

# DEVONIAN ROCKS OF SOUTHEASTERN MICHIGAN AND NORTHWESTERN OHIO

By

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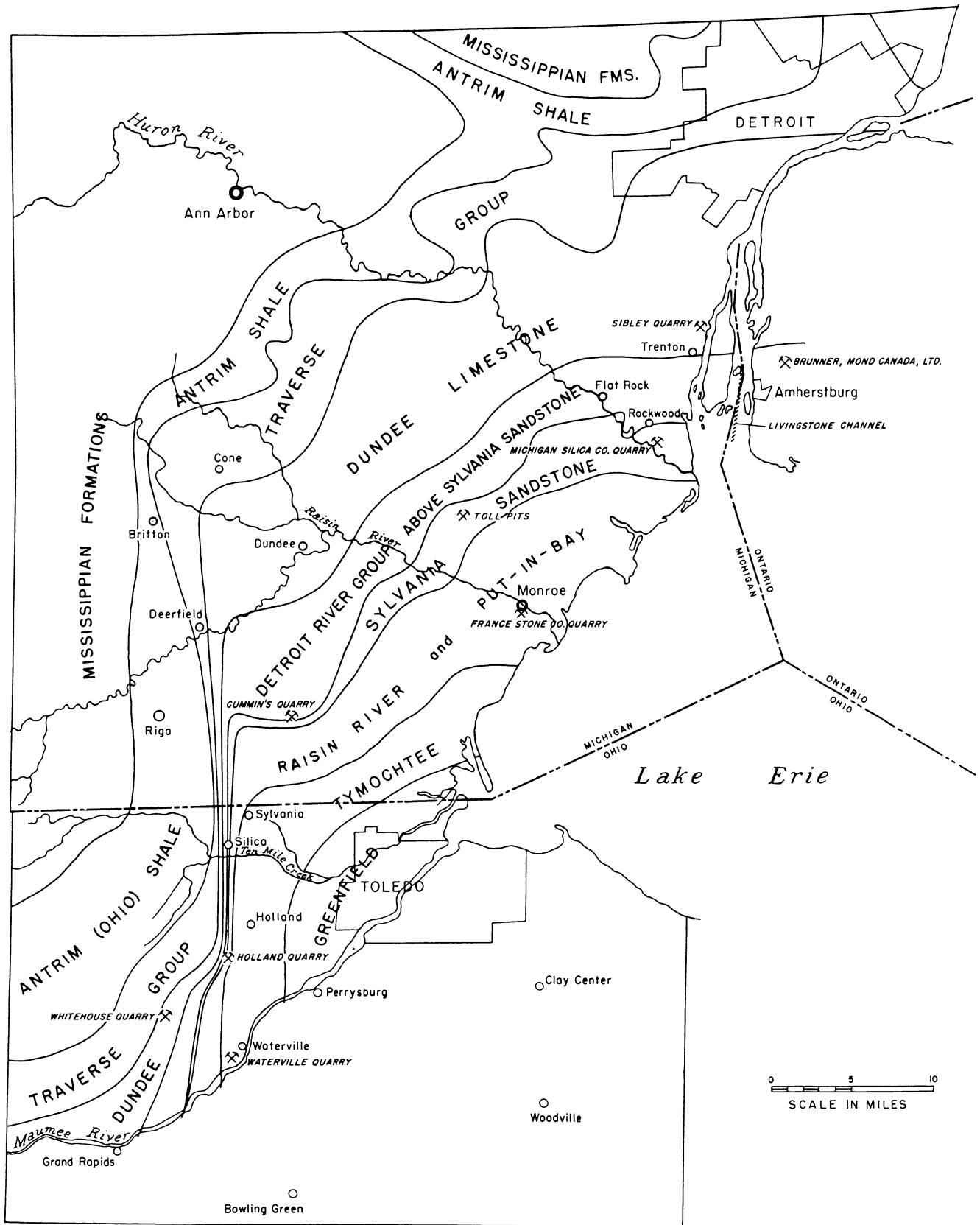
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Map 1. Areal geologic map showing distribution of Devonian rocks, underlying Silurian, and overlying Mississippian strata in parts of southeastern Michigan and northwestern Ohio.

## INTRODUCTION

This paper describes briefly the lithology, succession, and relationships of the Devonian strata of southeastern Michigan and northwestern Ohio a few miles south of the Michigan-Ohio boundary. The conditions under which some of the rocks were deposited, the chief diagnostic fossils of the various formations, and the correlation of the rocks with the Devonian strata of northern Michigan and New York are noted.

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# GEOLOGIC STRUCTURE

The Devonian rocks of southeastern Michigan and northwestern Ohio are located on the northwestern flank of the northeast branch of the Cincinnati geanticline. They dip gently into the Michigan basin except along the Lucas County monocline.

The location of the Lucas County monocline, which has been well described by J. E. Carman and Wilbur Stout (1934, pp. 523-525), is indicated by the closely spaced formational contacts shown in Map 1. The trend of the monocline is about N. 10° W. The average dip of the strata in the monocline as shown in the quarries near Silica, Ohio is about 6° S. 80° W. (see Pl. 2, Fig. 2).

## STRATIGRAPHY

### GENERAL DESCRIPTION OF ROCKS

#### BOIS BLANC FORMATION

The Bois Blanc formation, which is well exposed on Bois Blanc Island in Lake Huron and nearby parts of the Mackinac Straits region, is the oldest Devonian deposit of southeastern Michigan. According to K. K. Landes (1945b) this formation can be recognized by cuttings from deep wells as far south as Monroe County. He states (ibid.) that the formation "thins out 4 or 5 miles short of the outcrop of the Sylvania formation" in southeastern Michigan and rests on Upper Silurian dolomites of the Bass Islands group.

#### DETROIT RIVER GROUP - SYLVANIA SANDSTONE

The Sylvania sandstone, named by Dr. Edward Orton (1888, pp. 4, 88) for exposures near Sylvania, Lucas County, Ohio, is the oldest exposed Devonian formation in northwestern Ohio and southeastern Michigan. Its areal distribution is shown in Map 1. Except where underlain by Bois Blanc strata, the Sylvania rests disconformably on the Raisin River dolomite, the youngest formation of the Upper Silurian Bass Islands group. Its contact with the Raisin River dolomite is well shown in the Holland quarry about 7 1/2 miles south of Silica, Ohio, where, as reported by Carman (1936, pp. 258-259), the Sylvania contains a basal conglomerate with pebbles of the Raisin River dolomite. In northwestern Ohio its contact with the overlying Amherstburg dolomite is not sharply defined because the lowest beds of the Amherstburg are dolomitic sandstones, which grade downward into the Sylvania sandstone.

The Sylvania sandstone and the overlying formations of the Detroit River group are exceptionally well shown in several quarries near the village of Silica about 2 miles southwest of Sylvania, Ohio (see Fig. 1). The lithologic character, thickness, and more common fossils of all the Detroit River formations of the Silica region are given in the following descriptions (see Fig. 2 and Pl. 3).

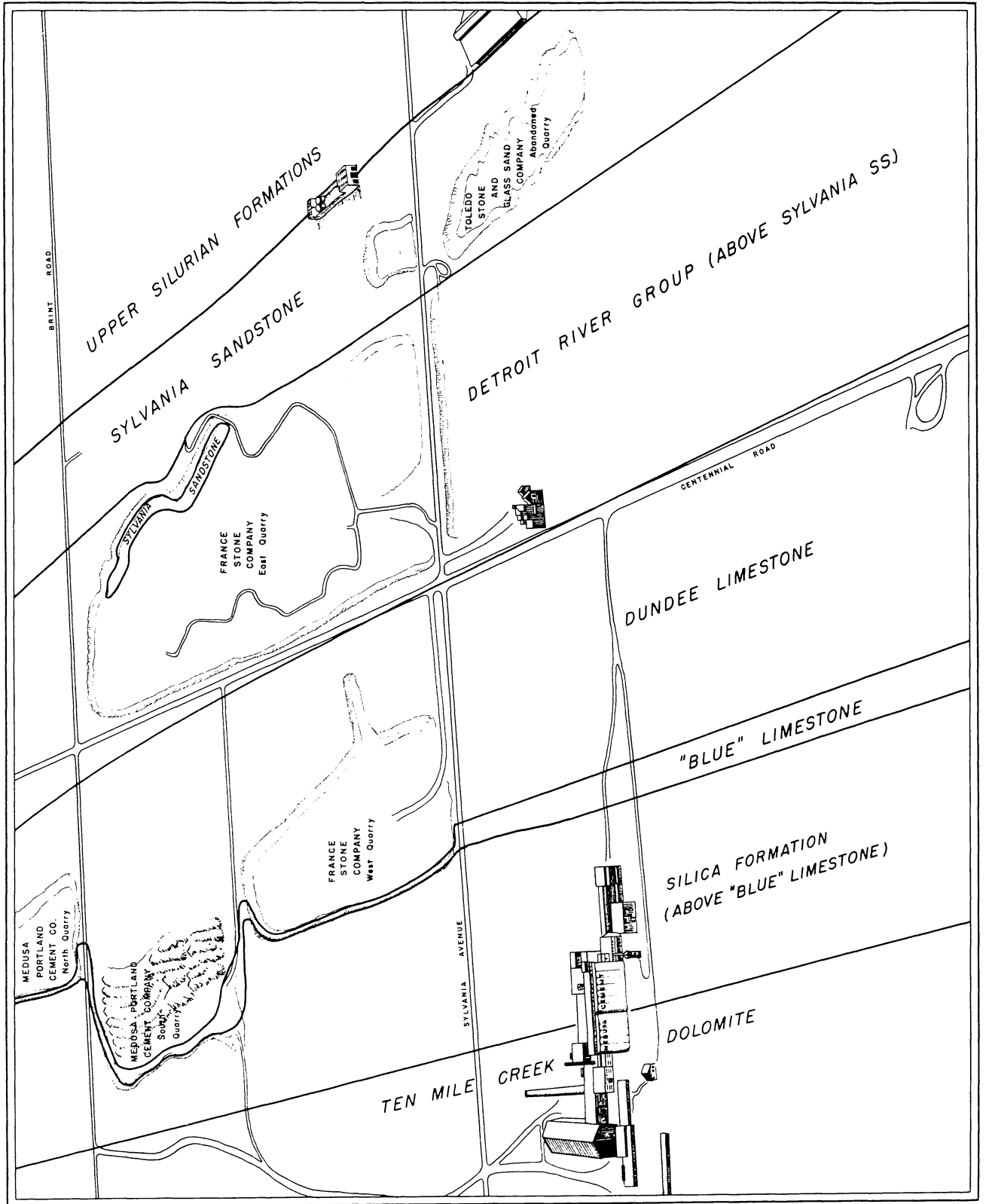


Fig. 1. Drawing made from an oblique aerial photograph of the Silica, Ohio region to show areal distribution of the Devonian formations and the main quarries in which they are exposed.

Description of Detroit River Group Exposed in the Silica, Lucas County, Ohio Region

ANDERDON LIMESTONE

Exposed in west wall of East quarry of France Stone Company about one-quarter mile north of Sylvania Avenue

Unit	Ft.	In.
7. Covered in large part; highest 1 to 2 feet consists of light buff dolomite with dark laminae of carbonaceous material. Exposed in field about 35 feet west of Centennial road and about one-fifth mile north of Sylvania Avenue. A rock cut being excavated in the east wall of the West Quarry of the France Stone Company near this point with the view to connecting the East and West Quarries of the France Stone Company by a tunnel beneath Centennial Road probably will be deepened by the time of this field conference so as to show the contact between the Detroit River group and the overlying Dundee limestone. . . . .	7±	0
6. Dolomite, light gray to dark buff-gray, unevenly bedded, surface white on weathering . . . . .	4-5	
5. Limestone, buff-gray, laminated, with laminae contorted in upper part . . . . .	2	10
4. Dolomite, buff-gray to buff, very finely crystalline, filled with vugs and geodes of crystalline calcite . . . . .	2	8
3. Dolomite, light buff, fine grained and laminated; weathers into layers 1 to 2 inches in thickness . . . . .	1	7
Exposed in small, abandoned, elongate quarry just south of Sylvania Avenue and just east of Centennial Road and in extension of west wall of East quarry of France Stone Company south of Sylvania Avenue		
2. Dolomite, dark buff to brown, crystalline and thick bedded. Thickness is 5 ft. 10 in. in west wall of East quarry of France Stone Company about one-third of a mile north of Sylvania Avenue. . . . .	4	3
1. Dolomite, light buff to buff-gray, with vugs of calcite crystals and molds of many small gastropods and of a small number of pelecypods, simple corals, and stromatoporoids. The most characteristic gastropods are <u>Pleurotrochus tricarinatus</u> Grabau and undescribed species of <u>Loxonema</u> , <u>Murchisonia</u> , <u>Platyloron</u> , <u>Rhineoderma</u> , and <u>Tropidodiscus</u> . The pelecypod <u>Conocardium sibleyense</u> La Rocque is associated with these gastropods. Dolomite has petro-liferous odor when struck with hammer. . . . .	1	2
Total . . . . .		23' 6" - 24' 6"

LUCAS DOLOMITE

Exposed in small abandoned quarry noted above

Unit	Ft.	In.
18. Dolomite, light buff-gray, fine-grained, with laminae which show well on weathered surfaces; a few specimens of <u>Prosserella planisinos</u> Sherzer and Grabau . . . . .	1	8
17. Dolomite, light buff-gray, fine-grained, similar in lithology to unit 18; weathered surfaces white; dolomite thins from 7 to 3 inches in places as the result of solution accompanying formation of stylolites at top. . . . .		3-7
16. Dolomite, buff, coarse-grained, thick-bedded, with carbonaceous laminae . . . . .	6	2
15. Dolomite, buff, fine-grained, thin-bedded, with closely spaced carbonaceous laminae; bedding planes and laminae with many undulations. . . . .	2	1
14. Dolomite, light buff-gray and fine-grained; dolomite much fractured, angular fragments surrounded by crystals of calcite; prominent stylolite parallel to bedding in center of unit. . . . .	1	

Unit	Ft.	In.
13. Dolomite, light buff and grayish-buff, crystalline, in beds 4 to 12 inches in thickness; some beds with carbonaceous laminae; few vugs of calcite crystals in lower part; buff gray oolite, 10 inches in thickness, top of which is 6 ft. 10 in. below top of unit. . . . .	19+	
12. Dolomite, buff, and in fragments mixed with crystals of calcite, many of which are "dog-tooth spar" 3 to 4 in. in length. The unit was in a zone of ground water solution. . . . .	2	8+
11. Dolomite, light buff-gray and buff, with some vugs of calcite crystals in the form of "dog-tooth spar". Some beds with laminae; others without laminae are porous and contain <u>Prosserella lucasi</u> Sherzer and Grabau, <u>Acanthonema holopiforme</u> Sherzer and Grabau, and other fossils. . . . .	19	
10. Dolomite, light gray; with disseminated, rounded and irregularly shaped areas of calcite, most of which are about one-sixteenth of an inch in diameter. . . . .	1	3
9. Dolomite, buff, with undulating laminae of carbonaceous material. Fragments of the dolomite are mixed with masses of calcite in the form of "dog-tooth spar". The unit was a zone of ground water solution. Unit is much weathered and similar to unit 12. . . . .	2	
8. Dolomite, buff to grayish-buff, medium to coarsely crystalline, with numerous laminae; weathers into layers 4 to 7 in. in thickness . . . . .	3	6
7. Dolomite, light gray mottled with pinkish-gray irregularly shaped areas, finely crystalline and laminated; laminae contorted, probably due to submarine gliding. . . . .		7
6. Dolomite, light buff, coarsely crystalline, massive, with few cavities . . . . .	1	9
5. Dolomite, arenaceous, buff-gray mottled with pinkish-gray irregularly shaped areas; massive, with vugs of calcite in the form of "dog-tooth spar". Rock contains ? <u>Cylindrophyllum</u> , <u>Prosserella</u> and other fossils. . . . .	2	4
4. Dolomite, buff-gray mottled with pinkish-gray irregularly shaped areas, medium to coarsely crystalline, containing few vugs of calcite in the form of "dog-tooth spar"; weathered surfaces show laminae. . . . .	2	5
3. Dolomite, similar to unit 5 but somewhat darker, in layers 6 to 12 inches in thickness . . . . .	5	10
2. Dolomite, very light gray, very fine grained, thin bedded, in layers 1 to 6 inches in thickness, and laminated; laminae prominent on weathered surfaces; some laminae contorted probably due to submarine gliding. Weathering along bedding planes and closely spaced joints causes dolomite to break into angular blocks. Weathered white surfaces of the rock make unit conspicuous. . . . .	2	3
Exposed in east wall of East quarry of France Stone Company about one-tenth mile south of Brint Road (see Fig. 1 and Pl. 2, Figs 1 and 2).		
1. Dolomite, buff-gray, light buff on weathered surfaces; thinner bedded than underlying Amherstburg dolomite . . . . .	10+	
Total thickness . . . . .		83' 9" - 84' 1"

## AMHERSTBURG DOLOMITE

Unit	Ft.	In.
2. Dolomite, gray to buff-gray, mottled with bluish-gray, thick-bedded, containing some fine quartz sand, vugs and geodes of crystalline calcite, and molds of <u>Cylindrophyllum profundum</u> (Sherzer and Grabau), <u>Zaphrentis carinata</u> (Sherzer and Grabau), <u>Prosserella modestoides</u> Sherzer and Grabau, <u>Conocardium monroicum</u> Grabau, <u>Mourlonia</u> ? sp. and other gastropods. Prominent zone of vugs and geodes between 1 and 7 ft. below top of unit . . . . .	14	2
1. Dolomite, gray to buff-gray, with much quartz sand and many large vugs and geodes of crystalline calcite; lower 2 ft. with abundant sand and more buff than remainder of unit . . . . .	5	3
Total thickness . . . . .		19' 5"

About 9 ft. of Sylvania sandstone is exposed below the Amherstburg dolomite at this locality. It consists of medium to coarse grained, buff-gray, cross bedded sandstone with grains of frosted quartz. Vugs and geodes with crystals of calcite present in considerable abundance between 1 and 3 ft. below top of sandstone.

#### SYLVANIA SANDSTONE

Exposed at east end of small abandoned quarry south of Sylvania Avenue, and in Toledo Stone and Glass Sand Company quarry

Unit	Ft.	In.
3. Sandstone, consisting of quartz sand in dolomitic matrix and having fossils near base. Some or all of unit may be sandy phase of Amherstburg dolomite . . . . .	10	
2. Sandstone, consisting of fine quartz sand in calcareous cement and thick bedded. Exposed in quarry face . . . . .	18	
1. Sandstone, consisting of fine quartz sand. Estimated thickness . . . . .	22	
Total thickness . . . . .	50'	

The best exposure of the Sylvania sandstone in Michigan is in the quarry of the Michigan Silica Company about 1 mile southeast of Rockwood, Wayne County, Michigan (see Map 1 and Pl. 1, Figs. 2 and 3). The lithologic character, thickness, and fossils of the formation in this quarry and in drill cores in this region are noted in the following description.

Description of Sylvania Sandstone Exposed in Quarry of Michigan Silica Company About  
1 Mile Southeast of Rockwood, Wayne County, Michigan

#### SYLVANIA SANDSTONE

Exposed in walls of quarry

Unit	Ft.	In.
4. Sandstone, white to grayish-white, cross-bedded and friable; quartz grains frosted and well rounded; some grains secondarily enlarged with crystalline silica. Locally sandstone contains some dolomitic cement. Crinoid columnals, and fragments of dendroid graptolites, <i>Favosites</i> sp., and other indeterminable fossils rare. Unit contains scattered masses of unusually fine calcite and celestite crystals. Sherzer and Grabau (1910, p. 84) found the sand of this sandstone "to actually <u>out-Sahara</u> the Sahara sand itself so far as purity, rounding and assorting are concerned." . . . . .	33	
Formerly exposed in walls of crusher pit below quarry floor		
3. Sandstone, similar to unit 4 . . . . .	12	
2. Dolomite, exceedingly arenaceous, light gray to nearly black with bands of chert nodules; some layers with numerous pebbles of dolomite and mud-lumps, both of which contain an abundance of quartz sand. Dolomite contains fragments of pelecypods, gastropods, <i>Mesoconularia</i> sp., and <i>Tentaculites</i> sp. and small, much worn pieces of arthrodiran bone. At the time of excavation of the crusher pit a very large flow of hydrogen sulphide water was encountered in this unit. . . . .	15	
Unexposed		
1. Sandstone, white to grayish-white, known from drill cores obtained from places near quarry . . . . .	30-35	
Total thickness . . . . .	90'-95'	

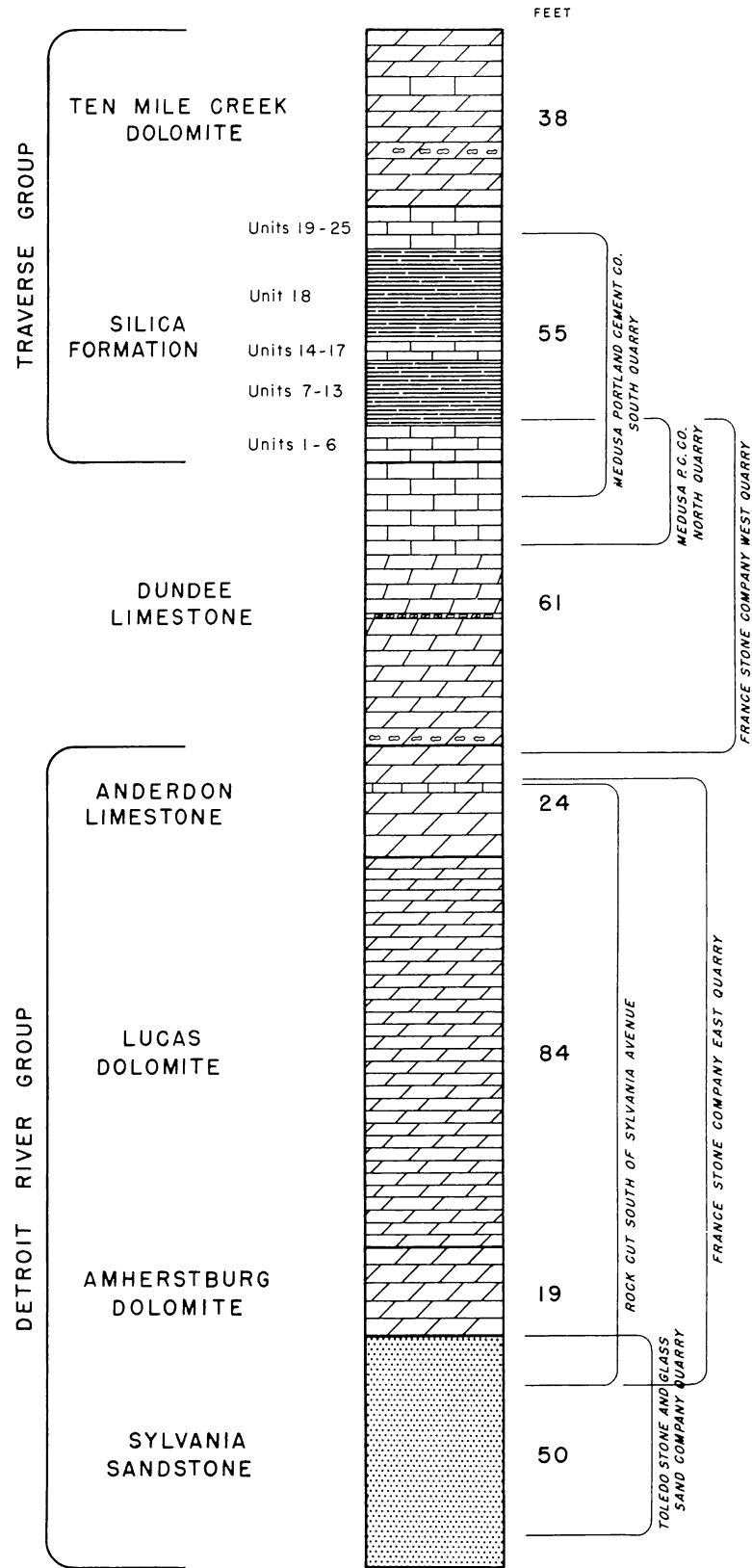


Fig. 2. Columnar section of the Devonian rocks of the Silica, Ohio region, giving the thickness of each formation and indicating the strata found in the various quarries.

The total thickness of the Sylvania sandstone near the area of outcrop as found in a core drilled by the International Salt Company about 1 mile west of this company's mine in Oakwood, near the southwestern limit of Detroit, is 120 feet. In the type area of the Sylvania sandstone, near Sylvania, Ohio, the thickness is only about 50 feet. In the region of the Michigan Silica Company quarry, the thickness is 90 to 95 feet, as indicated in the above description; the contact of the Sylvania with the underlying Raisin River dolomite in this region was encountered in the drill holes from which the cores were taken. The highest beds of the Sylvania were not penetrated because drilling began below the contact of the Sylvania with the overlying Amherstburg dolomite.

In the area delineated by Map 1, the greatest thickness of the formation is known from wells; according to Landes (1945b, Fig. 1) this thickness is over 300 feet and is found in eastern Washtenaw County, Michigan, about 5 miles east of Ann Arbor.

#### DETROIT RIVER GROUP - AMHERSTBURG DOLOMITE

The Amherstburg dolomite, which overlies the Sylvania sandstone, was named by Sherzer and Grabau (1909, pp. 542-543) for a thick bedded, brown dolomite brought to the surface during the course of the dredging of the eastern or Canadian channel of the Detroit River opposite Amherstburg, Ontario. At the time of Sherzer and Grabau's study it was also exposed a short distance west of the Canadian channel in a dry cut in the bottom of the Detroit River. The dolomite became almost completely covered by water when the river was directed into the cut to form the Livingstone Ship Channel (see Map 1).

Sherzer and Grabau (1910, p. 51) believed that only the Amherstburg dolomite was present in the bottom of the Detroit River. They (1910, p. 49) recorded the occurrence of Acanthonema holopiforme Sherzer and Grabau and Hormotoma subcarinata Grabau [= Murchisonia subcarinata (Grabau)] in the Amherstburg of the Detroit River. These two gastropods are characteristic of the Lucas dolomite and so far as known have not been found in the Amherstburg dolomite. A large part of the rocks which were exposed in the Detroit River at the time of the excavation of the Livingstone Channel, belong to the Lucas formation and Sherzer and Grabau erred in assigning many Lucas species to the Amherstburg dolomite.

At present the only accessible outcrop of the Amherstburg in southeastern Michigan is in the small abandoned Cummin's quarry located in the SE. 1/4 sec. 2, T. 8S., R. 6E., about 6 miles south and 1 3/4 miles east of Petersburg, Monroe County (see Map 1). This quarry shows about 15 feet of gray to buff-gray, porous dolomite with considerable quartz sand and many typical Amherstburg fossils preserved as molds. The Amherstburg rests on 2 feet of Sylvania sandstone, exposed in a shallow trench of the quarry floor.

The Amherstburg dolomite is well exposed in the Silica, Ohio, region. Its lithologic character, thickness and more common fossils are given in the description of the Detroit River group of this region previously presented.

The Amherstburg dolomite in the Silica, Ohio, region is about 50 feet thick. It increases in thickness toward the Detroit area where it has a thickness of about 70 feet.

#### DETROIT RIVER GROUP - LUCAS DOLOMITE

The Lucas dolomite was named by Prosser (1903, pp. 540-541) to include "all rocks between the top of the Sylvania sandstone and the base of the Columbus limestone" in Ohio or the Dundee limestone in southeastern Michigan. Prosser believed that the beds in northwestern Ohio which he called Columbus were the same beds that Mather (1859, p. 25) and Newberry (1873, p. 89) described by that name from quarries in the vicinity of Columbus, Ohio. As now recognized, the Columbus limestone is absent in northwestern Ohio and the younger Dundee limestone was the one to which Prosser referred. By Prosser's definition the lower part of his Lucas limestone included rocks which are now classified as Amherstburg and the upper part included rocks now called Anderdon.

Lane, Prosser, Sherzer, and Grabau (1909, p. 555) proposed the name Detroit River series for the rocks between the Sylvania sandstone and the Dundee limestone. They listed the Lucas dolomite as the uppermost bed of their Detroit River series, which also included the Flat Rock dolomite, Anderdon limestone, and Amherstburg dolomite (see Chart 1). This succession of beds was based on the erroneous belief of Sherzer and Grabau (1909) that the Dundee limestone overlapped all formations of their

Lane, Prosser, Sherzer, and Grabau - 1909			Classification used in this paper			
UPPER SILURIAN	MONROE FORMATION	Upper Monroe or Detroit River series  (Lane, Prosser, Sherzer and Grabau)	Lucas dolomite (Prosser-1903) Amherstburg dolomite (Sherzer and Grabau-1909) Anderdon limestone (Sherzer and Grabau-1908) Flat Rock dolomite (Sherzer and Grabau-1909)	MIDDLE DEVONIAN ULSTERIAN SERIES	Detroit River Group	Anderdon limestone
		Middle Monroe	Sylvania sandstone (Orton-1888)			Lucas dolomite (Restricted)
		Lower Monroe or Bass Islands series  (Lane, Prosser, Sherzer and Grabau)	— Disconformity — Raisin River dolomite (Sherzer and Grabau-1909) Put-in-Bay dolomite (Sherzer and Grabau-1909) Tymochtee beds (Winchell-1873) Greenfield dolomite (Orton-1871)	UPPER SILURIAN CAYUGAN SERIES	Bass Islands group	— Disconformity — Raisin River dolomite
Salina group	Put-in-Bay dolomite	Tymochtee beds				
						Greenfield dolomite

Chart 1. Chart comparing the classification used in this paper for rocks of the Detroit River group with that used by Lane, Prosser, Sherzer, and Grabau in 1909.



Detroit River series. In Figure 1 of Sherzer and Grabau's paper, their Detroit River series is shown in a syncline under the Detroit River between Sibley quarry and the Anderdon quarry, which is now worked by the Brunner, Mond Canada, Ltd. This syncline does not exist; the strata have a general northwesterly dip from the Anderdon quarry to Sibley quarry. At both quarries the Dundee limestone rests disconformably on the Anderdon limestone. The Lucas and Amherstburg dolomites are present beneath the Anderdon limestone at both quarries and throughout the entire southeastern Michigan - northwestern Ohio region and obviously could not have been removed from above the Anderdon by pre-Dundee erosion.

The Flat Rock dolomite was described by Sherzer and Grabau (1909, pp. 541, 546) from exposures in the Oakwood salt shaft, in a quarry at Flat Rock, Michigan, and along the Huron River at Flat Rock. Present investigations indicate that the Sylvania sandstone is succeeded respectively by the Amherstburg dolomite, the Lucas dolomite, and the Anderdon limestone. The Flat Rock dolomite of Sherzer and Grabau can not be distinguished as a distinct formation. Ehlers (1950, pp. 1455-1456) stated that there is little doubt that this dolomite is a part of the Amherstburg dolomite, and suggested that the name Flat Rock be dropped from stratigraphic nomenclature.

The name Lucas is restricted in this paper, as previously suggested by Ehlers (1950, pp. 1455-1456), to the beds above the Amherstburg dolomite and below the Anderdon limestone.

The Lucas dolomite is well shown in quarries of the type area near Silica, Ohio. Its lithologic character and thickness are given in the detailed description of the Detroit River group presented on previous pages.

The Lucas dolomite is very poorly exposed in southeastern Michigan. One of the largest exposures was shown in a cut made in the bed of the Detroit River at the time of the excavation of the Livingstone Channel. The Patrick quarry at the south end of Grosse Isle about 4 1/2 miles northeast of Rockwood and the Gibraltar quarry about 4 miles east of Flat Rock (see Map 1) showed representative sections of the Lucas dolomite with many fossils diagnostic of this formation before they were abandoned and became filled with water. A small section of the Lucas is shown in the walls of the crusher pit of the Solvay Process Company's quarry at Sibley, Michigan, and is described on later pages in a detailed description of all the rocks of this quarry. This section, like those of older quarries in Michigan exhibiting Lucas strata, is likely to become covered with water or earth because the Sibley quarry has now been abandoned as a source of limestone.

The Lucas dolomite in the Silica, Ohio, quarries is about 84 feet thick and in the Detroit region 170 feet.

#### DETROIT RIVER GROUP - ANDERDON LIMESTONE

The Anderdon limestone was named by Sherzer and Grabau (1908, p. 408) for a high calcium limestone exposed in the Anderdon (Brunner, Mond Canada, Ltd.) quarry about 1 1/4 miles north of Amherstburg, Ontario, (see Map 1). The lithologic character and thickness of the Anderdon limestone and the underlying Lucas and overlying Dundee formations at this locality are given in the following description.

##### Description of Rocks Exposed in Quarry of Brunner, Mond Canada, Ltd. ("Anderdon quarry" of many authors) in Anderdon township about 1 1/4 miles northeast of Amherstburg, Ontario

#### DUNDEE LIMESTONE

Exposed in wall of quarry

Unit	Ft.	In.
1. Limestone and dolomitic limestone similar to Dundee strata in Solvay Process Company quarry at Sibley, Michigan. Detailed description given by C. R. Stauffer (1915, p. 202). Basal bed of unit is buff, dolomitic limestone with considerable quartz sand. Thickness, given by Stauffer (1915, p. 202). . . . .	54	5
Total thickness . . . . .	54'	5"

DISCONFORMITY

ANDERDON LIMESTONE

Exposed in wall and floor of quarry

Unit	Ft.	In.
16. Limestone, light gray to light bluish-gray, finely crystalline, containing <u>Idiostroma</u> sp., other stromatoporoids, <u>Favosites</u> sp., an athyrid, a costate <u>Atrypa</u> , <u>Pentamerella</u> sp., <u>Leiorhynchus?</u> sp., several genera and species of cephalopods, many large, loosely-coiled, low-spired gastropods. Molds of many gastropods and cephalopods filled with buff, arenaceous and dolomitic-limestone of overlying Dundee formation. Quartz sand of basal Dundee present in weathered fissures of Anderdon limestone to a depth of 4 feet below top of unit 16 (unit 7 of Stauffer, 1915, p. 203) . . . . .		6
15. Limestone, light buff-gray, crystalline, containing few stromatoporoids, few poorly preserved tetracorals and brachiopods, many undescribed species of gastropods, and <u>Barychilina</u> sp., <u>Kloedenia</u> sp., and species of the ostracod families Cypridae and Leperditidae. Unit 6 of Stauffer (1915, p. 203) . . . . .	2	0
14. Limestone, gray, crystalline, with <u>Idiostroma</u> sp., numerous other stromatoporoids, many corals including the genera <u>Cystiphyllodes</u> , <u>Disphyllum</u> , <u>Emmonsia</u> , <u>Favosites</u> and <u>Heterophrentis</u> , a costate <u>Atrypa</u> , an athyrid, <u>Conocardium sibleyense</u> LaRocque, undescribed species of <u>Murchisonia</u> , <u>Platyloron</u> , <u>Rhineoderma</u> and <u>Tropidodiscus</u> , and species of the ostracod genera <u>Aparchites</u> , <u>Isochilina</u> , <u>Kloedenia?</u> , and <u>Punctoprimitia</u> . Small, low bioherms composed largely of a digitate <u>Favosites</u> in a brown to brownish-black dolomite having considerable asphaltic material present locally in quarry. Unit 5 of Stauffer (1915, p. 203). . . . .	4	8
13. Limestone (caliculitite), light buff-gray, banded with darker gray, with small disseminated crystals of calcite; lowest 6 inches more buff than rest of unit. Units 13 to 1 inclusive approximately equivalent to unit 4 of Stauffer (1915, p. 203) . . . . .	3	6
12. Dolomite, dark gray to blackish-gray, with scattered crystals of calcite and grains of quartz sand. . . . .		5
11. Limestone (caliculitite), very light buff-gray, with disseminated small crystals of calcite, conchoidal fracture, and stylolites . . . . .	2	4
10. Limestone (caliculitite), similar to unit 11, with some darker gray bands arranged parallel to bedding . . . . .	3	
9. Limestone (caliculitite), light gray to light buff-gray, with conchoidal fracture. . . . .		8
8. Limestone slightly dolomitic, buff to brown, medium to coarsely crystalline, with discontinuous thin bands of gray, finely crystalline limestone . . . . .		9
7. Limestone (caliculitite), buff-gray to light buff, with small scattered crystals of calcite and few grains of quartz sand; lowest 10 inches a calcarenite . . . . .	3	
6. Limestone (caliculitite), light buff-gray banded with darker buff-gray . . . . .		8
5. Limestone (caliculitite), like unit 6 but with wider bands of color. . . . .	1	2
4. Limestone (caliculitite), lighter buff-gray than unit 5, without color banding and with conspicuous conchoidal fracture . . . . .	1	10
3. Limestone, light gray, with few small vugs of calcite, and earthy feel, and stromatoporoids . . . . .		8

Exposed in ditch beside west wall of crusher

Unit	Ft.	In.
2. Limestone (calcarenite), light gray, with small vugs lined with crystals of calcite; ? <i>Idiostroma</i> sp. and athyrid . . . . .	1	11
1. Limestone, very light buff-gray, with very few small crystals of calcite and few ostracods . . . . .	1	8
Total thickness . . . . .	28'	9"

#### DETROIT RIVER GROUP - LUCAS DOLOMITE

Upper 5 to 6 feet exposed locally in quarry floor; remainder in walls of crusher pit.

Unit	Ft.	In.
14. Limestone, very dolomitic, crystalline, with stromatoporoids and corals. Units 14 and 13 approximately equivalent to unit 3, "Flat Rock dolomite?", of Stauffer (1915, p. 203). . . . .	1	0
13. Limestone, dolomitic, light buff, crystalline, with few very thin, undulating seams of black carbonaceous material, stromatoporoids and corals . . . . .	1	5
12. Limestone, slightly dolomitic, crystalline, light buff though darker than unit 13, with stromatoporoids and corals. Unit approximately equivalent to unit 2, "Flat Rock dolomite?", of Stauffer (1915, p. 203) . . . . .	1	6
11. Limestone (calclutite), gray, with minute disseminated crystals of calcite and few vugs of calcite; lowest 6 inches of unit buff-gray and without scattered crystals of calcite. The limestone is unit 1, "Flat Rock dolomite?", of Stauffer (1915, p. 203) but is 7 inches thinner in crusher pit than where observed elsewhere in quarry by Stauffer . . . . .	1	11
10. Limestone, dolomitic, buff to brown, medium to coarsely crystalline, with numerous undulating and interrupted laminae of carbonaceous material and few vugs of celestite . . . . .	6	3
9. Limestone (calclutite), light buff-gray, finely crystalline, with few minute crystals of calcite and a conchoidal fracture. . . . .		11
8. Dolomite, light buff, finely crystalline, with many rounded and frosted grains of quartz sand. . . . .	2	
7. Limestone, dolomitic, buff with thin bands of gray, finely crystalline. Top of unit marked by seam of black carbonaceous residuum. . . . .	2	6
6. Limestone, light gray and very finely crystalline. . . . .	4	
5. Limestone, dark gray mottled with buff, containing minute scattered crystals and small vugs of calcite. <i>Idiostroma</i> sp. and other stromatoporoids abundant, a small athyrid also present. . . . .		6-9
4. Limestone (calcarenite), light gray, with small vugs of calcite and many <i>Idiostroma</i> sp. . . . .	2	
3. Covered by concrete flooring at bottom of crusher pit . . . . .	1	4
2. Limestone (calcarenite), light gray with very small vugs of calcite, few <i>Idiostroma</i> sp., and few bands of very fine apparently unfossiliferous material (calclutite). Samples of limestone obtained below surface of water, filling small sump noted in unit 1. . . . .	2	
1. Covered by water in small sump excavated below concrete flooring at bottom of crusher pit. Rock of this covered unit probably is limestone or dolomite . . . .	2	
Total thickness. . . . .	29' 4"	- 29' 7"

The Dundee limestone of the above description has the same fauna as the Dundee limestone of southeastern Michigan and is not the Onondaga limestone as classified by Stauffer (1915, p. 202). The Anderdon limestone of the Brunner, Mond Canada, Ltd. quarry is a high-calcium limestone. In Sibley quarry, it is a dolomitic limestone. In the Silica, Ohio region most of the formation is dolomite. The

strata below the Anderdon limestone of the Brunner, Mond Canada, Ltd. quarry are assigned to the Lucas dolomite on the basis of stratigraphic position.

#### DUNDEE LIMESTONE

The Dundee limestone was named by Lane in Wadsworth (1893, p. 66) for rocks formerly exposed in the abandoned Pulver quarry in Dundee, Monroe County, Michigan.

As early as 1838 Douglass Houghton mentioned the occurrence of limestone in the bed of the Raisin River at Dundee. In the latter part of the nineteenth century the Pulver quarry located within the Dundee city limits was opened, but was soon abandoned and became filled with water. Sherzer (1900, pp. 77-78) examined the quarry, which at that time was filled with water to within 2 feet of the top. By examination of loose blocks of limestone scattered around the quarry and with information furnished by Pulver and former quarrymen, Sherzer pieced together a section aggregating 18 feet 6 inches in thickness. This section has been tabulated by Bassett (1935, p. 433).

The most nearly complete exposure of the Dundee limestone is located in the quarry of the Solvay Process Company at Sibley, 2 miles north of Trenton, Wayne County, Michigan (see Pl. 1, Fig. 1). The lithologic character, thickness, and fossils of the formation and of the underlying Anderdon and Lucas strata of this quarry are given in the following description.

#### Description of Strata Exposed in the Solvay Process Company's Quarry at Sibley, About Two Miles North of Trenton, Wayne County, Michigan

(Modified from description by Bassett, 1935, pp. 429-431; unit numbers in parentheses refer to Bassett's intervals)

#### DUNDEE LIMESTONE

Exposed in quarry walls

Unit	Ft.	In.
11 (25) Limestone, coarsely crystalline, light-gray to grayish-white to light buff-gray, becoming darker and more finely crystalline toward top. <u>Atrypa costata</u> Bassett, <u>Brevispirifer lucasensis</u> (Stauffer), and <u>Paracyclas proavia</u> (Goldfuss) are common in this unit . . . . .	24	8
10 (24) Limestone, finely crystalline, gray, weathering to buff. Lower part contains much chert, some of which is laminated. Many fossils. The most characteristic are <u>Favosites "turbinatus"</u> Billings, <u>Atrypa elegans</u> (Grabau), and <u>A. elegans</u> var. <u>gibbosa</u> Bassett. . . . .	1	6
9 (23) Limestone, granular with coarse coquina bands, buff-gray. <u>Actinodesma occidentale</u> (Hall) present in this unit or in unit 21 . . . . .	6	0
8 (22) Limestone, finely crystalline, buff-gray, fossiliferous, containing bands of chert and chert nodules. <u>Brevispirifer lucasensis</u> (Stauffer) and other fossils . . . . .	2	0
7 (21) Limestone, coarsely crystalline, grayish-white, and very fossiliferous. Two feet above the base is a <u>Cyrtina</u> bed 1 inch to 2 inches thick; at some places in quarry this is absent as the result of solution accompanying the formation of stylolites . . . . .	8	0
6 (20) Limestone, finely crystalline, gray, having a lumpy appearance when broken. Contains many small and well-preserved fossils . . . . .	0	8
5 (19) Limestone, similar to unit 4 but coarser crystalline and darker in color . . . . .	0	10
4 (18) Limestone, finely crystalline, light buff-gray, with numerous small black specks. Small chert nodules scattered in lower 1 1/2 feet; stylolites abundant in lower and upper parts of unit. Fossils rare . . . . .	5	6
3 (17) Limestone, coarsely crystalline but not as coarsely crystalline as unit 2, light pinkish to buff-gray; minute subspherical particles of crystalline calcite in lower 22 inches; lower 41 inches finer crystalline and more		

Unit	Ft.	In.
buff than overlying part of unit. At points 22, 29 and 39 inches above base are layers of chert nodules. The limestone above the chert is light gray, contains numerous columnals of crinoids, which stand in relief on the weathered surfaces of the rock, and thick-bedded. The upper 1 foot 7 inches of the limestone is light gray and contains numerous shells of fossils.		
Unit very fossiliferous . . . . .	9	7
2 (16) Limestone, coarsely crystalline, gray and containing few fossils . . . . .	1	6
1 (15) Limestone, coarse grained in upper and lower parts, finer grained in middle part; buff-gray. Coarse-grained parts are fossiliferous coquina limestone. The presence of many columnals of crinoids gives the surface of the limestone a rough appearance. The upper part contains many shells of <u>Rhipidomella variabilis</u> Grabau, cup corals, and <u>Favosites "turbinatus"</u> Billings. In the lower part, shells of <u>Stropheodonta</u> are more abundant than those of <u>Rhipidomella</u> . Distantly spaced chert nodules are present a short distance above and below the juncture of the lower coarse and the middle finer grained parts. The basal 6 inches of the unit is full of frosted quartz grains, which at some places are concentrated in shallow depressions in the top of the underlying Anderdon limestone. This arenaceous band at the base of the unit is the basal deposit of the Dundee limestone, which rests disconformably on the Anderdon limestone. . . . .	10	2
Total thickness. . . . .	70'	5"

## DISCONFORMITY

## DETROIT RIVER GROUP - ANDERDON LIMESTONE

Exposed in walls of quarry

Unit	Ft.	In.
8 (14) Limestone, finely crystalline, very light gray, unfossiliferous except for few molds of a minute gastropod found near the top of the bed at some places in quarry; vertical jointing and weathered light gray to white surfaces are conspicuous characteristics of unit. See Pl. 1, Fig. 1. . . . .	2	4
7 (13) Limestone, finer grained in lower and upper parts; coarser grained, with some frosted quartz grains in the middle part; buff. Many carbonaceous laminae in the upper and lower parts. Unfossiliferous . . . . .	4	0
6 (12) Limestone, finely crystalline, dark gray, 2 inches to 8 inches thick, containing small disseminated crystals of calcite. Unfossiliferous. . . . .	0	8
5 (11) Limestone, fine grained, light gray, unfossiliferous . . . . .	4	0
4 (10) Limestone, granular, dark buff to brown at base to light buff-gray at top. Lowest 3 inches has many carbonaceous laminae. Above this is a band, 3 inches to 4 inches thick, which contains molds of <u>Pleurotrochus tricarinatus</u> Grabau and of undescribed species of <u>Loxonema</u> , <u>Murchisonia</u> , <u>Platyloron</u> , <u>Rhineoderma</u> , <u>Tropidodiscus</u> and other genera of gastropods. <u>Conocardium sibleyense</u> La Rocque, <u>Diodontopteria ehlersi</u> La Rocque and a few other pelecypods and cephalopods are associated with the gastropods. The gastropods and pelecypods are present above and below the 4 inch band but are less abundant. Most of the unit is characterized by a digitate <u>Favosites</u> and hemispherical and explanate stromatoporoids, in such abundance as to form a biostrome. A small coarsely plicate <u>Atrypa</u> is fairly common in the biostrome. See Pl. 1, Fig. 1. . . . .	5	0
3 (9) Limestone, granular, buff, composed of finely comminuted shells, locally cross-bedded in lower part. Contains many quartz grains, especially in the cross-bedded part. Unfossiliferous . . . . .	5	0

Unit	Ft.	In.
2 (8) Limestone, fine grained, light buff with numerous carbonaceous laminae. Unfossiliferous . . . . .		3
1 (7) Limestone, fine grained, grayish buff, separated into linear and wavy laminae by thin films of carbonaceous matter. Upper 3 inches has small areas of dark gray limestone, some of which simulate pebbles. Many stylolites. Un- fossiliferous . . . . .	2	6
Total thickness . . . . .	23'	9"

## DETROIT RIVER GROUP - LUCAS DOLOMITE

Exposed in quarry wall

Unit	Ft.	In.
15 (6) Dolomite, finely crystalline, light buff, banded in light and dark shades of this color. Upper 4 inches has irregular gray bands of dolomitic lime- stone which are broken into angular fragments . . . . .	1	3
Formerly exposed in small sump in floor of quarry about one-fifth of a mile south of crusher. Sump now filled with rock and soil.		
14 (5) Limestone, dolomitic, fine grained, light buff-gray, on weathering shows layers one-half to four inches in thickness. Contains many small, ir- regular masses of calcite. Stylolites present. Unfossiliferous . . . . .	1	0
13 (4) Limestone, dolomitic, coarser grained than unit 12, buff, with laminae of lighter and darker shades. Locally, the laminae are bent and fractured. Contains irregularly shaped masses of crystalline calcite. Un- fossiliferous . . . . .	4	0
12 (3) Dolomite, exceedingly fine grained, light gray, on weathering shows mottling of pink or black. Unfossiliferous. . . . .		6
11 (2) Dolomite, fine grained, laminated, light to dark buff, with irregularly shaped masses of calcite. Angular fragments of dolomite locally present in middle of bed. Unfossiliferous . . . . .	3	0
10 (1) Limestone, dolomitic, fine grained, dark to light buff, with some calcite geodes. Base not seen . . . . .	1	6
9 Covered to unit 8 . . . . .	1 <sub>+</sub>	
Exposed in walls of crusher pit		
8 Limestone, dolomitic, more dolomitic at top and bottom, light buff-gray in lower part grading to buff in upper part, with vugs of calcite and numerous laminae of dark brown carbonaceous material; laminae dis- placed with faults of very small throw; prominent stylolite, 3 inches in height, at base of unit . . . . .	6	8
7 Limestone, dolomitic, buff, finely crystalline . . . . .	1	10
6 Limestone, dolomitic, light buff-gray to buff, finely crystalline . . . . .	12	4
5 Dolomite, light buff-gray with contorted light buff carbonaceous laminae in lower part grading into very light gray in upper part; lower part more crystalline than upper part; upper part with local concentrations of numerous rhombohedral crystals of calcite and few rounded grains of quartz . . . . .	2	2
4 Limestone, very dolomitic, light buff, finely crystalline, with disseminated small crystals of calcite and bent and interrupted laminae of brownish- black carbonaceous material; lower 4 inches in layers one-quarter to one-half inch in thickness . . . . .	4	6

Unit	Ft.	In.
3 Dolomite, buff, crystalline, with black carbonaceous laminae and scattered grains of quartz . . . . .	0	8
2 Limestone, light buff-gray, finely crystalline, with small scattered quartz, sand, brownish-black carbonaceous laminae, and stylolites. Thinner bedded than unit 1. Limestone apparently consists of comminuted fossils; few fragments of echinoderms and bryozoa recognizable . . . . .	4	4
1 Limestone, dolomitic, very light buff-gray grading downward into buff, porous, dolomite. Limestone has small vugs of calcite and few stylolites; dolomite contains a larger number of stylolites, <i>Prosserella</i> sp. and small, low spired gastropods. Water with hydrogen sulphide issues from strata below base of unit in bottom of crusher pit. . . . .	6	6
Total thickness . . . . .	51'	3"

The only other exposure of the Dundee limestone in southeastern Michigan is in the abandoned Christiancy quarry in the floodplain of Macon Creek about 2 miles northeast of Dundee. Sherzer (1900, p. 75) described over 20 feet of beds exposed in this quarry in 1900. Since that time all except the upper few feet and the surrounding dump piles have been covered with water.

An extensive exposure of the formation is present in the quarries near Silica, Ohio. The lithologic character, thickness and more common fossils of the Dundee limestone of the Silica region are given in the following description (see Figs. 1-2 and Pl. 4, Figs. 1-12).

Description of Dundee Limestone ("Columbus Limestone" of Ohio Geologists)  
Exposed in Silica, Lucas County, Ohio Region

DUNDEE LIMESTONE

Exposed in West Quarry of France Stone Company and South and North Quarries of Medusa Portland Cement Company

Unit	Ft.	In.
11. Limestone, light bluish-gray, in beds 4 inches to 12 inches thick, with many fossils. Most characteristic fossil of unit <i>Productella spinulicosta</i> Hall. <i>Cyrtina</i> sp. abundant in lower and upper part of limestone. Unit also contains <i>Brevispirifer lucasensis</i> (Stauffer), an excellent guide fossil, found also in the Dundee of northeastern Michigan and southwestern Ontario, <i>Atrypa costata</i> Bassett, other brachiopods, <i>Hexagonaria</i> sp., <i>Favosites</i> sp. and bryozoa. . . . .	5	0
10. Limestone, bluish-gray to brownish-gray, with few fossils. Most characteristic fossil of unit <i>Paracyclas proavia</i> (Goldfuss). <i>Cyrtina</i> sp. abundant in lenses. <i>Atrypa costata</i> Bassett also present . . . . .	3	6
9. Limestone, gray, with many fossils. <i>Sulcoretepora</i> sp. and other cryptostomatous bryozoa characteristic of unit. Some layers in upper part filled with a species of <i>Cyrtina</i> . <i>Phenacocyclus</i> sp. cf. <i>P. pohli</i> LaRocque, <i>Conocardium cuneus</i> (Conrad) and <i>Favosites</i> sp. also present . . . . .	2	6
8. Limestone, bluish-gray to brownish-gray, in layers 6 inches to 12 inches thick. <i>Cyrtina</i> sp. present in lenses in upper 2 feet. <i>Atrypa costata</i> Bassett also present . . . . .	5	6
7. Limestone, brownish-gray to brown, very fossiliferous. <i>Favosites</i> sp. cf. <i>F. turbinatus</i> Billings very common . . . . .	3	6

Units 1 to 6 exposed in rock cut in east wall of West Quarry of France Stone Company about one-fifth mile north of Sylvania Avenue.

Unit	Ft.	In.
6. Limestone, dolomitic, light buff-gray, uneven-bedded, in beds 6 inches to 8 inches in thickness; lighter in color than unit 5 . . . . .	3	2
5. Limestone, dolomitic, buff-gray, finely crystalline, in beds about 1 foot in thickness . . . . .	9	0
4. Limestone, dolomitic, buff-gray, with many chert nodules 2 inches to 8 inches thick. Nodules contain many specimens of trochiliscids, brachiopods, <i>Tentaculites scalariformis</i> Hall, and ostracods. Specimens of <i>Brevispirifer lucasensis</i> (Stauffer) and <i>Glyptodesma erectum</i> (Conrad) are less abundant. . . . .	1	3
3. Limestone, dolomitic, light to buff-gray, in beds 6 inches to 18 inches in thickness; few chert nodules in upper 5 feet with <i>Atrypa elegans</i> Grabau and other fossils . . . . .	8	0
2. Dolomite and dolomitic limestone, light buff-gray to buff; dolomite composes most of lower half of unit . . . . .	12	0
1. Covered in large part. Between the end of the rock cut in the east wall of the West Quarry of the France Stone Company and the contact between the Dundee limestone and the underlying Anderdon limestone about 35 feet west of Centennial Road are discontinuous field exposures of weathered buff dolomite, the lower beds of which contain chert. Probably most of the covered interval consists of dolomite or dolomitic limestone. The chert contains few fragmentary crinoid columnals, gastropods and orthoconic cephalopods. . . . .	8 <sub>+</sub>	
Total thickness . . . . .	61'	5"

A comparison of the Dundee section at Silica with the one at Sibley shows that the formation is thinning southward and that the lower beds have become dolomitic in northwestern Ohio.

#### SILICA FORMATION

The name Silica shale was proposed by Grace A. Stewart (1927, p. 5) for shales and thin, intercalated argillaceous limestones exposed in a quarry excavated a few years previously by the Sandusky Cement Company. Intermittent exposures of the formation along Ten Mile Creek had been previously called "Traverse" by Stauffer (1909, pp. 144-145) and other authors. The type locality for the formation is the aforementioned quarry, now operated by the Medusa Portland Cement Company (see South quarry, Fig. 1).

In 1927 only 23 feet of the formation was exposed, but later operations and drill cores revealed a total of 45 feet of beds of this type of lithology underlain by 8 feet of bluish-gray limestone which is somewhat argillaceous in its upper part. This limestone, directly overlying the Dundee limestone, was given the provisional name "Blue" limestone by J. E. Carman in Bassett (1935, p. 437) and in Stewart (1938, pp. 6-7). Because the fauna of the "Blue" limestone is similar to that of the overlying shales and intercalated limestones, the authors, after a field conference with Drs. Carman and Stewart, have dropped the name "Blue" limestone and have extended the name Silica formation to include the entire 53 feet of beds above the Dundee limestone.

The lithologic character, thickness and more common fossils of the Silica formation are given in the following description (see Figs. 1-2 and Pls. 4-5).

#### Description of Silica Formation Exposed in Silica, Lucas County, Ohio Region

#### SILICA FORMATION

Exposed in South Quarry of Medusa Portland Cement Company (see Pl. 2, Fig. 3).

Unit	Ft.	In.
25. "Cement Rock" (argillaceous limestone)--noted in drill cores . . . . .	6 <sub>+</sub>	0



Unit	Ft.	In.
24. Limestone, very argillaceous, gray, containing scattered marcasite; on weathering, rock breaks into small angular fragments. Unit contains cryptostomatous and trepostomatous bryozoa, an auloporid, <u>Stropheodonta</u> sp. and <u>Mucrospirifer</u> sp. . . . .		19
23. Limestone, argillaceous, lighter gray than units 20, 21, and 22, harder than overlying limestone, grading into overlying and underlying units, and having numerous specimens of <u>Leiorhynchus kelloggi</u> Hall and some specimens of <u>Mucrospirifer</u> sp. . . . .		6
22. Limestone, argillaceous, dark gray, with <u>Chonetes</u> sp., <u>Leiorhynchus kelloggi</u> Hall, <u>Mucrospirifer</u> sp., and other fossils . . . . .		8
21. Limestone, slightly argillaceous, dark gray, harder than units 22 and 20, containing much marcasite and numerous large tubed auloporids . . . . .		4
20. Limestone, argillaceous, dark gray, containing <u>Stropheodonta</u> sp. and few auloporids . . . . .		5
19. Limestone, argillaceous, gray, hard, containing <u>Leiorhynchus kelloggi</u> Hall, <u>Mucrospirifer</u> sp., and <u>Stropheodonta</u> sp. Base of limestone contains low discontinuous ridges similar to those at base of unit 14. . . . .		3
18. Covered - noted in drill cores as shale; upper 2 feet, bluish-gray shale with pyrite nodules, exposed in ditch beside road at south end of South Quarry of Medusa Portland Cement Company . . . . .	20	7
17. Limestone, very argillaceous, dark gray, containing an abundance of <u>Ambocoelia umbonata</u> (Conrad) and a smaller number of <u>Leiorhynchus</u> sp., <u>Rhipidomella</u> sp., and <u>Mucrospirifer</u> sp. . . . .	1	0
16. Limestone, argillaceous, gray, grading into unit 17 . . . . .	1	0
15. Shale, gray, containing many specimens of <u>Mucrospirifer</u> sp. . . . .		3
14. Limestone, argillaceous, dark gray. Top of limestone contains many specimens of <u>Rhipidomella</u> sp. Base of limestone has discontinuous, low ridges of calcareous material containing numerous crinoidal columnals and a smaller number of fragments of other fossils; ridges are 1 to 2 inches in width and one-half to three-quarters of an inch in height. Base of limestone also has discontinuous strap-like ridges of argillaceous material containing few fragments of fossils; the ridges average one-half inch in thickness. The two types of ridges intersect each other in a haphazard manner. At some places they underlie or overlie each other and at other places cut through each other. . . . .	1	10
13. Shale, dark gray, containing <u>Arthroacantha carpenteri</u> (Hinde), <u>Gilbertsocrinus ohioensis</u> Stewart, <u>Euryocrinus ? laddii</u> Stewart, undescribed genera and species of crinoids, and two species of blastoids. The shale contains many well preserved echinoderms only where it rests on the limestone of unit 12; it has comminuted echinoderms at other places in the quarry where unit 12 is represented by a shale. . . . .		$\frac{1}{4}$ - $1\frac{1}{4}$
12. Limestone, argillaceous, gray, containing many cryptostomatous bryozoa and constituting a lens. The lens is exposed in quarry wall for a distance of about 40 feet about one-tenth of a mile south of Brint Road. Elsewhere in the quarry the lens is represented by shale. . . . .		3-4
11. Shale, gray, breaking into angular fragments on weathering. Unit contains many specimens of <u>Chonetes</u> sp. and ostracods, few fragments of <u>Rhinocaris</u> sp. and very few values of a <u>Paraspirifer</u> . . . . .	2	2
10. Limestone, argillaceous, gray, containing cryptostomatous bryozoa in abundance. The most characteristic bryozoa are <u>Acanthoclema ohioensis</u> McNair, <u>Helopora inexpectata</u> McNair, <u>Streblotrypa anomala</u> McNair, and <u>Sulcoretepora deissi</u> McNair. . . . .		4
9. Shale, bluish-gray with variously shaped concretionary masses of pyrite and many pyritized fossils; strata 2 to 6 inches in thickness. Shale weathers to a clay which becomes sticky when wet. <u>Mucrospirifer prolificus</u>		

Unit	Ft.	In.
(Stewart) and <u>Paraspirifer bownockeri</u> (Stewart) are two common species, shells of which are very numerous in the lower 1 foot of unit. Most of the fossils described from the Silica shale come from this unit. . . . .	7	6
8. Limestone, argillaceous, bluish-gray, relatively hard, containing considerable pyrite and many pyritized fossils; limestone grades into shale of unit 9. The most abundant fossil is <u>Mucrospirifer prolificus</u> (Stewart). . . . .		8
7. Shale, calcareous, bluish-gray and very fossiliferous; many fossils worn by wave action at time of burial. <u>Protoleptostrophia</u> sp. and <u>Stropheodonta</u> sp. are abundant; <u>Hercoostrophia robusta</u> Williams is rare and known only from this unit; a large species of <u>Atrypa</u> is abundant in lower 1 foot of unit. . . . .	2	6

Exposed in West Quarry of France Stone Company and South and North Quarries of Medusa Portland Cement Company

Units 1 to 6 inclusive have been designated the "Blue" limestone by Doctor J. E. Carman (see C. F. Bassett, 1935, p. 437 and Grace A. Stewart, 1938, pp. 6-7). As the result of a recent field conference, Doctors Carman, Stewart, and the authors of this guide have concluded that the "Blue" limestone should be included in the Silica formation. The lower and upper boundaries of the "Blue" limestone have been shown in Fig. 1 in order that this part of the Silica formation may be readily recognized in the field.

6. Limestone, argillaceous, bluish-gray, shaly at top and bottom. Many specimens of a large <u>Atrypa</u> sp. and a smaller number of simple corals, <u>Athyris</u> , <u>Mucrospirifer</u> sp. and other spiriferids, <u>Schizophoria</u> sp., <u>Lophonychia cordata</u> Stewart, <u>Limoptera</u> sp., other pelecypods, <u>Platyceras</u> sp. and trepostomatous bryozoa . . . . .	1	0
5. Limestone, bluish-gray, crystalline and argillaceous at top, containing a large number of <u>Heterophrentis</u> sp. and other simple corals, a smaller number of compound tetracorals and tabulate corals, and numerous specimens of <u>Cyrtina</u> sp., <u>Spinocyrtia</u> sp. and other brachiopods; <u>Lophonychia cordata</u> Stewart at top of unit; weathers brown . . . . .	4	0
4. Limestone, very argillaceous, weathering to clay . . . . .		3
3. Limestone, bluish-gray, weathers brown. Unit contains <u>Hexagonaria anna</u> (Whitfield), <u>H. tabulata</u> Stumm, numerous simple tetracorals and tabulate corals, and many specimens of <u>Atrypa</u> sp., <u>Cyrtina</u> sp., <u>Stropheodonta</u> and spiriferids . . . . .	1	0
2. Limestone, bluish-gray to brownish-gray, containing <u>Favosites</u> sp. and some large <u>Chonetes coronatus</u> (Conrad) at base . . . . .	0	10
1. Limestone, bluish-gray, containing many specimens of <u>Chonetes coronatus</u> (Conrad) and <u>Tropidoleptus carinatus</u> (Conrad) associated with <u>Atrypa</u> sp., <u>Megastrophia</u> sp., <u>Protoleptostrophia</u> sp., a few spiriferids, <u>Paracyclas</u> sp. and <u>Gosselettia triquetra</u> (Conrad) . . . . .	1	4

Total thickness . . . . . 54' 8<sup>1</sup>/<sub>4</sub>" - 54' 10<sup>1</sup>/<sub>4</sub>"

The records of many wells drilled for oil in southeastern Michigan show a northward continuation of several units of the Silica formation exhibited in the quarries near Silica. Records of deep wells in the Detroit region indicate that the Silica formation is thicker than at Silica and that some of the limestones at Silica have graded into shales.

#### TEN MILE CREEK DOLOMITE

The Ten Mile Creek dolomite was named by J. E. Carman for exposures along Ten Mile Creek in the SE. <sup>1</sup>/<sub>4</sub> sec. 19, Sylvania township, Lucas County, Ohio (Stewart, 1938, p. 6).

The lithologic character and thickness of the beds of this formation are given in the following description by permission of J. E. Carman. See Map 1 and Fig. 2.

Description of Ten Mile Creek Dolomite Exposed Along Ten Mile Creek in the SE.  $\frac{1}{4}$  Section 19,  
Sylvania Township About Three-quarters of a Mile South of Sylvania Avenue  
and Points Along Creek Between One-quarter Mile and Slightly Less  
Than One-half Mile West of Centennial Road.

(From manuscript of J. E. Carman)

TEN MILE CREEK DOLOMITE

Unit	Ft.	In.
14. Bluish-gray, fine-grained dolomite in a firm ledge . . . . . Exposed about 150 rods west of the east line of the section near the bend of the creek, being the highest and most western rock exposures along Ten Mile Creek. The stone contains pyrite nodules which are rather abundant in the upper part and some small calcite pockets. On weathering the pyrite nodules give the stone a rusty appearance and ultimately weather out, producing a moderately uneven surface.	3	
13. Dark bluish-gray, fine-grained dolomite becoming argillaceous upward . . . . . In the upper part is a very abundant coral fauna.	1	
12. Dark bluish-gray, fine grained to dense dolomite in a firm ledge . . . . .	1	10
11. Brown carbonaceous, shaly dolomite . . . . . The upper 2" is black, carbonaceous, slightly calcareous shale.		10
10. Dark gray to drab, finely crystalline limestone in two layers . . . . .	2	9
9. Bluish-gray, crystalline dolomite with some brown, argillaceous partings and much chert . . . . . Unevenly bedded below; more evenly bedded above.	4	8
8. Blue shale and shaly dolomite. Estimated thickness . . . . . Poorly exposed in creek bank but present on the dump, from dredging of the creek.	3	
7. Firm, bluish-gray, crystalline dolomite in uneven beds of 2" to 6" and containing chert lenses. Estimated thickness . . . . . Poorly exposed along creek for about 175 feet west of the 80-rod line fence.	10	
6. Firm, light gray, crystalline dolomite with some bluish gray, slightly argillaceous, irregularly-bedded limestone . . . . . Contains a number of small pyrite nodules. The top of this zone, dipping west, comes to stream level at the 80-rod line fence. Zones 6 to 1 are exposed along the south bank of the creek, passing eastward from this fence, rising 1' to 2" above the creek level. A few chert nodules were seen in these zones but not in quantity as farther west.	3	
5. Firm, gray, crystalline dolomite in layers of 2" to 4" . . . . . There is a thin, shaly parting at 1' 4" above the base. Contains a number of pyrite nodules and a few cup corals.	3	8
4. Blue, argillaceous dolomite . . . . .		2
3. Firm, gray, crystalline dolomite . . . . .	1	10
2. Blue, argillaceous dolomitic limestone . . . . .	1	4
1. Brownish gray to drab, grainy to crystalline, somewhat laminated dolomitic limestone in layers of 2" to 4" . . . . .	1	4
Total thickness . . . . .	38'	5"

The top of the Ten Mile Creek dolomite is not exposed along Ten Mile Creek. Wells in the area indicate that the overlying, black, Upper Devonian, Ohio shale is present beneath the surface a very small distance west of the highest exposed bed of the Ten Mile Creek dolomite.

#### OHIO AND ANTRIM SHALES

The Ohio shale of northwestern Ohio is about 100 feet in thickness. Its northward continuation in Michigan, the Antrim shale, is 150 to 175 feet thick in the vicinity of Ann Arbor, Michigan (see Map 1).

# CORRELATION OF ROCKS

## BOIS BLANC FORMATION

The Bois Blanc formation is known in southeastern Michigan only from a study of rock cuttings from deep borings (see Landes, 1945). This formation, the oldest Devonian formation of this region, is well exposed in the Mackinac Straits region of northern Michigan. It is correlated with that part of the Onondaga limestone of southwestern Ontario, New York, and other states in the Appalachian region containing Amphigenia elongata (Vanuxem), Centronella glansfagea (Hall), Eodevonaria arcuata (Hall) and Calymene platys Green. See Chart 2.

It is possible that a part of the Bois Blanc formation in southeastern Michigan may be a sandstone now included in the basal part of the Sylvania sandstone.

## DETROIT RIVER GROUP

The formations of the Detroit River group thin rapidly from the central part of the Michigan basin to southeastern Michigan and northwestern Ohio; they were deposited in a sea which progressively transgressed on to the northwestern flank of the Cincinnati arch (see Fig. 3).

The Sylvania sandstone is the initial deposit of the transgressive Detroit River sea. Much of the sand was worked by wind but most, probably all, was deposited in the sea.

The Amherstburg dolomite in the Livingstone Channel of the Detroit River west of Amherstburg, Ontario, is a brown dolomite with molds of Zaphrentis carinata (Sherzer and Grabau), Heterophrentis alternata (Sherzer and Grabau), Prosserella modestoides Sherzer and Grabau, Schuchertella amherstburgense Grabau, Stropheodonta homalostriata Sherzer and Grabau, S. vasculosa Sherzer and Grabau and Spirifer submersus Sherzer and Grabau. At Cummin's quarry and the quarries near Silica, the Amherstburg is a gray to buff-gray dolomite with some quartz sand and contains specimens of most of the species found in the formation at the Livingstone Channel.

Amherstburg fossils have been found in the sandstone recorded as Sylvania sandstone in the quarry near Holland, Ohio (see Carman, 1936, pp. 260-262). The authors of this paper believe that the Sylvania sandstone near Holland should be regarded as a near-shore sandy phase of the Amherstburg formation (see Fig. 3).

The Lucas dolomite is the thickest formation of the Detroit River group in southeastern Michigan and northwestern Ohio and has the same lithological character in both regions. The brachiopods Prosserella lucasi Sherzer and Grabau and P. planisinosia Sherzer and Grabau and the gastropods Acanthonema holopiforme Sherzer and Grabau and Murchisonia subcarinata (Grabau) are excellent guide fossils for correlation of the Lucas strata in the two regions.

The Anderdon limestone is the thinnest formation of the Detroit River group. Its presence in the quarries near Amherstburg, Ontario, Sibley, Michigan, and Silica, Ohio has been recognized by the occurrence of Conocardium sibleyense LaRocque and several small undescribed species of gastropods in the strata of these quarries (see Ehlers, 1950, pp. 1455-1456).

## DUNDEE LIMESTONE

The Dundee limestone of southeastern Michigan contains Atrypa elegans, Grabau, Brevispirifer lucasensis (Stauffer), and other fossils which are limited to this formation. These species are also present in strata of northwestern Ohio previously assigned to the Columbus limestone, in some strata of southwestern Ontario that have been erroneously mapped with the Onondaga limestone, and in the Dundee limestone that is well exposed in the large quarry of the Michigan Limestone and Chemical Company near Rogers City, Presque Isle County, in northern Michigan. The occurrence of Dundee fossils in the strata of all these regions indicates the widespread extent of the Dundee formation in the Michigan basin (see Chart 2).

Epochs	Stages	New York (Generalized)		Northern Michigan	SE. Michigan and NW. Ohio		
Upper Devonian	Conewango	Oswayo fm.		Antrim shale	Antrim shale (SE. Michigan)  Ohio shale (NW. Ohio)		
		Cattaraugus					
	Cassadaga	Conneaut gp.					
	Chemung	Chemung ss.					
	Finger Lakes	Enfield sh.					
		Ithaca sh.					
Middle Devonian	Taghanic	Genesee shale		Squaw Bay ls.	[Hatched pattern]		
		Tully fm.		Thunder Bay ls.			
				Potter Farm fm.			
	Tioughnioga	Hamilton group	Moscow fm.	Norway Point fm.			
			Ludlowville fm.	Four Mile Dam fm.			
	Cazenovia	Hamilton group	Skaneateles fm.	Alpena ls.		Ten Mile Creek dol.	
				Newton Creek ls.		[Hatched pattern]	
				Genshaw fm.			
				Ferron Point fm.			
				Rockport Quarry ls.			
				Bell shale			Silica fm.
				Marcellus fm.		Rogers City ls.	[Hatched pattern]
	Onesque-thaw	Onondaga	Paraspirifer acuminatus zone	Dundee ls.		Dundee ls.	
				[Hatched pattern]		Detroit River group	Anderdon ls.
							Lucas dol.
Amherstburg dol.							
Amphigenia zone	Bois Blanc fm.	Bois Blanc fm. (SE. Mich., only)					
Lower Devonian	Deerpark	Oriskany ss.		Garden Island fm.	[Hatched pattern]		
	Helderberg	Helderberg group		[Hatched pattern]	[Hatched pattern]		

Chart 2. Correlation of the Devonian rocks of New York, northern Michigan, and southeastern Michigan and northwestern Ohio.

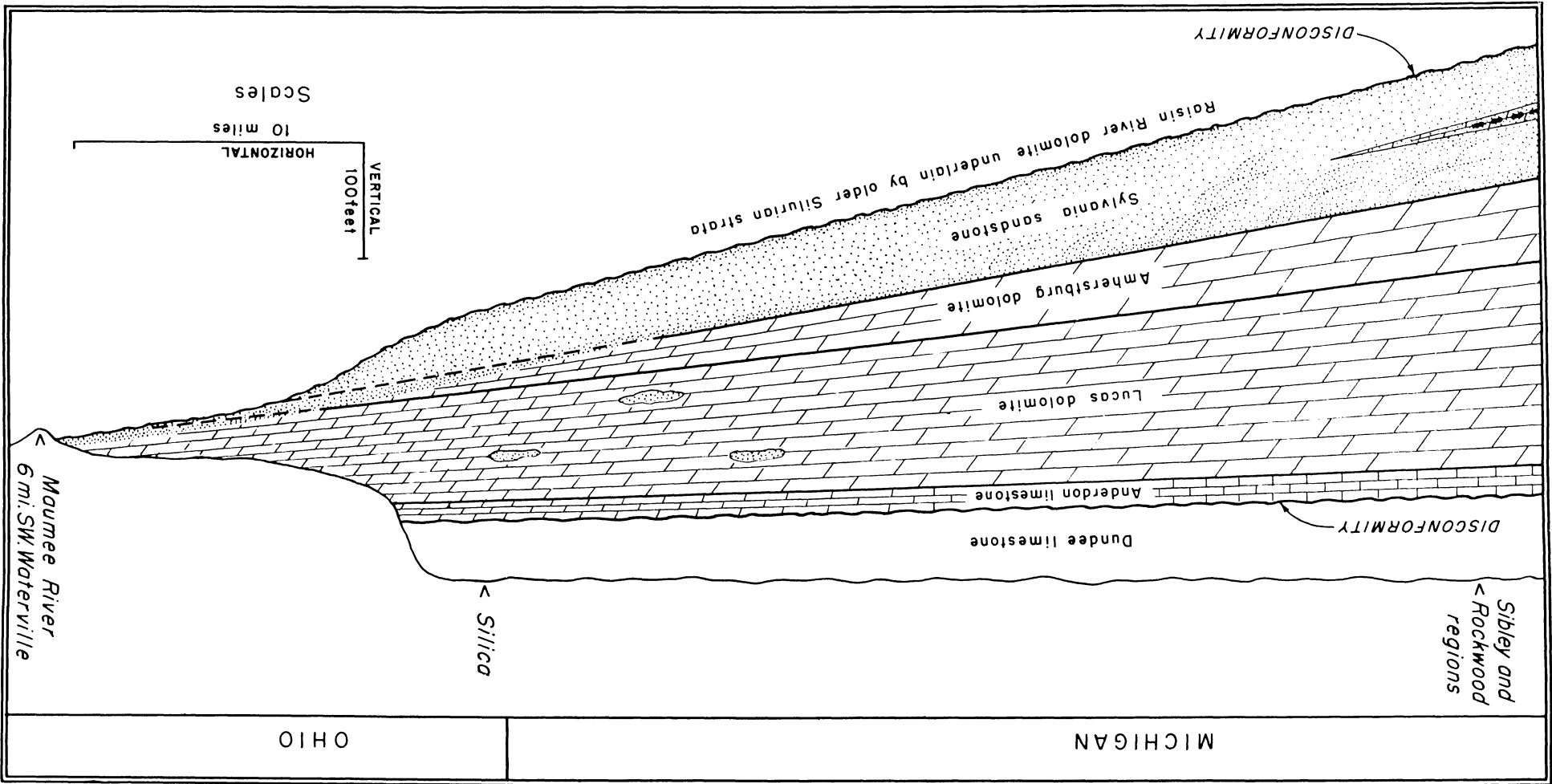


Fig. 3. Generalized section of the Detroit River group from the Sibley-Rockwood region, Michigan, to the Maumee River valley 6 miles south of Waterville, Ohio. Section shows the stratigraphic relationships of the various forma-

tions.

The Dundee limestone is faunally related to the Delaware limestone on the eastern side of the Cincinnati arch and is correlated with this limestone by the authors of this paper and by G. Arthur Cooper and associates (1942, p. 1754).

Strata of Columbus age may be present in the Michigan basin although no rocks of this age have been seen in outcrops beneath the Dundee limestone in northern Michigan, southeastern Michigan and northwestern Ohio. At these places the Dundee rests disconformably on beds of the Detroit River group. The Columbus limestone, which is well exposed on the southeastern side of the Cincinnati arch, is now known as far north as the Ingersoll, Ontario region about 19 miles east of London, Ontario (see Ehlers and Stumm, 1951). Only the highest part of the Columbus limestone, which was deposited in a northward transgressing sea, is represented in this area. Near Ingersoll the Columbus contains the Paraspirifer acuminatus zone, which is also present in the "upper" Onondaga of western New York (see Chart 2). In the exposures near Ingersoll, the Columbus consists of a basal sandstone and overlying beds of limestone with a considerable quantity of sand, indicating that this region was not far distant from the shore-line of the Columbus sea. The aforementioned observations would seem to indicate that the Columbus sea was present only on the southeastern side of the Cincinnati arch in Ohio and southwestern Ontario. In the central part of the Michigan basin the upper part of the Detroit River group of the petroleum geologists contains evaporite deposits having a maximum thickness of approximately 1100 feet. Proserrella planisnosa Sherzer and Grabau, which occurs near the top of the Lucas dolomite in the outcrop area of southeastern Michigan, has also been found in cores from a dolomite having a position below the evaporites. Landes (1951, pp. 2, 3, 19) has assigned the evaporites to the Lucas formation but has stated that they "may be the time equivalent of the Columbus limestone."

#### SILICA FORMATION

The Silica formation correlates with the part of the Traverse group occupying a position between the base of the Bell shale and the top of the Ferron Point formation (see Chart 2). The basal calcareous beds of the Silica formation, units 1 to 6, the "Blue" limestone, contain the tetracoral Hexagonaria anna (Whitfield), which is also present in the upper Bell shale, the Rockport Quarry limestone, and the basal part of the Ferron Point formation of the Traverse group of Michigan. Procteria cornu Stumm from the shale of unit 7 of the Silica formation also occurs in the upper part of the Bell shale. Mucrospirifer prolificus (Stewart) is present in the Silica formation between units 7 and 17 and in the upper part of the Bell shale and lower part of the Ferron Point formation. Phacops milleri Stewart of the Silica formation is also found in the shales of the Bell and Ferron Point formations. Specimens of Helopora inexpectata McNair and Streblotrypa anomala McNair are abundant in unit 10 of the Silica formation and the Ferron Point formation.

In the upper part of the Silica formation, units 19-25, the presence of Leiorhynchus kelloggi Hall and Mucrospirifer sp. cf. M. arkonense (Shimer and Grabau) indicate that these beds are closely related to the Plum Brook shale of north-central Ohio and the Arkona shale of southwestern Ontario. Mucrospirifer sp. cf. M. arkonense has been found in beds just below the top of the Ferron Point shale in northern Michigan.

#### TEN MILE CREEK DOLOMITE

The strata of the Ten Mile Creek dolomite containing "Strombodes" alpenensis Rominger and Callipleura nobilis (Hall) have been correlated with the Centerfield limestone member of the Ludlowville formation of New York, the Four Mile Dam formation of northern Michigan, and the Hungry Hollow formation of southwestern Ontario by G. Arthur Cooper and associates (1942, p. 1785 and correlation chart). See Chart 2. The authors of this paper believe that the strata from which the above-mentioned fossils were reported probably are in the lower part of the Ten Mile Creek dolomite.

A detailed study of the fossils of the upper part of the Ten Mile Creek dolomite may show that this formation contains strata younger than the Centerfield limestone and its correlatives.



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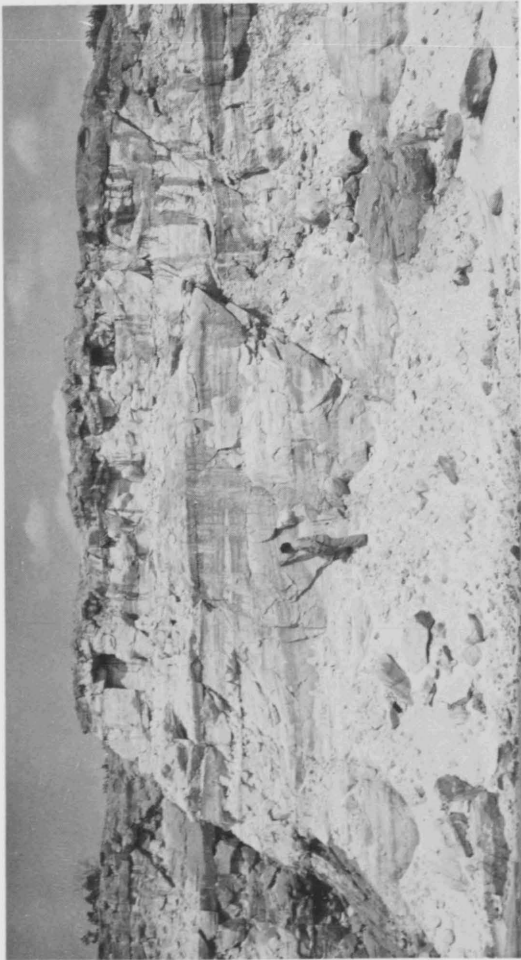
## EXPLANATION OF PLATE 1

Fig. 1. View of wall of Solvay Process Company's quarry at Sibley, Michigan. Floor of quarry is Lucas dolomite; contact of Lucas with overlying Anderdon limestone is hidden by talus at base of quarry wall; man's right hand is on bed (unit 4, Sibley quarry section) in Anderdon containing *Conocardium sibleyense* LaRocque and small gastropods; contact of Anderdon with overlying Dundee limestone is at top of thin, light colored bed with closely spaced, vertical joints just above middle of quarry wall.

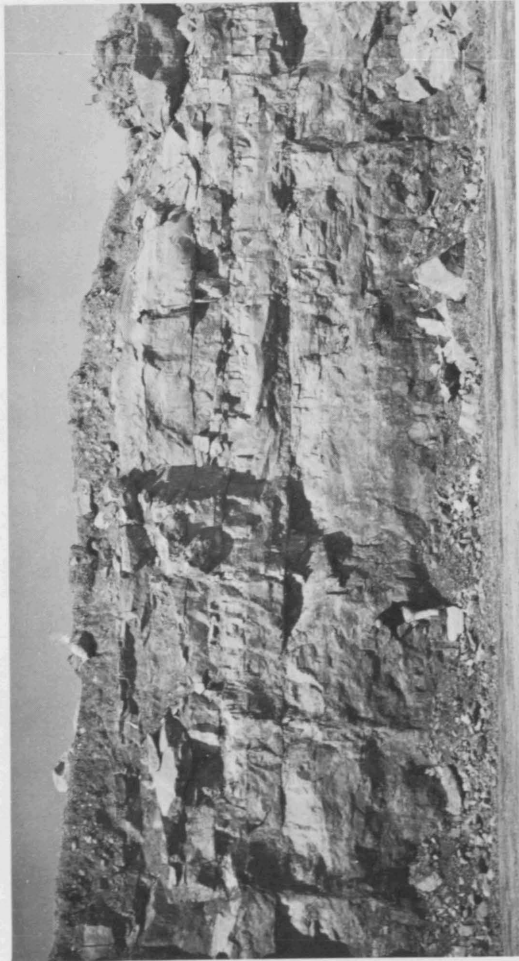
Fig. 2. View of Sylvania sandstone in wall of Michigan Silica Company's quarry, 1 mile southeast of Rockwood, Michigan.

Fig. 3. View of Sylvania sandstone in wall and pit excavated for crusher in same quarry. Lower half of pit wall shows cherty, arenaceous dolomite, unit 2 of quarry section; upper half shows sandstone, unit 3, similar to unit 4, shown in quarry wall; dark material above top of quarry wall is glacial till and lake clay.

PLATE 1



2



1



3

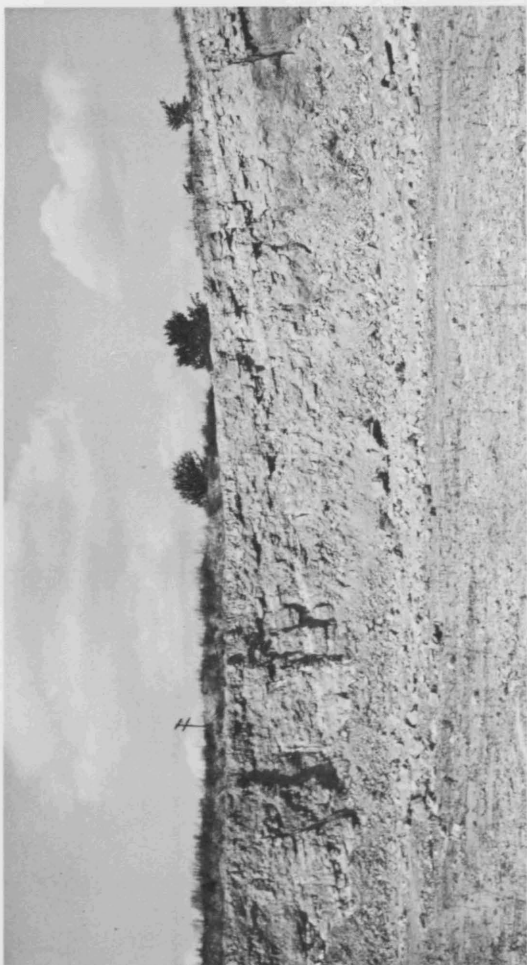
## EXPLANATION OF PLATE 2

Fig. 1. View of east wall of East Quarry of France Stone Company near Silica, Ohio. Contact between Sylvania sandstone and Amherstburg dolomite shown at man's right hand; contact of Amherstburg dolomite with overlying Lucas dolomite is near indistinct line separating dark and light colored rocks in upper part of quarry wall.

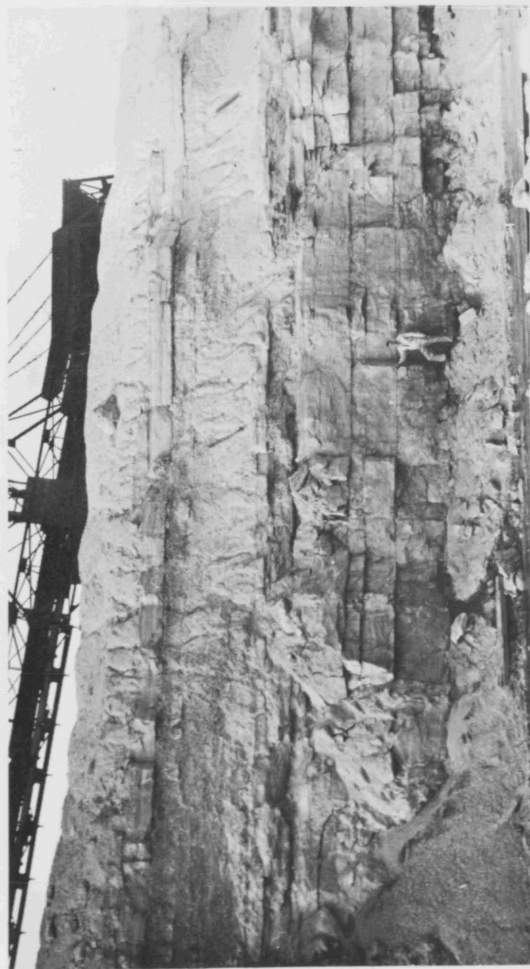
Fig. 2. View of north wall of same quarry showing westerly-dipping Amherstburg and Lucas strata in the Lucas County monocline. Thin, light colored bed, which reaches the top of the quarry wall shown at the right edge of the view, is unit 2 of the Lucas dolomite; the slightly darker colored strata beneath unit 2 comprise unit 1 of this formation; the much darker colored rock below unit 1, shown near the right margin of the view, is the Amherstburg dolomite.

Fig. 3. View of west wall of South Quarry of the Medusa Portland Cement Company showing strata of Dundee and Silica formations. Dundee strata are shown below man's right hand; units 1 to 17 inclusive of the Silica formation are shown above man's right hand; prominent ledge near top of wall consists of units 14, 15, 16 and 17 of Silica formation; most of shale on top of ledge was taken from shales beneath unit 14; some of this shale may be from unit 18.

PLATE 2



2



3



1

## EXPLANATION OF PLATE 3

### AMHERSTBURG FOSSILS

Figs. 1-3. Heterophrentis alternata (Sherzer and Grabau). 1 and 2, rubber cast and natural mold of calyx of a specimen from the Livingstone Channel; 3, mold of calyx of syntype from same locality. X 1.

Figs. 4-6. Zaphrentis carinata (Sherzer and Grabau). 4, cast of cardinal quadrants of calyx of syntype; 5, natural mold of calyx of same specimen; 6, rubber cast of entire calyx of same specimen, Livingstone Channel. X 1.

Fig. 7. Stropheodonta homolostriata Sherzer and Grabau. External mold of dorsal valve, Livingstone Channel. X 1.

Figs. 8-9. Prosserella modestoides Sherzer and Grabau. Front and side views of ventral valve of syntype, Oakwood salt shaft of International Salt Company. X 1.

Figs. 10-11. Prosserella depressa Grabau. Front and side views of internal mold of ventral valve of syntype, Livingstone Channel. X 1.

Figs. 12-14. Stropheodonta vasculosa Sherzer and Grabau. 12, cast from natural mold of interior of ventral valve of syntype, Livingstone Channel. X 1; 13, natural mold of exterior of a dorsal valve from same locality. X 2; 14, cast from mold of exterior of dorsal valve of syntype from same locality. X 1.

Fig. 15. "Spirifer" submersus Sherzer and Grabau. View of cast from natural mold of exterior of dorsal valve of syntype from Livingstone Channel. X 2.

### LUCAS FOSSILS

Fig. 16. Acanthonema holopiforme Sherzer and Grabau. View of casts from external molds of syntypes from Gibraltar quarry. X 4.

Fig. 17. Murchisonia subcarinata (Grabau). View of cast from external mold of syntype from Gibraltar quarry. X 2.

Figs. 18-19. Prosserella lucasi Sherzer and Grabau. Side and front views of internal mold of ventral valve of syntype from Patrick quarry. X 1.

Fig. 20. Prosserella planisinosa Sherzer and Grabau. Front view of internal mold of dorsal valve about 7-8 feet below top of formation; from drill core, 1 mile west of Oakwood salt shaft. X 1.

### ANDERDON FOSSILS

Fig. 21. Platyloron sp. View of cast from external mold of a specimen from unit 4, Sibley quarry. X 4.

Fig. 22. Murchisonia sp. View of cast from external mold of a specimen from unit 4, Sibley quarry. X 4.

Fig. 23. Tropidodiscus sp. View of cast from external mold of a specimen from unit 1 of East Quarry of France Stone Company, Silica, Ohio. X 4.

Fig. 24. Loxonema sp. View of cast from external mold of a specimen from Sibley quarry. X 4.

Figs. 25, 27. Rhineoderma sp. Views of two casts from external molds of two specimens from unit 4, Sibley quarry. X 4.

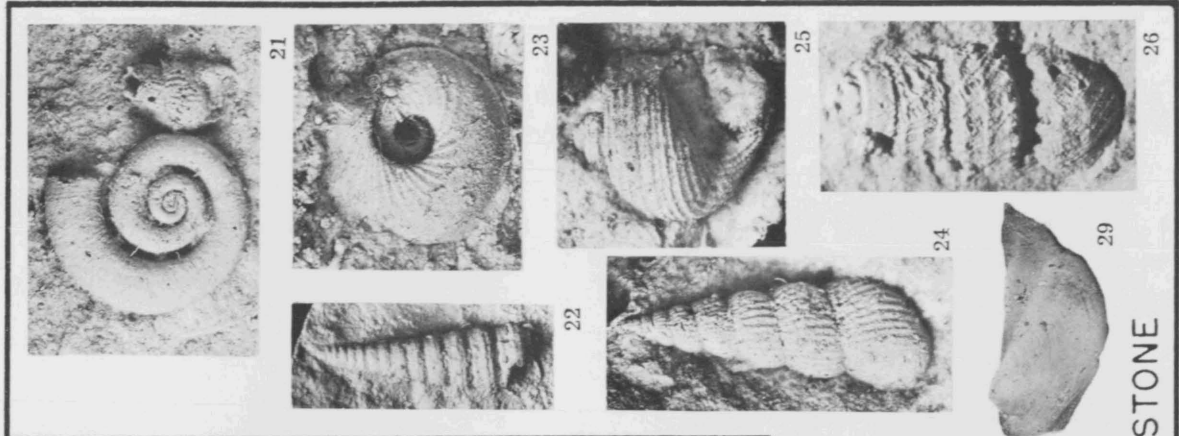
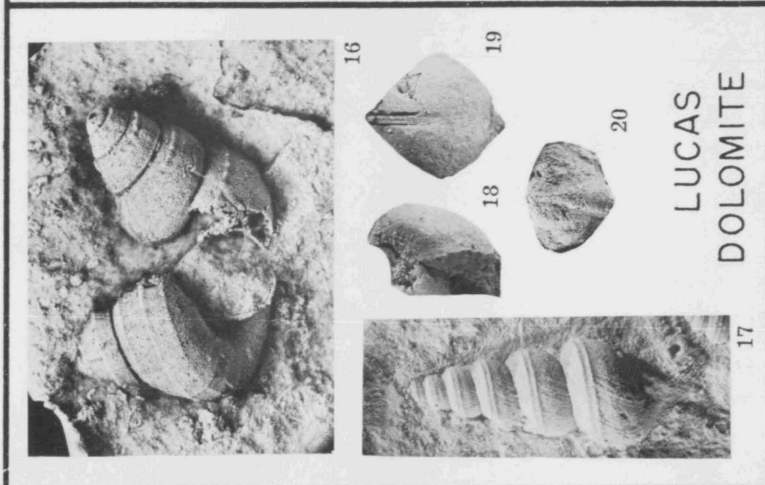
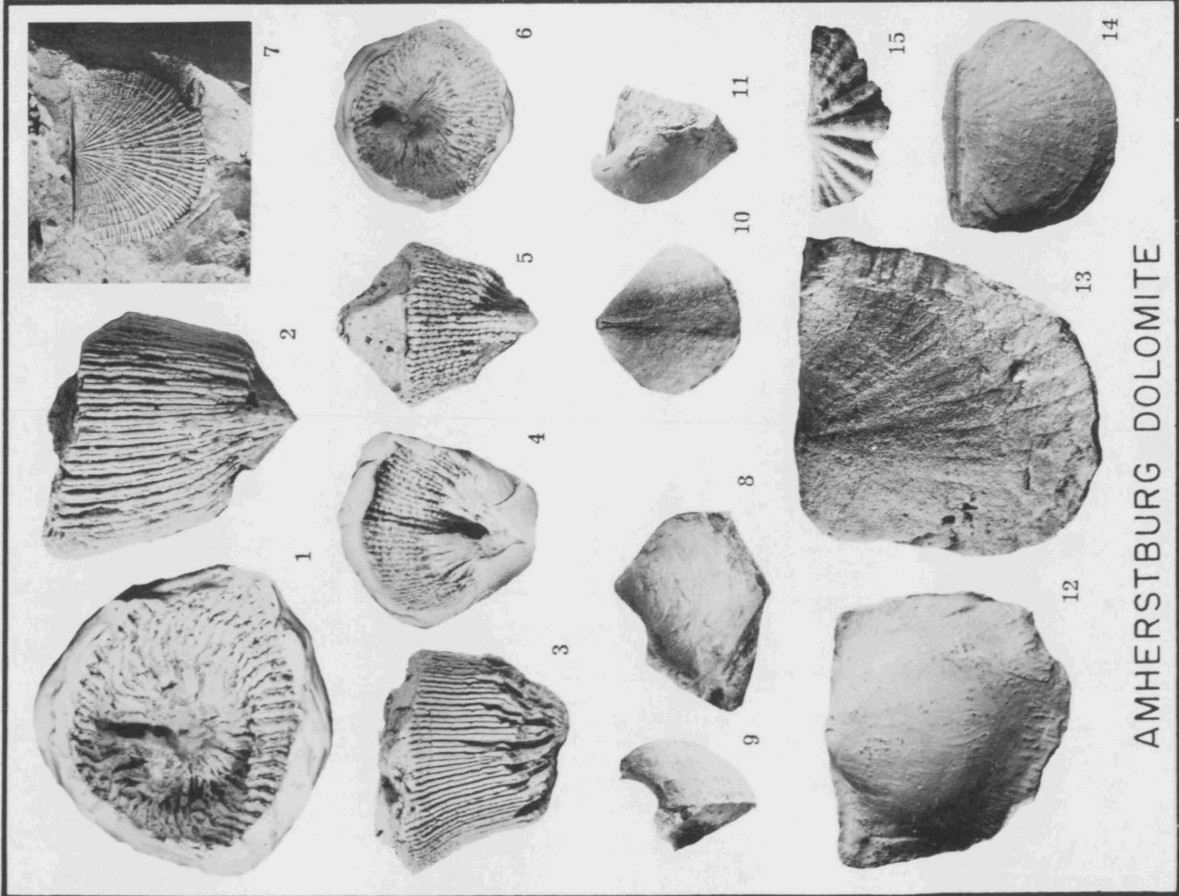
Fig. 26. Pleurotrochus tricarinatus Grabau. View of cast from external mold of specimen from unit 4, Sibley quarry. X 5.

Fig. 28. Conocardium sibleyense LaRocque. View of cast of right valve of paratype from unit 4, Sibley quarry. X 5.

Fig. 29. Diodontopteria ehlersi LaRocque. View of cast of left valve of paratype from unit 4, Sibley quarry. X 2.



PLATE 3



## EXPLANATION OF PLATE 4

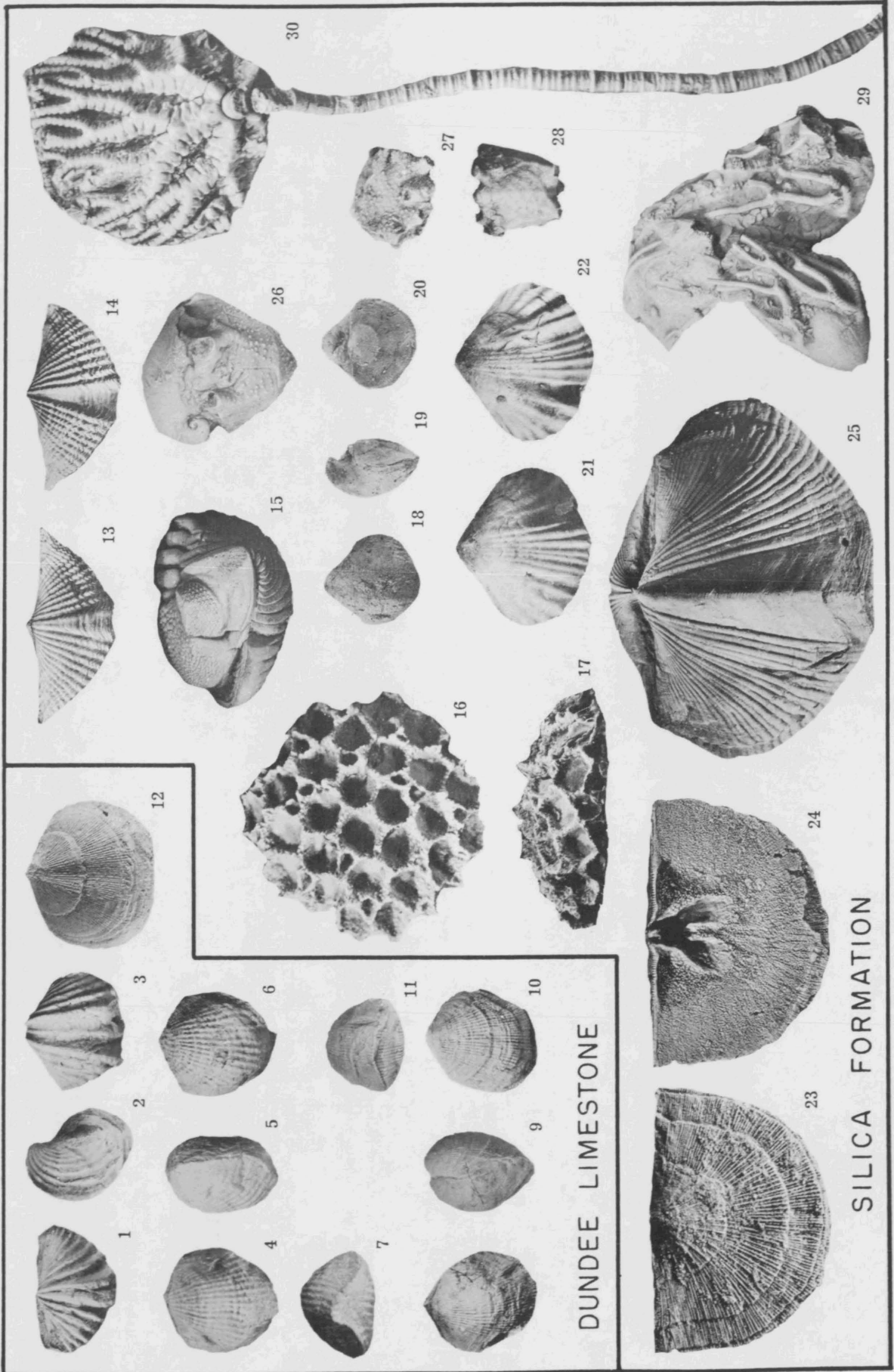
### DUNDEE FOSSILS

- Figs. 1-3. Brevispirifer lucasensis (Stauffer). Dorsal, side, and ventral views of a specimen from Whitehouse quarry, Lucas County, Ohio. X 1.  
 Figs. 4-7. Atrypa costata Bassett. Dorsal, side, ventral, and anterior views of holotype from unit 11 (25 of Bassett), Sibley quarry. X 1.  
 Figs. 8-11. Atrypa elegans Grabau. Dorsal, side, ventral, and anterior views of neoparatype from unit 10 (24 of Bassett), Sibley quarry. X 1.  
 Fig. 12. Rhipidomella variabilis Grabau. View of dorsal valve of neoholotype from Sibley quarry. X 1.

### SILICA FOSSILS

- Figs. 13-14. Mucrospirifer prolificus (Stewart). Ventral and dorsal views of a specimen from the South Quarry of the Medusa Portland Cement Company. X 1.  
 Fig. 15. Phacops milleri Stewart. Side view of enrolled specimen from same locality. X 1.  
 Figs. 16-17. Procteria cornu Stumm. Distal and side views of holotype from drill hole at Cone, Monroe County, Michigan. X 2.  
 Figs. 18-20. Ambocoelia umbonata (Conrad). Ventral, side, and dorsal views of a specimen from unit 17 of the South Quarry of Medusa Portland Cement Company, Silica, Ohio. X 2.  
 Figs. 21-22. Leiorhynchus kelloggi Hall. Dorsal and ventral views of a specimen from unit 23 of same locality. X 1.  
 Figs. 23-24. Hercostrophia robusta Williams. Exterior and interior of ventral valve of a specimen from unit 7 of same locality. X 2.  
 Fig. 25. Paraspirifer bownockeri (Stewart). View of dorsal valve of a specimen from unit 9 of the same locality. X 1.  
 Figs. 26, 29. Arthroacantha carpenteri (Hinde). 26, side view of calyx of specimen with Platyceras sp. attached; 29, two specimens with attached arms; all from unit 13 of same locality. X 1.  
 Figs. 27-28. Gilbertsocrinus ohioensis Stewart. 27, view of tegmen showing anal area; 28, view of posterior side of calyx of same specimen, from unit 13 of same locality. X 1.  
 Fig. 30. Euryocrinus ? laddii Stewart. Side view of specimen with attached arms and column, from unit 13 of same locality. X 1.

PLATE 4



DUNDEE LIMESTONE

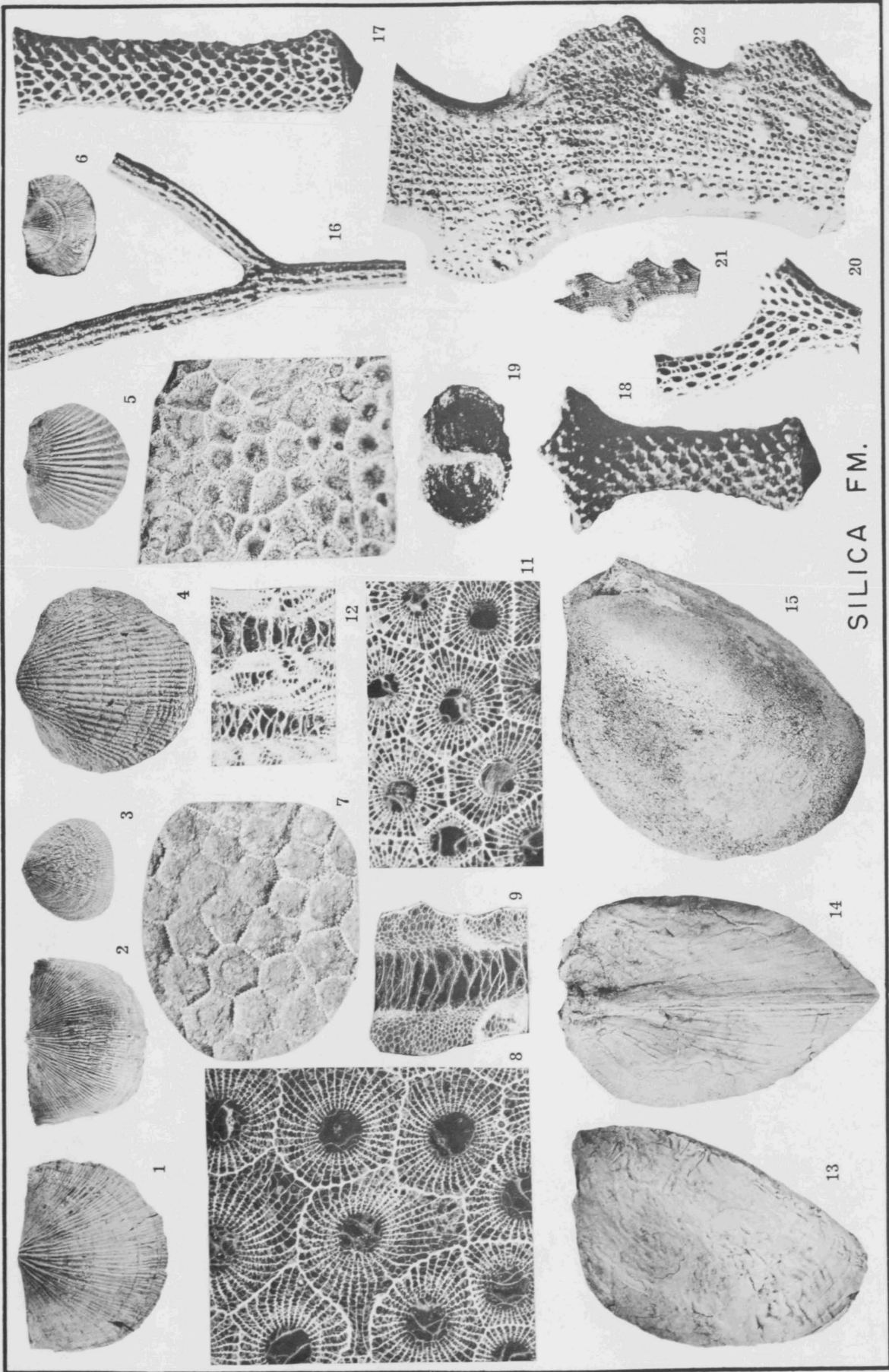
SILICA FORMATION

## EXPLANATION OF PLATE 5

### SILICA FOSSILS

- Fig. 1. Stropheodonta demissa (Conrad). View of ventral valve of a specimen from unit 7 of the South Quarry of the Medusa Portland Cement Company, Silica, Ohio. X 1.
- Fig. 2. Chonetes coronatus (Conrad). View of ventral valve of a specimen from unit 9 of the same locality. X 1.
- Fig. 3. Rhipidomella sp. View of dorsal valve of a specimen from unit 14 of the same locality. X 1.
- Fig. 4. Atrypa sp. View of ventral valve of a specimen from unit 7 of the same locality. X 1.
- Fig. 5. Tropidoleptus carinatus (Conrad). View of ventral valve of a specimen from the same locality. X 1.
- Fig. 6. Chonetes fragilis Stewart. View of ventral valve of a specimen from unit 9 of the same locality. X 1.
- Figs. 7-9. Hexagonaria anna (Whitfield). 7, distal surface of a paratype from unit 3 of the same locality. X 1; 8, transverse section of lectotype from Antwerp, Paulding County, Ohio. X 2; 9, longitudinal section of same specimen. X 2.
- Figs. 10-12. Hexagonaria tabulata Stumm. 10, distal surface of holotype from Whitehouse quarry, Lucas Co., Ohio. X 1; 11, transverse section of a paratype from the same locality. X 2; 12, longitudinal section of the same specimen. X 2.
- Figs. 13-14. Lophonychia cordata Stewart. 13, view of right valve from unit 5 of the South Quarry of the Medusa Portland Cement Company, Silica, Ohio. X 1; 14, anterior view of same specimen. X 1.
- Fig. 15. Gosselettia triquetra (Conrad). View of internal mold of right valve of a specimen from unit 1 of the North Quarry of the Medusa Portland Cement Company, Silica, Ohio. X 1.
- Fig. 16. Acanthoclema ohioense McNair. Side view of holotype from unit 10 of South Quarry of the Medusa Portland Cement Company, Silica, Ohio. X 10.
- Figs. 17-19. Helopora inexpectata McNair. 17, side view of holotype from Ferron Point formation, quarry of the Kelley's Island Lime and Transport Company, Rockport, Alpena County, Michigan. X 10. The same species is abundant in unit 10 of the Silica formation; 18, side view of a paratype from the Ferron Point formation, abandoned quarry on shore of Black Lake, one-half mile west of Onaway, Presque Isle County, Michigan. X 10; 19, end view of same specimen showing double socket. X 10.
- Fig. 20. Streblotrypa anomala McNair. Side view of paratype from unit 10 of the South Quarry of the Medusa Portland Cement Company, Silica, Ohio. X 10.
- Figs. 21-22. Sulcoretepora deissi McNair. 21, side view of holotype from unit 10 of same locality. X 1; 22, same specimen. X 5.

PLATE 5



SILICA FM.

## ITINERARY

Leave Bagley Street entrance of Statler Hotel, Detroit, Michigan at 8:00 A.M., Wednesday, November 7, 1951.

- Stop 1. Solvay Process Company quarry at Sibley. Formations exposed are the Lucas dolomite, Anderdon limestone, and Dundee limestone.
- Stop 2. Michigan Silica Company quarry, 1 mile southeast of Rockwood, Michigan. Formation exposed is the Sylvania sandstone.
- Stop 3. Luncheon at noon at the Stork's Nest on north side of Bancroft Street, seven-tenths mile east of Centennial Road and 2 miles south of Sylvania Avenue.
- Stop 4. Abandoned quarry of Toledo Stone and Glass Sand Company near Silica, Ohio. See Figure 1. Formation exposed is the Sylvania sandstone.
- Stop 5. Part of East Quarry of France Stone Company south of Sylvania Avenue. See Figure 1. Formations exposed are the Sylvania sandstone, Amherstburg dolomite, Lucas dolomite and Anderdon limestone.
- Stop 6. East wall of East Quarry of France Stone Company near Brint Road. See Figure 1. Formations exposed are the Sylvania sandstone, Amherstburg dolomite, and Lucas dolomite.
- Stop 7. West wall of same quarry about one-half mile south of Brint Road. See Figure 1. Formations exposed are the Lucas dolomite and Anderdon limestone.
- Stop 8. East wall of West Quarry of France Stone Company about one-tenth mile north of Sylvania Avenue. See Figure 1. The formations exposed are the Anderdon limestone and Dundee limestone.
- Stop 9. North end of same quarry. See Figure 1. Formations exposed are the Dundee limestone and lower part ("Blue" limestone) of the Silica formation.
- Stop 10. South Quarry of Medusa Portland Cement Company. See Figure 1. Formations exposed are the Dundee limestone and Silica formation.
- Stop 11. North Quarry of Medusa Portland Cement Company. See Figure 1. Formations exposed are the Dundee limestone and lower part ("Blue" limestone) of the Silica formation.
- Stop 12. Ten Mile Creek, about three-quarters of a mile south of Sylvania Avenue and one-quarter to one-half mile west of Centennial Road. See Map 1. and Figure 1. Formation exposed is the Ten Mile Creek dolomite.

Leave for Detroit at 5:00 P.M.