Stratigraphic Relations of the Merom Sandstone Near Merom, Indiana[1]

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The purpose of this paper is to present and discuss data bearing on the stratigraphic position of the Merom Sandstone in its type region. The exact stratigraphic position of this sandstone of late Pennsylvanian age has been in doubt for some time. Most of the confusion has been brought about by the fact that its relationship to well-known strata below it has never been clearly determined at its type locality. Because of its prominent exposure in the Wabash River bluff at Merom, Sullivan County, Ind. (fig. 1), and its bluff-forming characteristics elsewhere, it received a name long before most rock units above and below it. It was first described by John Collett in 1871 (2). He stated that "the stone work of the college edifice (at Merom) was quarried from massive ledges of the 'Merom sandstone' north of town . . ." He also referred to this sandstone as the "Anvil Rock," but the Anvil Rock Sandstone in Kentucky is much older than the Merom of Indiana. Later workers continued to use the term Merom for the Indiana sandstone.

The bluff facing the Wabash River at Merom rises from an altitude of 430 feet on the bank of the river to 585 feet on top of the hill at the Merom Institute. At most places along the 2-mile length of the bluff the difference in relief is more than 100 feet. Although many excellent outcrops do occur along this bluff, more than 30 feet of exposed rock is uncommon. Commonly the lower half of the bluff is covered by talus material, and Wisconsin outwash sands and gravels fill the valley.

The upland area is covered with a mantle of loess of Wisconsin age and a small amount of windblown sand. Beneath the loess and overlying the bedrock is a blanket of till of Illinoian age. Although the Merom Sandstone is the topmost bedrock unit, it is not exposed on the upland because of the till and loess cover.

The sandstone ranges from 10 to 35 feet in thickness at most exposures and is not known to exceed a thickness of 40 feet at any locality. The Merom Sandstone consists of two distinct lithologies: (1) an upper crossbedded medium- to coarse-grained sandstone and (2) a lower conglomerate. The upper unit weathers into tan to brown massive nearly vertical faces that have a fretted appearance and uneven parallel streaks. Where fresh and unweathered the sandstone is light gray. At some localities, especially in the upper few feet, the sandstone has thin regular bedding, but, in general, crossbedding is the rule. In a petrographic study of 16 samples from 3 localities on the bluff at Merom, Larson (4) determined that the nonconglomeratic part of the Merom Sandstone consists of 85 to 90 percent quartz, 5 to 10 percent feldspar (mostly microcline and orthoclase), less than 1 percent mica (mostly muscovite), and less than 5 percent heavy minerals (mostly limonite and hematite). The sand

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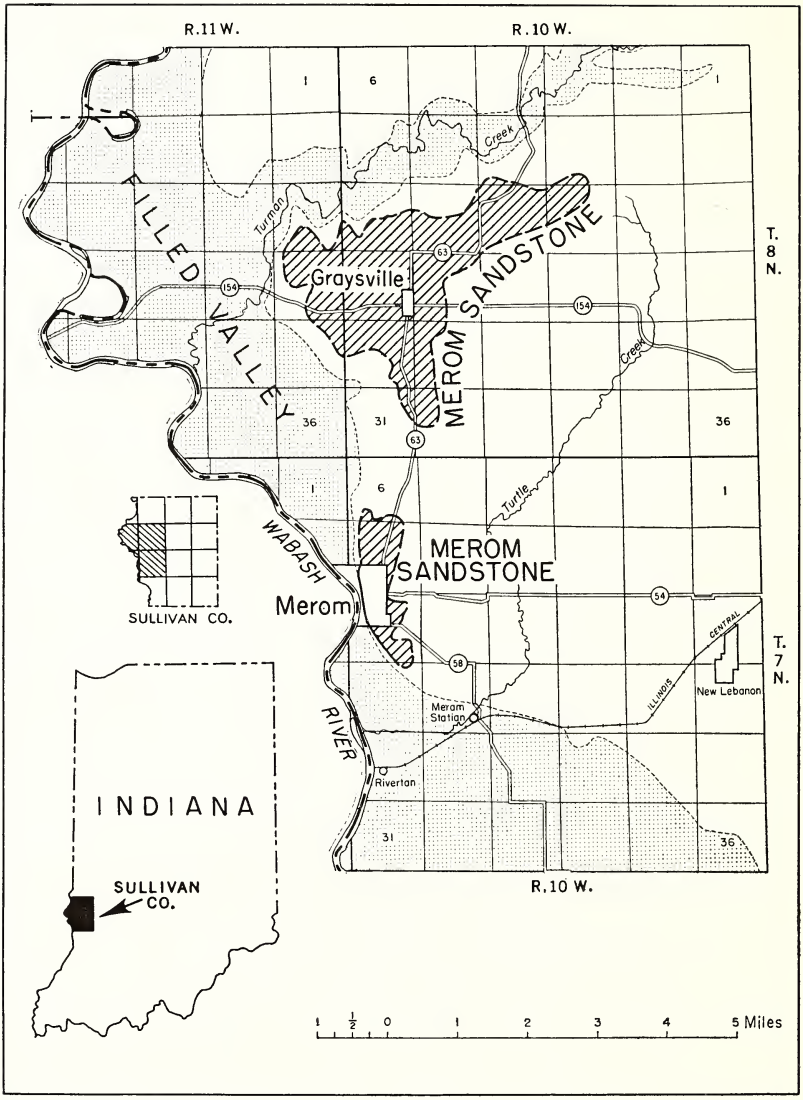

Figure 1. Map of west-central Sullivan County showing area underlain by the Merom Sandstone. Modified from Wier (5).

grains are well sorted (sorting coefficient 1.44), subrounded (roundness of 0.3), and medium-grained (mean size of 0.31 mm).

The basal conglomerate is gray to brown and is composed of a mixture of rounded to subrounded pebbles of limestone, chert, sandstone, coal, and clay. The pebbles are cemented by calcium carbonate. Fossils are common. They consist chiefly of brachiopods and crinoid columnals of various sizes.

This conglomerate ranges from 2 to 10 feet in thickness and at nearly all exposures along the bluff rests directly on the Livingston Limestone (fig. 2).

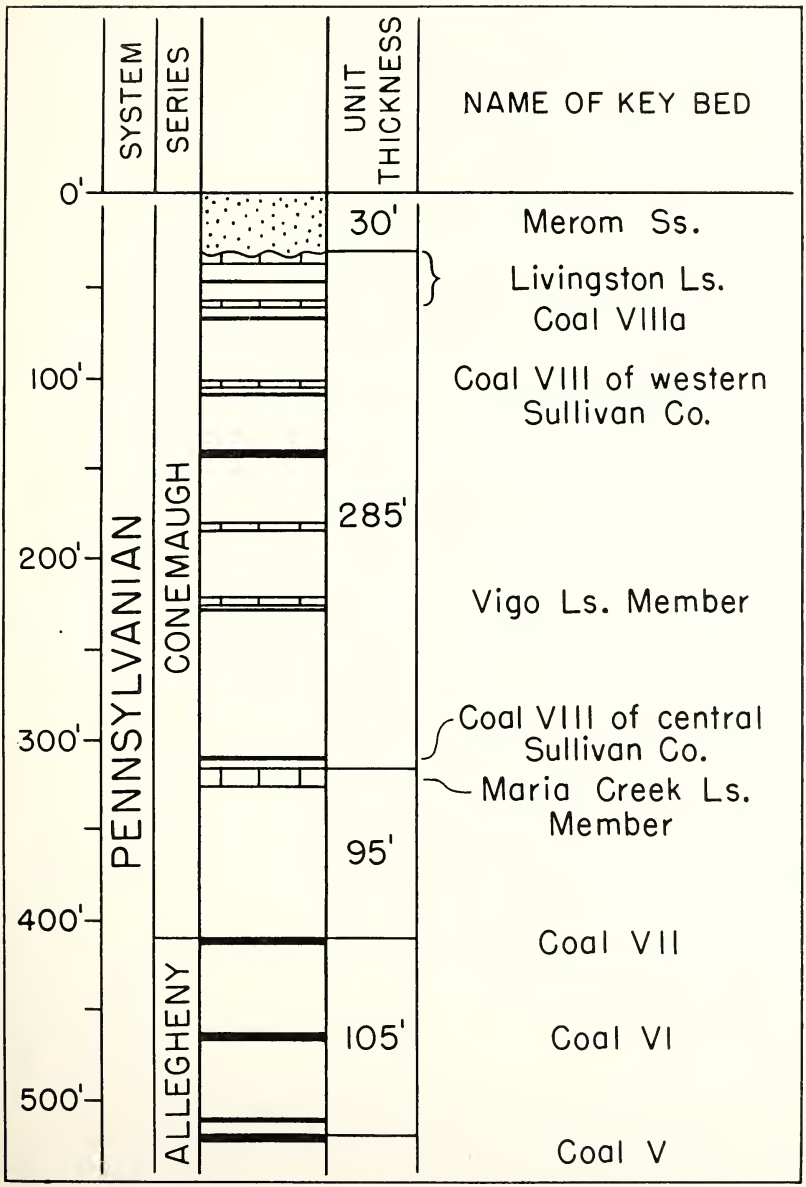

Figure 2. Skeletal columnar section showing relationship of Merom Sandstone to underlying coals and limestones.

The following stratigraphic section is representative of exposures along the bluff and is located a quarter of a mile south of the Merom Ferry in the NW¼NW¼ sec. 18, T. 7 N., R. 10 W.

	Thickness (feet)
MEROM SANDSTONE	
Sandstone: gray to tan, crossbedded, medium- to coarse-grained, subangular	17.0
Sandstone: tan, medium- to coarse-grained subangular; contains clay galls and ironstone nodules in upper 3 feet	8.5
Sandstone: light-gray, fine- to medium-grained; contains calcareous cement	2.5
Conglomerate: gray to brown; contains fragments of limestone, chert, coal, and sandstone in a calcareous cement	5.2
Total exposed thickness of Merom Sandstone..	33.2
LIVINGSTON LIMESTONE	
Limestone: dark-gray; contains abundant crinoid fragments and the large brachiopods *Linoproductus prattenianus* and *Echinoconchus semipunctatus*	4.0
Total thickness of measured section	37.2

The following composite section shows the rocks beneath the Merom Sandstone. It was compiled from 15 outcrops along the bluff and from a record of a drilling located between the bluff and the river in the NW¼NW¼ sec. 18, T. 7 N., R. 10 W., and it was modified and condensed from Wier (6).

	Lithologic Unit	Unit thickness (feet)	Depth (feet)
1.	Sandstone (*Merom Sandstone*)	32	32
2.	Limestone (upper *Livingston Limestone*)	4	36
3.	Shale: medium-gray	2	38
4.	Coal: bright, banded	2	40
5.	Shale: light-gray to black	18	58
6.	Limestone: blue-gray, nodular, argillaceous; contains abundant crinoid columnals (lower *Livingston Limestone*)	2	60
7.	Clay and shale	10	70
8.	Coal	1	71
9.	Underclay	4	75
10.	Shale, siltstone, and sandstone: locally contains a few inches of limestone or a gastropod-rich shale at the base. (Position of massive sandstone in Chimney Hills, sec. 31, T. 2 N., R. 10 W.)	43	118
11.	Coal	1	119
12.	Underclay	2	121

13.	Shale: light- to dark-gray; contains siderite bands near the base that locally contain brachiopods. (Position of massive sandstone in Wolf Hill, sec. 11, T. 4 N., R. 10 W., and at Old Fort Knox, surveys 50 and 51, T. 3 N., R. 10 W.)	38	159
14.	Coal	4	163
15.	Underclay	5	168
16.	Sandstone and shale	30	198
17.	Limestone: light-gray; contains brachiopods and crinoid stems	1	199
18.	Underclay	1	200
19.	Sandstone and shale. (Position of massive sandstone in eastern Clark County, Ill.)	35	235
20.	Limestone: black, argillaceous; contains brachiopods *(Vigo Limestone Member)*	1	236
21.	Shale: black, fissile	2	238
22.	Coal: bright, banded	1	239
23.	Clay and shale: contains siderite and limestone streak at the base	11	250
24.	Shale and sandstone: locally contains a coal near the base (*Coal VIIIa* of Ashley). (Position of massive sandstone northwest of Bicknell, T. 4 N., Rs. 8 and 9 W.)	67	317
25.	Limestone: gray to light-brown, finely crystalline; contains brachiopods and crinoid columnals *(Maria Creek Limestone Member)*	4	321
26.	Shale: gray to black; locally green and red	7	328
27.	Shale, siltstone, and sandstone	21	349
28.	Coal: bright, banded	1	350
29.	Shale and sandstone: *(Busseron Sandstone Member)* (Position of massive sandstone in central Sullivan County.)	62	412
30.	Coal: bright, banded *(Coal VII)*	3	415
31.	Underclay	5	420
32.	Limestone: gray, sublithographic *(Universal Limestone Member)*	1	421
33.	Sandstone, siltstone, and shale	35	456
34.	Coal: bright, banded *(Coal VI)*	4	460
35.	Clay	1	461
36.	Limestone: dark-gray, argillaceous; contains brachiopods and crinoid columnals	2	463
37.	Shale: dark-gray to black	6	469
38.	Coal: shaly	1	470
39.	Clay	3	473
40.	Shale and siltstone	28	501
41.	Coal: bright, banded *(Coal Vb)*	3	504
42.	Shale and siltstone	10	514
43.	Limestone: dark-gray, argillaceous; contains brachiopods *(Alum Cave Limestone Member)*	1	515

44.	Shale: black, fissile	1	516
45.	Coal: bright, banded *(Coal V)*	3	519

The only outcrops of Merom Sandstone in Sullivan County are found within the Merom and Graysville outliers. Although the known bedrock altitudes indicate that the Merom Sandstone is absent to the northwest of the Graysville outlier, a few acres of this sandstone may be present on the north side of Turman Creek beneath thick glacial drift. Numerous exposures may be found on the upland to the northwest in Clark County, Illinois.

Because sandstones, both above and below the Merom, exhibit similar massive exposures, they have been mistaken for it. Good exposures of these sandstones and of adjacent rocks are rare along the Wabash River in southwestern Indiana and in Illinois because of the low relief, the wide and deeply filled valleys, and the mantle of till, loess, and windblown sand that covers the upland adjacent to the valley. In some places many miles of covered area intervene between exposures. Because many outcrops consist of sandstone, without the more diagnostic coals and limestones, it is difficult to place these sandstones in their proper stratigraphic position. Perhaps the false presumption that the Merom Sandstone is the only well-developed sandstone near the top of the Indiana stratigraphic column has resulted in the higher sandstones being referred to the Merom horizon. Another erroneous assumption is that the Merom Sandstone is as much as 150 feet thick instead of actually 30 feet, simply because the Merom Bluff is more than 150 feet high.

G. H. Ashley (1), in his excellent summary of all available coal information, caused some confusion by identifying both the coal that overlies the Maria Creek Limestone Member in central Sullivan County (fig. 2) and the coal that occurs 75 feet below the Merom Sandstone at Merom as Coal VIII. Ashley assumed that the Merom Sandstone averaged 194 feet above Coal VII instead of the actual 380 feet. Thus Ashley used the name Merom for all massive sandstones above the Maria Creek Limestone Member in areas to the south, especially for those sandstones in Knox County. Numerous sandstone exposures in Wolf Hill, 8 miles north of Vincennes (sec. 11, T. 4 N., R. 10 W.), and in the area where U. S. Highway 41 crosses Maria Creek (sec. 24, T. 4 N., R. 10 W.) were called the Merom by Collett in 1874 (3) and by Ashley in 1899 (1), but the sandstone is actually older than the Merom. The sandstone that crops out in the bank of the Wabash River at old Ft. Knox (survey 51, T. 3 N., R. 10 W.) is also older than the Merom. Thus Merom Sandstone is not present in Indiana in the 25-mile area south of Merom. The Merom Sandstone may be present, but hidden by till and loess, near the top of Ft. Knox Hill. This would be the first occurrence of the Merom Sandstone in Indiana south of the type locality. Across the river from Ft. Knox, in Illinois, the Merom is present near the top of Robeson Hill.

If one has to depend solely on isolated outcrops of sandstone in order to correlate them, the correlations are uncertain. Enough lithologic variation occurs to allow two sandstones of different age to look alike and two sandstones of the same age to look different. Although the Merom Sandstone seems to be more persistent than most of the older sandstones,

in some localities it grades laterally into shale within a few miles. The best method of correlating the sandstones is to use key beds, such as coals and limestones, that are stratigraphically adjacent. Because younger rocks are not found north of Vincennes, we must utilize the older key beds that lie below the Merom Sandstone. The Merom Sandstone commonly rests unconformably on or within a few feet of one of the benches of the Livingston Limestone (fig. 2). Two large and distinctive brachiopods, *Linoproductus prattenianus* and *Echinoconchus semipunctatus*, are abundant in the Livingston; and, because they are not abundant in any other limestone in Indiana, they serve to identify the Livingston.

Unfortunately, outcrops of the Livingston Limestone cannot be found beneath many of the sandstone exposures. Thus the exact stratigraphic position of the sandstone can be determined only by using drilling information. The Maria Creek Limestone Member, which is 285 feet below the base of the Merom Sandstone (fig. 2), is the first good key bed below the Merom that can be picked readily in drillers' and electric logs. Where this limestone is poorly developed or its identification is uncertain, the intervals between the tops of Coals VII and V, which are respectively 380 feet and 485 feet below the Merom, can be used. These intervals apply only to Sullivan County and northern Knox County; the intervals increase greatly south of Vincennes, but Coals VII and V can still be used as marker beds.

Because of the vertical repetition of similar lithologies and the lateral variation of each lithology, correlation of rock units in Pennsylvanian rocks is difficult; but by paying careful attention to altitudes and intervals between units, the geologist can do a satisfactory job with the most difficult correlation problems.

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