GUIDE BOOK

To The

GEOLOGY IN THE VICINITY OF
CAPE GIRARDEAU, MISSOURI
Including
CROWLEYS RIDGE

CLAYTON H. JOHNSON
EDITOR

ASSOCIATION OF MISSOURI GEOLOGISTS
NINTH ANNUAL FIELD TRIP
SEPTEMBER 28 AND 29, 1962

Sponsored By The
DEPARTMENT OF EARTH SCIENCES
SOUTHEAST MISSOURI STATE COLLEGE
CAPE GIRARDEAU, MISSOURI
ASSOCIATION OF MISSOURI GEOLOGISTS

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DEDICATION

to
Edward Lee Clark
1908–1962

To Edward Lee Clark, whose career as teacher; as Regional Technical Advisor to the U. S. War Production Board for Missouri and adjoining states; as Geologist, Assistant State Geologist, and State Geologist on the Missouri Geological Survey; as ex-officio member of the Missouri Highway Commission; and as an appointed Consultant on the President's Cabinet Committee on Water Resources Policy helped so greatly to increase our knowledge of the geology of Missouri and to make the public cognizant of the usefulness of that knowledge, we dedicate this volume.
INTRODUCTION

The geology of the Paleozoic rocks on the southeastern flank of the Ozarks and of the Cretaceous and Tertiary rocks in Crowleys Ridge and the Mississippi Embayment is probably the least known in the state by most Missouri geologists. We are indeed fortunate, therefore, to have been invited by members of the Department of Earth Sciences of Southeast Missouri State College to see some of this geology.

Locally the structure and stratigraphy of the Paleozoics are extremely complex. Exposures of Cretaceous and Tertiary rocks are limited to widely scattered remanent ridges. Not enough time is available during this field trip to see all these complexities nor all these scattered exposures. The chief objective is to become acquainted with the stratigraphy so that those who have the opportunity to study the details will have a basis for beginning.

Geological interest in adjacent sedimentary basins and adjacent known mineralized areas make practical a knowledge of the areas covered by this field trip.

The guidebook comprises two route maps and two road logs with specific stops indicated on each log. Other points of geologic interest are indicated so that one can use the logs in the future and make as many stops as he chooses. Two special papers about the Mississippi Embayment are also included.

Previously published guidebooks that include information on parts of the Mississippi Embayment and/or the Cape Girardeau areas are:


It is the belief of the Field Trip Committee that often too much time is spent in pointing out exact contacts and many other features that are easily determined by each individual of a group of professional geologists and engineers such as the Association of Missouri Geologists. With this in mind we have left the last stop of each days trip non-sullied by names and descriptions. At each of these stops the exposures are only slightly different expressions of something that has been seen and explained earlier in the day. They are offered here as a REWARD comparable to the pleasure one experiences in meeting an old friend. It is doubtful that the Committee has any information other than that which is evident to all, but we will be happy to offer opinions on any question which may arise.
ACKNOWLEDGMENTS

Many persons and organizations contributed to the preliminary planning for a variety of trips that for some reason or another had to be abandoned in favor of the one selected. Nonetheless their efforts are herein acknowledged. This group includes Robert D. Knight, Missouri Geological Survey; Charles R. Golder and Colonel A. P. Rollins, Jr., Corps of Engineers, U. S. Army, Kansas City District; and Mr. C. W. Rushing, General Manager, Missouri Barge Line Company, Cape Girardeau.

Special thanks are given our president, Frank G. Snyder, for his help in the general organization of the trip, for geologic aid, for making arrangements for drafting, for assisting in the editing, and, above all, for encouragement. James A. Martin, Paul E. Gerdemann, M. G. Mehl, and George H. Fraunfelter led in selecting and logging the routes; and they, Kenneth G. Brill, and Louis Unfer deserve our gratitude for the geologic details at the stops.

We are indebted to F. N. Aukeman, Geologist, Marquette Cement Company, for the core drill log at the Marquette Quarry in Cape Girardeau, and to the Cement Company for permission to visit the quarry and for its hospitality. Thanks also are given to Mr. Tyree Brown, Bell City; Mr. Franklin Link, Route 2, Bloomfield; Mr. Edgar Hecht, New Wells; Mrs. George Terry, Route 4, Jackson; and Mr. Arnold Geiser, Dutchtown, for permission to go onto their properties.

We are grateful to the Drafting Department, St. Joseph Lead Company, for maps and geologic sections, and to Gustavo Morales, University of Missouri, for the map of Cape Girardeau. Several students at Southeast Missouri State College made the sites of stops more easily accessible just prior to the field trip.

We especially appreciate the leadership of Daniel R. Stewart, American Zinc, Lead and Smelting Company, and Lyle McManamy, Independent, Mt. Vernon, Illinois, over the Cretaceous and Tertiary sediments; and to Wayne Pryor and Irving L. Turner and Louis Unfer for their special papers.

We have not intentionally overlooked anyone who has helped to make this field trip successful. However, a general thank you is given to cover all such possibilities.
The assembly time is 12:30 p.m. (CST). The assembly point and Stop 1 for the trip is on the northwest-southeast road just west of the center of Bell City on the west side of the St. Louis-Southern Railroad tracks. The caravan will leave for Stop 2 at 1:00 p.m. (CST).

The trip will be conducted in the Mississippi Embayment of southeastern Missouri from Bell City to a point about two miles north of Bloomfield. The outcrops to be examined were selected to show representative Cretaceous and Tertiary sediments of the area. Two major physiographic provinces to be traversed are 1) the upland area of Crowleys Ridge, and 2) the Morehouse lowland which lies along the east flank of the ridge. Even though structural adjustments in the area may have played a part in the control of ancient drainage patterns, the present physiographic features are erosional remnants which outline the former courses of the ancestral Ohio and Mississippi Rivers and their tributaries. The adjustment of the Mississippi River to its present course is discussed at length by Marbut (1902) and Fisk (1944).

ROAD LOG

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<th>Mileage</th>
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<th>Diff.</th>
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<tbody>
<tr>
<td>0.00</td>
<td>STOP 1. SW(\frac{1}{4}) NW(\frac{1}{4}) sec. 1, T. 27 N., R. 11 E., (Advance Quadrangle). East front of Crowleys Ridge at Bell City.</td>
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<tr>
<td></td>
<td>An outcrop and slump blocks of the &quot;Commerce quartzite&quot; of the McNairy formation are present at this locality. About nine-tenths of a mile northeast of here, the sandstone and quartzite of this unit form a steep bluff 50 feet or more in height, at a place where the section is not easily accessible to a large group.</td>
<td></td>
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<td></td>
<td>Marbut used the name &quot;Bell City quartzite&quot; for the exposures in this area, and &quot;Commerce quartzite&quot; for equivalent exposures near the town of Commerce in Scott County. &quot;Commerce&quot; has been the preferred name in most references to the quartzite. The quartzite is the result of localized silicification of the upper sand in the lower part of the McNairy formation. The unit grades from a loose sand, through iron-cemented, case-hardened sandstone to quartzite. Exposures of the indurated phase are scattered over the general outcrop area of the McNairy in both Scott and Stoddard Counties. Well records indicate up to 400 feet of sand for the maximum thickness of the McNairy formation in Stoddard County.</td>
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<td></td>
<td>Turn southwestward on the gravel road which parallels the base of Crowleys Ridge.</td>
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<tr>
<td>0.2</td>
<td>STOP 2. SE(\frac{1}{4}) SE(\frac{1}{4}) sec. 2, T. 27 N., R. 11 E., (Advance Quadrangle). Sandstone pit in the lower McNairy formation.</td>
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<td>The gradation of sand to sandstone can be seen in the northeastern part of the pit. The sand grains are very fine to medium in size, and the exposed unit is crossbedded and micaceous throughout. A conspicuous micaceous layer occurs about 18 feet above the floor of the pit. In the quartzite and sandstone phases of the McNairy, mica flakes are relatively scarce. This section lies stratigraphically below the upper McNairy beds exposed at Stop 4.</td>
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<tr>
<td></td>
<td>Turn northwestward onto Missouri Highway 94 and ascend Crowleys Ridge.</td>
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FIG. 1. ROUTE MAP. FIRST DAY OF FIELD TRIP. STODDARD COUNTY.
FIG. 2. COLUMNAR SECTION - STODDARD COUNTY.
Mileage
Cum.  Diff.

1.4

1.6 Bridge.

0.5

2.1 Turn southward onto gravel road.

1.2

3.3 Road to west. Continue straight ahead, southward.

0.2

3.5 Sharp turn westward into gravel pit.

STOP 3. SE \(\frac{1}{4}\) SE \(\frac{1}{4}\) sec. 4, T. 27 N., R. 11 E., (Advance Quadrangle). See Figure 3 for stratigraphic section.

The gravels in this general area were originally named the “Piketon gravels” by Marbut. The site of the former town of Piketon is about one-half mile northwest of here, and a number of old gravel pits can be seen in the area from the road.

The overall appearance of units 1, 3, and 4 (Figure 3) is suggestive of Wilcox exposures farther south. However, the presence of brown chert in unit 3 implies that at least units 3 and 4 are in the “Lafayette” formation. If this is true the brown chert is probably re-worked Wilcox. Farrar and McManamy (1937) and Stewart (1942) have described red sands and clay bodies in the “Lafayette” as well as in the Wilcox. About 0.7 mile south-east of this place on the eastern escarpment of Crowleys Ridge, an exposure of 19 feet of Wilcox sand containing boulders of bauxitic clay is separated from the “Lafayette” gravels by 18 feet of Wilcox clay. The section which is exposed by landslide on the southeastern face of Crowleys Ridge, three-eighths of a mile southeast of Ardeola School, NE \(\frac{1}{4}\) SE \(\frac{1}{4}\) sec. 9, T. 27 N., R. 11 E., Bloomfield Quadrangle, is as follows: (Stewart, McManamy, and McQueen, 1943, p. 8).

5. Gravel, poorly sorted gravel in quartz sand matrix; the smaller pebbles are predominantly quartz, and the larger pebbles and smaller cobbles are brown chert and quartzite; all are well rounded and water worn.  

4. Sand, red, fine to medium-grained quartz, iron-strained, small flecks of light gray clay scattered throughout; sand grains are angular to subangular, probably regenerated; a 2 inch light gray to yellowish-brown clay band, 9 inches above base, containing quartz sand and and silt sized grains.  

3. Gravel in a sand matrix, top 2 feet alternating red sand and gravel bands; gravel is granule to pebble size consisting predominantly of waxy brown chert and black flint; pebbles are well rounded and water worn and show a fair degree of sorting; sand is red, fine to medium-grained, iron-stained; white and light gray clay flecks scattered throughout.  

2. Cover and slump.  

1. Sand, red, fine to medium, some coarse, quartz grains; contains several boulder size bodies of light gray to maroon sandy clay; flecks of light gray clay scattered throughout the sand.  

FIG. 3, Section. Stop 3. Location: SE$_{1_4}$ SE$_{1_4}$ SE$_{1_4}$  
Sec. 4, T. 27 N., R. 11 E., Advance Quadrangle, Stoddard County, Missouri.  
Quaternary System:
   Pleistocene Series:
      Loess:
         No. 7  Silty clay, yellow, brown. ................. 10

Tertiary System:
   Pliocene (?) Series:
      No. 6  Gravel, brown, well rounded
             with some red sand ..................... 18

Eocene Series:
   Wilcox Group:
      No. 5  Clay, silty, light gray to brown,
             somewhat lignitic .................... 18
      No. 4  Sand, light yellow to brown,
             medium grained with boulders
             of bauxitic clay erratically
             distributed .......................... 19

Paleocene Series:
   Midway Group:
      Porters Creek Formation:
         No. 3  Clay, dark gray to black,
                 weathering to light gray with
                 characteristic conchoidal
                 fracturing .......................... 85

      Clayton Formation:
         No. 2  Clay, sandy, greenish brown,
                 very glauconitic and fossiliferous ....... 5

Cretaceous System:
   Gulf Series:
      Owl Creek Formation:
         No. 1  Clay, sandy, yellowish brown
                 to dark gray, sparingly glauconitic
                 and very fossiliferous ............... 10

         Total .................................. 165

         Base not exposed.
47'-6" Clay, green. Nodular.

4'-6" Clay, green, sandy.

11' Clay, gray-brown, sandy, fossiliferous.

11' Clay, brown, micaceous, with sand lenses. "LEAF MEMBER"

11' Sand, white angular, interbedded with clay.

28'-8" Clay, light gray to dark brown and black, sandy, iron present. Lignitic in parts; basal member is + 1 ft. of lignite. "ZADOC MEMBER"

10'-3" Sand, fine, white, angular.

FIG. 4, Section. Stop 4. Location: NW-\(\frac{1}{4}\) Sec. 10, T. 27 N., R. 11 E., Advance Quadrangle, Stoddard County, Missouri. (McQueen, 1939, Stop 33, Fig. 25, p. 70).
Continue southward on loop to road.

3.6
Sharp turn onto road.

3.9
Top of Ardeola Hill.

4.1
Base of Ardeola Hill section.

STOP 4. NW 1/4 sec. 10, T. 27 N., R. 11 E., (Advance Quadrangle). See Figure 4 for stratigraphic section.

This succession (Figure 4) has become a standard reference section for the upper Cretaceous and lower Tertiary sediments in the Missouri part of the Mississippi Embayment. The McNairy and Owl Creek formations were identified as Cretaceous by L. W. Stephenson from fossils collected in the Owl Creek formation at this locality. Classifications of this section are shown on Figure 5.

Farrar, Grenfell, and Allen (1935, p. 19) list the following fauna taken from a clay bed 6 feet thick, the top of which is 5 feet below the top of the Owl Creek member, 0.35 mile northwest of Ardeola Station in the NW 1/4 NW 1/4 sec. 10, T. 27 N., R. 11 E., Advance Quadrangle. The geologic position is the Owl Creek tongue of the Ripley formation.

Pelecypods:

Leda sp.
Cucullaea capax Conrad (a young individual)
Inoceramus argenteus Conrad (fragment)
Exogyra costata Say (young individuals)
Trigonia sp.
Pecten simplicius Conrad
Lima aff. L. acutilineata (Conrad)
Pinna laqueata Conrad (fragment)
FIG. 5  CLASSIFICATION OF ARDEOLA SECTION.  LOCATION: NE 1/4 SW 1/4 NW 1/4 SEC 10, T27N, R11E, ADVANCE QUAD, STODDARD COUNTY, MISSOURI
Crenella sp. (Same as a large undescribed species from Owl Creek, Mississippi)
Liopistha protexis (Conrad)
Veniella conradi (Morton) (fragments)
Scambulla sp.
Cardium (Criocardium) tippanum Conrad
Cardium (Criocardium) sp.
Cardium (Pachycardium) sp. (young individual)
Two unidentified shells of the Veneridae family
Leptosolen buplicatus Conrad
Legumen ellipticum Conrad
Corbula sp.
Gastrochaena sp.
Unidentified pelecypods

Gastropoda:

Turritella vertebroides Morton?
Turritella sp. (Same as a large undescribed species from Owl Creek, Mississippi)

Unidentified gastropod

Cephalopoda:

Baculites sp. (fragment)
Scaphites (fragment)

Farrar, Grenfell, and Allen (1935, p. 21) list the following fauna taken from an outcrop of the Clayton formation of the Midway Group in the SW\(\frac{1}{4}\) NE\(\frac{1}{4}\) NW\(\frac{1}{4}\) sec. 35, T. 27 N., R. 10 E., Bloomfield Quadrangle.

Pelecypoda:

Cucullaea sp. cf. C. macrodonata Whitfield
Venericardia sp. possible sp. nov. group of V. hesperia Gardner
Carditoid gen. and sp. indet.
Crassatellites sp. cf. C. gabbi Safford
Crassatellites sp. nov.
Crassatellites ? sp. indet.
Pitaria ? sp. nov.

Gastropoda:

Turritid gen. and sp. indet.
Turritella sp. nov. ? Group of T. mortoni Conrad
Turritella sp. nov. ? Group of T. mortoni Conrad
Turritella sp. nov. ? Group of T. mortoni Conrad

0.3

4.4

Sharp turn eastward

CAUTION! Railroad crossing; St. Louis–Southwestern Railroad.

1.2
Mileage
Cum.  Diff.

1.2

5.6  Turn southward

This portion of the trip is on the Morehouse lowland. This lowland represents an ancestral course of the Ohio River, which was later occupied by the Mississippi River. (Figure 16).

1.9

7.5  Village of Toppertown. Junction with State Road Y.

Turn westward onto Y.

1.5

9.0  CAUTION! Railroad crossing; St. Louis–Southwestern Railroad.

0.2

9.2  Ascending east face of Crowleys Ridge.

Porters Creek clay, overlain by “Lafayette” gravels, is exposed in the ditch and on the back slope along the road.

One mile north in sec. 21, T. 27 N., R. 11 E., an auger hole (MGS #B271121–1), drilled at an elevation of 510 feet, about 200 feet above the level of the lowlands, penetrated 31 feet of Wilcox (Eocene) and 8 feet of the underlying Porters Creek, (Paleocene).

1.3

10.5  The log of auger hole MGS #B271120–2 at elevation 374 feet in sec. 20, T. 27 N., R. 11 E. is as follows:

Feet

0-14  Loess, light yellowish-brown
14-17  Porters Creek, green clay, some glauconite
17-22  Clayton, greenish-gray and brown glauconitic clay
22-27  T. D. Owl Creek? (Ripley) yellowish-brown clay

0.9

11.4  CAUTION! STOP! Junction of State Road Y with Missouri Highway 25. Turn southward onto Missouri Highway 25.

Castor River Valley. This is one of the major lowland areas dissecting Crowleys Ridge. Farrar and McManamy (1937) have mapped a NW-SE trending fault along the north border of the valley.

0.3

11.7  Castor River.
Mileage
Cum.  Diff.

.06

12.3  Village of Aquilla, State Road M to the west.

Continue southward on Missouri Highway 25.

1.0

13.3  State Road AB to the east.

Continue southward on Missouri Highway 25.

0.4

13.7  STOP 5. SW₁⁄₄ SW₁⁄₄ NE₁⁄₄ sec. 1, T. 26 N., R. 10 E. (Bloomfield Quadrangle). Outcrop in Link Creek on east side of road.

This is another exposure of a formation seen at STOP 4. In both places the fossils are so abundant and well preserved one should recognize them as being the same. Write in the name of the formation.

Proceed southward and turn around at the position of the flagman. Park cars on shoulder of northbound lane. USE CAUTION while loading and unloading cars. To return to Cape Girardeau go northward on Missouri Highway 25 to the junction with Missouri Highway 74 at Dutchtown. Go eastward (right) on 74 to U. S. Highway 61, and Cape Girardeau.

End of Road Log


McQueen, H. S., and others, 1939, Third day of Field Conference in 13th Annual Field Conf. Guidebook, Kansas Geol. Society, pp. 68-76

Marbut, C. F., 1902, The evolution of the northern part of the lowlands of southeastern Missouri: Univ. of Missouri Studies, vol. 1, no. 3, 63 pp., 7 pls.


Stewart, Dan R., 1942, the Mesozoic and Cenozoic geology of southeastern Missouri: Unpublished man- uscript, Missouri Geological Survey and Water Resources.

________, McManamy, Lyle and McQueen, H. S., 1943, Occurrence of bauxitic clay in Stoddard County, Missouri: Missouri Geol. Survey and Water Resources, Bienn. Rept. of the State Geologist to the 62nd General Assembly, 1941-42, app. 3, 21 pp., 7 pls., 1 map.
FIG. 6. ROUTE MAP. SECOND DAY OF FIELD TRIP. CAPE GIRARDEAU COUNTY.
The assembly time is 7:00 a.m. (CST). The assembly point is at the bottom of "The Loop" hill near the railroad tracks in Cape Rock Park, northeastern corner of Cape Girardeau. This also is STOP 6 and the LUNCH stop. Park your car here so it will be available for use in the afternoon.

This day's trip affords the opportunity to study the Champlainian (middle) and Cincinnatian (upper) Series of the Ordovician; the Alexandrian (lower) and Niagara (middle) Series of the Silurian; and the Lower Devonian strata as they are developed at the outcrop along the southeastern flank of the Ozarks. The type sections of the Dutchtown, Rock Levee, Cape, Girardeau, Bainbridge, and Bailey formations are all in this general area. The regional dip is toward the northeast into the Illinois basin.

Two main topographic provinces will be traversed, namely the rough to gently rolling Ozark upland area which is as high as 200 feet above the Mississippi River, and the relatively level Advance lowland which parallels the southeastern Ozark escarpment.

ROAD LOG

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<th>Mileage</th>
<th>Cum.</th>
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<tr>
<td>STOP 1-A. NE(\frac{1}{4}) NW(\frac{1}{4}) SE(\frac{1}{4}) sec. 24, T. 30 N., R. 12 E., Cape Girardeau Quadrangle. Bluff along gravel road, west of Missouri Highway 25 and Missouri Pacific Railroad tracks, village of Dutchtown.</td>
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The outcrops along the bluff show the variable lithologies in the Everton formation—
dolomite, sandy dolomite, limestone, and sandstone. The outcrop just to the west of the
one described in Figure 8 exhibits the irregular bedding, pinch-outs, and "algal reef-
like" structures common to the upper Everton. The formation can be traced from this
point northward into southern Jefferson County. Over most of its outcrop area, the
Everton is underlain by the Canadian, Cotter-Powell, cherty dolomite. In parts of
Perry and Ste. Genevieve Counties, there are some questionable Smithville beds beneath
the Everton.
10. Cover, blocks of sandstone float; large residual boulder of pink to red chert.  
   20’+

9. Sandstone, fine-grained; light yellow fresh; dirty gray weathered.  
   1’ 3”

8. Cover  
   2’ 6”

7. Limestone, fine grained to sub-lithographic; thin-bedded; blue gray.  
   8” to 1’

6. Calcareous sandstone, very fine to medium; poorly sorted; massive; broken limestone fragments on upper surface; light yellow on fresh, dark gray weathered.  
   3’

5. Limestone, coarsely crystalline to dense, massive; 2 beds 3’ to 4’ each; light blue gray; rough bumpy surface.  
   5’ - 8’

4. Dolomite, dense to finely crystalline; light gray to buff; very thin platy beds at base.  
   4” to 8”

3. Sandstone, fine to medium grained; poorly sorted; very calcareous; light gray; case-hardened at top.  
   8”

2. Dolomite, medium crystalline; medium bedded; light gray.  
   2’

1. Calcareous sandstone, fine grained; irregularly bedded; light yellowish-brown.  
   2’ 6”

Road Level

FIG. 8, Section. Stop 1A. Location: NE-$\frac{1}{4}$ NW-$\frac{1}{4}$ SE-$\frac{1}{4}$ Sec. 24, T. 30 N., R. 12 E., Cape Girardeau Quadrangle, Cape Girardeau County, Missouri. J. A. Martin & P. E. Gerdemann - 1962.
5. Sandstone, predom. fine-grained; qtz. grains rounded & frosted some showing regeneration; calc. cement in lower part; light gray to white becomes iron stained upper part. 20’+-

4. Sandstone, predom. fine-grained; massive; calc. cement in part; light gray to white; small round qtz. sand "concretions" giving gross appearance of a conglomerate on weathered surface. 5’

3. Cover. 1’

2. Dolomitic sandstone, yellow gray, slightly calc. in part; small veinlets of calcite; fine-grained to medium grained quartz. 1’ 8”

1. Dolomite, crse. xyln.; slightly calc.; sparse, fine to medium, floating quartz sand grains; yellow brown. 4’

Cover to creek level. 8’+-

FIG. 9, Section. Stop 1-B. Location: NW-3 NE-3
SE-3 Sec. 24, T. 30 N., R. 12 E., Cape Girardeau Quadrangle, Cape Girardeau County, Missouri.
Cross Hubble Creek and Missouri Highway 25. Walk northward to creek. Roadcut is in the St. Peter formation.

STOP 1-B. NW\textsuperscript{1/4} NE\textsuperscript{1/4} NE\textsuperscript{1/4} SE\textsuperscript{1/4} sec. 24, T. 30 N., R. 12 E., Cape Girardeau Quadrangle. South bank of creek, east side of Missouri Highway 25, village of Dutchtown.

St. Peter–Everton contact. McQueen (1937, 1939) placed the lower 50 to 70 feet of sandstone, above the Everton dolomite, in the Everton formation. Criteria for this were the irregularity of grain size; regeneration of quartz grains; induration by dolomitic, calcareous, and siliceous cement; lower porosity and greater resistance to drilling. Gealy (1955) disagreed with this interpretation by McQueen, citing the wide degree of rounding and range of grain size in the St. Peter as given by Dake, and concluding that these variations were too inconsistent to be valid for subdivision of the sandstone unit. He therefore placed the Everton–St. Peter contact at the dolomite–sandstone break. This is the break used in Figure 9. Proceed eastward on gravel road along base of bluff.

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<td></td>
<td></td>
</tr>
</tbody>
</table>

Outcrops of massive, cross-bedded, St. Peter sandstone are exposed along the bluff, on the north side of road. CAUTION! Junction with Missouri Highway 74. Proceed eastward on 74.

1.0

STOP 2. Southeastern part of U. S. Survey No. 214. (SW corner NW\textsuperscript{1/4} NW\textsuperscript{1/4} sec. 20 projected) T. 30 N., R. 13 E., Cape Girardeau Quadrangle, Arnold Geiser* property, north side of Missouri Highway 74. This is the type section of the Dutchtown formation which is described by McQueen (1937, p. 18) as:

<table>
<thead>
<tr>
<th>Thickness</th>
</tr>
</thead>
<tbody>
<tr>
<td>Feet</td>
</tr>
<tr>
<td>Inches</td>
</tr>
</tbody>
</table>

Middle Member:

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>8.</td>
<td>Limestone, dense, grayish-blue and brown, lithographic, argillaceous; breaks with a conchoidal fracture and thin splintery edges. Weathers to a buff color. Contains thin buff partings of clay.</td>
</tr>
<tr>
<td>7.</td>
<td>Limestone, light bluish and brownish-gray, with one-half inch, darker blue bands, parallel to bedding; dense, lithographic, massive but weathers along the darker colored bands into thin beds 3 inches thick. Thin shale partings are common. Upper and lower parts of this bed are fossiliferous and contain crystalline calcite.</td>
</tr>
<tr>
<td>6.</td>
<td>Limestone, similar to that in Bed No. 2; dense, best exposed in vertical face along joint plane, striking N. 43° W.; weathers along shaly partings into beds 2 inches to 12 inches thick</td>
</tr>
<tr>
<td>5.</td>
<td>Limestone, buff, fissile, and shaly</td>
</tr>
<tr>
<td>4.</td>
<td>Limestone, brown, lithographic, contains small flat gastropods.</td>
</tr>
<tr>
<td>3.</td>
<td>Limestone, shaly as in No. 4</td>
</tr>
<tr>
<td>2.</td>
<td>Limestone, dark blue to brown, dense to finely crystalline, and slightly granular in upper portion, occurs in one bed; gastropods and pelecypods are common. Limestone conglomerate of shingle type occurs near the base</td>
</tr>
</tbody>
</table>

*Mr. Geiser requests that anyone desiring to inspect exposures in the quarry, call at his home, located just east of the quarry on State Highway 74, before doing so.
Lower Member:

1. Limestone, dark blue to black, very nodular, weathers in 6-inch beds, with thin, dark-brown, shaly partings. Ostracods are common in the limestone, and conodonts are present in the shale. Exhibits locally, a wavy-bedded, reef-like appearance. Calcite-encrusted partings, and calcite-lined vugs also noted. Asphalt occasionally noted in vugs. . . . 5 0

Total thickness exposed . . . . . . . . . . . . . . . . . . . . . 15 5

A 5 foot 8 inch layer of dense, fossiliferous limestone, about 4 feet above the quarry floor, contains abundant gastropods and some ostracods and brachiopods. A fair quantity of well preserved conodonts have been obtained by digestion of the limestone with 10 percent solution of glacial acetic acid.

0.7

2.3 Along the bluff to the north, there is a small fault with a displacement of approximately 40 feet. The downthrown side is to the east. On the west side of the fault, the contact of the Dutchtown limestone with the overlying Joachim dolomite is exposed. On the east side of the fault, only the Joachim formation crops out. Calcareous sandstone, 5 feet thick informally named the “Pecan Grove” by McQueen, is present about 60 feet above the base of the Joachim throughout this area.

1.7

4.0 STOP 3. NW 3/4 NW 1/4 NE 1/4 sec. 22 projected, T. 30 N., R. 13 E., Cape Girardeau Quadrangle, Arnold Quarry (abandoned) north side of Missouri Highway 74. Notes are by G. K. Brill.

Although there are numerous quarries in Ordovician strata that might be visited in the area, the Arnold Quarry is readily accessible and contains a typical exposure of Joachim strata. About 70 feet of the Joachim formation is visible (Fig. 10). The upper 41 feet of the face contains several beds of oolite (pseudo-oolite) and limestone breccia which may be best observed at the east end of the quarry.

The terminology used by various writers for Middle Ordovician strata in this area is shown on the correlation chart (Fig. 11). The names Joachim and Plattin, given by Winslow and Ulrich, respectively, to strata near St. Louis have been brought south from Jefferson County. McQueen (1939, p. 64) referred the upper part of the Joachim in this area to the Stones River group of Tennessee. This correlation was based on Ulrich’s discovery of Protorhyncha ridlevana and Tetradius syringoporoides in the Adam quarry nearby.
Loess

Limestone medium gray, weathers lighter, lithographic, wavy laminated banding, algal? humps. 10.0

Limestone light gray, weathers yellowish gray, shaly, argillaceous, weak. 1.3

Limestone medium gray, weathers lighter, lithographic, little banding, yellow at top. 5.8

Limestone light gray, laminated banding, algal humps, dolomitic, prominent bedding plane 1’ above base. 5.4

Limestone poorly exposed. 1.0

Dolomite grayish orange pink, argillaceous?, smooth face. 2.3

Limestone breccia medium gray, lighter elongate fragments up to 1” diameter, oolites in matrix. 0.8

Dolomite yellowish gray, calcareous, poor bedding. 1.0

Dolomite light gray, banded, lithographic, wavy lamination, smooth face. 4.3

Limestone light gray mottled, dolomitic, thin-medium bedded. 5.5

Dolomite, grayish orange pink-yellowish gray, very fine crystalline, banded, basal 1’ has algal humps, smooth face. 2.3

Limestone like Int. below but has algal humps and oolites, elongate fragment of limestone at base. 1.7

Limestone light gray mottled, slightly argillaceous, dolomitic, weathers to irregular fragments, basal .5’ weak. 3.3

Limestone yellowish gray, dolomitic, rounded quartz grains, elongate white limestone fragments, pyritic matrix. 0.65

Limestone light gray, mottled, banded, slightly dolomitic. 1.9

Limestone very light gray, dolomitic, poor bedding. 0.35

Limestone light-medium gray, banded, shoal breccia 4.3’ above base, weak unit. 7.0

Limestone light gray with purplish mottling and banding, dolomitic, top has algal humps. 2.4

Dolomite yellowish gray, limy, one bed, weathers yellowish. 0.5

Limestone light gray, banded, weathers lighter, slightly dolomitic, top has bedding plane with shale break. 9.2

Limestone light gray mottled purplish and brown, dense, top beds argillaceous. (In sump). 3.3

FIG. 10. COLUMNAR SECTION ARNOLD QUARRY. Stop 3.
NW, NE, 22, T.30 N., R. 13 E.
Groshkopf (1948) restricted the Joachim formation to the basal 175 feet and proposed the term Rock Levee formation for strata that formerly comprised the upper Joachim and basal Plattin formations. In this area the Rock Levee was approximately equal to the Stones River group. The basal 155 feet of the type Rock Levee is in the Adams water well (NW1/4 NW1/4 sec. 24, T. 30 N., R. 13 E.), and the upper 78 feet is visible in the nearby Adam and Oglesby quarries.

The Joachim–Rock Levee contact is marked by a thin bed of chert nodules and is believed to lie just below the floor of the Arnold Quarry (Groshkopf, 1948). The Rock Levee–Plattin contact is marked by an oolite and conglomerate which lie below a widespread thin shale (the Establishment shale member of Templeton and Willman ms.). The contact is visible in the Oglesby Quarry about 2 miles east of the Arnold Quarry.

Although the oolite and limestone conglomerate mark the base of the Plattin in both Jefferson and Cape Girardeau Counties, similar beds occur in the Joachim formation in Cape Girardeau County. This led Gealy (1955, p. 61) to place the base of the Plattin at the oolite and conglomerate (Interval 15) in Arnold Quarry. This is about 200 feet lower, stratigraphically, than the Joachim–Plattin contact at Oglesby Quarry.

Templeton and Willman of the Illinois Geological Survey have regrouped the Middle Ordovician of the Mississippi Valley region into numerous new formations and members based on lithology and fauna. Although their study has not been published at this writing, their classification of formations for this part of the section is shown in Fig. 11.
FIG. 11. CORRELATION CHART OF A PART OF THE MIDDLE ORDOVICIAN IN THE AREA OF THE FIELD TRIP SHOWING POSITION OF THE QUARRIES ON ROUTE.
Continue eastward on Missouri Highway 74.

1.3

Junction with U. S. Highway 61. Go under overpass and continue straight ahead (east) on South Sprigg Street.

0.3

Adam Quarry (abandoned) (NW\(\frac{1}{2}\) NW\(\frac{1}{2}\) NW\(\frac{1}{2}\) sec. 24, T. 30 N., R. 13 E., Cape Girardeau Quadrangle). Upper part of the Rock Levee formation.

0.1

Olgesby Quarry (abandoned) NW corner, NW\(\frac{1}{2}\) NE\(\frac{1}{2}\) NW\(\frac{1}{2}\) sec. 24, T. 30 N., R. 13 E., Cape Girardeau Quadrangle). The Rock Levee-Plattin contact lies about 20 feet above the level of the road. The basal Plattin bed is an oolitic, intraformational, limestone conglomerate. This quarry was designated the type locality of the Rock Levee formation by Groshkopf (1948).

0.3

Bluff of Plattin limestone.

0.6

Faulted zone in the Plattin on the north side of the road behind houses.

1.5

STOP 4. NE\(\frac{1}{4}\) SE\(\frac{1}{4}\) NW\(\frac{1}{4}\) sec. 18, T. 30 N., R. 14 E., Cape Girardeau Quadrangle. Marquette Cement Company Quarry. Notes and core drill log are by F. N. Aukeman.

The Marquette Cement Company has drilled several core holes in the Plattin formation in their Cape Girardeau quarry. None of these reaches the St. Peter sandstone, and possibly none penetrates the full thickness of the Plattin. The deepest hole in the quarry bottoms at about 72 feet below sea level (elevation of the road at the rim of the quarry is approximately 355 feet above MSL) in a light buff, cryptocrystalline limestone. No mention of oolitic or conglomeratic rock is made in the logs of these holes.

Analyses of the cores indicate that two high-magnesia zones, which may or may not be tongues of the Rock Levee formation, occur about 150 feet and 240 feet below the second quarry level now being worked. Drilling indicates that the dip of the Plattin at this location is approximately 10 degrees and the strike is about N. 80 E.

A detailed log of a core obtained from the Federal Materials Company quarry, adjacent to the Marquette quarry, is on file at the Missouri Geological Survey in Rolla. This log, prepared by H. B. Willman (Illinois Geological Survey) and T. R. Beveridge and J. H. Williams (Missouri Geological Survey) includes the Plattin formation and part of the Joachim Formation.

The following log is of core drill hole No. 55-3 in the Marquette Cement Company quarry, Cape Girardeau, Missouri. The top elevation is 240 feet above sea level on the floor of the second quarry level.
<table>
<thead>
<tr>
<th>Depth From (Feet)</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Limestone, dove colored, cryptocrystalline to medium crystalline. Mottled or banded with darker limestone between 31' to 32', 47' to 48', 86' to 95', 100' to 102.</td>
</tr>
<tr>
<td>104</td>
<td>Limestone, alternating beds of dove colored and light gray cryptocrystalline stone.</td>
</tr>
<tr>
<td>125</td>
<td>Limestone, dark gray, cryptocrystalline.</td>
</tr>
<tr>
<td>135</td>
<td>Limestone, dove gray, banded, slightly crystalline, somewhat dolomitic.</td>
</tr>
<tr>
<td>160</td>
<td>Limestone, gray, mottled, slightly dolomitic.</td>
</tr>
<tr>
<td>165</td>
<td>Limestone, dove colored, mottled and banded with light gray limestone, slightly dolomitic.</td>
</tr>
<tr>
<td>177</td>
<td>Limestone, dove colored, crystalline. Banded with darker limestone between 202' to 203' and 216' to 220'.</td>
</tr>
<tr>
<td>220</td>
<td>Limestone, dark gray, cryptocrystalline, banded.</td>
</tr>
<tr>
<td>223</td>
<td>Limestone, light gray, cryptocrystalline.</td>
</tr>
<tr>
<td>225</td>
<td>Limestone, dark gray, cryptocrystalline, banded.</td>
</tr>
<tr>
<td>228</td>
<td>Limestone, dove colored.</td>
</tr>
<tr>
<td>237</td>
<td>Limestone, light buff.</td>
</tr>
<tr>
<td>238</td>
<td>Limestone, dove colored, lower part of unit banded, slightly dolomitic.</td>
</tr>
<tr>
<td>241</td>
<td>Limestone, dark gray, slightly dolomitic.</td>
</tr>
<tr>
<td>244</td>
<td>Limestone, light buff, slightly dolomitic.</td>
</tr>
<tr>
<td>246</td>
<td>Limestone, dove colored, banded zones, slightly dolomitic.</td>
</tr>
<tr>
<td>257</td>
<td>Limestone, light gray, banded, slightly dolomitic.</td>
</tr>
<tr>
<td>258</td>
<td>Limestone, dark gray, banded, slightly dolomitic.</td>
</tr>
<tr>
<td>259</td>
<td>Limestone, alternating beds of light gray and dove colored stone, slightly crystalline, slightly dolomitic.</td>
</tr>
<tr>
<td>281</td>
<td>Limestone, dark gray, slightly dolomitic. Slightly broken at 281.</td>
</tr>
<tr>
<td>287</td>
<td>Limestone, alternating beds of light gray and dove colored stone, slightly crystalline, slightly dolomitic. Dark gray limestone between 306' and 307'.</td>
</tr>
</tbody>
</table>
Federal Materials Quarry on the west. (NW 1/4 NE 1/4 sec. 18, T. 30 N., R. 14 E.) Originally an open-pit operation, the company is now mining limestone underground. The quarry is in the Plattin formation.

Bear east (right) onto Giboney Street.

CAUTION! Railroad Crossing.

S-turn: right on Elm Street, left on Fountain Street.

CAUTION! Railroad Crossing. Bear right on Willow Street.

Bluff of Kimmswick limestone on left. Mississippi River bridge on right.

Left on Williams Street for one block, right on Spanish Street.

THREE-WAY STOP! Independence Street. Continue straight ahead.

STOP SIGN! Broadway. Turn right (east) on Broadway for 1 block. Left (north) on Main Street.

STOP 5. NW 1/4 NE 1/4 NE 1/4 sec. 5 projected, T. 30 N., R. 14 E., Cape Girardeau Quadrangle. This section is described by Louis Unfer, Jr. as follows:

Loess

Thebes sandstone
Sandstone, brown, fine-grained, massive. .......................... 5' 6"

Maquoketa shale
Shale, brown and greenish-gray, poorly exposed.

Cape limestone (Fernvale)
Limestone, brownish-gray, coarsely crystalline, fossiliferous, with thin interbedded brown to tan shales .......................... 8' 0"
Kimmswick limestone

Unit 3  Limestone, brownish-gray finely crystalline (Vanuxemia bed) ........................................ 2' 6"

Unit 2  Limestone, brownish-gray coarsely crystalline, massive (Echinospaerites bed) ................... 5' 6"

Unit 1  Limestone, light-gray, coarsely crystalline, massive, fossiliferous (Receptaculites oweni), Whitish-gray, rough weathered surface ........................................ 4' 6"

Continue northward on Main Street.

0.3

11.5  Jog west (left) then north (right).

0.5

12.0  STOP SIGN! Fourth Street.

0.3

12.3  STOP SIGN! Rogers Street.

0.4

12.7  Eastward on Cape Rock Drive to Cape Rock Park. Keep left at Circle Drive, "The Loop," and continue to bottom of hill.

1.2

13.9  STOP 6. NW \(\frac{1}{4}\) NE \(\frac{1}{4}\) SE \(\frac{1}{4}\) sec. 28. T. 31 N., R. 14 E., Jonesboro Quadrangle. The section in the St. Louis-San Francisco Railroad cut and along the bank of the Mississippi River below the tracks is described by Louis Unfer as follows:

Loess

Sexton Creek
  Limestone, gray, fine-grained; with chert, gray to black, green, weathering to tan, in nodules and bands up to 3".................. 27'

Girardeau
  Limestone, olive-gray to bluish-gray, sublithographic, thin-bedded, with 1/8" to 1/4" tan shale bands; tan weathered chert nodules in upper 6" .................. 5' 6"

LUNCH

Continue in private cars northward on Cape Rock Drive, parallel to St. Louis-San Francisco tracks.

0.8

14.7  Bridge, Cape Creek. Bainbridge limestone in bed of creek and along bank.
Mileage
Cum. Diff.

0.1

14.8 Junction with State Road V. Turn westward onto V. Maroon and grey argillaceous for-
mention exposed along creek and bank.

0.7

15.5 Road fork--Bear right (north).

0.3

15.8 Road fork--Bear left (west). Paralleling Cape Creek.

1.0

16.8 STOP 7. SE$_{1}^{1}$ NE$_{1}^{1}$ NE$_{1}^{4}$ sec. 19, T. 31 N., R. 14 E., Cape Girardeau Quadrangle. The
section at this locality is:

Loess

Bainbridge

2. Limestone, buff to light green, shaly, massive to very
thin-bedded. .................................................. 8'

1. Limestone, red with light gray bands, shaly, massive
to very thin-bedded, slightly fossiliferous, jointed.
Jointing strikes N to N 10° W. ............................. 9'

Bear left--road to southwest--Cape Rock Drive.

1.8

18.6 Junction with Perryville Road. Turn northward.

2.4

21.0 Bear left (northwest), cross creek and continue northwestward on Perryville Road.

6.1

26.1 Continue straight ahead (north) on State Road W.

2.1

28.2 Junction with State Road J. Turn eastward onto J.

0.5

28.7 Turn north onto private road.

0.3

29.0 STOP 8. NE$_{1}^{4}$ NW$_{1}^{4}$ SE$_{1}^{4}$ sec. 17, T. 32 N., R. 13 E., Cape Girardeau Quadrangle.
Park in area around barn. Walk down lane to creek northwest of house.
7. Limestone, yellow gray to pinkish gray, fine to medium, xyn; thin to medium bedded; prominent yellow brown chert bands; nodules (¼” to 3”) weathering out as protrusions; chert is tripolitic along weathered edges. 4’

6. Limestone, pale green gray weathering to olive to dark gray; finely crystalline with scattered crinoid columnals & medium calcite xyls; medium bedded, weathers massive 2’

5. Nodular limestone w/ intercalated green shale is dk gray speckled brown; medium to coarse crystalline; fragmental fossil debris; cross-bedded in upper 1’; medium bedded. 2’ 6”

4. Alternating olive shale and nodular limestone beds is - fine grained, argillaceous, fossiliferous. 5’

3. Slump. 10’

2. Shale, yellow-green gray. 1’

1. Limestone, oolitic, dk gray, weathers speckled light gray. - bed of creek - 1’ exp.

FIG. 12, Section. Stop 8. Location: NE-¼ NW-¼ SE-¼
Sec. 17, T. 32 N., R. 13 E., Cape Girardeau Quadrangle, Cape Girardeau County, Missouri.
<table>
<thead>
<tr>
<th>Mileage</th>
<th>Cum.</th>
<th>Diff.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0.3</td>
<td></td>
</tr>
<tr>
<td>29.3</td>
<td></td>
<td>Turn east (left) onto State Road J.</td>
</tr>
<tr>
<td>34.7</td>
<td></td>
<td>Junction with State Road V. Continue straight ahead (east) on State Road J. Bluff along creek about one-half mile to the southeast is leached Bailey consisting of tripolitic chert and clay. This material grades laterally into cherty limestone.</td>
</tr>
</tbody>
</table>
3. Limestone, blue gray; finely xyln; argillaceous in part; numerous chert bands and nodules; thin bedded; chert bands prominent on weathered surface. 9' 6"

2. Limestone, olive gray, v. argillaceous; v. thin, to fissile bedded. 0' 6"

1. Limestone, dark gray to blue gray; finely xyln to dense; thin to medium bedded; blue gray chert nodules and bands - road level. 3' 9"

Mileage
Cum.  Diff.

2.2

36.9  Bailey formation.

0.2

37.1  Neelys Landing.

0.1

37.2  STOP 9. NE$_{1\over 4}$ SE$_{1\over 4}$ NW$_{1\over 4}$ sec. 33, T. 33 N., R. 14 E., Altenburg Quadrangle.

This is cherty limestone of the Bailey Formation. Samples collected at this place in 1961 produced large sporomorphs of the genus "Tasminites" by the flotation process outlined in the 1961 K. G. S. Guidebook. Samples collected more recently from the same locality and zone (Bed 2, Fig. 13) failed to produce spores. However, fragments of small brachipods and a few conodont scraps were found.

Intermittent outcrops of Bailey limestone and chert for the next mile.

1.1

38.3  Sheppard School. Turn northward.

0.8

39.1  CAUTION! Steep downhill grade.

2.3

41.4  Lovejoy Creek. Bailey outcrops along creek.

0.6

42.0  Bear right (northeast) at road fork. Church to left.

1.6

43.6  CAUTION! Steep downhill grade.
4. Limestone, Greenish-gray, fine-grained, argillaceous; numerous smoky gray chert nodules and bands up to 8" in thickness. Overlain by heavy chert and triplite chert residuum. 25' +

3. Limestone, green gray, angillaceous; chert nodules weathers shaly, basal 6" a fine-grained, light green crinoidal limestone. 5'

2. Shale, green gray to yellow-green gray, mottled maroon in lower 1-1/2', calcareous; w/thin gray to maroon; fine-grained limestone beds and stringers. 6'

1. Limestone, predominantly maroon, and light gray with red and green mottles; fine grained; argillaceous, medium bedded, weathers shaly; fossiliferous, crinoid stems, corals. 6'

Mileage  
Cum.  Diff.

0.2

43.8  Junction with State Road CC. Turn westward onto State Road CC. Intermittent exposures of Bailey limestone and chert residuum for next 3.5 miles.

3.4

47.2  STOP 10. NW¼ SW¼ SE¼ sec. 10, T. 33 N., R. 13 E., Altenburg Quadrangle. Silurian-Devonian contact.

Samples collected in the lower part of the section at this locality were chosen in the hope that a precise contact could be determined. The samples were processed by boiling in the conventional manner, but only that collected at the top of bed 2 (Fig. 14) produced fossils of importance. These included scraps of crinoids and brachiopods and a considerable variety and abundance of ostracods.

Continue westward on CC.

0.3

47.5  Bainbridge limestone along ditch on south side of road.

1.1

48.6  Junction of CC with State Road C.

0.1

48.7  Bridge. Blue Shawnee Creek.

STOP 11. NW¼ SW¼ SE¼ sec. 9, T. 33 N., R. 13 E., Altenburg Quadrangle.

These beds, exposed along Blue Shawnee Creek for 0.1 mile south of the bridge, are similar to and contain similar fossils as beds you have seen elsewhere today. Many of these are typical index fossils. Several samples in, above and below the very fossiliferous beds near the water level were processed, without success, in the hope of adding microfossils to the list of familiar megafossils. What is your stratigraphic position at this place?

End of Road Log
Roadcut on the east side of Interstate Route - 55
E½ SW¼ sec. 9 (proj.), T. 31 N., R. 13 E., Cape Girardeau Quadrangle

The rock exposed here appears to be a northern extension of an elongate collapse structure. Fred Lasater, District Geologist, Missouri State Highway Department, reports that a core taken at the north end of this cut recovered 113 feet of Bainbridge from 40 feet to 153 feet, total depth. The core indicated a dip of about 45°. No Sexton Creek was identified in the core. About ½ mile south, in an east-west tributary to Randol Creek, exposures of the collapse structure include Clear Creek chert as well as Sexton Creek.

The stop is approximately on the trace of a southeast-northwest trending fault mapped by Gealy (1955) and which he named the Jackson fault. Indications are that the fault trace passes just to the south of this cut and that it pre-dates the collapse structure which apparently crosses it. In the immediate area outcrops of Plattin and Kimmswick, at approximately the same elevation, are evidence of the fault. The north side is downthrown and is offset from one to three miles to the west. McQueen noted the fault, with about 200 feet of displacement, from well logs at Jackson. Evidence is more apparent east of here, where younger strata are found in juxtaposition with older beds and several smaller faults split from the main trace (Marshall, 1950; Gealy, 1955).


McQueen, H. S., 1937, The Dutchtown, a new lower Ordovician formation in southeastern Missouri: Missouri Geol. Survey and Water Resources Bienn. Rept. of the State Geologist to the 59th General Assembly, app. 1, 27 pp., 5 pls., 1 fig.

_______ and others, 1939, Third day of Field Conference in 13th Annual Field Conf. Guidebook Kansas Geol. Society, pp. 59 to 68

MESOZOIC-CENOZOIC HISTORY OF THE MISSISSIPPI EMBAYMENT

by

Wayne A. Pryor*

The Gulf Coastal Plain Mesozoic-Cenozoic sediments extend northward along the Mississippi River Valley as far as southeastern Missouri and southern-most Illinois, forming the Mississippi Embayment. These sediments, as old as early upper Cretaceous and as young as Pliocene, unconformably overlie Paleozoic sediments. Whereas the Paleozoic rocks are fully consolidated and structurally deformed, the Mississippi Embayment materials are, for the most part, completely unconsolidated, nearly flat-lying, and structurally uncomplicated. The Mississippi River traces the approximate axis of a gently southward plunging structural and depositional basin. The strata on the western flank of this basin, in Missouri and Arkansas, dip at very low angles to the east. In southern Illinois they dip at very low angles to the south. On the eastern, in western Kentucky and Tennessee, they dip at very low angles to the west.

Two generalized stratigraphic columns are shown in Figure 15 to illustrate the sequence in the northern part of the embayment, in southeastern Missouri and southern Illinois, and the sequence in the central and southern part of the embayment, in Tennessee and Arkansas.

Several relatively recent regional investigations of Mississippi Embayment sediments, utilizing subsurface stratigraphic and facies studies (Sterns, 1958 and Pryor, 1960 and 1961) and petrologic studies, which include paleocurrent patterns, thin-section analysis, heavy mineral analysis, and clay mineral analysis (Potter, 1955; Pryor, 1960; Pryor and Glass, 1961; Potter and Pryor, 1961), have brought into focus many of the regional and local characteristics of these sediments. These studies do permit and facilitate the construction of paleogeographic concepts and a geologic history for the Mississippi Embayment sediments.

The sequence of sediments shown in Figure 15 records a series of events in this region that began in the early part of late Cretaceous time and continued, with only minor interruptions, until late Eocene time, a period of over 40 million years. Sedimentation then did not occur in this region until it resumed only briefly during the late Pliocene.

*Geologist, Gulf Research & Development Company, Pittsburgh, Pa.
Figure 15
GENERALIZED STRATIGRAPHIC COLUMNS
The major elements of these events were a subsiding basin, a rising sea level, and variable pulsations of source area with attendant pulsations in supply of detrital materials. The vertical and lateral variabilities in the sediment column record the degree of predominance of each of the various elements.

Mineralogic investigations of the sediments indicate that they were derived principally from the exposed axial parts of the central and southern Appalachian Mountains and the Piedmont Plateau and Blue Ridge Provinces. This source area remained relatively constant from late Cretaceous until early Pleistocene when the Canadian Shield became the major source area. The clastic materials were carried westward from the southern Appalachians to the embayment by a rather large stream system that probably occupied the same general area as the present Kenahwa-Ohio River Valley. As this stream system, which could be categorized as the ancestral Mississippi River, entered the marine waters of the youthful embayment a deltaic mass was formed. It is this delta and its pulsations and configurations that form the major paleogeographic feature of the embayment area.

The Upper Mississippi Embayment probable did not exist, as such, during Early Cretaceous time. The topographic expression and the well developed soil horizon on the Paleozoic basement rock of the area suggest that it was mature and low lying just prior to deposition of the Upper Cretaceous sediments. There was probably a well developed stream pattern on this surface which carried sediments southward during pre-Late Cretaceous time.

The lithologic character of the Tuscaloosa formation suggests local derivation and, as the basal unit of the Upper Cretaceous Series, probably represents the results of slight uplift of the area north of and adjacent to the areas of deposition. Sterns (1958) suggests that the central part of the present embayment was uplifted and eroded. This uplift and erosion was accompanied by a subsidence in the southern part of the area and transgression of marine waters into the newly formed embayment. The pattern of Eutaw deposition suggests development of the embayment into only the southeastern part of the area, followed by quiescence and slight erosion. The streams developed on the Paleozoic surface did not contribute large amounts of sediments to the presently outcropping Eutaw formation, as the heavy mineral suite in it is similar to that of the upper Cretaceous rocks in Alabama and Georgia rather than to the sediments of the embayment.

The erosional interval was followed by general subsidence of the embayment and transgression of marine waters northward. Accompanying this transgression was the introduction into the northern part of the embayment of clastic materials, represented by the Coffee formation, a deltaic deposit associated with renewed erosion in the source area.

Subsidence continued with the transgressive seas moving northward into the southeastern part of Missouri, where they reached their early maximum extent. This major late Cretaceous transgression resulted in the deposition of transitional marine upper Coffee formation sediments and marine Selma formation chalks and calcareous clays, overlapping the deltaic lower Coffee sediments. Subsidence probably continued at a regular rate, but renewed erosion in the source area resulted in the dumping of large amounts of coarse clastics into the northeastern part of the embayment. These clastics (McNaury formation sands) formed a southward building delta, which rapidly filled the north end of the embayment, overcoming the subsidence and causing a general regression of the seas.

While the McNaury formation materials were being deposited in a flood plain and deltaic environment, the Coon Creek formation was being deposited at the delta front in shallow marine waters to the south. As the McNaury delta spread southward and westward it overlapped Selma and Coon Creek sediments previously deposited at the delta front. The regression reached its maximum extent when the seas withdrew to northern Mississippi and eastern Arkansas.

Subsidence proceeded at a slower rate, with the Coon Creek formation materials being deposited at the delta front and Selma deposition being continued in deeper waters. This was accompanied by a lesser contribution of sediment from the source area.

Apparently subsidence ceased and slight uplift followed in the embayment. This resulted in slight tilting and erosion of the materials on the northern periphery of the embayment.

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Following this hiatus in deposition there was a pulse of general subsidence, which resulted in the rapid transgression of the seas to, at least, southern Missouri and Illinois and probably to southern Indiana. Reworking of the pre-existing McNairy delta sediments plus a very slight increment of materials from the source area yielded the Owl Creek formation. During this maximum transgression, the Prairie Bluff chalks were being deposited in deeper water to the south, contemporaneous to the Owl Creek clays in the north. The axis of the embayment may have shifted slightly to the west as is inferred by Sterns (1958).

Subsidence apparently halted for a time, during which the late Cretaceous sediments were exposed to subaerial erosion and soil development. This hiatus was followed by a pulse of general subsidence and rapid northward advance of Midway marine waters. The northern extent of this advance is not known, but the great thickness and lack of near-shore facies in the Porters Creek formation at its present terminus indicate it probably extended rather far to the north, possible for several hundred miles. As the Midway sea advanced, materials from the source area, filling in the embayment, were principally montmorillonitic clays with very little coarse clastics. This may have been the result of a rather low lying and mature source area. The Clayton formation represents nearshore materials whereas the Porters Creek formation represents deposition in an outer neritic environment. Again subsidence halted briefly and the marine waters withdrew far to the south subjecting the Paleocene sediments to subaerial erosion and weathering.

A rejuvenation of the middle and southern Appalachian source area in the beginning of the Eocene again yielded coarse clastic materials which began building deltaic deposits into the marine water in northern Mississippi and central Arkansas. The Eocene sediments record three advances and retreats of this deltaic mass; the Wilcox, Claiborne, and Jackson stages. As the delta waxed and waned, its flood plain and upper delta regions swept back and forth across the upper Mississippi Embayment leaving behind a rather heterogeneous series of sands, clays and lignites.

During the Oligocene and Miocene the locus of subsidence moved farther to the south, into northern Louisiana and central Mississippi, where the deltaic accretion continued. Although the river system probably continued to pass through the upper part of the embayment none of its flood plain material was recognized as being preserved.

In late Pliocene time the stream emanating from the central Appalachians was apparently diverted to the northwest into the ancient Teays system. The ancestral Tennessee River, draining westward from the southern Appalachians, began depositing fluvial Lafayette type gravels and sands in the northern part of the embayment. There were also fluvial gravels and sands derived from the Paleozoic strata adjacent to the embayment and reworked materials from the now slightly upturned edges of the Cretaceous and Tertiary embayment sediments.

The locus of deltaic sedimentation had, by Pliocene time, moved completely out of the Mississippi Embayment area and was located in central and southern Louisiana. It remained there throughout the Pleistocene and presently occupies the same general location. The ancient Teays drainage was diverted and buried by glacial activity and with the exception of the Tennessee River there is only minor drainage off the west slopes of the southern Appalachian Mountains.
Cretaceous-Tertiary Exposures in Southeastern Missouri

In southeastern Missouri exposures of embayment sediments are not numerous nor do the outcrops that are present expose large or continuous sequences. Therefore, in order to see these sediments one must visit a number of scattered, small exposures along Crowleys Ridge. Only the McNairy formation and later sediments are exposed in southeastern Missouri.

One of the most nearly complete exposures is a road cut on the southeastern slope of Crowleys Ridge at Ardeola. This exposure is in the NW 1/4 NW 1/4 sec. 10, T. 27 N., R. 11 E. Stoddard County, Missouri. Cretaceous, Paleocene, and Pliocene sediments are present.

<table>
<thead>
<tr>
<th>ARDEOLA SECTION</th>
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<tbody>
<tr>
<td>Feet</td>
</tr>
<tr>
<td>Quaternary systems</td>
</tr>
<tr>
<td>Pleistocene series</td>
</tr>
<tr>
<td>Loess, yellowish-brown ........................................ 5</td>
</tr>
<tr>
<td>Unconformity.</td>
</tr>
<tr>
<td>Tertiary systems</td>
</tr>
<tr>
<td>Pliocene series</td>
</tr>
<tr>
<td>Gravel, brown, well-rounded pebbles, and some red sand ........................................ 6</td>
</tr>
<tr>
<td>Unconformity.</td>
</tr>
<tr>
<td>Paleocene series</td>
</tr>
<tr>
<td>Midway group</td>
</tr>
<tr>
<td>Porters Creek formation</td>
</tr>
<tr>
<td>Clay, dark-green on fresh surface, weathering to light gray, locally including interstratified beds of ferruginous clay. ........................................ 47</td>
</tr>
<tr>
<td>Clayton formation</td>
</tr>
<tr>
<td>Clay, pale-green, sandy, very glauconitic, oolitic in lower part, containing white angular sand grains near base; abundantly fossiliferous, including indigenous species and reworked Owl Creek species ........................................ 5</td>
</tr>
<tr>
<td>Unconformity.</td>
</tr>
<tr>
<td>Cretaceous system</td>
</tr>
<tr>
<td>Gulf series</td>
</tr>
<tr>
<td>Owl Creek Formation</td>
</tr>
<tr>
<td>Sand, yellowish-brown, argillaceous, glauconitic, finely micaceous. contains many prints of fossils ........................................ 5</td>
</tr>
<tr>
<td>Clay, greenish-gray mottled with yellow and brown, sandy, sparingly glauconitic, finely and strongly micaceous. containing a few prints of fossils ........................................ 6</td>
</tr>
<tr>
<td>Unconformity, contact sharp.</td>
</tr>
<tr>
<td>McNairy sand:</td>
</tr>
<tr>
<td>Clay and sand, brown, laminated, crossbedded with parting planes of muscovite mica; contains abundant comminuted plant remains; borings in upper 8 or 10 inches are filled with sandy matrix from over-lying Owl Creek formation ........................................ 11</td>
</tr>
<tr>
<td>Sand, grains angular, white to bright orange, cross-bedding, lignitic, locally cemented with limonite ........................................ 11</td>
</tr>
</tbody>
</table>

-46-
Clay, brown, light-and dark-gray to black
with interbedded sand; limonite and muscovite
mica along bedding planes .............................. 27
Lignite, very sandy ......................................... 1
Sand, grains angular, white, with iron oxide
stains, somewhat lignitic ............................... 11
Concealed to lowland level .................. 38

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In a sandpit on the western outskirts of Bell City, in secs. 1 and 2, T. 27 N., R. 11 E., Stoddard County, the McNairy sand with quartzitic lenses is well exposed showing typical development.

In a road cut east of Oran, in the NW\(\frac{1}{4}\) SW\(\frac{1}{4}\) NE\(\frac{1}{4}\) sec. 20, T. 28 N., R. 13 E., Scott County, Missouri, another nearly complete section exposes Upper Cretaceous, Paleocene, and Eocene sediments.

**ORAN SECTION**

Feet

Quaternary System:
  Pleistocene Series:
    Loess:
      Clay, yellow-brown .................................. 35

Tertiary System:
  Eocene Series:
    Wilcox Group:
      Clay, gray-white to gray-grown, sandy with
      few poorly preserved fossil leaf prints ............. 3-5
    Midway Group:
      Porters Creek formation:
        Clay, dark gray-green to nearly black, blocky .... 24
      Clayton formation:
        Clay, dark green, highly glauconitic, with con-
        siderable pyrite and limonite in the basal portion .. 2-4

Cretaceous System:
  Gulf Series:
    Owl Creek formation:
      Clay, gray-green, weathering to light gray,
      and marked by pale yellow stains, sandy,
      sparingly fossiliferous ............................. 5
    McNairy formation:
      Clay, brown, thin-bedded, with white angular
      micaceous sand, somewhat stained by iron
      oxide, along bedding planes ....................... 4
      Covered interval .................................. 10
      Sand, white, angular, with interbedded brown
      and pink clay .................................. 5-20
      Covered to road level ............................

The following is a listing, by stratigraphic sequence, of the locations of several rather accessible outcrops.
Gulf Series

East of highway on west side of the valley in the western part of sec. 20, T. 27 N., R 11 E., Stoddard County.

Stream cut in $S\frac{1}{4} NW\frac{1}{4} SE\frac{1}{4}$ sec. 17, T. 27 N., R. 11 E., Stoddard County, several hundred feet west of road culvert. The Owl Creek formation, Clayton formation, and Porters Creek formation are also exposed in this cut.

Midway (Paleocene) Series

Along west side of road in the $E\frac{3}{4} SW\frac{3}{4} SE\frac{1}{4}$ sec. 17, T. 27 N., R. 11 E., Stoddard County.

Along road in $NE\frac{3}{4} SW\frac{1}{4}$ sec. 21, T. 26 N., R. 11 E., Stoddard County.

Roadside ditch at junction in $NE\frac{3}{4} SE\frac{1}{4} NE\frac{1}{4}$ sec. 28, T. 26 N., R. 11 E., Stoddard County.

Wilcox (Eocene) Series

Stream cut, $S\frac{1}{4}$ sec. 9, T. 26 N., R. 11 E., Stoddard County.

Road cut, C., sec. 1, T. 25 N., R. 10 E., Stoddard County.

Road cut $NE\frac{1}{4}$ sec. 2, T. 23 N., R. 9 E., Stoddard County.

Sand pit, center of the east line of sec. 22, T. 26 N., R. 11 E., Stoddard County.

Road cut along ridge in center of sec. 1, T. 25 N., R. 10 E., Stoddard County.

Lafayette (Pliocene) Series

Gravel pit in $NE\frac{3}{4} SE\frac{1}{4}$ sec. 34, T. 28 N., R. 11 E., Stoddard County.

Gravel pit in $SW\frac{1}{4}$ sec. 2, T. 26 N., R. 10 E., Stoddard County.

References


PHYSIOGRAPHY OF THE SOUTHEAST MISSOURI LOWLANDS

by

Irving L. Turner ¹ and Louis Unfer, Jr. ²

The lowlands of southeastern Missouri make up the northwestern quadrant of the Mississippi embayment and lie entirely within the Coastal Plains province. They are essentially a broad, flat plain gently sloping to the south with northerly oriented remanental uplands and terraces. They are underlain by unconsolidated Cretaceous and Tertiary sediments which in turn overlap the older Paleozoic sediments of the Ozark province. Four physiographic subdivisions have been recognized (Marbut, 1902) in this part of the state: (1) The Advance lowland, between the bluffs of the Ozark province and the lesser slopes of northeasterly oriented Crowleys Ridge, extends from Cape Girardeau southwestward into Arkansas; (2) Crowleys Ridge extends from Bell City into Arkansas; (3) the Morehouse lowland southeast of Crowleys Ridge but merging on the north with the Advance lowland; and (4) farther to the southeast, the Mississippi lowland (Fig. 16).

The area of the Lowlands province is approximately 4,100 square miles and includes all or parts of ten counties.

Although named the Tertiary lowland by Marbut (1896), the later designation of the name, Southeast Missouri lowlands, was proposed by Marbut (1902).

Relief

The difference between the highest and lowest points in the province is about 340 feet. The lowland elevation at the southern edge of the Ozark province is 335 feet and decreases to a low of 240 feet in southern Pemiscot County.

The maximum elevation on Crowleys Ridge is about 580 feet one mile south of Bloomfield, and that on Benton Hills Ridge is about the same.

¹Geologist, St. Joseph Lead Co.

²Assistant Professor of Geology, S. E. Missouri State College.
Aside from the uplands, the general relief is from 5 to 10 feet with the heights of the minor prominences of the terraces ranging from 20 to 30 feet.

DRAINAGE

Drainage in the province is in the modified phase (Marbut, 1896, p. 78) in contrast to the radial drainage more characteristic of the inner Ozark province. Thus the drainage of the St. Francis and Little Rivers is peripheral to the Uplift and does not contribute to the Mississippi River until the first two rivers are well into Arkansas and on the flood plain of the latter river.¹

Flint (1941) shows that the course of the Mississippi River between St. Louis and Cape Girardeau is antecedent to the several states of uplift that created the Ozark dome in post Wilcox time. The continued course of that river creating the Advance lowland in a later time provided a course for the St. Francis River east of Ash Hills and for Little River east of the Kennett-Malden Prairie.

Four water gaps cut across the Crowleys Ridge complex and connect the Advance lowland with the Morehouse and Mississippi lowlands to the east, within the state. These are Thebes Gap, the Bell City-Oran Gap, the Castor River Gap, and the St. Francis River Gap.

Thebes Gap, the most recently formed, cuts between Benton Hills and the Shawnee Hills of southern Illinois. The gap is 7 miles long and its greatest width is barely one mile. The presence of barbed tributaries pointing upstream while draining the adjacent highlands into the Mississippi indicates that Thebes Gap once was the site of a minor north flowing stream (Fisk, 1944).

The Bell City-Oran Gap is oriented between the two towns for which it is named and has Benton Hills (Marbut, 1902) or the Scott County Hills (Magill, 1958) as the upland to the northeast. Formerly a water gap for the Mississippi River (Fig. 16), the gap was later utilized by the Whitewater-Little River prior to that river being drained by canals.

The Castor River Gap, southwest of Ardeola, formerly served the Castor River prior to its drainage by canals. Approximately 10 miles long, the gap varies in width from one-half mile on the southeast to one mile on the northwest.

The St. Francis River Gap, southwest of Campbell, is occupied by the river where it forms the northwestern border of the Missouri "boot-heel." This mile long gap is located where Crowleys Ridge is low and narrow. The gap is widest to the northwest.

The widening of the last two water gaps to the northwest is cited by Fisk (1944) to be indicative that both water gaps are in the valleys of beheaded, formerly northwesterly flowing streams. Fisk further notes other gaps along Crowleys Ridge that do not contain streams at this time and have their eastern termini some 35 feet above the Morehouse lowland.

Between 1890 and 1910, 700,000 acres of the seven original "swamp counties" had been reclaimed by drainage ditch and canal. The most ambitious project, the Little River Drainage District, was started in 1913 and upon completion, drained a watershed of 1,136 square miles through a drainage district 90 miles in length from Cape Girardeau to Arkansas and 30 miles wide in the north to 4 miles wide in the south (Nolen, 1913).

SPECIAL PHYSIOGRAPHIC FEATURES

The Upland Complex

Crowleys Ridge, when considered as an aggregate that includes the subdivisions of Bloomfield Hills and Benton Hills, extends from Commerce, Missouri, to Helena, Arkansas, a distance of 200 miles.

¹The flow of Little River southward is supplanted by the canal system near Homersville, Missouri.
The ridge is some 12 miles wide in the north and reaches heights of 250 feet above the eastern plains. In the southern one-half the ridge averages a width of 3 miles and a height of 100 to 150 feet. A bluff is present on the eastern side of the ridge but the western side slopes more gently. The Shawnee Hills section of southern Illinois is a northeastern extension of Crowleys Ridge only recently severed by the Mississippi River.

The history of the dissection of Crowleys Ridge is complex but has been discussed by several writers. Three of these are: Marbut (1895, 1902, 1896), Matthes (1931, 1934), and Fisk (1944). The present writers feel that the initial resume presented by Marbut (1901, pp. 62-63) cannot be much improved upon:

"The existing cycle was inaugurated by the uplift (to the north) at the close of the first glacial epoch. The Mississippi River entered the region by way of where Cape Girardeau now stands and turned westward*. . . . The Ohio River flowed southwestward and then southward (through the Cache lowland and along the eastern edge of Crowley's Ridge) . . . During the first stage of this period the Mississippi eroded the . . . Advance lowland and the Ohio eroded the much broader belt of . . . the Morehouse and Charleston lowlands and (the area underlying the Sikeston Ridge).

"The Mississippi River was finally turned through the ridge that separated its valley from that of the Ohio through (what is now the Bell City-Oran water gap). All that part of the Advance lowland lying west of the present position of the city of Delta, south of which the turn through the ridge took place, was abandoned by the Mississippi. It continued to be occupied, however, by the (Little), possibly, but certainly by the Castor, St. Francis, and Black Rivers, but only in a misfit way.

. . . "(The relation of the Mississippi) to the Ohio was not yet a satisfactory one. Just south of where Cape Girardeau stands now, it approached within about eight miles of the valley of the latter stream, whose flood plain was several feet lower than its own. Furthermore, the same facilities for getting into the Ohio Valley by way of the valley of a stream tributary to the Ohio, were soon offered and accepted. By this change, the river abandoned the eastern end of the Advance lowland belt and the whole of the Morehouse lowland belt, and entered the Ohio Valley at Commerce instead of (through the Bell City-Oran Gap). This change happened recently—so recently that the river has not yet had time to fully adapt the small valley to its own size."

The Terrace Deposits

The flat-topped terraces and prairies 20 to 30 feet above the general level of the lowlands include (1) Sikeston Ridge, (2) the Kennett-Malden Prairie, and the terraces of even lesser prominence west of Crowleys Ridge, (3) Melville Ridge, (4) Ash Hills, and (5) Dudley Ridge.

Mapped as Quaternary alluvial deposits, these terraces from three general groups (Fig. 16), maintaining a parallel elongation to the south of the more prominent upland features. The terraces appear to be wholly of alluvial origin and Fisk (1944) notes that scars of a braided channel of the Ohio River have been traced on Sikeston Ridge. However, Fuller (1912, Pl. 1) ascribes the origin of these terraces "possibly in part due to uplift" in his discussion of the New Madrid earthquakes of 1811-1812.

Features Attributed to the New Madrid Earthquakes

The series of disturbances occurring in 1811-1812 on December 16, January 23, and February 7, in parts of southeastern Missouri, northeastern Arkansas, and western Kentucky and Tennessee have been described as unequalled for number, continuance of disturbance, and area affected even when compared to the San Francisco earthquakes of 1906 (Fuller, 1912).

*See: Influence on Regional Structure.
The area most directly affected by the disturbance (that produced such features as uplifts, sunken lands, fissures, sinks, sand blows, and landslides) extended west of a line drawn from Cairo, Illinois, on the north to Memphis, Tennessee, on the south to another drawn along the eastern edge of Crowleys Ridge (Fuller, 1912).

Terraces and domelike uplifts. Aside from ascribing a partial origin of the alluvial terraces described above to the New Madrid disturbance, Fuller (1912) almost reluctantly offers a similar, at least partial origin, to three positive areas south of the New Madrid area. These are (1) Tiptonville dome, extending from south of New Madrid to Reelfoot Lake, (2) the Blytheville dome, in Arkansas just south of the Missouri state line, and (3) the Little River dome, 20 miles southwest of Blytheville. Fisk (1944, p. 25) more confidently states that the Tiptonville dome just across the Mississippi River from the southern end of Sikeston Ridge “is not a continuation of that feature” and is separated from Reelfoot Lake on the south by a fault escarpment representative of an uplift of at least 15 feet.

Sunken lands. Areas of subsidence resulting from the local settling or warping of alluvial deposits during the New Madrid earthquakes occur in the main outside Missouri in such depressions as Reelfoot Lake, Tennessee; and Big Lake, St. Francis Lake, and Tyronza Lake, Arkansas. Part of the St. Francis River depression is coincident to the western border of the Missouri “boot-heel.” A subsided area on the Little River southeast of Kennett, formerly known as Lake Nicormy but since drained by canals, is also located in Missouri.

Amounts of subsidence vary from 5 to 8 feet near Kennett to 14 feet at New Madrid and 5 to 20 feet at Reelfoot Lake (Fuller, 1912).

INFLUENCE OF REGIONAL STRUCTURE

The strikingly apparent northeast-southwest and lesser northwest-southeast lineation evident in the escarpments and water gaps of the southeast Missouri lowlands reflects the principal fault patterns of all the central Gulf Coastal Plain and much of the Ozark province to the northwest.
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SOME NOTES ON THE DUTCHTOWN FORMATION

by

M. G. Mehl*

Early in the twentieth century most American stratigraphers assumed there was an appreciable
time gap between the deposition of the St. Peter sand and that of the Joachim sediments. However, it was
not until near 1935 that there was an adequate defense against the persistent argument that deposition
was continuous. This defense was based on the large amount of St. Peter-like sand in the base of the
Joachim, particularly "floating grains" well up in the dolomite.

In 1906, more than 100 feet of dark gray limestone and shale was noted between the St. Peter and
Joachim (as the latter was known in outcrop at the time) in a water well drilled in Jackson. This
"abnormal" succession was observed again in a well drilled for the Goodwin Ice and Storage Company in
Jackson in 1910, and again in the well drilled by the college at Cape Girardeau in 1916. The sediments
in question were assigned to the lower Joachim as late as 1924.

In 1924, at the start of another deep well at Jackson, H. S. McQueen was assigned the study of the
groundwater problems centering about the project. Some of McQueen's colleagues called his attention to
limestone outcrops near Dutchtown and several other places that had not been satisfactorily "age-assigned"
at the time. McQueen's work resulted in the establishment of the Dutchtown formation with type locality
at the place studied at STOP 2 (second day) of this field trip. At this place is exposed the lowed part of
the middle division. The formation is known to occur as a "feather edge" west of Jackson and to thicken to
about 175 feet at Cape Girardeau.

The importance of McQueen's work was not generally recognized before the surge of conodont
studies about 1930. It was then recognized that there was a marked difference between the fauna of the
Joachim and that of the western equivalents of the St. Peter. When Cullison (1938) described the conodonts
of the Dutchtown, the fauna was hailed as partly filling the gap which was still further bridged by Branson,
Mehl, Branson in 1946. Although it is difficult to point out the exact boundary between the St. Peter and
Joachim in most outcrops, it is no longer popular to argue continued deposition between the two formations.

Sample collectors will find that the highly fossiliferous bed (5' 8" thick) about four feet above the
Geiser quarry floor contains well preserved conodonts. These may be recovered by crushing the rock to
"pea size" and digesting the sample in 10 percent glacial acetic acid. Conodonts are segregeted by allow-
ing residue to settle through acetelenetetrabromide which will barely float calcite. It was this locality that
furnished the conodonts described by Youngquist and Cullison (1946). Conodonts may be collected in much
greater abundance and somewhat greater variety from the thin sandy facies of the Dutchtown a few miles
west and a little north of Jackson.

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* Emeritus Professor of Geology, University of Missouri.