

## Clastic Rocks Near the Chester-Meramec Contact in Putnam County, Indiana

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**General.**—It is difficult to place the contact between rocks of Meramecian and Chesterian age in Putnam County because a massive limestone sequence, exposed in the south half of the area, is only locally interrupted by significant changes in lithology. The boundary may be marked by sandstone or shale, but as a rule this stratigraphic interval is either covered or poorly developed. The sandstone, if present, is generally calcareous and fine-grained. Inspection with a lense reveals the sand. The sandy limestones and calcareous sandstones that commonly make up the cross laminated Rosiclare member of the Ste. Genevieve formation are confusing because they may be within a few feet of the Paoli limestone. Aux Vases shale and sandstone, mostly of green-gray color, are rarely recognized and of limited use as a marker at the Ste. Genevieve-Paoli break.

### Criteria for Recognizing the Chester-Meramec Contact

**Stratigraphic sequence.**—Massive limestones of the Ste. Genevieve-Lower Chester interval are so uniform lithologically that an examination at the outcrop should be made to attempt to locate markers above and below. The upper St. Louis limestone is mostly thin-bedded, cherty, and rich in bryozoans. *Lithostrotion proliferum* is sparsely scattered throughout. *Lithostrotionella canadense* is in a zone of massive limestone a few feet above the thin cherty beds. If the section goes low enough the gray-blue St. Louis cherty beds provide a known horizon.

The massive gray Ste. Genevieve limestone beds above the St. Louis limestone are 50 feet to 60 feet thick. Paoli limestone ranges from 0 to 12 feet thick, and may rest directly upon massive Ste. Genevieve limestone. Thus to find the Chester-Meramec contact, the Mooretown shale and Beaver Bend limestone above should be located, if present, and used as a guide.

Two typical sections that include the contact are given.

3 miles southwest of Greencastle, in the  
SW  $\frac{1}{4}$  NW  $\frac{1}{4}$  sec. 36, T. 14 N., R. 5 W.

#### MISSISSIPPIAN

Paoli limestone	Feet
7. Limestone, light-gray, oolitic in part, conglomerate in center; small brachiopods.....	10
<b>Aux Vases? formation</b>	
6. Sandstone, buff, medium-grained, white and calcareous upward .....	4
5. Covered, shale in part.....	6
4. Sandstone, light buff to white, calcareous.....	1
3. Shale, sandy, greenish.....	0.5

**Ste. Genevieve limestone**

- |   |      |
|---|------|
| 2. Limestone, fine-grained, gray, brecciated and mottled above (Bryantsville) ..... | 2.5  |
| 1. Limestone, massive, gray .....   | 17.5 |
- Covered

Lone Star Cement Quarry, 2 miles south of Greencastle,  
SE  $\frac{1}{4}$  SW  $\frac{1}{4}$  sec. 28, T. 14 N., R. 4 W., Putnam County.

- |   |      |
|---|------|
| PLEISTOCENE                                     | Feet |
| 18. Glacial drift, buff above, gray below ..... | 10   |

## PENNSYLVANIAN

**Mansfield formation**

- |                            |   |
|----------------------------|---|
| 17. Shale, dark gray ..... | 1 |
|----------------------------|---|

## MISSISSIPPIAN

**Paoli? limestone**

- |  |    |
|--|----|
| 16. Limestone, oolitic, white, iron stained on top .....   | 4  |
| 15. Limestone, gray, fine crystalline .....  | 3  |
| 14. Limestone, gray, crystalline, carbon spots below .....   | 5  |
| 13. Shale, siltstone, fine sandstone, gray, with limestone lenses; small brachiopods; charcoal-like inclusions ..... | 10 |

**Aux Vases? formation**

- |   |     |
|---|-----|
| 12. Shale, black, finely laminated .....            | 3.5 |
| 11. Shale, medium gray, blocky, pyrite common ..... | 1.5 |

**St. Genevieve limestone**

- |  |    |
|--|----|
| 10. Limestone, nodular, brecciated, mottled, weathered greenish clay (Bryantsville) .....          | 1  |
| 9. Limestone, gray, dense, crystalline .....   | 4  |
| 8. Limestone, shaly, gray-green, fossiliferous .....   | 4  |
| 7. Limestone, gray, dense, thin bedded .....   | 2  |
| 6. Limestone, dark gray, fine grained, brecciated near the top .....                               | 4  |
| 5. Limestone, gray, crystalline, massive .....   | 6  |
| 4. Limestone, gray, massive, cross-bedded, oolitic, rounded grains of chert sand (Rosiclare) ..... | 12 |
| 3. Limestone, gray, massive, crystalline .....   | 18 |

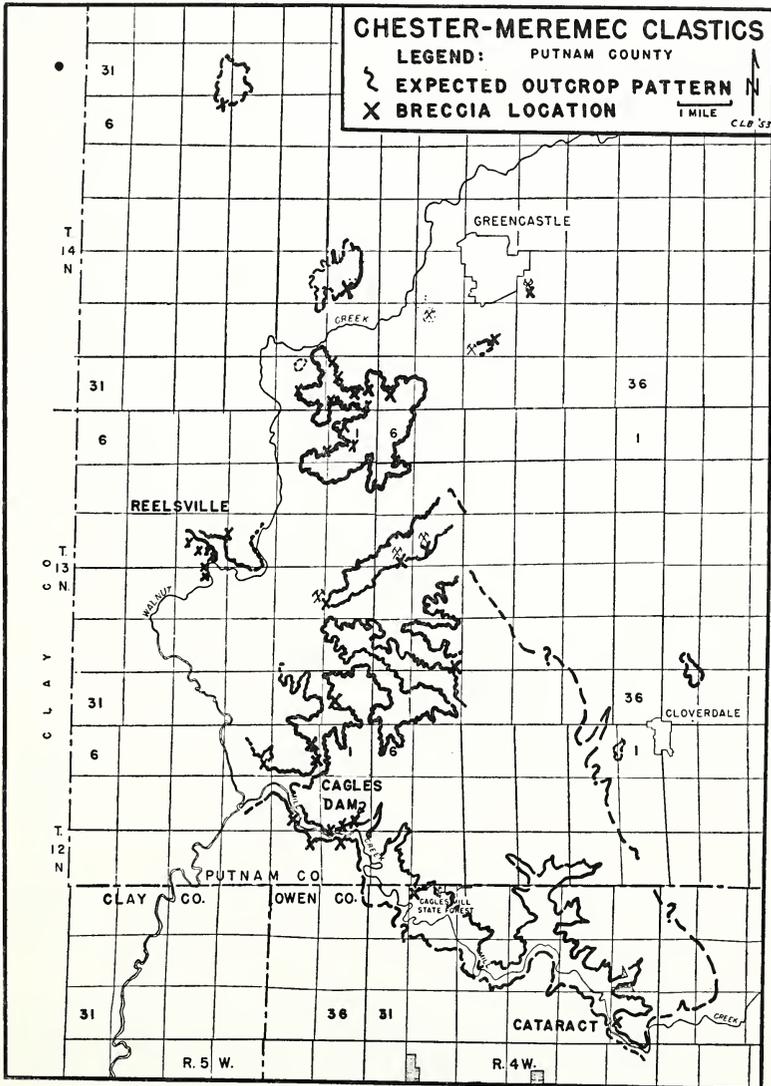
**St. Louis limestone**

- |   |   |
|---|---|
| 2. Limestone, gray with shaly parting above, <i>Syringopora</i> and <i>Lithostrotionella canadense</i> scattered with the bedding ..... | 3 |
| 1. Limestone, thin bedded, cherty, bryozoa and speriferoid brachiopods common .....   | 6 |
- Quarry floor

**Breccias and conglomerates.**—The most persistent zone of limestone breccia is at the top of the Ste. Genevieve formation. This breccia correlates with that exposed in the vicinity of Bryantsville in Lawrence County. The horizon has been traced from the Ohio River northward into west central Indiana (3). In Putnam County the angular limestone fragments of the breccia vary in color from medium dark-gray to nearly black, and are commonly sublithographic. The most characteristic Bryantsville breccia

cia is found in or associated with fine-grained limestone. The zone often overlies massive crystalline beds. The bedding in the brecciated zone is mostly irregular and undulating, and may wander vertically in seams for as much as 3 to 5 feet. Finely laminated limestone is sparingly present. The rock of the breccia is commonly all limestone though sandy limestone occurs.

Oolites are rare to plentiful. Locally greenish calcareous sandstone is included in the matrix. Weathering of the horizon produces a nodular rubbly limestone with sparse amounts of greenish clay. Examples of this



type of Bryantsville is at Upper Cataract Falls in Owen County (1), and along Maiden's Branch 1 mile north of Reelsville in the NW $\frac{1}{4}$ SE $\frac{1}{4}$  sec. 16, T. 13 N., R. 5 W.

Other brecciated and conglomeratic zones lense in and out locally through the Ste. Genevieve and less commonly in the Paoli. Conglomerate made up of whitish flat limestone pebbles ranging in diameter from one-half inch to about one inch is rather common in the cross-laminated beds of the Rosiclare member of the Ste. Genevieve limestone. This conglomerate and breccia may be 10 or more feet below the Bryantsville breccia. Even more complex are the conglomerates and breccias in the exposures at the west end of the tunnel at Cagles Mill Dam in the NW $\frac{1}{4}$  sec. 13, T. 12 N., R. 5 W.

**Sandstones.**—The most persistent sandstone in the St. Genevieve-Paoli sequence is the Rosiclare (middle) member of the Ste. Genevieve formation. The rock of this massive member ranges from an oolitic or non-oolitic limestone to a calcareous sandstone. The sand grains vary from fine to coarse and are composed of clear frosted quartz and chert. Tiny sand grains form some of the nuclei of oolites. Sand grains are commonly scattered, but tend to concentrate where cross bedding is prominent. The Rosiclare member usually exhibits cross bedding.

Above the Rosiclare member, and associated with the Bryantsville breccia are locally lensing calcareous sand beds. The layers are at the approximate Aux Vases (lowest Chester) interval. Thickness of these local sand lenses range up to about 5 feet. Color is from greenish-gray to white. The local sand layers are either above or below the Bryantsville breccia. The sandstone of the lowest Chester horizons is composed of fine subangular quartz grains.

A typical sample sieve analysis of the Aux Vases? sandstone located 3 $\frac{1}{2}$  miles southwest of Greencastle in the SW $\frac{1}{4}$ NW $\frac{1}{4}$  sec. 36, T. 14 N., R. 5 W. is given.

Mesh size	% of total sand
50	18.0
60	4.8
70	4.9
80	11.6
120	28.0
200	17.6
pan	12.8
	98.6

A heavy mineral study (4) shows that minerals above 2.9 in specific gravity make up slightly less than 1 percent of the sandstone by weight. Heavy minerals most frequently present are leucoxene and zircon. Those less common are tourmaline, rutile, ilmenite, and brookite.

**Shale.**—Notable shale is not present immediately below the Chester-Meramec contact, though the upper Ste. Genevieve limestone has local shaly facies. Dark gray to greenish shale (Aux Vases?) with associated

calcareous sandstone is locally present above the Bryantsville breccia. The dark shale, when present, is easily confused with the Mooretown shale above the Paoli limestone, especially since the Paoli-Ste. Genevieve forms an almost continuous limestone sequence. One of the best exposures of the shales near the contact is in the wall of the Lone Star Cement Quarry 2 miles south of Greencastle (see section). The prominent upper shale is here interpreted as the equivalent of Aux Vases (lowest Chester). An earlier study is not in agreement (2).

**Use of fossils.**—Fossils are not plentiful in the massive limestones. They are mainly brachiopods of productid and spirifer type, spines of echinoids, and fragments of blastoids and crinoids. Of these, the stem fragments of *Platycrinus penicillus* have been used as a marker for the Ste. Genevieve formation. There is some doubt as to the stratigraphic reliability of the fossil, however. These oval sprocket-like stem fragments are not common nor easily discovered on exposures in Putnam County. Columnals with petal-shaped centers are of some worth as guides for upper Ste. Genevieve and lower Chester limestones.

**Other means of locating the contact.**—Insoluble residue studies help in locating the siliceous horizons which are near the Chester-Meramec contact. Cross bedding and ripple marks are most common in the Rosiclare member of the Ste. Genevieve limestone. The cross bedded zones of the Rosiclare interval commonly carry sand grains. Paoli limestone cross beds are present to rare, and bear sand sparingly.

The mapping of sink holes has been found helpful in locating the general horizon of the clastic rocks. There are few sinkholes in the Salem of Putnam County, relatively few in the St. Louis, but they are common and large in the area of outcrop of the Ste. Genevieve-Paoli limestones. The line of contact of the present study is associated with the western margin of the main sink hole pattern.

**Summary.**—Calcareous sandstones, shales, breccias, and conglomerates of Chester-Meramec time were probably formed by currents and storm waves carrying sand and mud into comparatively shallow seas where limestone was forming. Off-lap and on-lap may account for apparent reversals in sequence, and for lensing of sands and breccias. Some of the clastic rocks may have been destroyed by pre and post Chester erosion but evidence of widespread unconformity between Meramecian and Chesterian rocks in Putnam County is vague. Future drilling should aid in the correlation of dark shales near the contact.

#### Literature Cited

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