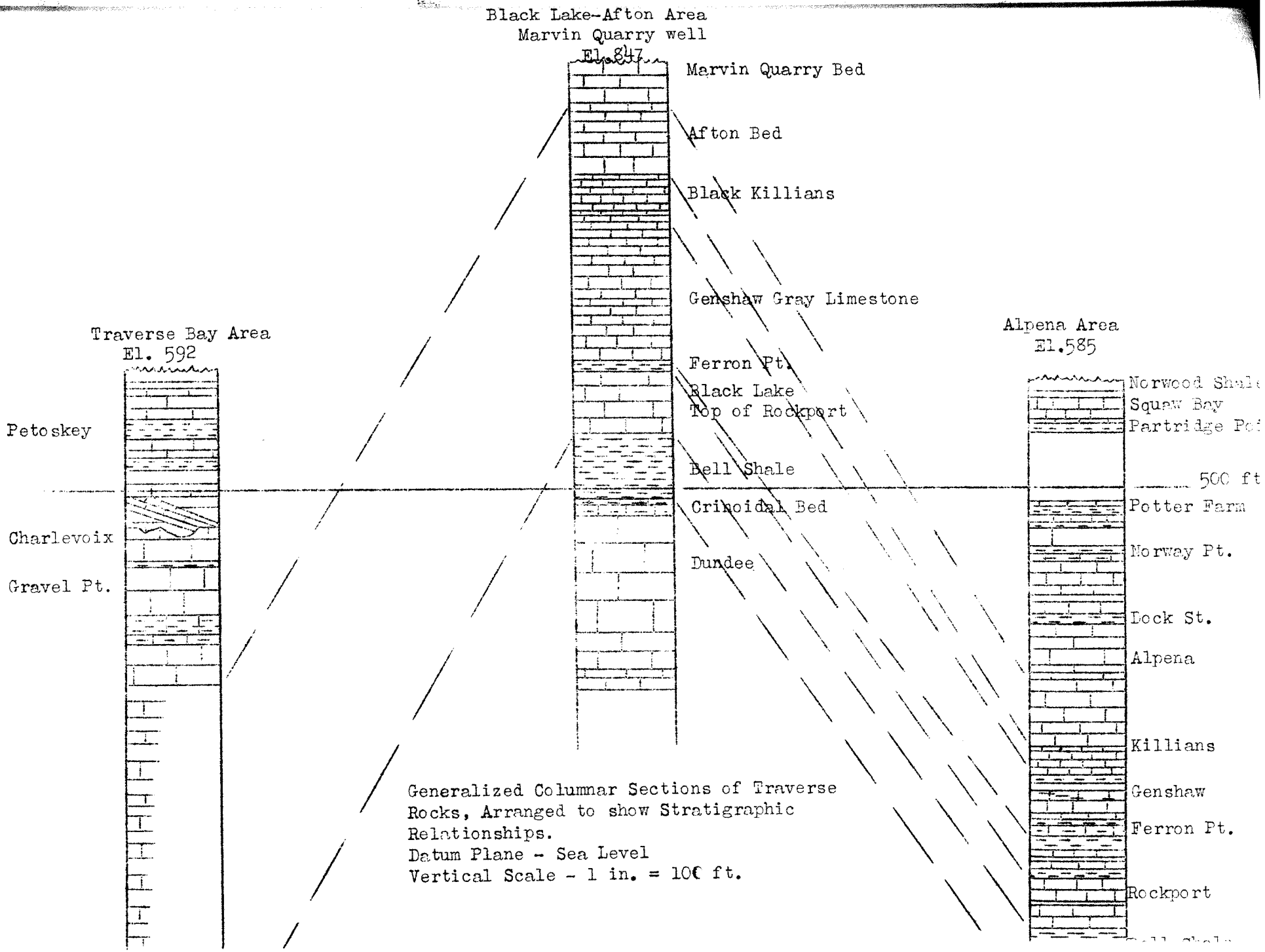
The Nipissing shore stands below the level of Douglass and Black Lakes so is absent along their rims. The Nipissing feature is present, however, around the borders of Burt, Mullet and Crooked lakes. It stands about 15 feet above the level of Crooked Lake and 25 feet above the Cheboygan River at its mouth near Cheboygan.

With the sinking of the level of Lake Algonquin in the transition to the Nipissing stage, Douglass and Black lakes became isolated while the lower part of the depression in which Mullet, Burt and Crooked lakes lie was still submerged.

During Nipissing times the opening at Little Traverse Bay was partially closed by a bar thrown across the headlands. The sand of this bar was subsequently whipped up by the winds into a series of dune ridges. Further recession of the Nipissing waters down to the present Great Lakes level isolated a large inland lake which at first occupied all of the basin between the bay mouth bar at Petoskey and Cheboygan. As the Cheboygan River deepened its channel the water was divided by a bar at Indian River and subsequently lowered to its present level.



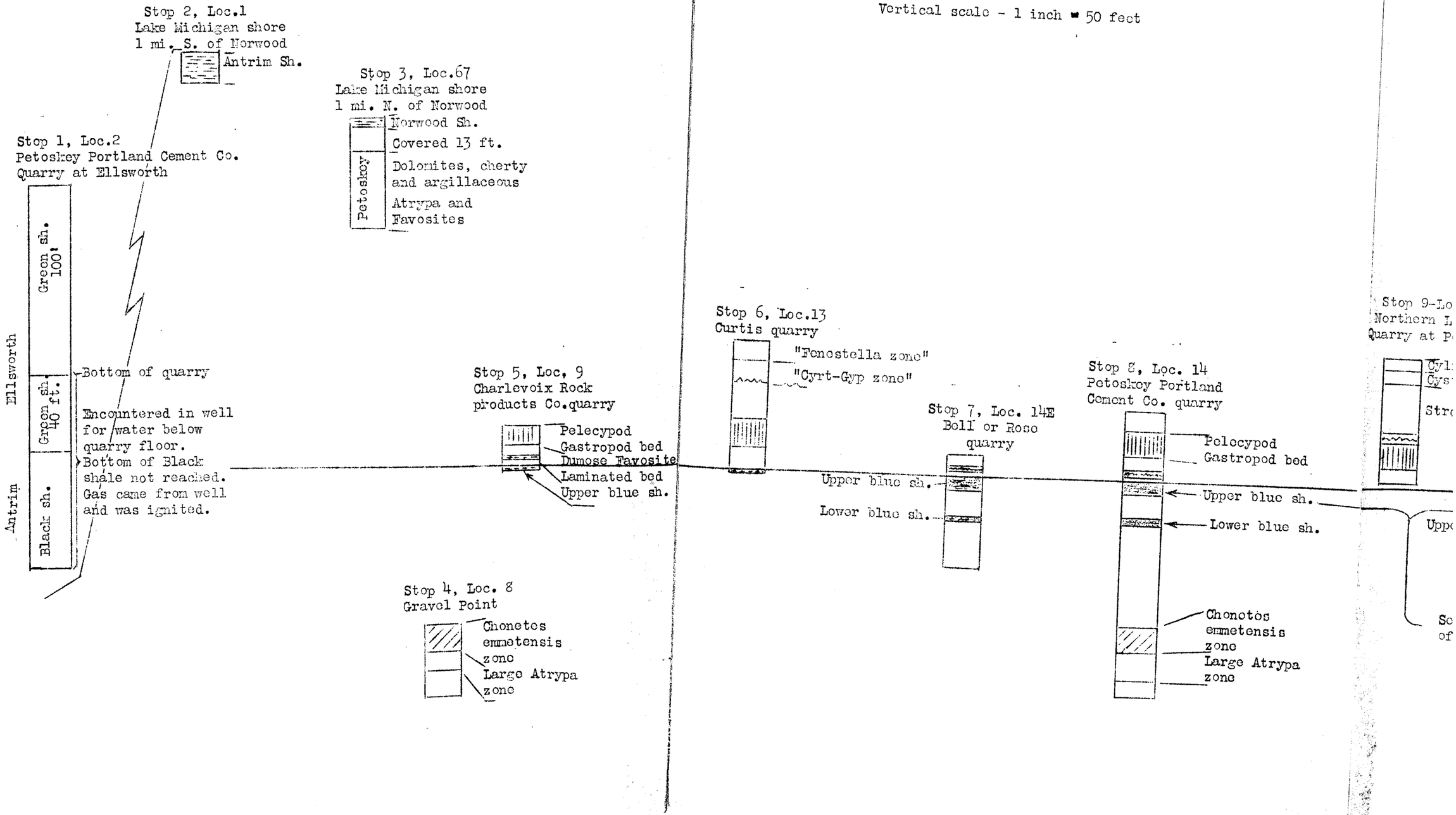
Generalized Columnar Sections of Traverse Rocks, Arranged to Show Stratigraphic Relationships.
Datum Plane - Top of Bell Shale.
Vertical Scale - 1 inch = 100 fee



Generalized Columnar Sections of Traverse Rocks, Arranged to show Stratigraphic Relationships.
Datum Plane - Sea Level
Vertical Scale - 1 in. = 100 ft.

Columnar sections of the Traverse and higher beds of the Little Traverse Bay region, arranged to show stratigraphic relationships

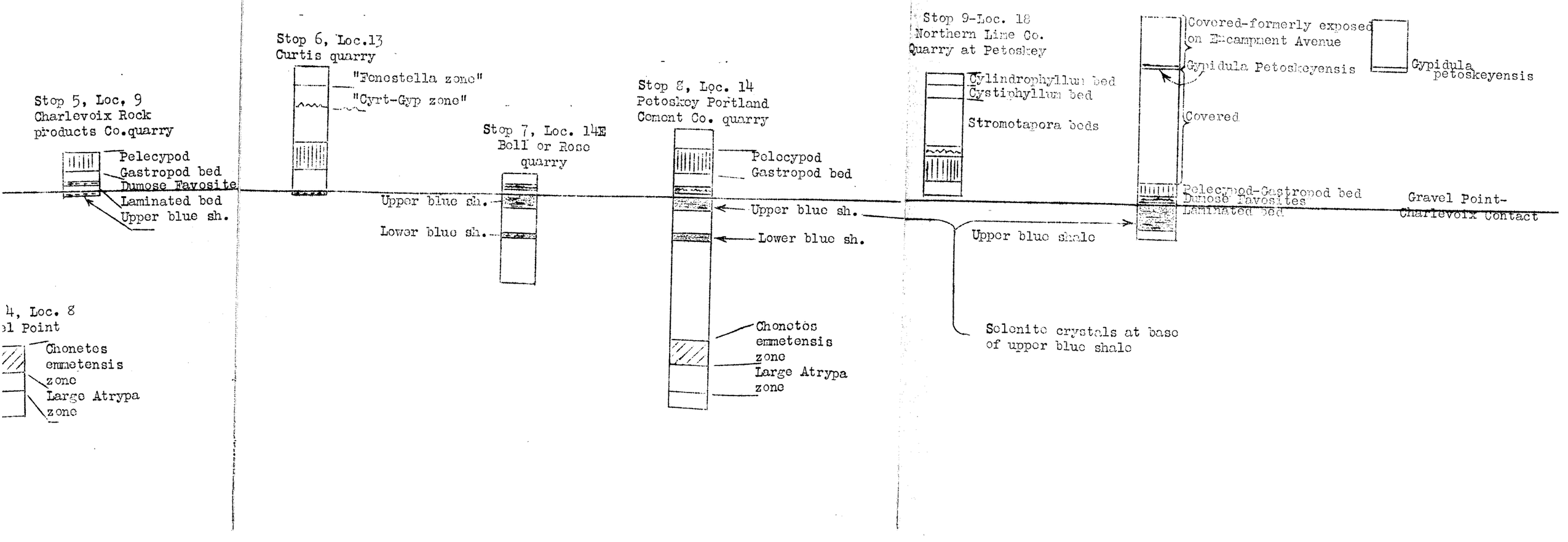
Vertical scale - 1 inch = 50 feet



.67
shore
orwood
i Sh.
i 13 ft.
tes, cherty
gillaceous
and
tes

Columnar sections of the Traverse and higher beds of the Little Traverse Bay region, arranged to show stratigraphic relationships

Vertical scale - 1 inch = 50 feet



Stop 10-Loc. 18A
Shore of Little Traverse Bay near Pennsylvania R. R. Sta. at Bay View and Encampment Avenue opposite station.

Stop 11-Loc. 21
East Bay View or Mud Lake Quarry

Section of strata Exposed in the Campbell

Stone Co. Quarry at Afton

By G. M. Ehlers - 1934

		Ft.	In.
Top.	8. Limestone, gray, very fine grained. Contains Gypidula, Prismatophyllum sp. with small corallites, columnals of crinoids, Spirifer sp. -S. mucronatus type, Stropheodonta sp.-S. erratica type, and Fenestrellina sp. indet.	8	
	7. Limestone, brownish-gray, with irregular black shale partings. Numerous Favosites sp.-F. alpenensis type and cup corals. Carbonaceous shale abundant in lower 2 feet and in a 10 inch band at top.....	4	10
	6. Limestone, gray, numerous fossil fragments in beds, separated above and below by carbonaceous shale partings. Contains Prismatophyllum and Favosites	1	9
	5. Limestone, oolitic, light buff gray, thick bedded and massive, Favosites near top	8	4
	4. Limestone, similar to that below, more thinly bedded and darker; contains numerous specimens of Welleria aftonensis Warthin	2	4
	3. Limestone, gray, with some laminae of carbonaceous material, breaking into thick blocks	4	4
	2. Limestone, light brown, contains chert and lenses of brown limestone		10 to 16
	1. Limestone, lithographic, gray, numerous small cavities, base not exposed	6	9
		37'2"	37'8"

Section of Traverse Group

Exposed Along North-South Road One-half Mile West of Afton, Michigan, and Between Points 1½ and 2 3/4 Miles South of Afton

By E. O. Ulrich, et al. - Michigan Geol. Surv., 1926

Locality 23 (1926 Michigan Geol. Survey)

		Ft.	In.
Top. 25	Ls., dove-colored, massive with irregular stringers of calcite and ramose Favosites	1	4
24	Ls., gray, lower half resembling versicular chert in structure and upper half containing corals and Idiostroma	1	8
23	Shale, gray, with concretions of darker gray limestone filled with ostracods. Bythocyprids particularly abundant. Ulrichia, Kloedenia and Primitia noted	2	
22	Ls., light-gray, fine-grained, thicker bedded than limestone of interval 21 but with thin irregular layers and lenses of chert 1½ to 2 inches thick. Idiostroma (with small hole in center), 2 species of gastropods, a cephalopod, a large Ceratopora, large heads of Favosites and massive stromatoporoids. Some fossils are silicified	4 (maximum)	
21	Ls., magnesian, finely crystalline and yellowish. Poorly exposed.....	1 (maximum)	
20	Ls., dove-colored, platey, obscurely laminar, with dumose Favosites Aulopora, Athyris (½ to 3/4 in. in diameter) in lower 1 foot	4 (maximum)	
19	Ls., black, sandy, streaked and laminated	3-4	
18	Ls., dove-colored, laminated with cavities, almost vesicular; top almost black in color	2-4	
17	Ls., laminated, yellowish-gray at base becoming pinkish at top	3	6
16	Ls., yellowish-gray and argillaceous; becomes cobbly upon weathering. Prismatophyllum at base	6	
15	Shale, calcareous, gray, with two fossiliferous zones. The lower zone is about 6 feet above base and contains Spirifer of a wide S. mucronatus type, Stropheodonta, small Atrypa and a Spirifer with a prominent cardinal area, one valve encrusted with Hederella and other bryozoa. The upper fossiliferous zone is about 6 feet below the overlying beds of interval 15 and contains Sulcoretepora, Astraeospongia and other fossils	22	

Section of Traverse Group - 2

		Ft.	In.
Locality 26 (1926 Michigan Geol. Survey)			
14	Covered. Interval probably contains shale	5-10	
13	Ls., argillaceous, platey, gray, with chert layers 1 inch thick and many silicified fossils. Productella, Cyrtina with high cardinal area, small mucronate Spirifer, Stropheodonta - variation of S. erratica type, large Auloporoid, Atrypa. Productella is especially abundant at top	1	6-8
12	Chert with fossils similar to ls. of interval 13	1	
11	Ls., gray, platey, thickening northward into a coral reef	2	6
10	Ls., gray, laminated, with sedimentary planes through it	2	6
9	Coral "reef". Prismatophyllum with raised rim about pit, 2 species of Conocardium, Cyricardinia, 2 or 3 cephalopods, 3 gastropods, Holopea or Straparollus, Dolatocrinus or Megistocrinus, Goniophora, Alveolites, large branched Cladopora, Cystiphyllum, Chonophyllum, Stromatoporoids, Phacops, Chaetetes, Favosites, of F. alpenensis type	3	
8	Ls., Gray, breaks into spalls, fossils abundant Favosites, Gypidula, large Stropheodonta demissa, Stropheodonta erratica, Spirifer mucronatus, Terebratuloid, Pholidostrophia, Prismatophyllum	1	6
7	Ls., gray, black-specked, massive; abundant crinoidal fragments and few shells, Pholidostrophia	2	
6	Ls., crystalline, thin-bedded, fossiliferous, Fistuliporoids, small-celled Favosites, Fenestella, Ceratopora - large species. Bottom not seen		6
Locality 22 (1926 Michigan Geol. Survey)			
5	Ls., dove-colored, fine-grained, with numerous, irregularly shaped cavities. Contains pelecypods, simple corals, Cladopora and crinoidal fragments which are at top in a peculiarly streaked layer with minute crystals of calcite	3	
4	Ls., more gray than limestone of interval 5 and possibly more magnesian; cavities, where present, smaller than those of interval 5	2	
3	Ls., similar to above, with very few cavities and laminated	3	

Section of Traverse Group - 3

	Ft.	In.
2. Covered. Blocks of Gray, somewhat crystalline ls. are present at the side of ditch; they contain numerous crinoidal fragments, a Prismatophyllum, a large Spirifer, and a small tubed Favosites. It is possible that these blocks came from the covered rocks of this interval	1	2
1. Ls., dove-colored, fine-grained, with numerous small crystals of Calcite. Ls. seems to be very high in $CaCO_3$.....		
	80'6"	88'8"

Intervals 1 - 5 exposed at locality 22

" 6 -14 " " " 26

" 15 -25 " " " 23

BIBLIOGRAPHY

Arnold, C. A. 1931. On Callixylon newberryi (Dawson): Contrib. Mus. Paleon., Univ. of Michigan, vol. 3, pp. 207-232, 7 pls. 9 text figs.

Arnold, C. A. 1934. The so-called branch impressions of Callixylon newberryi (Dawson) and the conditions of their preservation: Journ. Geol., vol. 42, pp. 71-76.

Bassett, C. F. 1935. Stratigraphy and paleontology of the Dundee limestone of southeastern Michigan: Bull. Geol. Soc. Amer., vol. 46, pp. 425-462, pls. 33-39, 1 fig.

Case, E. C. 1931. Arthrodiran remains from the Devonian of Michigan: Contrib. Mus. Paleon., University of Michigan, vol. 3, pp. 163-182, 5 pls., 13 text figs.

Deiss, C. F. 1932. A description and stratigraphic correlation of the Fenestellidae from the Devonian of Michigan: Contrib. Mus. Paleon., Univ. of Michigan, vol. 3, pp. 233-275, 14 pls.

Eddy, G. E. 1933. A study of the insoluble residues of the lower Traverse, Bell and upper Dundee formations of Michigan: Michigan Acad. Sci., Arts and Letters, vol. 18, pp. 345-361, pls. 31-38, text fig. 14, map 32.

Ehlers, G. M. 1935. Two new crinoids from the Devonian of Michigan: Contrib. Mus. Paleon., Univ. of Michigan, vol. 2, pp. 99-104, 1 pl.

Ehlers, G. M. and Hussey, R. C. 1921. A new gastropod and a new cephalopod from the Devonian of Michigan: Papers of the Michigan Acad. Sci., Arts and Letters, vol. 1, pp. 248-251, pl. 37, figs. 1-4, pl. 38.

Ehlers, G. M. and Virginia Kline 1934. Revision of Alexander Winchell's types of brachiopods from the Middle Devonian Traverse group of rocks of Michigan: Contrib. Mus. Paleon., Univ. of Michigan, vol 4, pp. 143-178, 4 pls.

Ehlers, G. M. and Leighly, J. B. 1922. Lipsanocystis traversensis, a new cystid from the Devonian of Michigan: Papers of the Michigan Acad. Sci., Arts and Letters, vol. 2, pp. 155-158, pl. 10, figs. 1-5, text figures 4-6.

Ehlers, G. M. and T. E. White. 1932. Cylindrophyllum panicum (Winchell) and Cylindrophyllum hindshawi sp. nov., Tetracoralla from the Traverse group of Michigan: Contrib. Mus. Paleon., Univ. of Michigan, vol. 4, pp. 93-100, 5 pls.

Ehlers, G. M., and Radabaugh, R.E. 1938. The Rogers City limestone, a new Middle Devonian formation in Michigan: Papers of the Mich. Acad. Sci., Arts and Letters, vol. 23, pp. 441-445, 2 pls.

Fenton, C. L. & Fenton, Mildred Adams. 1930. Studies on the genus Atrypa: The American Midland Naturalist, vol. 12, no. 1, pp. 1-18, 2 pls.

Fenton, Mildred Adams. 1931. A Devonian stromatoporoid reef: American Midland Naturalist, vol. 12, no. 7, pp. 195-202, 2 pls.

Foerste, A. F. 1927. Devonian Cephalopods from Alpena in Michigan: Contrib. Mus. Paleon., Univ. of Michigan, pp. 189-208, 5 pls.

Foerste, A. F. 1930. The color patterns of fossil cephalopods and brachiopods, with notes on gastropods and pelecypods: Contrib. Mus. Paleon., Univ. of Michigan, vol. 3, pp. 109-149, 5 pls.

Foerste, A. F. 1930. Additional notes on Nephriticerina: Contrib. Mus. Paleon., Univ. of Michigan, vol. 3, pp. 151-154, 1 pl. and 1 fig.

Grabau, A. W. 1902. Stratigraphy of the Traverse group of Michigan: Michigan Geol. Survey., Ann. Rep't. for 1901, pp. 161-210.

Hake, B. F., and Maebius, J. B. 1938. Lithology of the Traverse group of central Michigan: Papers of the Michigan Acad. Sci., Arts and Letters, vol. 23, pp. 447-461, 4 figs.

Imlay, R. W. 1932. Gypidula petoskeyensis sp. nov., a new brachiopod from the Traverse group of Michigan: Contrib. Mus. Paleon., Univ. of Michigan, vol. 4, pp. 101-104, 1 pl.

Leverett, Frank, Taylor, F. B. Pleistocene of Indiana and Michigan and the History of the Great Lakes. U. S. Geol. Survey Monograph LIII.

Leverett, Frank. 1917. Surface geology and agricultural conditions of Michigan: Michigan Geol. and Biol Surv., pub. 25, geol. ser. 21, 223 pp. Note - map showing surficial geology accompanies this publication.

Leverett, Frank. Map of surface formations of Southern Peninsula of Michigan.

Martin, Helen M. The centennial Geological Map of the Southern Peninsula of Michigan, pub. 39, Geol. Ser. 33 (1936)

Newcombe, R. B. 1932. Oil and gas fields of Michigan: Dep't. of Conservation, Geol. Surv. Division, Pub. 38, Geol. Ser. 32, pp. 293

Pohl, E. R. 1930. The Middle Devonian Traverse group of rocks in Michigan, a summary of existing knowledge: Proc. U. S. Nat. Mus., vol. 76, art. 14, pp. 1-34, 2 pls.

Scott, I. D. Inland Lakes of Michigan - Mich. Geol. and Biol. Surv. Pub. 30, Geol. Ser. 25, 1920

Smith, R. A. 1916. Limestones of Michigan: Michigan Geol. and Biol. Survey pub. 21, Geol. Ser. 17, pp. 103-311, 8 pls., 15 text-fig.

Springer, Frank. 1921. The fossil crinoid genus Dolatocrinus and its allies: U. S. Nat. Mus., Bull. 115, 78 pp., 16 pls.

Van Pelt, Herberta L. 1933. Some ostracods from the Bell shale, Middle Devonian, of Michigan: Jour. Paleon., vol. 7, pp. 325-342, pl. 39.

Warthin, A. S. 1934. Common ostracoda of the Traverse group: Contrib. Mus. Paleon., Univ. of Michigan, vol. 4, pp. 205-226, 1 pl.

Warthin, A. S. and Cooper, G. Arthur. 1935. Hamilton correlations in Ontario and Michigan: Proc. Geol. Soc. Amer. for 1934, pp. 362-363.

Warthin, A. S. and Cooper, G. Arthur. 1935. New formation names in the Michigan Devonian: Jour. Washington Acad Sciences, vol. 25, pp. 524-526.