

**ASSOCIATION
of
MISSOURI GEOLOGISTS**



THIRD ANNUAL FIELD TRIP
September 28 & 29, 1956

**Sponsored by the
MISSOURI STATE HIGHWAY DEPARTMENT
Jefferson City**

ASSOCIATION OF MISSOURI GEOLOGISTS

J. S. Brown
James F. Westcott
Walter V. Searight

President
Vice-President
Secretary-Treasurer

EXECUTIVE COMMITTEE

J. S. Brown, St. Joseph Lead Company
James F. Westcott, A. P. Green Fire Brick Company
Walter V. Searight, Missouri Geological Survey
Charles R. Allender, Missouri State Highway Dept.
Robert J. Leininger, Corps of Engineers

Ex officio
Ex officio
Ex officio

COMMITTEE ON ARRANGEMENTS

R. B. Aylor
W. G. Jones

General Chairman

FIELD TRIP LEADER

R. B. Aylor

PROGRAM

Friday, September 28

1:30 P.M.: Missouri State Highway Department Laboratory
Highway 50 West

Inspection and explanation of mobile equipment
Mobile testing laboratory -- Mr. C. N. Laughter
Depth drilling equipment -- Mr. A. G. Copeland

Discussion of soil profile specimens --
Mr. C. L. Scrivner, Soils Dept., U. of Mo.

Tour of the Materials Testing Laboratory
including Physical, Chemical and Cement
Departments -- Mr. H. H. Darling, Director

6:30 P.M.: Adcock's Cafe, 216 Madison Street

Annual Dinner

Welcome -- Mr. J. J. Corbett, Ass't. Chief Engineer

Speakers -- Mr. E. H. Logan, Ass't Engineer of
Materials
Mr. G. M. Threlkeld, Director of
Information

Business Meeting

Saturday, September 29

7:30 A.M.: Old Highway 54 North

Field Trip departure

Jefferson City to Danville

Introduction

The Missouri State Highway Department is honored to play host to the Association of Missouri Geologists on the occasion of its third annual meeting. Through the efforts of Mr. R. B. Aylor and Mr. W. G. Jones, a trip has been arranged which we trust will prove informative to you. We propose to show you some areas in Central Missouri which, though perhaps not as interesting as lead or coal mines, will give you an idea of some of the applications of geological and soils knowledge in the construction of a highway.

The Geology and Soils section of the Missouri State Highway Department has been in existence almost as long as the Department itself, since Missouri was one of the first states to use Geologists in the Highway Department. Expansion was by fits and starts, but at present one man in each of the ten Districts bears the title of District Geologist and is responsible for the geological and soils work in his area of ten to twelve counties.

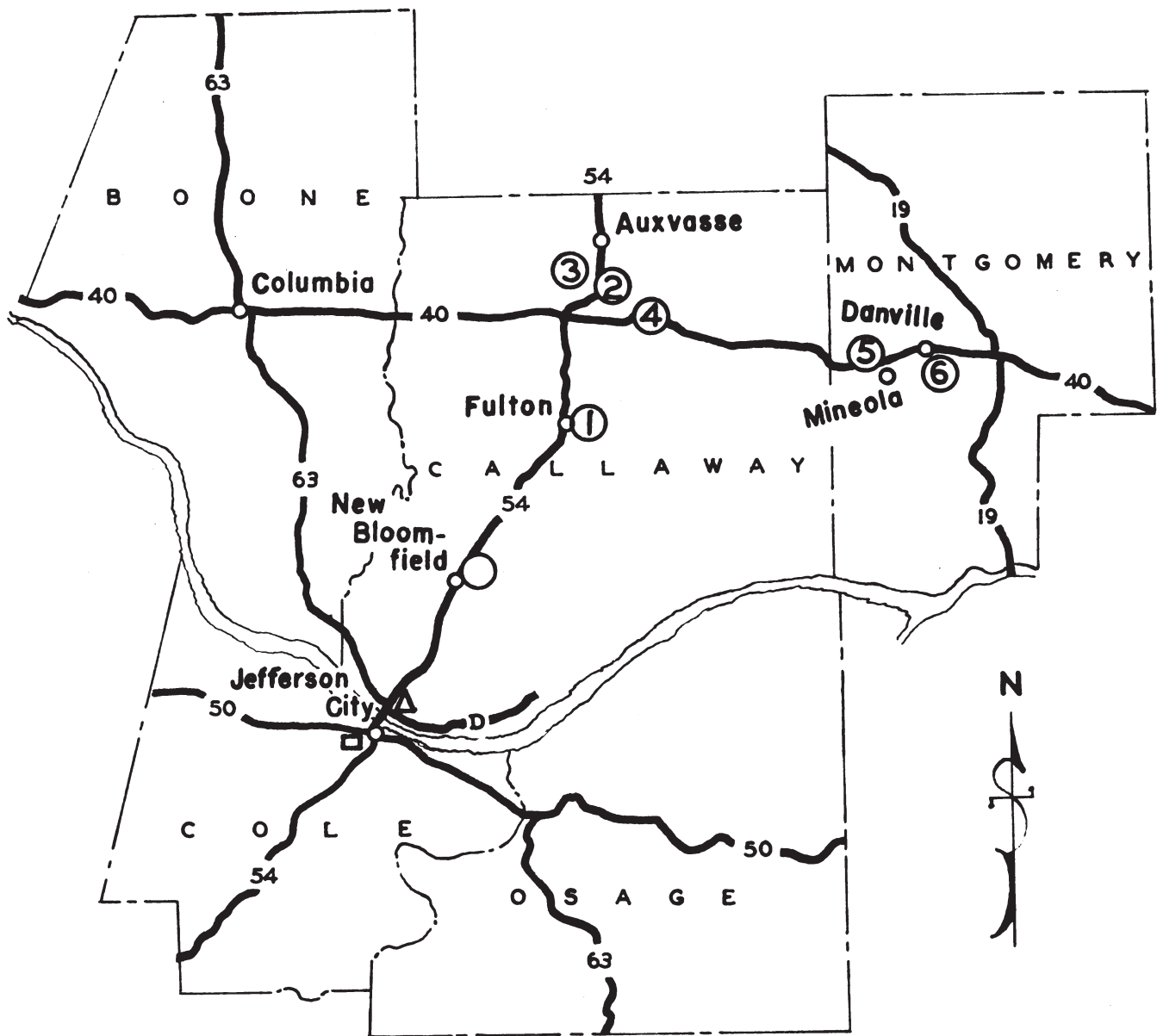
Since all soils result from the disintegration of geological formations the two subjects of Soils and Geology go hand-in-hand, as becomes evident when the District Geologist interprets soil survey and material survey data for the benefit of the design and the construction engineers. His geological knowledge is brought into play as he:

1. Classifies materials of excavation
2. Investigates material sources
3. Recognizes potential slide conditions
4. Interprets bridge foundation soundings
5. Determines relationship of various strata, their effect on subsurface movement of water and makes drainage recommendations
6. Makes recommendations regarding the necessity for berms, benches, etc., to catch spalls in rock cuts if type of rock demands such construction
7. Makes recommendations after boring investigations of sinkhole areas
8. Assists in resistivity investigations of some proposed highway locations.

Soil surveying, with its attendant identification, sampling, testing and classification of various soil types, compaction of soils and bases, borrow pit investigation and base stabilization occupy much of the remainder of his time.

All in all, the proper design, materials, construction and maintenance of highways in Missouri is inextricably involved with Geology and Soils. We hope this third annual trip of the Association will provide evidence of the excellent results when correct use is made by the Designer of the information submitted by the Geologist, and the construction is carried out according to specifications.

W. C. Davis
Chief, Geology & Soils
Mo. State Highway Dept.



□ State Highway Department Laboratory and
Geology & Soils Office

Δ Assembly Point

○ Stops and Points of Interest

FIELD TRIP

Saturday, September 29, 1956

Time of Assembly 7:30 A.M.

General Instructions

A. The Assembly Point for the Saturday field trip is Old Highway 54 North. This point is located near the New Bridge Drive-In Theater and may be reached by crossing the Missouri River Bridge and turning right on Route D at the junction then left on Old Highway 54.

B. Line up cars at the Assembly Point headed north and be prepared to depart promptly at 7:30 A.M. (C.S.T.)

C. In order to reduce the number of cars in the caravan as much as possible it is suggested that those who return by way of Jefferson City double up in other cars for the field trip.

D. Drivers and riders should at all times be alert for danger points, etc. whether listed on the road log or not.

E. At the stops, assemble around the leader as quickly as possible. Please do not use your hammers while preliminary discussions are in process.

F. If you have car or tire trouble please pull out to the side of the road and allow the cars following to pass.

G. Under no circumstances pass another car in the caravan when the caravan is in motion, unless that car has dropped out of line.

H. Maintain your position as close to the car ahead of you as is convenient for safety. Give proper hand and light signals.

I. Have your car serviced the day before so that it may depart promptly.

J. As you will note from the Guidebook the total distance covered on the trip will be about 62 miles with the last stop (STOP 6) at Danville in Montgomery County the dispersal point. The trip should reach a conclusion at about noon on Saturday.

ROAD LOG

Mileage

0.0 Assembly Point (Old Highway 54 North).

0.1 Left and Right turns onto Highway 54.

The soils in the Missouri River flood plain are the Wabash Series of alluvial origin.

1.4 Borrow pits to right and left.

Soil from these two areas was used in the construction of the north approach fill across the Missouri River Valley. (Memphis silt loam)

4.9 Holts Summit.

Soils from the bluffs north to about this point are wind blown or mixed wind blown and glacial in origin. They are the Knox, Memphis and Union silt loams. The underlying formations are the Jefferson City dolomite, St. Peter sandstone, Callaway limestone and occasional Burlington limestone remnants.

8.4 KRCG-TV Station.

10.2 New Bloomfield.

Except for localized small areas the soils throughout the remainder of the trip are either the prairie or rolling phase of the Putnam silt loam. This soil type is essentially of glacial origin with modifications due to loessial, residual and topographic influences.

12.7 SLOW!

13.1 Hillers Creek - NE $\frac{1}{4}$, SE $\frac{1}{4}$, Sec. 21, T.46N., R.10W., Callaway County.

Exposed in the cut south of the bridge is the Graydon formation, of basal Pennsylvanian age, (Krebs group by Searight and others, 1953) on an eroded surface of the Burlington limestone. The Callaway limestone (Devonian) is exposed in the creek bed. Recent core drilling at a nearby quarry revealed 10.9 feet of Chouteau limestone, Bushberg sandstone, and

Snyder Creek shale, in the interval between the Burlington and Callaway limestones.

This cut presents a minor maintenance problem. The poorly consolidated conglomeratic material in the Graydon weathers rapidly and falls to the shoulder and ditch areas necessitating periodic clearing operations. The original construction was early in 1923 with various improvements up through the early 1930's. Modern design would provide for wider shoulders and a berm or bench beyond the ditch where such material is to be encountered.

- 14.0 Ft. Scott limestone on left.
- 17.5 Ft. Scott limestone on right.
- 21.0 Old fire clay pit on right.
- 22.3 Entering Fulton.
- Ft. Scott limestone overlying Graydon formation on right.
- 22.6 CAUTION! Stop light. Turn right on 5th Street. Proceed with caution.
- 22.8 STOP 1. NW $\frac{1}{4}$, SW $\frac{1}{4}$, Sec. 16, T.47N., R.9W., Callaway County. Leave cars and walk south along driveway.
- Lovers Leap" is a well known exposure of the Graydon formation. This 40 foot bluff along Stinson Creek represents one of the best exposures of the coarse chert conglomerate and fine-grained ferruginous sandstone in the area. About one mile east the Burlington limestone is exposed below a more modest outcrop of the conglomeratic material. The Ft. Scott limestone is exposed across Stinson Creek to the south (mileage 22.3) and on roughly the same level as the top of the "Lovers Leap" exposure. The underlying Graydon at that location is lower in elevation and composed mainly of sandstone.
- 22.9 Turn left on Grand Avenue.
- 23.2 Turn left on 8th Street.
- 23.3 CAUTION! Sharp right turn on Highway 54.
- 23.6 Stop light. Straight ahead.
- 26.0 SLOW! Winding road ahead.

30.3 CAUTION! Four way stop. Junction Highways 54 and 40.
Straight ahead.

33.0 STOP 2. NW $\frac{1}{4}$, Sec. 2, T.48N., R.9W., Callaway County.
Auxvasse Creek Relocation, Route 54.

A complete soil survey and cut classification with core drilling and bridge footing soundings was made prior to the design and construction of this project. In this area Pennsylvanian shales and the Graydon formation lie on an eroded surface of the Burlington limestone. During construction two small fire clay pockets were exposed in a cut near the south approach. Special precautions were taken regarding drainage and the placing of the roadway relative to the fire clay in the subgrade.

Facts regarding the construction of the project:

Total length - 0.820 miles
Total cost - \$191,339.23 (grading, paving and bridge)
Total time - 133 working days
Completion date - August 24, 1955
Contractor - Arthur Engineering Company
Sub-contractors - C. H. Atkinson Paving Company
Midco Construction Company
Bridge - new concrete and salvaged steel from
Route 40 Auxvasse Creek bridge
Base - 4" x 24' compacted granular base. Material
furnished by the Auxvasse Stone and Gravel Co.
and consisted of a mixture of stone from the
Burlington, Sedalia and Chouteau formations
P.C.C. pavement - 8" x 22' uniform
Concrete aggregates - Burlington limestone in bridge
Callaway limestone in pavement
Missouri River sand

33.6 Turn left. Quarry entrance.

34.1 STOP 3. SW $\frac{1}{4}$, Sec. 35 & SE $\frac{1}{4}$, Sec. 34, T.49N., R9W.,
Callaway County. Auxvasse Stone and Gravel
Company Quarry.

Open pit operations began in 1918 with the first tunnel started in 1921. Hand and mule labor was employed to quarry a mixture of the Burlington limestone and Sedalia dolomite for road building purposes. The quarry was idle from 1941 until the start of the present large-scale operations in 1944.

Because of the several formations exposed to quarrying, the different types of stone involved and present day specifications, the operation is on a

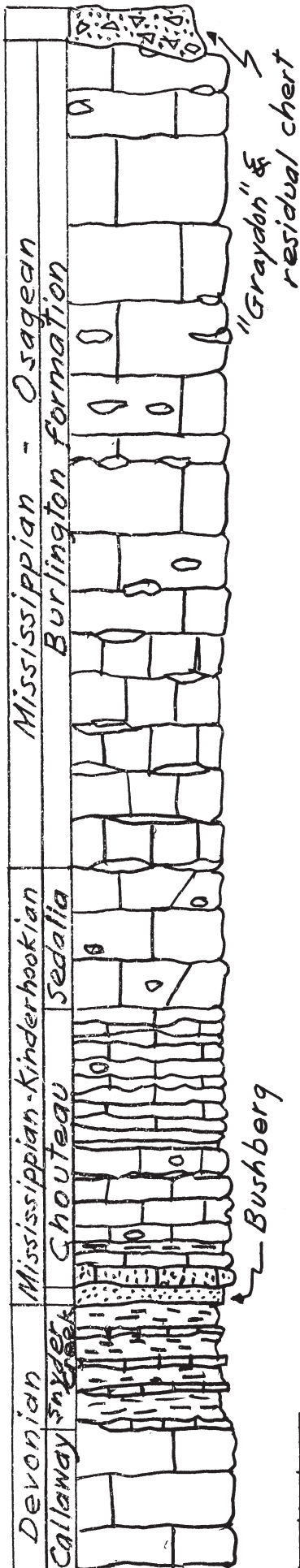


FIGURE - 1

12. Conglomerate ("Graydon"), and residual chert and clay; deeply weathered; covers upper surface of Burlington; thickness highly variable
11. Limestone (Burlington); light gray crinoidal, medium-to coarse-grained; massive; cherty; approximately 40'
10. Limestone ("Lower Brown Burlington"); gray to brown; slightly dolomitic; argillaceous; massive, even beds separated by persistent chert bands; this unit may be the Pierson (Personal Communication: T.R. Beveridge); average thickness about . . . 15'
9. Limestone (Sedalia); light to dark gray; somewhat dolomitic and argillaceous; massive; scattered nodules of light gray chert . 8-10'
8. Limestone (Chouteau); mottled light and dark gray; hackly fracture; thin, wavy bedding 9'
7. Limestone (Chouteau); mottled light and dark gray; relatively thick beds with fossiliferous shale partings; this and other divisions of the Chouteau contain scattered nodules of dark-to medium-gray chert 3' 3"
6. Limestone (Chouteau); light gray, massive . . . 2' 4"
5. Shale parting 4"
4. Limestone (Chouteau); light gray, sandy 2' 4"
3. Sandstone (Bushberg); light gray-green; calcareous; upper part more nearly an extremely sandy limestone; average thickness . 1'
2. Shale and limestone (Snyder Creek); unit comprises 4 or 5 thin, dense, argillaceous limestone beds separated by massive greenish-blue claystone or poorly bedded shale; total thickness 8'
1. Limestone (Callaway); upper part only is now exposed; approximately 24 feet of light tan, massive, fine-grained to lithographic limestone was quarried here; upper part (now above water) is composed principally of the stromatoporoid Idiostroma; core drilling data indicate a total thickness of 66 feet of Callaway at this locality



Note: Other thickness data from core drilling are: Platin, 42 feet; Joachim, 36 feet; and St. Peter, 18 feet plus.

Described by: Unklesbay and Aylor.

Stratigraphic description of beds exposed at the Auxvasse Quarry. STOP 3.

selective basis in order to produce material which is acceptable for various highway construction purposes. The Burlington, Chouteau and Callaway limestones are suitable for the production of asphaltic concrete and other bituminous aggregates; the Burlington and Callaway for P.C.C. (Portland cement concrete) aggregate; and all stones including the Sedalia are used in surfacing and base material. The product is subject to inspection at all times and must meet the governing specifications regarding the content of chert, shale, soft and porous stone, mudballs, etc., as well as the gradational requirements.

In September, 1954 two cores were obtained at this quarry. The first extended from the top of the Burlington into the lower Callaway, a depth of 137 feet. The second was from the upper Callaway well down into the St. Peter sandstone, a depth of 151 feet. (See Figure 1).

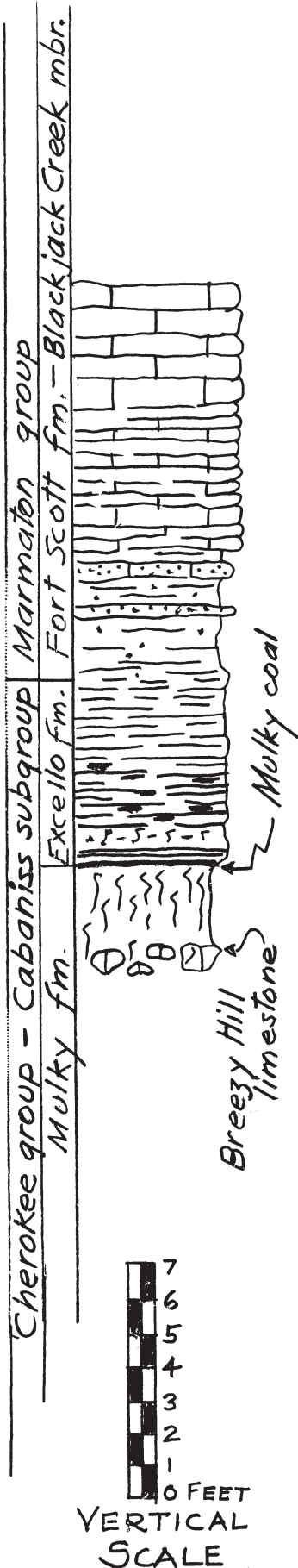
During the years between 1929 and 1952 mushrooms were grown commercially in the unused tunnels. This had to be discontinued because of a disease which developed.

- 34.5 Leave Auxvasse Quarry. Turn right on Highway 54.
37.8 Junction Highways 54 and 40. Turn left on Highway 40.
42.9 STOP 4. NW $\frac{1}{4}$, NW $\frac{1}{4}$, Sec. 17, T.48N., R.8W., Callaway County. Auxvasse Creek Relocation, Route 40.

A soil survey and soundings were also made prior to the design and construction of this project. A considerable thickness of glacial soil and drift overlies the Ft. Scott limestone in the cut on the west side of the Auxvasse Creek. About one mile further east and at roughly the same elevation the Graydon formation and Burlington limestone were encountered. (See Figure 2)

Facts regarding the construction of the project:

Total length - 3.170 miles
Total cost - \$398,118.47 (grading, paving and bridge)
Total time - 140 working days
Completion date - June 27, 1952
Contractor - Knutson-Gould Construction Co.
Sub-contractors - Atkinson-Windle Paving Co.
Base - 4" x 26' rolled stone base. Material furnished by Auxvasse Stone and Gravel Co. and consisted of Burlington and Chouteau limestones.
P.C.C. pavement - 8" x 24' uniform
Concrete aggregates - Callaway limestone in pavement and bridge. Missouri River sand.



10. Limestone (Blackjack Creek); light bluish-gray, weathering to yellow-brown; argillaceous; bedding irregular; fossils include brachiopods, corals, and large crinoid columnals; rock is overlain by glacial deposits; thickness of limestone approximately . . . 8'
9. Shale, tan to gray, silty; calcareous; includes a massive silty limestone bed near the top; *Dictyoclostus* common in the limestone; average thickness about 1' 6"
8. Siltstone, calcareous 2-3"
7. Shale (beds 7, 8, and 9 are classed with the Blackjack Creek member); gray to brown, weathering gray; silty, calcareous; contains scattered chonetids and *Marginifera muricatina* in lower part 2'
6. Shale (Excello); medium-to dark gray; contains abundant phosphatic concretions in lower and middle parts 4' 4"
5. Clay and shale, dark, carbonaceous slickensided 4-6"
4. Shale, (beds 4 and 5 are classed with the Excello); dark gray to black, fissile 1-3"
3. Coal (Mulky); soft, impure 1-2"
2. Clay (underclay); light gray 2-3'
1. Limestone (Breezy Hill); discrete masses of argillaceous limestone in a clay matrix; exposed in ditch 1'

Described by: Unklesbay and Howe.

Stratigraphic description of beds exposed at the Auxvasse Creek Relocation along U. S. Highway 40. STOP 4.

FIGURE - 2

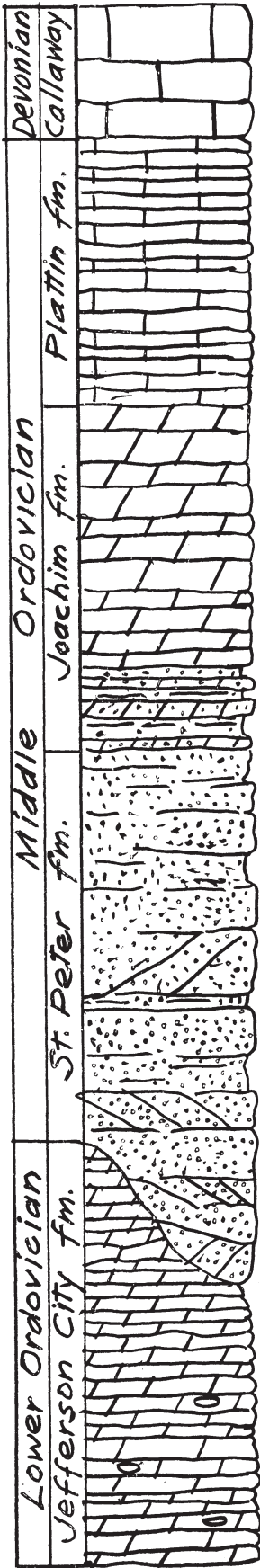
Early in 1955 a slide developed along the south fill slope between the two cuts on the west side of Auxvasse Creek. It was of such magnitude that if left untended the roadway would be endangered. A special investigation of the conditions was conducted by members of the Geology and Soils Department and recommendations made regarding correction. The Maintenance Division performed the corrective measures that are in effect now with satisfactory results thus far.

- 44.0 Graydon conglomerate on left.
- 44.3 Burlington limestone on left.
- 44.9 Special test section. Subgrade Moisture Investigation.

During the construction of this project a special test section of pavement was installed to study the subgrade and base moisture conditions relative to pavement performance. It was designed to help determine the source of subgrade moisture and the quantitative effect upon subgrade moisture of controlling the method of entry of the surface water. The control of the entrance of surface water was attempted by sealing a waterstop asphaltic membrane to the bottom of the slab at the edges and joints and by providing an oiled earth membrane over the entire subgrade surface. Eight 100 foot sections were treated in various ways in order to evaluate and compare the methods. Through the installation of fiberglass moisture cells and moisture collecting drains and drums a record is now being kept to compare with atmospheric conditions.

- 51.3 Williamsburg.
- 55.0 Callaway-Montgomery County line.
- 56.9 Beginning of Mineola Relocation, Route 40.
- 59.0 STOP 5. NE $\frac{1}{4}$, SW $\frac{1}{4}$, Sec. 27, T.48N., R.6W., Montgomery County.

In 1950 a soil survey was completed for this three mile relocation. The need for such an improvement is all too obvious to anyone who has ever tried to negotiate the notorious "Mineola Hill" behind a loaded stock truck. The geology of the area is well known and was almost as clearly defined at the time of the survey as it is today. The highway now roughly



5. Limestone (Callaway); light-to reddish-gray; coarsely crystalline to fine-grained; thick irregular beds; predominantly fine-grained reddish-gray portions have relatively few fossils and are mostly confined to basal part; common fossils in the coarse gray limestone are corals and stromatoporoids; filled solution structures common; approximate thickness, as exposed in cuts west of Loutre River 15'
4. Limestone (Plattin); mottled light and dark gray, locally pink; sparsely cherty; thinly and evenly bedded; weathered surface honeycombed; locally highly fossiliferous with high-spired gastropods; contact with underlying Joachim not well defined; approximate thickness 30'
3. Dolomite (Joachim); dark gray to earthy, reddish-brown; evenly-bedded except lower part, which consists of sandy dolomite with shale breaks; contact with underlying St. Peter gradational; approximate thickness 40'
2. Sandstone (St. Peter); massive; thick to thin-bedded; some cross-bedding; several beds near top very friable, others very tightly cemented; uppermost bed contains small sandstone concretions; approximate thickness 45'
1. Dolomite (Jefferson City); thin-bedded, fine-grained; distorted; thickness exposed approximately 50'

Described by: Unklesbay and Aylor.

Stratigraphic description of beds exposed in cuts along Mineola Relocation, U. S. Highway 40. STOP 5.

FIGURE-3

coincides with the east-west axis of the "Mineola Dome" while the Loutre River in following a course along the north-south axis has eroded away most of the western flank of the anticlinal structure. The eastern flank is fairly well intact and in various places pronounced dips are measurable. (See Figure 3).

Facts regarding the construction of the project:

Total length - 2.984 miles

Total cost - \$731,257.26 (grading, paving and bridges)

Total time - 160 working days

Completion date - July 6, 1953

Contractor - R. G. Aldridge

Sub-contractors - Atkinson-Windle Paving Co.

E. L. Harlin

Base - 4" x 26' or 36' compacted granular base.

Material furnished by Hall and Riley Quarries from the Plattin limestone near the west end of the project.

P.C.C. pavement - 8" x 24' uniform and 8" x 34' with climbing lanes.

Concrete aggregates - Plattin limestone in pavement and bridges. Missouri River sand.

A few hundred yards north on the east side of the Loutre River is Graham Cave, a long-used Indian shelter, in which the Archaeological Department of the University of Missouri has unearthed several levels of civilization. A wealth of information and important artifacts has been obtained at this site and the radio-carbon test method has back-dated the lowest level of civilization about 9700 years.

61.1 Danville. Turn right at quarry entrance.

61.7 STOP 6. SE $\frac{1}{4}$, NE $\frac{1}{4}$, Sec. 25, T.48N., R.6W., Montgomery County. Danville Stone Company Quarry.

Plattin limestone - light to dark gray mottled; mottling more pronounced in lower part with localized pink areas; sub-lithographic to medium-grained; evenly-bedded, massive in fresh exposures, thin-bedded and honey-combed on weathered surfaces; some beds fossiliferous. In this quarry there are many filled solution structures which contain a mixture of green sandy shale, white tripolitic chert, limestone fragments, phosphatic material and scattered fossils. In some fissures the shale is well laminated, soft and waxy and contains very little

or no sand and silt. Sandstone (Graydon formation) rests on an irregular surface above the Plattin in most places although small outliers of the Callaway limestone are present in the area.

Rough exposures of the Plattin limestone in this area were first investigated in November, 1954. Samples of the stone were taken from three test pits representing about three-fourths of the hill now being quarried. Preliminary tests on this stone indicated that it would be suitable for use in various aggregates. Several cores were then taken in the immediate area. The deepest hole went 121 feet through 61 feet of Plattin limestone, 57 feet of Joachim dolomite and 3 feet into the St. Peter sandstone.

Production was started in May, 1955 after the installation of a 32" x 40" Universal Impact-Master crusher, screening units and bins. The crusher weighs 30 tons, has a 250 ton per hour capacity, and produces a more cubical shaped aggregate as opposed to the splintery type often obtained by jaw crushers.