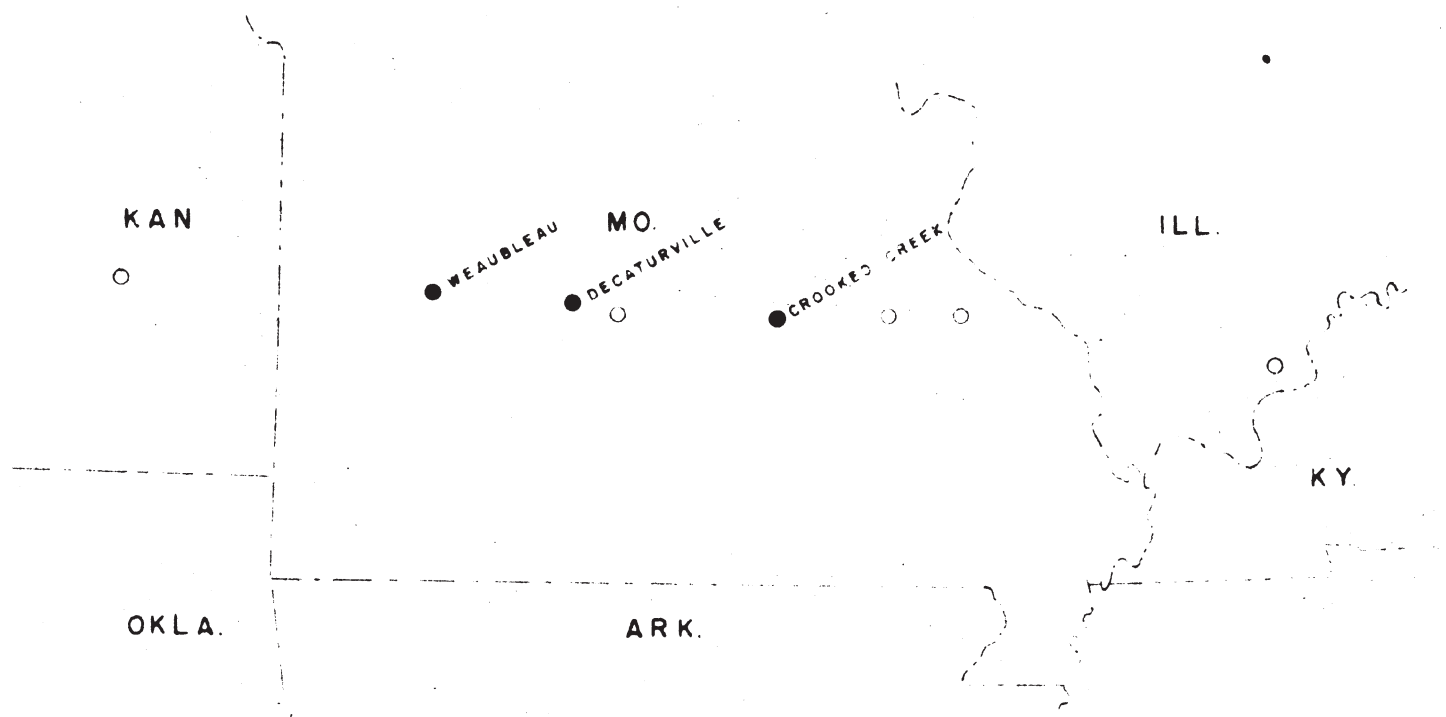


GUIDE BOOK

CRYPTOVOLCANIC  
STRUCTURES OF  
SOUTH CENTRAL MISSOURI

EDITED BY F. G. SNYDER



ASSOCIATION OF MISSOURI GEOLOGISTS  
ELEVENTH ANNUAL FIELD TRIP  
SEPTEMBER 25-26, 1964

ASSOCIATION OF MISSOURI GEOLOGISTS

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ELEVENTH ANNUAL FIELD TRIP

September 25-26, 1964

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F. G. Snyder, Chairman  
Thomas R. Beveridge  
Paul E. Gerdemann  
Herbert E. Hendriks  
Larry Fellows

Local Committee

Jerry Vineyard, Chairman  
Bob D. Pyeatt  
Richard D. Hagni

GENERAL SCHEDULE

Friday, September 25

Assemble: 12:30 p.m., C.S.T., Cherryville, Missouri, junction of Missouri Highways 19 and 49.

The Crooked Creek Structure - Leaders Herbert E. Hendriks and Paul E. Gerdemann.

Lebanon, Missouri: Shepherd Hills Restaurant.

6:30 p.m., C.S.T. - Convivialities

7:30 p.m., C.S.T. - Annual Dinner of the Association  
Business meeting  
Discussion of cryptovolcanic structures, cryptoexplosion structures, astroblemes, and unusual structural features.

Saturday, September 26

Assemble: 7:30 a.m., C.S.T., Lebanon, Missouri, along Business Route 66 in front of Shepherd Hills and other motels.

The Decaturville Structure - Leaders F. G. Snyder and Paul E. Gerdemann.

Lunch: Box lunch, Glendorf Roadside Park, U. S. Highway 54.

The Weaubleau Structure - Leaders Thomas R. Beveridge and F. G. Snyder.

End of trip: Approximately 3:30 p.m., C.S.T.

\* \* \* \* \*

At each geologic stop, leader will brief group on features to be seen. After you park, assemble around leader as quickly as possible.

At trip stops along highways, use caution getting in and out of cars and crossing highways.

Be considerate of fences and farmers property.

Maintain place in caravan, do not leap frog.

STRATIGRAPHIC SUCCESSION IN SOUTH CENTRAL MISSOURI

SYSTEM	SERIES	FORMATION
PENNSYLVANIAN		
MISSISSIPPIAN	Meramecian	St. Louis Salem Warsaw
	Osagean	Keokuk Burlington Pierson
	Kinderhookian	Northview Sedalia Compton
MISSISSIPPIAN or DEVONIAN (Unassigned)		Chattanooga Sylamore
ORDOVICIAN	Cincinnatian	Maquoketa Fernvale
	Champlainian	Kirmswick Decorah Plattin Joachim St. Peter
	Canadian	Powell Cotter Jefferson City Roubidoux Gasconade (Gunter Member)
CAMBRIAN	Upper Cambrian	Eminence Potosi Derby-Doerun Davis Bonneterre Lamotte
PRECAMBRIAN		

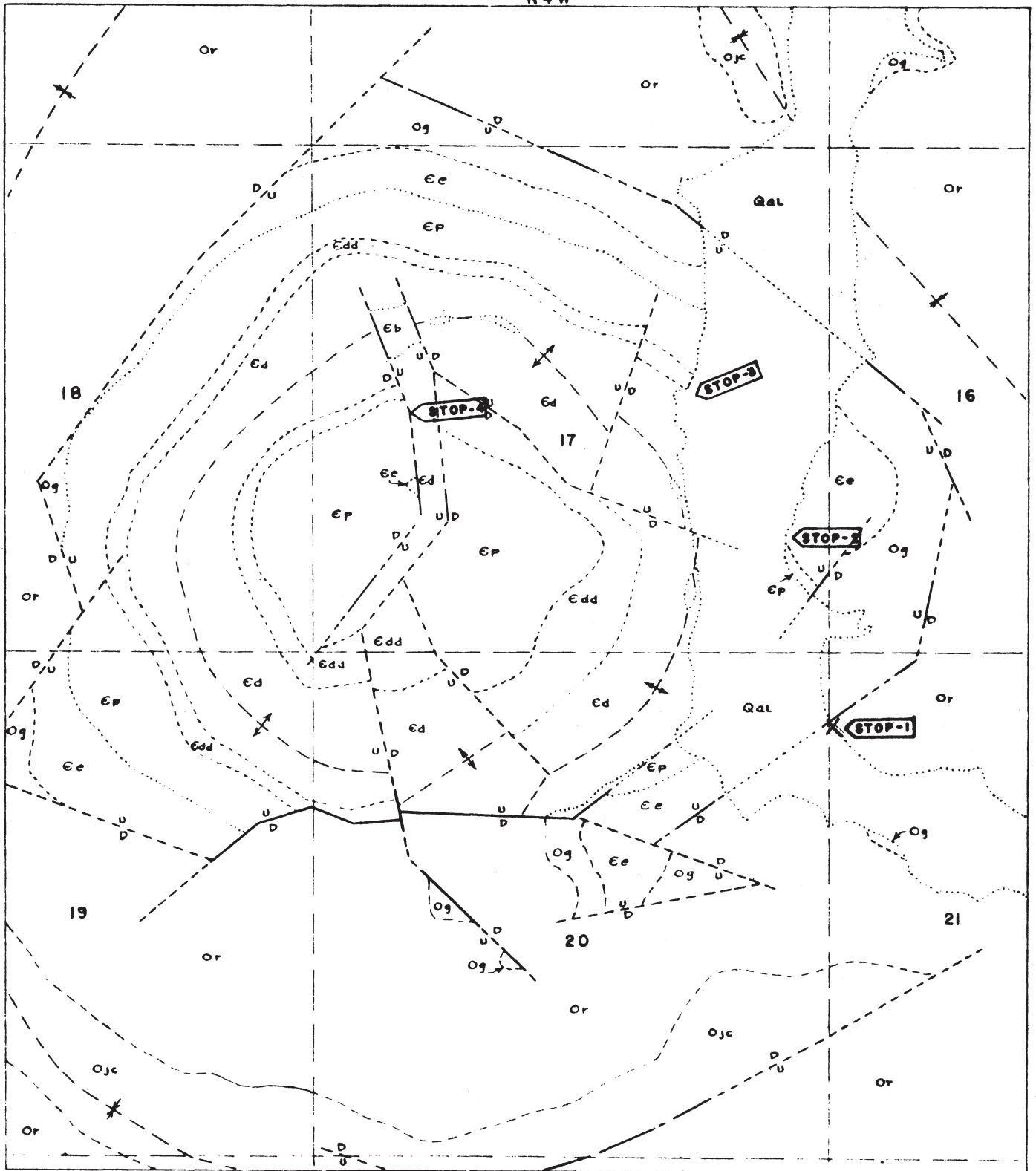
FIRST DAY

Route Log: Cherryville to Crooked Creek by Paul E. Gerdemann; geology of Crooked Creek area by Herbert E. Hendriks; Crooked Creek to Lebanon by James H. Williams.

Outbound mileage

<u>Cum.</u>	<u>Diff.</u>	
0.0		Junction of Mo. Highways 49 and 19 at Cherryville. Assembly point for trip. South on Highway 19. Gasconade fm. in creek bottoms; Roubidoux on hills.
2.1	2.1	Cross Palmer fault zone (fault not exposed), Roubidoux ss. on right of highway.
2.4	0.3	Eminence fm. in ditch, right side of road.
3.2	0.8	Gasconade-Eminence contact.
4.8	1.6	Junction Highway 19 and gravel road, turn right onto gravel road.
5.8	1.0	Junction, New Home church road, bear left.
6.6	0.8	Road junction, bear right.
8.1	1.5	Road junction, turn left.
8.3	0.2	STOP 1: NW $\frac{1}{4}$ , NW $\frac{1}{4}$ , Sec. 21, T. 36 N., R. 4 W. The Crooked Creek disturbed area, approximately four miles by three miles in diameter, is bounded by ring faults that separate it from normal Gasconade and Roubidoux fms. surrounding the structure. The structure consists of two elements: a highly deformed, uplifted central area about 7,000 feet in diameter, and an encircling ring graben which varies from one to two miles in width.  The central uplift is a domal structure with a depressed center surrounded by a ring anticline. The Davis fm. and a few windows of Bonneterre fm. are exposed at the crest of the anticline, while Potosi fm. outcrops at the center of the structure. A narrow dog-leg horst with a maximum displacement of 400 feet crosses the central uplift from north to south.  The synclinal ring graben has Jefferson City fm. exposed at the trough, flanked by Roubidoux and Gasconade fms.  At Stop 1, the ring fault separating the central uplift from the ring graben is exposed. The downthrown side of the fault, to the southeast, exposes massive quartzitic beds of Roubidoux dipping steeply away from the

GEOLOGIC MAP  
OF  
THE CROOKED CREEK AREA  
A PORTION OF THE STEELVILLE QUADRANGLE, MISSOURI  
AFTER  
H.E. HENDRICKS, 1947  
R 4 W



LEGEND

- |  |  |  |
|--|--|--|
| <span style="border: 1px solid black; padding: 2px;">QaL</span> ALLUVIUM       | <span style="border: 1px solid black; padding: 2px;">Og</span> GASCONADE | <span style="border: 1px solid black; padding: 2px;">Edd</span> DERBY-DOERUN |
| <span style="border: 1px solid black; padding: 2px;">Ojc</span> JEFFERSON CITY | <span style="border: 1px solid black; padding: 2px;">Ee</span> EMINENCE  | <span style="border: 1px solid black; padding: 2px;">Ed</span> DAVIS         |
| <span style="border: 1px solid black; padding: 2px;">Or</span> ROUBIDOUX       | <span style="border: 1px solid black; padding: 2px;">Ep</span> POTOSI    | <span style="border: 1px solid black; padding: 2px;">Eb</span> BONNETERRE    |
| --- FAULT  | ..... FORMATION CONTACT  | ↑ CREST OF ANTICLINE   |
|  |  | ∩ TROUGH OF SYNCLINE   |

SCALE: 1"=1800'

fault. The steep dips and well-cemented character of the Roubidoux result in a conspicuous obsequent fault scarp. To the northwest, patchy exposures show Gasconade fm. dipping toward the fault zone.

- 8.5      0.2      Return to preceding road junction.
- 8.6      0.1      Road junction, bear right.
- 8.7      0.1      STOP 2:  $SE\frac{1}{4}$ ,  $SE\frac{1}{4}$ , Sec. 16, T. 36 N., R. 4 W.  
Exposure of small normal fault, marked by intense brecciation, near the eastern margin of the central uplift. Potosi fm., brecciated and dipping steeply to the southeast, is exposed along the road northwest of the fault; Gasconade fm. is exposed southeast of the fault.
- 9.1      0.4      Road junction, turn left.
- 9.4      0.3      STOP 3:  $SE\frac{1}{4}$ ,  $NE\frac{1}{4}$ , Sec. 17, T. 36 N., R. 4 W.  
At this stop the section from the base of the Potosi to the base of the Davis is exposed on the northeast side of the ring anticline. Beginning at a point 250 feet north of the road and west of the stream, steeply dipping Potosi overlies Derby-Doerun. Traversing southwest, the Derby-Doerun is crossed and Davis is exposed in the small stream near the road.
- 10.0      0.6      STOP 4:  $NW\frac{1}{4}$ ,  $NW\frac{1}{4}$ , Sec. 17, T. 36 N., R. 4 W.  
North of the road, the Bonneterre fm. is exposed where the dog-leg horst crosses the ring anticline. An unusually hard, tightly cemented breccia, possibly an intrusive breccia dike, is exposed along the creek bank in the fault zone east of the horst. About 250 feet to the northwest, ledges of quartz sandstone are exposed. Stratigraphic position of the sandstone is unknown, but it may be one of the Lower Pennsylvanian sandstones thought to unconformably overlie the structure.  
  
South of the road, in a stream bed in the  $NE\frac{1}{4}$ ,  $SW\frac{1}{4}$ , Sec. 17, T. 36 N., R. 4 W., shatter cones in the Potosi fm. are exposed. The Potosi at the center of the structure is bleached, highly silicified, and intensely shattered.
- 10.2      0.2      Road junction, turn right.
- 11.4      1.2      Pennsylvanian clay filled sink on right.
- 12.2      0.8      Junction Highways VV and M. Turn right on M.
- 19.1      6.9      Junction Highways M and V, continue on M.
- 20.2      1.1      Junction County Highway M and Mo. Highway 8, turn left on Highway 8.

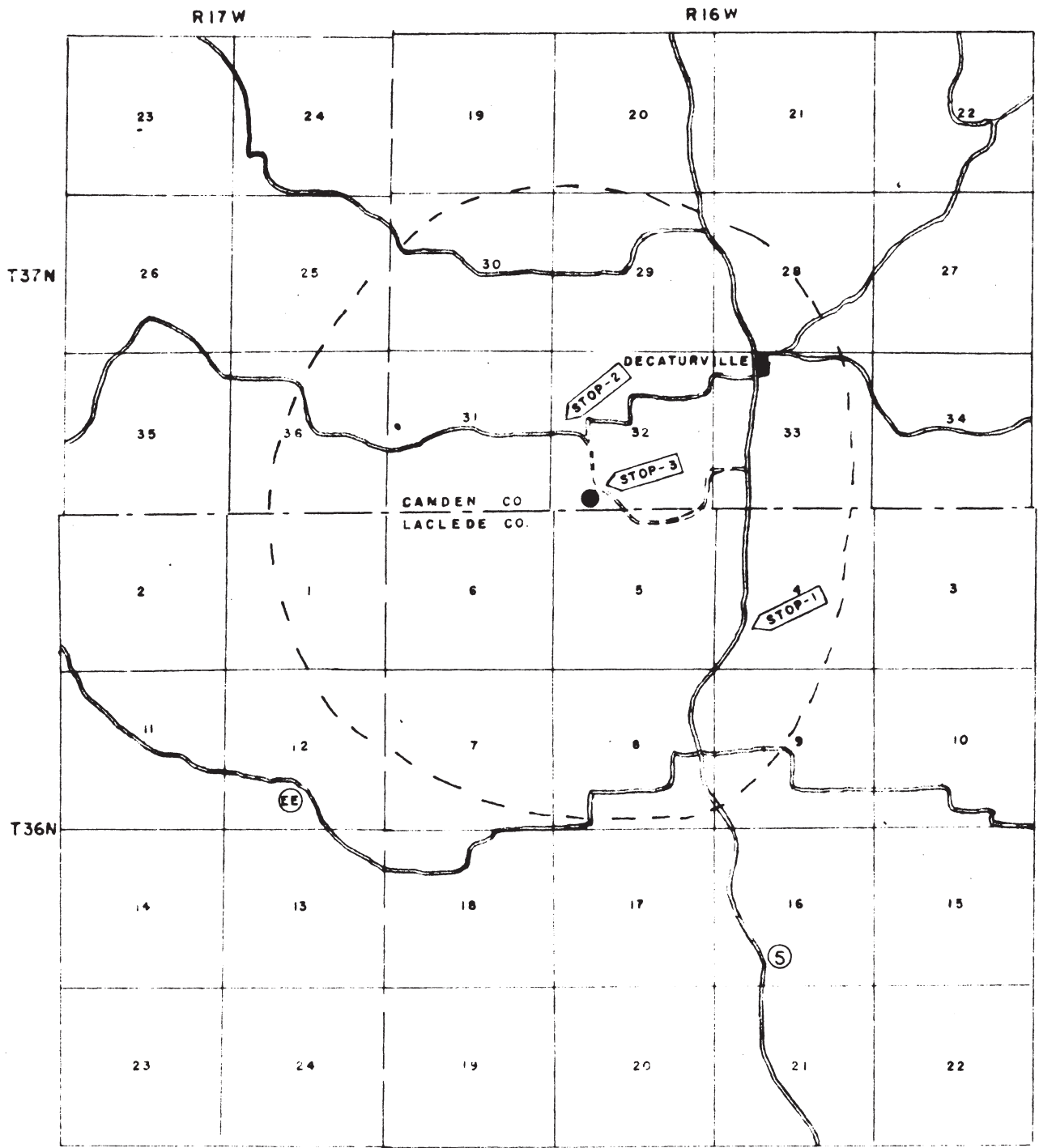
- 27.7        7.5        Quarry in Gasconade fm. on left side of road.
- 27.8        0.1        Entrance to Meramec Spring.
- 28.2        0.4        Gasconade dolomite on right side of road.  
Exposures show lateral transition between dolomite,  
cherty dolomite, into chert beds with cryptozoon  
structure.
- 30.4        2.2        Junction Mo. Highways 8 and 68. Highway 8 ends,  
continue on 68.
- 33.8        3.4        City limits St. James, continue on Highway 68 through  
city.
- 36.2        2.4        Junction Mo. Highway 68 and U. S. 66. Follow 66 west  
to Lebanon. U. S. 66 from St. James to Rolla is  
mostly on Jefferson City fm., with excellent exposures  
of filled sinks.
- 49.6        13.4        Contact of Roubidoux sandstone and Gasconade dolomite.
- 49.9        0.3        Jefferson City-Roubidoux contact exposed on right side  
of road.
- 66.8        16.9        Vertical Gasconade bluffs in deep road cut, Roubidoux  
sandstone caps hill.
- 74.5        7.7        Cryptozoon chert in Gasconade exposed on left.
- 75.6        1.1        Road cut in massive upper Gasconade dolomite.
- 89.7        14.1        Jefferson City-Roubidoux contact exposed.
- 103.3       13.6        Business Route 66 turn off to Lebanon. Continue  
straight ahead on U. S. 66 to Shepherd Hills Motel.
- 106.2       2.9        Shepherd Hills Motel turn-off.  
End of first day's trip.

SECOND DAY


Route Log: Lebanon to Camdenton, Camdenton to Wheatland by T. R. Beveridge; geology of Decaturville area by F. G. Snyder and Paul E. Gerdemann; geology of Weaubleau area by T. R. Beveridge.

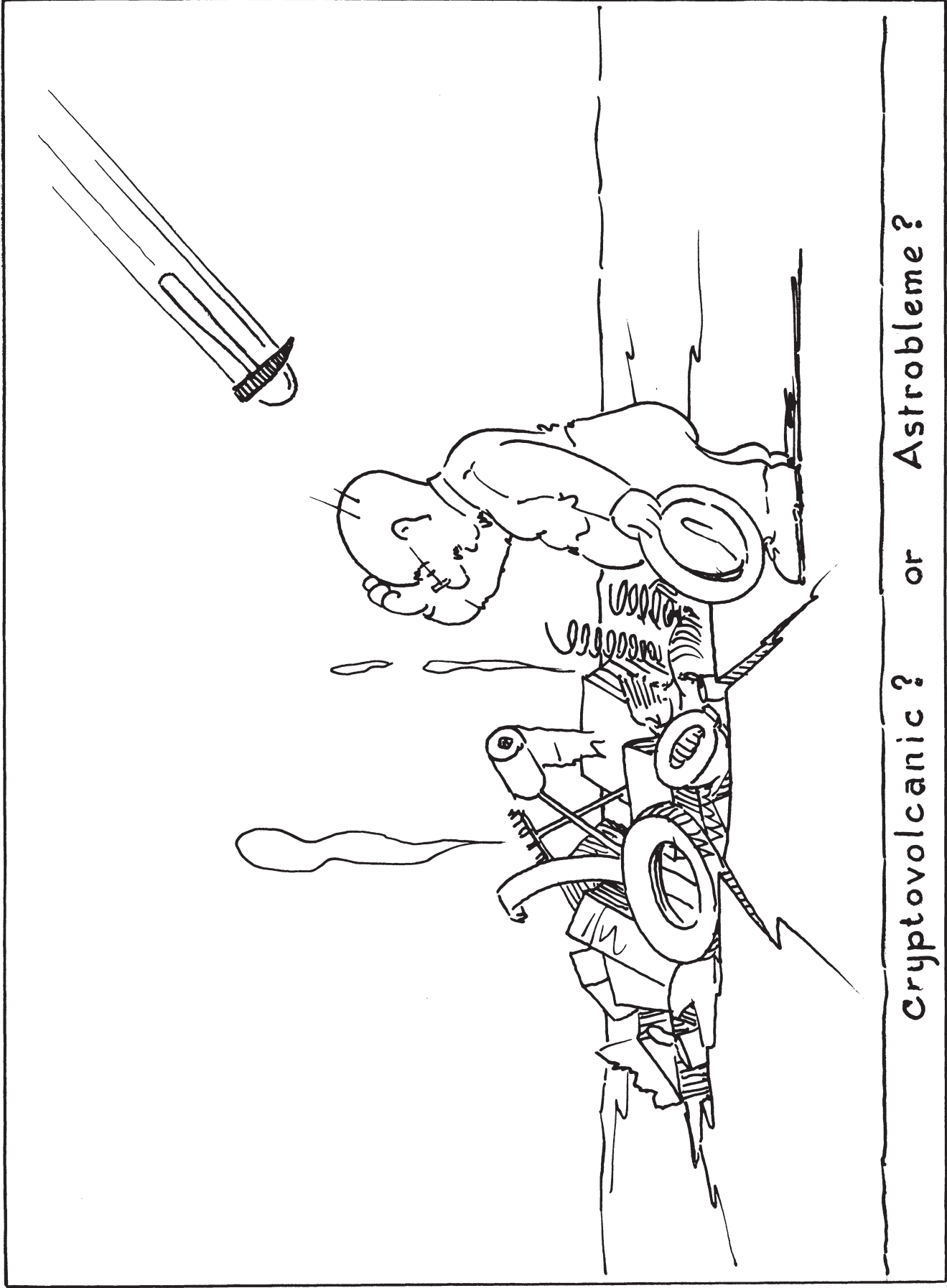
Outbound mileage

<u>Cum.</u>	<u>Diff.</u>	
		Assemble in front of motels at 7:30 a.m., C.S.T., heading north on Business Route 66, Lebanon, Mo. With caravan proceed north and east on Business Route 66.
0.0		Junction Business Route 66 and Mo. Highway 5, turn left on Highway 5, stay on Highway 5.
1.8	1.8	Junction Highways 5 and YY, continue on 5. For the next several miles Roubidoux fm. is poorly exposed.
15.1	13.3	Approximate position of southeast boundary of Decaturville structure.  The Decaturville disturbed area reveals a well developed symmetrical ring structure about $3\frac{1}{2}$ miles in diameter. The structure consists of an uplifted, intensely brecciated core approximately one mile in diameter and an outer zone of folded and down-faulted younger fms.  Outside the disturbed area, Gasconade fm. occupies the lowlands and Roubidoux caps the hills; depth to Precambrian is about 1,400 feet. Within the structure formations as young as Kimmswick and Plattin are preserved in down-faulted blocks, and Precambrian granite pegmatite is exposed at the center of the area.  In the central core, formations show massive and thorough brecciation, generally without much intermixing of blocks of one unit with another. In addition to the massive breccia, numerous intrusive breccia dikes or pipes are found. These consist of fragments of sedimentary formations in a black mud matrix. The intrusive breccia bodies are irregular and discontinuous in form; they carry appreciable amounts of iron, lead, and zinc sulfides.
15.4	0.3	STOP 1: Center SW $\frac{1}{4}$ , Sec. 4, T. 36 N., R. 16 W. This exposure, in the southeast part of the Decaturville structure, shows beds of relatively flat-lying Jefferson City along the crest of the hill on both sides of the highway. East of the bridge, in the stream bed, steeply dipping beds of Roubidoux and Jefferson City are encountered. Faults, parallel to strike of beds and marked by breccia zones, occur at about 30 feet and again at 500 feet east of the bridge.

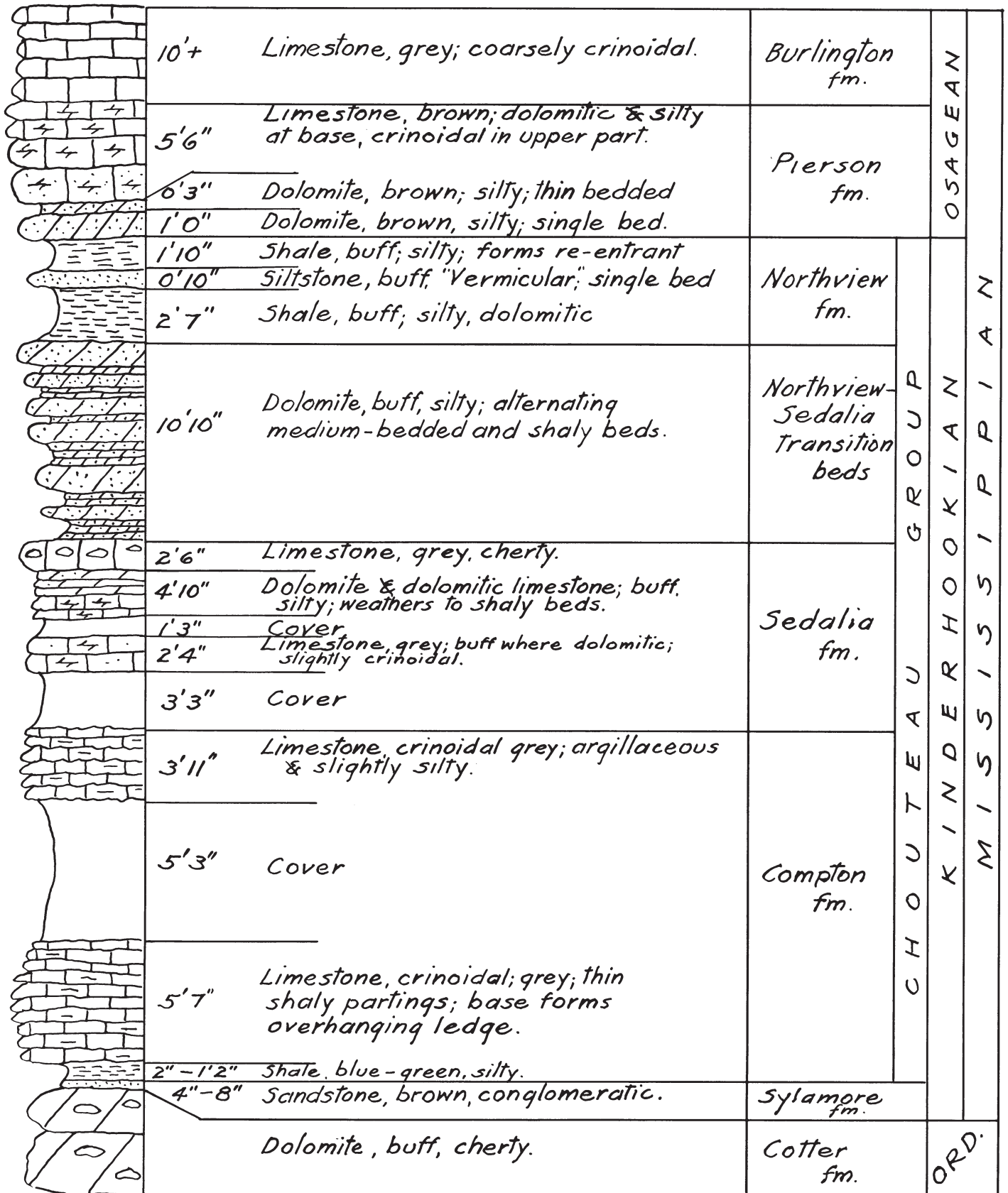


**DECATURVILLE  
LEGEND**

- PEGMATITE
- - - APPROXIMATE BOUNDARY OF DISTURBED AREA
- SCALE 



Cryptovolcanic ? or Astrobleme ?



Section by T.R. Beveridge

FIG. 6. STOP 3. SECTION ON SOUTH SIDE U.S. HIGHWAY 54 SE $\frac{1}{4}$  NE $\frac{1}{4}$  SE $\frac{1}{4}$  SEC. 20, T. 37N, R. 21W, HICKORY COUNTY.

Between the faults a synclinal structure has steep dips adjacent to the faults and gentle dips at the trough. At this stop, units are deformed by folding and faulting but without extensive brecciation.

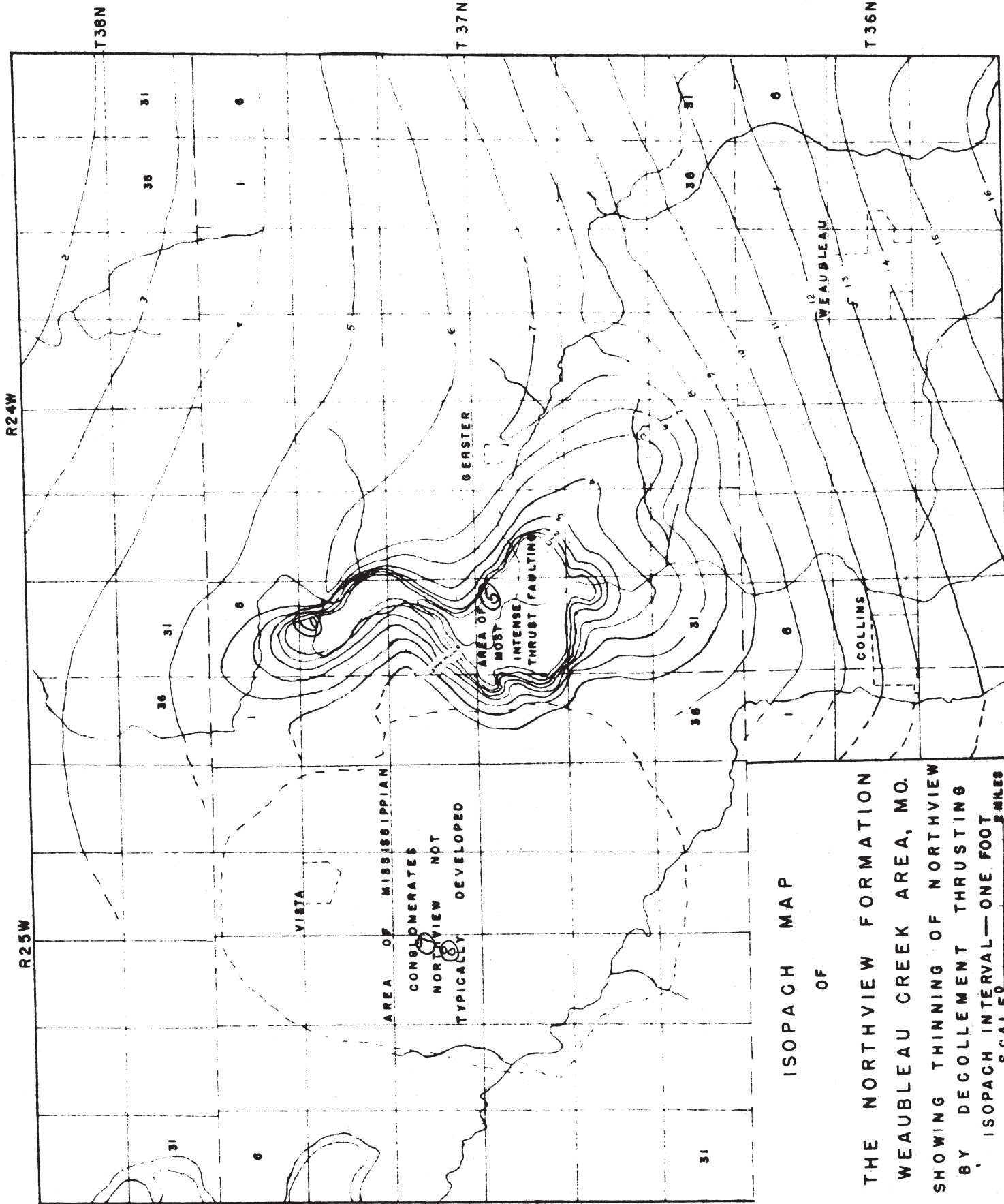
17.1            1.7            Junction with gravel road at Decaturville. Turn left on gravel road.

18.5            1.4            STOP 2: Center  $W\frac{1}{2}$ , Sec. 32, T. 37 N., R. 16 W. This exposure, in the NW quadrant of the structure, shows steeply dipping beds with huge blocks of unbrecciated units in diverse orientations. After parking, proceed to bridge across gravel road. North of the bridge the following units are exposed:

<u>Distance From Bridge</u>	<u>Description</u>
0 - 100'	<u>Sandstone</u> , massive, friable, finegrained, badly crushed.
100'	<u>Fault zone</u> , dolomite breccia, strike N.45 E.
100-230'	<u>Jefferson City dolomite</u> , strike N. 45 E., dip 50° NW.
230'	<u>Fault zone</u> , dolomite breccia, strike N. 38 E.
230-460'	<u>Dolomite breccia</u> , with massive blocks of sheared and brecciated sandstone at about 460'. Farther downstream large blocks of randomly oriented dolomite (probably Gasconade) are exposed.
500'	On the bed of a small stream to the left large blocks of randomly oriented dolomite (probably Gasconade) are exposed. Up hill a prominent bed of sandstone (probably Roubidoux) illustrates interesting structural relationships. To the east of the parking area, abundant outcrops show intensely brecciated Eminence fm. Undoubtedly, the rock was subjected to tremendous pressure, but in a manner that precluded jumbling of formations.

- 19.0            0.5            STOP 3: SW $\frac{1}{4}$ , SW $\frac{1}{4}$ , Sec. 32, T. 37 N., R. 16 W., office of Ozark Explorations Company. The Ozark Explorations Company has diamond drilled the center of the structure and exposed numerous features by test pits and bulldozing.
- The granite pegmatite making the center of the structure has been shown by drilling to be a large block with brecciated sediments below. The igneous rock is Precambrian in age; K/Ar measurements coincide closely with other Missouri granites. The formation enclosing the granite is much bleached and altered, and is probably Derby-Doerun or Potosi. A short distance from the igneous outcrop, shatter cones in bleached, altered dolomite are abundant.
- South and southwest of the granite breccia dikes have been exposed by trenching. In the large pit, Davis and Derby-Doerun fms. are exposed by trenching. Breccia dikes intrusive into the Derby-Doerun are composed of fragments of several formations in a black mud matrix. Sulfides suggest more than one period of brecciation.
- 20.5            1.5            Junction of Ozark Explorations Co. road with Mo. Highway 5. Continue north on Highway 5.
- 29.7            9.2            Enter Camdenton.
- 30.3            0.6            Intersection Mo. Highway 5 and U. S. Highway 54. Stop, turn left on U.S. 54.
- 33.4            3.1            Eminence fm. exposed for next 0.7 mile.
- 34.1            0.7            Gunter ss. exposed.
- 34.7            0.6            Red Arrow fault mapped by H. E. Hendriks.
- 52.4            17.7            LUNCH STOP. Glendorf Roadside Park.
- 65.7            13.3            STOP 4: N $\frac{1}{2}$ , SE $\frac{1}{4}$ , SE $\frac{1}{4}$ , Sec. 20, T. 37 N., R. 21 W., south side of Highway 54. This exposure shows the Northview, Sedalia, and Compton fms. of the Chouteau group. The Chouteau group here is much thinner than in the type area; lithologic contrasts between Compton and Sedalia are more marked; the Northview is thicker. This is a transition facies as beds of upper Sedalia laterally change southward to the Northview shale and siltstone facies.
- 65.9            0.2            Burlington limestone to left of road.
- 67.9            2.0            Cotter-Jefferson City contact.
- 70.0            2.1            Quarry in Cotter "cotton rock" on left.
- 70.5            0.5            Quarry in Chouteau group on right.

- 72.3 1.8 Burlington limestone forming Eureka Springs escarpment. This is the western margin of the Ozarks.
- 73.5 1.2 Junction with Mo. Highway 83, continue west on U.S. 54.
- 77.7 4.2 Junction with Mo. Highway 83, turn very sharp right (north) onto Highway 83.
- 78.3 0.6 Junction with Highway T, turn left on T.
- 84.8 5.5 Approximate boundary Weaubleau area. Small stream valley follows a fault with downthrown Sedalia to the right.
- 85.0 0.2 Compton limestone on upthrown side of fault. Formations on opposite sides of the fault dip toward the fault. In southwest Missouri, and particularly in this area, beds on opposite sides of faults dip mutually into or mutually away from fault zones to form faulted chevron folds.
- The Weaubleau area shows intense thrust faulting over an area approximately 7 miles long and 3 miles wide. Evidence for thrusting includes:
1. Duplication of the section with resulting fensters or windows.
  2. Thinning or complete elimination of formations where near-horizontal thrust surfaces intersect structural highs.
  3. Decollement and imbricate structures.
  4. Interthrusts of slices of Ordovician into Mississippian formations.
- 85.5 0.5 Enter Gerster.
- 86.5 1.0 Intersection Highway T and gravel road. Turn left on gravel road.
- 87.5 1.0 Turn right and cross railroad track.
- 87.7 0.2 STOP 5: Park cars on right shoulder, leaving room for a car to pass.  $S\frac{1}{2}$ ,  $NE\frac{1}{4}$ , Sec. 19, T. 37 N., R. 24 W. Go past house and walk southwest along spur. The rucked Burlington is on the basal Compton and the Jefferson City with intervening strata eliminated by near horizontal thrust faulting. Beds of Jefferson City are thrust into the Burlington. The Jefferson City beds superficially are similar to clastic dikes but are not clastic; they were emplaced as rigid, competent units.
- Return to cars; five cars at a time will drive to loop west of house, turn and reform caravan heading north.



ISOPACH MAP  
 OF  
 THE NORTHVIEW FORMATION  
 WEAUBLEAU CREEK AREA, MO.  
 SHOWING THINNING OF NORTHVIEW  
 BY DECOLLEMENT THRUSTING  
 ISOPACH INTERVAL—ONE FOOT  
 SCALE 2 MILES

- 89.1 1.4 Bear left on cut-off to Highway T.
- 89.2 0.1 Intersect Highway T, left on T.
- 92.0 2.8 STOP 6: NE $\frac{1}{4}$ , NW $\frac{1}{4}$ , Sec. 7, T. 37 N., R. 24 W.  
Gouging in thrust surface. West 0.2 mile a sill-like  
interthrust of Jefferson City in Burlington is exposed.
- 94.9 2.9 Cross railroad tracks, enter Vista.
- 95.1 0.2 Junction Highway T and Missouri Highway 13. Turn right  
on Highway 13.
- 96.1 1.0 Highway 13 turns right; leave Highway 13 by continuing  
straight ahead on Highway WW.
- 96.15 0.05 Turn left on Highway WW.
- 99.7 0.55 Pennsylvanian sandstones exposed on left.
- 100.8 1.1 STOP 7: E. side Sec. 16, T. 37 N., R. 25 W.  
Kinderhookian and Osagean conglomerate containing  
Jefferson City pebbles is exposed in road cuts.  
The conglomerate covers an area of approximately  
17 square miles and is the only known area in  
Missouri where the Mississippian contains such  
conglomerates. The area is also unusual in that  
the Mississippian is a dolomite in many places.  
The Burlington contains abundant spherical,  
"cannon-ball" cherts.
- 101.3 0.5 STOP 8: SE $\frac{1}{4}$ , Sec. 16, T. 37 N., R. 25 W. Park on  
shoulder, walk northwest (downstream) along creek.  
Normal Chouteau grades laterally into massive breccia  
with boulders of Jefferson City.
- 104.3 3.0 Continue south on WW 1 mile, east 2 miles to old  
Highway 13.

END OF TRIP.