

CONTRIBUTIONS FROM THE MUSEUM OF PALEONTOLOGY

THE UNIVERSITY OF MICHIGAN

Vol. 25, No. 8, p. 155-168 (3 text-figs.)

July 15, 1979

**MIDDLE DEVONIAN STRATIGRAPHY ALONG FRENCH ROAD,
ALPENA COUNTY, MICHIGAN**

BY

**GEORGE M. EHLERS, ROBERT W. KELLEY,
ROBERT V. KESLING, G. ERVIN LAMB,
AND HARRY O. SORENSEN**



**MUSEUM OF PALEONTOLOGY
THE UNIVERSITY OF MICHIGAN
ANN ARBOR**

CONTRIBUTIONS FROM THE MUSEUM OF PALEONTOLOGY

Gerald R. Smith, Director

Robert V. Kesling, Editor

Diane Wurzinger, Editor for this number

This series of contributions from the Museum of Paleontology is a medium for the publication of papers based chiefly upon the collection in the Museum. When the number of pages issued is sufficient to make a volume, a title page and a table of contents will be sent to libraries on the mailing list, and to individuals upon request. A list of the separate papers may also be obtained. Correspondence should be directed to the Museum of Paleontology, The University of Michigan, Ann Arbor, Michigan, 48109.

VOLS. II-XXV. Parts of volumes may be obtained if available. Price lists available upon inquiry.

MIDDLE DEVONIAN STRATIGRAPHY ALONG FRENCH ROAD, ALPENA COUNTY, MICHIGAN

By

George M. Ehlers¹, Robert W. Kelley²,
Robert V. Kesling³, G. Ervin Lamb²,
and Harry O. Sorensen²

INTRODUCTION

EACH FIELD INVESTIGATION refines the knowledge of geology in an area. Seldom if ever can this knowledge reach completion and perfection. Data is added slowly and maps are improved, leading to a better understanding of formations and their history.

Thus, only eight years after a publication on the geology of Alpena and Presque Isle Counties, Michigan (Ehlers and Kesling, 1970), new exposures along French Road supplement our information on the area between Long Lake and Alpena. Topographic control also enables us to establish dips more accurately in this narrow strip.

Our purpose here is to make these results available for further mapping and interpretation. Already, the southern part of French Road has been blacktopped, obscuring outcrops in the road bed; according to plans of the county highway commission, the remainder of French Road will soon be blacktopped. As progress and outcrops appear to be inversely proportional, we deem it important to record timely geologic information.

The topographic survey was made by Kelley, Lamb, and Sorensen in 1970. A detailed section of the Killians Member of the Genshaw Formation was described and measured by Ehlers and Sorensen in 1970 and 1971. Formational contacts were determined by Ehlers and Sorensen in 1970, and were checked and revised by Kesling in 1977. Dips were computed by Kesling in 1978. From this team effort, we can demonstrate some of the irregular dips which characterize outcrops in the margin of the Michigan Basin and establish the formational contacts as intercepted by French Road.

GEOLOGICAL SETTING

The French Road section is part of the outcrop belt of Middle Devonian Traverse Group rocks which curves across the northern part of the Lower Peninsula of Michigan from Charlevoix County on the west to Alpena County on the east. Just south of Long Lake is the contact of the Ferron Point Formation and the overlying more resistant Genshaw Formation. At the southern end of French Road, outcrops contain silicified fossils of the Norway Point Formation. All strata strike N 40° W with varying dip S 50° W.

¹ Deceased, formerly Professor Emeritus of Geology and Mineralogy and Curator Emeritus of Invertebrates, Museum of Paleontology, The University of Michigan

² Michigan Geological Survey, Division of Natural Resources

³ Professor of Geology and Mineralogy and Curator of Micropaleontology, Museum of Paleontology, The University of Michigan

ELEVATIONS

All elevations above mean sea level were computed from a bench mark at elevation 692.023 feet located about center of NW¼ sec. 5, T 31 N, R 8 E, 4.6 miles northwest of Alpena along Detroit & Mackinac Railroad, about 810 feet west of milepost 127, about 195 feet east of railroad crossing, 28 feet north of centerline of Truckey Road and 28 feet south of the south rail and level with the track, western Alpena Township, Alpena County, Michigan.

Level of Long Lake established by U.S. Corps of Engineers = 645 feet. Legal level of Long Lake established 23 August 1948 = 650.89 feet. Level of Long Lake computed at time of traverse in 1970 = 648.3 feet.

TOPOGRAPHIC TRAVERSE ALONG FRENCH ROAD

Shore of Long Lake south along French Road to beyond Grover Road, surveyed August 20, 21, 1970, by Harry O. Sorensen and G. Ervin Lamb, using engineer surveyed level, stadia rod, and chain:

<u>Station</u>	<u>Eleva- tion (MSL)</u>	<u>Distance south of Long Lake</u>	<u>Distance between stations</u>	<u>Description</u>
0	648.3	0		Shore of Long Lake due north of end of French Road.
I	670.2	691.0	691	Top of culvert on southwest corner of junction of French Road and West Long Lake Road.
II	674.9	1123.3	432.3	Edge of road 2 feet east of mailbox of Edward Schellie, Jr.
III	687.9	2014.3	891.0	Edge of road 3 feet east of mailbox of M. Werner (No. 9617).
IV	694.4	2091.0	76.7	Outcrop on west shoulder of road; 1400 feet south of culvert at junction with West Long Lake Road.
V	708.7	2447.0	356.0	Outcrop on west shoulder of road, short distance south of mailbox No. 9542; 1756 feet south of junction with West Long Lake Road.
VI	720.5	2705.0	258.0	Outcrop on west shoulder of road near base of escarpment; 2014 feet south of junction.

<u>Station</u>	<u>Elevation (MSL)</u>	<u>Distance south of Long Lake</u>	<u>Distance between stations</u>	<u>Description</u>
VII	726.2	2891.0	186.0	Edge of road 2 feet east of mailbox of Ch. Crawford just beyond crest of escarpment; 2200 feet south of junction.
VIII	733.3	3944.8	1053.8	Edge of road near mailbox of Beau-bien (No. 9271), about 75 feet north of rock pavement in road.
IX	728.0	5317.6	1372.8	Junction with Grover Road (gravel road leading east).
X	755.2	6241.6	924.0	Edge of road by mailbox of Fr. Plieszynski.

From end of previous traverse to intersection with Lacombe Road, surveyed September 3, 1970, by Robert W. Kelley and Harry O. Sorensen, using engineer level, stadia rod, and measuring wheel:

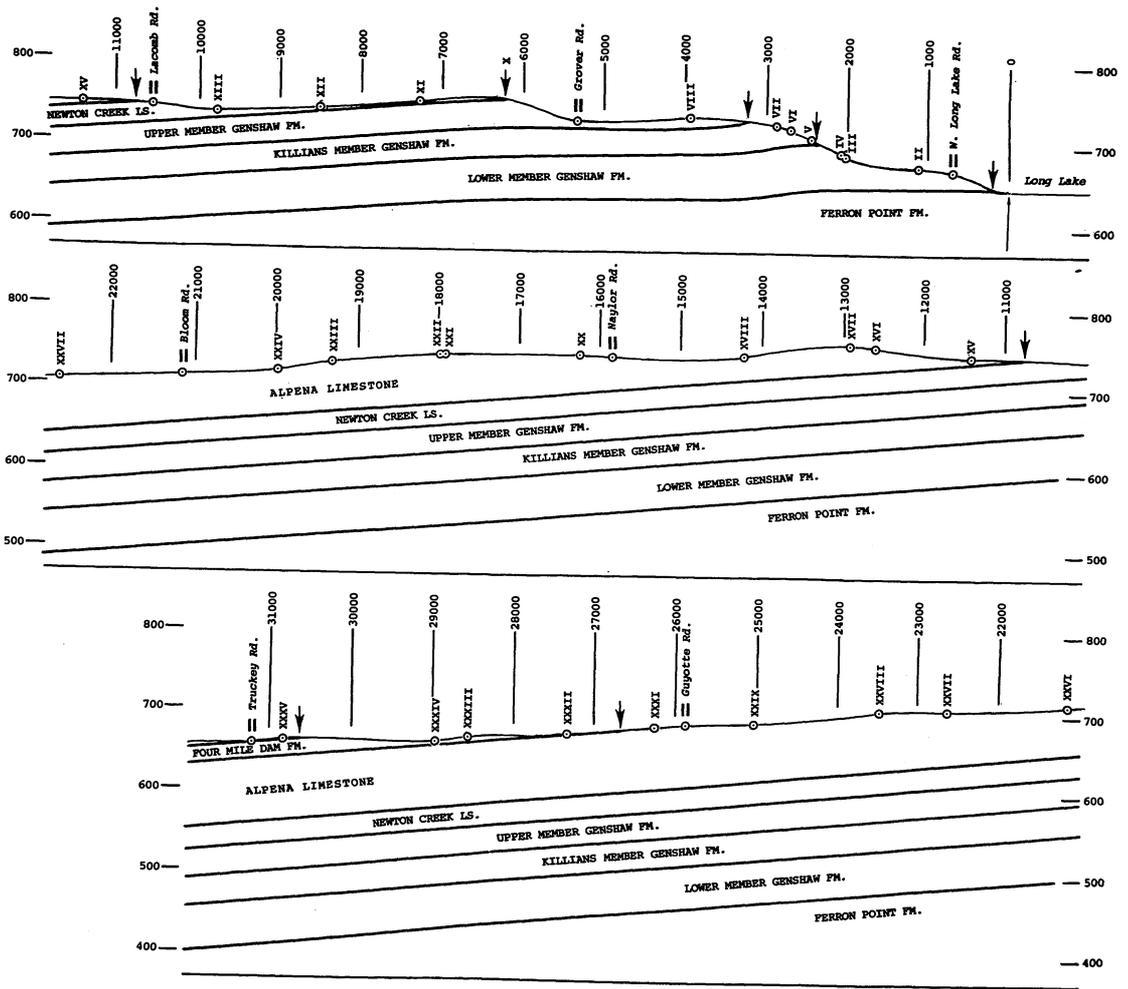
<u>Station</u>	<u>Elevation (MSL)</u>	<u>Distance south of Long Lake</u>	<u>Distance between stations</u>	<u>Description</u>
X	755.2	6241.6		Edge of road by mailbox of Fr. Plieszynski.
XI	749.8	7284.4	1042.8	Edge of road 3 feet east of mailbox of P. Donakowski (No. 8618), slight rise between this and last station.
XII	740.2	8512.0	1227.6	Edge of road 3 feet east of mailbox of John Hoppe (No. 8385).
XIII	735.7	9785.8	1273.8	Edge of road 3 feet east of mailbox of H. Cadarette (No. 8135).
XIV	743.4	10558.0	772.2	Center of intersection with Lacombe Road.

From junction with Truckey Road northward to join with previous traverse at Lacombe Road, surveyed September 1, 2, 1970, Robert W. Kelley and Harry O. Sorensen, using engineer level, stadia rod, and measuring wheel:

<u>Station</u>	<u>Elevation (MSL)</u>	<u>Distance south of Long Lake</u>	<u>Distance between stations</u>	<u>Description</u>
XIV	743.4	10558.0		Center of intersection with Lacombe Road.
XV	746.1	11406.1	848.1	Edge of road 3 feet west of mailbox of Francis Lacombe (No. 7820); rock exposed on east side of road; fossiliferous exposure with cephalopod 35 feet south and 10 feet east of mailbox.
XVI	755.3	12607.3	1201.2	Edge of road 2 feet west of mailbox of Roy Anderson (No. 7602).
XVIII	742.1	14230.9	1306.8	Edge of road 2 feet west of mailbox of Gary L. Millar (No. 7495); rubbly rock at surface; upgrade toward previous station in line with telephone pole L1-88, rubbly rock on east side of road.
XIX	740.9	15864.4	1633.5	Center of intersection with Naylor Road; low-lying cedar swamp between this and previous station.
XX	745.4	16257.1	392.7	Edge of road 3 feet west of mailbox of L. Mason (No. 6893); rise in road with exposed rock pavement about 100 feet south.
XXI	743.8	17907.1	1650.0	Edge of road 3 feet west of mailbox of C. Engelski, top of rise.
XXII	743.1	17997.1	90.0	Edge of road 4 feet west of east edge, 90 feet south of C. Engelski mailbox.
XXIII	731.3	19326.1	1329.0	Edge of road 2 feet west of mailbox of John Jones (No. 6358); rock ledge in east ditch extending 500 feet south to base of rise, suggesting reef.
XXIV	720.0	19979.5	653.4	Edge of road 2 feet west of mailbox of George Jones (No. 6217).
XXV	712.9	21160.9	1181.4	Rock pavement on east edge of road at intersection with Bloom Road.

<u>Station</u>	<u>Elevation (MSL)</u>	<u>Distance south of Long Lake</u>	<u>Distance between stations</u>	<u>Description</u>
			0.0	
XXVI	712.4	21160.9		East edge of road 6 feet west of sign post at intersection with Bloom Road.
			1478.4	
XXVII	706.8	22639.3		East edge of road directly west of telephone pole L1-112.
			851.4	
XXVIII	704.6	23490.7		Edge of road 2 feet west of mailbox of Mrs. Olive Melligen and N. Kaperwas (No. 5454), 50 feet south of knoll in road.
			1564.2	
XXIX	689.1	25054.9		Edge of road 2 feet west of mailbox of C. Hall (No. 5157).
			818.4	
XXX	686.0	25873.3		Center of intersection with Guyotte Road; rock exposed in ditches on both sides of road 400 feet north.
			369.6	
XXXI	682.4	26242.9		East edge of road directly west of telephone pole L1-121.
			1085.7	
XXXII	674.6	27328.6		Edge of road 1 foot west of mailbox of Frank J. Oliver and Fred Hull (No. 4662).
			1227.6	
XXXIII	667.4	28556.2		Edge of road 1 foot west of mailbox of Wm. Grace (No. 4492).
			429.0	
XXXIV	662.7	28985.2		Edge of road 1 foot west of mailbox of W. B. Rider (No. 4288).
			1861.2	
XXXV	662.0	30846.4		Top of north rail at intersection with Detroit & Mackinac Railroad.
			359.7	
XXXVI	659.2	31206.1		Center of junction with Truckey Road.

End of traverse. At this point, French and Truckey Roads join to continue southeast parallel to the tracks of the Detroit & Mackinac Railroad to the junction with US 23. This section of road is variously known as French Road, Truckey Road, or French-Truckey Road.



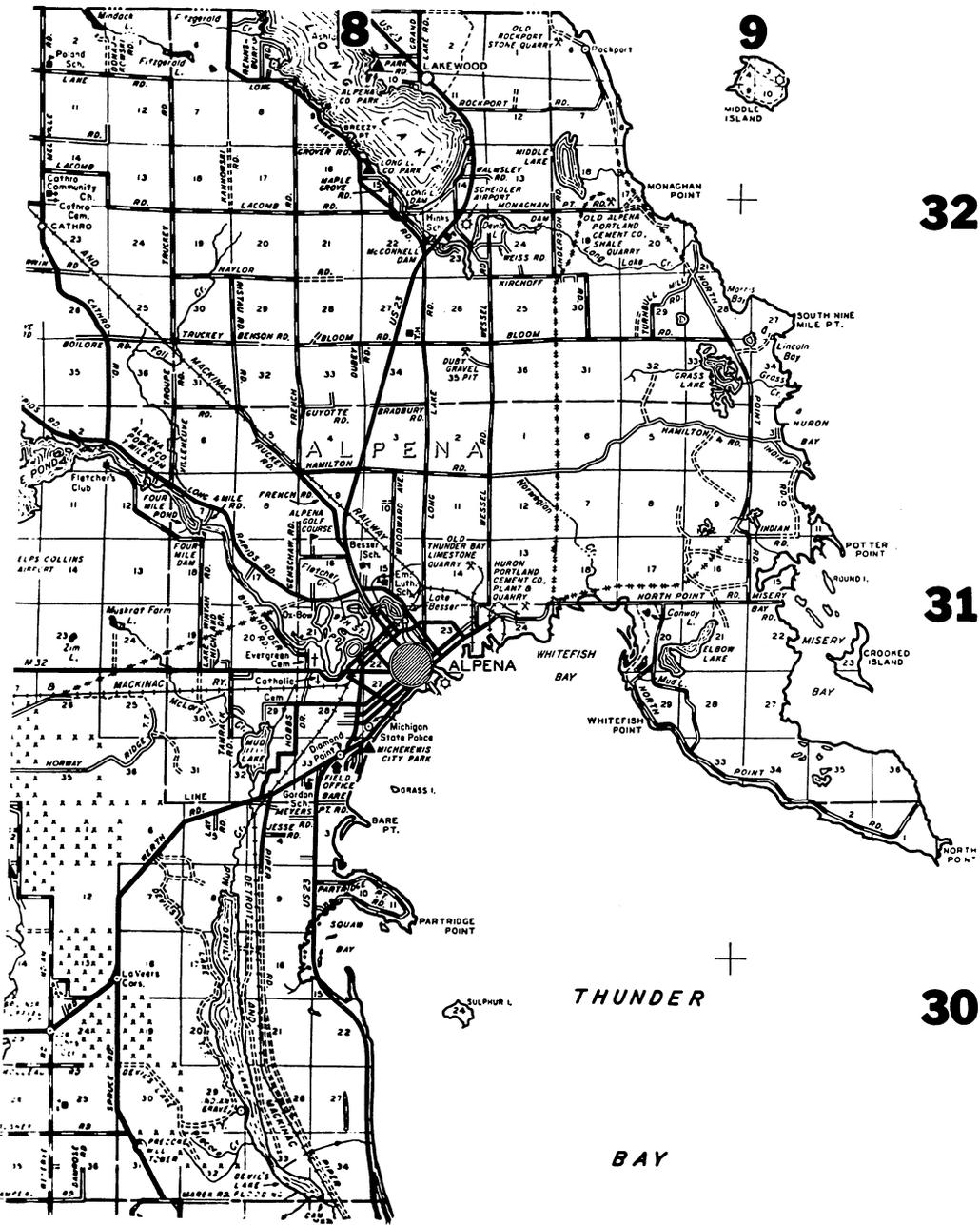
TEXT-FIG. 1 - Topographic and geologic section along French Road, Alpena County, Michigan. Roman numerals refer to surveyed points; arrows are directed toward surface contacts of stratigraphic units; and short parallel lines indicate road crossings and junctions.

OUTCROPS ALONG FRENCH ROAD

Localities in this list are identified by land survey reference in which each locality is identified by four elements: number of the Township North, number of the Range East, number of the township, and quadrants of quadrants (etc.) within the township.

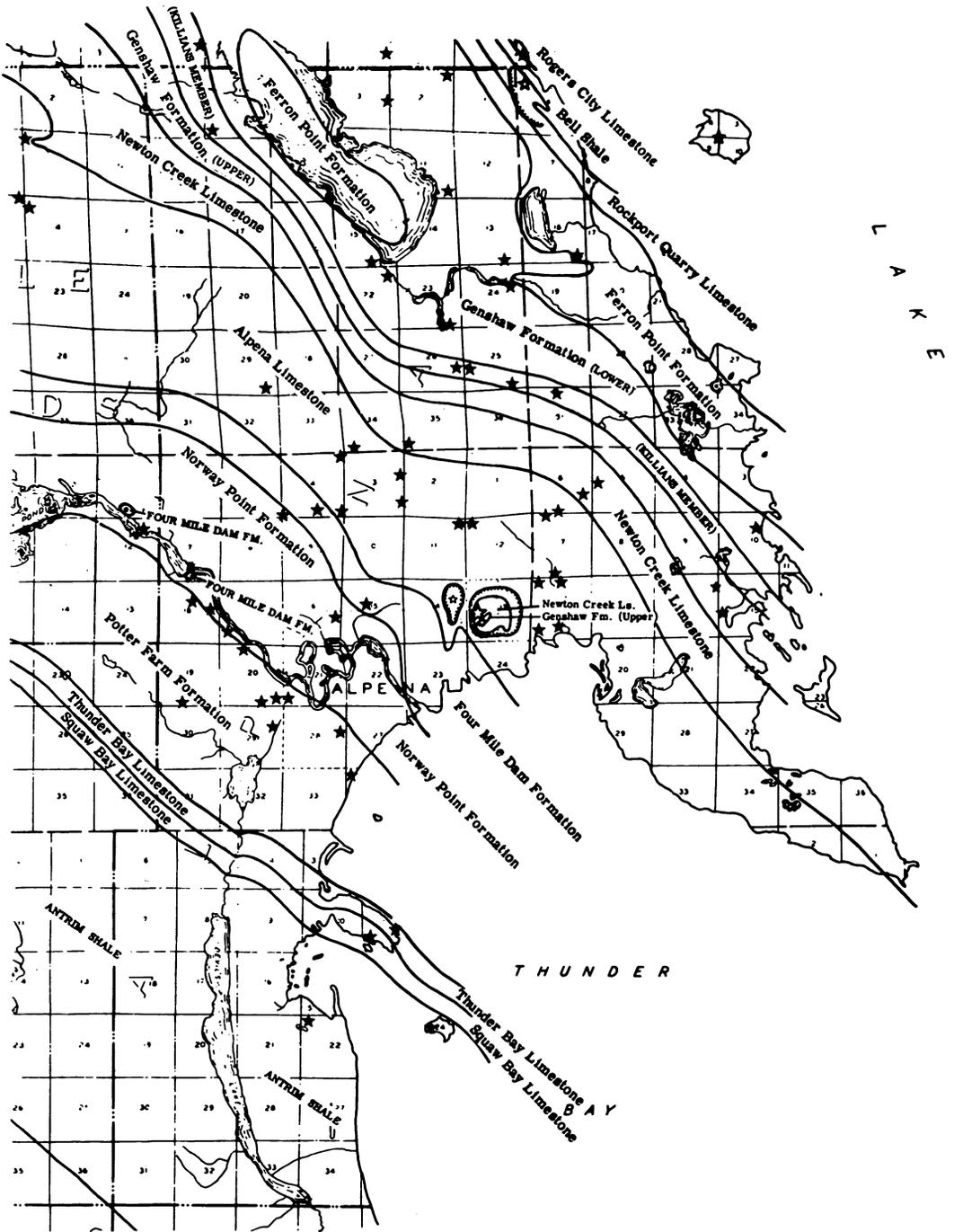
1. 32-8-8 NE NE / 32-8-9 NW NW: southwest shoulder of junction with West Long Lake Road (Station I) and small area on southeast shoulder, buff limestone weathering light brown,

- containing many brachiopods including large spiriferids, *Atrypa*, and *Sieberella romingeri* – Lower Member of Genshaw Formation.
2. 32-8-8 NE SE SE NE: Station IV, west shoulder of road about 1400 feet south of West Long Lake Road, limestone containing typical brachiopod fauna and a few corals – Lower Genshaw.
 3. 32-8-8 SE SE SE NE: west shoulder of road and ditch, starting 303 feet south of Station IV and continuing with interruptions to the south – Killians Member of Genshaw Formation (see measured section).
 4. 32-8-8 NE NE NE NE SE: Station VI, west shoulder of road and ditch, good exposure – Killians Member.
 5. 32-8-8 NE NE NE NE SE: along ditch and in ledge on west side of road between Stations VI and VII – Killians Member.
 6. 32-8-8 SE NE NE SE: scabby outcrops and boulders of siliceous black limestone west of road, ending about 235 feet south of Station VII – Killians Member, last occurrence of Killians rocks. Presumed contact with Upper Member of Genshaw Formation 100 feet farther south (3226 feet south of Long Lake).
 7. 32-8-8 S SE NE NE SE: low escarpment of gray limestone weathering brown, containing crinoid columnals, *Favosites*, and some brachiopods, exposed in woods west of road about 200 feet south of the above exposure – Upper Member of Genshaw Formation.
 8. 32-8-8 NE NE SE SE: rock pavement exposed in knoll in road 75 feet south of Station VIII – Upper Member of Genshaw Formation.
 9. 32-8-8 SE SE SE SE / 32-8-17 NE NE NE NE: rock pavement on west side of road at Station IX, aligned with center of Grover Road (gravel road leading east) – Upper Member of Genshaw Formation.
 10. 32-8-17 NE SE NE NE: rocks from adjacent fields piled along fence at Station X, containing numerous pieces of dark unfossiliferous limestone giving petroliferous odor when struck by hammer – Newton Creek Limestone/Genshaw Formation contact placed here.
 11. 32-8-16 SW SW SW SW: gravel pit near northeast corner of intersection with Lacombe Road (Station XIV), numerous fragments and possibly outcrop of brown crystalline limestone barren of fossils and giving strong petroliferous odor when struck by hammer – Newton Creek Limestone.
 12. 32-8-21 NW SW NW NW: field exposures on both sides of access road 35 feet south and 10 feet east of Station XV, fragments of gray limestone containing a variety of brachiopods, bivalves, and gastropods and one long straight cephalopod – Alpena Limestone, presumed to be near base of the formation. Alpena/Newton Creek contact arbitrarily placed 200 feet south of Lacombe Road.
 13. 32-8-21 SW SW NW SW: Station XVIII, west side of road 1630 feet north of Naylor road, weathered rubbly rock in ditch – Alpena Limestone.
 14. 32-8-29 SE NE NE NE: rock pavement in road about 100 feet south of Station XX – Alpena Limestone.
 15. 32-8-28 NW SW SW NW: Station XXII, limestone in bed of road about 4 feet west from east edge of road – Alpena Limestone.
 16. 32-8-28 SW NW SW / NW NW SW SW: rock ledge along ditch on east side of road extending south from Station XXIII most of the way to Station XXIV – Alpena Limestone.
 17. 32-8-28 SW SW SW: Station XXV, rock pavement on northeast corner of intersection with Bloom Road – Alpena Limestone.
 18. 32-8-32 NE NE NE SE / 33 NW NW NW SW: exposures in ditches on both sides of road 547 feet south of Station XXVIII, weathered gray limestone with numerous crinoidal remains – Alpena Limestone.



TEXT-FIG. 2 – Cultural map of eastern part of Alpena County, Michigan. Heavy numerals indicate Townships North and Ranges East.

19. 32-8-32 NE SE SE SE / 33 NW SW SW SW: rock exposed in ditches on both sides of road about 400 feet north of Station XXX (Guyotte Road intersection), gray coarse-grained limestone containing cup corals, *Hexagonaria*, crinoids, occasional brachiopods, *Favosites*, and a large bivalve – Alpena Limestone.



TEXT-FIG. 3 – Geologic map of eastern part of Alpena County, Michigan. Stars indicate significant outcrops. (See Ehlers and Kesling, 1970, for locality descriptions.)

20. 31-8-5 E NE NE: rock exposed intermittently in ditch on west side of road from Station XXX (Guyotte Road intersection) south for a distance of 800 feet (past Station XXXI), dark-gray, finely crystalline, thin-bedded limestone with black shale partings – Alpena Limestone, exposures presumed to end near contact with Four Mile Dam Formation.
21. 31-8-4 SW NW NW SW: pavement for distance of 10 feet in ditch on east side of road about 60 feet south of Station XXXIV, about 1800 feet north of Detroit & Mackinac Railroad crossing, gray limestone containing a few conodonts – probably Four Mile Dam Formation.
22. 31-8-4 W SW SW SW: nearly continuous exposures on east side of road from about 200 feet north of Station XXXV (railroad crossing) south to Hamilton Road with extensive exposures at northeast corner of intersection with Hamilton Road, limestone with fossils silicified at soil contact including numerous specimens of *Camarotoechia*, rhynchonellid brachiopods, and other fossils common to the formation – Norway Point Formation. Norway Point/Four Mile Dam contact placed arbitrarily 200 feet north of crossing.
23. 31-8-9 NW NW: exposures on northeast side of road just southeast of its junction with Truckey Road and just south of its junction with Hamilton Road (French-Truckey Road there parallel to Detroit & Mackinac Railroad tracks), limestone with silicified fossils at soil contact – Norway Point Formation.

EXPOSURES NEAR FRENCH ROAD

The following exposures within two miles of French Road aid in establishing the strike of the strata.

1. 32-805 SW SW: road cut on West Long Lake Road (County Road 634) about 1 mile west of its junction with French Road – Killians Member of Genshaw Formation.
2. 32-8-15 S: ditches along Maple Grove Road just north of its junction with West Long Lake Road (along one of the abandoned routes of the latter), buff limestone containing *Billingsastrea pauciseptata* and *Sieberella romingeri* – Lower Member of Genshaw Formation.
3. 32-8-20 S / 29 N: rock pavement in Naylor Road about ½ mile west of French Road, forming low escarpment, brown thin-bedded limestone containing corals, stromatoporoids, and crinoid remains, possibly a reef – Alpena Limestone.
4. 32-8-22 NE: ditches along West Long Lake Road not far west of its junction with US 23, buff to brown limestone containing large *Atrypa*, *Sieberella romingeri*, and large spiriferid brachiopods; also thrown out when basements were dug for nearby small houses around 1960 – Lower Member of Genshaw Formation.
5. 32-8-29 S SE: large area of reef limestone exposed on old Leon Manville farm (now owned by Ray Cousineau), west and north of junction of Bloom Road and French Road – Alpena Limestone.
6. 32-8-29/30: along Truckey Road south of Naylor Road (2 miles west of French Road), many indications of reefs – Alpena Limestone.
7. 32-8-34 S SW: road cut and field exposures along US 23 near Bradbury Road, about ¾ miles north of Chisholm Street bridge in Alpena, limestone reef – Alpena Limestone.
8. 31-8-3 SW: west side of Long Lake Road ¼ mile north of Hamilton Road and 2 miles north of Detroit & Mackinac Railroad yards (at northern edge of Alpena), limestone bioherm – Alpena Limestone.
9. 31-8-3 SE NE: exposure on west side of Long Lake Road between Hamilton and Bradbury Roads – Alpena Limestone.

10. 31-8-4 NE NE NE: exposure near corner of section at west end of Bradbury Road, limestone reef – Alpena Limestone.
11. 31-8-4 SE SE: road cut on US 23 near Hamilton Road, 2½ miles north of Chisholm Street bridge in Alpena, reef and flank beds – Alpena Limestone.
12. 31-8-4 S SE SE: road leading north from Hamilton Road 600 feet west of US 23 (cut in 1970), weathered fossiliferous limestone at junction and extending a short distance north, possibly the core of a reef – Alpena Limestone.
13. 31-8-4 SW SW SE: road leading north from Hamilton Road about 0.6 mile east of French Road (cut in 1970), rock exposed in ditches on both sides of new road 0.1 mile north from intersection with Hamilton Road, soft shale containing crinoid plates and fragments (*Dolatocrinus*) and the brachiopod *Callipleura nobilis* – Dock Street Clay Member of Four Mile Dam Formation.
14. 31-8-15 SE NW: site of projected quarry and kiln of Foxton brothers, south of Detroit & Mackinac Railroad tracks and ¾ mile northwest of train yards, less than one mile southeast of southern end of French Road (at its junction with US 23) – Alpena Limestone and Dock Street Clay Member of Four Mile Dam Formation.
15. 31-8-16 SE: exposures in roadside ditches along US 23 and on properties of the Presbyterian Church, Fletcher Motel, and Grove Tavern, north of Long Rapids Road and west of US 23 – Norway Point Formation.

MEASURED SECTION OF KILLIANS MEMBER

The Killians Member of the Genshaw Formation is a conspicuous dark series of interbedded siliceous limestones and shales which form a low cuesta because of their resistance to weathering. Along French Road between West Long Lake Road and Grover Road are numerous exposures of the Killians Member. Nearly continuous section extends from the base exposed 2393 feet south of Long Lake at elevation 703 feet to the residence of C. H. Crawford (Station VII in traverse) 2891 feet south of Long Lake at elevation 726 feet:

<u>Unit</u>	<u>Ft.</u>	<u>In.</u>
14 Soil cover and black limestone with white corals	3	0
13 Limestone, black, with 2-inch shale layer 6 inches from the top, corals and brachiopods conspicuous – <i>Favosites</i> , <i>Strophodonta</i> , and fish fragments	1	8
12 Shale, black	1	0
11 Limestone, black, with 3-inch shale seam in middle <i>Favosites</i> and crinoid columnals	1	5
10 Shale, black	0	6
9 Limestone, black, large <i>Hexagonaria</i> and <i>Favosites</i>	1	0
8 Shale, black	1	3
7 Limestone, dark gray	1	5
6 Shale, black	1	1
5 Limestone, dark gray to black	1	2
4 Shale, black, fossiliferous with numerous large white <i>Mucrospirifer</i> ; other brachiopods include <i>Cyrtina</i> , <i>Strophodonta</i> , and <i>Atrypa</i>	5	4
3 Covered. Slump area along escarpment to north	5	4
2 Limestone, dark gray to black, crystalline, fossils throughout but only numerous in basal 3 inches	2	2
1 Shale, black, numerous white <i>Mucrospirifer</i> , some <i>Cyrtina</i> , and an assortment of other large and small fossils	<u>5</u>	<u>4</u>
Thickness	31	8

FORMATION THICKNESSES

Lower Member of Genshaw Formation.— In line with French Road, the contact of the Genshaw with the underlying Ferron Point Formation is presumed to lie between the south shore of Long Lake and West Long Lake Road, closer to the former. It is here arbitrarily placed 200 feet south of the shore at an elevation of 650 feet. The contact of this member with the overlying Killians Member lies 2194 feet farther south at an elevation of 703 feet. Thus, if the beds were horizontal, the member would be 53 feet thick. This figure is very little more than the 51½ feet reported by Warthin and Cooper (1943, p. 58), based on a composite section from exposures in the abandoned Alpena Portland Cement Company shale pit off Monaghan Point Road (32-9-18 SE), along Long Lake Road (32-8-22 NE), and along French Road (32-8-8 NE). Because we believe the strata dip at least slightly toward the south at this place, we have arbitrarily placed the thickness at 54 feet.

Killians Member of Genshaw Formation.— The measured section along French Road recorded here amounts to 31 feet 8 inches. It terminates before reaching the Upper Member. The last good exposure is at Station VII (residence of Ch. Crawford). For the next 235 feet to the south, there are black limestone boulders presumed to be within the outcrop belt of the Killians. A total thickness of 35 feet seems reasonable.

Upper Member of Genshaw Formation.— The thickness of 35 feet reported by Warthin and Cooper (1943, p. 58) for this member in the Huron Portland Cement Company Quarry in Alpena is accepted as the thickness along French Road. The two localities are about 7 miles apart.

Newton Creek Limestone.— Even at the type locality in the Huron Portland Cement Company Quarry, this lagoonal limestone can be seen to vary in thickness. The thickness of 25 feet reported by Ehlers and Kesling (1970, p. 70) is used here.

Alpena Limestone.— The thickness of 79 feet measured by Ehlers and Kesling (1970, p. 72, 75) in the Huron Portland Cement Company Quarry is accepted here.

Four Mile Dam Limestone.— The thickness of the formation (including the basal Dock Street Clay Member) where reefs are absent was computed by Ehlers and Kesling (1970, p. 83) to be 21 feet. This figure is used here.

With these thicknesses of the Newton Creek, Alpena, and Four Mile Dam formations, the change in dip is gradual and consistent.

DIPS

In the table (p. 167), the dips are first computed as the components in the direction of French Road (due south or within a few degrees of south). The strike direction is about N 40° W – S 40° E and the dip is S 50° W in this strip as shown in the map of the area by Ehlers and Kesling (1970, p. 121). Using this dip direction, the southerly components of dip are translated into the full amount of dip by trigonometry.

In the map of the Alpena area (see Ehlers and Kesling, op cit.), the basal contact of the Ferron Point Formation reaches Lake Huron in 32-9-34 NE NW at Lincoln Bay, and the upper contact of the Potter Farm Formation reaches Lake Huron in 30-8-3 NE SW at Thunder Bay just north of Partridge Point. These two-points, nearly aligned in the direction of dip, are 10¼ miles apart. Thus, the average dip through this section of the Traverse Group, about ten miles east of French Road, is about 43 feet per mile.

As shown in the table (p. 167), the dips of the formations exposed along French Road vary, approximating the variations shown along a north-south section two miles east of French Road by

Ehlers and Kesling (1970, text-fig. 3) in being steeper through the resistant Killians Member of the Genshaw Formation. The essentially flat-lying Lower Member of the Genshaw just south of Long Lake is succeeded by the steeper inclined Killians Member (averaging 99 feet/mile), then the Upper Member of the Genshaw becomes gently dipping again (22 feet/mile), and succeeding higher formations gradually dip more steeply (66 to 79 feet/mile). The average of strata exposed along French Road between the Ferron Point and Norway Point formations is 64 feet/mile.

LITERATURE CITED

- EHLERS, G. M., and R. V. KESLING. 1970. Devonian strata of Alpena and Presque Isle Counties, Michigan: Mich. Basin Geol. Soc., Guidebooks for Field Trips (in connection with North-central Section of Geol. Soc. Amer.), p. 1-130, 38 pls., 4 text-figs., 11 maps. [Also separately reprinted with new cover by Museum of Paleontology, The University of Michigan.]
- WARTHIN, A. S., Jr., and G. A. COOPER. 1943. Traverse rocks of Thunder Bay region, Michigan: Bull. Amer. Assoc. Petrol. Geologists, v. 27, no. 5, p. 571-595, 8 figs.