DETAILED ACCOUNT OF SECTIONS OF SILURIAN AND DEVONIAN ROCKS OF EASTCENTRAL KENTUCKY.

GENERAL INDEX.

In the following detailed account of the various sections of Silurian and Devonian limestones studied in east-central Kentucky the aim has been to enable those interested to learn precisely what deposits may be found at each locality named. The sections described have been selected in such a manner that practically the entire territory between Stanford and Owingsville where Silurian and Devonian deposits are known to occur, has been covered, and anyone interested in any special district can find described some section sufficiently near this district to enable this investigator to recognize also the strata which are present in the area in which his special interest centers.

West of Berea the subdivisions of the Crab Orchard division of the Silurian have not been determined definitely. The correlations indicated in the descriptions and on the plates of sections are merely provisional.

The number given at the beginning of each section described is the number by means of which the locality is designated on the accompanying maps and sections. The letters preceding the hyphen (-) indicate the atlas sheet or quadrangle of the Geologic Atlas of the United States on which the number is to be found, and the letters following the hyphen (-) indicate the section of this quadrangle on which the number is located, while the page on which the map is found is given in the table below, as follows:

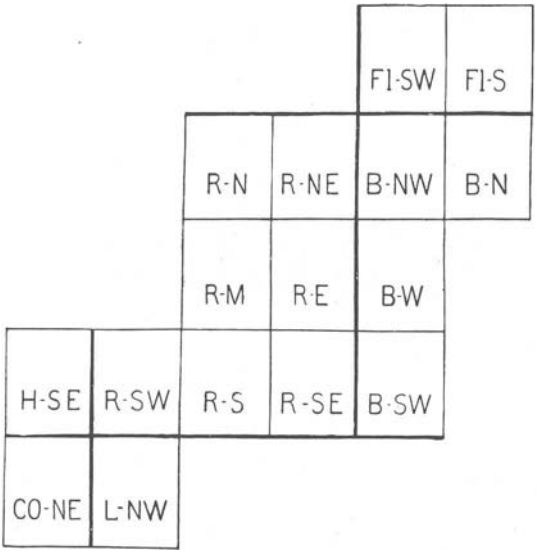


Diagram indicating relative position of road maps accompanying this bulletin.

	Quadrangle.	Section.	Map on Page
CO-NE	Crab Orchard	Northeast	140
L-NW	London	Northwest	140
H-S	Harrodsburg	South	140
H-SE	Harrodsburg	Southeast	140
R-SW	Richmond	Southwest	155
R-S	Richmond	South	167
R-SE	Richmond	Southeast	173
R-E	Richmond	East	173
R-NE	Richmond	Northeast	185
B-W	Beattyville	West	173
B-NW	Beattyville	Northwest	193
Fl-SW	Flemingsburg	Southwest	202

See Index of Maps and Localities at the end of this Bulletin

A. SECTIONS WEST OF STANFORD.

(Map 1, page 140.)

North of Junction City, three quarters of a mile north of the railroad crossing, at Duffin cut.

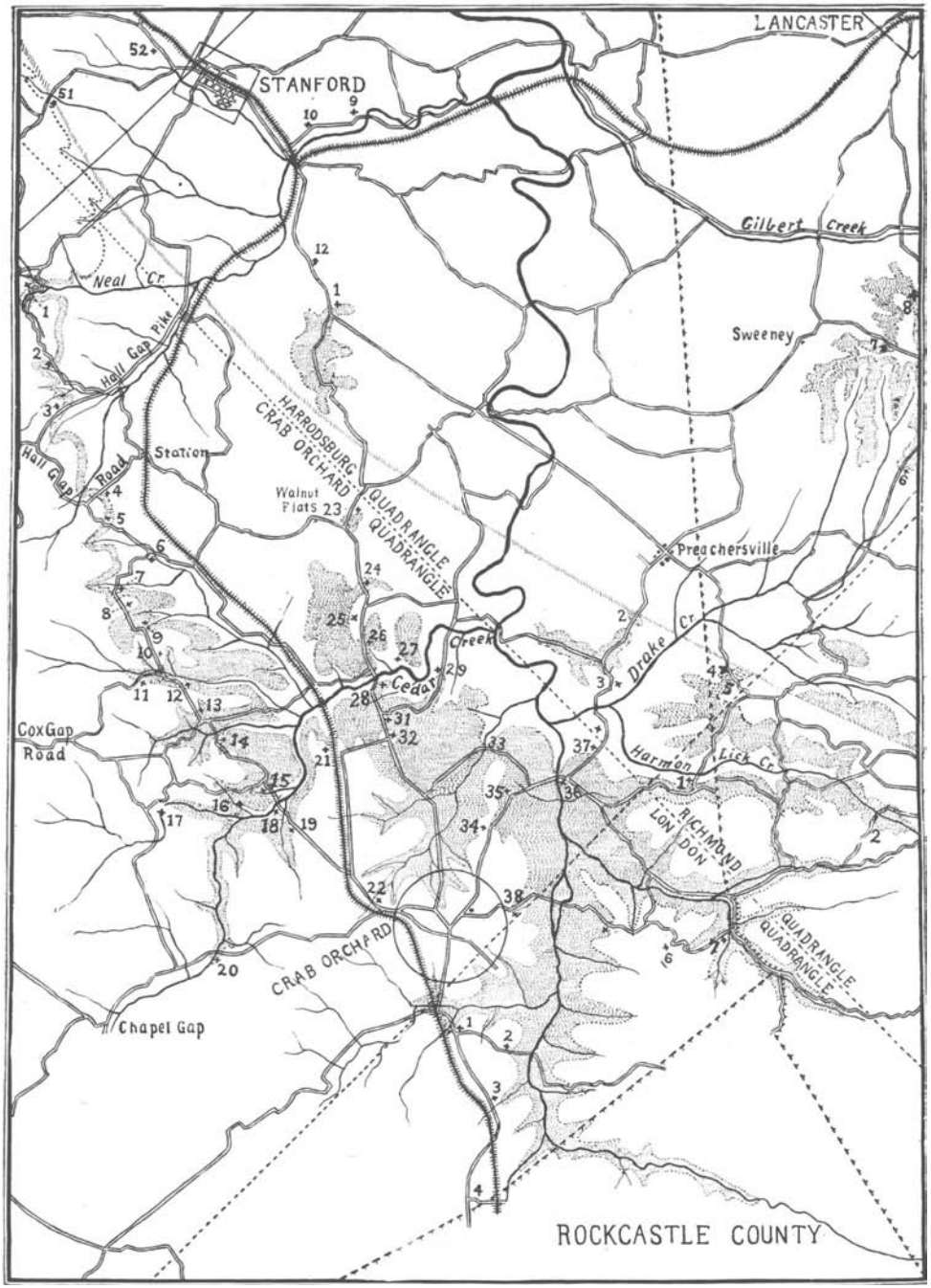
Black shale.		
Rock having a brecciated appearance, weathering brown, containing a few crinoid stems and corals, the weathered surface occasionally showing numerous small quartz concretions. Sometimes not having the brecciated appearance, and then well-bedded. It contains fucoidal markings. This layer may conveniently be called the Duffin layer. It appears to be widely distributed.....	6 ft.	
Bluish white siliceous limestone, full of chert layers and concretions, with Devonian corals.....	4 ft.	8 in.
Dense bluish white limestone.....		6 in.
Dense bluish white limestone, with chert, and with *Cystiphyllum*	2 ft.	4 in.
Thin shaly limestone, badly weathered, with fenestelloid bryozoans and other fossils.....		4 in.
White dense limestone, with abundant chert concretions of small size, also with large crinoid stems at top.....	2 ft.	
Dense light gray limestone, with *Reticularia fimbriata*, and large fucoidal markings, *Taonurus caudagalli*, near the base, and with fish teeth just above the base	2 ft.	6 in.
Top of Ordovician, Richmond division.		
Clay rock, cracking irregularly.....	7 ft.	
Fault at north end of cut.		
Rock, with *Platystrophia lynx*, *Lophospira bowdeni*, *Lophospira tropidophora*, belonging to the Maysville division.		

52 H-S.—At the Buffalo spring, about a quarter of a mile west of Stanford, on the pike to Hustonville.

Black shale.	
Brecciated or Duffin layer. Total thickness of Devonian rock.....	11 ft.
Devonian faulted against the Ordovician.	

Three quarters of a mile southwest of the Buffalo spring, west of Stanford, and then about half a mile northwest of the pike, along another road.

Here six feet of Devonian limestone is exposed beneath the Black shale. The total thickness is unknown.



Map 1. Map of area between Stanford, Crab Orchard and Lancaster.

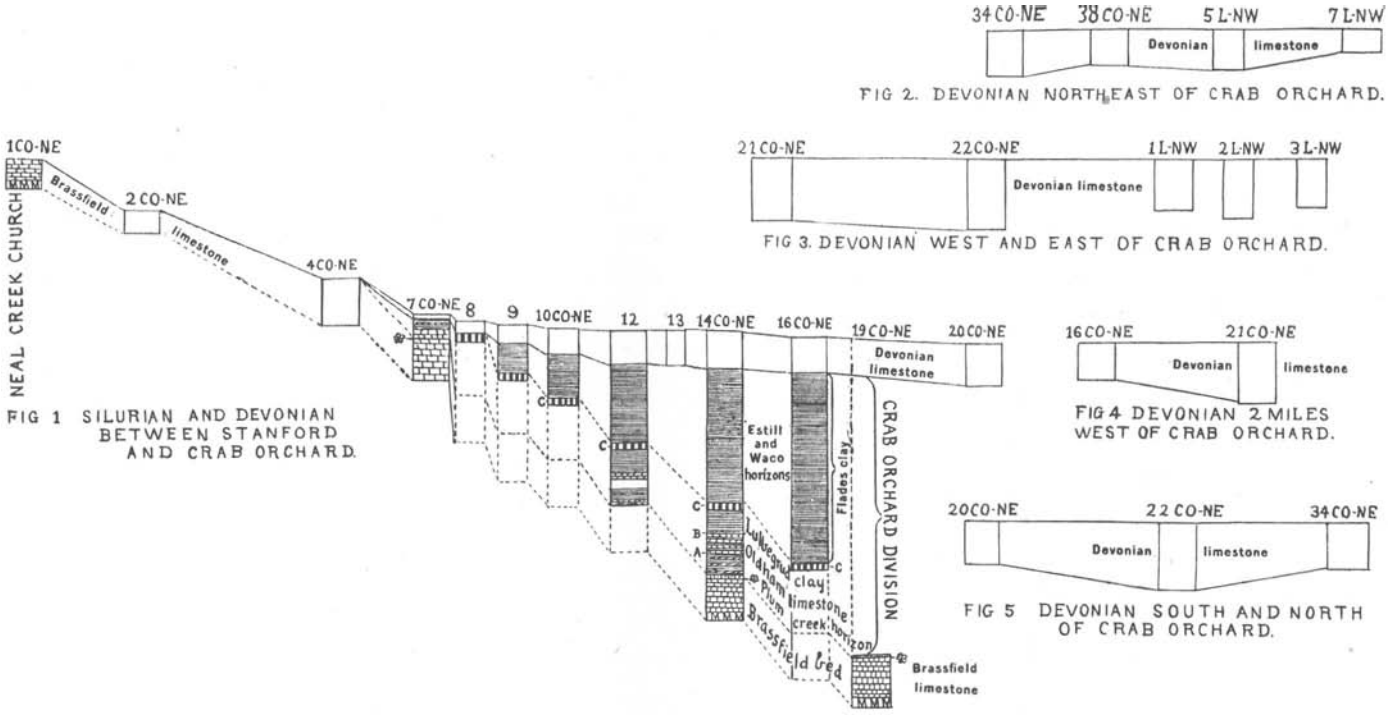


FIG 1 SILURIAN AND DEVONIAN BETWEEN STANFORD AND CRAB ORCHARD.

FIG 2. DEVONIAN NORTHEAST OF CRAB ORCHARD.

FIG 3. DEVONIAN WEST AND EAST OF CRAB ORCHARD.

FIG 4 DEVONIAN 2 MILES WEST OF CRAB ORCHARD.

FIG 5 DEVONIAN SOUTH AND NORTH OF CRAB ORCHARD.

Plate C. Sections of Silurian and Devonian Strata between Stanford and Crab Orchard.

Much Devonian chert is found half a mile south of the pike, along a road turning off a short distance westward.

B.—Sections Between Crab Orchard and Stanford, South of the Louisville & Nashville Railroad.

(Figure 1, plate C, page 141.)

20 CO-NE.—Southwest of Crab Orchard, about two miles from the railroad station, east of the road leading to Chapel Hill, east of the east fork of Cedar creek, near the bridge.

The thickness of the Devonian limestone is eleven feet. The contact with the Black shale is exposed.

17 CO-NE.—Southwest of Crab Orchard, about three miles in a direct line from the railroad Station; reached by following the Chapel Hill pike almost three miles, and then turning off westward along a road which crosses the main fork of Cedar creek about a mile and a half from the pike.

The Black shale is exposed down the creek for a considerable distance. In one of the side valleys northeastward, a fine spring issues from beneath a massive exposure of Devonian limestone, nine feet thick. The Crab Orchard clay shale (Alger clay), along the Upper part of the main fork of Cedar creek (16 CO-NE) is at least fifty feet thick. The total thickness is not exposed at any point visited so far.

19 CO-NE.—West of Crab Orchard, about a mile and a half west of the railroad station, along the county road a short distance west of the home of Cyrene G. Ware. This may be at the same locality as that described next.

Here the total thickness of the Brassfield bed, to the top of the layer containing numerous large crinoid beads, is thirteen and a half feet. The lower part of the section, two and a half feet thick, consists of massive limestone, while the overlying part consists of limestone layers of moderate thickness.

18 CO-NE.—West of Crab Orchard, almost two miles west of the railroad station, east of the crossing of the county road over a small branch of Cedar creek.

The contact between the Silurian and Ordovician is exposed. Of the Silurian, the lower part, twenty-three to twenty-five feet thick, is seen; this includes the more massive Brassfield bed at the base, and the more clayey beds with more or

less intercalated limestone (Indian Fields formation) immediately above. The Silurian limestones have weathered to a rusty brown. In the upper part of the Brassfield bed, the following fossils were found: *Orthis flabellites, Platystrophia daytonensis, Leptaena rhomboidalis, Cyathophyllum daytonensis,* and *Cyathophyllum calyculum.*

15 CO-NE.—West of Cedar creek, along the county road, the base of the Silurian section is formed by the more massive limestone, eight and a half feet thick, belonging to the Brassfield bed. This is overlaid by softer rock, about three feet thick, followed by more solid limestone, probably belonging to the horizon which elsewhere contains the large crinoid beads. Ten feet above this level, and for some distance farther west also at higher levels, there is a whitish clay occupying the horizon of the Crab Orchard clay shale, but resembling the clays of the Irvine formation.

14 OO-NE.—West of Crab Orchard, about three miles in a direct line from the railroad station, along the county road east of a branch of Cedar creek, at the home of Abel Bryant.

The following section is exposed, described in descending order:

	Thickness.	Total from base of section.
Red soil, containing Devonian brachiopods.....		
Crab Orchard clay shale (Estill and Waco horizons)....	35 ft.	64 ft. 2 in.
Massive limestone layer.....	2 ft.	29 ft. 2 in.
Clay (Lulbegrud clay).....	6 ft.	27 ft. 2 in.
Chiefly limestone, with some interbedded clay (top of Oldham horizon).....	2 ft.	21 ft. 2 in.
Poorly exposed.....	1 ft. 6 in.	19 ft. 2 in.
Solid limestone layer.....	8 in.	17 ft. 8 in.
Poorly exposed (Plum creek clay).....	5 ft.	17 ft.
Limestone, large crinoid beads at base.....	1 ft.	12 ft.
More massive limestone, belonging to the Brassfield bed	11 ft.	11 ft.
Top of Ordovician.		

The following is a more detailed description of part of this section, also in descending order:

	Thickness.	Total from base of section.
Reddish brown limestone	1 ft. 6 in.	30 ft. 1 in.
Soft blue Lulbegrud clay	5 ft.	28 ft. 7 in.
Light brown limestone, at top of Oldham bed	4 in.	23 ft. 7 in.
Blue clay	6 in.	23 ft. 3 in.
Limestone	6 in.	22 ft. 9 in.
Clay and thin limestone	2 ft.	22 ft. 3 in.
Reddish brown limestone, at base of Oldham bed	3 in.	20 ft. 3 in.
Plum Creek clay and rotten rubble stone	5 ft.	20 ft.
Hard, reddish brown limestone	2 ft.	15 ft.
Horizon with large crinoid beads		
Reddish brown stone, belonging to the Brassfield bed	11 ft.	13 ft.
Massive limestone	2 ft.	2 ft.
Top of Ordovician.		

The differences between these records are due to changes in the exposure, eight years having intervened; the dropping of the limestone layers, owing to the washing out of clay along the roadside, obscures different parts of the sections at different times.

13 CO-NE.—West of Crab Orchard, almost three and a half miles in a direct line from the railroad station, west of a branch of Cedar creek, east of the home of George Boone.

Devonian brachiopods are found in the red soil along the road. Northeast of the house, at the spring, the thickness of the Devonian limestone is about eight and a half feet.

12 CO-NE.—About a quarter of a mile farther west, the following section is exposed, described in descending order:

	Thickness.	Total above base of section.
Devonian limestone.		
Crab Orchard clay shale (Estill and Waco horizons)	20 ft.	47.5 ft.
Massive limestone layer	2 ft.	27.5 ft.
Clay, poorly exposed (Lulbegrud clay)	5 ft. 6 in.	25.5 ft.
Limestone, at top of Oldham horizon	1 ft. 6 in.	20 ft.
Chiefly clay (chiefly Plum Creek clay)	6 ft. 6 in.	18.5 ft.
It is estimated that the base of the Brassfield bed is at least twelve feet farther down, but this part of the section is not exposed		12 ft.

11 CO-NE.—West of Crab Orchard, a little less than four miles west of the railroad station, along the county road, then south along a road leading to Cox gap.

A short distance up this road the contact between the Black slate and the Devonian limestone is seen. The thickness of this limestone is eleven and a half feet. The top is dark brown and has a sort of brecciated appearance. The underlying part contains *Spirifers* and *Atrypa reticularis.* A considerable thickness of the more continuous part of the Crab Orchard clay shale is exposed beneath the Devonian limestone. This was estimated at the time of the visit to be about thirty-five feet thick, but this estimate is probably too large, in view of the carefully measured sections along the county road. This section requires further study. Some fairly well stratified rock is stated in former notes to underlie the Devonian limestone, but no rock of this description is known in the more continuous part of the Crab Orchard shales; possibly it also belongs to the Devonian limestone section, which at this locality may be of unusual thickness.

10 CO-NE.—West of Crab Orchard, about four miles in a direct line from the railroad station, along the county road, west of a branch of Cedar creek, at the home of William Pleasants.

The thickness of the exposed part of the Devonian limestone is six and a half feet. The total thickness is not known. Immediately below, the upper, more continuous Crab Orchard clay shales are exposed, eleven feet thick.

9 CO-NE.—West of Crab Orchard, about four and a quarter miles in a direct line from the railroad station, along the county road, half a mile east of the point at which the road turns sharply northward.

The contact between the Black shale and the Devonian limestone is exposed. The limestone is a very dark grayish blue, like the lower part of the Devonian at Duffin cut. The exposed part is two feet four inches thick, but its total thickness is estimated at five feet. The Devonian limestone rests on clayey shale, seven and a half feet thick, belonging probably to the more continuous part of the Crab Orchard clay shales. Immediately below there is a considerable exposure of the underlying Silurian rocks, but their thickness was not determined.

8 CO-NE.—West of Crab Orchard, about four and a half miles in a direct line from the railroad station, along the county road, west of a point at which the road turns off toward the north.

The base of the Devonian limestone rests upon a layer of reddish brown limestone, two feet thick, which is believed to be the massive layer at the base of the more continuous part of the Crab Orchard clay shales (at top of the Lulbegrud clay). Of the Devonian limestone only the lower part, three feet thick, is exposed, but the total thickness is estimated at, at least, six feet.

7 CO-NE.—West of Crab Orchard, about five miles from the railroad station, along the county road, where the road turns sharply northward, northwest of the home of James Thomas Bailey.

Here the following section is presented, described in descending order:

Black slate.		
Red clay, resulting from the decay of Devonian limestone	1 ft.	
Clay	1 ft.	
Clayey limestone		4 in.
Clay at base of Plum creek horizon	1 ft.	
Massive limestone (base of Crab Orchard division)	1 ft.	6 in.
Limestone, with large crinoid beads in lower part	1 ft.	
Limestone belonging to the Brassfield bed	11 ft.	
Upper beds of Richmond division of the Cincinnatian series of the Ordovician, base not seen	40 ft.	

The Brassfield bed at this locality is quite crinoidal, although the fragments of crinoid stems show that the diameters of the stems are small.

6 CO-NE.—Southeast of Hall Gap station, about one mile from the station, at the school at the road corner a little over half a mile north of James Thomas Bailey, on the county road leading west from Crab Orchard.

The thickness of the Richmond beds exposed here is at least one hundred feet, but the base of the Richmond section is not seen.

5 CO-NE.—South of Hall Gap station about one mile, and

then a quarter of a mile east on the county road leading west from Crab Orchard.

Below the Black slate there is red clay resulting from the decay of limestone, evidently of Silurian age. Ordovician rock is found north of the Black shale exposure, apparently separated from the latter by a fault.

4 CO-NE.—A little over a quarter of a mile westward, north of the road corner, the Black shale rests upon rock too decayed to be recognizable, twelve feet thick. Immediately below, the top of the Ordovician is exposed. The greater part of the decayed rock is believed to belong to the Brassfield bed; in case the Devonian is very thin or absent, it may include all of the Brassfield bed up to the level of the layer containing the large crinoid beads. No silicified Devonian fossils were found in the upper part of this decayed rock. Apparently the Devonian is absent at this locality, and as far west as Neal creek church.

3 CO-NE.—A mile west of the last locality is another exposure showing the base of the Black shale. It is reached by going from Hall Gap station less than a mile south, then almost a mile west to the Hall Gap pike, and finally north along this pike almost half a mile to a point south of the blacksmith shop. The Brassfield bed is exposed along the road north of the shop. But very little of the rock can be seen.

2 CO-NE.—Less than half a mile north of the last exposure, a road turns off from the pike in a southwesterly direction; about half a mile from the pike, a short distance before reaching Hale's well, the base of the Black shale is separated from the top of the Ordovician by an unexposed interval, six feet thick, believed to be formed by the decay of the lower part of the Brassfield bed.

1 CO-NE.—Northwest of Hale's well, about one mile in a direct line, and about three miles south of Stanford, along Neal creek, below Neal creek church.

A short distance east of the church, the Black shale rests on the Brassfield bed. The thickness of the bed preserved at this locality is eight and a half feet. Only the lower part of the bed is present, the top layer with the large crinoid beads and *Whitfieldella cylindrica-subquadrata* not being preserved. As in the sections farther eastward, this lower part of the

Brassfield bed consists of rather massive limestones, the upper part of the exposure being more distinctly bedded. Where less weathered, in the creek, the rock has a bluish color. On the banks, where more weathered, its color is rusty brown. Some of the layers are sparingly crinoidal, but with crinoid stems or segments of stems of small diameter. The lowest layer of the Brassfield bed includes numerous rounded, black pebbles and grains, possibly phosphatic, varying in size from an eighth to a quarter of an inch; a few equal even as much as an inch in diameter. Immediately below, the top of the Ordovician is exposed.

The upper part of the Brassfield bed exposure contains the following fossils: *Orthis flabellites, Dalmanella elegantula, Strophonella daytonenisis, Pachydictya bifurcata, Halysites catenulatus, Favosites niagarensi, Cyathophyllum calyculum.* The fossils are most frequent in front of the home of John Raines.

This is the most western exposure of the Brassfield bed on the eastern side of the Cincinnati geanticline, in central Kentucky.

C.—SECTIONS BETWEEN CRAB ORCHARD AND STANFORD, NORTH OF THE LOUISVILLE & NASHVILLE RAILROAD.

(Figures 3, 4, 5, plate C, page 141.)

22 CO-NE.—At the western end of Crab Orchard, immediately north of the road following the railroad, at the head of a small gully.

Immediately below the Black shale is a layer of brownish rock, eight inches thick, equivalent to the Duffin layer. The underlying rock, two feet thick, contains masses of calcite, minute but distinct grains of quartz, and a few corals. The remainder of the Devonian limestone section is sixteen feet thick; it is well stratified, and can readily be quarried. At the base of this section, for a distance of three feet, the rock is white, solid, and crinoidal. The overlying part is more brownish or dark gray. Silicified corals have weathered out from layers at the top of the Devonian limestone section. The total thickness of the Devonian limestone exposed is about nineteen feet. The contact between the Devonian and Silurian can not

be seen, but is probably immediately below the crinoidal limestone.

In the crinoidal layers at the base of the section, crinoid stems of considerable thickness are found. Immediately above these crinoidal layers, several *Spirifers* with hingelines three and a half inches long were seen. The overlying, well stratified beds are almost devoid of fossils.

21 CO-NE.—West of Crab Orchard station, where the road along the northern side of the railroad turns northward, a little over two miles west of the station.

Along the railroad there is an excellent exposure of the Devonian limestone, sixteen and a half feet thick. The top of the limestone section, immediately below the Black shale, for a thickness of thirty inches, consists of the brecciated or Duffin layer. Beneath this, there is a bluish layer, three feet thick. The lower part, eleven feet thick, consists, of well stratified layers of gray, argillaceous-looking limestone. No part of the Devonian limestone section is crinoidal. In general the rock resembles the lower part of the Devonian limestone section at Junction City. Below the Devonian limestone, at the western end of the railroad cut, the Crab Orchard clay shales (Alger clay) are well exposed.

A salt well was formerly worked in the fields southwest of the railroad in the Crab Orchard shales.

31-32 CO-NE.—Northwest of Crab Orchard, about two and a half miles from the center of the village along the pike to Stanford, from the first road east of Cedar creek turning off toward the north, to the road turning off south toward the railroad cut.

At the top of the section, eastward, Devonian corals are found in red soil formed by the decay of the Devonian limestone. Below this red soil the following strata are found, in descending order:

Crab Orchard clay shale (Estill and Waco horizons)..	66 ft.	
Massive limestone layer.....	1 ft.	3 in.
Chiefly clay (Lulbegrud clay).....	6 ft.	6 in.
Limestone layers, poorly exposed, base not seen.....	2 ft.	

In this section no account is taken of the eastward dip of the strata. The thickness of the Crab Orchard clay shales

(Alger clay) above the massive limestone probably exceeds eighty feet at this locality.

29 CO-NE.—Northwest of Crab Orchard, three miles from center of village, along first road east of Cedar creek turning north from pike to Stanford, about a mile north from the Stanford pike.

The Brassfield bed is exposed at the top of the hill, before descending into the valley of Cedar creek. The upper part of the Richmond division of the Cincinnatian series of Ordovician rocks, ninety feet thick, is found immediately beneath, while farther northward the Maysville bed is exposed, probably separated by a fault. At the top of the Maysville bed *Platystrophia lynx* is present.

28 CO-NE.—Northwest of Crab Orchard, about three miles from the center of the village, east of the crossing of the pike to Stanford over Cedar creek.

North of the pike the following section is exposed, described in descending order:

	Thickness.	Elevation above base of section.
Top of limestone layer.		
Interval	3 ft.	24 ft. 4 in.
Sandy limestone layer, massive	8 in.	21 ft. 4 in.
Poorly exposed, chiefly clay (Plum creek horizon)	5 ft. 6 in.	20 ft. 8 in.
Massive sandy limestone, with large crinoid beads	2 ft.	15 ft. 2 in.
Soft rock, poorly exposed	2 ft.	13 ft. 2 in.
Massive limestone, sandy at top	2 ft.	11 ft. 2 in.
Soft rock, poorly exposed	1 ft. 6 in.	9 ft. 2 in.
Limestone, in layers, belonging to the more massive part of the Brassfield bed	3 ft. 4 in.	7 ft. 8 in.
Massive limestone, belonging to the Brassfield bed	4 ft. 4 in.	4 ft. 4 in.
Top of Ordovician.		

The layer containing the large crinoid beads appears to belong to a very constant horizon, at the top of the Brassfield bed. Some of the crinoid beads have a diameter of three quarters of an inch. *Whitfieldella cylindrica-subquadrata* and *Leptaena rhomboidalis* occur in the upper part of the sandy limestone containing the crinoid beads.

In the bottom of Cedar creek valley, on the south side of

the pike, rock is exposed dipping southward at angles varying from twenty to thirty-five degrees.

27 CO-NE.—Northwest of Crab Orchard, about three and a half miles from the center of the village, west of Cedar creek, at the southeastern corner of a hill north of the pike.

Here the following section is exposed, described in descending order:

Massive limestone layer	1 ft.	
Softer rock	3 ft.	6 in.
More massive limestone, belonging to the Brassfield bed	10 ft.	
Ordovician rock of Richmond age, total Richmond section not exposed	70 ft.	

The limestone layer at the top of the section belongs stratigraphically to the *Whitfieldella* horizon, at the top of the Brassfield bed.

23 CO-NE.—Northwest of Crab Orchard, along the pike to Stanford, about an eighth of a mile northwest of Walnut Flats, five miles from the center of Crab Orchard.

Here the layer containing the large crinoid beads, at the top of the Brassfield bed, is exposed. The rock has a strong southward dip. The underlying massive part of the Brassfield bed is exposed, but not in such a manner that the total thickness of this bed can be determined. Faulting appears to have taken place; the rock forms a poor exposure along the northern side of the pike, and only a thickness of six feet can be determined with confidence. However, the original thickness of the bed was probably about ten to thirteen feet, as elsewhere in this part of the State.

24 CO-NE.—Three quarters of a mile southeast of the Walnut Flats, the elevation of the Brassfield bed is fully eighty feet above the exposure of this bed northwest of Walnut Flats. From the more eastern locality, the Clinton or Brassfield bed dips rapidly toward Cedar creek. The probability is that the series of faults which cross the country north of Harmon creek connect with others following the same general direction in the vicinity of the Walnut Flats.

The base of the Brassfield bed, three quarters, of a mile southeast of the Walnut Flats (25-CO-NE) is one hundred feet higher than the base of the same bed about half a mile west of

Cedar creek, and 130 feet higher than the base of this bed east of Cedar creek. The layer with large crinoid beads is exposed half a mile west of the creek, west of the culvert.

1 H-SE.—East of Stanford three miles, on the pike to Crab Orchard, west of the point at which the road to Preachersville turns off, north of the pike.

Whitfieldella cylindrica-subquadrata occurs in loose blocks; a little limestone belonging to the Brassfield bed is exposed. There is plenty of chert weathered out from the Devonian limestone immediately above the limestone blocks belonging to the Brassfield bed. The Crab Orchard clay shales appear to have been removed before the deposition of the Devonian.

D.—SECTIONS EAST AND NORTHEAST OF CRAB ORCHARD, CHIEFLY IN THE NORTHWESTERN CORNER OF THE LONDON QUADRANGLE

(Figures 2, 3, plate C, page 141.)

1 L-NW.—Southeast of Crab Orchard, a little over a mile from the railroad station, north of the pike north of the railroad, east of a branch of Flades creek, near the home of Bill Monk.

The contact between the Black shale and the Devonian limestone is seen along the pike. The top of the Devonian limestone section consists of a fine-grained, brownish rock, not well exposed, possibly three feet thick, equivalent to the Duffin layer. As usual, it contains very few fossils.

Immediately below, massive, white limestone, eleven feet thick, is exposed. The rock contains numerous specimens of corals, and also a few brachiopods, evidently of Devonian age, however not in a condition favorable for collecting. The lower part of the section, five feet thick, is crinoidal.

The total thickness of the Devonian limestone exposed is about fourteen feet. The contact of the Devonian with the Silurian can not be seen at this locality.

2 L-NW.—East of Crab Orchard, less than two miles in a direct line from the railroad station, reached by following the road to Bill Monk's house, and then turning off northeastward for a distance of three quarters of a mile, at the bluff on the south side of the valley of Dix river.

The Black slate overlies Devonian limestone, fifteen and a half feet thick. About four and a half feet, above the base of

the limestone, *Atrypa reticularis,* a large Devonian *Spirifer,* and some corals are found. The limestone occurs in layers one to two feet thick; it is not crinoidal. In the upper part, corals occur.

3 L-NW.—Southeast of Crab Orchard, a little over two miles from the railroad station, along the pike north of the railroad where crossed by a small stream emptying into Dix river, near the home of Mr. Howard.

The contact between the Black shale and the Devonian limestone is seen. Of the Devonian limestone a thickness of about thirteen feet is exposed, but the total thickness may be greater since the contact between the Devonian and Silurian can not be seen at this locality.

The lower part of the section, four feet thick, contains small *Spirifers* and other brachiopods. Immediately above this brachiopod horizon specimens resembling *Taonurus caudagalli* are abundant.

38 CO-NE.—At the northeastern edge of Crab Orchard, about a quarter of a mile from the center of the village, along a road turning off at the school in the northern part of Crab Orchard.

The thickness of the Devonian limestone at this locality is nine feet. The contact with the Black shale is exposed.

5 L-NW.—Northeast of Crab Orchard, about a mile and three quarters in a direct line from the center of the village, at the bluff north of Dix river, half a mile south of Fall Lick creek, south of the road.

The thickness of the Devonian limestone is ten and a half feet. The base of the Devonian rests upon the more continuous part of the clay shales, forming the Estill clay division of the Crab Orchard bed. The top of the Crab Orchard clay shale is about ninety feet above the bed of the creek; since the limestone layers belonging to the Oldham and Brassfield beds are not exposed in the bottom of the creek, the thickness of the more continuous Crab Orchard clay shales is estimated at more than ninety feet.

6 L-NW.—About three quarters of a mile in a direct line northeast of the last locality, the contact of the Black shale with the Devonian limestone is seen. The locality is about a fifth of a mile east of the point where a road turns off northwest-

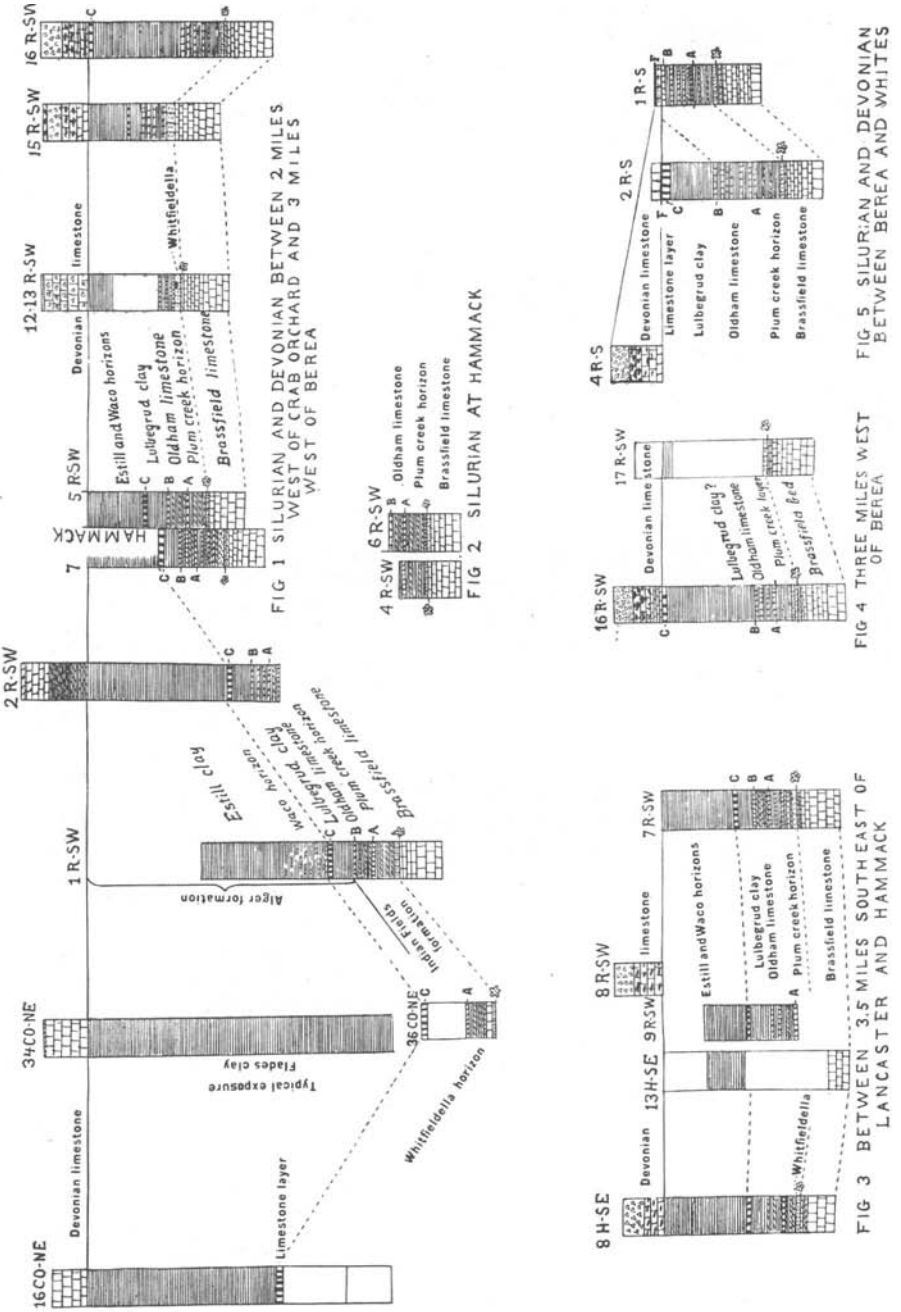
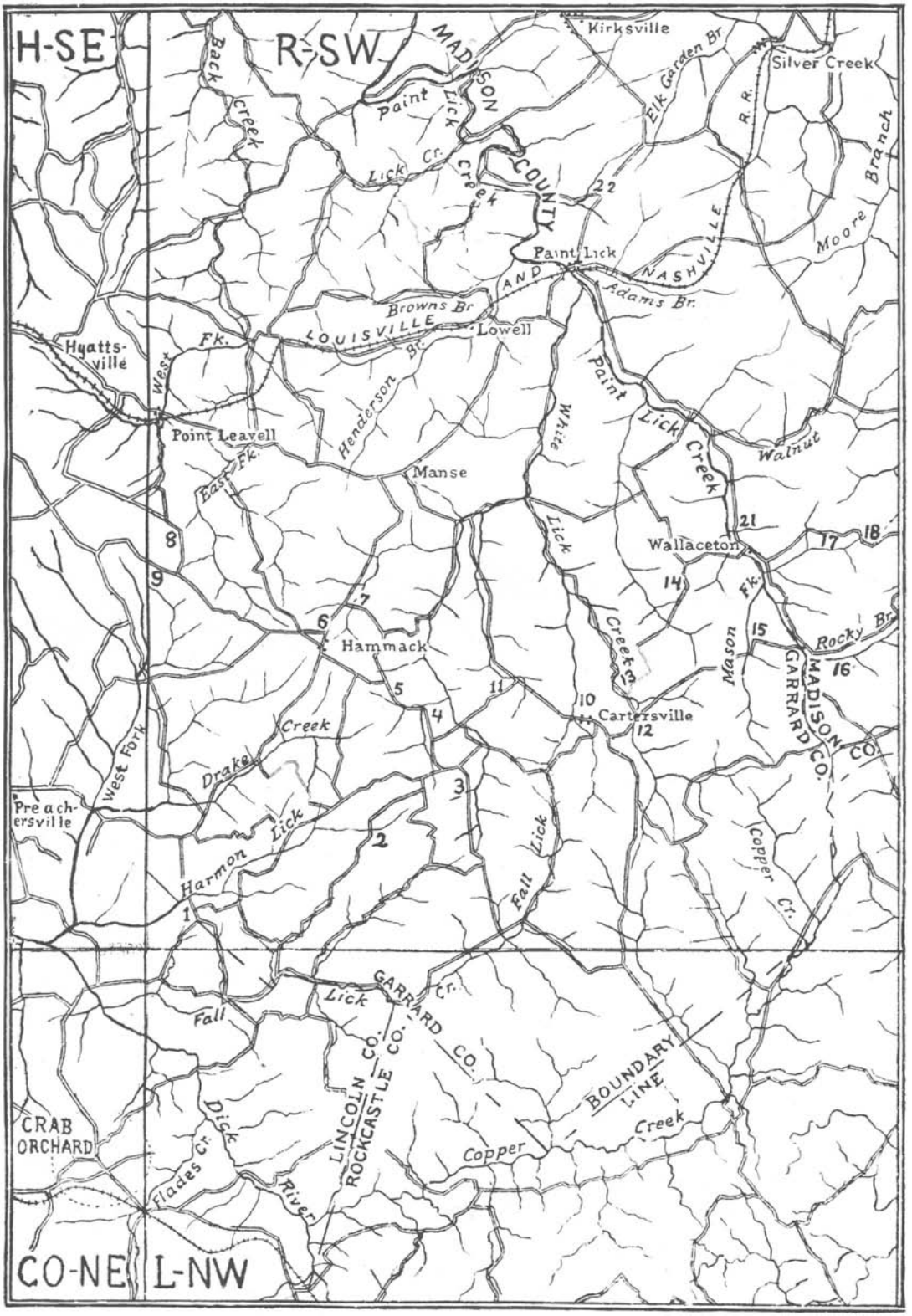


Plate D. Sections of Silurian and Devonian Strata between Crab Orchard and Berea.



Map 2. Map of area between Crab Orchard, Hammack, Berea and Paint Lick.

ward and joins the road following the upper part of Fall Lick creek.

7 L-NW.—About half a mile in a direct line northeast of the last locality, and a quarter of a mile before reaching Fall Lick creek, the thickness of the Devonian limestone is only six feet. Its base is thirty-five feet above the level of the creek, and the interval is occupied by the top of the Estill clay division of the Crab Orchard clay shale. The top layer of the Devonian limestone, four inches thick, has a brecciated appearance, and corresponds to the Duffin layer.

E.—SECTIONS BETWEEN CRAB ORCHARD AND BEREA.

(Figures 2, 5, plate C, page 141; figures 1, 2, 4, plate D, page 154.)

34 CO-NE.—North of Crab Orchard, along the pike to Preachersville, about a mile and a quarter from the center of the village.

The contacts between the Black slate and the Devonian, and between the Devonian and the Silurian are well exposed. The total thickness of the Devonian limestone is twelve feet. At the top of the section, for a distance of four inches, the rock is gray, and has a brecciated appearance. This is equivalent to the Duffin layer. Immediately below, the rock is weathered to a reddish brown, and a number of Devonian corals have weathered out. Northward, in the fields west of the pike, the Alger clay division of the Crab Orchard shales are well exposed. The Clinton or Brassfield limestone is found at the bridge across Dix river.

34-35 CO-NE.—North of Crab Orchard, along the pike to Preachersville, about a mile and a quarter from the center of the village.

The contact between the Devonian limestone and the Alger clay division of the Crab Orchard clay shales is seen along the pike. In a gully along the western side of the pike, the Crab Orchard shale is exposed for a distance of sixty-five feet below the Devonian contact. At the base of the section a salt well goes still deeper into the Crab Orchard shale. The total thickness of the Crab Orchard shales is unknown, but the top of the section is about seventy-six feet above the level of the bridge across Dix river.

36 CO-NE.—At the bridge, a section consisting of limestone alternating with clay rock, five feet thick, is exposed. At the top of this section there is a layer of solid limestone, ten inches thick, and at the bottom are two layers of limestone having a total thickness of about eight inches, but the middle part contains considerable clay, and probably is equivalent to the Plum creek clay layer. Below this section there is a layer of massive limestone, a foot and a half thick. The underlying limestone has a more sandy appearance, and contains large crinoid beads and specimens of *Whitfieldella cylindrica-subquadrata.* This *Whitfieldella* layer is a very constant horizon and forms the top of the more continuous limestone section, the Brassfield bed, in this part of Kentucky.

North of the bridge, a thick layer of limestone is found ten feet above the level of the bridge. About a quarter of a mile north of the bridge, where the steeper part of the hill begins, this massive limestone layer is well exposed about thirty-nine feet above the level of the bridge. The rock apparently dips southward. It was not struck by the salt well at the foot of the Crab Orchard shales in the section here described. It is probable that the total thickness of the Crab Orchard shales above this massive limestone, including the Estill and Waco horizons, equals at least one hundred feet. The distance of this limestone above the *Whitfieldella* layer can not be determined at this locality with certainty.

37 CO-NE.—About half way between Crab Orchard and Preachersville, along the pike, between the bridges over Dix river and Drake creek, the Clinton or Brassfield bed is exposed at several localities west of the pike. Faulting has taken place, with the downthrow on the southern side. There is evidence of faulting also north of Drake creek, where the Brassfield bed is about one hundred feet above Drake creek. No study of the direction of these faults or the amount of throw of the beds affected has been made as yet.

4 H-SE.—Several faults occur also less than a mile northeast of that part of the pile from Crab Orchard to Preachersville which lies between the bridges over Dix river and Drake creek. These faults lie about three miles southwest of Hammack, and may be reached by following the road east from Preachersville. At the northern end of the series of faults, on

the southern side of Drake creek, along the steep ascent of the hill, there is a considerable exposure of the Maysville or Middle division of the Cincinnatian series of rocks, but only about half of the Richmond division is exposed. South of the first line of faulting the Clinton with part of the clay division of the Crab Orchard bed is seen. South of a second fault (5 H-SE) the Devonian limestone and the Black shale are exposed. Farther south, along a third fault, the Brassfield bed occurs at a higher level, on the south side of the fault, than the Devonian limestone on the northern side. Many problems of structural geology are presented by these and other faults in this vicinity, but these must wait for solution until the more detailed work of the survey can be taken up.

1 R-SW.—North of Crab Orchard, fully three miles in a direct line, on the pike to Hammack and Richmond, south of Harman creek.

Here the following section is seen, described in descending order:

	Thickness.	Elevation above base of sectione.
Crab Orchard clay shale, belonging to the Estill and Waco horizons, with lower 11 feet of section containing small rock fragments, but no fossils	33 ft.	62 ft. 2 in.
Massive limestone layer	1 ft.	29 ft. 2 in.
Chiefly clay, Lulbegrud horizon	5 ft.	28 ft. 2 in.
Thin limestone and clay, Oldham bed	5 ft.	23 ft. 2 in.
Limestone layer	8 in.	18 ft. 2 in.
Considerable clay with limestone interbedded, Plum creek horizon	5 ft.	17 ft. 6 in.
Massive limestone	1 ft. 6 in.	12 ft. 6 in.
Horizon of large crinoid beads.		
Limestone layers belonging to the massive Clinton or Brassfield horizon	11 ft.	11 ft.
Ordovician contact.		

The contact of the Crab Orchard shales with the Devonian is not seen at this locality.

2 R-SW.—About three miles in a direct line southwest of Cartersville, and two and a half miles south of Hammack, on the headwaters of Harmon creek; reached by going from Cartersville northwest one mile, then southwest a little over a mile

and a quarter, south a third of a mile, west a quarter of a mile, south an eighth of a mile, and finally southwest nearly a mile. The exposure is on the southern side of Harmon creek.

Black shale.		
Brownish rock, like that of Duffin layer	1 ft.	
Streak of Black shale.		
Devonian limestone, with the top resembling the brecciated or Duffin layer	6 ft.	
Soft material, weathered back, poorly exposed, with a streak of clay	5 ft.	6 in.
Bluish clay rock, Devonian, weathering brownish and shaly, unlike Devonian rock elsewhere	4 ft.	6 in.
Crab Orchard clay shale (Estill and Waco beds), well exposed	37 ft.	
Massive limestone layer	1 ft.	3 in.
Chiefly clay (Lulbegrud clay), possibly including strata belonging to the Oldham horizon	10 ft.	
Thin limestone interbedded with clay, believed to be a short distance above the 5-foot clay layer, above the *Whitfieldella* bed. Not determined.		
Bed of creek.		

3 R-SW.—Seven and a half miles in a direct line southwest of the railroad station at Berea, about a mile and a half southwest in a direct line from Cartersville; reached by going from Cartersville northwest about a mile along the pike, then southwest almost a mile, southeast nearly a third of a mile, southwest about a third of a mile, and finally south of the last fork of the road about a third of a mile where the road crosses a small stream, two and a half miles in a direct line southeast of Hammack.

Here considerable cherty Devonian limestone is exposed.

4 R-SW.—Two miles west of Cartersville in a direct line; reached by going from Cartersville one mile northwest along the pike, then a mile and a quarter southwest, and a third of a mile northwest, east of Brandy Spring branch. (Fig. 2, Plate of sections, D.)

Black shale.	
Brecciated dark brown or Duffin layer	8 ft.
Fault.	
Poorly exposed, limestone interbedded with clay	7 ft.
Limestone with large crinoid beads, *Triplecia ortoni*, and *Cyathophyllum calyculum*.	
Limestone forming the Brassfield bed	9 ft.
Top of Ordovician.	

5 R-SW.—About half a mile northwest of the last locality, and a mile southeast of Hammack, at the sharp angle in the road near the point where the road crosses a small stream entering Brandy Spring branch, half a mile east of the home of Robert Parsons. The section begins at the meeting of three roads northwest of the main exposure.

Black shale, weathered to clay.		
Massive brecciated or Duffin layer, weathered so as to be almost unrecognizable.		
Devonian chert abundant, showing presence formerly of the Devonian limestone, with chert.		
Crab Orchard clay shale (Estill and Waco beds)....	15 ft.	
Limestone, lower part softer.....	1 ft.	3 in.
Clay shale (Lulbegrud clay).....	5 ft.	
Limestone, fairly hard (top of Oldham horizon).....		8 in.
Limestone layers interbedded with clay.....	4 ft.	4 in.
Limestone, fairly solid.....		8 in.
Limestone interbedded with clay (equivalent to Plum creek clay horizon.....	4 ft.	4 in.
Limestone with large crinoid beads.....		6 in.
Limestone forming the Brassfield bed.....	9 ft.	
Top of the Ordovician.		

6 R-SW.—Northeast of Hammack, at the northeastern angle of a triangle made by various roads, at the northern edge of the hill where the old part of the road, now abandoned, descends into the valley of a western branch of Brandy Spring creek, south of Doc. Hunt. (Fig. 2, Plate of Sections, D.)

Rotten limestone, belonging to the Oldham horizon...	1 ft.	
Clay shale and soft clayey rock.....	3 ft.	
Hard limestone.....		6 in.
Clay with rotten limestone layers (equivalent to Plum creek clay horizon).....	5 ft.	
Limestone with *Whitfieldella* and large crinoid beads..		6 in.
Hard limestone with large crinoid beads, one seven-eighths of an inch across, also with *Leptaena rhomboidalis*, *Favosites*, and *Cyathophyllum calyculum*...	1 ft.	
Rusty brown limestone, forming the Brassfield bed....	8 ft.	
Top of Ordovician.		

7 R-SW.—About half a mile north of Hammack, on the road to Manse, south of the home of Wood Walker, along a road crossing the stream and then going eastward up the hill.

	Thickness.	Total thickness to base of section.
Devonian chert fragments.		
Crab Orchard clay shale (Estill and Waco beds)	20 ft.	48 ft. 1 in.
Solid white limestone	1 ft. 3 in.	28 ft. 1 in.
Soft blue clay (Lulbegrud clay)	4 ft.	26 ft. 10 in.
Limestone layers (top of Oldham limestone)	10 in.	22 ft. 10 in.
Clayey limestone	1 ft.	22 ft.
Solid limestone	1 ft.	21 ft.
Softer limestone layers	1 ft. 2 in.	20 ft.
Solid limestone	1 ft.	18 ft. 10 in.
Clayey rock and soft clayey limestone (top of Plum creek clay horizon)	3 ft.	17 ft. 10 in.
Harder clayey rock	6 in.	14 ft. 10 in.
Soft rock	6 in.	14 ft. 4 in.
Limestone	8 in.	13 ft. 10 in.
Softer stone	6 in.	13 ft. 2 in.
Limestone with large crinoid beads	1 ft. 10 in.	12 ft. 8 in.
Softer limestone	1 ft. 2 in.	10 ft. 10 in.
Reddish brown limestone, forming the Brassfield bed.	9 ft. 8 in.	9 ft. 8 in.
Top of Ordovician.		

12-13 R-SW.—Five and a half miles southwest of the railroad station at Berea, nearly three quarters of a mile directly east of Cartersville, east of White Lick creek.

Phosphatic nodules, 1-2 inches long, at base of the Waverly.		
Black shale, no account taken of the dip, the amount of which is not known	102 ft.	
Sandy rock		6 in.
Brown brecciated or Duffin layer, apparently faulted and otherwise disturbed so that its original thickness is uncertain	11 ft.	
Crab Orchard bed, upper part consisting of lower part of Alger clay, probably with Plum creek clay bed at base	19 ft.	
Thin limestone interbedded with clay	4 ft.	
Solid limestone with *Whitfieldella*	1 ft.	6 in.
Limestone with large crinoid beads, *Cyathophyllum calyculum*, and *Zaphrentis daytonensis*		6 in.
The remainder of the Brassfield bed consists of reddish brown limestone	12 ft.	
Top of Ordovician.		

10 R-SW.—At the western end of Cartersville, north of the pike, along a stream. There is a considerable exposure here of the brecciated or Duffin layer and of the cherty Devonian limestone, apparently underlaid by well bedded rock belonging to the Devonian; beneath this level there is greenish clay.

11 R-SW.—About a mile northwestward from Cartersville, along the road which turns off from the pike toward the southwest, the Clinton or Brassfield bed is exposed along the roadside.

15 R-SW.—About four miles southwest of the railroad station at Berea, on the eastern side of Mason Fork, near the home of Charles Baker.

Black shale.		
Dark gray clay rock		4 in.
Very cherty rock	1 ft.	
Brecciated or Duffin layer, but very cherty	4 ft.	
Next layers exposed farther south.		
Devonian limestone with chert	4 ft.	
Dark gray, well-bedded limestone	3 ft.	
Crab Orchard clay	10 ft.	
Thin-bedded limestone, with *Orthis flabellites*, at base of Waco horizon		6 in.
Section with chiefly clay in the upper part, but with limestone interbedded in lower part	10 ft.	
Sandy limestone, *Whitfieldella* layer	2 ft.	
Horizon with large crinoid beads.		
Reddish brown limestone, belonging to the Brassfield bed	12 ft.	

16 R-SW.—Three miles in a direct line southwest of the railroad station at Berea, along Rocky branch, west of the home of Sam Todd. (Fig. 4, Plate D.)

Black shale.		
Brecciated or Duffin layer, with parts of crinoid stems and cyathophylloid corals	5 ft.	6 in.
Devonian limestone with coarse chert	3 ft.	
Gray limestone with very little chert	3 ft.	6 in.
Devonian limestone, crinoidal		6 in.
Massive Silurian limestone, rusty brown (possibly layer at base of Waco horizon)	1 ft.	
Poorly exposed	23 ft.	
Clay with several heavy beds of limestone interbedded in upper part	10 ft.	

Reddish brown stone, coarse	6 in.
Limestone with *Whitfieldella cylindrica-subquadrata*	10 in.
Limestone with large crinoid beads, *Cyclonema*, and *Cyathophyllum calyculum*	6 in.
The remainder of the Brassfield bed was not measured here, but was estimated at about	12 ft.

17-18 R-SW.—Two and a half miles west of the station at Berea, a mile and a half east of Wallaceton. (Fig. 4, Plate D.)

The layer, at the base of the Waverly, with phosphatic nodules an inch long is eighty-five feet above the Devonian limestone, but no account of the dip is taken here. In the same manner the base of the Black shale is found thirty-five feet above the layer with large crinoid beads, at the top of the Brassfield bed. In the gully, south of the road, the thickness of the Brassfield bed, up to the top of the layer with large crinoid beads, is twelve feet.

F.—SECTIONS BETWEEN HAMMACK AND LANCASTER.

(Figure 3, plate D, page 154; map 1, page 140.)

8 R-SW.—Nearly two miles west of Hammack and two miles south of Point Leavell, about a quarter of a mile north of the Flat Woods church, along the new road from Hammack to Point Leavell, above a spring north of a farm house.

Black shale.		
Brown rock corresponding to the brecciated or Duffin layer	5 ft.	6 in.
Devonian limestone, very cherty	7 ft.	6 in.
Crab Orchard clay shale, full thickness not known (probably belonging to the Estill and Waco beds)	20 ft.	

9 R-SW.—Along the road from the Flat Woods church to Lancaster, a short but not recorded distance west of the church, the following section was exposed:

Crab Orchard clay shale, top not exposed (probably chiefly the Waco horizon)	11 ft.	
Solid limestone layer	1 ft.	3 in.
Poorly exposed, chiefly clay (Lulbegrud clay at top)	11 ft.	
Limestone	1 ft.	

13 H-SE.—A short distance farther west, along the same road, east of a branch west from the home of Peter Spainhower.

Loose fragments of Devonian material.		
Interval unknown	11 ft.	
Crab Orchard clay shale	10 ft.	
Interval	23 ft.	
Massive limestone belonging to the lower part of the Brassfield bed	5 ft.	6 in.
Greenish clay, top of the Ordovician.		

6 H-SE.—The base of the Brassfield bed is exposed also at the Lawson chapel, about half a mile south of the Lancaster road, southwest of the home of Peter Spainhower.

8 H-SE.—About three and a half miles southeast of Lancaster, on the road to Hammack, northwest of the home of James M. Anderson.

Black shale.		
Brecciated or Duffin layer, fossiliferous	5 ft.	6 in.
Devonian limestone, very cherty	5 ft.	6 in.
Crab Orchard clay shale (probably Estill and Waco beds)	22 ft.	
Solid limestone	1 ft.	3 in.
Chiefly clay (Lulbegrud clay at top)	8 ft.	
Solid limestone	1 ft.	
Clayey limestone interbedded with clay (equivalent to Plum creek clay)	3 ft.	
Limestone	1 ft.	
Horizon with large crinoid beads, at top of Brassfield bed.		
Limestone in layers	2 ft.	
Massive limestone	7 ft.	
Top of Ordovician.		

Platystrophia lynx occurs about a mile farther west, just east of the main crossing over Gilbert creek.

About a mile and a half southwest of the home of James M. Anderson, northeast of Sweeney Morgan, Devonian rock with Devonian corals occurs.

G.—SECTIONS BETWEEN BEREA AND WHITES.

(Figure 5, plate D, page 154; map 3, page 167.)

1 R-S.—Four miles north of Berea, half a mile south of White station.

Argillaceous beds at base of Black shale.		
Devonian, blue argillaceous, gritty limestone with fish remains		3 in.
Limestone containing much calcite, in some places in considerable blotches, possibly corresponding to the Devonian rock below the layer with fish remains southwest of Elliston, east of Moberly	1 ft.	3 in.
Limestone, at Oldham horizon, apparently contains poor specimens of *Stricklandinia*	1 ft.	3 in.
Blue clayey shale		10 in.
Limestone interbedded with considerable clay	6 ft.	
Chiefly clay with layers of clay rock interbedded, corresponding to the 5-foot layer of clay forming the Plum creek horizon in more northeastern sections.	5 ft.	
Limestone with large crinoid beads and *Whitfieldella cylindrica-subquadrata* near base	1 ft.	4 in.
Limestone, heavy and thinner beds, interbedded with clay	9 ft.	
Massive limestone, at base of the Brassfield bed	2 ft.	2 in.
Top of Ordovician.		

There is probably a fault a short distance north of the Silurian outcrop since the nearest outcrop of *Platystrophia lynx* is only forty-five feet below the base of the Silurian.

2 R-S.—Less than three miles north of Berea, where the railroad crosses over a deep valley.

Near Berea the dark brown brecciated rock, the Duffin layer, overlies the cherty Devonian limestone. This was not seen in the section here described.		
Devonian limestone	2 ft.	4 in.
Layer with fish remains		1 in.
Massive reddish brown limestone; may be the 2-foot layer in the Crab Orchard shale	2 ft.	
Crab Orchard clay shale (Lulbegrud clay), only the upper part, 4 feet thick, well exposed	11 ft.	
Limestone interbedded with clay in upper part of section	18 ft.	
Limestone layer, with large crinoid beads, *Orthothetes, Platystrophia daytonensis, Heliolites subtubulata,* and *Cyathophyllum calyculum*	1 ft.	
Limestone, with thin clay layers at top, belonging to the Brassfield bed	10 ft.	

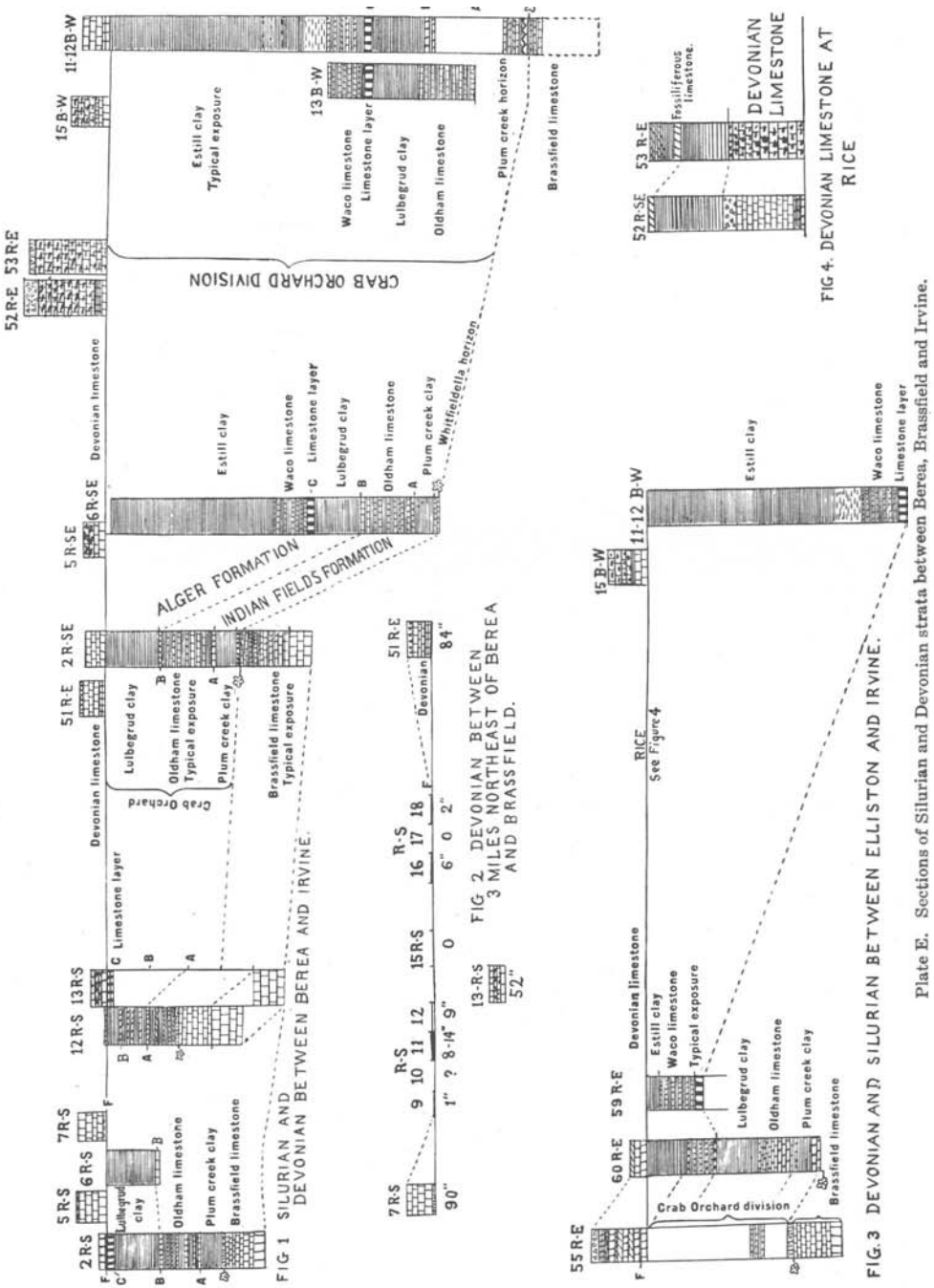
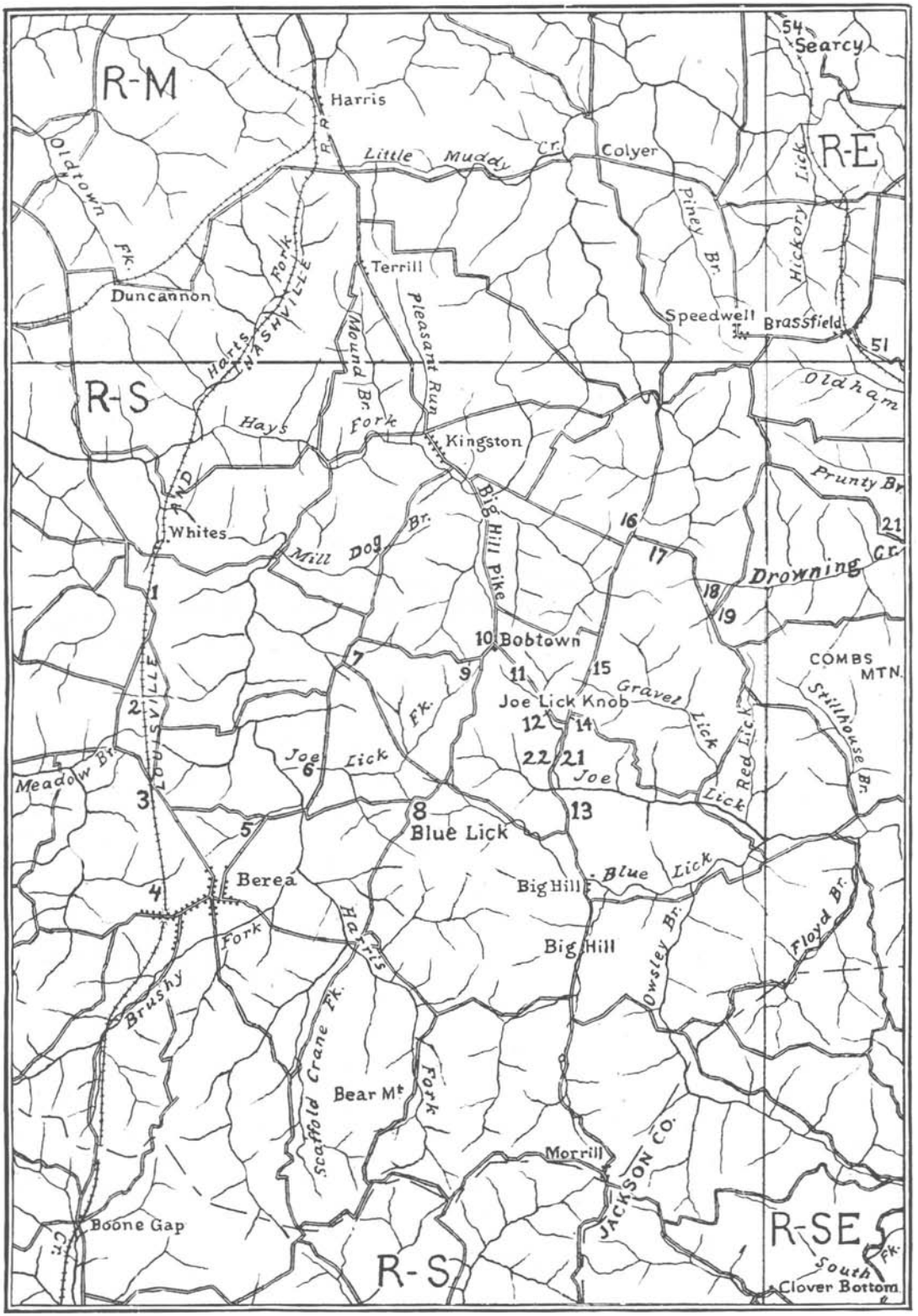


Plate E. Sections of Silurian and Devonian strata between Berea, Brassfield and Irvine.



Map 3. Map of area between Berea and Brassfield.

4 R-S.—Half a mile north of Berea, along the railroad.

Black shale.		
The brecciated, dark blue Duffin layer.....	5 ft.	
Devonian limestone, very cherty near the top.....	8 ft.	6 in.

H.—SECTIONS BETWEEN BEREA AND BRASSFIELD.

(Figures 1, 2, plate E, page 166.)

5 R-S.—About a mile northeast of the center of Berea, on the Kingston turnpike.

Black shale.		
Interval.		
Chert containing cyathophylloid corals.....		4 in.
Devonian limestone, upper part with parts of crinoid stems	8 ft.	

6 R-S.—About two miles northeast of Berea, where the road crosses Joe Lick, a quarter of a mile west of the road, south of the home of Bever Terrell.

Devonian limestone.	
Crab Orchard clay shale (probably Lulbegrud clay)...	13 ft.
Reddish brown limestone with calcite forming nodular masses.	

7 R-S.—Four miles northeast, of Berea, on the I. C. Baker farm.

South of the house there appears to be an exposure of the Brassfield bed. The thickness of the bed appears to be ten and a half feet, and of this the lower part, seven feet thick, is massive limestone. A fault appears to extend north of here. On the north side of the fault, north of the house, at about the same level as the Clinton or Brassfield bed, the Devonian is seen. It slants strongly toward the southwest. The top of the exposure, six and a half feet thick, consists of gray Devonian limestone. The base, one foot thick, weathers to a more shaly rock, contains tiny black nodular masses, and apparently corresponds to the layer with fish remains.

9 R-S.—About four miles northeast of the center of Berea, an eighth of a mile northeast of the New Liberty church, and half a mile south of the Bobtown store.

The Devonian limestone, at the cross roads and also half a mile farther west, is reduced to a thin sandy layer, half an

inch thick, believed to be equivalent to the layer which elsewhere contains fish remains.

10 R-S.—At the north end of Bobtown, north of the home of Dave Garrett. A single massive layer of Brassfield rock, four feet thick, is seen west of the road. Farther south, at Joe Creekmore's house, in the well, the Black shale rests almost directly on the Crab Orchard shale (probably the Lulbegrud clay). The Devonian limestone was not identified here. The interval between the base of the Black shale at the Creekmore well and the top of the massive bed north of the home of Dave Garrett is sixteen feet six inches, but this interval, in the well, is occupied altogether by clay shale, suggesting the presence of a fault here between the two exposures.

11 R-S.—Half a mile southeast of Bobtown, near the house owned by Mat Moody, the Devonian limestone, under the Black shale has a thickness of eight inches. The Crab Orchard shale (probably the Lulbegrud clay) is seen below.

Farther southeast, where the road crosses a stream, the thickness of the Devonian limestone is fourteen inches.

12 R-S.—Four and a half miles northeast of the center of Berea, about a mile southeast of Bobtown, at the end of the Jackson hollow.

Argillaceous beds in the lower part of the Black shale.		
Devonian limestone		9 in.
Chiefly clay, belonging to the Crab Orchard clay shale, with layers of thin limestone included in the lower part which is equivalent to the Oldham limestone.	11 ft.	
Limestone		9 in.
Chiefly clay (Plum creek clay)	5 ft.	
Limestone	1 ft.	
Clay, limestone and clay, in descending order		9 in.
Red sandy limestone with *Whitfieldella cylindrica-subquadrata* common	1 ft.	
Horizon with large crinoid beads common.		
Limestone, in thinner beds than the layers below	9 ft.	
Massive limestone forming the lower part of the Brassfield bed	8 ft.	

13 R-S.—At Mat Moody's store, about two miles and a quarter southeast of Bobtown, about a mile east of Joe Lick knob.

Black shale.		
Grayish rock	1 ft.	4 in.
Devonian limestone, very cherty		10 in.
Gray limestone with a little chert		10 in.
Grayish Devonian limestone	1 ft.	4 in.
Reddish brown limestone, Silurian	1 ft.	
Reddish brown limestone	1 ft.	
Interval estimated at	38 ft.	6 in.
(The top of this interval is formed by the Lulbegrud clay.)		
Top of massive limestone forming the lower part of the Brassfield bed.		

14 R-S.—South of the Log cabin school-house, about, a quarter of a mile north of Mat Moody's store.

There is a fault here.

Chiefly clay.	
Interval consisting chiefly of limestone interbedded with clay	6 ft.
Massive limestone forming the lower part of the Brassfield bed	8 ft.
Clay rock, upper part of Richmond division.	

15 R-S.—About half a mile north of Mat Moody's store, on the north side of Gravel Lick creek.

Black shale.		
Clay rock layers at base of the Black shale	4 ft.	
Devonian limestone absent.		
Limestone, probably of Silurian age		8 in.
Lulbegrud clay shale	12 ft.	
Thin limestone interbedded with clay; Oldham limestone.		

Farther north there is a fault with Black shale on the south side and Ordovician rock on the north.

16 R-S.—About two and a half miles north of Mat Moody's store, south of the home of Joe Gibbs:.

White Irvine clay.		
Black shale.		
Hard clay rock in Black shale.		
Interval	2 ft.	6 in.
Sandy Devonian rock		6 in.
Crab Orchard clay (probably Lulbegrud clay).		

17 R-S.—A quarter of a mile east of the last locality, three miles northeast of the top of Joe Lick knob.

Black shale.		
Crab Orchard limestone layer.....		3 in.
Crab Orchard clay shale (probably Lulbegrud clay).		

18 R-S.—Half a mile southwest of the last locality, reached by going from Brassfield west one mile, then south three miles in a direct line, and finally northwest a distance of almost half a mile, where the road crosses the head of Drowning creek. The exposure is on the southeastern side of the crossing.

Solid clay rock in the Black shale.....	4 ft.	
A thin layer of Black shale.		
Devonian limestone with fish remains.....		2 in.
Reddish brown limestone, Silurian.....	1 ft.	2 in.
Crab Orchard clay shale (Lulbegrud clay).....	10 ft.	
Stream bed.		

The rock above the layer with fish remains may be equivalent to some of the layers identified as Devonian limestone elsewhere. Some distance farther up the Black shale contains argillaceous rock layers.

19 R-S.—Less than half a mile southeast of the last locality, at the forks of the road, at the locality known as the Bear Wallow, White Irvine clay, with rusty brown sandy material in it, is exposed.

I.—SECTIONS BETWEEN IRVINE AND BRASSFIELD.

(Figures 1, 4, plate E, page 166; map 4, page 173.)

11 B-W.—North of Irvine, north of the springs about three quarters of a mile, from the junction of the White Oak creek road and the road to Calloway creek, northeastward, up the hill.

The following section is exposed, described in descending order:

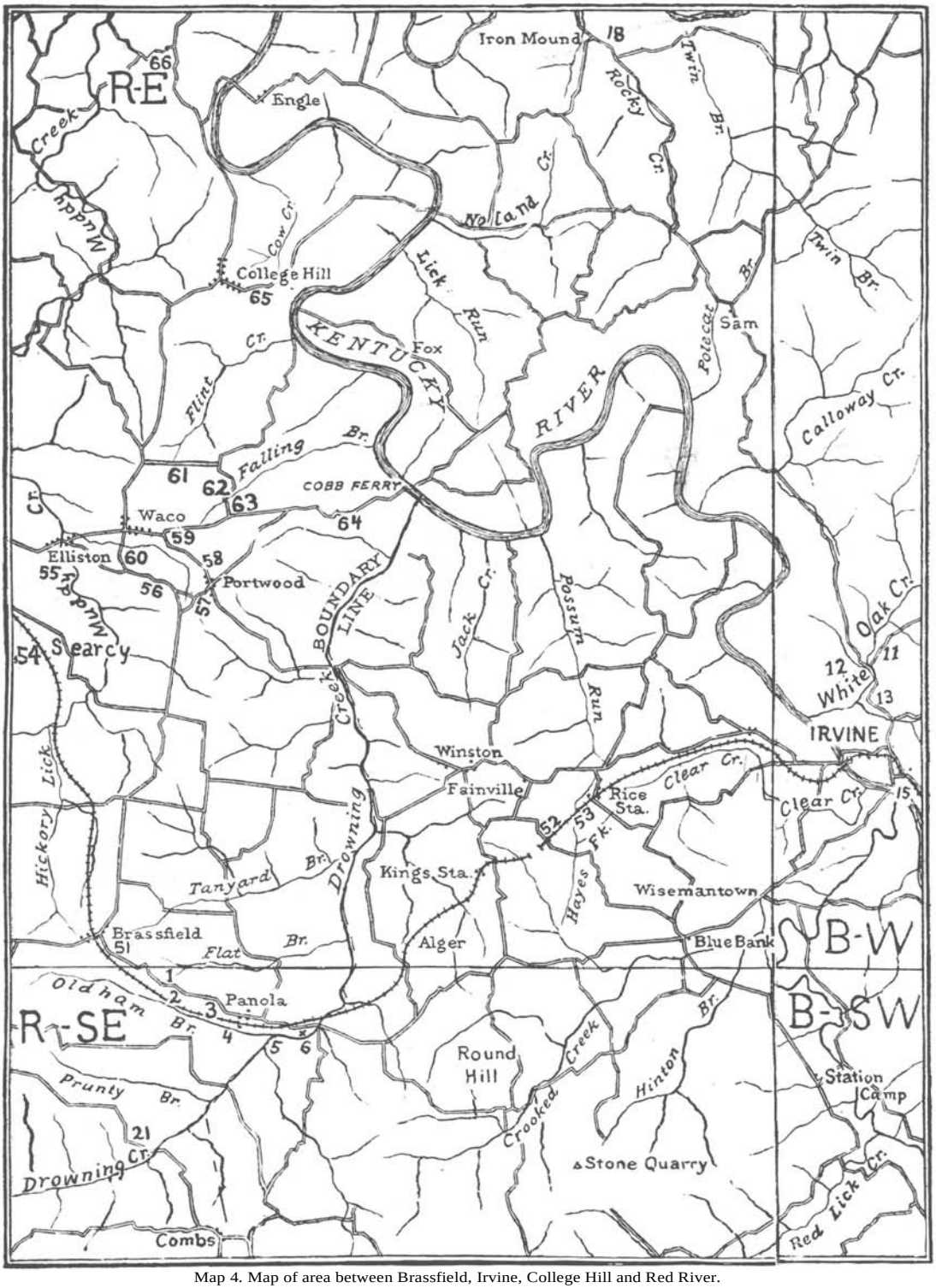
Black shale.		
Devonian limestone, base of section not well exposed.	7 ft.	6 in.
White Estill clay, with thin argillaceous shale in lower 7.5 feet of section.....	60 ft.	6 in.
Waco bed, clay with limestone.....	10 ft.	

Solid brownish limestone, a layer of wide distribution at this level	2 ft.	
Lulbegrud clay	14 ft.	6 in.
Interval occupied by Oldham limestone, and Plum creek clay poorly exposed	27 ft.	6 in.
Coarse-grained limestone, wave-marked at top		8 in.
Whitfieldella cylindrica-subquadrata horizon, at top of the Clinton or Brassfield bed.		

Immediately below the layer with *Whitfieldella cylindrica-subquadrata* and the large crinoid beads, are several feet of limestone belonging at the top of the Brassfield bed. These contain *Calymmene niagarensis, Cyclonema daytonensis, Rhynchotrema scobina, Leptaena rhomboidalis, Plectambonites transversalis, Dalmanella elegantula, Orthis flabellites, Rhinopora frondosa, Phylloporina angulata,* and *Cyathophyllum calyculum.*

12 B-W.—North of Irvine, about half a mile north of the springs, from the point where the road first reaches White Oak creek northwestward up the hill along a private road past the home of James F. Harris.

Black shale.		
Devonian limestone, weathered to a red clay with cherty fragments.		
White Crab Orchard clay shale, top of Estill clay, poorly exposed	11 ft.	6 in.
White Crab Orchard clay shale, well exposed, with comparatively few sandy shale fragments	30 ft.	
White clay, with small and very thin sandy shale fragments	11 ft.	
Clay with considerably sandy shale of gray color, and with thin brownish limestone, equivalent to the Waco layer, but without fossils here. A layer of rotten brownish limestone, 6 inches thick, occurs 5 feet 6 inches above the base, and below this level most of the section consists of white clay	16 ft.	6 in.
Solid brownish limestone, a layer of wide distribution at this level	2 ft.	
White clay, at top belonging to the Estill layer; the lower half with thin interbedded limestone belonging to the Oldham horizon	25 ft.	
Rotten limestone in thin layers, also belonging to the Oldham horizon	5 ft.	6 in.
Whitfieldella cylindrica-subquadrata layer not exposed here, but estimated to occur below the last-mentioned limestone a distance of	12 ft.	
Bottom of creek is about 12 feet lower.		



Map 4. Map of area between Brassfield, Irvine, College Hill and Red River.

13 B-W.—North of Irvine, north of Estill Springs about a quarter of a mile, along the road before reaching White Oak creek.

Clay with numerous fragments of thin limestone, equivalent to the Waco layer, with fossils	10 ft.	
Massive limestone layer	2 ft.	
Clay, forming the Lulbegrud layer	13 ft.	
Thin limestone interbedded with clay equivalent to the Oldham limestone	12 ft.	
Immediately below or only a few feet lower should occur the 5-foot layer of clay equivalent to the Plum creek clay layer.		

15 B-W.—West of the railroad station at Irvine, half way to the railroad bridge, along the railroad.

Black shale, with argillaceous rock layers in lower 6 feet of section.		
Cherty Devonian limestone	6 ft.	6 in.
Darker, more sandy appearing rock, with *Ambocoelia umbonata* common at top		8 in.
Massive ferruginous brown limestone	3 ft.	3 in.
Crab Orchard clay shale, belonging to the Estill clay horizon.		

Along Station camp creek, south of Irvine, no exposures of the Devonian limestone thicker than seven feet were noticed.

16 B-W.—Two miles southeast of Irvine, opposite the mouth of Big Doe creek.

Black shale is exposed: down to the river's edge.

53 R-E.—West of Irvine about four miles in a direct line, west of Rice Station, along the railroad.

Black shale, the top of the section not exposed	40 ft.	
Thin clayey rock layers in Black shale	4 ft.	
Clayey	2 ft.	6 in.
Solid argillaceous limestone, with Devonian corals and *Atrypa reticularis*	2 ft.	
Shale, some of it argillaceous and of a more gray color	13 ft.	
Brownish limestone, probably equivalent to the Duffin layer which has a brecciated appearance	1 ft.	4 in.
Devonian limestone with chert; probably 7 to 10 feet of the section consists of chert	20 ft.	
Crab Orchard clay, belonging to the Estill clay horizon, indurated at top.		

52 R-E.—West of Irvine about four and a half miles in a direct line, three quarters of a mile southwest of Rice Station, east and west of the tunnel.

Black shale with alum salts oozing out at base.		
Clayey layers in Black shale, equivalent to the clayey layers west of Clay City	10 ft.	
Black shale with fossiliferous clay rock at base	9 ft.	
Interval, exposed but not described in field notes	18 ft.	6 in.
Hard, brownish rock, equivalent stratigraphically to the brecciated or Duffin layer	4 ft.	
Very cherty Devonian limestone	16 ft.	
Bluish argillaceous rock	2 ft.	
Brownish rock, without chert	1 ft.	
Crab Orchard clay shale, belonging to the Estill clay horizon.		

6 R-SE.—East of Panola about a quarter of a mile, from the creek to the western end of the railroad cut.

Crab Orchard clay shale, belonging to the Estill clay horizon, the top not exposed	45 ft.	88 ft. 6 in.
Clay and limestone, equivalent to the Waco layer, with fossils	9 ft.	43 ft. 6 in.
Massive limestone. This layer has a very wide distribution	2 ft.	34 ft. 6 in.
Lulbegrud clay	12 ft. 6 in.	32 ft. 6 in.
Clay with many intercalated layers of thin limestone, especially toward the top, belonging to the Oldham limestone horizon	15 ft.	20 ft.
Clay, equivalent to the Plum creek clay layer	5 ft.	5 ft.
Limestone within one or two feet of the *Whitfieldella* horizon.		

4 R-SE.—Southwest of the railroad station, west of the road, the very massive unfossiliferous layer at the bottom of the Brassfield limestone section is well exposed. In some of the immediately overlying layers, *Heliolites subtubulata* is present. Southwestward, up the hill (5 R-SE.), Devonian limestone, six feet thick, is seen. The upper half of this limestone is very cherty.

2 R-SE.—Between eight and ten miles southwest of Irvine in a direct line, north of the railroad between Panola and Brassfield.

	Thickness	Total from base of section.
Black shale.		
Devonian limestone, gray	5 ft.	62 ft. 3 in.
Chiefly clay, belonging to the Lulbegrud clay horizon of the Crab Orchard clay shale bed, poorly exposed.	18 ft.	57 ft. 3 in.
Thin limestone and thin clay shale interbedded, near top of Oldham limestone	6 ft. 6 in.	39 ft. 3 in.
Medium and thin limestone layers interbedded with thin clay	3 ft. 9 in.	32 ft. 9 in.
Chiefly clay, with thin limestone interbedded	.2 ft.	29 ft.
Limestone	1 ft.	27 ft.
Plum creek clay, with very little thin limestone	5 ft.	26 ft.
Ferruginous limestone, with *Cyathophyllum calyculum*. *Whitfieldella cylindrica-subquadrata* and large crinoid bead horizon, forming top of Brassfield limestone.	1 ft. 6 in.	21 ft.
Irregularly bedded limestone with very little clay, containing *Orthothetes fissiplicata*	2 ft.	19 ft. 7 in.
Clay forming from half to three-fourths of the section, with interbedded limestone; containing *Calymmene vogdesi, Cyclonema daytonensis, Rhynchotrema scobina, Leptaena rhomboidalis, Plectambonites transversalis, Platystrophia reversata, Dalmanella elegantula Echinopora frondosa, Aspidopora parmula,* and *Cyathophyllum calyculum*	3 ft. 4 in.	17 ft. 7 in.
Limestone, irregular bedded, with a little thin clay forming partings between some of the limestone layers	8 ft. 3 in.	14 ft. 3 in.
Very massive limestone, at base of Brassfield bed, more bluish than the overlying layers, apparently unfossiliferous	6 ft.	6 ft.
Top of the Ordovician.		

3 R-SE.—At another locality along the railroad: between Panola and Brassfield the following section was seen:

Limestone, with large crinoid beads and *Whitfieldella cylindrica-subquadrata*	2 ft.
Reddish purple, sandy rock, soft, at top of Brassfield bed	1 ft.
Clayey rock	1 ft.
Well bedded limestone	10 ft.
Massive, more bluish layer, unfossiliferous	6 ft.
Ordovician.	

1 R-SE.—North of the county road from Panola to Brassfield, about a mile and a quarter from Panola, along the hill-slope in a field northeast of a large farm house, the following section was recorded. It is evident that some disturbance has taken place in the rocks, since this exposure is apparently much thinner than that measured immediately south of this locality, north of the railroad.

Black shale.		
Devonian rock.		
Clay, poorly exposed	15 ft.	
Limestone		3 in.
Clay, poorly exposed	5 ft.	6 in.
Limestone		6 in.
Clay interbedded with rubble limestone	9 ft.	
Interval, chiefly clay, poorly exposed	10 ft.	
Solid limestone, belonging to the Brassfield bed	10 ft.	

The rock appear to be much tilted and the section irreliable.

51 R-E.—Beneath the overhead bridge across the railroad, south of the station at Brassfield, and thence eastward along the railroad. This is the most carefully measured section in this vicinity.

Black shale.		
Brownish rock belonging to the Duffin layer, appearing brecciated	1 ft.	6 in.
Devonian limestone, more brown than the underlying layer of limestone, with a few fossils	4 ft.	
Bluish argillaceous Devonian limestone	1 ft.	6 in.
Lulbegrud clay	15 ft.	
Thin layers of limestone	2 ft.	
Oldham limestone, consisting of thicker layers with comparatively little clay intercalated. *Stricklandinia* occurs at the top	9 ft.	
Elkins limestone interbedded with more clay	3 ft.	4 in.
Plum creek clay	3 ft.	3 in.
Thin clayey limestone interbedded with clay, also belonging to the Plum creek horizon	1 ft.	10 in.
Massive limestone with *Whitfieldella*. The top, for a distance of 6 to 9 inches, is oolitic	2 ft.	6 in.
More frequently bedded part of Brassfield limestone, with large crinoid beads at top (Clinton)	12 ft.	3 in.
Very massive limestone at base of Brassfield limestone	6 ft.	
Ordovician.		

J.—SECTIONS BETWEEN MOBERLY, WACO, AND THE KENTUCKY RIVER.

(Figure 3, plate E, page 166; map 4, page 173.)

55 R-E.—Half a mile southeast of Moberly, a stream crosses the railroad track. A short distance east of the railroad, in the bed of the stream, the base of the Black shale is seen. The following section is exposed, down the stream:

Black shale.	
Limestone	2 ft.
Interval, poorly exposed	7 ft.
Limestone with abundant chert; a few large crinoid stems, and *Spirifer curyteines*	5 ft.
Base of Devonian limestone not exposed here.	

The relation of this section to that southwest of Elliston, along the same branch of Muddy creek, has not been determined.

55 R-E.—East of Moberly a mile and a half, southwest of Elliston, on the western side of Muddy creek.

	Thickness	Total thickness above base of sect.
Black shale.		
Massive rock, equivalent to the brecciated or Duffin layer	2 ft. 6 in.	70 ft. 8 in.
Solid limestone, in 3 to 4 inch layers	1 ft. 2 in.	68 ft. 2 in.
Sandy, gray rock, weathering back	1 ft. 4 in.	67 ft.
Massive rock, with crinoid stems	2 ft.	65 ft. 8 in.
Rotten limestone layer	6 in.	63 ft. 8 in.
Gray massive limestone	1 ft. 6 in.	63 ft. 2 in.
Gray sandy rock	1 ft. 2 in.	61 ft. 8 in.
Gray massive rock	1 ft. 6 in.	60 ft. 6 in.
Gray, well-bedded, sandy limestone	2 ft.	59 ft
Horizon with small black nodules, with fish remains.		
Gray, well-bedded, sandy rock forming base of Devonian section	2 ft.	57 ft.
Not exposed; probably Waco, Lulbegrud, and part of Oldham horizons of the Crab Orchard bed	29 ft.	55 ft.
Interval, chiefly clay with thin limestone layers at top, probably almost entirely clay in lower half, including part of Oldham limestone and all of Plum creek clay	10 ft. 6 in.	26 ft.
Sandy limestone, with ferruginous layer immediately above. Sandy layer contains *Whitfieldella cylindrica-subquadrata* and large crinoid beads	1 ft. 6 in.	15 ft. 6 in.
Thinner bedded limestone with large crinoid beads at top, forming top of Brassfield bed	3 ft. 6 in.	14 ft.
Solid, well-bedded limestone belonging to the Brassfield bed	7 ft.	10 ft. 6 in.
Solid massive rock, unfossiliferous	3 ft. 6 in.	3 ft. 6 in.
Top of Ordovician.		

Immediately below the *Whitfieldella* layer occur *Orthis flabellites, Leptaena rhomboidalis,* and *Cyathophyllum calyculum.* The well bedded limestones, forming the main body of the Brassfield bed, weather to a rusty brown color.

60 R-E.—South of Waco, along the road leading southward up the hill.

Fissile Black shale.		
Soft argillaceous rock		6 in.
Black shale with an argillaceous layer near the middle.	6 ft.	3 in.
Argillaceous rock	1 ft.	3 in.
Devonian limestone, not cherty	3 ft.	9 in.
Estill clay	11 ft.	
Waco limestone with fossils	7 ft.	6 in.
Limestone layer		10 in.
Lulbegrud clay	13 ft.	
Thin-bedded Oldham limestone and clay	5 ft.	6 in.
Rather heavy Oldham limestone with clay	3 ft.	6 in.
Chiefly clay, Plum creek horizon	6 ft.	
Sandy limestone with *Whitfieldella*	2 ft.	6 in.
Limestone with large crinoid beads	1 ft.	
Level of creek.		

59 R-E.—Half a mile east of Waco, north of the corner at which the road to Cobb ferry leaves the road to Bybeetown, or Portwood.

Black shale.		
Devonian limestone.		
Crab Orchard clay shale, fossiliferous, chiefly the Waco layer	13 ft.	6 in.
Massive limestone layer	2 ft.	
Distance down to *Whitfieldella* layer is estimated from the exposure south of Waco at	28 ft.	

The fossiliferous part of the Crab Orchard clay shale, here called the Waco layer, extends from the massive two-foot layer of limestone to a point, ten feet higher up.

64 R-E.—East of Moberly, about five miles in a direct line, west of Cobb ferry, along the road.

Black shale.	
Brownish rock with brecciated appearance, equivalent to the Duffin layer, with fragments of crinoid stems at top, and with *Favosites* and some chert near the base	5 ft.

Devonian limestone, very cherty	16 ft.	6 in.
Interval formed chiefly by the Lulbegrud clay division of the Crab Orchard shales	20 ft.	
Clay with considerable limestone interbedded, including the lower part of the Oldham and all of the Plum creek bed	11 ft.	6 in.
Limestone layers, ferruginous at base	2 ft.	6 in.
Whitfieldella layer		6 in.
Well-bedded limestone, with thicker beds at base of section, belonging to the Brassfield bed	14 ft.	
Massive limestone, unfossiliferous, forming base of the Brassfield bed	3 ft.	
Clay shale, forming upper part of the Richmond division of the Cincinnatian series of Ordovician rocks. Thin streaks of limestone, apparently the result of concretionary action, in the lower half, and near the base the clay includes more irregular small concretionary rubble	54 ft.	
Blue limestone at top, and clayey limestone at base of section, including *Hebertella sinuata, Platystrophia, Streptelasma rusticum-canadensis;* at base of section, also *Strophomena vetustn*	9 ft.	
Clayey rock with *Streptelasma rusticum-canadensis* at various levels	5 ft.	
Not exposed, probably sandy clay shale	26 ft.	6 in.
Sandy clay rock	10 ft.	
Not exposed, probably sandy clay rock	53 ft.	
Dense, blue limestone layer	1 ft.	
Sandy shale with thin blue limestone layers	2 ft.	
Dense, blue limestone	1 ft.	
Sandy rock, at river's edge	5 ft.	

The dense blue limestone near the base of this section is believed to belong at the top of the Maysville division.

Calapoecia cribriformis was found loose in the Irvine sand along the road, west of top of this section.

62 R-E.—About a mile and a third in a direct line northeast of Waco, north of Falling branch, opposite the home of Tom Curtis, at Moore spring.

Black shale, fissile above, earthy toward the base.		
More solid rock		9 in.
Argillaceous shale	3 ft.	
More solid argillaceous rock	3 ft.	
Argillaceous shale	11 ft.	6 in.
Devonian limestone, with comparatively little chert	18 ft.	
Crab Orchard clay shale, probably near the base of the Estill clay.		

65 R-E.—Northeast of Moberly about five miles in a direct line, almost three quarters of a mile east of College Hill, along the road to Fox.

Black shale.		
Devonian limestone, poorly exposed	6 ft.	6 in.
Blue, well-bedded limestone, with several chert layers.	3 ft.	6 in.
Devonian limestone, crinoidal, poorly exposed	2 ft.	6 in.
Base of Estill clay and all of Waco horizon, the latter with fossils	14 ft.	
Limestone layer		8 in.
Lulbegrud clay	14 ft.	
Oldham limestone, estimated at	11 ft.	
Plum creek clay with thin limestone, 10 inches thick, interbedded at base	4 ft.	3 in.
Whitfieldella layer	1 ft.	
Layer with large crinoid beads, at top of Brassfield limestone.		
Limestone interbedded with clay	4 ft.	6 in.
Well-bedded limestone with very little clay, top layer wave-marked	7 ft.	6 in.
Massive base of Brassfield limestone	1 ft.	4 in.
Argillaceous rock, forming upper part of Richmond division of the Cincinnatian; whitish, clayey	33 ft.	
Argillaceous rock, with one specimen of *Strophomena sulcata* at top and with more frequent specimens of this species at the bottom	8 ft.	6 in.
Argillaceous rock	53 ft.	
Horizon with *Strophomena* and *Streptelasma*, too imperfect for identification.		
Earthy thin-bedded clay	20 ft.	
Interval poorly exposed	70 ft.	
Limestone, blue, fine-grained, with small *Orthoceras* and *Lophospira*, near top of Maysville division		3 in.
Clay rock		9 in.
Massive, blue, fine-grained limestone with worm-borings and small specimens of *Lophospira*	1 ft.	6 in.
Shaly, thin-bedded rock, without *Pl. lynx*	18 ft.	6 in.
Platystrophia lynx not rare	6 ft.	6 in.
Platystrophia lynx comparatively rare	15 ft.	
Platystrophia lynx comparatively common	10 ft.	
Not well exposed	15 ft.	
Bed of river.		

66 R-E.—Three and a half miles north of College Hill, where the road for Union City turns off toward the southwest.

Black shale.		
Brownish rocks resembling the Duffin layer	1 ft.	
Black shale		9 in.
Brownish rock with numerous specimens of *Taonurus cauda-galli*	3 ft.	
Brownish rock	1 ft.	3 in.
Limestone with abundant chert	4 ft.	
White crinoidal limestone with corals	2 ft.	6 in.
Light brown massive Devonian limestone, with a few *Spirifers* within 2 feet of the base	10 ft.	
Silurian clay, probably at base of Estill division of the Crab Orchard, poorly exposed.		

Taonurus cauda-galli is considered the result of tracings made by some form of marine worm, lodging in some vertical hole and sweeping the upper end of its body in all directions for food.

67 R-NE.—Five and a half miles north of College Hill, on the old Bloomingdale road. Along the road south of a house; north and south of a deep valley.

Black shale.		
Devonian limestone, upper part cherty	17 ft.	6 in.
Interval	5 ft.	
Clay with thin limestone containing Waco fossils	5 ft.	6 in.
Clay, no fossils noticed	5 ft.	6 in.
Limestone, with strong fucoidal markings		6 in.
Lulbegrud clay	8 ft.	6 in.
Oldham limestone with *Stricklandinia* at top	7 ft.	6 in.
Plum creek clay	2 ft.	6 in.
Limestone		3 in.
Clay		6 in.
Limestone, base of Plum creek clay		6 in.

The exposures are poor.

K.—SECTIONS BETWEEN INDIAN FIELDS, VIENNA, AND LULBEGRUD CREEK

(Figures 1, 2, 3, 4, plate F, page 184; map 5, page 185.)

7 R-NE.—Two miles west of Indian Fields, reached by going south along the road from the station, then turning west along the Winchester pike about a mile and a half. At the Curry bridge over Howard creek.

The *Whitfieldella cylindrica-subquadrata* layer at the top of the Brassfield layer is exposed at the top of the hill. The thickness of the Brassfield bed was not determined, but the base of this bed is estimated to be about 145 feet above the highest layers containing *Platystrophia, lynx,* although the actual measured interval was about 120 feet. The rocks dip eastward.

8 R-NE.—Half a mile southwest of Indian Fields, north of the home of John Goff, and thence south up the hill south of the pike. (Fig. 4, Plate F.)

Base of the Waverly clay, with traces of phosphatic rock.		
Black shale	40 ft.	
Clay		12 in.
Black shale	1 ft.	8 in.
Clay		8 in.
Black shale	1 ft.	6 in.
Clay		8 in.
Black (Huron) shale	82 ft.	
Sandy rock with worm borings	1 ft.	6 in.
Devonian limestone	1 ft.	10 in.
Sandy rotten stone	1 ft.	6 in.
Ferruginous brown limestone with fish plates		11 in.
Layer with fish remains and tiny black nodules		5 in.
Estill clay division of the Crab Orchard clay shale.		

1 B-NW.—South of Indian Fields about a quarter of a mile, along the road, where it crosses a small branch of Lulbegrud creek, crossing the M. H. Hisle farm. (Fig. 4, Plate F.)

Black shale.		
Solid brownish Devonian limestone	1 ft.	8 in.
Layer with fish remains	1 ft.	
Clay, with Waco fossils in the lower half	20 ft.	
Limestone layer		9 in.
Lulbegrud clay	13 ft.	
Top of Oldham limestone with *Stricklandinia* in bed of branch	2 ft.	

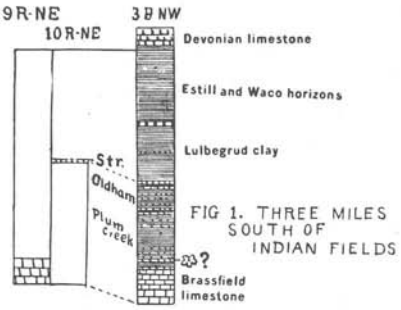


FIG 1. THREE MILES SOUTH OF INDIAN FIELDS

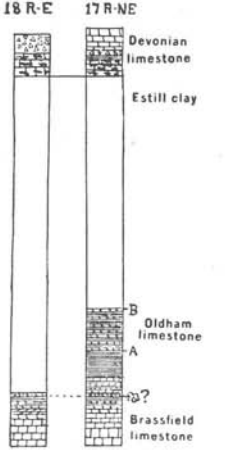


FIG 3. NEAR VIENNA.

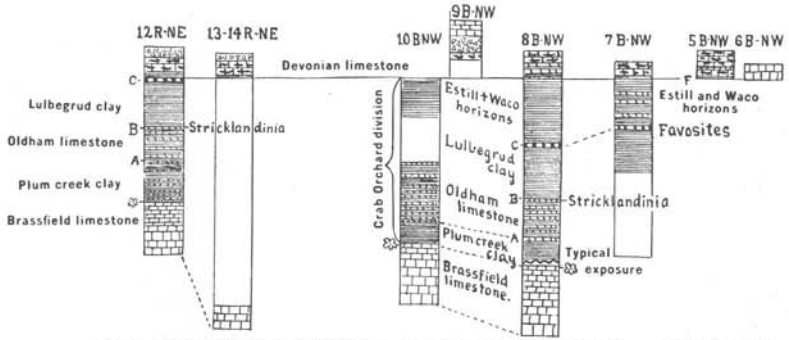


FIG 2. SILURIAN AND DEVONIAN BETWEEN J.T. ELKINS AND CLAY CITY

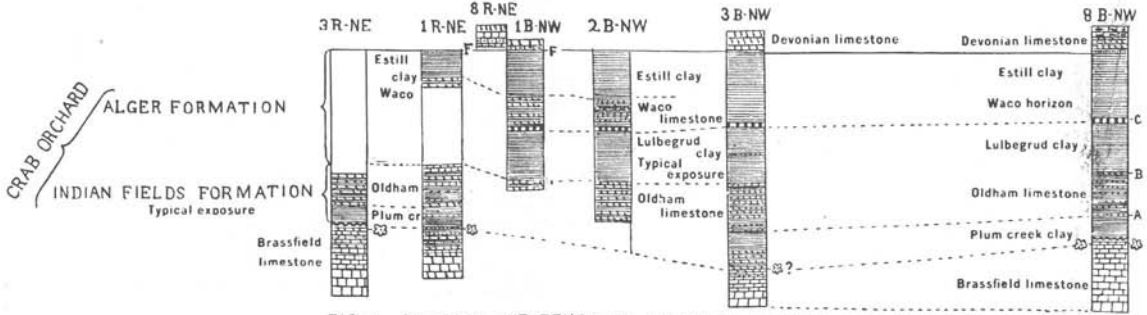
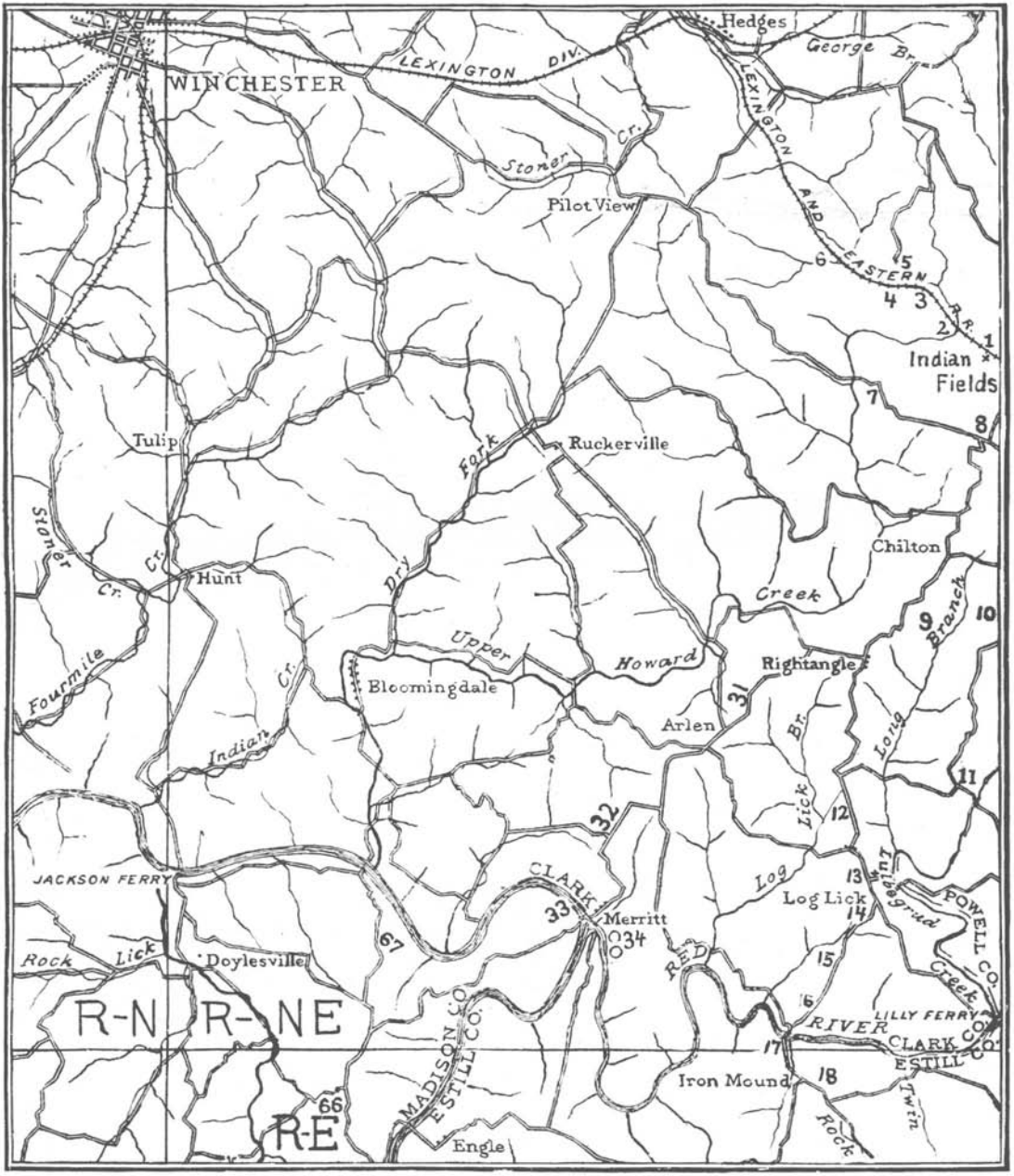


FIG 4 SILURIAN AND DEVONIAN BETWEEN 2 MILES NORTWEST OF INDIAN FIELDS AND 3 MILES SOUTHWEST OF CLAY CITY.

Plate F. Sections of Silurian and Devonian strata between Indian Fields, Clay City and Vienna.



Map 5. Map of area between Red River, Indian Fields and Winchester.

The Oldham limestone contains also *Heliolites subtubulata, Halysites catenutaus, Cyathophyllm calyculum,* and *Zaphrentis daytonensis.*

2 B-NW.—About a mile southeast of Indian Fields along the railroad, and then south along a road toward Lulbegrud creek; a short distance east of the home of Brownlow Bruner. (Fig. 4, Plate F.)

Black shale.		
Brown rock, Devonian.		
Estill clay	12 ft.	
Clay with thin limestone layers and Waco fossils	8 ft.	3 in.
Limestone		9 in.
Lulbegrud clay	13 ft.	
Top of Oldham limestone, with *Stricklandinia*	5 ft.	6 in.
Interval	6 ft.	
Lulbegrud creek.		

3 B-NW.—South of Indian Fields about two and a half miles in a direct line, at Abbott's mill, on Lulbegrud creek. (Fig. 1, Plate F.)

Black shale.		
Devonian limestone with worm borings	3 ft.	9 in.
Rusty brown limestone	1 ft.	3 in.
Probably the layer with fish remains		6 in.
Crab Orchard clay shale, Estill and Waco horizons	19 ft.	
Reddish brown limestone	1 ft.	
White clay, Lulbegrud horizon	7 ft.	6 in.
Limestone layer.		
White clay	7 ft.	6 in.
Clay with reddish brown limestone at various levels, Oldham and Plum creek horizons	23 ft.	6 in.
Reddish brown limestone with *Rhinopora frondosa, Zaphrentis daytonensis,* and *Cyathophyllum calyculum.* Owing to faulting, the top of the Clinton or Brassfield bed is not well exposed at this point, and the full thickness of this bed is probably greater	5 ft.	4 in.
Reddish brown limestone, with bluish argillaceous rock at the base. Containing *Cyclonema daytonensis, Leptaena rhomboidalis,* and *Clathropora frondosa*	3 ft.	7 in.
Soft blue clay shale	2 ft.	

9 R-NE.—South of Indian Fields about two and a half miles in a direct line, about half a mile southeast of Chilton, on the Old Billy Snowden farm near the headwaters of Long branch, west of the creek. (Fig 1, Plate F.)

Here the distance from the base of the Silurian to the base of the Devonian limestone is sixty-two feet.

10 R-NE.—On the eastern side of Long branch, on the Morgan Eubanks farm, *Stricklandinia* occurs about thirty feet above the base of the Silurian.

11 R-NE.—About four and a half miles south of Indian Fields, at Crow ford, on Lulbegrud creek.

The base of the Silurian here is seventy-three feet above the creek.

12 R-NE.—About five miles west of south from Indian Fields, on the road to Vienna, along the run crossing the road south of the home of J. T. Elkins. The section is much obscured by soil and by the dip of the rock, the strata being exposed at distant points along the run and along the road. (Fig. 2, Plate F.)

Fissile Black shale.		
Argillaceous rock, equivalent to the Duffin layer.....	3 ft.	
Devonian limestone, with chert.....	3 ft.	9 in.
Not exposed, probably clay.....	1 ft.	9 in.
Massive reddish brown limestone, probably the 2-foot layer at the base of the Waco horizon of other sections	1 ft.	
Blue clay, probably the Lulbegrud layer.....	12 ft.	
Brownish limestone, *Stricklandinia* layer at top of Oldham limestone.....		4 in.
Chiefly clay, some interbedded limestone.....	5 ft.	
Solid brown limestone.....		6 in.
Soft clay, Plum creek horizon.....	8 ft.	
Clayey limestone.....		2 in.
Chiefly clay, with limestone interbedded.....	5 ft.	6 in.
Horizon with large crinoid beads; cross-bedded limestone at top of Brassfield bed.....		6 in.
Well-bedded limestone.....	8 ft.	
Massive limestone, unfossiliferous.....	6 ft.	6 in.
Top of Ordovician.		

13 R-NE.—Six miles west of south of Indian Fields, along the road to Vienna, along the road east of Log Lick church. (Fig. 2, Plate F.)

Black shale.		
Brownish rock, brecciated in appearance, belonging to the Duffin layer	2 ft.	
Massive, cherty Devonian limestone	4 ft.	
Probably clay, poorly exposed		6 in.
Solid layer of limestone, brownish red, probably the 2-foot layer at the base of the Waco horizon of other sections		9 in.
Distance from preceding layer to base of Brassfield bed	66 ft.	

14 R-NE.—About six and a quarter miles south of west from Indian Fields, on the road to Vienna, at the forks of the road about a quarter of a mile south of Log Lick church. (Fig. 2, Plate F.)

Black shale.
Devonian limestone, 67 feet above the base of the Brassfield bed.

16 R-NE.—North of Vienna, along the road from Indian Fields, to Vienna.

Devonian not seen at top of the hill.	
Crab Orchard clay shale	38 ft.
Possibly a fault near the base of this part of the section.	
Horizon with large-celled species of *Favosites*, and with *Hindia sphaeroidalis*. The latter was found loose. This is believed to be near the horizon of the 2-foot layer at the base of the Waco horizon of other sections. Distance above the base of the Brassfield bed	85 ft.

If this interpretation is correct, the strata must dip southward at a considerable angle on this hill slope. This requires further study.

17 R-NE.—Eight and a half miles in a direct line west of south of Indian Fields, across the river from Vienna, along the road to the home of Old Jones Finnell. (Fig. 3, Plate F.)

Black shale.		
Hard brown limestone	5 ft.	3 in.
Brecciated clay	1 ft.	
Soft rock	1 ft.	
Devonian limestone with much chert	6 ft.	
Crab Orchard clay shale, not exposed, Estill, Waco and Lulbegrud beds	62 ft.	

Limestone layer.		
Not exposed, probably Oldham clay and limestone....	6 ft.	
Thin, badly weathered limestone interbedded with clay	5 ft.	6 in.
Not exposed, probably chiefly Plum creek clay.....	6 ft.	6 in.
Limestone, poorly exposed, with thin clay partings...	3 ft.	6 in.
Strongly cross-bedded layer at top; Brassfield limestone with clay interbedded immediately below; much less clay toward the base.....	9 ft.	6 in.
Massive limestone.....	4 ft.	2 in.
Top of Ordovician.		
Clay rock, weathering into clay, upper part of Richmond	48 ft.	
Well-bedded argillaceous limestone.....	14 ft.	9 in.
Interval above river, clay rock.....	17 ft.	6 in.
Base of Richmond, not exposed.		

18 R-E.—Eight and a half miles south of Indian Fields, about three quarters of a mile southeast of Vienna, up a branch entering Rocky creek from the east, along the hillside near the home of James Stone. (Fig. 3, Plate F.)

Black shale.		
Brown, brecciated appearing rock, equivalent to the Duffin layer.....	5 ft.	
Devonian limestone, with chert.....	6 ft.	
Crab Orchard clay shale with limestone layers at various levels, especially in lower half.....	85 ft.	
Massive cross-bedded limestone, probably at the *Whitfieldella* horizon.....		8 in.
Rotten Brassfield limestone, interbedded with clay at top	3 ft.	
Limestone, badly weathered.....	2 ft.	
Solid limestone, belonging to the base of the Brassfield bed	8 ft.	
Top of Ordovician, above Red river.....	80 ft.	

L.—SECTIONS BETWEEN RIGHTANGLE AND MERRITT.

(Map 5, page 185.)

31 R-NE.—Southwest of Indian Fields five miles, on the road to Merritt, northeast of Arlen, near Goosey's Old Stand.

Brecciated in appearance at top; a little chert in the lower part, 18 inches thick, Devonian limestone.....	5 ft.

The *Whitfieldella* layer occurs near by, but whether brought up by a fault or not, was not determined.

32 R-NE.—About seven miles southwest of Indian Fields, at the fork of the pike about a mile north of Merritt ford, near the old Simpson Brock place.

Limestone, poorly exposed.		
Clayey layer, probably corresponding to the 5-foot Plum creek layer.		
Strongly cross-bedded, sandy layer	1 ft.	
Horizon at top of Brassfield limestone, with large crinoid beads, *Whitfieldella cylindrica-subquadrata*, *Rhinopora frondosa*, *Cyathophyllum calyculum*, *Ptychophyllum ipomea*, and *Dalmanella elegantula* near top. Total thickness of the limestone, including the fossiliferous layers	10 ft.	6 in.

The limestone layers over the five-foot bed are very near the level of the Devonian limestone, possibly brought up by a fault.

33-34 R-NE.—Nearly eight miles in a direct line southwest of Indian Fields, above and below the landing at Merritt's ferry.

Limestone layers.		
Interval, not exposed, probably clay	5 ft.	
Coarse sandy layer, probably the *Whitfieldella* horizon, or just above	1 ft.	
Limestone, Brassfield bed	11 ft.	
Clay rock, weathering readily, upper part of Richmond division	90 ft.	
Tetradium horizon, with *Streptelasma rusticum-canadensis* a short distance above.		
Clayey limestone layers with fossils	10 ft.	
Clay rock, chiefly Richmond	46 ft.	
Indurated clay rock with *Platystrophia lynx Hebertella sinuata*, near top of Maysville division	1 ft.	
Soft clayey shale	6 ft	6 in.
Labechia ohioensis abundant		3 in.
Top of Mount Auburn bed.		
Rubble, clayey limestone with *Platystrophia lynx* and bryozoans very abundant	11 ft.	
Layer with *Hebertella sinuata*, *Platystrophia lynx*, *Lophospira bowdeni*, and bryozoans		6 in.
Layer with numerous lamellibranchs, and with *Orthoceras*	1 ft.	
Argillaceous limestone, rather hard	2 ft.	
Chiefly clayey shale with some clayey limestone, fossils few	15 ft.	6 in.

M.—SECTIONS BETWEEN INDIAN FIELDS, CLAY CITY, AND LULBEGRUD CREEK.

(Figure 2, plate F, page 184; map 6, page 193.)

7 B-NW.—Southwest of Clay City, about two miles in a direct line, at Tipton ferry.

Irvine clay and sand.		
Black shale.		
Cherty Devonian limestone	2 ft.	
Hard limestone, with cherty nodules, and with fish remains at base	2 ft.	
Soft limestone with fish remains		8 in.
Crab Orchard clay shale, lower part belongs to the fossiliferous Waco horizon	16 ft.	
Brown limestone	1 ft.	4 in.
Horizon with *Favosites gothlandica*.		
Chiefly Lulbegrud clay at top, base of this part of section not seen on account of being below river level	33 ft.	6 in.
Red river.		

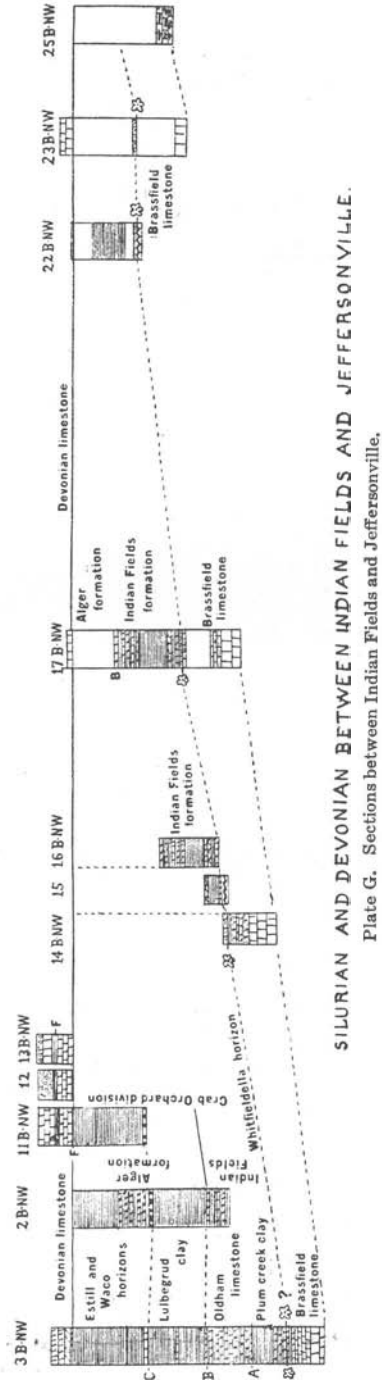
6 B-NW.—West of Clay City, northwest of the bridge across Red river.

Devonian limestone	4 ft.	8 in.

5 B-NW.—About half a mile west of the bridge at the western end of Clay City, along the railroad.

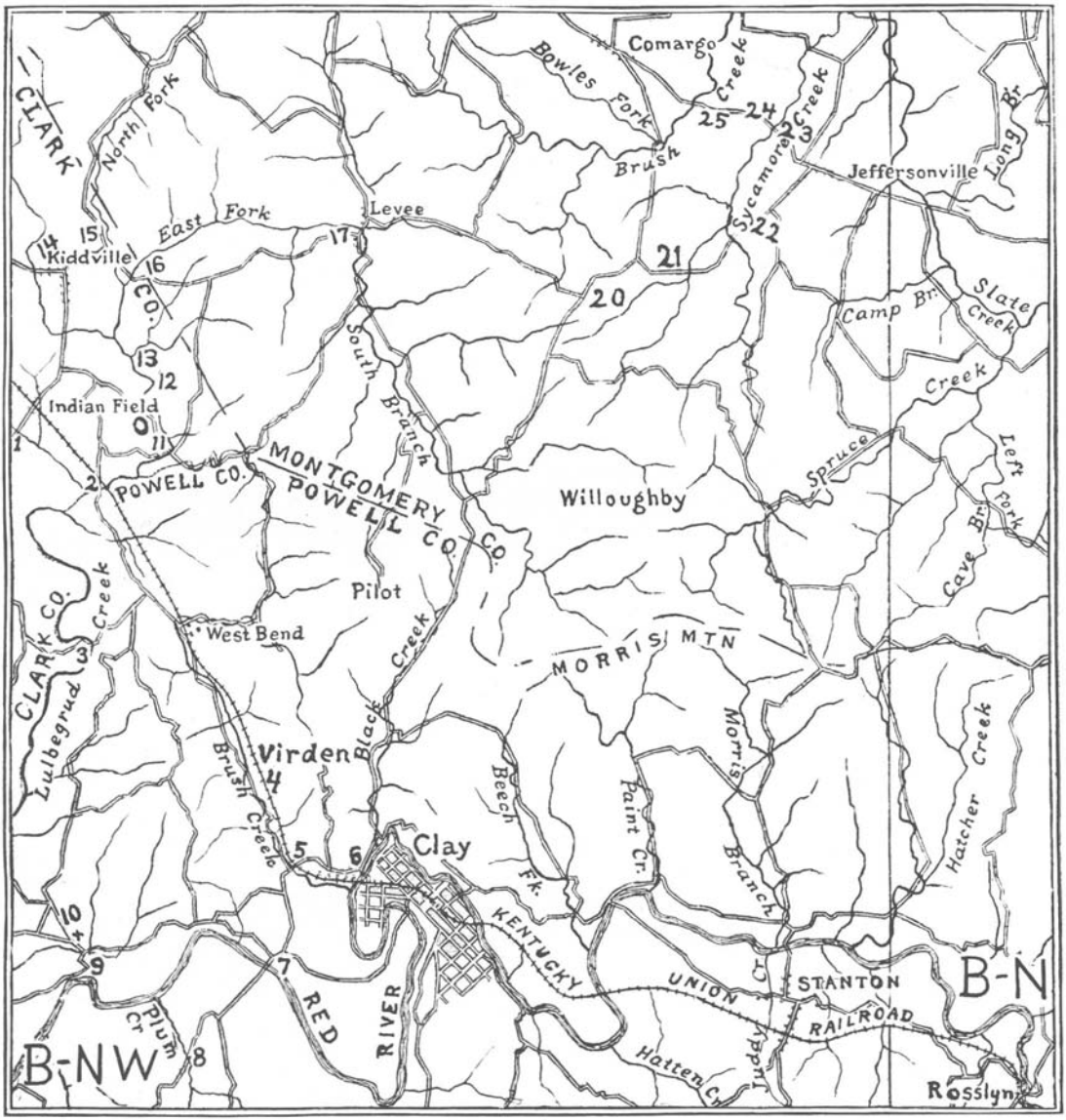
Rusty brown limestone with coarse chert	4 ft.	
Soft rock, weathering back, with Devonian corals in lower part	1 ft.	
Rusty brown limestone with chert, and *Reticularia fimbriata*	1 ft.	8 in.
Rusty brown limestone with small black nodules and fish remains in lower part		6 in.
Waco horizon of the Crab Orchard clay shale, with worm borings, vertical, in a thin clay rock near the top. Within 2 feet of the top occur *Favosites favosus* and *Cyathophyllum*.		

The exposures of the fossiliferous Waco horizon beneath the Devonian limestone continue northwest, toward Virden.



SILURIAN AND DEVONIAN BETWEEN INDIAN FIELDS AND JEFFERSONVILLE.

Plate G. Sections between Indian Fields and Jeffersonville.



Map 6. Map of area between Indian Fields, Clay City and Jeffersonville.

8 B-NW.—Southwest of Clay City, about three miles in a direct line, along the road leading from Tipton ferry to Plum creek, along that part of the road descending toward Plum creek, northeast of the home of George McIntosh.

Irvine formation.		
Black shale.		
Argillaceous rock	1 ft.	8 in.
Devonian limestone, cherty	3 ft.	
Crinoidal limestone with *Hindia*	1 ft.	
Soft rock, weathering back		6 in.
Crinoidal limestone		10 in.
Soft rock, weathering back		7 in.
Soft rock with fish teeth, tuberculated plates and black phosphatic nodules		6 in.
Estill clay, and Waco clay with limestone layers	17 ft.	
Limestone	1 ft.	2 in.
Lulbegrud clay	13 ft.	
Oldham limestone with *Stricklandinia* and *Strophonella* near the top. A ferruginous layer occurs about 6 feet below the top. The lower half contains *Platystrophia daytonensis*, *Dalmanella elegantula*, *Leptaena rhomboidalis*, *Cyathophyllum calyculum*, and *Halysites catenulatus*. Section not clearly exposed, thickness about	11 ft.	
Plum creek clay, exposed in bottom of creek as far south as a point directly east of the home of George McIntosh, formerly occupied by John Burgher	5 ft.	6 in.
Limestone, strongly wave-marked	1 ft.	
Whitfieldella layer.		
Layer with large crinoid beads.		
Brassfield limestone. Owing to the irregular dip of the rock, and the poor exposures, the thickness of the Brassfield bed can not be determined, but it is probably about 19 feet. At this exposure the bottom of the Brassfield bed is found below the nearest Plum creek clay exposure	21 ft.	
Top of Ordovician.		

9 B-NW.—About three and a half miles west of Clay City, north of Hudson's mill, on the road from the mill to Snow creek church.

Black shale.	
Argillaceous rock, brecciated at base as in case of the Duffin layer, with brachiopods	9 ft.
Devonian limestone with *Favosites* and *Chonophyllum*.	

10 B-NW.—North of Snow creek church, just before crossing Snow creek.

Devonian limestone.		
Estill and Waco beds of the Crab Orchard Clay shale..	22 ft.	3 in.
Limestone layer.		
Section, upper part chiefly clay (Lulbegrud clay), lower part with limestone layers interbedded (Oldham limestone)	16 ft.	
Plum creek clay bed.....	5 ft.	6 in.
Whitfieldella layer, ferruginous.		
Limestone, belonging to the Clinton or Brassfield bed.	15 ft.	9 in.
Top of Ordovician.		

N.—SECTIONS WEST OF INDIAN FIELDS, ALONG THE RAILROAD.

(Figure 4, plate F, page 184; map 5, page 185.)

1 R-NE.—Clay pit along the railroad, about three quarters of a mile northwest of Indian Fields.

Irvine formation, sandy clay with pebbles, varies in thickness from 2 to.....	5 ft.	
Black shale, badly decayed, 1 or 2 feet in thickness at point of observation.		
Devonian limestone, badly decayed.....	1 ft.	6 in.
Estill clay.....	7 ft.	
Waco clay with fossiliferous limestones, only the top is exposed.		
Interval, about.....	38 ft.	
Reddish brown limestone full of *Cyathophyllum calyculum*, probably equivalent to the *Whitfieldella* layer.		
Poor exposures of the Brassfield limestone, along the eastern side of Howard creek.		

2 R-NE.—Northwest of Indian Fields, about a mile, west of Howard creek, along the railroad.

The most eastern exposure of the Oldham limestone contains *Stricklandinia* near the top. Ferruginous layers occur within two feet of the top of the limestone. All the layers of the limestone are well shown at the various cuts along the railroad, but,

owing to the dip, it is not easy to determine the precise thickness of the Oldham limestone at this locality. It is estimated at about fourteen feet. The massive limestone at the base of the Brassfield section is exposed along Howard creek; east of the creek, north of the railroad, it has a thickness of about seven feet.

3 R-NE.—A short distance farther westward, at the western end of a low railroad cut, the following section is exposed:

Light brown or reddish brown limestone with thin clay partings forming lower part of Oldham bed..	8 ft.	
Chiefly soft Plum creek clay with a little limestone at the top and with thin streaks of limestone at irregular intervals.....	5 ft.	
Sandy limestone with *Whitfieldella.*		
Strongly wave-marked layer; large crinoid beads near top of underlying layers.		
Reddish brown Brassfield limestone with some interbedded clay, containing *Calymmene vogdesi, Cyclonema daytonensis, Rhynchotrema scobina, Triplecia ortoni, Orthothetes fissiplicata, Leptaena rhomboidalis, Dalmanella elegantula, Phylloporina angulata, Rhinopora frondosa, Phaenopora expansa, Zaphrentis daytonensis,* and *Cyathophyllum calyculum*.....	7 ft.	
Reddish brown limestone with interbedded clay, and plenty of *Cyathophyllum calyculum* at top.....	5 ft.	6 in.
Reddish brown massive limestone, forming base of Brassfield limestone, about.....	7 ft.	
Top of Ordovician.		

4 to 6 R-NE.—Section from the Hornback curve, a mile and a half west of Indian Fields, westward along the railroad to the home of Tom Will Abbott, three miles west of Indian Fields.

Base of Clinton or Brassfield limestone at top of the exposure at the Hornback curve, 1.5 miles west of Indian Fields, at locality 4 R-NE.	
Whitish, soft clay, Upper Richmond.....	10 ft.
Clay, light brown or blue, Upper Richmond.....	12 ft.
Clayey rock with some layers of thin limestone, fossiliferous, Upper Richmond. Contains *Strophomena sulcata,* abundant; *Streptelasma divaricans,* common; *Hebertella sinuata; Platystrophia,* small Upper Richmond form; *Streptelasma rusticum,* rare; *Pterinea demissa*.....	13 ft.

Thin bedded clay rock and argillaceous limestone with fossils in the lower part, exact thickness not known, only estimated. Contains *Strophomena planumbona*, common; *Hebertella occidentalis*, *Rhynchotrema capax*; *Streptelasma rusticum-canadensis*; Middle Richmond	17 ft.	
More sandy interval, fossils few, Middle Richmond	17 ft.	
Massive layer of limestone, showing along the foot path from the railroad down northeast to the home of Jim Hornback (locality 5 R-NE); also west of the beginning of this path, at the second cut along the railroad, Middle Richmond	1 ft.	6 in.
Massive indurated clay, spalling, well shown in first cut west of path leading down to Jim Hornback. Lower Richmond	30 ft.	
Thin bedded clay rock, Lower Richmond	18 ft.	
Thin shaly section corresponding to the section at the base of the Richmond section along the Kentucky river, east of College Hill, and at Cobb Ferry. Exact age unknown, exposure poor; interval estimated at	20 ft.	
Platystrophia lynx abundant, associated with *Leptaena rhomboidalis*, at the home of Tom Will Abbott, near top of Maysville division of the Cincinnatian. Locality 6 R-NE	8 ft.	

O.—Sections Between Indian Fields and Jeffersonville.

(Plate G, page 192.)

O-B-NW.—Southeast of the hotel at the Oil spring about a mile and a half east of Indian Fields. From this point the section leads upward along the road toward the Indian Fields and Kiddville pike.

Irvine sands.		
Phosphatic nodule layer at base of Linietta clay.		
Black Devonian shale	40 ft.	
Thin clay layers in Black shale at various levels	15 ft.	
Black (Huron) shale	75 ft.	
Level of the Soda Spring.		
Black shale (Huron), fissile	14 ft.	
More solid layer, earthy, bluish gray, weathering to irregularly shaly fragments		3 in.
More shaly, the upper part very fissile and black	1 ft.	
Solid, light brown, like Duffin layer but not brecciated.		10 in.

Strongly brecciated and weathered so as to bring out the brecciated appearance splendidly, contains celestite, crinoid stems, cyathophylloid and favositoid corals	1 ft.	
Black shale, fissile		2 in.
Solid, light brown limestone, contains black nodules near the base up to ⅝ inch in length. The Oil Spring issues from just beneath this level.		
Estill clay at top of Crab Orchard division of the Silurian.		

O-B-NW.—Northeast of the Oil spring hotel, one hundred yards, in a little run entering Lulbegrud creek from the west.

Black shale.		
Solid limestone		10 in.
Brecciated Duffin layer		10 in.
Solid limestone	1 ft.	2 in.
Limestone weathered cavernous	1 ft.	6 in.
Poorly exposed, solid limestone in part	1 ft.	6 in.
Not exposed, soft		4 in.
Solid, hard, siliceous limestone	1 ft.	3 in.
Rotten stone		1 in.
Ferruginous brown limestone with black nodules		5 in.
Rotten stone		4 in.
Ferruginous brown limestone with phosphatic black nodules		4 in.

13 B-NW.—About a mile east of Indian Fields, at the Hollywood or Stuart mill on Lulbegrud creek.

Black shale.		
Brecciated or Duffin layer	1 ft.	8 in.
Devonian limestone	2 ft.	3 in.
Sandy rock, with tiny black nodules and fish remains.	1 ft.	9 in.
Reddish brown Devonian limestone, with *Phacops rana* and other fossils, massive rock, forming the falls..	4 ft.	4 in.
Estill clay division of the Crab Orchard clay shale.		

12 B-NW.—About half a mile southeast of the Hollywood mill, on the eastern side of Lulbegrud creek, at the spring north of the home of Will Lawrence, north of the oil spring.

Black shale, fissile.		
Black shale, with lenticular calcareous layers of rock.	8 ft.	
Brecciated or Duffin layer of limestone	3 ft.	9 in.
Shaly rock	1 ft.	3 in.
Massive Devonian limestone	3 ft.	4 in.
Crumbling rock with fish remains		4 in.

11 B-NW.—East of Indian Fields a mile and a half, south of the Oil spring, at the Eastin mill.

Black shale, interbedded with clayey rock near the base	8 ft.	
Massive Devonian limestone	4 ft.	6 in.
Softer, argillaceous rock	1 ft.	
Massive limestone	3 ft.	6 in.
Layer with fish teeth		1 in.
Estill clay and Waco horizon of the Crab Orchard clay shale, blue	18 ft.	6 in.
Solid limestone		9 in.

14 B-NW.—North of Indian Fields a mile and a half, west of Kiddville, east of the western fork of Lulbegrud creek, north of the road, northwest of Jim Peel.

Along the top of the hillside, loose boulders containing *Whitfieldella cylindrica-subquadrata* and large crinoid beads	1 ft.	
Poorly exposed, Brassfield bed, chiefly limestone but with some interbedded clay at top, and half a foot of clay near the base	5 ft.	6 in.
Limestone, fairly well exposed	7 ft.	6 in.
Top of Ordovician.		

15 B-NW.—Northeast of Kiddville, along a little stream emptying into the northern fork of Lulbegrud creek.

Ferruginous layer.		
Interval not measured, estimated at	3 ft.	
Thin limestone layers with large crinoid beads.		
Heavy cross-bedded layer, full of *Cyathophyllum calyculum;* wave marked at top		8 in.
Remainder of the Brassfield bed not exposed.		

16 B-NW.—Half a mile east of Kiddville, at the junction of the North and East Forks of Lulbegrud creek.

Limestone		4 in.
Thin limestone layers, Oldham bed, interbedded with clay	5 ft.	6 in.
Chiefly blue clay, Plum creek bed, with a little thin limestone, especially toward the top	5 ft.	
Limestone		8 in.
Ferruginous layer with *Orthothetes*	1 ft.	3 in.
Interval	1 ft.	6 in.
Limestone with *Cyathophyllum calyculum* abundant, at top of the Brassfield limestone.		
Remainder of Brassfield bed not exposed.		

17 B-NW.—Northeast of Indian Fields four miles, about a quarter of a mile west of Levee.

Devonian limestone	1 ft.	6 in.
Probably a fault or a strong monoclinal dip.		
Interval	11 ft.	
Light brown, thin-bedded limestones, interbedded with clay, Oldham bed	5 ft.	6 in.
Blue clay, thickness not accurately determined, Plum creek clay, in part. Total interval recorded as	12 ft.	
Sandy limestone with a few large crinoid beads, one with a diameter of one inch, also with *Cyathophyllum calyculum*		4 in.
Very fine-grained purple rock, with large crinoid beads, *Whitfieldella*, *Orthothetes*, and *Leptaena rhomboidalis*		6 in.
Interval belonging to Brassfield horizon not exposed	6 ft.	6 in.
Solid limestone		6 in.
Softer layers, not well exposed	2 ft.	
Massive limestone, unfossiliferous, forming base of Brassfield bed	5 ft.	
Top of Ordovician.		

There is a strong dip here, as much as eighteen feet in a distance of 200 feet. Making allowance for the dip, the distance from the base of the Silurian to the base of the Devonian may be estimated at approximately sixty-seven feet. This would necessitate a considerable increase in the estimate of the strata above the sandy limestone with the large crinoid beads, since no correction for dip was made in taking these measurements.

20 B-NW.—About five and a half miles east of Indian Fields, at the road corner two and a half miles southeast of Levee.

The base of the Waverly, which usually consists of a layer containing phosphatic nodules, consists here of a continuous purple phosphatic bed, varying from one foot to a foot and a half thick.

At the angle in the road, a quarter of a mile farther north, a hard argillaceous rock is found near the base of the Black shale, underlaid by a little additional black shale.

22 B-NW.—About seven and a half miles east of Indian Fields, and a mile southwest of Jeffersonville, where the road crosses Sycamore creek.

Black shale, fissile.		
Hard argillaceous rock.		
Black shale	5 ft.	6 in.
Hard rock, Devonian		4 in.
Crab Orchard clay shale, including Plum creek, Oldham and Lulbegrud horizons	16 ft.	
Thin, fine-grained purple layer.		
Red sandy rock, with one crinoid bead having a diameter of three-quarters of an inch	1 ft.	6 in.
Limestone in bed of stream, irregularly wave-marked, with lumps of argillaceous rock, also with numerous large crinoid beads, forming top of Brassfield layer.		

23 B-NW.—Half a mile northwest of Jeffersonville, at the crossing of the pike to Mount Sterling over Sycamore creek, east of creek.

Argillaceous rock in lower part of Black slate section.	
Devonian limestone poorly exposed, on west side of creek	3 ft.
Interval, not exposed, occupied chiefly by Oldham and Plum creek horizons	16 ft.
Red sandy rock	1 ft.
Layer with large crinoid beads.	
Interval occupied by Brassfield limestone	10 ft.
Red massive layer forming base of Brassfield bed	2 ft.
Bed of Creek.	

25 B-NW.—A mile west of Jeffersonville, on the eastern side of Brush creek.

The interval between the base of the Devonian limestone and the base of the Silurian appears to be about twenty-six feet. The massive layer at the base of the Clinton or Brassfield bed is less than five feet thick, and is cherty. This is the most southern exposure at which the Clinton is found to be distinctly cherty.

Plate H.

Map 7. Map of area between Jeffersonville, Preston and Olympia.

SILURIAN AND DEVONIAN BETWEEN SPENCER AND OLYMPIA

P.—SECTIONS BETWEEN SPENCER AND OLYMPIA.

(Plate H, map 7, page 202.)

1 FI.—East of Spencer, west of Slate creek bridge.

Devonian limestone, brown, not brecciated	4 ft. 3 in.	94 ft. 3 in.
Brecciated rock, like Duffin layer	1 ft. 6 in.	90 ft
Layer composed almost entirely of chert	1 ft. 6 in.	88 ft. 6 in.
Devonian limestone with chert and cherty corals	5 ft.	87 ft.
Interval	61 ft. 8 in.	82 ft.
Limestone full of *Whitfieldella cylindrica-subquadrata*, *Cyathophyllum calyculum*, and *Orthothetes*. It contains thin streaks of fine-grained purple argillaceous rock at top of Brassfield bed	4 in.	20 ft. 4 in.
Clay	2 in.	20 ft.
Thin, clayey limestone, full of large crinoid beads	2 in.	19 ft. 10 in.
Chiefly clay	2 ft. 5 in.	19 ft. 8 in.
Massive limestone	5 in.	17 ft. 3 in.
Clay	6 in.	16 ft. 10 in.
Massive limestone	9 in.	16 ft. 4 in.
Chiefly clay	10 in.	15 ft. 7 in.
Thin limestone layers	10 in.	14 ft. 9 in.
Chiefly clay, poorly exposed	2 ft.	13 ft. 11 in.
Thin-bedded limestone	1 ft. 8 in.	11 ft. 11 in.
Massive limestone	8 in.	10 ft. 3 in.
Limestone in thin layers, separated by blue clay partings	3 ft.	9 ft. 7 in.
Massive limestone	1 ft. 4 in.	6 ft. 7 in.
Massive limestone	8 in.	5 ft. 3 in.
Blue clay	9 in.	4 ft. 7 in.
Thin-bedded limestone. Base of Brassfield bed	3 ft. 10 in.	3 ft. 10 in.
Top of Ordovician.		

2 FI.—East of Spencer, on the eastern side of Slate creek, south of the pike following the railroad.

Devonian limestone, full of chert	5 ft.	65 ft. 2 in.
Interval	1 ft. 2 in.	60 ft. 2 in.
Devonian limestone, massive, cherty	3 ft.	59 ft.
Interval	56 ft.	56 ft.
Base of Brassfield bed, exposed on west side of Slate creek bridge.		

3 FI.—Section along the pike east of Howard's Mills.

Cherty base of the Brassfield or Clinton bed.		
Belfast bed		15 in.
Greenish Upper Richmond clay		24 ft.
Sandy clayey limestone interbedded with sandy clay, Middle Richmond	27 ft.	6 in.
Massive sandy Middle Richmond limestone bed, containing *Strophomena vetusta*, *Strophomena planumbona*, *Streptelasma rusticum-canadensis*, and *Hebertella sinuata*	5 ft.	6 in.
Poorly exposed sandy clayey rock, Lower Richmond	12 ft.	6 in.
Blue clay rock, spalling and cracking irregularly	17 ft.	
Sandy clay with *Prasopora* not very common	5 ft.	6 in.
Prasopora hospitalis abundant in sandy clay	6 ft.	6 in.
Hard blue clay rock, regarded as of Lower Richmond age, containing *Prasopora*, *Lophospira bowdeni*, and lamellibranchs	3 ft.	
Bluish clay rock, much broken, Lower Richmond, *Prasopora* common	4 ft.	6 in.
Blue limestone		8 in.
Rubble limestone composed largely of bryozoan remains, probably at junction of Lower Richmond and upper Maysville horizons, including forms of each not carefully discriminated at this exposure.	12 ft.	9 in.
Platystrophia lynx found in lowest part of a section consisting of dark blue clay rock, nearly unfossiliferous, belonging to the Arnheim bed	18 ft.	
Platystrophia lynx abundant at various levels	42 ft.	
Fossils scarce	12 ft.	
Creek level.		

4 FI.—Two and a quarter miles southwest of Preston, west of a small branch entering Slate creek from the south, along the road to Howard's Mills.

Abundant chert, loose, left after the decay of Devonian limestone.		
Interval, poorly exposed, down to base of Plum creek clay	76 ft.	93 ft. 2 in.
Wave-marked layer with large crinoid beads	8 in.	17 ft. 2 in.
Interval	5 ft.	16 ft. 6 in.
Limestone with crinoid beads	2 ft.	11 ft. 6 in.
Solid limestone, belonging to the Brassfield bed	7 in.	9 ft. 6 in.
Irregularly bedded limestone interbedded with clay	3 ft.	8 ft. 11 in.
Blue clay	4 in.	5 ft. 11 in.
Solid limestone	1 ft. 6 in.	5 ft. 7 in.
Blue clay	6 in.	4 ft. 1 in.
Massive limestone with chert, forming the lower part of the Clinton or Brassfield bed	3 ft. 7 in.	3 ft. 7 in.

5 FI.—Southwest of Preston about two miles in a direct line, along the road, east of a small branch entering Slate creek from the south.

Cherty Devonian limestone	2 ft.	96 ft. 10 in.
Alger clay, poorly exposed	60 ft.	94 ft. 10 in.
Thinner Oldham limestone, with more clay	3 ft.	34 ft. 10 in.
Thin Oldham limestone, with less clay	6 ft. 6 in.	31 ft. 10 in.
Plum creek clay	5 ft. 6 in.	25 ft. 4 in.
Wave-marked layer of limestone	4 in.	19 ft. 10 in.
Clay	4 in.	19 ft. 6 in.
Limestone, strongly ferruginous, wave-marked, red purple in part. *Whitfieldella*	1 ft.	19 ft. 2 in.
Brassfield limestone, full of large crinoid beads	2 in.	18 ft. 2 in.
Clay	2 ft. 6 in.	18 ft.
Strongly wave-marked layer of limestone with large crinoid beads	9 in.	15 ft. 6 in.
Clay	2 ft. 3 in.	14 ft. 9 in.
Irregular limestone	1 ft. 2 in.	12 ft. 6 in.
Solid limestone	10 in.	11 ft. 4 in.
Clay	6 in.	10 ft. 6 in.
Massive limestone, belonging to the Brassfield bed	10 ft.	10 ft.

About a mile west of Preston, along the railroad, a short distance east of the home of William Johnson, the *Whitfieldella* layer is exposed. The Devonian limestone is seen farther east, in a deep railroad cut. Here the following exposures are seen:

Devonian Black shale.		
Devonian limestone	11 ft.	8 in.
Alger clay	60 ft.	
Oldham limestone and clay	5 ft.	
Plum creek clay	7 ft.	6 in.
Light brown limestone		4 in.
Clay		8 in.
Ferruginous limestone with large crinoid beads in lower part	1 ft.	
Limestone, containing large crinoid beads and one well-preserved *Whtifieldella subquadrata*		5 in.
Clay, at top of Brassfield section		7 in.
Limestone		4 in.
Clay		7 in.
Ferruginous limestone	1 ft.	
Remainder of Brassfield section not examined.		

About four miles east of Owingsville, on the northern side of Rose Run, there is a wide area in which oolitic iron ore is quarried. Here the following section is exposed:

Oldham limestone and clay, lower part of section....	5 ft.	
Plum creek clay.....	8 ft.	
Limestone, wave-marked.....		4 in.
Blue hydrated iron ore.....		5 in.
Red hematitic iron ore.....	3 ft.	
Brown limestone, top of Brassfield section.....		5 in.
Clay		4 in.
Limestone with large crinoid beads.....		6 in.
Remainder of Brassfield section not measured.		

6 FI.—South of Preston about a mile, east of a small branch, entering Mill creek from the west.

Black shale.		
Brownish rock with traces of the brecciated appearance of the Duffin layer.....	2 ft. 6 in.	68 ft. 3 in.
Cherty Devonian limestone.....	5 ft. 6 in.	65 ft. 9 in.
Layer with fish remains.....	3 in.	60 ft. 3 in.
Alger clay, exposed for a vertical distance of.....	60 ft.	60 ft.

7 FI.—Southeast of Preston, two miles in a direct line, on the eastern side of Blue Bank creek, south of the road.

Black shale.		
Cherty limestone.....	1 ft.	
Brown limestone, full of *Ambocoelia umbonata*.....	1 ft.	6 in.
Reddish limestone, massive.....	1 ft.	3 in.