GUIDE BOOK

Indiana Geologic Field Conference

Upper and Middle Mississippian Formations

of

Southern Indiana

1948

GUIDE BOOK

Second Annual Geologic Field Conference

May 7, 8, and 9, 1948

on

UPPER AND MIDDLE MISSISSIPPIAN FORMATIONS OF SOUTHERN INDIANA

Conference Leader
Ralph E. Esarey

Sponsored by

Department of Geology, Indiana University, and
Division of Geology, Indiana Department of Conservation,
Charles F. Deiss, Chairman and State Geologist.

Compiled by
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Bloomington, Indiana
May, 1948.

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The 1948 Field Conference has been planned to provide group observation, and to promote group discussion of the Indiana outcrop sections of Upper and Middle Mississippian age. These formations are of special economic interest because the greater part of petroleum, agricultural limestone, road metal, and building stone in Indiana is produced from this rock series.

The stratigraphy of the Indiana Chester formations is emphasized because of the wide divergence of opinion held upon their correlation with the subsurface formations of the Illinois Basin and the outcrops of similar age in the states surrounding the basin. The problems of time correlation by fossil evidence and of lithologic correlation by sedimentation units will be discussed. We hope that discussion combined with actual field examples of the Indiana section will provide a better understanding of the Chester correlation problems to all conference members. This opportunity to become better acquainted and to exchange ideas is the most important part of the program.

SUMMARY OF PROGRAM

Headquarters for the conference is Spring Mill Inn, Spring Mill State Park, Mitchell, Indiana.

The conference opens Friday evening, 7:30, May 7, with discussions of the stratigraphy, lithology, and fauna of the Upper and Middle Mississippian formations in Indiana. Short talks will be given by Dr. J. J. Galloway, Indiana University, Dr. C. A. Malott, Indiana University, and Mr. R. E. Stouder, Louisville Gas and Electric Company. After the talks, the meeting is open to informal discussion in which you are invited to participate.

Saturday morning, May 8, at 8:00, the party leaves Spring Mill State Park for the first stop on the itinerary. A picnic lunch will be provided by Spring Mill Inn for guests. Other members of the conference are urged to carry a lunch, as no lunch facilities are available. Dinner in the evening can be obtained at Spring Mill Inn by all members who wish to eat there. After dinner, Spring Mill Inn will sponsor a program of group singing and dancing.

Sunday morning, May 9, at 8:00, the party leaves Spring Mill State Park for the 6th stop on the itinerary. The last geologic section will be at the old Royal Blue Quarry, southwest of Bedford. After dinner at Spring Mill Inn, the party is invited to stay for a conducted tour through the Ingalls Limestone Mill.

Saturday, May 8, 1948

Start: Leave Spring Mill State Park, Mitchell, Indiana, at 8:00 a. m.

The party will drive 57 miles to Leavenworth, Crawford County, without stopping. Formations along the highway are labeled to permit checking the geology en route.

Drive west on Highway 60 to Highway 37. Turn south on Highway 37. The highway follows the Mitchell plain, a typical Karst plain developed upon Middle Mississippian limestones. Check speedometer reading in Orleans.

Slow down 2.4 miles south of Orleans at a small quarry which shows the contact of the St. Louis and Ste. Genevieve limestones.

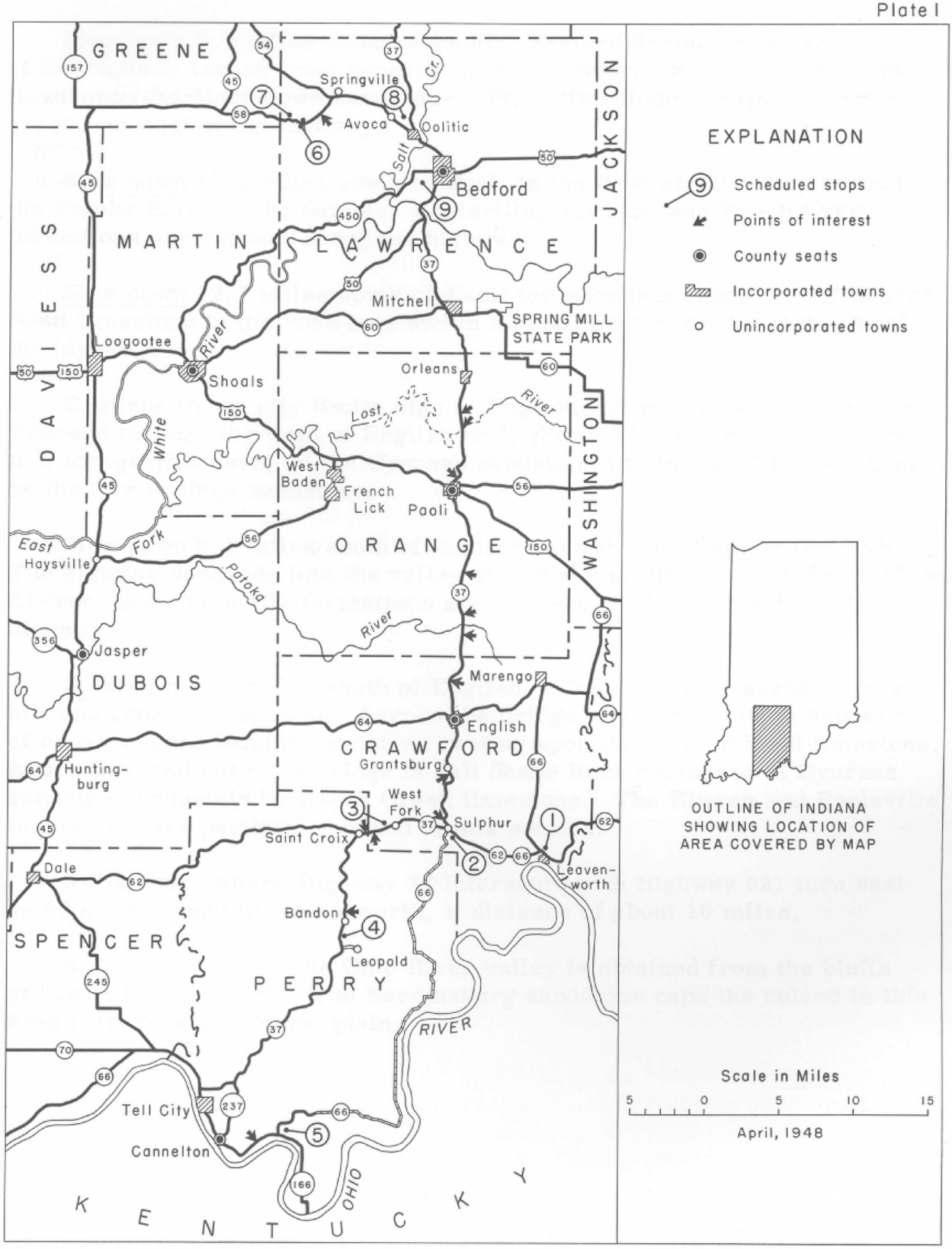
Slow down 3.7 miles south of Orleans at the dry bed of Lost River. The dry bed of Lost River is part of the surface course, about 21 miles in its meandering length, which is usually dry between the sinks of the stream and the rise of the waters to the surface. Following heavy rains, the dry bed is occupied by the muddy storm waters which overtax the underground route. The permanent water table is about 40 feet beneath the bridge on Highway 37. The bridge here is about 4 miles down the stream from the first rather small sinks in the stream bed. Much larger swallow holes occur along the dry bed course. The whole of the dry bed route is used by the surface flows only a few times each year.

Slow down 7.7 miles south of Orleans at outcrop of Sample sandstone in road cut just north of Paoli. At this place the highway leaves the Mitchell plain and enters the outcrop belt of the Chester Series.

Check speedometers at courthouse in Paoli. Continue south on Highway 37. The road ascends a long hill to a structural plain developed on the Cypress sandstone.

Numerous outcrops of the Chester series can be seen along the highway. Formation names have been placed upon some of the good exposures.

Slow down 4.3 miles south of Paoli. The highway ascends a long hill, passing over the Beech Creek, Cypress, and Golconda formations. The firetower on the top of the hill is erected upon the Hardinsburg sandstone, which forms a structural plain in this area.



ROUTE MAP OF FIELD CONFERENCE ON UPPER AND MIDDLE MISSISSIPPIAN FORMATIONS IN SOUTHERN INDIANA

Slow down 8.6 miles south of Paoli. Teaford Spring on the east side of the highway issues from beneath 13 feet of Beaver Bend limestone and flows upon the Mooretown sandstone. Paoli limestone is exposed in the creek bed west of the highway.

Slow down 10.2 miles south of Paoli in the first small valley beyond the Patoka River. The Sample, Reelsville, Elwren, and Beech Creek formations are exposed along the highway.

Slow down 12.1 miles south of Paoli for excellent exposures of Beaver Bend limestone in the road cuts and in a small quarry on the east side of the highway.

Continue to the city limits sign of English and re-check speedometer. Proceed through the town of English on Highway 37. The highway climbs to a topographic level on the Cypress sandstone and to a still higher level on the Tar Springs sandstone.

Slow down 5.2 miles south of English beyond the village of Grantsburg. The highway descends into the valley of Little Blue River. The Beech Creek, Elwren, and Reelsville formations are exposed on the west side of the highway.

Slow down 8.2 miles south of English. The highway descends a long hill and crosses a stream. Across the bridge on the right is an exposure of cross-bedded Sample sandstone resting upon the Beaver Bend limestone. Above the road cut on the ridge is Salt Shake Rock composed of Cypress sandstone underlain by Beech Creek limestone. The Elwren and Reelsville formations are partially covered in this section.

At Sulphur, where Highway 37 intersects with Highway 62, turn east on 62 and proceed to Leavenworth, a distance of about 10 miles.

A splendid view of the Ohio River valley is obtained from the bluffs at “new” Leavenworth. The Hardinsburg sandstone caps the upland in this area forming a structural plain.

Stop #1

Leavenworth. (Time allotted, 12 hours)

Park cars at “new” Leavenworth. The party will walk down the road into “old” Leavenworth in the river valley. Exposures of the Lower Chester and Ste. Genevieve formations can be seen along the road and in the quarry about half way down the hill. The route follows the foot of the cliff to the large spring at the west edge of town. The party ascends the cliff (see figure 1) and follows the small creek back to "new" Leavenworth.

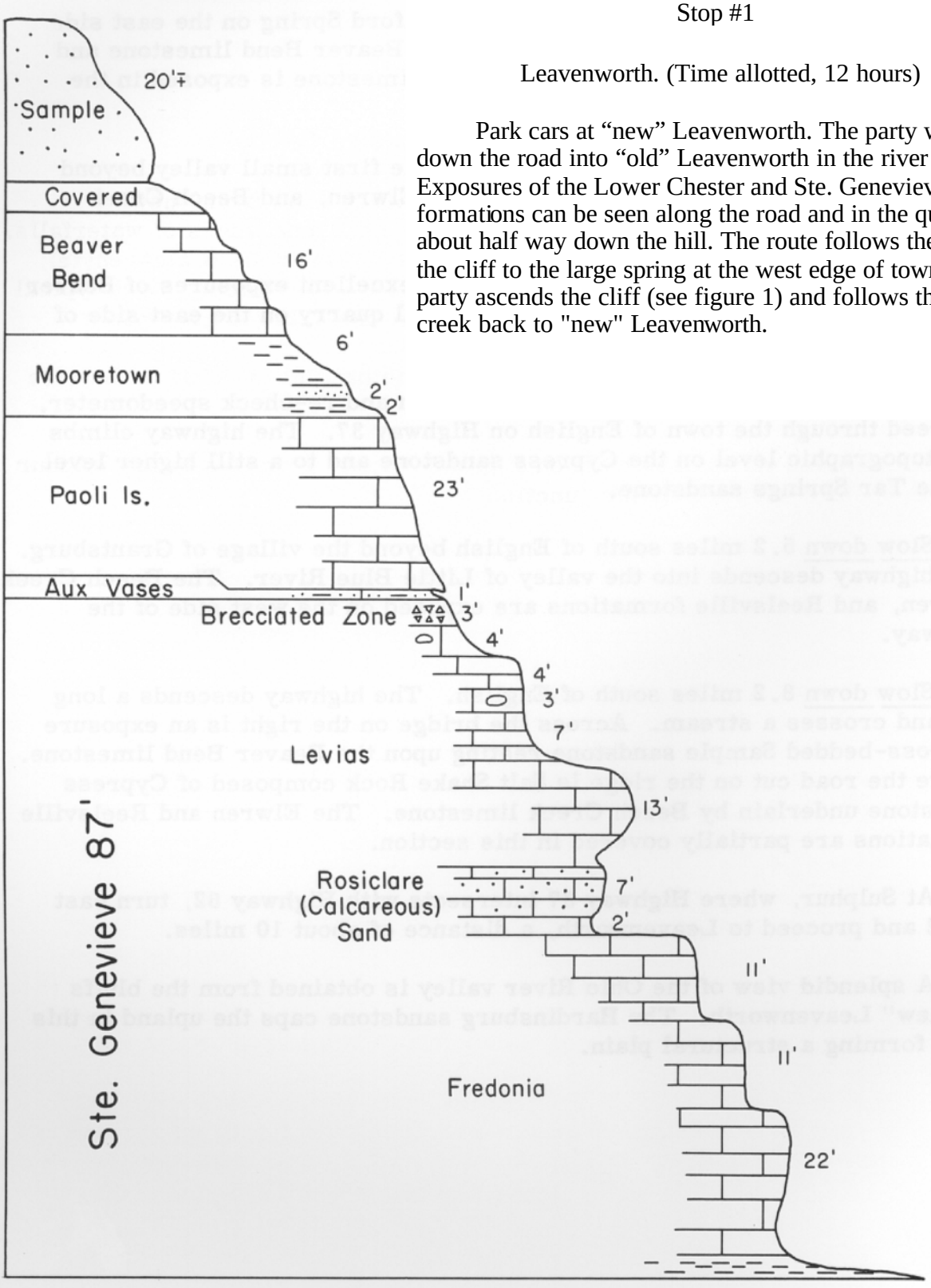


Fig. 1

Stop #1

Leavenworth Cliff

(sec. 6, T. 4 S., R. 2 E., Crawford County)

The section is taken along a small creek which runs from “new” Leavenworth to the old town, plunging over the cliff in a series of waterfalls. The Rosiclare is represented by 7 feet of detrital limestone (Calcarenyte), and the Aux Vases is shaly, calcareous sand only 1 foot thick. More typical development of these formations can be seen in the Webster quarry.

The spring emerging from a sinkhole at the base of the cliff is the rise of Dry Run Creek.

The caravan turns back west on Highway 62 and proceeds to the Sulphur section, ½ mile east of Sulphur Junction.

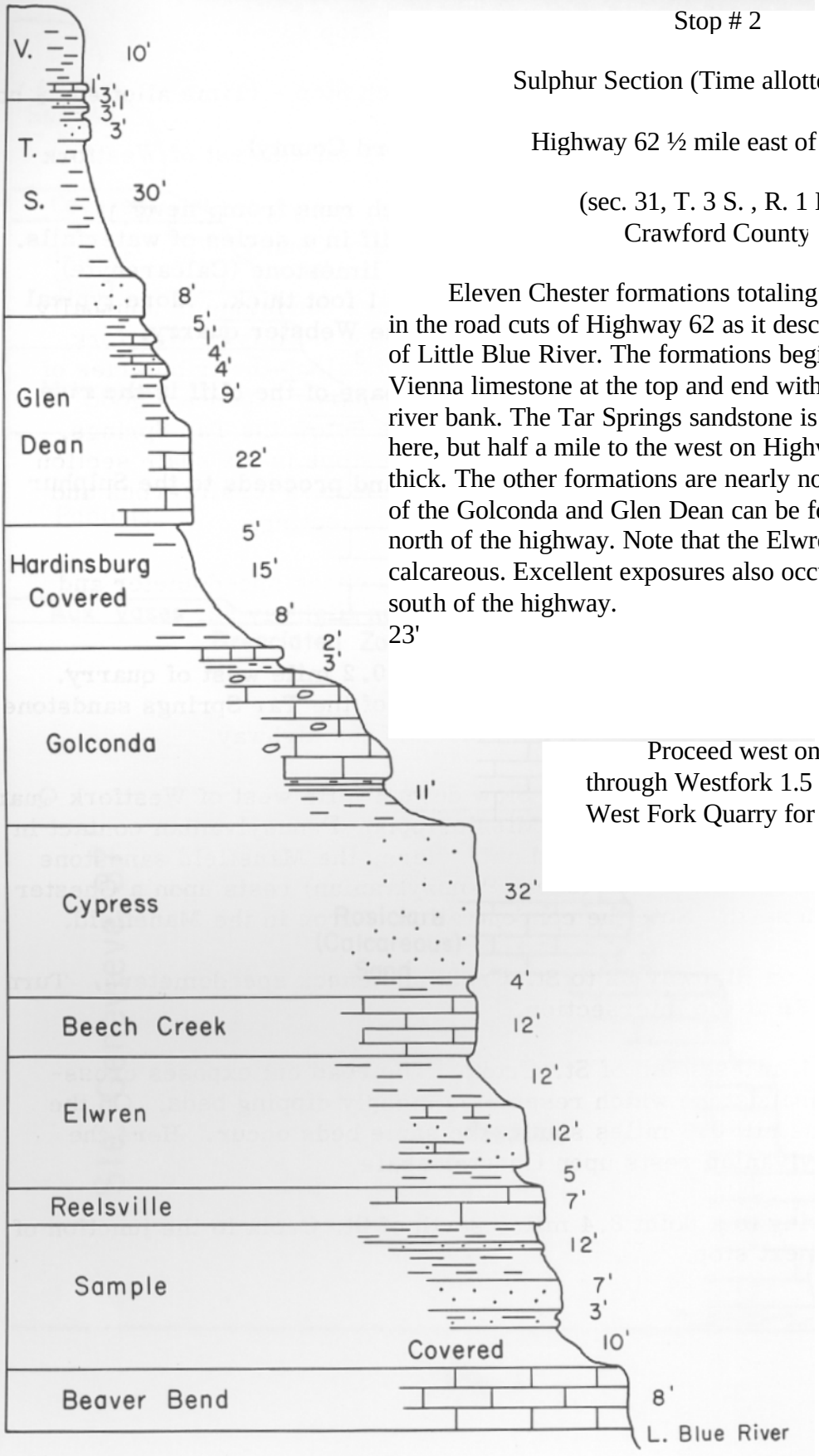


Fig. 2

Stop # 2

Sulphur Section (Time allotted, 1 hour)

Highway 62 ½ mile east of Sulphur

(sec. 31, T. 3 S. , R. 1 E.)
Crawford County

Eleven Chester formations totaling 296 feet are exposed in the road cuts of Highway 62 as it descends the west bluff of Little Blue River. The formations begin with the thin Vienna limestone at the top and end with Beaver Bend in the river bank. The Tar Springs sandstone is poorly developed here, but half a mile to the west on Highway 66, it is 50 feet thick. The other formations are nearly normal. Better sections of the Golconda and Glen Dean can be found in ravines just north of the highway. Note that the Elwren is highly calcareous. Excellent exposures also occur in the old road bed south of the highway.
23'

Proceed west on Highway 62 through Westfork 1.5 miles. Stop at the West Fork Quarry for a picnic lunch.

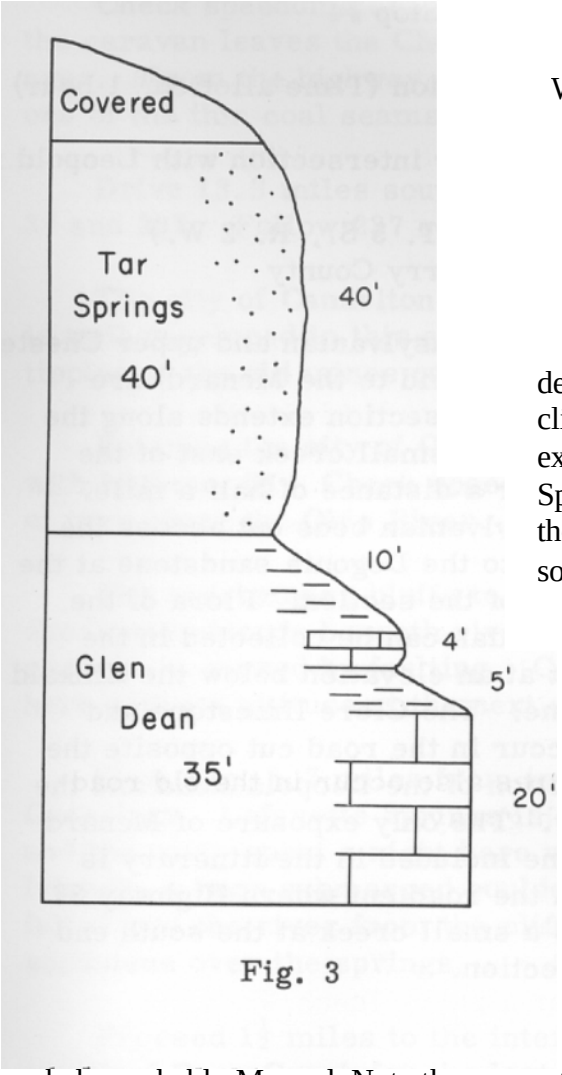


Fig. 3

Stop #3

Westfork Quarry - Lunch Stop - (Time allotted, 2 hour)

On Highway 62, 12 miles west of Westfork

(NE¼ sec. 30, T. 3 S., R. 1 W.)
Perry County

The Tar Springs sandstone is unusually well developed in the vicinity of Westfork, and forms the cliffs along the tributaries of Blue River. The quarry exposes a good section of the beds below the Tar Springs. The siliceous limestone in the shale section of the upper Glen Dean is fossiliferous and may afford some collecting.

After lunch check speedometer and continue west on Highway 62.

Slow down 0.2 mile west of quarry. Note the bluffs of the Tar Springs sandstone on both sides of the highway.

Slow down 1 mile west of Westfork Quarry for Mississippian- Pennsylvanian contact in road cut. Here, the Mansfield sandstone (basal Pennsylvanian) rests upon a Chester shale, probably Menard. Note the concentration of iron in the Mansfield.

Continue west on Highway 62 to St. Croix and check speedometers. Turn south on Highway 37 at the intersection.

Slow down 5.4 miles south of St. Croix. The road cut exposes cross-bedded Mansfield sandstone which resembles steeply dipping beds. On the opposite side of the hill 0. 3 miles south, the same beds occur. Here the base of the Pennsylvanian rests upon Chester shale.

Continue driving to a point 8.4 miles south of St. Croix to the junction of Leopold road for next stop.

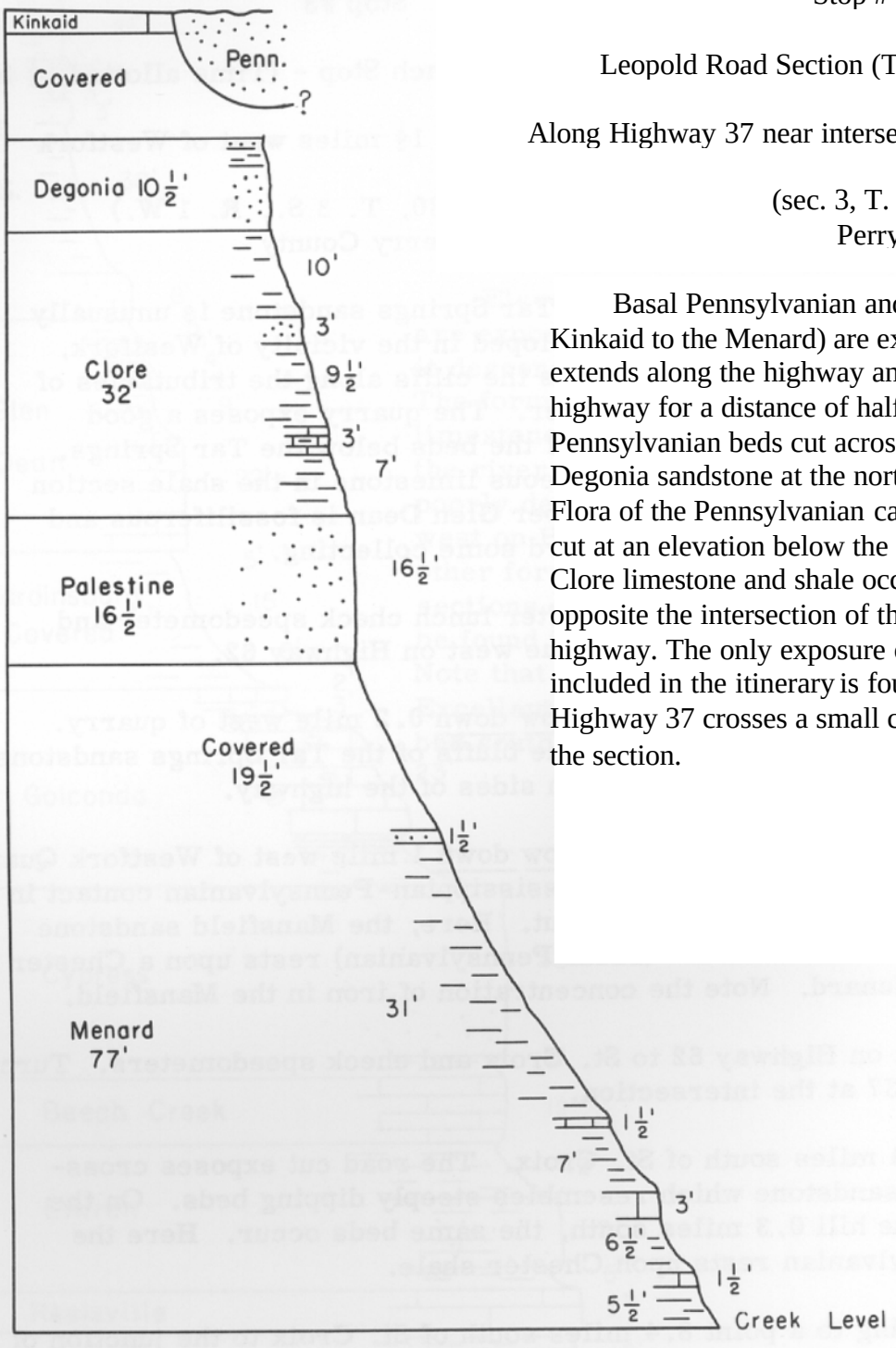


Fig. 4

Stop #4

Leopold Road Section (Time allotted, 1 hour)

Along Highway 37 near intersection with Leopold road

(sec. 3, T. 5 S., R. 2 W.)
Perry County

Basal Pennsylvanian and upper Chester (from the Kinkaid to the Menard) are exposed. The section extends along the highway and a small creek east of the highway for a distance of half a mile. The Pennsylvanian beds cut across the Kinkaid onto the Degonia sandstone at the north end of the section. Flora of the Pennsylvanian can be collected in the road cut at an elevation below the Kinkaid limestone. The Clore limestone and shale occur in the road cut opposite the intersection of the Leopold Road and the highway. The only exposure of Menard limestone included in the itinerary is found in the road cut where Highway 37 crosses a small creek at the south end of the section.

Check speedometers at Leopold road intersection. From this stop, the caravan leaves the Chester belt and enters the Pennsylvanian outcrop area. From the highway, an occasional coal mine can be seen working one of the thin coal seams in the lower Pottsville.

Drive 13. 3 miles south of Leopold road to the intersection of Highways 37 and 237. Follow 237 south into Cannelton.

The city of Cannelton derives its name from a bed of cannel coal which is well developed in this area. The coal is almost exhausted, but a few tipples of the old mines can be seen along the bluffs of the Ohio River.

Entering the city of Cannelton, the party follows 237 to the intersection with Highway 66. Check speedometers here. Follow Highway 66 east out of town along the Ohio River.

The overhanging bluffs to the left are Mansfield sandstone. The sandstone extends beneath river level at this point. Its abnormally low position is caused by faulting. Compare the altitude of the Mansfield here with its altitude at the next stop, Jones Hill.

Slow down 3.7 miles from intersection of Highways 237 and 66 in Cannelton. Lafayette Springs is on the left. The Marquis de Lafayette and his party spent a night here when their boat ran aground upon “Rock Island”, a huge submerged boulder of Mansfield sandstone which had fallen into the river from the cliff. Note the cross-bedding in the sandstone over the springs.

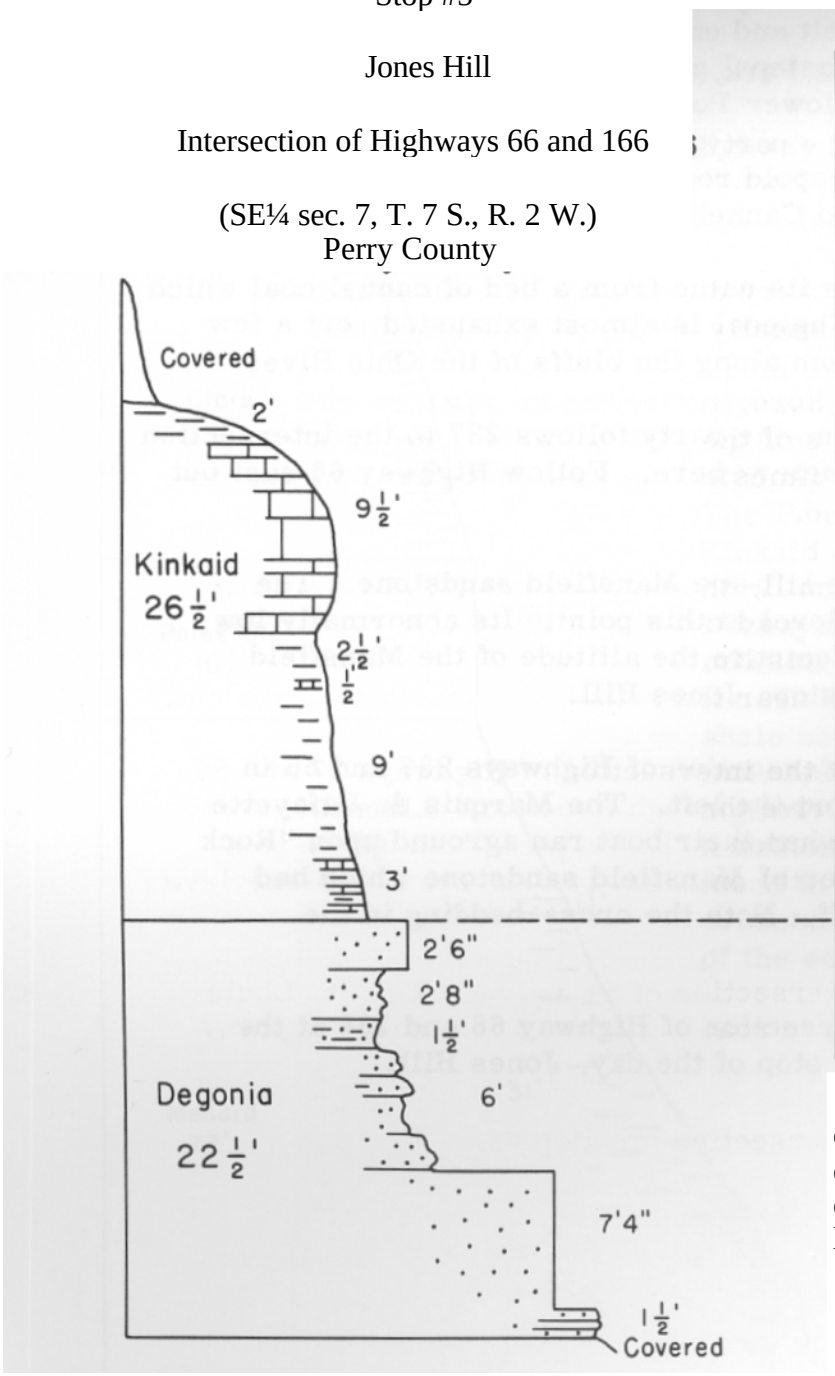
Proceed 12 miles to the intersection of Highway 66 and 166 at the mouth of Deer Creek for the last stop of the day, Jones Hill.

Stop #5

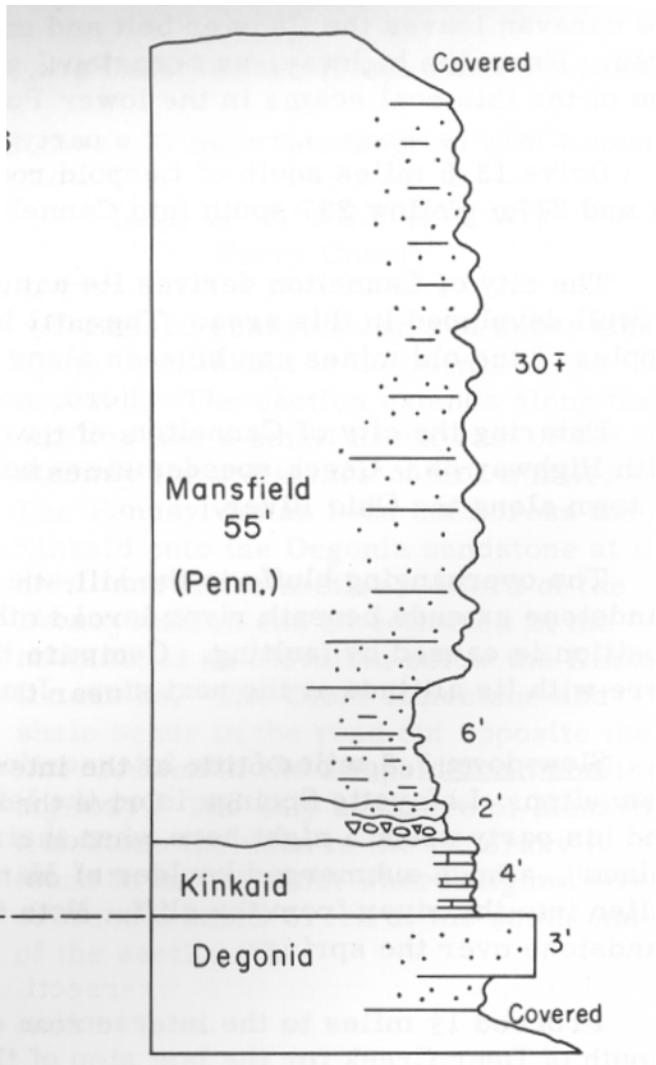
Jones Hill

Intersection of Highways 66 and 166

(SE¼ sec. 7, T. 7 S., R. 2 W.)
Perry County



Normal section of Degonia and Kinkaid. Degonia hard and quartzitic. Note undulating bedding planes, Spirifer increbescens, and Chaetetes in the Kinkaid.



Along the hill to the east, the Mansfield cuts out most of the Kinkaid section. The contact is marked by a two foot breccia composed of weathered fragments of Kinkaid limestone, limonite blisters, and sandy shale.

The huge blocks of Degonia sandstone on the hillside are a remarkable example of slumping.

Fig. 5

Sunday, May 9, 1948

Start: Leave Spring Mill State Park, Mitchell, Indiana, at 8:00 a. m.

Leaving the Park entrance, the party drives west on Highway 60 to the intersection with Highway 37. Turn north on Highway 37 and proceed through Bedford to Oolitic.

The route leads through the quarry district of the famous Indiana oolitic building stone, known geologically as the Salem limestone.

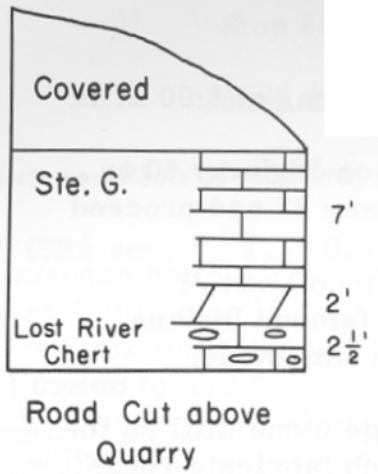
At the north city limits of Bedford, notice the large stone mill on the left. This is one of the many mills of the district which fabricate rough stone from the quarries. Indiana limestone is used more for building than any other quarry stone in the world.

A short distance north of the mill, the highway descends a long hill into the valley of Salt Creek. The road cut shows the massive character of the Salem. A few feet of St. Louis limestone caps the hill and the Harrodsburg limestone is exposed near the bridge at the bottom of the cut.

In the north edge of Oolitic at the intersection of Highways 37 and 54, turn left (west) on Highway 54. Drive through Avoca and 0. 5 mile beyond the village of Springville to intersection of Highways 54 and 58. Check speedometers here. Turn left (south) on Highway 58. The Ste. Genevieve limestone is exposed in the road cut at the corner.

Slow down 1.3 miles from intersection of 54 and 58. The St. LouisSte. Genevieve contact is exposed in road cut about 5 feet above highway level.

Proceed to 2.2 miles past intersection for stop #6.



Road Cut above Quarry

Stop #6

Armstrong Quarry and Road Cut (Time allotted, ½ hour)

Highway 58, ¼ mile west of Armstrong

(cen. sec. 32, T. 6 N., R. 2 W.)
Lawrence County

The contact of the St. Louis and the Ste. Genevieve limestones is near water level below the main floor of the quarry. The contact is irregular, marked by 6 feet or more of drab, well bedded, cherty limestone in the St. Louis overlain by a thick bedded, white, granular limestone in the basal Ste. Genevieve. The quarry exposes almost all of the Fredonia member. The Lost River Chert occurs in the upper beds of the quarry and in the road cut above the quarry. A dolomite bed and oolitic zone of the Fredonia are exposed above the chert in the road cut. The Ste. Genevieve section is continued upward from this horizon at the next stop.

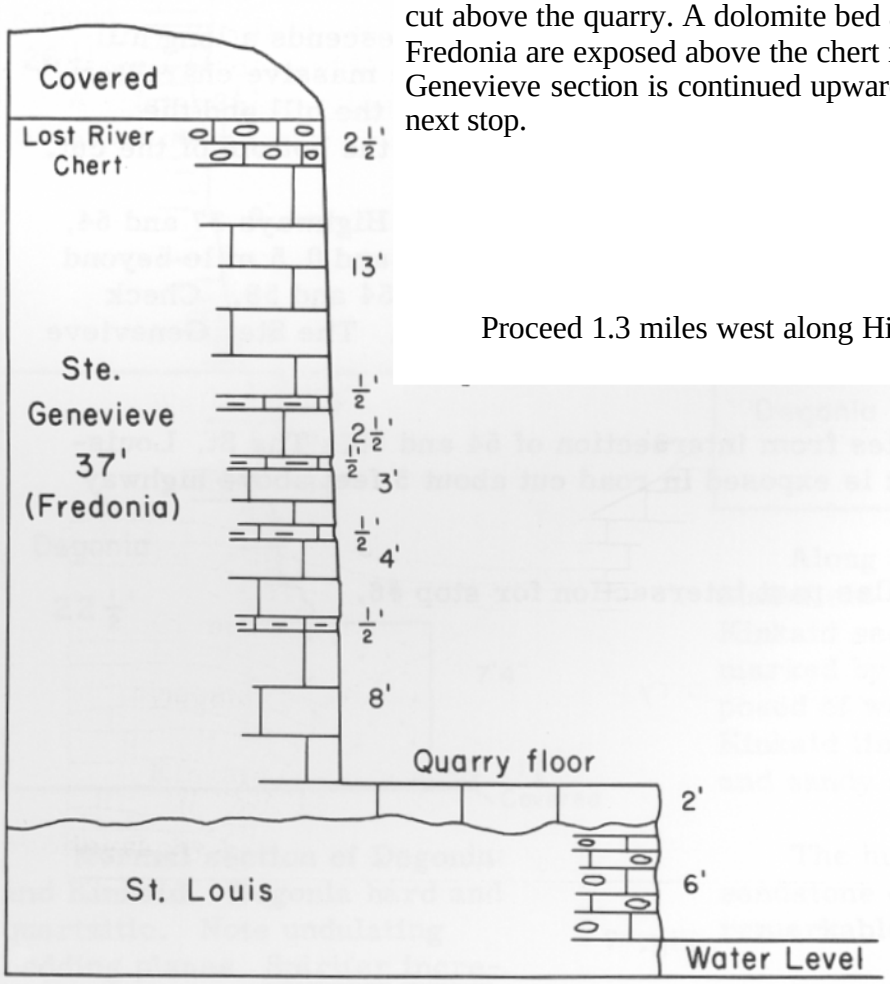


Fig. 6

Proceed 1.3 miles west along Highway 58 to stop #7.

Stop #7
Webster Quarry and Road Cut (Time allotted, 1 hour)

Along Highway 58 (SE¼ sec. 31, T. 6 N., R. 2 W.)

Lawrence County

An excellent composite section exposing the Ste. Genevieve limestone from the Lost River Chert to the contact with the Aux Vases sandstone of Chester age. A bed of dolomite, curiously weathered and in part reworked, overlies the Lost River Chert. The origin or mode of formation of this zone is difficult to explain. The Rosiclare sandstone is well developed. Note how low in the section it occurs. The lower face of the quarry is composed of brittle, lithographic limestone which makes high quality road metal. A small, sharp flexure is exposed in the road cut.

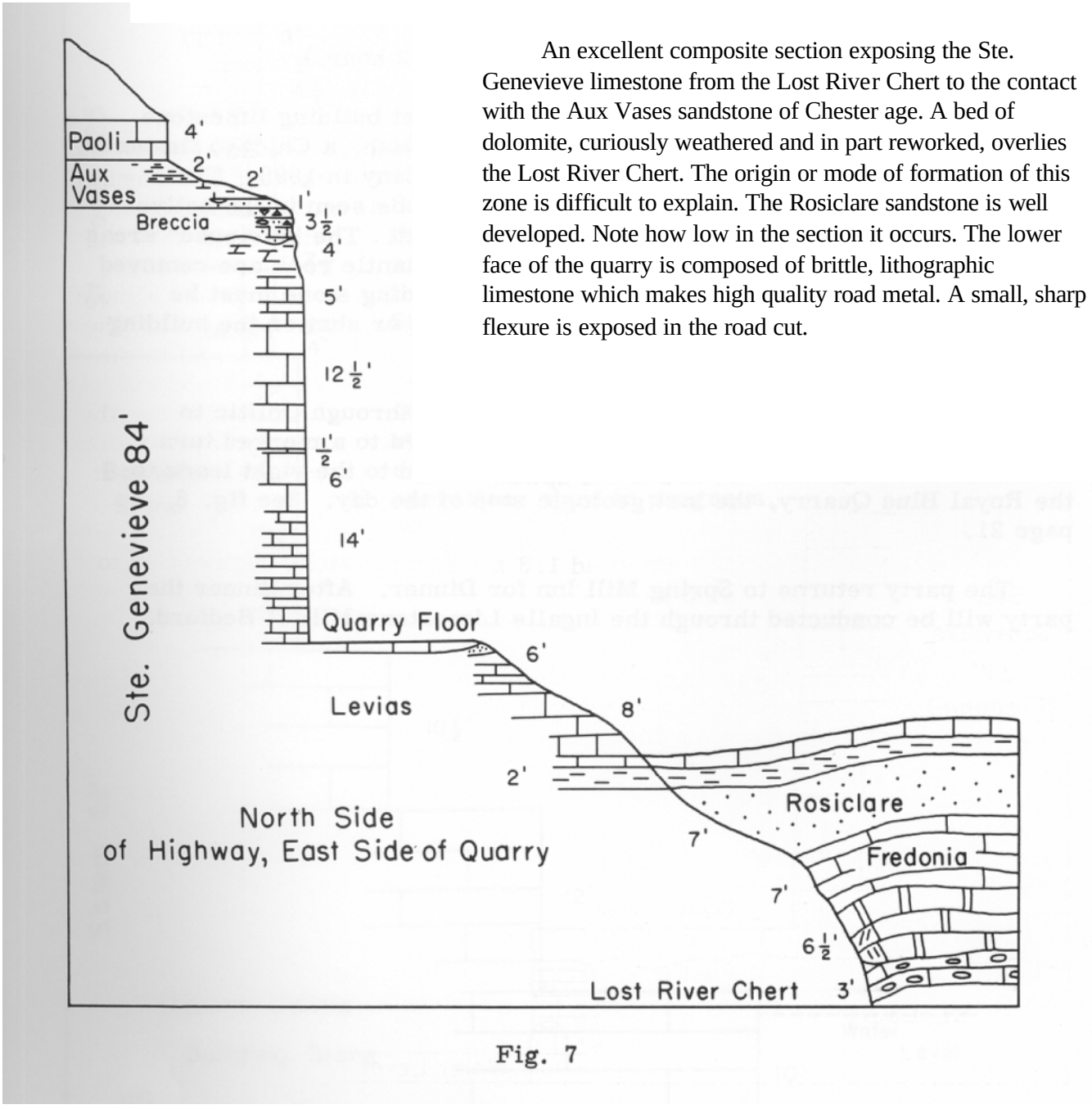


Fig. 7

The caravan returns by the same route to the intersection of Highways 58 and 37 in the city of Oolitic. Turn north on Highway 37 and proceed to the Walsh Quarry at the north edge of town.

Stop #8

Walsh Quarry (Time allotted, ½ hour.)

The Walsh Quarry is reported to be the largest building limestone quarry in the world. It was named for John R. Walsh, a Chicago financier, who purchased it from the Bedford Quarries Company in 1895. The equipment and methods of quarrying the stone can be seen in the active opening. The scene is typical of the entire district. The "stripped" areas are being prepared for quarrying. The soil and mantle rock are removed by hydraulicing and the bedrock overlying the building stone must be channeled and brokenout. Blasting would fracture or shatter the building stone.

From the Walsh quarry, the caravan returns through Oolitic to Bedford on Highway 37. Follow 37 through Bedford to a marked turn in the southwest part of the city. The narrow road to the right leads to the Royal Blue Quarry, the last geologic stop of the day. See fig. 8, page 21.

The party returns to Spring Mill Inn for Dinner. After dinner the party will be conducted through the Ingalls Limestone Mill at Bedford.

Stop #9

Royal Blue Quarry of Norton Stone Company

S. W. edge of Bedford (abandoned)

(SW¼ sec. 22, T. 5 N., R. 1 W.)
Lawrence County

This quarry contains an unusually high quality of building stone. The cap rock, or “bastard” stone of the quarrymen, is well developed. The Salem - St. Louis contact is a few inches below the highest floor in the quarry. Note the large amount of clastic material in the lower portion of the St. Louis. The curious, pitted bed in the St. Louis can be traced throughout this region.

A small fault with displacement of 1 to 2 feet occurs in the southeast corner of the quarry. The vugs and “pores” of the bastard stone contain oil, some of which ran down the quarry face when operations were in progress.

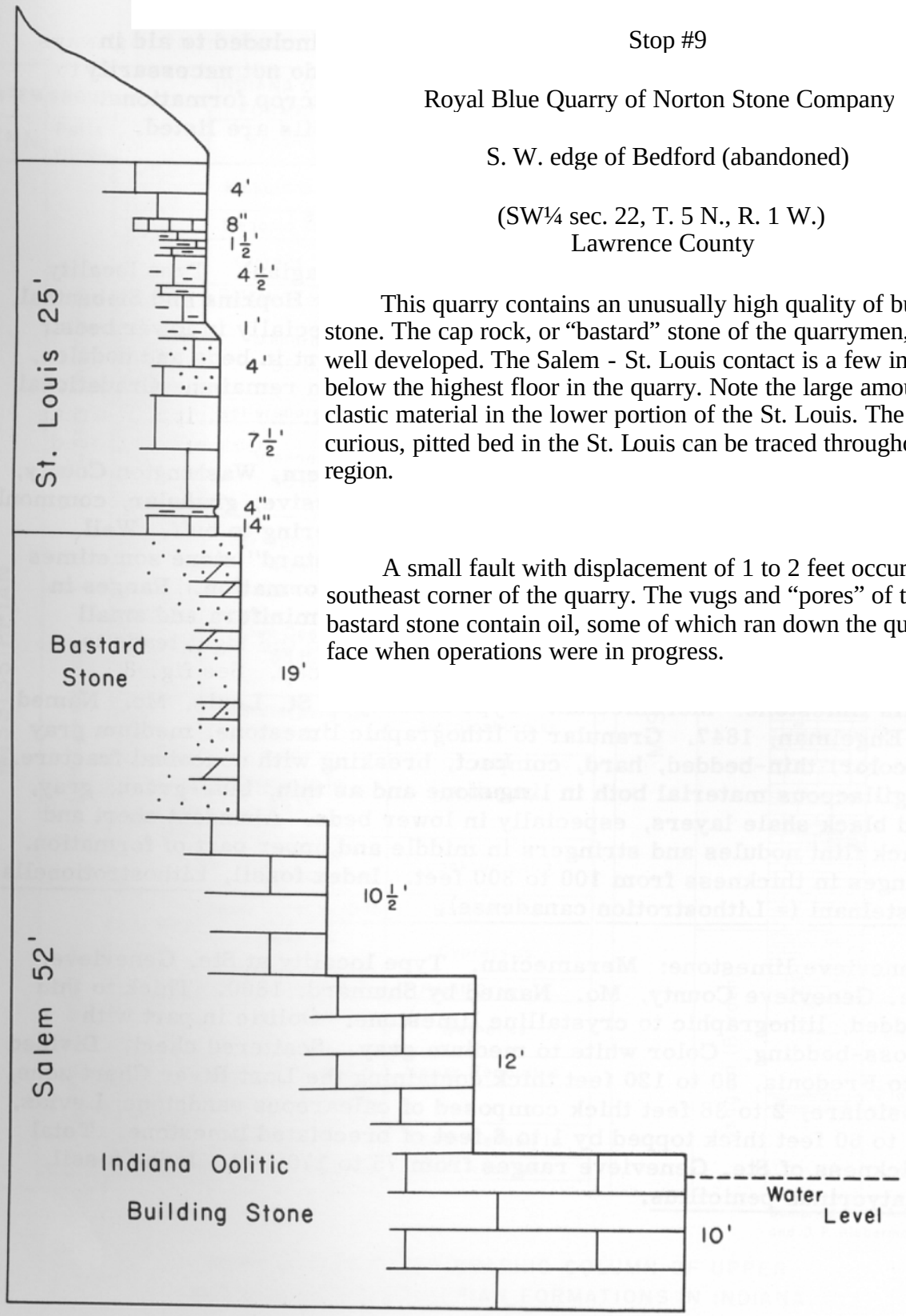


Fig. 8

The following descriptions of the formations are included to aid in identification. The descriptions are generalized and do not necessarily describe all outcrops. Thicknesses applytoIndiana outcrop formations. Only the important index fossils and the abundant fossils are listed.

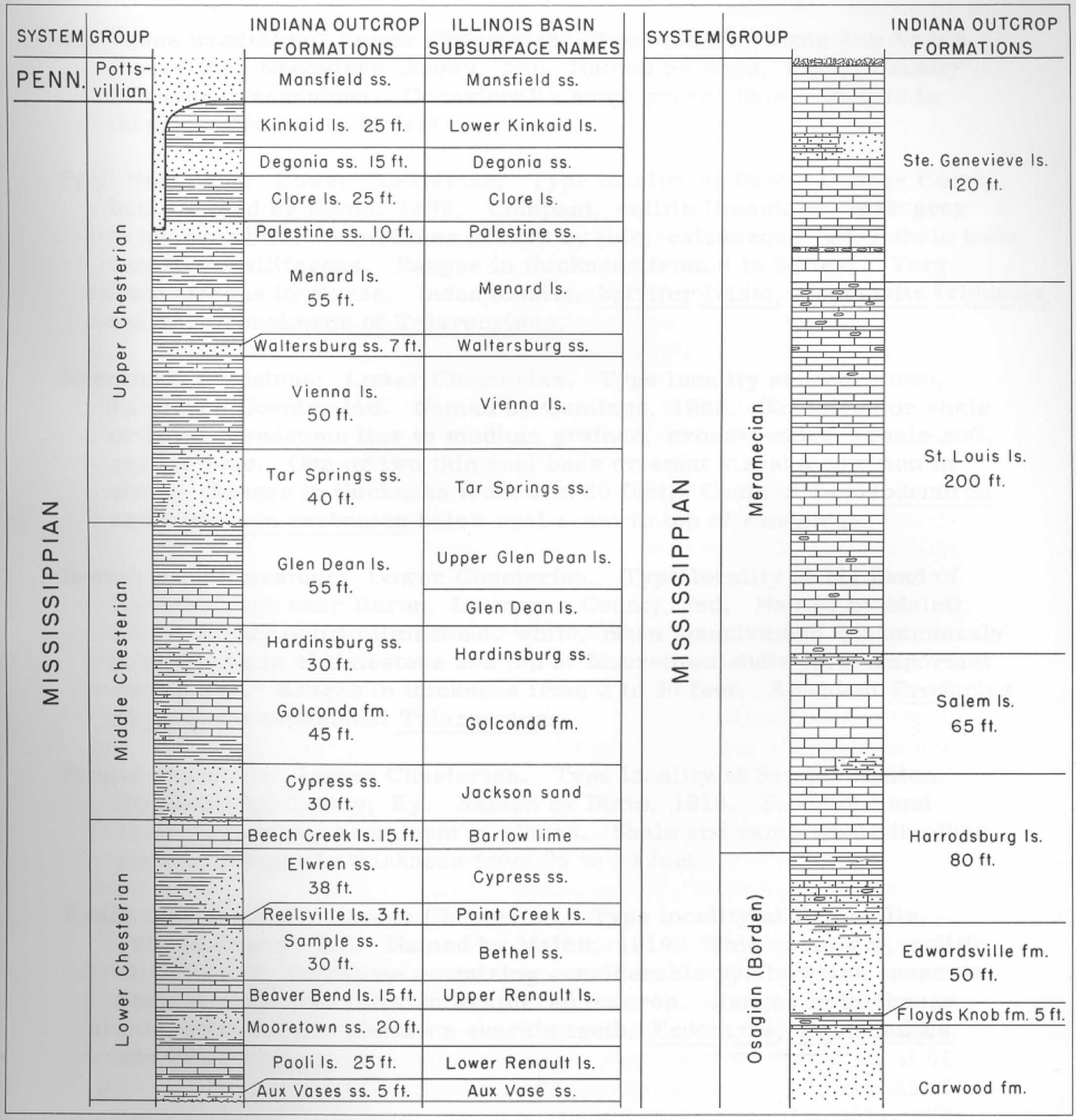
Middle Mississippian Formations

Harrodsburg limestone: Meramecian (lower beds Osagian). Type locality at Harrodsburg, Monroe County, Ind. Named by Hopkins and Siebenthal, 1897. Limestone with some shale partings, especially in lower beds. Limestone coarsely crystalline, crinoidal. Chert in beds and nodules. Upper 10 to 15 feet composed largely of bryozoan remains. Gradational contacts. Ranges in thickness from 60 to 90 feet.

Salem limestone: Meramecian. Type locality at Salem, Washington County, Ind. Named by Cumings, 1901. Limestone massive, granular, commonly cross-bedded. Color gray to bluish gray weathering to buff. Well developed oolitic grains. Dolomitic, silty, "bastard" stone sometimes either above or below building stone, or entire formation. Ranges in thickness from 30 to 80 feet. Abundance of foraminifera and small crinoid stems. Index fossil, Endothyra baileyi.

St. Louis limestone: Meramecian. Type locality at St. Louis, Mo. Named by Engelman, 1847. Granular to lithographic limestone, medium gray in color, thin-bedded, hard, compact, breaking with concoidal fracture. Argillaceous material both in limestone and as thin, blue-green, gray, and black shale layers, especially in lower beds. Abundant chert and black flint nodules and stringers in middle and upper part of formation. Ranges in thickness from 100 to 300 feet. Index fossil, Litho strotionella castelnaui (= Lithostrotion canadense).

Ste. Genevieve limestone: Meramecian. Type locality at Ste. Genevieve, Ste. Genevieve County, Mo. Named by Shumard, 1860. Thick to thin bedded, lithographic to crystalline limestone. Oolitic in part with cross-bedding. Color white to medium gray. Scattered chert. Divided into Fredonia, 30 to 120 feet thick containing the Lost River Chert zone; Rosiclare, 2 to 38 feet thick composed of calcareous sandstone; Levias, 30 to 60 feet thick topped by 1 to 6 feet of brecciated limestone. Total thickness of Ste. Genevieve ranges from 75 to 170 feet. Index fossil, Platycrinus penicillus.



Compiled by C. A. Malott, R. E. Esarey, and D. F. Bieberman, April, 1948.

GENERALIZED STRATIGRAPHIC COLUMN OF UPPER AND MIDDLE MISSISSIPPIAN FORMATIONS IN INDIANA

Upper Mississippian Formations

Aux Vases sandstone: Lower Chesterian. Type locality along Aux Vases River, Ste. Genevieve County, Mo. Named by Keys, 1892. Usually calcareous sandstone. Occasionally some green shale. Ranges in thickness from 0 to 15 feet.

Paoli limestone: Lower Chesterian. Type locality at Paoli, Orange County, Ind. Named by Elrod, 1899. Compact, oolitic limestone, dark gray to nearly white. Sometimes broken by thin, calcareous, gray shale beds, usually fossiliferous. Ranges in thickness from 0 to 38 feet. Very fossiliferous in places. Index fossils, Spirifer leidei, Composita trinucula, and rare specimens of Talarocrinus.

Mooretown sandstone: Lower Chesterian. Type locality at Mooretown, Lawrence County, Ind. Named by Cumings, 1922. Sandstone or shale or both. Sandstone fine to medium grained, cross-bedded. Shale soft, gray to blue. One or two thin coal beds or smut streaks common in shale. Ranges in thickness from 5 to 30 feet. Casts of Lepidodendron and Stigmaria carbonica below coal seam in top of sandstone.

Beaver Bend limestone: Lower Chesterian. Type locality at big bend of Beaver Creek near Huron, Lawrence County, Ind. Named by Malott, 1919. Highly oolitic limestone, white, often massive and conspicuously jointed. Base of limestone and top of Mooretown shale form important spring line. Ranges in thickness from 2 to 20 feet. Abundant Productus ele ans and occasional Talarocrinus.

Sample sandstone: Lower Chesterian. Type locality at Sample station, Breckenridge County, Ky. Named by Butts, 1918. Sandstone and shale. Sandstone prominent in places. Shale and sandy shale in other places. Ranges in thickness from 25 to 30 feet.

Reelsvllle limestone: Lower Chesterian. Type locality at Reelsville, Putnam County, Ind. Named by Malott, 1919. Thin, compact, oolitic to sub-oolitic limestone containing considerable pyrite which causes a characteristic red color in weathered outcrop. Ranges in thickness from 0 to 10 feet. Contains shark's teeth, Endothyra, Pentremites, and Talarocrinus.

Upper Mississippian Formations

Elwren sandstone: Lower Chesterian. Type locality at Elwren station, Monroe County, Ind. Named by Malott, 1919. Sandstone, shale, and an occasionally thin siliceous limestone. Sandstone medium to fine grained and characteristically ripple-marked. Shale blue-gray to olive green with maroon streaks. Ranges in thickness from 25 to 50 feet.

Beech Creek limestone: Lower Chesterian. Type locality at Beech Creek, eastern Greene County, Ind. Named by Malott, 1919. Distinctive, hard, gray, semi-crystalline limestone. Weathers into ragged, cubical blocks displaying large crinoid stems. Spring line at base. Ranges in thickness from 8 to 30 feet. Contains Martinia contracta, index fossil of the Paint Creek; Pentremites godini, typical lower Chester; and rare Productus inflatus, index fossil in Kentucky.

Cypress sandstone: Middle Chesterian. Type locality at Cypress Creek, Union County, Ill. Named by Engelmann, 1868. Sandstone characteristically laminated, rarely cross-bedded. Cliff former. Occasionally represented by shale. Locally, thin black shale bed between sandstone and Beech Creek limestone. Ranges in thickness from 25 to 40 feet.

Golconda formation: Middle Chesterian. Type locality at Golconda, Pope County, Ill. Named by Brokaw, 1916. Limestone and shale. Limestone coarse, crinoidal, often oolitic, broken by thin shale beds. Only limestone of Chester containing chert. 20 feet of olive shale below limestone. Ranges in thickness from 40 to 50 feet. Contains Pterotocrinus plates, Pentremites, and many Archimedes.

Hardinsburg sandstone: Middle Chesterian. Type locality at Hardinsburg, Breckinridge County, Ky. Named by Brokaw, 1916. Sandstone and shale. Sandstone flaggy and ripple-marked, occasionally massive and cross-bedded. Ranges in thickness from 25 to 45 feet.

Glen Dean limestone: Middle Chesterian. Type locality at Glen Dean, southern Breckinridge County, Ky. Named by Butts, 1918. Massive, cream-colored, oolitic limestone. Sometimes relatively thin, gray dense beds intercalated with oolitic beds. 10 to 35 feet of fossiliferous shale and thin limestone beds above massive limestone. Total thickness ranges from 35 to 60 feet. Pentremites spicatus in the massive limestone and Prismopora serrulata in the shale above.

Upper Mississippian Formations

Tar Springs sandstone: Upper Chesterian. Type locality at Tar Springs, Breckinridge County, Ky. Named by Owen, 1856. Massive, characteristically cross-bedded sandstone. Uneven base. Sometimes interval consists of bands of shale, sandstone, and limestone. Ranges in thickness from 0 to 90 feet. Occasionally, scanty plant remains.

Vienna limestone: Upper Chesterian. Type locality at Vienna, Johnson County, Ill. Named by Weller, 1920. Interval between Tar Springs sandstone and Waltersburg sandstone. Variable shale with thin, sandy beds and thin limestones. Shale dark to olive green. Limestones weather yellow. Ranges in thickness from 40 to 60 feet.

Waltersburg sandstone: Upper Chesterian. Type locality at Waltersburg, Pope County, Ill. Named by Weller, 1920. Sandstone hard, resistant to weathering. Forms waterfalls. Not readily recognizable in southern two-thirds of Perry County. Ranges in thickness from 0 to 25 feet.

Menard limestone. Upper Chesterian. Type locality at Menard, Randolph County, Ill. Named by Weller, 1913. Interval between Waltersburg sandstone and Palestine sandstone. Shale with shaley limestone and one fossiliferous limestone. Limestone 2 to 20 feet thick. Interval ranges in thickness from 40 to 65 feet. Abundant Allorisma, bryozoa, and crinoid stems.

Palestine sandstone: Upper Chesterian. Type locality at Palestine Twp., Randolph County, Ill. Named by Weller, 1913. Sandstone fine-grained, hard, and often quartzitic. Forms benches and waterfalls on hillsides. Ranges in thickness from 5 to 30 feet.

Clore limestone: Upper Chesterian. Type locality at Clore school, Randolph County, Ill. Named by Weller, 1913. Interval between Palestine sandstone and Degonia sandstone. Mostly shale with thin yellow impure limestones. Ranges in thickness from 20 to 45 feet. Contains Bastostomella nitidula, Clore index fossil from Illinois, and numerous Composita subquadrata.

Degonia sandstone: Upper Chesterian. Type locality at Degonia Twp., Randolph County, Ill. Named by Weller, 1920. Sandstone fine-grained hard, often quartzitic. Forms waterfalls. Ranges in thickness from 10 to 35 feet.

Kinkaid limestone: Upper Chesterian. Type locality at Kinkaid Creek, Jackson County, Ill. Named by Weller, 1920. Limestone and shale interval 20 to 35 feet thick when not cut out by Pennsylvanian. Limestone, 2 to 15 feet thick, displays typical undulating bedding-planes on weathered surfaces. Contains Spirifer increbescens and Chaetetes (undescribed).

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