THE STRATIGRAPHY OF THE MIDDLE DEVONIAN OF THE TENNESSEE BASIN

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The presence of strata of Middle Devonian age in the valley of the Harpeth River in Davidson and Cheatham counties, Tennessee, has been recognized at least since 1901, when Foerste[1] briefly described the occurrence of from 3 to 12 feet of Middle Devonian limestone in three localities between Newson and the bridge a mile and a half west of Pegram, Tennessee. These strata he designated as the Pegram formation because of their occurrence in the vicinity of the town of that name. On the basis of fossils found he correlated the upper part with the Sellersburg of Indiana, and indicated the possible Corniferous equivalence of the lower part. In a later paper,[2] Foerste described three feet of limestone near Bakerville, Tennessee, which he considered the equivalent of the Pegram formation. Without regard to the Sellersburg species previously found near Pegram station, he correlated the Pegram limestone with the older Jeffersonville (Onondaga) limestone of Indiana on the basis of the abundant coral fauna found near Bakerville. Pate and Bassler,[3] Drake,[4] Miser,[5] Dunbar,[6] and Jillson,[7] have mentioned the Pegram but the attention given this formation has always been secondary. In all only six widely scattered occurrences have been noted.

The purpose of this paper is to present the results of a study of the areal distribution, lithologic character, fauna, and correlation of the Middle Devonian in Cheatham and Davidson counties, Tennessee. The writer gratefully acknowledges his indebtedness to Dr. Pohl for indispensable suggestions in all phases of the problem as well as for the identification of some half dozen species.

[1] Foerste, A., Silurian and Devonian Limestones of Tennessee and Kentucky. G. S. A., XII, pp. 425-426, 1901.
[2] Jour. Geol. XI, pp. 687-688, 1903.
[3] Proc. U. S. National Museum, Vol. 34, p. 430, 1908.
[4] Resources of Tenn., Vol. IV, p. 105, July, 1914.
[5] Mineral Resources of the Waynesboro Quadrangle. Tenn. Geol. Survey, Bull. 26, pp. 23-31, 1921.
[6] Stratigraphy and Correlation of the Devonian of Western Tennessee. Tenn. Geol. Survey, Bull. 21, pp. 90-91, 1919.
[7] Unique Devonic Sand-bar. Pan-Amer. Geol., Vol. 40, pp. 333-340, 1923.

Distribution

Four of the six previously described occurrences of Middle Devonian in Tennessee are in the valley of the Harpeth River west of Nashville. The next occurrence is 50 miles to the west at the "whirl" on Buffalo River, 4 miles north of Bakerville. Another occurrence is known about 50 miles to the south of Bakerville near Forty-eight post-office in Wayne County.

During the winter of 1929-30, Dr. E. R. Pohl found in Trousdale and Sumner counties some outcrops of a sandstone and a limestone, both of which he identified as equivalent to the Jeffersonville formation at the Falls of the Ohio.[8] Thus the presence of Mid-Devonian rocks in Tennessee is known from scattered exposures on the north and west flanks of the Nashville Dome.

The Harpeth River, like the other streams which drain the Central Basin, leaves it in a relatively narrow groove cut into the Highland Rim. The valleys of its tributaries are youthful. The field study made by the writer has shown that the Middle Devonian occurs in extensive exposure in the valleys of the Harpeth River and its tributaries in Davidson and Cheatham counties. The eastermost occurrence (locality 15) lies in an air-line a mile and a quarter northeast of Newsom. The westermost exposure is found at the Narrows of the Harpeth River, three miles north of Kingston Springs.

The distribution of the two stratigraphic units composing the Pegram formation is worthy of note, for the Pegram formation at its type locality consists of two parts, clearly differentiated by their faunal character. As a result of this study the upper beds are correlated with the Sellersburg of Indiana, the lower beds with the Jeffersonville of the same state. It is proposed to drop the name Pegram limestone and to extend the use of Jeffersonville and Sellersburg to include their respective time equivalents in Tennessee.[9]

That the Jeffersonville and Sellersburg formations are not coextensive in the valley of the Harpeth River is perhaps significant. The Jeffersonville formation is found at all exposures of the Middle Devonian, but the Sellersburg has not been identified east of Pegram station. It occurs, however, at localities 1, 2, and 3. (See sketch map.)

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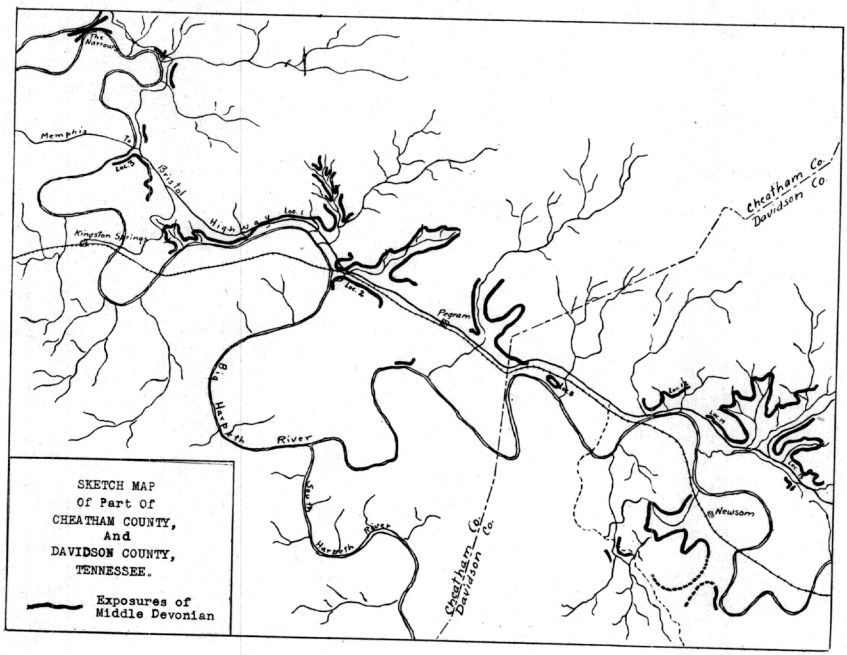
[8] This work is as yet unpublished, but Dr. Pohl has kindly furnished the writer with a list of the fossils identified, and has given permission for this mention of his work.

[9] Pohl, E. R., Devonic Record in Central Tennessee. (Abst.) G. S. A. Meeting, 1929. (Abst.) Pan-American Geol. Vol. 53, p. 150, 1930.

Character

In the Central Basin, the Sellersburg formation consists largely of gray, massive, crystalline limestone, the upper part of which is often distinctly arenaceous and contains little masses of pyrite. In at least one exposure, (locality 1) the top member is a thin, gray, fossiliferous shale bed, containing nodules of marcasite.

The Jeffersonville formation has as its top member in several localities, a light brown, loosely cemented, saccharoidal sandstone. This sandstone is an inconstant member, and is quite variable in thickness,



although in general, it is thickest toward the east near the old Middle Devonian shore line.[9]

In central Tennessee, the Jeffersonville limestone member is white to pink, massive, crystalline, and crinoidal, with small lenses of saccharoidal sandstone, one to four inches thick at various intervals. The lower portion of the limestone is generally pinkish in color, and is frequently more coarsely crystalline than the upper part. The limestone is relatively pure. A chemical analysis made by the writer showed a 96.9% calcium carbonate content.

The thickness of the Middle Devonian in the Harpeth River valley cannot be dismissed with the statement that it thickens to the west, as Foerste suggested in 1901. The thickest measured section of the Jeffersonville occurs near the eastern limit of exposure in Davidson County (locality 15). Here the section consists of fourteen feet of limestone and five feet of sandstone. At Newsom, a mile and a quarter to the southwest, only 32 inches of limestone are present at the eastermost exposure. However, from Newsom, there seems to be a general increase in thickness toward the west. The section at the Narrows of the Harpeth River, the westermost exposure of the Mid-Devonian in Cheatham County, is probably the thickest of all, though definite measurements have not been made.

The few known exposures of the Sellersburg show a thinning to the east. However, the formation is always thin, the thickest section being three feet, four inches.

The character and relationship of the Middle Devonian is best illustrated by two selected sections, the first of which was made at locality 1 (see sketch map). Locality 1 is at the bluff on the north side of Tennessee State Highway No. 1, two and one-fifth miles west of Pegram, Cheatham County, Tennessee. Within the last year or two, in rebuilding the road, a portion of the bluff has been newly exposed through blasting. To the east, a gentle anticline and slope of the road, combine to raise the Devonian formation from road level to twenty feet or more above the road. The section exposed is as follows:

GEOLOGIC SECTION AT LOCALITY 1

Waverlian
- *Kinderhook group*
  - *Ridgetop formation*
    - Gray shale with bands of chert..... 35 ft.
- *Chattanooga group*
  - *Chattanooga formation*
    - Black bituminous shale..... 20 ft.
    - Hardin sandstone member ..... 1 ft.

Devonian
- *Traverse group*
  - *Sellersburg formation*
    - Gray, shaly member containing nodules of pyrite. Fossiliferous with various species of *Zaphrentis, Heterophrentis, Heliophyllum, Cystiphyllum, Cyathophyllum, Favosites;* also, *Aulacophyllum conigerum, Ancyrocrinus bulbosus* var., *Rhipidomella penelope, Platyceras dumosum,* etc. ..... 8 in.
    - Massive, gray, crystalline, arenaceous limestone with *Ancyrocrinus bulbosus* var., *Athyris fultonensis, Proetus sp.,* etc. ..... 2 ft. 8 in.

Onondaga group
Jeffersonville formation
Pinkish or brownish, coarsely crystalline, crinoidal limestone with *Atrypa reticularis*, etc..... 3 ft. 7 in.
Massive, white to gray, crystalline limestone with *Atrypa reticularis, Favosites turbinatus, Buskopora lunata*, etc..... 4 ft. 9 in.

Silurian
Niagaran group
Lobelville formation (exposed in dome along road)
Shaly member ..... 1 ft.
Massive blue limestone..... 7 ft. 6 in.
Thin bedded shaly limestone, brownish on weathered surface. Very fossiliferous, corals especially abundant, discoid *Favosites*, other *Favosites, Blothrophyllum, decorticatum, Heliolites interstinctus*, various cup corals, brachiopods, etc. ..... 4 ft.

Behind a negro cabin on the north side of the Memphis to Bristol highway, a half mile east of the intersection with the Newsom road, one of the best sections of the Jeffersonville is exposed. The Chattanooga shale forms a sloping, covered shelf above. Only a few feet of the formations below the Devonian are exposed. To the east, the Jeffersonville thins out and disappears.

GEOLOGIC SECTION AT LOCALITY 15

Waverlian
Chattanooga group
Chattanooga formation
Black, bituminous shale..... 12 ft.
Hardin sandstone member..... 1 ft. 2 in.

Devonian
Onondaga group
Jeffersonville formation
Sandstone member: Brown to reddish saccharoidal sandstone ..... 5 ft. 3 in.
Limestone member: White to pink, crystalline, crinoidal limestone, with little lenses of saccharoidal sandstone, 1 to 4 inches thick in the upper part. Very fossiliferous especially at the top, with *Hadrophyllum orbignyi*, a number of bryozoa, including *Cystodictya gilberti, Polypora levinodata, P. shumardi;* a number of brachiopods especially *Pholidostrophia iowaensis, Stropheodonta demissa, Chonetes muchronatus, Camarotoechia tethys, Centronella glansfagea* and *Spirifer varicosus;* also *Platyceras dumosum, Proetus clarus, P. crassimarginatus, Dalmanites anchiops, Kirkbya* cf. *subquadrata*, etc. Five feet below the sandstone member were found a number of *Leptaena rhomboidalis*. Fossils were found in all parts of the limestone examined ..... 14 ft. 3 in.

Silurian
Niagara group
Lego formation
Massive, brownish gray, crystalline limestone..... 20 ft.
Laurel formation
Massive, blue-gray limestone, to stream level.

	Name.	Jeffersonville of Tennessee.	Sellersburg of Tennessee.	Jeffersonville Falls of Ohio.	Sellersburg Falls of Ohio.	Columbus of Ohio.	Grand Tower of Illinois.
1.	Hadrophyllum orbignyi E. & H	x		x		x	
2.	Zaphrentis cornalba Davis		x		x		
3.	Z. sp	x	x				
4.	Z. sp		x			x	
5.	Heterophrentis cp. prolifica (Billings)		x	x	x		
6.	Aulacophyllum conigerum Davis		x		x		
7.	Cyathophyllum pustulosum Davis		x	x			
8.	Heliophyllum cp. exiguum (Billings)		x	x		x	
9.	H. halli E. & H		x	x			
10.	H. infoveatum (Davis)		x				
11.	H. sp		x		x		x
12.	Cystiphyllum cf. americanum E. & H		x		x	x	
13.	C. cf. ohiense Nicholson		x	x	x		
14.	Favosites digitatus Rominger	x		x		x	x
15.	F. emmonsi Rominger		x		x		
16.	F. placenta Rominger	x					
17.	F. turbinatus Billings	x					
18.	F. sp		x		x		
19.	Alveolites goldfussi Billings		x	x	x		
20.	Aulopora cornuta Billings	x		x		x	x
21.	Nucleocrinus verneuili (Troost)		x		x		
22.	Ancyrocrinus bulbosus var. Hall	x		x			
23.	Fistulipora subcava (Hall)	x		x			
24.	Buskopora lunata (Rominger)	x		x			
25.	Fenestella depressa Hall	x		x			
26.	F. cf. singularitas Hall	x		x			
27.	F. cf. variopora Hall		x	x			
28.	Semicoscinium interruptum Hall	x					
29.	S. sp	x		x		x	
30.	Unitrypa tegulata (Hall)	x		x			
31.	Polypora levinodata Hall	x					
32.	P. rigida (Hall)	x		x			
33.	P. cf. shumardi Prout	x					
34.	P. sp	x		x			
35.	Ptiloporella bifurca Ulrich	x					
36.	Ptiloperina sp	x					
37.	Reteporina cf. rhombifera (Hall)	x		x		x	x
38.	Cyst of Diciya gilberti (Meek)	x		x			
39.	C. rigida (Hall)	x					
40.	Lichenalia cp. torta Hall	x					
41.	Crania sp		x		x		
42.	Rhipidomella goodwini (Nettleroth)	x	x				
43.	R. penelope (Hall)	x	x	x	x	x	x
44.	R. Vanuxemi (Hall)	x		x		x	x
45.	Leptaena rhomboidalis (Wilckens)		x		x	x	x
46.	Stropheodonta concava Hall	x		x	x	x	x
47.	Stropheodonta demissa (Conrad)	x		x		x	
48.	S. hemispherica Hall	x	x	x	x	x	x
49.	Leptostrophia perplana (Conrad)	x		x	x	x	x
50.	Pholidostrophia iowaensis (Owen)		x		x		
51.	Tropidoleptus carinatus Conrad	x	x	x	x		x
52.	Schuchertella arctistriata Hall	x					x
53.	S. cf. perversa (Hall)	x		x		x	x
54.	Chonetes mucronatus (Hall)		x		x	x	x
55.	C. yandellanus Hall	x		x		x	x
56.	Pentamerella arata (Conrad)	x		x		x	x
57.	Camarotoechia carolina (Hall)		x		x		x
58.	C. sappho (Hall)	x		x		x	x
59.	C. tethys (Billings)	x			x	x	x
60.	Centronella glansfagea (Hall)	x		x	x	x	
61.	Eunella lincklaeni (Hall)	x		x	x	x	x
62.	Atrypa reticularis (Linnaeus)	x		x			
63.	Spirifer arctisegmenta Hall	x		x		x	
64.	S. fornaculus Hall	x		x		x	x
65.	S. gregarius (Clapp)	x		x		x	x
66.	S. grieri Hall		x				
67.	S. cp. mucronatus (Conrad)	x			x		
68.	S. oweni Hall	x	x	x	x	x	x
69.	S. varicosus Hall	x	x	x	x	x	x
70.	Cyrtina near hamiltonensis (Hall)	x		x		x	
71.	C. cf. crassa Hall		x	x	x		x
72.	Athyris fultonensis (Swallow)		x				
73.	Actinopteria decussata Conrad	x					
74.	Leiopteria sp	x	x	x	x	x	x
75.	Platyceras dumosum Conrad	x		x			x
76.	Proetus clarus Hall	x		x		x	x
77.	P. crassimarginatus Hall		x				
78.	P. sp	x		x			
79.	Dalmanites anchiops (Green)	x		x			
80.	Kirkbya cf. subquadrata Ulrich						

Fauna

The Middle Devonian of central Tennessee contains an abundant fauna, and it is believed that the following list of eighty identified species represents only a fraction of what the beds will yield upon careful study.

The faunal table below gives the species of the Jeffersonville and Sellersburg formations in Tennessee. The species that are common to this locality and certain Middle Devonian formations of other states are shown. The species indicated as occurring at the Falls of the Ohio are taken from the list by Butts.[10] The Columbus forms are from Stauffer's list.[11]. Savage has given a list for the Grand Tower of Illinois.[12]

Correlation

As has been intimated, all who have noted the so-called Pegram formation have not agreed upon the exact place it should occupy in the time scale. In order to make a proper correlation of this formation, collections were made at a number of localities and from all horizons. The faunal evidence seems conclusive for the correlation given.

Three exposures of the so-called Pegram beds show a faunal break within two to three and one-half feet of the top of the section. Only seven species of the eighty forms identified are common to the two horizons. Four of the seven species common to the two members show distinct differences as they occur in the two horizons. The four species are *Rhipidomella penelope, Schuchertella arctistriata, Cyrtina* near *hamiltonensis,* and *Platyceras dumosum.* Although the large faunal break is represented by an almost imperceptible physical break, the so-called Pegram limestone clearly comprises two formations. Twenty-nine species from the upper formation have been identified specifically and may be used for correlation purposes. Butts[13] lists 21 of these as occurring in the Sellersburg at the Falls of the Ohio. Of the remaining eight species *Actinopteria decussata* and *Spirifer* cp. *mucronatus* indicate beds younger than the Onondaga. The forms especially indicative of the Sellersburg are: *Zaphrentis cornalba* Davis, *Cyathyphyllum pustulosum* Davis, *Cystiphyllum* cf. *americanum* Edwards & Haime, *Cystiphyllum* cf. *ohiense* Nicholson, *Favosites placenta* Rominger, *Alveolites goldfussi*

[10] Geology of Jefferson County, Kentucky. Ky. Geol. Surv., Ser. IV, Vol. III, Pt. II, 1915. p. 105.

[11] Middle Devonian of Ohio. Geol. Survey of Ohio, 4th Ser., Bull. 10, pp. 160, 1909.

[12] The Grand Tower (Onondaga) Formation of Illinois and Its Relation to the Jeffersonville of Indiana. Ill. Academy of Science, Trans. Vol. 3, pp. 116, 1910.

[13] Op. cit. pp. 124-128.

Billings, *Ancyrocrinus bulbosus* var. Hall, *Rhipidomella goodwini* (Nettleroth), *Tropidoleptus carinatus* (Conrad), and *Camarotoechia sappho* (Hall).

The faunal evidence seems sufficient basis for correlation with the Sellersburg of Indiana and Kentucky. The Sellersburg formation has commonly been classified as equivalent to the Hamilton of New York. In 1929, Pohl[14] suggested that the Sellersburg is equivalent to the Traverse of Michigan.

The older formation comprising the Middle Devonian of Cheatham and Davidson Counties is considered the equivalent or at least the part equivalent of the Jeffersonville of Indiana and Kentucky. Forty-nine forms from this older formation have been identified. Butts has listed 39 of these as occurring in the Jeffersonville at the Falls of the Ohio. Several are characteristic Onondaga species, such as, *Hadrophyllum orbignyi* Edwards and Haime, *Favosites emmonsi* Rominger, *Nucleocrinus verneuili* (Troost), *Camarotoechia tethys* (Green), *Spirifer gregarius* (Clapp), *Spirifer grieri* Hall, and *Kirkbya subquadrata* Ulrich. All of the 17 species of bryozoa identified indicate equivalence to the Jeffersonville. Butts gives 87 species of bryozoa for the Jeffersonville at the Falls of the Ohio, and only two for the Sellersburg at the same locality. The close similarity of faunas indicates a correspondence of the older formation with the Jeffersonville of Indiana. Pohl has recently made this same correlation.

The older formation of the Middle Devonian of central Tennessee is also closely related to the Grand Tower of Illinois as shown by a comparison of faunas. Twenty-seven species are common to the two formations. Nearly all of these occur in the upper half of the Grand Tower, while a number are absent from the lower part of that formation. This is to be expected, for Savage concluded that the upper part of the Grand Tower is equivalent to the Jeffersonville formation, and that the lower beds are not represented in Indiana or Kentucky.

Summary

1. Beds of Middle Devonian age have been found not only in the four previously mentioned localities but in nearly all places in the valley of the Harpeth River where the structure and topography are favorable for their exposure.

2. The Middle Devonian in this region does not thicken uniformly to the west as suggested by Foerste but is quite variable in thickness.

[14] Correlation throughout the Mississippi Basin, read before the Tenn. Acad. Sci. Nov., 1929.

3. Beds of this age in the Central Basin comprise two distinct stratigraphic units.

4. The upper formation is correlated with the Sellersburg of Indiana and Kentucky and the Traverse of Michigan.

5. The lower formation is considered the equivalent or part equivalent of the Jeffersonville of Indiana and Kentucky, the Columbus of Ohio, the upper part of the Grand Tower of Illinois and the Onondaga of New York.

6. The name Pegram is dropped since it comprises beds belonging to two different groups of the Middle Devonian. The use of Jeffersonville and Sellersburg is extended to include beds of the same age in Tennessee.