STATE OF OHIO
DEPARTMENT OF NATURAL RESOURCES
DIVISION OF GEOLOGICAL SURVEY
Horace R. Collins, Chief

Report of Investigations No. 78

MIDDLE DEVONIAN FORMATIONS IN THE SUBSURFACE OF NORTHWESTERN OHIO

by

A. Janssens

Columbus

1970

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GEOLOGY SERVES OHIO

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MIDDLE DEVONIAN FORMATIONS IN THE SUBSURFACE OF NORTHWESTERN OHIO

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INTRODUCTION

Middle Devonian rocks ranging stratigraphically from the Sylvania Sandstone to the Tenmile Creek Dolomite (fig. 1) are present in an eight-county area in northwestern Ohio. The area of investigation includes Williams, Defiance, Fulton, and Henry Counties, and parts of Lucas, Paulding, Wood, and Putnam Counties. These rocks, bounded below by Silurian carbonates and above by the Ohio [Antrim] Shale, occupy part of the southern rim of the Michigan Basin. In post-Devonian time they acquired a regional dip of between 15 and 20 feet per mile toward the basin and were subsequently bevelled by erosion (figs. 2 and 3). As a result, the rocks discussed in this report lie directly below glacial deposits in a relatively narrow outcrop belt, with a few quarry exposures in Lucas, Wood, and Paulding Counties.

Although there have been extensive investigations of the outcrop, primarily in Lucas County, there are no published studies of the subsurface occurrence of these rocks in northwestern Ohio. The present report fills this gap and complements studies in southeastern Michigan and northern Indiana.

This study shows that the Sylvania Sandstone has a very restricted areal distribution in northwestern Ohio and probably reflects the position of an early Middle Devonian shoreline. It has also been found that the lower Dundee of the outcrop in Lucas County thins westward and is absent in the westernmost part of the report area. The lower part of the upper Dundee of the outcrop in Lucas County undergoes a facies change and becomes a lithographic limestone a short distance west of the outcrop. In Williams County the two members of the Traverse Group of northwestern Ohio, the Silica Formation and the Tenmile Creek Dolomite in ascending order, can no longer be differentiated and the name Traverse Formation is proposed for the undifferentiated rocks in that area.

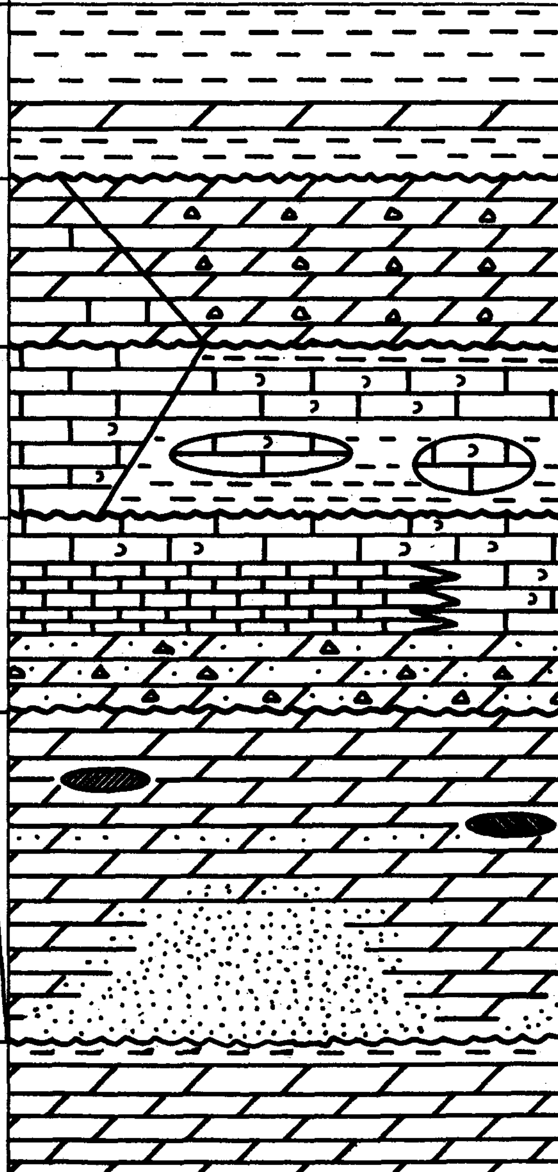
PREVIOUS INVESTIGATIONS

The earliest systematic investigations were published as county reports. Gilbert (1873, p. 573-577), in his report on Lucas County, listed in ascending order Oriskany Sandstone, Corniferous Limestone, and Hamilton Group as outcropping units. His Oriskany was later named the Sylvania Sandstone by Orton (1888). The Corniferous comprised a section extending from the top of the Sylvania to the top of the Silica Formation as then exposed. The Hamilton Group, not seen in outcrop by Gilbert, was believed "to be represented by a bed of soft gray shale, outcropping in a narrow band along the edge of the Huron shale." This seems to indicate that his Hamilton was made up of rocks now included in the Silica, and that the Tenmile Creek was concealed.

Why the sandstone below the Corniferous was correlated with the Oriskany was not indicated, although almost certainly the reason was its stratigraphic position.

The outcropping Middle Devonian rocks in the remainder of northwestern Ohio were described by Winchell (1874). In a generalized section of rocks of Paulding and Defiance Counties (p. 342) he gave the following descriptions, to which the present writer's interpretations have been added on the right:

1. Black slate (Huron shale of the Ohio reports)	Ohio [Antrim] Shale
2. Bluish shale (Olentangy of Delaware County)	Silica Formation
3. Blue and blackish limestone; hard and siliceous (Tully limestone of New York)	
4. Blue limestone; the whole, including the lowest observed part, holds Hamilton fossils (Hamilton limestone of New York)	



System	Group	Formation	Stratigraphic thickness (ft)	Description
Upper Devonian		Ohio Shale	300+	Shale, black and dark-brown; basal 30 feet interbedded with minor dense dark-brown dolomite, referred to the "Traverse Formation" in Michigan
Middle Devonian	Traverse Group	Tenmile Creek Dolomite	18 - 54	Dolomite, light-yellowish-gray to very light-yellowish-brown, dense to medium crystalline; containing abundant white chert; referred to the "Traverse Limestone" in Michigan
Middle Devonian	Traverse Group	Silica Formation	10 - 54	Limestone, grayish-brown, fine- to coarse-grained, argillaceous, fossiliferous, interbedded with calcareous fossiliferous bluish- and brownish-gray shale. Toward the northwest Silica and Tenmile Creek cannot be differentiated and comprise the TRAVERSE FORMATION
Middle Devonian		Dundee Limestone	25 - 108	Divided into upper and lower parts. Upper part limestone, light-yellowish-gray to medium-brown, medium- and coarse-grained, fossiliferous; basal upper Dundee grading westward into lithographic limestone. Lower Dundee dolomite and limestone, light-grayish-brown, finely and medium crystalline, sucrosic, sandy; containing white and light-brown chert
Middle Devonian	Detroit River Group	undifferentiated	24 - 175	Dolomite, gray and brown, microcrystalline, laminated; with nodular anhydrite and gypsum
Middle Devonian	Detroit River Group	Sylvania Sandstone	0 - 50	Sandstone, fine- and medium-grained, friable
Upper Silurian		Raisin River Dolomite	base not examined	Dolomite, gray and brown, microcrystalline, argillaceous in part; thin green shale on top

FIGURE 1.—Generalized section of Middle Devonian rocks of northwestern Ohio.

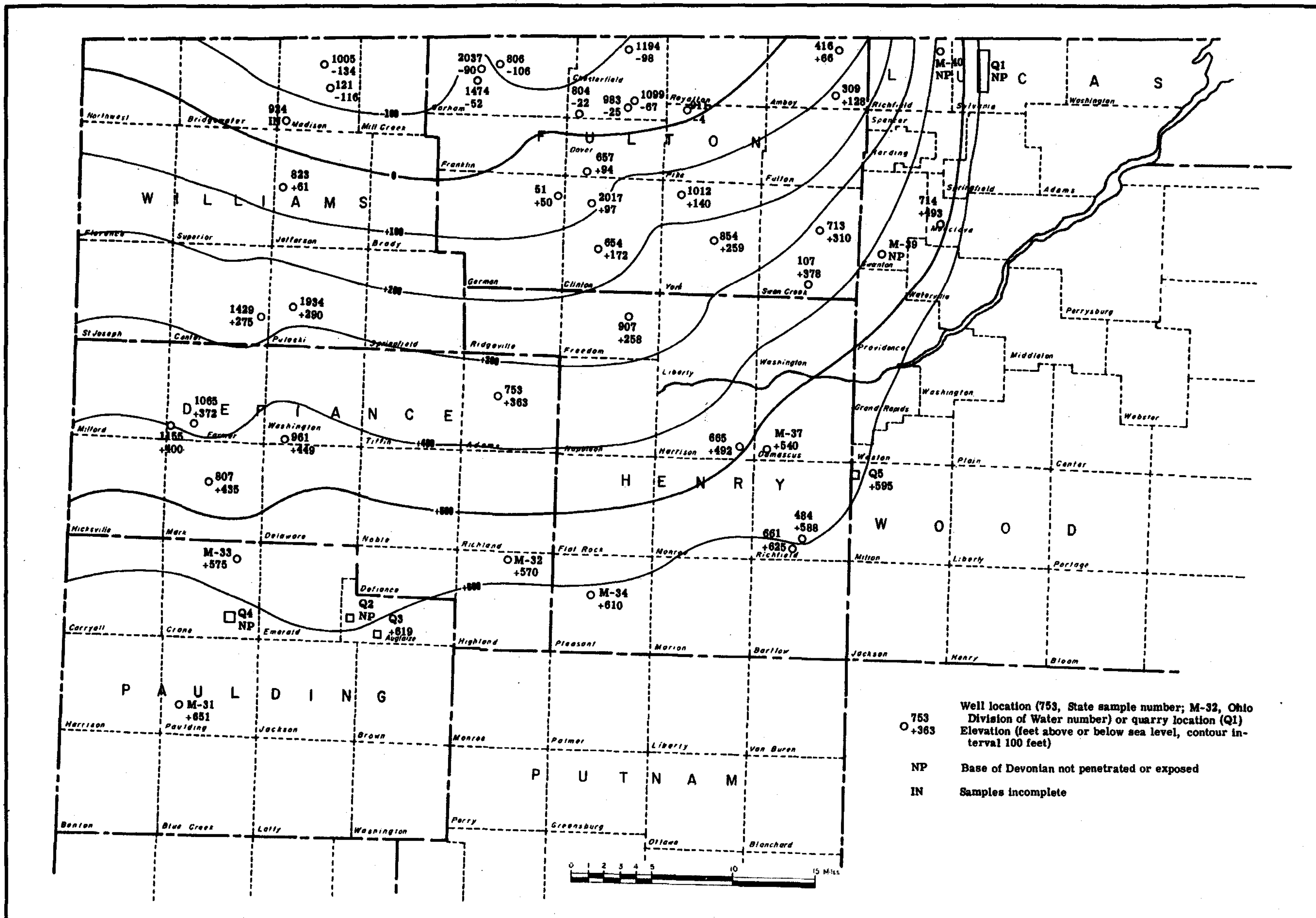


FIGURE 2.—Structure on top of Silurian rocks.

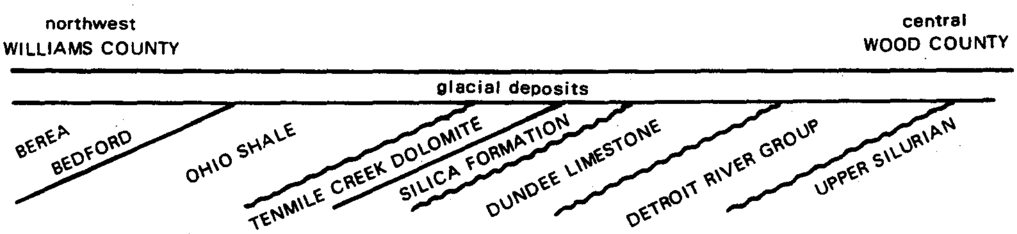


FIGURE 3.—Sketch showing regional dip of formations in northwestern Ohio.

5. Saccharoidal, very fossiliferous limestone (Delhi beds of Delaware County; Corniferous limestone of New York)	Dundee Limestone (upper)
6. Buff, magnesian limestone; the upper half is thin-bedded (Onondaga limestone of New York)	Detroit River Group
7. Quartzose sandstone; conglomeratic in Delaware County (Oriskany of New York)	Sylvania Sandstone

Exposures then, as now, were very sparse and it is probable that Winchell saw no outcropping Tenmile Creek Dolomite.

The limestone in his unit 5, correlated with the Delhi beds of Delaware County, Ohio, is without doubt the upper Dundee of northwestern Ohio. The Delhi beds of Delaware County are now considered the upper part of the Columbus Limestone. Winchell's correlation of the Dundee with the Columbus was followed by Ohio geologists until Ehlers (1945, p. 112; Ehlers and others, 1951) showed on the basis of fauna that the Dundee is the equivalent of the Delaware Limestone of central Ohio and thus younger than the Columbus.

In his discussion of Wood County, Winchell (1874, p. 379-383) referred to a section near Grand Rapids along the Maumee River where 5 feet of "Waterlime" (Upper Silurian dolomite) was exposed beneath 10 to 12 feet of sandstone or arenaceous limestone (Winchell's Oriskany). Carman (unpublished manuscript) observed that Winchell in this section mistook sandy and sucrosic limestone or dolomite of the lower Dundee for Sylvania, in part perhaps because local people applied the term sandstone to Dundee of this lithology, and that this miscorrelation accounts for the peculiar map pattern of the "Oriskany" on Winchell's geologic map (1874, opposite p. 368). It is interesting to note that Winchell identified Detroit River rocks underlying the lower Dundee as "Waterlime" rocks of Silurian age, a fact that suggests lithologic similarity between the two.

In the Pugh quarry in Wood County, Winchell (1874, p. 383) found 1 foot of very fossiliferous limestone overlying 3 feet of unfossiliferous magnesian limestone. The quarry has been deepened and now exposes 28 feet of lower Dundee, 53 feet of Detroit River dolomite, and 2 feet of Sylvania Sandstone.

The entire Middle Devonian outcrop was studied by Stauffer (1909). Stauffer distinguished, in ascending order, the Columbus [Dundee] Limestone and the Traverse Formation. The base of his section was the contact between the Columbus [Dundee] and the underlying Lucas Dolomite [Detroit River Group], which at the time was considered to be Silurian. In describing the Columbus [Dundee] of northwestern Ohio Stauffer remarked (1909, p. 144): "The Columbus consists of the usual fossiliferous gray limestone which passes downward into sparingly fossiliferous brown limestone resembling the lower part of the same formation in central Ohio." The apparent lithologic similarity, earlier noted by Winchell, between this limestone in northwestern Ohio and the Columbus in central Ohio was thus also observed by Stauffer. The sandy lower Dundee beds near Grand Rapids, earlier mistaken by Winchell for Oriskany [Sylvania], were correctly identified by Stauffer (1909, p. 152).

Probably the most extensive knowledge of the Devonian rocks was acquired by the late Dr. J. Ernest Carman in Lucas County over a period of more than 30 years, but the results of his work are unpublished.

Several regional subsurface studies of the section described in this report have been made in the southern peninsula of Michigan. Landes has reported on the Sylvania Sandstone (1945) and on the Detroit River Group (1951). The Dundee and overlying Rogers City formations were studied by Cohee and Underwood (1945), and the Traverse Group was studied by Cohee (1947). The sedimentary history of the Detroit River rocks of the Michigan Basin was analyzed by Briggs (1959).

The Detroit River rocks in the subsurface of northern Indiana were studied by Doheny (1967). Doheny, Pinsak and Shaver (1964), and Rooney and French (1968) did not recognize the Dundee in northern Indiana. Instead, they included the rocks in that stratigraphic position in the Detroit River.

STUDY METHODS

This report is based primarily on examination of well samples. The well sample study was supplemented with information from two quarries in Wood and Paulding Counties. The quarry in Wood County bottoms in the Sylvania Sandstone; the lowest exposed bed in the quarry in Paulding County lies approximately 1 foot below the base of the Devonian.

Where possible the samples have been correlated with gamma ray-neutron logs. These logs permit an accurate identification of the top of the Tenmile Creek Dolomite and in many cases the top and base of the Silica Formation. The logs can also be used to draw the base of the Detroit River Group where this unit is underlain by shale or argillaceous dolomite.

Well and quarry data are listed in tables 1 and 2. Formation thicknesses in the quarries in Lucas County are those given by Ehlers and others (1951). Sample descriptions and quarry sections are shown in the appendix.

TABLE 1.—*Well data*

County	Township	Section	Permit no.	Sample and map no.	Operator	Well no.	Lease name	Elevation*
Defiance	Adams	16	4-A	753	Archbold	1	Harper	745 GL
	Farmer	29	31	1065	Wand	1	Saltzman	752 KB
	Farmer	31	32	1155	Rovell	1	Smith	780 T
	Highland	3	--	M-32	Water well			743 GL
	Mark	9	15	807	Brown	1	Smucker	726 T
	Washington	32	20	961	Maumee Valley	1	Boland	715 T
Fulton	Amboy	11	--	416	Ohio Drilling	--	Metamora	726 GL
	Amboy	26	1-A	309	Stevens	1	Assumption	728 GL
	Chesterfield	10	22	1194	North American	1	Deyo	815 KB
	Chesterfield	26	21	1099	American Liberty	1	Jones	813 KB
	Chesterfield	31	13	804	McClure	1	Keefer	732 KB
	Chesterfield	34	19	983	Covey & Null	1	Tuggle	797 DF
	Clinton	17	35	2017	Rock Castle & Turrill	1	Vonier	765 DF
	Clinton	33	26-A	654	Grim	1-B	Murphy	766 GL
	Dover	5S	1	657	Stevens	1	Vonier	765 GL
	German	13	29-A	51	Stevens	1	Roth	710 GL
	Gorham	17	14	806	McClure	1	Thomas	788 DF
	Gorham	19	36	2037	McClure	1	Erbskorn	810 DF
	Gorham	19	24	1474	McClure	1	Gamble	820 DF
	Pike	32N	16	911	Dunn	1	Kirkendall	771 KB
	Swan Creek	10S	33-A	107	Stevens and others	1	Baker	678 GL
	Swan Creek	22	12	713	Ohio Oil	1	Munn	680 GL
	York	8N	18	1012	Covey & Null	1	Neuswander	758 DF
	York	27	15	854	Wehmeyer	1	Brinkman	720 KB
Henry	Damascus	32	--	M-37	Water well			680 GL
	Freedom	23	20	907	Lesh	1	Badenhop	718 KB
	Harrison	36	2	665	Stevens	1	Nagel	682 GL
	Pleasant	16	--	M-34	Water well			725 GL
	Richfield	27	9	484	Parkinson	1	Smith	695 T
	Richfield	33	12	661	Murdock	1	Schultz	693 T
Lucas	Monclova	23	25	714	Ohio Oil	1	Mohring	663 GL
	Richfield	11	--	M-40	Water well			680 GL
	Swanton	32	--	M-39	Water well			665 GL
Paulding	Crane	2	--	M-33	Water well			690 GL
	Paulding	29	--	M-31	Water well			730 GL
Williams	Center	25	37	1429	Tamp	1	Wineland	735 T
	Jefferson	18	28	823	McClure	1	Kaspar	889 DF
	Madison	5	30	924	McClure	1	Barnhart	868 DF
	Madison	15	31	1005	Mohawk	1	Grimm	876 GL
	Madison	26	--	121	Ro-Kin-Da	1	Hendricks	889 T
	Pulaski	20	43	1934	Eastern	1	Sinn	735 GL

*DF = Derrick floor GL = Ground level KB = Kelly bushing T = Topographic

TABLE 2.—*Quarry data*

County	Township	Section	Map no.	Quarry company
Lucas	Sylvania	7, 18	Q1	Medusa Portland Cement Co.
	Sylvania	17, 20	Q1	Toledo Stone & Glass Co.
Paulding	Auglaize	25W	Q2	Abandoned
	Auglaize	32	Q3	Maumee Stone Co.
	Crane	26	Q4	Peninsular Portland Cement Co.
Wood	Milton	6	Q5	Pugh Quarry Co.

DETROIT RIVER GROUP

The name Detroit River series was proposed by Lane and others (1909) for rocks lying between the Sylvania Sandstone and the Dundee Limestone in the vicinity of the Detroit River near Detroit and in adjacent Ontario. This sequence formed the upper part of the rocks earlier named Monroe by Lane (*in* Wadsworth, 1893, p. 66) and was the same section Prosser (1903, p. 540-541) had proposed calling Lucas Dolomite.

In the original definition the Detroit River series comprised in ascending order the Flat Rock, Anderdon, Amherstburg, and Lucas Dolomites. As shown by Ehlers (1950) and Ehlers and others (1951), the definition was in error, in large part owing to the postulation by Sherzer and Grabau (1909) that a syncline was present in the type section. At the time Sherzer and Grabau were studying the geology of the Detroit River area two quarries on opposite sides of the river, the Sibley quarry in Michigan and the Anderdon quarry in Ontario, showed Dundee overlying Anderdon. However, these authors believed that the Lucas and Amherstburg were present in the channel of the river, and to explain these relations, they postulated that after deposition of the Lucas the land emerged, the Detroit River strata were folded into a syncline, and sufficient erosion occurred to remove the Lucas and Amherstburg from the quarry areas prior to Dundee deposition.

According to Ehlers (1950) and Ehlers and others (1951), the Lucas and Amherstburg are present below the Anderdon in both quarries and, instead of synclinal dips, the strata have a regional northwestward dip. As a result, Ehlers (1950) established the Anderdon as the highest Detroit River unit, underlain by the Lucas and Amherstburg in that order. The beds previously assigned to the Flat Rock were included by Ehlers (1950) in the Amherstburg, and he accepted the proposal by Carman (1936) that the Sylvania become the basal Detroit River unit.

The accepted classification of the Detroit River in outcrop is:

Anderdon Limestone
Lucas Dolomite
Amherstburg Dolomite
Sylvania Sandstone

Examination of well samples from northwestern Ohio has shown that subdivision of Detroit River rocks in the subsurface is not possible beyond recognition of the Sylvania Sandstone as a separate formation. This conclusion agrees with that reached by Carman (unpublished manuscript, 1958):

> Lithologically and stratigraphically the three dolomites of the Detroit River Group might well be considered a single formation.
>
> There are no definite, sharp faunal breaks within the Detroit River succession to set off the formations. It is rather a Detroit River fauna within which changes were taking place by the coming in of new species and the disappearance of other species so that certain species by their presence or their abundance may be recognized as characteristic of or in some cases diagnostic of a formation.
>
> The writer continues here the use of the three subdivisions as a matter of convenience rather than as a recognition of prominent lithologies or faunal differences.

SYLVANIA SANDSTONE

The Sylvania Sandstone was named by Orton (1888, p. 4) for exposures near Sylvania in Lucas County, where the formation unconformably overlies Silurian rocks and underlies, with gradational contact, dolomite of the Detroit River Group. As used in this report the Sylvania consists of 50 percent or more quartz sand; the remainder of the formation in the subsurface of northwestern Ohio consists of dolomite that may be present either as the cement of the sandstone or in the form of thin sandy dolomite lenses within the sandstone body. This definition is necessary because of the gradational contact of the Sylvania with the overlying rocks.

The Sylvania in the report area consists of friable fine- and medium-grained sandstone with frosted and well-rounded quartz sand grains. The cement of the sandstone may be dolomite or silica; in most samples the grains have become disaggregated and appear as individual grains. Thin lenses of sandy light- and medium-gray dolomicrite are present in the Sylvania, as they are through the remainder of the Detroit River; however, they become less numerous and contain finer grained sand higher in the Detroit River.

Thickness of the Sylvania ranges from 0 feet to an estimated 50 feet (fig. 4). Instead of being a blanket deposit (Hatfield and others, 1968, p. 227), the Sylvania has a definite trend of maximum thickness which runs from the northwest corner of the report area east-southeast to southern Fulton County, where it swings northeastward. The continuation of this trend beyond western Sylvania Township in Lucas County is problematical, because the Sylvania and overlying Devonian rocks have been removed by post-Devonian erosion south and east of western Lucas County. It is known, however, that the Sylvania Sandstone is not present some 60 miles to the east and beyond, where Middle Devonian rocks again are present.

The distribution of the Sylvania in the report area is interpreted as showing the position of an early Middle Devonian shoreline. The continuation of this shoreline into Michigan has recently been mapped by Sanford (1967, fig. 6a). There is general agreement that an already mature sandstone such as the St. Peter in Wisconsin was recycled to provide the source for the Sylvania Sandstone in Michigan and Ohio.

The base of the Devonian rocks has been drawn at the base of the Sylvania or, where the Sylvania is absent, at the base of sandy Detroit River rocks. Below this lies a gray or brown dolomicrite or dolosiltite that is argillaceous in part. In most wells a sandy green shale averaging 1 foot in thickness lies immediately below the sandy Devonian rocks. The sand in the shale is similar to the sand in the basal Devonian. This shale is present with a thickness of about 3 feet in a core from the active quarry (Q3) in Auglaize Township, Paulding County, where it grades into the underlying Silurian rocks. Green shale was also observed by Carman (unpublished manuscript) in the now abandoned and water-filled Holland quarry in Lucas County (Carman, 1960), where it filled depressions in the Raisin River Dolomite (Upper Silurian). The depressions were circular in plan view, measured 20 to 50 feet across, and had a depth of 15 to 30 feet. Stratigraphically, the shale was bounded above by the Sylvania Sandstone. It is probable that this shale represents a weathered residual deposit of the underlying Silurian parent dolomite. If this is true, then its age may range from post-Raisin River Silurian to earliest Middle Devonian.

The contact of the Sylvania with the overlying undifferentiated Detroit River dolomite is gradational and in this report has been placed at the top of the beds in which sandstone predominates over dolomite.

UNDIFFERENTIATED DETROIT RIVER DOLOMITE

The undifferentiated Detroit River dolomite consists of light- and medium-gray, grayish-brown, and brown dolomicrite and dolosiltite; the basal portion is pelletal in a few wells. Laminated dolomite is common in well samples. The quarry sections in Paulding and Wood Counties show an abundance of laminations that in cross section are either planar or irregularly domal and probably correspond to cryptalgalaminate and domal stromatolitic structures as described by Aitken (1967). Some of these laminated beds are brecciated; by far the most conspicuous of them is exposed in the quarry in Wood County. It lies 3 feet below the Dundee Limestone, has a thickness of 3 to 4 feet, and contains angular fragments of laminated dolomite 1 foot or more in length. Pyrite and dog-tooth crystals of brown calcite are abundant in the bed, which displays cavernous holes several feet in diameter and depth. The Detroit River overlying the brecciated unit is undisturbed. The brecciation may indicate a supratidal origin of the dolomite or it may have been caused by the leaching of a soluble evaporite (salt) and subsequent collapse.

Locally the Detroit River contains thin beds, apparently without fixed stratigraphic position, of very porous finely crystalline medium-brown dolomite in which much of the porosity is the result of leaching of evaporites. Thin stringers of sandy light- and medium-gray dolomicrite are present throughout the Detroit River; the quartz sand in these thin beds is well rounded and decreases in size from medium at the base to very fine at the top.

Anhydrite and gypsum are found throughout the Detroit River in amounts that in a given sample interval may range from a trace to 50 percent. It is believed that these evaporites occur as nodules within the dolomite rather than as bedded deposits because they are not laterally persistent.

Chert in trace amounts is present in the Detroit River in 5 out of the more than 40 suites of samples examined and in the upper Detroit River exposed in the quarry (Q3) in Auglaize Township, Paulding County.

The stratigraphic thickness of the Detroit River ranges from 175 feet in the north to 24 feet in the southwest (fig. 5). The southward thinning is, in the writer's opinion, both depositional and erosional.

The contact with the Dundee Limestone is sharp and is drawn at the change from gray or brown dolomicrite or dolosilitite to sandy medium-grained or crystalline dolomite or limestone, or at the change to lithographic limestone. The contact is an unconformity and is well shown in Wood County, where fine- and medium-grained sandstone lies on the contact in lenses up to 1 inch thick and fills fractures in the underlying Detroit River. In places in the quarry rounded pebbles of Detroit River lithology lie within or immediately above the sandstone.

Although the Detroit River carbonates have not been subdivided in this report, subdivision of these rocks is not uncommon in the surrounding areas; criteria for subdivision seem to vary from author to author, however. Warthin (*in* Cooper and others, 1942, p. 1755) has observed that the various members in outcrop may

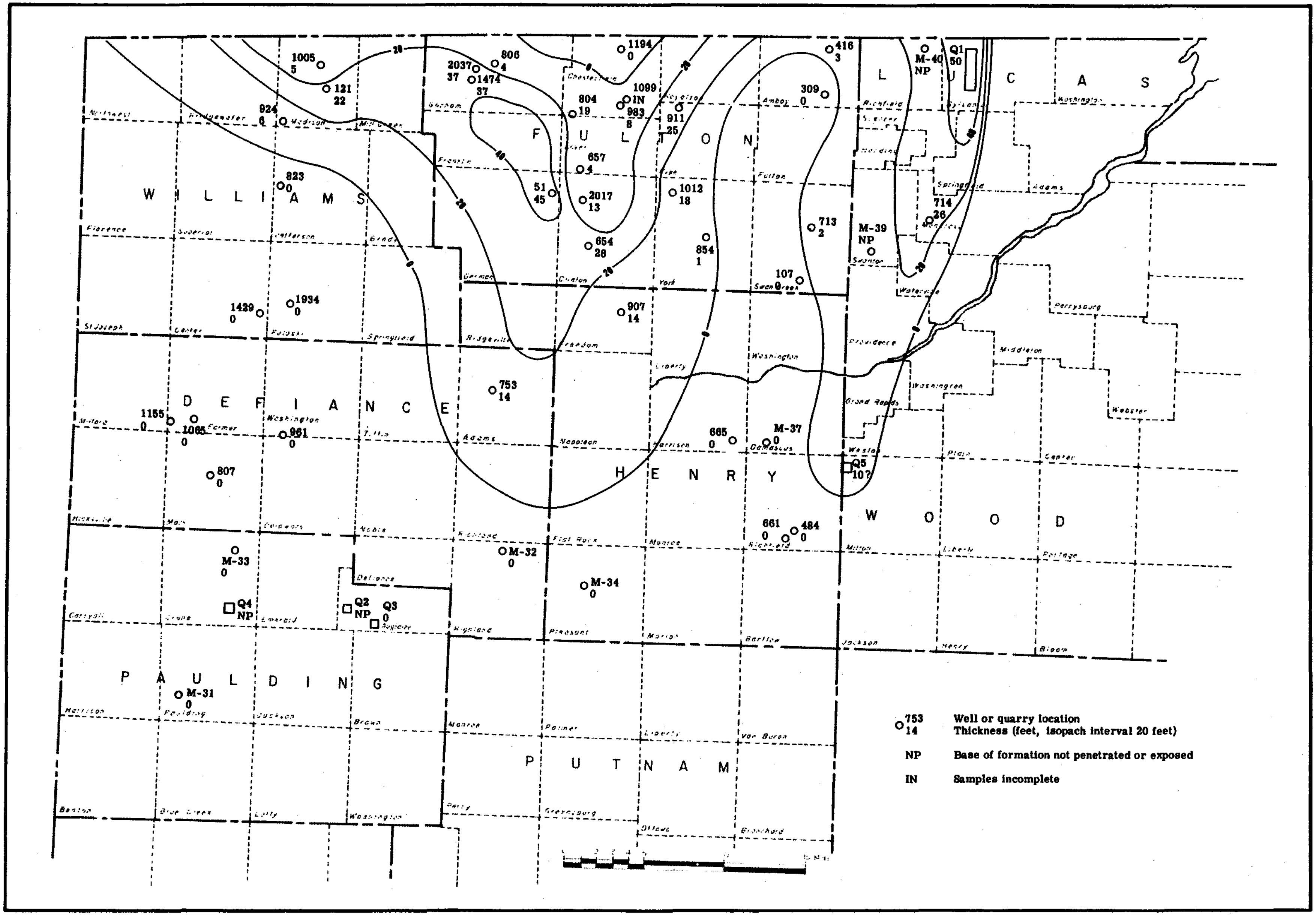


FIGURE 4.–Thickness of Sylvania Sandstone.

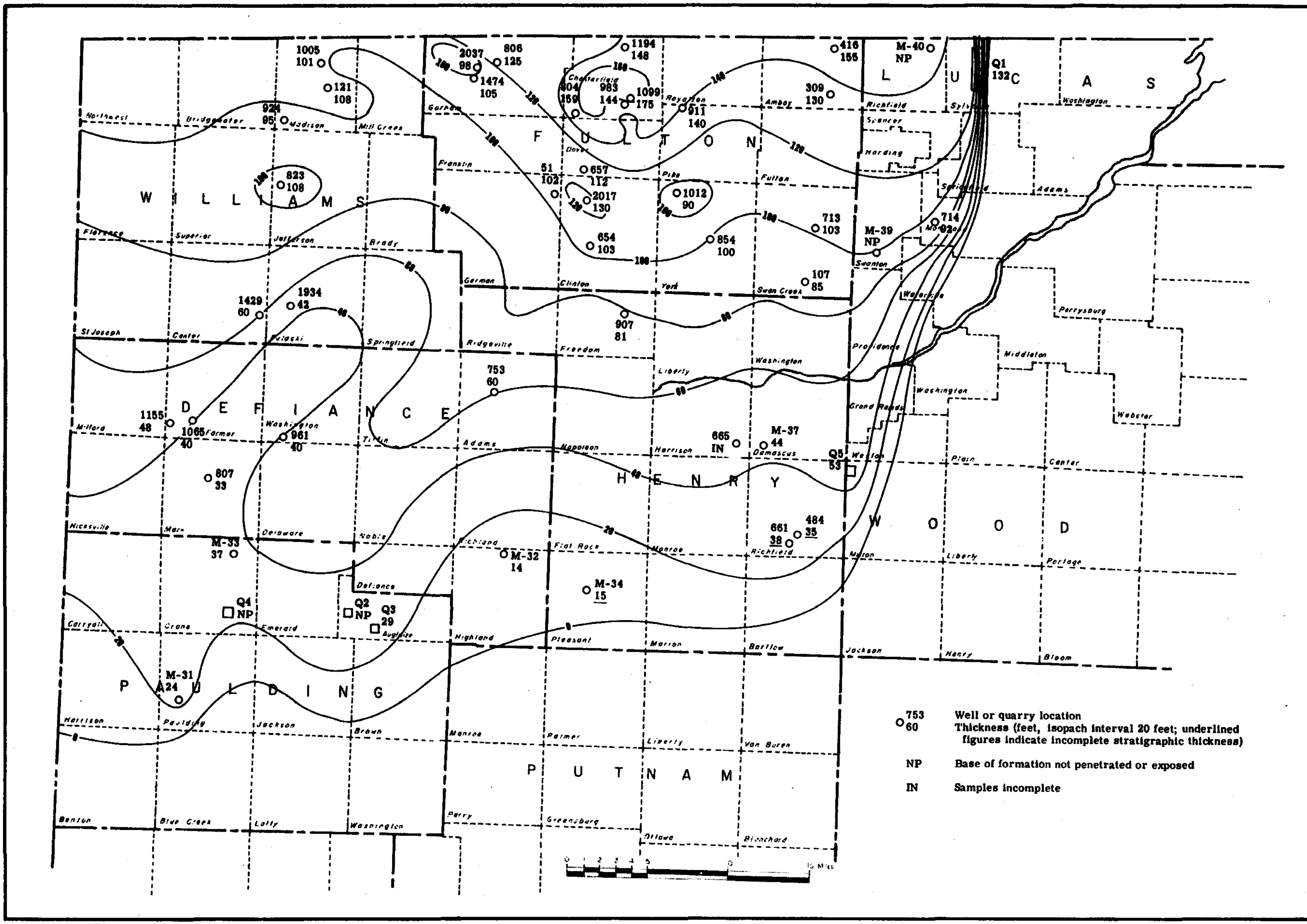


FIGURE 5.—Thickness of Detroit River dolomite.

be facies of a single formation or may have a very local distribution. In some cases (p. 10) fossils appear to be the main criterion for subdivision. Landes (1951) does not recognize the Anderdon in the Michigan Basin, stating (p. 3) that "it has not been identified anywhere in the subsurface except at the Detroit salt mine which is less than eight miles from the outcrop." Sanford (1967, p. 983) considers the Anderdon as the limestone facies of the Lucas and shows it absent in the center of the Michigan Basin. Doheny (1967, p. 20), in a study in northern Indiana, correlates the Detroit River, which contains bedded evaporites in that area, with the Lucas member of the Michigan Basin by accepting Briggs' (1959) interpretation of the Lucas as the evaporite-bearing Detroit River member. The type Amherstburg appears to be a local stromatoporoid-coralline facies (Briggs, 1959, p. 46).

DUNDEE LIMESTONE

The name Dundee limestone was used by Lane (*in* Wadsworth, 1893, p. 66) for rocks exposed in Dundee, Monroe County, Michigan. The stratigraphy and paleontology of the formation in southeastern Michigan were studied by Bassett (1935). A nearly complete section of the Dundee is exposed in Lucas County where Carman (Bassett, 1935, p. 438) divided it into lower and upper parts. The lower Dundee is about 42 feet thick and consists of very sparsely fossiliferous dolomitic limestone or dolomite with much nodular chert. The upper Dundee is 20 feet thick and consists of very fossiliferous limestone (Ehlers and others, 1951, p. 17-18; their units 1 through 6 comprise the lower Dundee and the remaining units the upper Dundee). Probably the full stratigraphic thickness of the lower Dundee is exposed in the quarry in Wood County, and almost the entire Dundee is present in a quarry (Q3) in Auglaize Township, Paulding County. The latter quarry lies 2 miles from an abandoned and water-filled quarry (Q2) from which Stauffer (1909, p. 152-154) described the Tenmile Creek Dolomite and the Silica Formation.

The lower and upper Dundee can be traced from the outcrop into the subsurface of northwestern Ohio. The lower Dundee consists of sucrosic sandy finely and medium-crystalline light-grayish-brown dolomite that contains fairly abundant nodular white and light-brown chert. The quartz sand is predominantly very fine- and fine-grained and subangular to rounded. In about one-quarter of the wells the dolomite is interbedded with sandy and sucrosic limestone, dolomitic in part, that may be fossiliferous and pelletal and oolitic and contains nodular chert. In one well (No. 1 Neuswander, York Township, Fulton County), 20 feet of medium-grained subrounded quartz sand overlies the lower Dundee.

The lower Dundee thins from a maximum of 58 feet in central Fulton County to 30 feet or less in Wood County and is absent in the westernmost part of the report area (fig. 6).

The basal portion of the upper Dundee in the western two-thirds of the report area consists of lithographic limestone. An exception is a well in Amboy Township, Fulton County (No. 1 Village of Metamora), where the lower part of the upper Dundee consists of medium-grained and crystalline medium-brown dolomite, described by Shearrow (1957, p. 12). The lithographic limestone is pelletal, very light-gray and brown, and unfossiliferous except for coral fragments found in the upper part of the unit in four wells.

The full stratigraphic thickness of the lithographic limestone (fig. 7) is exposed in the quarry in Auglaize Township, Paulding County, where the unit shows numerous stylolites and birdseye structures and several pelletal beds. In a quarry in Crane Township, Paulding County, 9 to 11 feet of the same lithology is exposed.

The lithographic limestone grades into fossiliferous medium- and coarse-grained light-yellowish-gray to medium-brown limestone that extends to the top of the Dundee. This biocalcarenite is exposed in the quarries in Lucas and Paulding Counties. Thickness of the entire Dundee sequence is shown in figure 8.

The contact with the Silica Formation is sharp and is drawn at the change from clean to argillaceous limestone. The contact is an unconformity and in northwestern Ohio represents the time of Rogers City limestone deposition in the Michigan Basin. The Rogers City overlies the Dundee in the basin and pinches out north of the Ohio-Michigan border (Cohee and Underwood, 1945).

TRAVERSE GROUP AND FORMATION

General statement

The Traverse Group in northwestern Ohio comprises the Silica Formation and Tenmile Creek Dolomite. In the Michigan Basin the group consists of 11 formations that have an aggregate thickness of 800 feet (Cohee, 1947). Type sections of the Traverse rocks are in the area of Little and Grand Traverse Bays in the southern peninsula of Michigan.

Rocks in northwestern Ohio presently assigned to the Traverse Group were formerly placed in the Traverse Formation (Stauffer, 1909). Type sections were subsequently designated for the Silica and Tenmile Creek (see Stewart, 1927; 1938, p. 7). Ehlers and others (1951) introduced the name Traverse Group in Ohio.

Silica Formation

The name Silica shale was applied by Stewart (1927) to 10 feet of shale underlain and overlain by blue limestone in a quarry near Silica in Lucas County. She included the Silica as a member in the Traverse

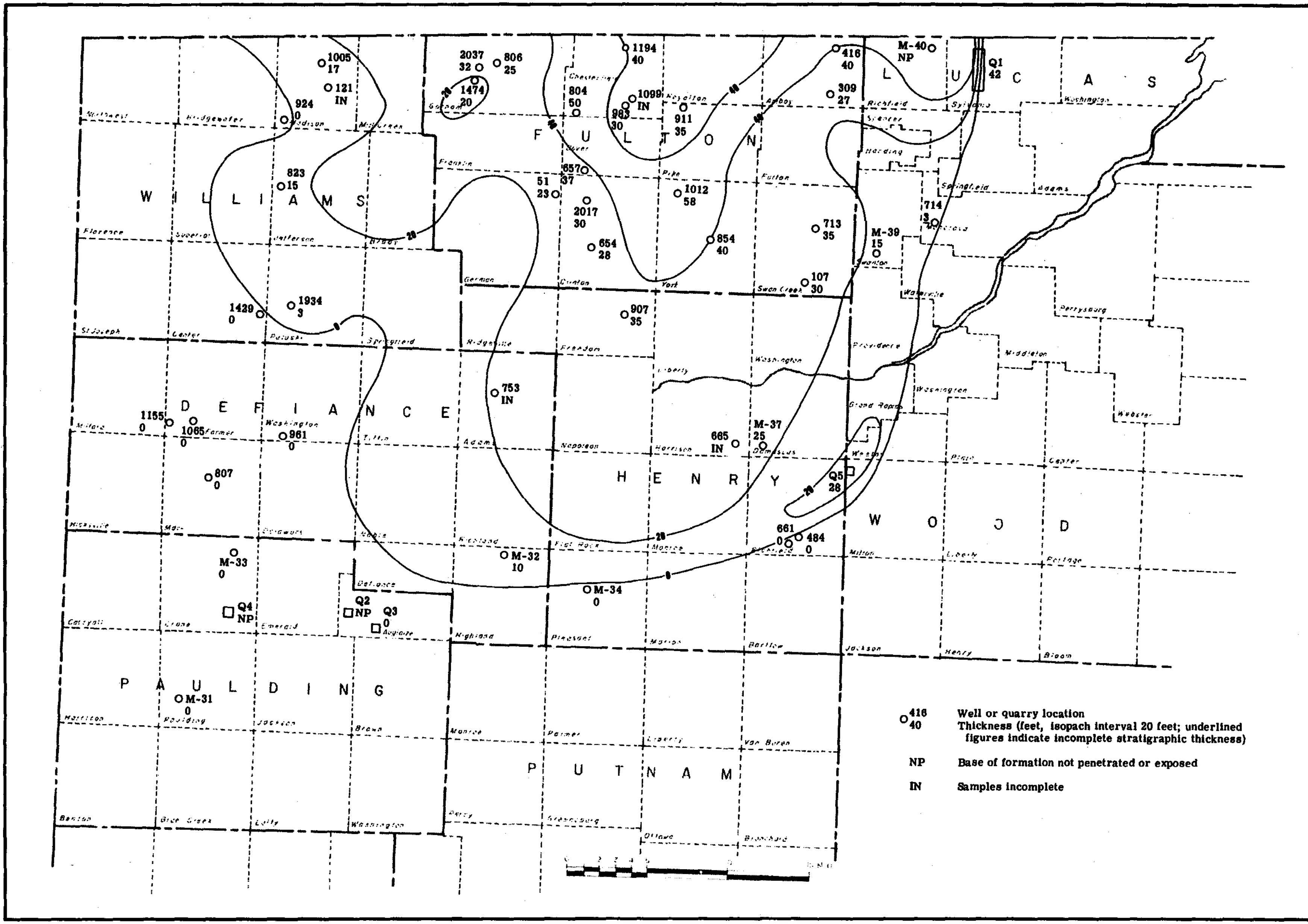


FIGURE 6.–Thickness of lower Dundee Limestone.

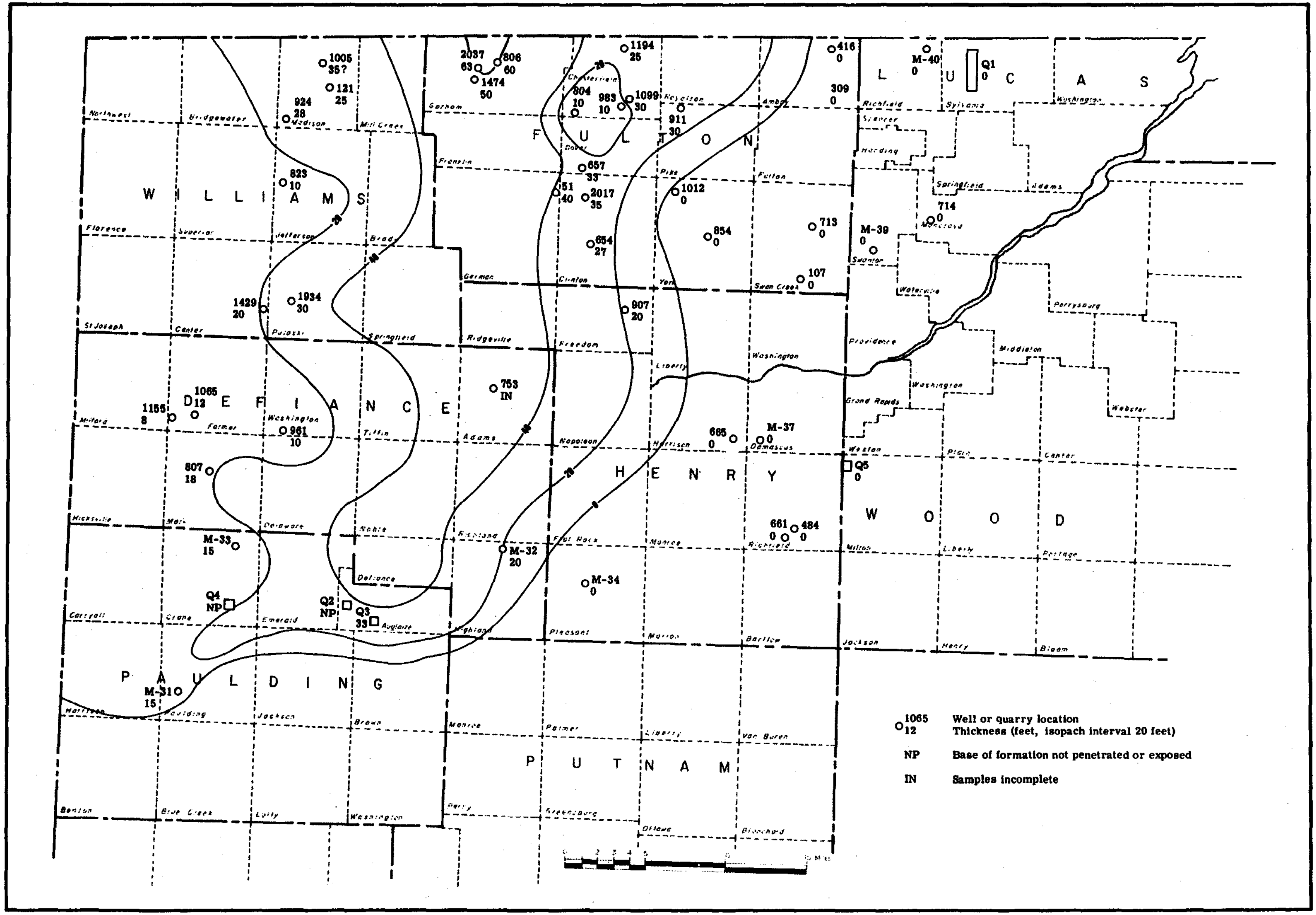


FIGURE 7.—Thickness of lithographic Dundee Limestone.

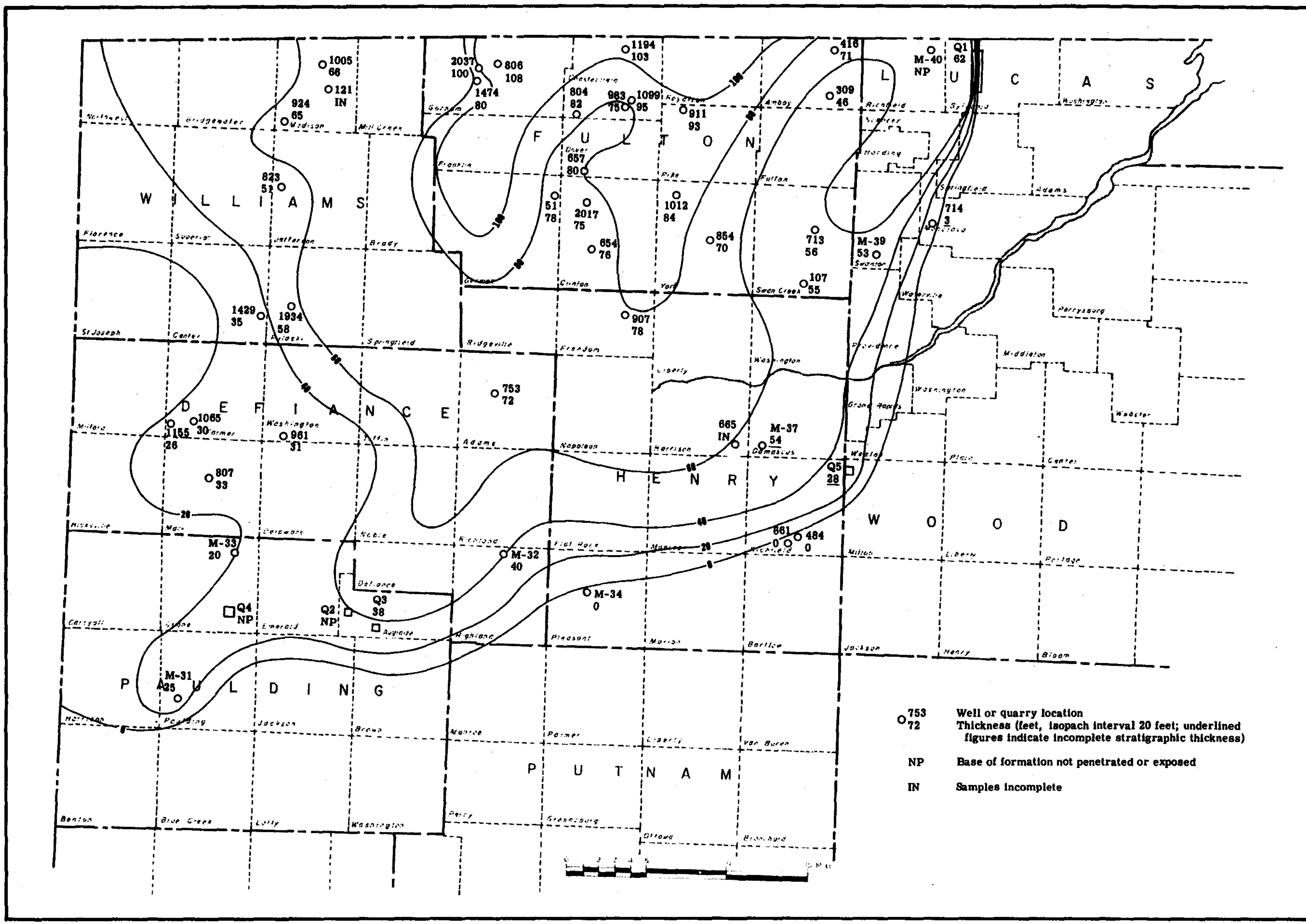


FIGURE 8.–Thickness of Dundee Limestone.

Formation. The unit was raised to formation status by Cooper and others (1942, chart) and included as a formation in the Traverse Group by Ehlers and others (1951). The Silica in the type area has recently been subdivided into members by Mitchell (1967), but the basis for subdivision is biostratigraphic and his members cannot be used in lithostratigraphic studies.

The Silica in the subsurface of northwestern Ohio consists of argillaceous and fossiliferous fine- to coarse-grained grayish-brown limestone interbedded with varying amounts of fossiliferous and calcareous bluish- to brownish-gray shale. The shale content decreases westward toward Defiance and Williams Counties, where in several wells the shale is entirely absent.

The full stratigraphic thickness of the Silica ranges from 54 feet in the Medusa Portland Cement quarry in Lucas County (Ehlers and others, 1951) to 10 feet in the quarry in Crane Township, Paulding County (fig. 9).

Except where shale is absent in the Silica, the contact with the Tenmile Creek Dolomite is sharp and is marked by the change from argillaceous limestone or fossiliferous shale to light-yellowish-gray dolomite. In the area where the Silica contains no shale the contact is gradational because of the presence in the Tenmile Creek of limestone that is similar in appearance to the Silica. Where this situation prevails it is proposed that the name Traverse Formation be used for the undifferentiated Silica-Tenmile Creek (fig. 9). This conforms to the usage in northern Indiana (Doheny, 1967).

Unconformities within and on top of the Silica are indicated by Cooper and others (1942, chart) and an unconformity on top of the Silica is shown by Ehlers and others (1951, p. 24). More recent correlation charts (Oliver and others, 1967, 1969) show the Silica conformable with both Dundee and Tenmile Creek. The current sample study has not proven or disproven the existence of these unconformities, although the sharp lithologic break between the Silica and the Tenmile Creek in all but the westernmost part of northwestern Ohio suggests a disconformable contact.

Tenmile Creek Dolomite

Dolomite with abundant nodular chert exposed along Tenmile Creek in Lucas County was named the Tenmile Creek Dolomite by Carman (Stewart, 1938, p. 7). Carman's description of the type section is given in Ehlers and others (1951, p. 21): the unit is said to consist of dense to crystalline dolomite containing much lenticular and nodular chert and interbedded with minor shaly dolomite and shale. The formation is exposed in the Medusa Portland Cement quarry in Lucas County and in the quarry in Crane Township, Paulding County.

In the subsurface of northwestern Ohio the Tenmile Creek consists of dense to medium-crystalline light-yellowish-gray to very light-grayish-brown dolomite containing abundant nodular white chert. The exception is in Williams County, where limestone similar to the Silica occurs in the lower part of the formation.

Thickness of the Tenmile Creek ranges from 18 to 54 feet, decreasing toward the south (fig. 10). Figure 9 also shows the thickness of the Traverse Formation in the area where the Silica and Tenmile Creek cannot be differentiated.

An unconformity separates the Tenmile Creek from the Ohio [Antrim] Shale. In the samples the contact between the light-colored dolomite and the black or dark-brown shale is sharp.

GEOLOGIC HISTORY

The earliest Middle Devonian marine transgression of northwestern Ohio resulted in deposition of the Sylvania Sandstone. In places this deposit may be eolian material that was reworked by the transgressing sea.

The very shallow Detroit River sea transgressed the Sylvania shoreline and deposited mud and silt consisting of primary or penecontemporaneous dolomite. Some Sylvania sand was moved by the transgressing sea and became incorporated in the basal Detroit River dolomite sediments beyond the Sylvania shoreline. Salinity of the seawater fluctuated, but at times became sufficiently high to result in deposition of nodular anhydrite and gypsum. Farther west, in Indiana, bedded gypsum was deposited and farther north, in Michigan, bedded salt and anhydrite were laid down. Algal stromatolites indicate that part of the deposition took place in the tidal zone; brecciated stromatolitic dolomite suggests deposition in the supratidal zone.

During the time that a generally highly saline environment prevailed in northwestern Ohio, normal marine deposition took place 60 to 70 miles to the east, where the Columbus Limestone was laid down. The boundary between these two depositional areas was a biostromal, and in places perhaps a biohermal, biotope of Amherstburg age. As Detroit River sedimentation continued, this boundary shifted westward from Erie County into Ottawa County.

The land emerged after Detroit River deposition and a short period of subaerial erosion followed. Although the effects of this erosion were generally slight, the southward thinning of the Detroit River indicates that erosion increased as the distance from the center of the Michigan Basin increased. The Tioga bentonite, a volcanic ash present in the Illinois and Appalachian Basins, may have been removed from the study area during this emergence.

Transgressing this briefly exposed land area was the shallow Dundee sea. Its initial deposit was a very sparsely fossiliferous lime mud that, through postdepositional changes including dolomitization, became lithified as the lower Dundee sucrosic dolomite and

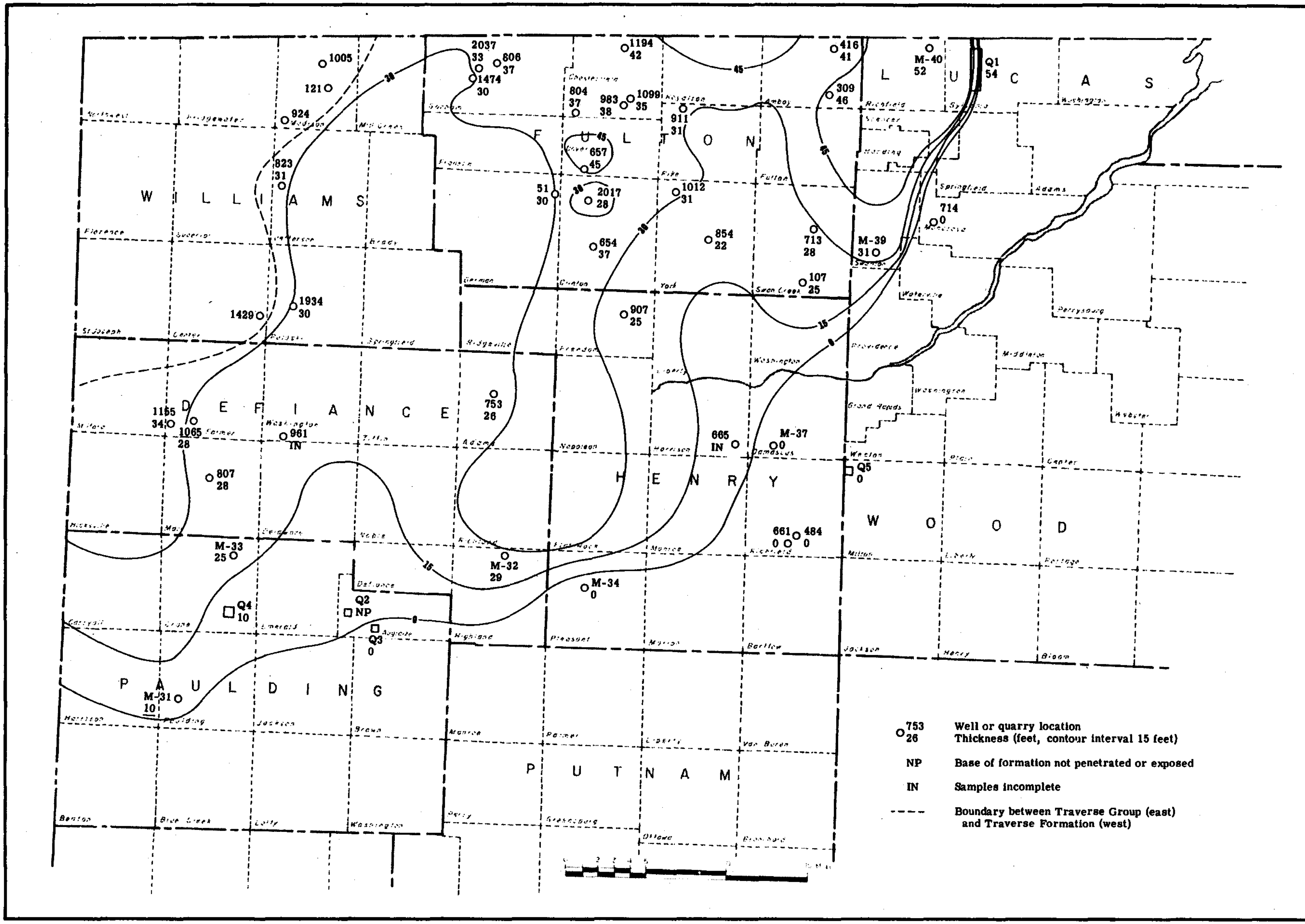


FIGURE 9.—Thickness of Silica Formation.

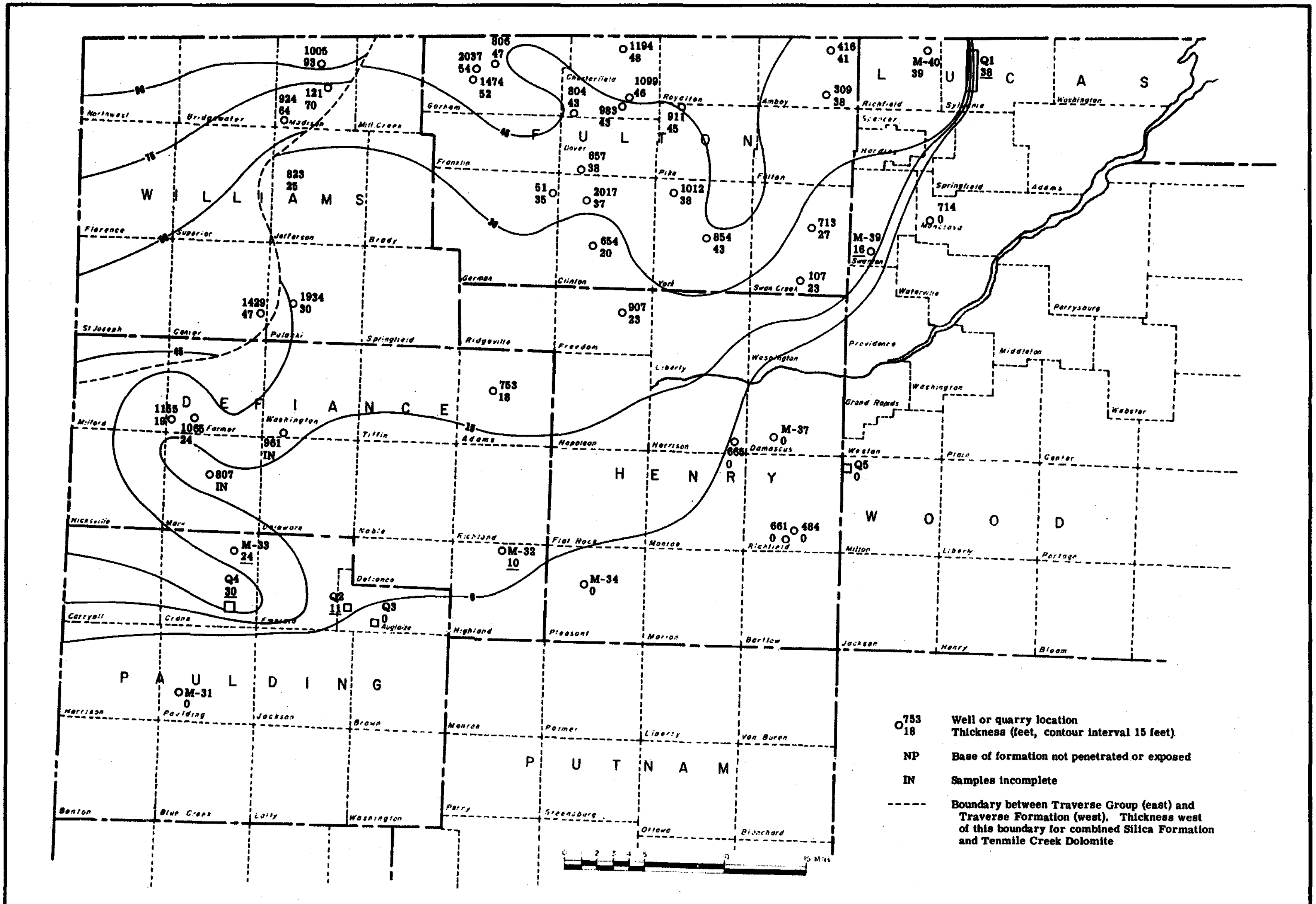


FIGURE 10.–Thickness of Tenmile Creek Dolomite and of Traverse Formation.

dolomitic limestone. The paucity of marine megafossils in the lower Dundee carbonate is not well understood. Climatic reasons can be ruled out, as, 60 miles to the east, the time-equivalent sequence of the Dundee, the Delaware Limestone, is highly fossiliferous in places. It is probable that either deposition of the lower Dundee sediments in a restricted embayment or interstitial highly saline water percolating upward from the underlying Detroit River sediments accounts for the absence of an extensive marine fauna.

Sandy zones, probably eolian in origin, are present in the basal Dundee in the study area as they are on the western rim of the Michigan Basin in Michigan (Briggs, 1959, p. 46) and on its eastern rim in Ontario (Sanford, 1967, p. 983-985). This sand was derived from the same general western source as the Sylvania sand and locally was concentrated by wind or currents into orthoquartzitic sandstone.

A short emergence may have followed deposition of lower Dundee sediments. The evidence for this is meager and the supposition is based only on the sharp lithologic change between lower Dundee and overlying sediments.

The carbonate overlying the lower Dundee in all but the eastern third of the study area accumulated as lime ooze in a protected nearshore environment such as a lagoon. Chemically the lagoon was a reducing environment in which organisms could not survive. In the eastern third of the area at this time fine-grained lime accumulated in a tidal environment generally unfavorable to marine life; these sediments were subsequently dolomitized.

An open shallow sea transgressed the fine-grained lime and lime ooze and deposited the biocalcarenite of the upper Dundee. As with the earlier Detroit River sea, Dundee transgressions were southward to westward.

Following a brief period of subaerial erosion the Traverse sea inundated northwestern Ohio with a heavy influx of clay from the northeast. The environment prevailing during early Traverse time, when the sediments of the Silica accumulated, was that of a shallow open sea with a prolific fauna. The influx of clay stopped rather abruptly and, following a brief emergence, lime ooze and fine-grained sediments were deposited in a shallow sea rich with colloidal silica and without a numerically significant fauna. These Tenmile Creek sediments were subsequently dolomitized. This sedimentation period was followed by a prolonged emergence, after which the Ohio [Antrim] sea transgressed the area.

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APPENDIX

WELL SAMPLE DESCRIPTIONS

Fulton County
Amboy Township
Section 26

Stevens #1 Assumption
Permit No. 1-A
Sample No. 309
Elevation (GL) 728 feet

Depth (ft)	
316 - 319	Shale, black
319 - 327	Dolomite, light- to medium-brown, very finely to finely crystalline. TENMILE CREEK DOLOMITE AT 319 FEET
327 - 332	Dolomite as above. Chert, light-brown; trace
332 - 346	Dolomite, very light-grayish-brown to medium-brown, very finely to medium crystalline. Chert, white and light-gray, fossiliferous; 10%
346 - 357	Dolomite as above. Chert as above, trace
357 - 367	Dolomite, medium-grayish-brown, fine-grained, slightly calcareous. Shale, light- to medium-gray, calcareous; minor. SILICA FORMATION AT 357 FEET
367 - 377	Shale as above
377 - 382	Shale as above. Limestone, medium-grayish-brown, fine-grained, fossiliferous; minor
382 - 395	Limestone and shale as above
395 - 403	Limestone as above. Shale as above, trace
403 - 423	Limestone, predominantly medium-brown, medium- to coarse-grained, fossiliferous; some very light-yellowish-brown. DUNDEE FORMATION AT 403 FEET
423 - 435	Dolomite, medium- to dark-brown, finely to medium crystalline, sucrosic, very slightly sandy (very fine-grained sand). Limestone as above, trace. LOWER DUNDEE AT 423 FEET
435 - 447	Dolomite as above, light-brown. Chert, light-brown; trace
447 - 461	Dolomite, light-brown, microcrystalline, slightly sandy (fine-grained sand). Dolomite as above, minor. Chert, light-brown and very light-gray; trace. DETROIT RIVER GROUP AT 450 FEET
461 - 479	Dolomite, very light- to light-brown, microcrystalline
479 - 484	Dolomite, light-yellowish-gray and light- to dark-brown, microcrystalline to very finely crystalline
484 - 490	Dolomite, light-brown, microcrystalline. Dolomite, light-gray, microcrystalline, sandy (very fine-grained sand); minor
490 - 509	Dolomite, very light- to medium-brown, microcrystalline to very finely crystalline. Dolomite, light-gray, microcrystalline; trace
509 - 519	Dolomite, very light- to light-brown, microcrystalline. Anhydrite and gypsum, trace
519 - 542	Dolomite as above
542 - 550	Dolomite, very light- to light-brown, microcrystalline, anhydritic in part (anhydrite, brown), laminated in part; sandy in part (fine- to medium-grained sand, rounded)
550 - 565	Dolomite, light- to medium-brown, microcrystalline, pelletal or pseudo-oolitic (coarse-grained)
565 - 579	Dolomite, very light- to medium-brown, microcrystalline, sandy in part (fine-grained sand)
579 - 594	Dolomite, medium-brownish-gray to grayish-brown, microcrystalline, sandy (fine- to medium-grained sand, rounded)
594 - 600	Dolomite as above. Sandstone, medium-grained; trace. Dolomite, light- to medium-brown, microcrystalline. Sand, fine- to medium-grained, rounded; trace. Shale, light-green, very dolomitic, sandy; trace. SILURIAN AT 597 FEET

Fulton County
Pike Township
Section 32N

Robert E. Dunn #1 Kirkendall
Permit No. 16
Sample No. 911
Elevation (KB) 771 feet

Depth (ft)	
456 - 461	Shale, black. Dolomite, medium-brown, finely crystalline; trace
461 - 465	Dolomite, light-brown to yellowish-brown, finely crystalline. Shale, black; trace. TENMILE CREEK DOLOMITE AT 466 FEET (GRN)
465 - 469	Dolomite, light-grayish-brown to yellowish-brown to medium-brown, finely crystalline
469 - 476	Dolomite as above. Dolomite, very light-gray to yellowish-gray, fossiliferous and pyritic. Shale, medium- to dark-gray, dolomitic; minor. Chert, white, fossiliferous; heavy trace
476 - 480	Dolomite, very light-brownish-gray to grayish-brown, fine- to medium-grained, finely crystalline. Chert, white and very light-brownish-gray, fossiliferous; 20%
480 - 488	Dolomite as above. Dolomite, medium-brown, fine- to coarse-grained, finely to medium-crystalline. Chert, as above, 40%
488 - 501	Dolomite as above. Chert as above, trace to heavy trace
501 - 516	Limestone, medium-brownish-gray, fine- and medium-grained, fossiliferous. Shale, medium-gray, calcareous. Dolomite as above, minor. SILICA FORMATION AT 511 FEET (GRN)
516 - 536	Limestone as above, very fossiliferous. Shale as above, minor.
536 - 544	Limestone as above, trace. Limestone, light-yellowish-gray to medium-brown, fine- to coarse-grained, fossiliferous. DUNDEE FORMATION AT 542 FEET (GRN)
544 - 570	Limestone, fine- to coarse-grained as above
570 - 586	Limestone, very light-gray, lithographic to sublithographic
586 - 600	Limestone as above, medium-grained
600 - 614	Limestone, very light-brown to yellowish-brown, medium-grained, sandy (fine-grained sand)
614 - 626	Limestone as above, light-brown. Chert, white; 40%
626 - 636	Dolomite, very light-yellowish-brown to medium-brown, medium-grained, sandy (fine-grained sand). Chert as above, heavy trace. Dolomite, medium-brown to grayish-brown, microcrystalline; trace. DETROIT RIVER GROUP AT

635 FEET

636 - 641 Dolomite, very light-gray, light-yellowish-brown and yellowish-gray to light-brown, microcrystalline to very finely crystalline; some pinpoint porosity

641 - 658 Dolomite, light-yellowish-gray to light-brown, sublithographic and microcrystalline

658 - 666 Dolomite as above, light-brownish-gray

666 - 672 Dolomite, light- to medium-brown, very finely crystalline; medium-grained in part

672 - 678 Dolomite as above, very light-brown in part. Dolomite, light-gray, microcrystalline, slightly sandy; sand rounded, medium grained

678 - 696 Dolomite, very light-grayish-brown to medium-brown, microcrystalline to finely crystalline; medium-grained in part. Gypsum, trace to heavy trace

696 - 712 Dolomite, very light-brownish-gray to gray, very finely crystalline; coarse-grained in part. Gypsum, trace

712 - 731 Dolomite, very light-brownish-gray to medium-brown, very finely crystalline; some pinpoint porosity

731 - 735 Dolomite, very light-gray to gray, microcrystalline, sandy (medium-grained sand, rounded, frosted)

735 - 743 Dolomite as above. Dolomite, light- to medium-brown and light-yellowish-gray. Sand, fine to medium grained, rounded, frosted. Chert, very light-gray, sandy; trace

743 - 750 Dolomite as above, very sandy

750 - 768 Sand, medium-grained, rounded, frosted. Sand, fine- to coarse-grained, rounded, frosted; minor. Sandstone, medium-grained, siliceous; in part dolomitic; trace. SYLVANIA SANDSTONE AT 750 FEET

768 - 775 Sand as above, 50%. Shale, dark-greenish-gray, very dolomitic. Shale, light-green, waxy, trace

775 - 780 Dolomite, very light-brownish-gray to light-brown, sublithographic to microcrystalline. SILURIAN AT 775 FEET (GRN)

Henry County
Freedom Township
Section 23

Lesh Drilling Company
#1 Badenhop
Permit No. 20
Sample No. 907
Elevation (KB) 718 feet

Depth (ft)

Samples poor because of contamination with material from uphole

225 - 240 Shale, dark-brown. Dolomite, light- to medium-brown, very finely crystalline

240 - 250 Shale as above. Dolomite, very light-grayish-brown to medium-brown, fine- to coarse-grained, finely to medium-crystalline. Chert, white, fossiliferous; heavy trace. TENMILE CREEK DOLOMITE AT 239 FEET (GRN)

250 - 260 No samples

260 - 275 Dolomite as above, minor. Shale, light-gray, calcareous, fossiliferous. Limestone and dolomite, medium-gray to brownish-gray, fine-grained and argillaceous in part, fossiliferous. Dolomite as above, minor. SILICA FORMATION AT 262 FEET (GRN)

275 - 290 Sample predominantly shale as above

290 - 310 Limestone and shale as above. Limestone, very light-grayish-brown to light-yellowish-brown, fine- to coarse-grained, fossiliferous. DUNDEE FORMATION AT 287 FEET (GRN)

310 - 330 Limestone, very light-gray to yellowish-gray, lithographic (predominantly) and medium-grained

330 - 340 Dolomite, very light-brownish-gray to yellowish-gray, fine- to medium-grained, finely to medium-crystalline; sandy (very fine- to fine-grained and subangular sand), good intercrystalline porosity

340 - 345 Dolomite as above (half of sample limestone as above)

345 - 350 Dolomite as above, very light- to light-brown; becoming light- to medium-brown

350 - 365 Dolomite as above. Chert, white; heavy trace

365 - 370 Dolomite as above (more than 95% of sample). Dolomite, light-yellowish-brown, microcrystalline. DETROIT RIVER AT 365 FEET

370 - 380 Dolomite, light-yellowish-brown to very light-brown, microcrystalline to very finely crystalline

380 - 395 Dolomite, medium-brown to light-grayish-brown, microcrystalline to very finely crystalline; some pinpoint porosity and some lathlike cavities; grayish-brown dolomite sandy in part (fine- to medium-grained sand, rounded)

395 - 400 Dolomite, very light- to medium-brown to light-yellowish-brown; fine- to medium-grained in part; good vuggy and pinpoint porosity in part; recrystallized in part

400 - 405 Dolomite as above. Dolomite, light-gray, microcrystalline, sandy to very sandy (fine- to medium-grained sand, rounded). Anhydrite and sulfur, trace

405 - 410 As above. Gypsum, trace

410 - 415 Dolomite, very light-yellowish-brown to very light-brown, microcrystalline; fine- to coarse-grained in part

415 - 420 Dolomite as above; very light- to light-brown; oolitic in part

420 - 430 Dolomite as above, anhydritic in part. Gypsum, trace

430 - 440 Dolomite, light- to medium-gray, microcrystalline, sandy (fine- to medium-grained sand, rounded). Dolomite, light- to medium-brown, microcrystalline; some pinpoint porosity

440 - 445 Dolomite, very light-yellowish-brown and grayish-brown to light-gray, microcrystalline to very finely crystalline; fine- to medium-grained in part; sandy as above

445 - 450 Sand, medium-grained, rounded; 40%. Dolomite, light-gray to grayish-brown, microcrystalline; sandy as above

450 - 455 Sand and sandy dolomite as above, minor. Dolomite, light- to medium-brown and light-grayish-brown, microcrystalline

455 - 460 As above. Sandstone, white, fine- to medium-grained; trace. Shale, light-gray, waxy; sandy in part; some pieces of sandstone with fragments of shale incorporated; trace

460 - 470 Dolomite, light- to medium-brown and very light-grayish-brown, microcrystalline. SYLVANIA SANDSTONE AT 446 FEET? SILURIAN AT 460 FEET (GRN)

Williams County
Madison Township
Section 5

McClure Oil Co. #1 Barnhart
Permit No. 30
Sample No. 924
Elevation (DF) 868 feet

Depth (ft)

678 - 686 Shale, black. Dolomite, medium- to dark-brown to grayish-brown, microcrystalline to very

	finely crystalline
686 - 695	Dolomite, light- to medium-brown, very finely crystalline. TENMILE CREEK DOLOMITE AT 686 FEET (GRN)
695 - 705	Dolomite as above. Dolomite, very light-brownish-gray, fine- to coarse-grained, finely to medium-crystalline. Chert, white, fossiliferous; heavy trace
705 - 709	Dolomite as above, light-yellowish-gray
709 - 717	Limestone, medium-grayish-brown, fine- to medium-grained, fossiliferous; argillaceous in part
717 - 721	Limestone, very light-brownish-gray, fine- to coarse-grained. Chert, white; 30%
721 - 725	Dolomite, very light-brownish-gray to grayish-brown, finely to medium-crystalline. Chert, white and light-brown; 50%
725 - 731	Limestone as in 717-721-foot sample. Chert, white; 20%
731 - 736	Limestone, medium-grayish-brown, fine- to coarse-grained, fossiliferous. SILICA FORMATION? AT 731 FEET (GRN)
736 - 742	Limestone as above, in part light-brownish-gray
742 - 752	Limestone as above, very fossiliferous. Shale, light- to medium-gray; calcareous in part
752 - 776	Limestone, very light- to medium-grayish-brown, fine- to coarse-grained, fossiliferous. DUNDEE FORMATION AT 750 FEET (GRN)
776 - 781	Limestone as above, predominantly very light-grayish-brown. Limestone, light-brown, very finely crystalline, dolomitic; minor
781 - 787	Limestone, light-brown to yellowish-brown, fine- to medium-grained
787 - 803	Limestone, very light-grayish-brown to medium-brown, lithographic to medium-grained, dense
803 - 815	Limestone as above, very light-yellowish-brown to medium-brown
815 - 824	Shale, black (misplaced sample)
824 - 830	No samples
830 - 836	Dolomite, light- to medium-brown, microcrystalline to very finely crystalline; fine- to medium-grained in part. DETROIT RIVER GROUP AT 830 FEET
836 - 842	Dolomite as above. Dolomite, light-gray, microcrystalline, slightly sandy (fine-grained sand); trace
842 - 858	Dolomite as above, brown. Chert, very light-brownish-gray to light-brown; heavy trace
858 - 866	Dolomite, very light-brownish-gray to grayish-brown to light-brown, microcrystalline
866 - 877	Dolomite as above. Dolomite, light- to medium-gray. Anhydrite, trace
877 - 893	Dolomite, very light-brownish-gray to yellowish-gray to medium-brown, microcrystalline to very finely crystalline; fine- to medium-grained in part; some pinpoint porosity. Dolomite, light-gray, microcrystalline, slightly sandy (very fine- to fine-grained sand); minor
893 - 900	Dolomite as above, anhydritic in part (brown anhydrite). Anhydrite, white; trace
900 - 911	Dolomite as in 877-893-foot sample, light-gray dolomite sandy to very sandy
911 - 920	Dolomite, very light- to light-gray, microcrystalline, sandy to very sandy (fine- to coarse-grained sand; predominantly fine; rounded)
920 - 931	Dolomite as above, grading into fine- to medium-grained sandstone. SYLVANIA SANDSTONE AT 925 FEET?
931 - 940	Sandstone as above, trace. Dolomite, very light-grayish-brown to light-brown, sublithographic to finely crystalline. Shale, medium-green, waxy; trace. SILURIAN AT 931 FEET (GRN)

QUARRY SECTION DESCRIPTIONS

Auglaize Quarry
Maumee Stone Co.
Paulding County, Auglaize Township
Section 32
Junction Quadrangle

Unit	*Feet*	*Inches*	
	15	0	Overburden (thickness estimated)
			Dundee Limestone
15	5	0	Limestone, light-brownish-gray, coarse-grained, very fossiliferous (brachiopods, corals); biocalcarenite
14	33	0	Limestone, very light-gray, very light- to medium-brown, lithographic (micrite); pelletal and oolitic in part; numerous stylolites, birdseye structures; disconformable lower contact
			Detroit River Group
13	6	0	Dolomite, light-gray, light- to dark-brown, microcrystalline (dolomicrite and dolosiltite), burrowed, laminated in part; mottled dark gray; patches of white sparry dolomite; nodular chert locally in top 2 feet; 1 to 2 inches of laminated very finely crystalline gray and brown dolomite at top
12	4	7	Dolomite, very light-grayish-brown, microcrystalline (dolosiltite), massive; laminated in top 5 inches
11	0	9	Dolomite, light-brown, microcrystalline (dolosiltite); dark-gray cryptalgalaminations
10	1	0	Dolomite, very light- and dark-gray, mottled, microcrystalline (dolomicrite), burrowed; numerous solution (crystal) cavities
9	3	0	Covered interval
8	3	0	Dolomite, light-brown, microcrystalline (dolosiltite); dark-gray laminations
7	0	9	Dolomite, light-brown, microcrystalline (dolosiltite), burrowed; mottled dark-gray; 2 inches of dark-gray dolomicrite at top
6	2	8	Dolomite, light-brown, microcrystalline (dolosiltite), algal-laminated
5	0	6	Dolomite, light-gray, microcrystalline (dolosiltite), sandy (fine-grained sand), rubbly-looking; irregularly interbedded black shale; in places made up of brecciated stromatolitic dolomite
4	5	6	Dolomite, light-brown, microcrystalline (dolosiltite); dark-gray laminations; some carbonaceous black shale; disconformable upper contact
3	0	8	Dolomite, light-gray, microcrystalline (dolosiltite), sandy; ½ inch of black shale on top
2	0	6	Sandstone, fine- and medium-grained; interbedded sandy and argillaceous greenish-gray dolomite; disconform-

		able lower contact
		Upper Silurian undifferentiated
1	1	Dolomite, light- to dark-gray, microcrystalline (dolomicrite); vuggy porosity; base not exposed

Crane Quarry
Peninsular Portland Cement Co.
Paulding County, Crane Township
Section 26

Feet	*Inches*	
50		Overburden
		Tenmile Creek Dolomite
30	0	Dolomite, light-yellowish-gray, microcrystalline to medium-crystalline; much nodular white chert; some interbedded blue-gray shale
		Silica Formation
10	0	Shale, blue-gray, calcareous, fossiliferous; much interbedded argillaceous and fossiliferous limestone
		Dundee Limestone
4	6	Limestone, yellowish- to brownish-gray, coarse-grained (biocalcarenite), very fossiliferous (corals, brachiopods)
11		Limestone, grayish-brown to medium-brown, lithographic (micrite); base not exposed

Pugh Quarry
Pugh Quarry Co.
Wood County, Milton Township
Section 6
McClure Quadrangle

Unit	*Feet*	*Inches*	
	15	0	Overburden
			Dundee Limestone
8	28	0	Dolomite, light- and medium-brown to very light-brownish-gray, sandy (fine- and medium-grained sand), bedded (1 to 3 feet) to massive; finely sucrosic with good intercrystalline porosity; nodular fossiliferous white chert on top of unit; in places basal ¼ inch of fine- and medium-grained medium-grayish-brown sandstone containing pebbles with Detroit River lithology; sharp disconformable contact with underlying unit
			Detroit River Group
7	6	0	Dolomite, very light-gray, very light- and light-brown, microcrystalline (dolomicrite grading downward into dolosiltite); stromatolitic laminations in lower half
6	3	6	Dolomite, light- and medium-brown to grayish-brown, microcrystalline (dolomicrite and dolosiltite), stromatolitic, brecciated; cobble-sized fragments; much dog-tooth calcite and pyrite; grading into underlying unit
5	7	0	Dolomite, light-brownish-gray, microcrystalline (dolosiltite with interbedded dolomicrite), massive; poor vuggy porosity
4	2	6	Dolomite, light-gray and brownish-gray, microcrystalline (dolosiltite), stromatolitic (showing truncated surfaces), massive
3	7	6	Dolomite, light-grayish-brown to dark-brown, microcrystalline (dolosiltite), cryptalgalaminated, bedded (1 to 2 feet) to massive
2	28	0	Dolomite, light- and medium-brown, microcrystalline (dolosiltite); cryptalgalaminated in part; interbedded dolomicrites in beds 3 feet thick; good vuggy porosity; some vugs aligned along stromatolitic structures
			(Sylvania Sandstone)
1	10(est.)		Sandstone, fine- and medium-grained; rounded and frosted grains; 2 feet exposed