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GEOLOGICAL SECTION

ST. LOUIS TO SHAWNEETOWN.

BY PROF. J. M. NICKLES



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**GEOLOGICAL SECTION—ST. LOUIS TO
SHAWNEETOWN.**

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Introductory.

THE field work for this section was carried on during July and August, 1892. The limited time and small number of exposures of strata and the considerable intervals by which these exposures were commonly separated made it impossible to ascertain the exact position of each particular outcrop in the vertical series or determine the relations of the various outcrops to one another. This difficulty is increased by the striking sameness in material composing the deposits of the Coal Measures Series in southern Illinois; sandy shales, sometimes shading off into sandstone, at other times into clay shales, being predominant, and limestones few and infrequent. Fossils are rare or wanting at all but a few horizons, though in some beds and in some localities abundant. But from the general likeness of the strata and the uniformity in deposition and character of material, with the preliminary work done years ago by the Geological Survey, under the direction of Prof. A. H. Worthen, of which I have freely availed myself, it has been comparatively easy to decide to which of the main divisions of the Coal Measures to assign the various outcrops.

For the surface contour I am indebted to Prof. J. W. Rolfe, of the University of Illinois, who kindly sent me tracings from the topographical county maps, prepared

under his direction from the survey undertaken to prepare the topographical map of the State, which formed part of the Illinois exhibit at the World's Fair.

The diagrams of the sections which are given on the accompanying plate are reproduced, on a smaller scale, from those displayed in the geological department of the Illinois exhibit. Some of the data contained in the following pages are shown in the diagrams, but the greater part are precluded from appearing by the necessarily small scale of the diagrams.

The line of the sections extends in a southeast-by-east direction from St. Louis, on the Mississippi river, to Shawneetown, on the Ohio river. The line passes diagonally through the center of St. Clair county, a little southwest of the center of Washington county, intersects the northeast corner of Perry county, southwest part of Jefferson county, the northern part of Franklin county, the southwest corner of Hamilton county, northeast corner of Saline county, and the center of Gallatin county.

All the strata outcropping on the line or in its immediate vicinity belong to the Carboniferous Series and the Coal Measures Division. During the reconnaissance, search was made for exposures, and, whenever found, measurements of the thickness of the outcropping strata were made, and specimens of the different strata collected. The sections thus made and other data accumulated, logs of coal shafts and drill holes, are given in the following pages, to show the data from which the diagram sections were constructed.

But few exposures are found in the vicinity of the line, owing to the comparatively small variation in altitude of the surface, and to the entire region being covered with a sheet of Quaternary deposits, clay, gravel, or loess, to the depth of from 10 to 150 feet,

and also to the general softness of the strata, so that even along the streams but few outcrops are seen, and these of limited extent. It is as Mr. Engelmann justly said, in describing the geology of Washington county: "In conformity with the predominating prairie character and on account of the softness of most of the strata, outcrops of rocks are quite scarce, and rocky cliffs are only developed on a small scale."

The section is begun with the Belcher well at St. Louis, the record of which will be found in the "Transactions of the St. Louis Academy of Science" (Vol. I., pp. 80-86, 1857). East of the Mississippi river the line of the section crosses first the flood plain of the Mississippi, known as the American bottom, for a distance of about seven miles, in which there are no exposures. The first outcrops are found in the bluffs which rise to a height of from 120 to 200 feet above the plain at their foot: at the time of my examination the bluffs were so overgrown with vegetation that the strata could be seen in but few places.

St. Clair County.

GEOLOGICAL FORMATIONS.

(GEOL. SUR. ILL. I., 298.)

Quaternary, marl, clay, sand, gravel, etc.....	20-150 feet.
Lower coal measures, including the conglomerate, about	300 "
Subcarboniferous or Mississippian series, comprising the Chester and St. Louis subdivisions, about.....	300 "

SECTION I.

Outcrop in Mississippi river bluff, seven miles northwest of Belleville, on the northwest quarter of section 35, town-

ship 2 north, range 9 west. Top of section is about 500 feet above sea level.

1. Shale, blue, argillaceous, exposed.....	8 feet.	
2. Shale, yellow, argillaceous.....	6 "	
3. Limestone, in part nodular with conchoidal fracture.....	1 foot.	
4. Shale, blue, argillaceous, like No. 1.....	2 feet.	
5. Limestone, like No. 3.....	3 "	
6. Shale, bituminous, slaty.....	-	3 inches.
7. Coal No. 6, "Belleville Coal".....	5 feet.	
Total thickness seen.....	25 "	3 "

SECTION II.

Outcrop in bluff at Strowbinger's coal mine, about one-fourth mile southwest of preceding section. Top of section about 490 feet above sea level.

1. Limestone.....	3 feet.
2. Shale, bituminous, slaty.....	3 "
3. Coal No. 6.....	7-8 "
4. Fire-clay, from 1 foot 6 inches to.....	4 "
5. Limestone, exposed.....	2 "
Total thickness seen.....	20 "

SECTION III.

Section in Chris. Lauf's stone quarry on bank of Richland creek, and coal shaft below quarry in Belleville. Top of section is about 510 feet above sea level,

1. Clay, loess, quarried for the manufacture of brick, tile, etc.....	15-25 feet.
2. Limestone, brownish, fossiliferous.....	3 " 6 inches.
3. Fire-clay.....	7 "
4. Limestone, granular, fossils, few, indistinct.	6 "
5. Limestone, fine-grained, bluish, bottom of quarry.....	6 "
6. Limestone, one eight feet ledge, several two feet ledges.....	21 "
7. Shale, bituminous, the "slate" of the miners.	2 "
8. Coal No. 6, "Belleville Coal".....	7 "
Total thickness.....	77 feet 6 inches.

SECTION IV.

Record of a well bored at Belleville, near the northwest corner of section 3, township 1 north, range 8 west, in 1889, taken from the Belleville News-Democrat of March 8, 1889. Top of well is about 530 feet above sea level.

1. Soil and clay.....	26 feet.
2. Sand and gravel.....	2 "
3. Yellow clay.....	34 "
4. Limestone.....	58 "
5. Coal (No. 6).....	7 "
6. Fire clay.....	2 "
7. Shale and sandstone.....	169 "
8. Gray sandstone.....	14 "
9. Black shale.....	3 "
10. Sandstone, white.....	10 "
11. Clay shale.....	8 "
12. Sandstone, reddish.....	47 "
13. Sandstone, white.....	10 "
14. Sandstone, gray.....	12 "
15. Shale.....	27 "
16. Sandstone, soft.....	14 "
17. Sandstone, hard.....	15 "
18. Sandstone, gray.....	58 "
19. Sandstone, dark.....	21 "
20. Limestone.....	25 "
21. Sandstone, brown.....	19 "
22. Limestone.....	13 "
23. Sandstone.....	16 "
24. Limestone, hard.....	21 "
25. Shale.....	100 "
26. Limestone.....	93 "
27. Shale.....	86 "
28. Sandstone.....	10 "
29. Conglomerate.....	30 "
30. Shale.....	56 "
31. Sandstone and shale.....	70 "
32. Shale, black.....	20 "
33. Sandstone and shale.....	25 "
34. Cherty rock.....	20 "
Total depth.....	1141 feet.

No 20, in the above, marks the uppermost limestone, or No. 1, of Worthen, of the Chester group. The dividing line between the lower coal measures and the conglomerate is not easily drawn; perhaps No. 12 above may be regarded as the top of the conglomerate; this gives the conglomerate a thickness of 204 feet. Perhaps this is too great a thickness, and it may be better to regard No. 17 as the top; this would make the conglomerate 94 feet thick.

No. 34 probably marks the summit of the St. Louis group. If so, the thickness of the Chester group, under St. Clair county, at this point, is 584 feet. Prof. A. H. Worthen (Geol. Surv. Ill. I, 305.) says: "This group (Chester), which is at least 600 feet thick in the southern part of Randolph county, has already thinned out, before reaching the southern part of St. Clair, to an aggregate of less than 100 feet, and includes only the lower sandstone and a thin bed of limestone, which probably represents also the lower limestone division in Randolph County."

The section above would indicate that the Chester group does not thin to the north as rapidly as has been supposed. If the interpretation given above is correct, and it seems the best explanation of the record, it goes to show that the study of surface exposures, few in number, without the knowledge given by the drill, is misleading; and illustrates how really small is our knowledge of the geology of Illinois, and enforces the necessity for a new geological survey of the State, or if not a new survey, then a continuous organization which shall accumulate and utilize the facts developed by the drill and other exploitation.

As correlated with the Chester group of Randolph county, the beds in the record above have their equivalents as follows:

- No. 20—Limestone No. 1.
- No. 21—Sandstone No. 1.
- No. 22—Limestone No. 2.
- No. 23—Sandstone No. 2.
- No. 24—Limestone No. 3
- No. 25—Lyropora shale.
- Nos. 26 and 27—Limestone No. 4.
- Nos. 28 to 33—Basal sandstone, or Aux Vases sandstone, of the Chester group.

SECTION V.

Van Court's coal shaft, at O'Fallon, Ill. Top of shaft about 520 feet above sea level.

1. Soil	1 foot 6 inches.
2. Yellow clay	29 feet.
3. Yellow sandstone	16 "
4. Blue slate, mixed with sandstone.....	29 "
5. Blue slate, mixed with iron ore.....	35 "
6. Fire clay.....	4 "
7. Conglomerate.....	1 foot 6 inches.
8. Red shale and marl.....	4 feet.
9. Gray limestone.....	6 " 6 "
10. Clay shale.....	6 " 6 "
11. Sandstone	8 "
12. Bluish shale	4 " 6 "
13. Black-spotted limestone.....	6 " 6 "
14. Gray limestone.....	1 foot 6 "
15. Shale	46 feet 6 "
16. Coal	7 " 6 "

Total depth.....207 feet 6 inches.

The coal, No. 16, in the above record, is undoubtedly Coal No. 6, or the "Belleville Coal." This would show that the shale above the coal, which is almost wanting in Section III, preceding, and is much thicker but inclu-

ded in No. 4, in Section IV, thickens very much eastwardly. At Belleville, Coal No. 6 is about 420 feet above the sea level, and at O'Fallon, about 320 feet above the sea level.

SECTION VI.

Shaft of the great Coal Pit at Summerfield, Ill. Top of shaft is about 500 feet above sea level.

1. Soil and clay	35 feet.
2. Sandstone	3 " 6 inches.
3. Shale	11 "
4. Sandstone	12 "
5. Hard limestone.....	5 " 6 inches.
6. Sandstone	12 "
7. Shales.....	81 "
8. Conglomerate	4 "
9. Gray shale.....	18 "
10. Shale, blue, black, etc.....	24 "
11. Hard limestone.....	5 "
12. Fire clay and black shale.....	25 "
13. Clay, shale and sandstone.....	8 "
14. Gray limestone.....	8 "
15. Gray shale.....	19 " 4 inches.
16. Coal	4 " 8 "
Total depth.....	276 feet.

No. 5 (above) is the well marked horizon which has been called by various names in the geological reports of the State—Shoal creek limestone, Curlew limestone, Carlinville limestone—and is regarded as marking the boundary between the Lower and Upper Coal Measures.

No. 16 is coal No. 6. At Summerfield it lies about 230 feet above sea level; hence, in a distance of about nine miles from O'Fallon to Summerfield, the elevation of Coal No. 6 has declined ninety feet, about, or a fall of ten feet to the mile. This, however, is probably not the full amount of the dip, as the general dip of the strata is not directly to the east.

SECTION VII.

Outcrops along Jack's Run, one-half mile east of Freeburg, on section 29, township 1 south, range 7 west.

1. Shale, arenaceous, exposed.....	6 feet.
2. Sandstone, soft, micaceous, massive layer.....	2-3 "
3. Sandstone, thinly stratified, in part shaly.....	15 "
4. Shale, argillaceous, greenish.....	5 "
	<hr/>
Total thickness.....	29 feet.

These strata lie some forty feet above the Belleville quarry rock, according to Worthen's report on St. Clair county, and correspond to Nos. 7-10 of Section VI, and Nos. 10-12 of Section V. A well was bored to the depth of 480 feet at Freeburg, some years ago, but investigation developed the fact that no record of the strata passed through had been preserved.

SECTION VIII.

Boring at Lementon, on the Cairo Short Line (St. L., A. & T. H. R. R.), on section 8, township 2 south, range 7 west. (Geol. Sur. Ill., VII, 31). Surface about 460 feet above sea level.

1. Soil.....	3 feet.
2. Yellow clay.....	14 "
3. Sand and gravel.....	1 foot.
4. Blue clay.....	20 feet.
5. Carbonaceous clod.....	1 foot.
6. Clay shale.....	24 feet.
7. Rock (not defined).....	1 foot.
8. Clay shale.....	7 feet.
9. Black shale.....	9 " 6 inches.
10. Coal No. 5.....	1 foot 6 "
11. Fire clay and shale.....	34 feet.
12. Hard rock (limestone?).....	1 foot 6 inches.
13. Black shale.....	3 feet 6 "
14. Coal (No. 3, Worthen).....	0 " 2 "
15. Fire clay and shale.....	9 "

16. Brown shale.....	4 feet.
17. Black or blue shale.....	9 "
18. Hard blue shale.....	1 foot.
19. Sandstone.....	9 feet.
20. Brown shale.....	1 foot.
21. Sandstone.....	1 "
22. Coal (No. 2, Worthen).....	1 "
Total depth.....	156 feet 2 inches.

SECTION IX.

Boring from the bottom of coal shaft of White Oak Coal Co., near Marissa, Ill. (Geol. Sur. Ill., VII, 31). Top of shaft approximately 500 feet above sea level.

1. Strata above Coal No. 6.....	141 feet.
2. Coal No. 6.....	6 "
3. Fire clay.....	7 " 11 inches.
4. Limestone.....	2 " 10 "
5. Fire clay.....	1 foot.
6. Limestone.....	0 feet 11 inches.
7. Clay shale with iron ore concretions.....	50 " 10 "
8. Black shale.....	5 " 6 "
9. Clay shale.....	33 "
10. Blue shale, containing nodules.....	18 " 3 "
11. Limestone.....	1 foot 3 "
12. Black shale.....	6 feet.
13. Coal.....	1 foot 3 "
14. Fire clay and coal.....	2 feet 7 "
15. Fire clay.....	5 " 4 "
16. Coal.....	0 " 10 "
17. Fire clay.....	11 " 6 "
18. Variegated shale.....	1 foot 6 "
19. Sandy shale.....	8 feet 9 "
20. Dark limestone.....	0 " 3 "
21. Micaceous sandstone.....	15 " 6 "
22. Sandy shales with clay partings in lower part.....	50 " 1 "
Total depth.....	372 feet 1 inch.

Nos. 13-16 of the above represent one of the lower seams, perhaps No. 3. Coal No. 5 does not appear to be developed at this point.

Washington County.

The geological formations which outcrop at the surface, with their estimated thickness, are given by Mr. Henry Englemann in the Geol. Sur. Ill., III, 148, as follows:

Upper sandstone formation..... 200-250 feet.

(Worthen considers the thickness here given an over-estimate, and thinks 100 feet to be a much nearer approximation).

Shoal Creek limestone.....	7 feet.
Slaty division.....	15-50 "
Lower sandstone formation.....	270 "

The Quaternary, which covers the county as with a blanket, varies from ten to fifty feet, and at some points is still thicker. But few outcrops embracing any considerable vertical thickness, were met with.

SECTION X.

Outcrops on Williams creek, on the south half of section 22, township 2 south, range 4 west. Top section about 470 feet above sea level.

1. Shale, bluish, somewhat marly, exposed.....	3 feet.
2. Sandstone, soft, massive, micaceous.....	4 "
3. Shale, argillaceous, bluish.....	2 "
4. Interval not exposed, probably shale.....	7 "
5. Shale, argillaceous.....	6 "
6. Sandstone, thinly stratified, soft, micaceous.....	2 "
7. Sandstone, massive, micaceous, exposed.....	2 "
Total thickness.....	26 feet.

No. 5, in the above, presents a peculiar appearance. Undoubtedly a coal measure stratum and *in situ*, it showed, irregularly distributed on the face of the exposure, two large, exceedingly hard limestone boulders and one sandstone boulder, and a large number of pebbles, the whole reminding one of some deposits of the drift formation. Is this debris of an ancient iceberg or glacier

—a carboniferous glacial period? Unfortunately, but a few feet were exposed, so that nothing definite could be ascertained.

SECTION XI.

Outcrop on Elkhorn creek, on northeast quarter of section 32, township 2 south, range 4 west. Elevation above sea level of the top of the section, about 460 feet.

1. Sandstone, soft micaceous, forming an overhanging bluff, probably underlaid by shale, exposed thickness 20 feet.

SECTION XII.

Outcrops on Elkhorn creek and its branches, in the vicinity of Oakdale, on sections 14 and 15, township 3 south, range 4 west. Top of section about 520 feet above sea level.

1. Sandstone	8 feet.
2. Shale, black.....	0 " 8 inches.
3. Shale, sandy.....	1 foot.
4. Limestone, impure, with carbonaceous material disseminated.....	0 feet 4 "
5. Clay, shale, greenish and grayish.....	3 "
6. Limestone, impure, hard, splintery, locally termed "bastard," quarried for foundations.....1 foot 3 inches to	0 " 8 "
7. Clay shale.....	2 "
8. Not exposed, probably clay shale, about	5 "
9. Sandstone, micaceous.....	20 "
10. Clay shale.....	5 "
11. Sandstone and sandy shale.....	25 "
Total thickness.....	70 feet 8 inches.

Top of the above section is about seventy feet below the top of the Lower Coal Measures. Judging from the depth beneath the surface of Coal No. 6, at Coulterville and at Nashville, at Oakdale Coal No. 6 will be found at a depth of about 340 feet below the surface.

SECTION XIII.

Coal shaft at Nashville, Ill. Record kindly furnished by Col. L. H. Krughoff. Top of shaft about 510 feet above sea level.

1. Yellow clay.....	15 feet.	
2. Sand	8 "	
3. Pale yellow clay.....	7 "	
4. Blue clay.....	8 "	
5. Blue shale.....	4 "	6 inches.
6. Limestone, Shoal creek.....	6 "	6 "
7. Black shale.....	4 "	
8. Coal No. 9.....	2 "	
9. Clay shale.....	6 "	
10. Sandstone	8 "	
11. Sandy shale.....	47 "	
12. Limestone	0 "	4 inches.
13. Blue shale	14 "	
14. Conglomerate of clay, gravel and limestone	2 "	
15. Black shale.....	1 foot 6 "	
16. Fire clay.....	4 feet.	
17. Clay shale.....	8 "	
18. Sandy shale.....	25 "	
19. Soft sandstone.....	22 "	
20. Blue shale.....	26 "	
21. Coal No. 7.....	1 foot 2 "	
22. Fire clay.....	1 " 8 "	
23. Conglomerate of sand and limestone.....	4 " 6 "	
24. Sandy shale.....	63 "	
25. Blue and black shale.....	43 "	
26. Fire clay.....	1 foot 8 "	
27. Blue shale	3 feet.	
28. Fire clay	4 " 6 "	
29. Soft rock, mixture of sand and limestone	5 "	
30. Fire clay	1 foot 6 "	
31. Hard limestone.....	15 feet 10 "	
32. Black shale.....	3 " 8 "	
33. Blue shale, with boulders and lime rock..	3 "	
34. Sandy shale.....	5 "	
35. Sandstone	9 "	
36. Fire clay	1 fo "	
37. Blue shale.....	2 feet	

38. White shale.....	0 feet 6 inches.
39. Limestone.....	4 " 2 "
40. Dark blue shale.....	2 " 6 "
41. Fossiliferous limestone.....	0 " 10 "
42. Dark blue shale.....	7 " 6 "
43. Black limestone.....	4 " 6 "
44. Dark gray limestone.....	3 " 6 "
45. Black shale.....	2 " 8 "
46. Coal No. 6.....	6 "

Total depth..... 420 feet.

If No. 46 is really the No. 6 coal, which seems to be the general opinion, the general section of the Coal Measures given in Geol. Sur. Ill., VI., 2-4, does not give sufficient thickness of strata between Coal No. 6 and the Shoal creek limestone. In 1889 a drill hole was put down at Nashville to the depth of 1,000 feet, or somewhat more, but if a record was kept, about which there is some dispute, repeated efforts have failed to obtain it.

SECTION XIV.

Outcrop on Locust creek, about the middle of section 24, township 3 south, range 3 west. Top of section about 410 feet above sea level.

1. Clay and gravel (Quaternary).....	20 feet.
2. Shale, soft, micaceous, sandy.....	8 "
Total thickness.....	28 feet.

SECTION XV.

Outcrop on Watering creek, on the northeast quarter of section 18, township 3 south, range 2 west. Top of section about 420 feet above sea level.

1. Clay and gravel (Quaternary).....	
2. Limestone.....	0 " 4-6 "
3. Shale.....	10 "
4. Sandstone layer, soft.....	1 foot.
5. Shale, argillaceous.....	10 feet.
6. Sandstone, hard.....	0 " 8-10 "
Total thickness.....	22 feet 4 inches.

SECTION XVI.

Outcrop on Beaucoup creek, on the northwest quarter of section 35, township 2 south, range 2 west. Top of section is about 470 feet above sea level.

1. Soil and clay (Quaternary).....	
2. Shale, argillaceous, bluish.....	1 foot.
3. Coal No. 9.....	0 feet 6 inches.
4. Shale, black, carbonaceous.....	3 " 6 "
5. Shale, argillaceous, partly nodular.....	7 "
Total thickness.....	<u>12 feet.</u>

A short distance below where the section was taken, fragments of the Shoal Creek Limestone were found in the bed and on the banks of the creek, but no outcrops could be found showing the limestone in place. Hence I could not determine how great a distance intervened between the Coal No. 9 and the Shoal Creek Limestone at this point.

SECTION XVII.

Outcrops adjacent to Little Muddy river, on the west half of section 27, township 3 south, range 1 west. Top of section about 510 feet above sea level.

1. Sandy shale and thinly stratified sandstone.....	20 feet.
2. Sandstone, even-bedded, layers from three to twelve inches thick, has been largely quarried.....	4 "
Total thickness.....	<u>24 feet.</u>

Perry County.

The line of the section passes diagonally through the northeast township of the county. The few surface outcrops are near the dividing line between the Upper and Lower Coal Measures. A bed of sandy shale, about 15 feet thick, was seen near Little Muddy river, on the northeast quarter of section 3, township 4 south, range 1 west, the same bed as No. 1 in Section XVI.

SECTION XVIII.

Outcrop on northeast quarter section 13, township 4 south, range 1 west. (Geol. Sur. Ill., III, 96). Top of section is about 485 feet above sea level.

1. Gray shale, with nodules of iron.....	3 feet.
2. Hard, bluish-gray limestone (Shoal Creek)	5 "
3. Shale	4 " 6 inches.
4. Coal No. 9.....	1 foot.
5. Clay shale.....	6 feet.
Total thickness.....	19 feet 6 inches.

Jefferson County.

The line of the section cuts diagonally the southwest corner of Jefferson county. The very few surface exposures represent the lowest strata of the Upper Coal Measures, the Shoal Creek Limestone being but a short distance beneath the surface.

SECTION XIX.

Outcrop on Little Muddy river and adjacent hillside, near the line between sections 30 and 31, township 4 south, range 1 east. Top of section about 480 feet above sea level.

1. Sandy shale	10 feet.
2. Interval not exposed, probably shale.....	10 "
3. Sandstone, soft, ferruginous, partly massive, partly evenly stratified.....	8 "
Total thickness.....	28 feet.

Franklin County.

The surface of the northern part of the county traversed by the line is rolling, but presents no great variation in altitude, hence outcrops are few, and but limited in vertical extent. The Quaternary varies from 10 to 30 feet in thickness. All the outcrops belong to the lower part of the Upper Coal Measures.

On a small branch in section 5, township 5 south, range 2 east, an exposure of three feet of micaceous

sandstone was seen. No other exposures were met on the Big Muddy river or its affluents in the northwestern part of the county.

Two miles north of Benton, on the west half of section 6, township 6 south, range 3 east, an outcrop of about thirty feet of soft, brownish, ferruginous sandstone, with some sandy shale interstratified, has been quarried for building purposes.

About two and one-half miles northeast of Benton, in the northeast quarter of section 9, township 6 south, range 3 east, an outcrop of soft, ferruginous, micaceous sandstone, of about 20 feet, underlaid with two or more feet of clay shale, with concretions, usually of small size, of kidney iron ore, and with the fragmentary remains of fossil plants, occurs on a small branch. A little farther on, near the center of section 36, township 5 south, range 3 east, the wagon road cuts through sandstone and sandy shale, exposing about six feet.

In a small run in township 7 south, range 4 east, on section 12, probably was seen an exposure of clay shale, with concretions of kidney iron ore.

These were all the outcrops examined in Franklin county. The only boring at all near the line, of which I could learn, and it too shallow to give much information, is the following section.

SECTION XX.

Boring at Parrish, Ill., near the line of the St. Louis & Paducah R. R. Surface about 450 feet above sea level. Data furnished by Mr. J. N. Bryant.

1. Soil and clay.....	3 feet.
2. Sandstone.....	11 "
3. Carbonaceous shale.....	3 "
4. Coal (No. 8?).....	1 foot.
5. Clay shale.....	30 feet.
6. Sandstone.....	12 "
Total thickness.....	<hr/> 60 feet.

Hamilton County.

But one small exposure was discovered in the southwestern corner of Hamilton county, about one-half mile east of the county line, on section 6, township 7 south, range 5 east, where about six feet of a micaceous sandstone outcropped.

Saline County.

The geological formations outcropping, are:

Upper Coal Measures.

Lower Coal Measures.

Chester Group.

The exposures of the Chester are in an axis of uplift in the southeastern part of the county, several miles southwest of the line, known as the Eagle mountains. The few outcrops discovered belong to the Upper Coal Measures.

About one-half mile north of Gallatia, some 25 feet of shale are exposed, with about three feet of the underlying sandstone.

SECTION XXI.

Boring at Ledford, on section 29, township 9 south, range 6 east, about ten miles southwest of the line of the section. Surface about 420 feet above sea level. These strata belong to the Lower Coal Measures.

1. Loess	13 feet.
2. Hard sandstone.....	6 "
3. Gray shale.....	2 "
4. Sandstone	7 "
5. Gray shale.....	2 "
6. Hard sandstone.....	6 "
7. Hard, dark shale.....	2 "
8. Hard sandstone ..	3 "
9. Sandstone and shale.....	9 "
10. Soft sandstone.....	17 "
11. Coal No. 6.....	5 "
12. Soft sandstone.....	45 "

Total thickness..... 117 feet.

Gallatin County.

The geological formations of this county are Lower Coal Measures and Chester Group. The latter occupies the hilly or mountainous country in the southwestern corner of the county. Along the line only Coal Measure strata appear at the surface.

SECTION XXII.

Outcrop on east bank of the North fork of the Saline river, on the northeastern quarter of section 22, township 8 south, range 8 east. Top of section 390 feet above sea level.

1. Soil and clay.....	
2. Shale, arenaceous, ferruginous.....	3 feet.
3. Shale, dark blue, argillaceous, contains nodules of kidney iron ore.....	30 "
4. Shale, arenaceous, micaceous.....	12 "
5. Limestone, chert-like, splintery, much cracked and seamed at the surface.....	3 " 6 inches.
6. Shale, black, friable, exposed.....	4 "
Total thickness.....	52 feet 6 inches.

SECTION XXIII.

Strata at north end of Equality, at Peter Brightner's coal mine, on section 17, township 9 south, range 8 east. Data from Mr. Brightner. This section overlies the next (XXIV) at some interval, which I had no means of determining.

1. Sandstone	30 feet.
2. Fire clay.....	1 foot.
3. Limestone "bastard," very hard	4 feet.
4. Black shale.....	0 " 6 inches.
5. Coal No. 7	4 "
6. Fire clay.....	2 "
Total thickness.....	41 feet 6 inches.

SECTION XXIV.

Outcrops at Equality, on southeast quarter of section 17, township 9 south, range 8 east. Top of section about 430 feet above sea level.

1. Sandstone, ferruginous, micaceous.....	10 feet.
2. Argillaceous shale.....	15 "
3. Coal (No. 6?).....	1 foot 6 inches.
4. Shales and sandstone.....	40 feet.
Total thickness.....	66 feet 6 inches.

SECTION XXV.

Record of the Shawneetown Gas and Oil Co.'s well boring, made 1887-8. As a churn drill was used, the thickness assigned the various strata is only approximately correct. Surface about 350 feet above sea level.

1. Clay, sand and gravel.....	110 feet.
2. Hard, flinty rock.....	2 "
3. Soft, black slate.....	19 "
4. Soft sandstone.....	10 "
5. Fine clay.....	1 foot 6 inches.
6. Shale.....	80 feet.
7. Coal No. 7.....	7 "
8. Shale.....	78 "
9. Coal No. 5.....	5 "
10. Clay shale.....	130 "
11. Sandstone.....	15 "
12. Shale, lower part producing a limited amount of gas.....	96 "
13. Sandstone.....	20 "
14. Shale.....	30 "
15. White sandstone, with some oil.....	50 "
16. Shale.....	10 "
17. Coal No. 1.....	2 "
18. Shale.....	25 "
19. Clay shale.....	37 "
20. Black shale.....	10 "
21. Soft blue sandstone (salt water).....	55 "
22. Sandy shale.....	60 "

22. Soft white sandstone.....	20 feet.
24. Sandy shale.....	15 "
25. Clay shale.....	25 "
26. Sandy shale.....	40 "
27. Shale.....	30 "
28. Hard white sandstone.....	30 "
29. Soft shale.....	5 "
30. Hard sandy shale.....	40 "
31. Shale.....	60 "
32. Hard sandstone (salt water).....	130 "
33. Soft shale.....	10 "
34. Shale.....	15 "
35. Hard sandstone (salt water).....	50 "
36. Shale.....	10 "
37. Hard sandstone.....	70 "
38. Limestone.....	30 "
39. Hard sandstone.....	10 "
40. Soft sandstone.....	20 "
Total depth.....	1542 feet 6 inches.

Nos. 1-27 may be regarded as Lower Coal Measures proper; Nos. 28-37 as the Conglomerate. The dividing line is seldom well marked, and may be drawn somewhat higher or somewhat lower in the series without doing any violence. No. 38 marks the highest limestone of the Chester Group. This makes the thickness of the conglomerate 480 feet at this point—very much greater than has been hitherto thought. Prof. A. H. Worthen, in the Geological Survey of Illinois, volume VI, pp. 2-5, where an exhaustive section of Coal Measures strata is given, says that the thickness of the coarse sandstone or conglomerate forming the base of the Coal Measures, usually range from 20 to 110 feet. Possibly only Nos. 35-37 should be regarded as Conglomerate; this gives a thickness of 130 feet. In this event, there is a vastly greater accumulation of strata between the Conglomerate and Coal No. 1 than is given in Prof. Worthen's section above referred to.

SECTION XXVI.

Outcrop on bank of Ohio river, in front of Shawneetown. (Compare Geol. Sur. Ill., VI, 198). Strata all dip to the south, at an angle varying from 10° to 25° . Estimates of thickness are somewhat doubtful approximations. The vertical thickness of the strata is given, not the amount of space occupied horizontally. The section crosses the upturned edges from north to south.

1. Black shale, with concretionary bands of clay iron-stone interstratified	15 feet.
2. Hard, black, bituminous shale.....	6 "
3. Coal	2 "
4. Bluish shale, with irregular beds of thin, fine-grained sandstone interstratified.....	12 "
5. Shale, gray or dove-colored.....	10 "
6. Arenaceous shale.....	6 "
7. Argillaceous shale.....	30 "
8. Sandstone, hard, fine-grained.....	20 "
9. Shale and sandstone, layers alternating.....	10 "
10. Shale, arenaceous, micaceous.....	3 "
11. Sandstone, fine-grained.....	10 "
12. Shale, bluish, arenaceous, micaceous.....	4 "
13. Sandstone, ferruginous.....	30 "
Total thickness.....	158 feet.
14. Interval not exposed.	
15. Sandstone, soft, ferruginous, <i>horizontal</i> , exposed, 5 feet.	

The indications are that there is a fault between Nos. 13 and 15, but the limited examination I could make, and the insufficient exposure, furnished me no data for establishing the surmise.

These strata belong to the lowest part of the lower Coal Measures, in part to the basal sandstone known as the Conglomerate.

Geological Section in Southern Illinois through Waterloo, Sparta, Murphysboro and Olmstead.

Introductory.

This line essentially parallels the Mississippi River at a distance from it of from 15 to 20 miles. Beginning with the Lower Carboniferous it crosses the southwestern border of the Lower Coal Measures, again issues upon the Lower Carboniferous and leaves the State after passing through the Tertiary in Pulaski county. The line changes direction at Sparta and Murphysboro, bending each time more towards the south.

Monroe County.

Monroe is one of the most interesting counties in the State to the geologist and paleontologist. The outcropping strata over a large part of the county belong to the Lower Carboniferous, or Subcarboniferous, for which term Mississippian is now being substituted, a formation abounding with a wealth of fossils often exquisitely preserved. In the extreme northern part the county is crossed by an axis of disturbance, bringing to the surface some of the lower formations; entering from Missouri the uplift causes quite a dislocation near Salt Lick Point, and disappears southeastwardly.

The following table of geological formations, having surface outcrops, is taken from the Geol. Sur. Ill. V., 270.

Coal measures.....	40- 50 feet.
Chester group.....	100-350 "
Upper St. Louis limestone.....	140-150 "
Lower St. Louis or Warsaw beds.....	120-130 "
Keokuk limestone.....	150 "
Burlington limestone.....	75-100 "
Kinderhook group.....	80-100 "
Trenton limestone (in part).....	120 "

No boring could be found which would give an idea of the underground geology. An artesian well was put down at Waterloo some years ago, but no record seems to have been kept. The time at my disposal was too limited to enable me to make much exploration of the surface outcrops.

SECTION XXVII.

Outcrops along Fountain Creek on sections 27 and 34, township 2 south, range 10 west. Strata dip to the west at a low angle. Top of section about 540 feet above sea level. All strata belong to the St. Louis group.

1. Limestone, in layers from four inches to four feet thick, with occasional shaly or marly partings between layers, fossiliferous, some layers weathering cherty.....	15 feet.
2. Limestone, cherty fossils numerous, mainly bryozoa and brachiopoda.....	5 "
3. Limestone, quarried for building purposes..	12 "
4. Marl layer with a peculiar assemblage of small fossils, mainly gasteropoda, pentremites and bryozoa, varying in thickness from 2 inches to 10 inches, averaging	0 " 6 inches.
5. Limestone.....	4 "
6. Marly or shaly layer contains most abundantly an undescribed species of stenopora	0 " 4 inches.
7. Limestone, fossiliferous.....	5 "
Total thickness.	41 feet 10 inches.

SECTION XXVIII.

Outcrop on small branch flowing into Prairie du Long creek, on west half of section 21, township 3 south, range 8 west. Top of section about 450 feet above sea

level. All the strata belong to the Chester group, but the exact position in the series has not been determined.

1. Limestone layers with shaly partings.....	8 feet.
2. Limestone layer.....	2 "
3. Limestone layers with shaly and marly partings.....	5 "
4. Limestone layer.....	1 foot.
5. Shale and marl with thin slabs of limestone intercalated.....	9 feet.
6. Limestone layer.....	0 " 8 inches.
7. Limestone layers with shale partings.....	4 feet 6 "
8. Blue marly shale	1 foot 3 "
9. Limestone layers.....	4 feet.
Total thickness.....	35 feet 5 inches.

All the limestones in the above sections are fossiliferous, but the shales and marls much more so. Brachiopods, pentremites and fragments of crinoids are common, but the bryozoa are by far the most numerous represented, the genera *Fenestella*, *Archimedes* and *Rhombopora* leading in representation. More examples of the rare *Coelocomus granosus*, Ulrich, have been obtained from this locality than from any other though it is a widely distributed form.

My studies in the Chester Group confirm the earlier observations of Prof. Worthen, that the different beds of the Chester so much resemble each other lithologically and in their fossil contents, that the identification of the various beds, either by their fossils or lithological characters, is impossible. It may be that long-continued, painstaking, patient collection and study of the fossils will serve to discover some distinctive or particular horizons, so that eventually we may be able to say just where in the series any given outcrop belongs; but at present, unless continuous outcrops showing relative superposition give the clue, we are unable to place any given outcrop in its proper place.

Randolph County.

The geological formations seen at the surface in this county are the Lower Coal Measures, including the Conglomerate, the Chester Group and the St. Louis Group. The line of the section cuts the northern and eastern parts of the county, and all the outcropping strata passed over belong to the Chester and Lower Coal Measures.

It is in this county that the Chester has its typical development; for comparison with what follows, Prof. Worthen's tabular presentation is given. (Geol. Sur. Ill., I, 284).

Chester Group.

1. Gray, compact, siliceous limestone No. 1.....	25-30 feet.
2. Shale and shaly sandstones, partially exposed...	80-100 "
3. Shaly limestone No. 2.....	15-18 "
4. Massive brown sandstone.....	40
5. Limestone No. 3.....	40-45
6. Green and blue argillaceous shales, with plates of limestone.....	45-70
7. Arenaceous and argillaceous limestone No. 4.....	20-30
8. Massive and shaly sandstone.....	15-20
9. Compact and granular gray limestone No. 5, with intercalations of blue, green and purple shales, about.....	150 "
10. Massive quartzose brown sandstone.....	120 "

I have, in this report, adopted the numbering of the limestone beds as given above, though afterwards, in the reports of the Geological Survey, in the chapters describing the geology of Johnson, Massac, Pope and Hardin counties, the beds are differently numbered.

Whether detailed study will bear out this division into five different successive limestone beds, each with an underlying sandstone except No. 3, I am not prepared to say. There may also be some doubt whether these sandstones are continuous over wide areas.

SECTION XXIX.

Strata displayed in hillside northwest of court house at Chester, Ill., from top of hill to river level (ten feet of water in the channel).

1. Not exposed, elsewhere shown to be sandstone in lower part.....	73 feet.
2. Limestone	1 foot.
3. Green, blue and purple shales.....	12 feet.
4. Limestone, regularly bedded.....	10 "
5. Limestone, irregularly bedded, partly nodular and argillaceous	42 "
6. Green, blue and purple shales, partly marly, highly fossiliferous in places (Lyropora shale).....	53 "
7. Compact gray limestone....	27 "
8. Not exposed, elsewhere seen to be limestone mainly..	46 "
Total thickness.....	264 feet.

Nos. 4 and 5, above, are the Limestone No. 3 of the general section; No. 7, above, is the Limestone No. 4; and No. 8, above, is probably Limestone No. 5, in which case there is no sandstone at this place between Limestones Nos. 4 and 5. To No. 6 of the section above, I have given the name of Lyropora shale. It forms an easily recognized horizon, in which the bryozoan Lyropora, to whose stony supports, with the fenestration between lost or broken away, the name "frog mouths" has been popularly applied, is very characteristic. I have not yet succeeded in ascertaining whether the Lyropora is restricted to this shale and the underlying limestone, but at any rate it is rare, or wanting in strata higher in the series.

SECTION XXX.

Boring made with diamond-core drill at Red Bud, Ill., in 1888. Data generously furnished by Mr. Geo. Saxemeyer. Surface about 450 feet above sea level.

1.	Soll and clay	8 feet.
2.	Limestone	14 " 6 inches.
3.	Clay shale	11 " 1 "
4.	Sandstone	2 " 6 "
5.	Clay shale	7 "
6.	Clay shale and sandstone mixed	6 " 11 "
7.	Sandy shale	19 " 6 "
8.	Limestone	1 foot.
9.	Sandstone	0 feet 10 "
10.	Limestone	2 " 3 "
11.	Clay shale	2 " 4 "
12.	Limestone, with shale partings	25 " 7 "
13.	Green and brown shale	10 "
14.	Limestone and shale mixed	2 " 3 "
15.	Green and red shale	7 "
16.	Limestone, fossiliferous	3 " 6 "
17.	Red clay shale	1 foot.
18.	Sandstone	6 " 9 "
19.	Clay shale	13 "
20.	Sandstone and sandy shale	15 " 3 "
21.	Clay shale	15 " 9 "
22.	Sandstone and sandy shale	12 "
23.	Clay shale	15 "
24.	Sandy shale	3 "
25.	White sandstone, coarse, siliceous	63 " 6 "
26.	Hard limestone	198 " 6 "
27.	Limy sandstone	18 "
28.	Limestone	28 "
29.	Sandy limestone	12 "
30.	Limestone	64 "
Total depth		580 feet.

Expressed in geological terms, the preceding section reads:

Nos.		
1.	Quaternary	8 feet.
2.	Chester Group—Limestone No. 4.	14 " 6 inches.
3-7.	" —Sandstone and shale	47 feet.
8-17.	" —Limestone No. 5.	55 " 9 "
18-25.	" —Sandstone (Aux Vases).	134 " 3 "
26.	St. Louis limestone	198 " 6 "
27-30.	St. Louis (Warsaw Division).	122 "
Total thickness		580 feet.

SECTION XXXI.

Outcrop of Chester Group strata on the Okaw or Kaskaskia river, on the northwest quarter of section 16, township 4 south, range 7 west. Top of section about 380 feet above sea level.

1. Limestone in ledges measuring 9, 8, 15 and 10 inches.....	3 feet 6 inches.
2. Marly shale, with abundance of characteristic fossils	1 foot.
3. Limestone, exposed.....	1 " 8 "
Total thickness.....	6 feet 2 inches.

Natural Gas at Sparta.

1. BRIEF HISTORY.

A period of depression had fallen upon Sparta and the adjacent country. Something must be done to pull out from the slough of despondency into which all things had fallen. To Mr. W. B. Taylor was due the suggestion which led to the formation of a stock company, in December, 1887, to bore into the earth. The drill was started January 28, 1888, in the west end of the city of Sparta. Various delays and ill luck attended the drillers, but at length on the eighth of June, at a depth from the surface of 845 feet, most unexpectedly, gas with strong pressure and in large volumes burst forth. The discovery was as grateful as it was unexpected. For a time, in the absence of any means of holding it in or utilizing it, the gas was suffered to flow out unchecked, and many millions of feet went to waste. Meantime the large burning flame, twenty feet in height, aroused the surrounding country to a wonderful degree. But soon mains were laid, and the citizens were industriously piping their houses and putting gas burners into their stoves, and proceeded to enjoy nature's most impressive gift to man. Exploitation continued with the degree of success usually attending the drill.

A second well, one-half mile west of the first, gave no gas. A third well, one-half mile distant, in a southeasterly direction, gave an abundant supply. And now the usual cupidty came into play with the attendant wastefulness. An adjoining landowner put down a well as near No. 3 as he could get. Of course it was successful, but as it was draining the same territory it simply decreased the life of its predecessor. The following table shows the continuation of the exploitation, and the accompanying chart the location of the wells.

2. TABLE SHOWING EXPLOITATION.

Number of Well.	When Bored.	Result.	Present Condition
1	Jan.-June, 1888	Strong flow of gas	Produced but little after 1890; abandoned in 1893.
2	Aug.-Sept., 1888	No gas	Quit suddenly.
3	Sept.-Oct., 1888	Very strong flow of gas.	June, 1894.
4	Oct.-Nov., 1888	Strong flow of gas.	Still yielding slightly.
5	Dec.-Jan., 1889	Scarcely any gas.	Never used.
6	Feb.-Mar. 1889	Small flow of gas; rock close textured.	Never used.
7	April, 1889	Scarcely any gas.	Never used.
8	June, 1889	A little gas; rock close textured.	Never used.
9	Sept.-Oct., 1889	Strong flow of gas.	Has ceased to yield.
10	Sept.-Dec., 1890	Abandoned before reaching gas rock with loss of tools.
11	Oct.-Nov., 1891	Strong flow of gas.	Still producing.
12	November, 1891	Strong flow of gas.	Ceased producing suddenly.
12a	Nov.-April, 1892	Abandoned at 480 feet with loss of tools.
13	December, 1891	Strong flow of gas.	Producing.
14	December, 1891	Strong flow of gas.	Producing.
15	Jan.-April, 1892	Medium flow of gas.	Producing.
16	April-May, 1892	Strong flow of gas.	Producing.
17	January, 1893	Strong flow of gas.	Producing.
18	Mar.-April, 1893	No gas; rock close textured.
19	May-June, 1893	A moderate flow of gas.	Producing a little.
20	Dec.-Jan., 1894	Medium flow of gas.	Producing.
21	April.-May, 1894	No gas; rock close textured.
22	June-Aug., 1894		

Diagram Showing Location of Wells.

Sketch showing location of wells at Sparta.

Productive gas wells †

Non-producing wells •

Scale: 2 inches = 1 mile.



Distance from well No 12^a from which the water which you analyzed was taken (Laboratory No 2737) is 350 ft the log from well No 3 the log of which is on page 191 to 196

3. RECORDS OF BORINGS.

Logs of the wells, showing the thickness of the strata passed through and kind of material, were kept of wells Nos. 1, 2, 3, 5 and 8, which will be given hereafter. None are very reliable, though No. 8 seems most worthy of confidence. No records have been preserved of later wells. In the earlier wells, the gas sand was penetrated from four to seven feet, but in the later wells, Nos. 12 to 20, the rock has been penetrated deeper, from ten to forty feet. Sometimes the flow has been increased by going deeper, other times not.

Had records of all the wells been preserved, an interesting chapter might have been written upon the topography prior to the glacial period. The depth of drift deposits varies from 34 feet, in No. 1 and 57 feet in No. 2, to 99 feet in No. 3, 116 feet in No. 5, 65 feet in No. 7, 70 feet in No. 8, 104 feet in No. 11, 109 feet in No. 13, 107 feet in No. 14, 120 feet in No. 16, 115 feet in No. 17, 94 feet in No. 15. These figures, even if not all accurate, indicate a very uneven surface under the drift, possibly the bed and banks of an ancient water-course.

4. ROCK PRESSURE AND FLOW.

The confined pressure of the wells had never been accurately determined. No. 1 exceeded 200 pounds, but how much was never known. No. 3 reached 350 pounds on a steam gauge, the limit of the gauge. The later wells, Nos. 12, 13 and 14, had an initial pressure of from 180 to 200 pounds. This accords with experience in other fields, that the pressure lessens as the field is opened up.

But one measurement had been made of the open or flow pressure—on No. 4, at an early date, by Mr. D. McConathy, of Louisville, Ky. This showed between four and five pounds through a two-inch pipe, which would

represent a production of something over a million feet per day. This is, however, a maximum under the best conditions.

5. LIFE OF WELLS.

No. 1 was greatly weakened by No. 3, which has probably produced a larger amount of gas than any other well. Nos. 3, 4 and 9, all within a few feet of each other, supplied the town for considerably more than two years; after which they still continued to yield, but had to be helped by additional wells. No. 3 has lasted about five and a half years; No. 4 is still yielding slightly, but shows signs of exhaustion. Seven years will represent the extreme life of a well in this area, under the best conditions. As the field is drained, the later wells cannot be expected to last as long or be nearly as productive as the early ones. During the winter of 1890-1, during the cold spells, the wells were allowed to flow freely, *i. e.*, without any back pressure. The next winter showed them greatly weakened.

6. PRODUCTION AND COST.

The following data, for which, with many others, I am indebted to Mr. D. P. Barker, the obliging secretary of the Sparta Natural Gas and Oil Co., were furnished to the agent of the Census Bureau. They cover the year 1889:

Total production of gas.....	80,830,000 cubic feet.
Waste from leakage and other causes.....	4,000,000 "
Consumed for domestic fuel (400 fires)....	54,000,000 "
Consumed in steam establishments (3)....	22,830,000 "
Gas sold for.....	\$3,842.30
Tons of coal required for equivalent work.	3,340
Value of coal displaced, at \$1.50 per ton..	\$5,010.00

The Gas Company furnished about two-thirds of the gas consumed, hence the total production of the field, for the year, would aggregate in the neighborhood of

120,000,000 cubic feet. As this was the year of maximum production, the total output of the field since its opening has fallen not far short of 500,000,000 cubic feet. This from a territory less than one mile square.

The amount of money expended by the Gas Company and private parties in developing the gas, has amounted, in round numbers, to \$60,000, composed of the following items:

Drilling, casing and equipping wells.....	\$30,000
Pipe lines	15,000
Labor, repairs and miscellaneous items.....	15,000

In addition, the piping of some 200 houses, paid for by the owners, at an average cost of \$25, amounts to \$5,000. To offset this amount of \$65,000 which has gone after the gas, there is an income of \$40,000 from the sale of gas. This corroborates experience in some other fields, that the gas involves an actual money loss. However, the convenience, comfort and cleanliness of gaseous fuel, fully compensate for its increased cost. When at its best, the gas supplied some 600 domestic fires, five steam establishments, and one brick-burning plant.

7. WELLS.

The wells have all been put down with a cable rig. Two attempts were made with a pole rig, but were failures. The time required to drill to gas rock has varied, but after some experience in handling the strata was acquired, it was no uncommon thing to go the 845 or 865 feet in two weeks. Most of the wells have been cased as follows: Eight inch drive-pipe to work, varying from 30 to 116 feet; next, five and five-eighths inch pipe to about 500 feet, to shut out water from the shales and sandstones resting upon Limestone No. 2; lastly, four and one-quarter inch pipe, with packer nearly to the gas

rock. In the earlier wells, the gas sands could seldom be drilled deeper than three or four feet. Later, some of these wells were deepened. In the later wells, the drill has usually been sent down from 14 to 40 feet after the gas was encountered.

8. EXTENT OF THE FIELD.

The area exploited at Sparta, covers less than two square miles. Although drilling in other parts of southern Illinois was stimulated by the discovery at Sparta, at no other place has gas been found in commercial quantities. Hence not enough is known to determine the extent or capacity of the field. That all the wells but one drilled without a small, well defined area, have proved failures, seems rather inexplicable. The records of the borings are not accurate enough to determine, in so small an area, what is the structure of the gas sand and adjoining strata, whether we have to deal with a quaquaversal or dome, or with an anticline. The sandstone, which serves as the holder for the gas, varies in porosity, being most porous in the strongest wells, and quite dense in those which have yielded little or no gas. Further exploitation may prove differently, but it looks as though we had here a small but once bountifully filled pocket, which is now (August, 1894,) rapidly nearing exhaustion.

SECTION XXXII.

Borings at Sparta, Ill. Surface from 520 to 545 feet above sea level.

I have attempted, in the following table, to correlate the record of such of the gas wells as were kept by the drillers. The borings were made with a churn drill, the results of which are always inaccurate, and are made up with less or more of guess-work—usually more. In

this case the records are further corroded by the fact that the drillers were drillers, and not geologists or mineralogists. The men had no interest except to reach the gas sand as quickly as possible, and so, besides, being unable to always discriminate the strata, they were uninterested and careless. The record of well No. 3 is especially inaccurate. The drillers gave a depth of 886 feet to the gas sand, while 864 feet of casing were put into the gas sand. Of the logs given, that of No. 8 seems the most accurate.

The drilling was stopped whenever gas was found in quantity. If gas failed to come, the drilling was continued, as in wells Nos. 2, 5 and 8, until the water became salty. Below salt water, the drillers stoutly maintained, gas could not be found; they had all learned their lesson in the Ohio and Indiana field. That the conditions in this field might be different, was to them manifestly impossible. However, it is very improbable that more gas can be found by going deeper.

CHESTER GROUP LOWER COAL MEASURES.

WORTHEN'S SECTIONS.	WELL No. 1.	WELL No. 8.	WELL No. 2.	WELL No. 3.	WELL No. 5.
Geol. Sur. Ill. 1, 281, 284-5 Econ Geol. 1, 214, 217.	Bored by Lancy & Churchill	Bored by H. W. Carter.	Bored by C. P. Brandt.	Bored by C. P. Brandt.	Bored by C. P. Brandt.
Micaceous sand- stone and shale. 30-40	Feet. Soil & drift.. 34 Sandstone... 30	Feet. Soil & drift.. 36 Clay & soft stone..... 34	Feet. Soil & drift.. 57	Feet. Soil & drift.. 99	Feet. Soil & drift.. 116
Limestone..... 3		Limestone.. 14	Limestone .. 4	Limestone... 10	Limestone... 10
Shale..... 12	Shale..... 35	Shale..... 35	Coal (No. 7?) 3 Slate..... 25	Coal (No. 7?) 2 Limestone... 11 Clay shale... 2 Sandstone... 3 Slate..... 5	Coal (No. 7?) 2 Limestone... 11 Clay shale... 2 Sandstone... 3 Slate..... 5
Limestone and bituminous shale 4-6	Belleville limestone .. Shale & lime- stone..... 19		Limestone .. 12	Limestone... 17	Limestone .. 17

Chester Group Lower Coal Measures—Continued.

WORTHEN'S SECTIONS.	WELL NO. 1.	WELL NO. 8.	WELL NO. 2.	WELL NO. 3.	WELL NO. 5.
Geol. Sur. Ill. 1, 281, 284-5. Econ. Geol. 1, 2, 4, 217.	Bored by Laney & Churchill.	Bored by H. W. Carter.	Bored by C. P. Brandt.	Bored by C. P. Brandt.	Bored by C. P. Brandt.
Coal-Belleville	Feet. Coal & shale. 6	Feet. Coal 5	Feet. Coal 6	Feet. Coal 6	Feet. Coal 6
Coal No. 6.					
Fire clay & lime- stone 3-6	Limestone 8	Fire clay & shale 6	Fire clay 2	Fire clay 2	Fire clay 2
Shale or shaly sandstone 30-40	Shale 8	Limestone 8	Clay shale 20	Limestone 3	Limestone 10
Limestone 3-4	Limestone 10	Slate 4			
Bituminous 3-5					
Coal No. 5 ?		Coal No. 4.		Coal 4	Coal 4
Coal No. 5.					
Fire clay 2-4	Black slate 25	Slate 14	Limestone 12	Limestone 40	Limestone 40
	Limestone 5	Limestone 10	Slate 8	Shale 13	Black slate 13
		Black slate 14			
Coal No. 3 ?	Coal 2	Coal 4	Coal 4		

		Shale 35	Shale 38	Clay shale . . . 15	Limestone . . . 26	Limestone . . . 26
	Coal No. 2 ? .	Coal 3	Coal 5		Coal 2	Coal 2
Shale and sandstone (conglomerate) 50-150		Clay shale . . . 45 Lime & sand . . 20 Slate 35 Sandstone . . . 10 Sandstone . . . 10 Clay shale . . . 40 Limestone . . . 15 Slate 13	Fire clay & slate 29 Sandstone . . . 120 Limestone . . . 10 Slate 20	Sandstone . . . 200 Clay shale . . . 20 Limestone . . . 19 Fire clay . . . 3 Limestone . . . 11 Slate 13 Clay shale . . . 13 Sandstone . . . 61 Slate 17	Sandstone . . . 117 Slate 3 Limestone . . . 7 Coal (local) . . 5 Fire clay . . . 3 Limestone . . . 6 Slate 30 Limestone . . . 20 Slate 2 Sandstone . . . 80 Slate 3 Limestone . . . 7 Slate 19	Slate 10 Limestone . . . 2 Coal (local) . . 5 Fire clay . . . 3 Limestone . . . 6 Slate 30 Limestone . . . 20 Slate 2 Sandstone . . . 80 Slate 3 Limestone . . . 7 Slate 19
Limestone 25-30	Limestone No. 1	Limestone . . . 5	Limestone . . . 15	Limestone . . . 40	Limestone . . . 16	Limestone . . . 11
Shales and shaly sandstone 80-90		Sandstone . . . 25 Slate 10 Sandstone . . . 40 Slate 80	Slate 80 Sandstone . . . 25 Caving soapstone 15	Slate 20 Sandstone . . . 25 Caving soapstone 15	Shale 14 Limestone . . . 22 Shale 31 Sandstone . . . 2 Clay shale . . . 7	Caving slate . 60 Limestone . . 3 Black slate . . 17

Chester Group Lower Coal Measures—Continued.

WORTHEN'S SECTIONS.	WELL NO. 1.	WELL NO. 8.	WELL NO. 1.	WELL NO. 3.	WELL NO. 5.
Geol. Sur. Ill. 1, 281, 284-5. Econ. Geol. 1, 214, 217.	Bored by Laney & Churchill.	Bored by H. W. Carter.	Bored by C. P. Brandt.	Bored by C. P. Brandt.	Bored by C. P. Brandt.
Feet. Shaly limestone.. 15-18	Feet. Limestone... 44	Feet. Limestone .. 15	Feet. Limestone... 64	Feet Limestone... 13	Feet. Limestone... 16
Massive brown sandstone 40	Slate..... 46 Sandstone .. 30	Slate..... 25 Sandstone... 30 Slate..... 15	Shale 22 Sandstone... 10 Slate..... 20	Slate..... 5 Sandstone... 15 Slate..... 15 Limestone... 24 Shale 5	Slate..... 14 Limestone... 22 Shale 31 Sandstone... 2 Clay shale... 10
Limestone..... 40-45	Limestone No. 2.....	Limestone .. 30	Limestone .. 10	Limestone... 22	Limestone. . 13
Green and blue shales with plates of limestone..... 45-70	Clay shale... 104	Soft shale... 65	Conglomerate Caving red- rock 15 Slate..... 10	Slate..... 8 Sandstone... 7 Red rock... 13	Clay shale... 20 Sandstone... 15 Slate..... 10

Limestone (some- times shalo)....20-30	Limestone No. 4.....	Limestone... 20	Limestone... 32	Limestone .. 20	Limestone .. 15	Limestone .. 22
Massive and sha- ly sandstone....15-20	Shale	35 Sandstone....	28 Sandstone....	38 Sandstone....	Slate..... Limestone... 53	3 Shale..... 7 Sandstone... 15 Red slate....
Limestone No. 5 compact, granu- lar with intercal- ations of blue, green and purple shale.....150	Limestone No. 5.....	Red slate.... 15 Limestone .. 18 Slate..... 22 Limestone... 13 Shale	Light shale .. 55 Limestone .. 45	Clay shale... 67 Limestone... 20 Clay shale... 22	Slate..... Limestone... 11 Shale	41 Limestone... 16 11 Slate..... 3 16 Limestone .. 53 4 Soft shale... 41 11 Limestone... 13 5 Slate..... 16 9 4 2
Gas sand.....	Gas sand.....	Sandstone... 5	Sandstone.... 7	Sandstone.... 5	Sandstone... 5	Sandstone.... 5

Chester Group Lower Coal Measures—Concluded.

WORTHEN'S SECTIONS.	WELL No. 1.	WELL No. 8.	WELL No. 2.	WELL No. 3.	WELL No. 5.
Geol. Sur. III. 1, 201, 284-5 Econ. Geol. 1, 214, 217.	Bored by Laney & Churchhill.	Bored by H. W. Carter.	Bored by C. P. Brandt.	Bored by C. P. Brandt.	Bored by C. P. Brandt.
		Feet. Shale..... 6 Limestone... 16 Slate..... 41 Sandstone.... 7 Limestone... 4 Sandstone.... 4 Limestone.. 15 Salt water sandstone... 3	Feet. Dark gray stone..... 6 Slate..... 21 Limestone.. 14 Shale..... 48 Limestone.. 4 Red slate.... 40 White sand- stone..... 18 Red slate... 16 Limestone... 5 Red sand- stone..... 11 Red slate.... 2 Salt water sandstone... 13		Feet. Caving slato. 11 Red slato.... 16 Limestone... 4 Sandstone... 15 Slate..... 8 Limestone.. 14 Red rock.... 8 Limestone.. 4 Salt water stone..... 2
Massive quartzose sandstone 120 Aux Vases sandstone of keys.					

In the following table are given some figures compiled from the preceding logs, showing thickness of formation, etc.:

	Well No. 1.	Well No. 3.	Well No. 2.	Well No. 3.	Well No. 5.
Elevation of top of well above sea level.....	545	545	535	525	520
Depth of well.....	850	948	1025	891	981
Depth from surface to gas sand	845	845	822	886	894
Depth to gas sand from top of first limestone beneath surface	781	775	765	787	778
Thickness of strata between the top of the first limestone and the top of Coal No. 6..	54	49	44	50	50
Thickness of Coal Measures (including conglomerate) from top of first limestone beneath surface.....	334	340	331	394	340
Thickness of Chester to base of Limestone No. 4.....	332	307	287	191	266
Thickness of Chester to top of gas sand	447	435	434	393	438
Thickness of Chester Lime- stone No. 5 to gas sand....	80	100	109	103	142
Total of Limestone No. 5 penetrated.....	80	203	312	103	229

It seems probable that well No. 2 penetrated into the basal sandstone of the Chester Group, but from the record it is impossible to exactly mark the beginning. In the record of No. 3, I am unable to locate the base of the Coal Measures. As I have placed it, the thickness is too great. To regard the "limestone 11 feet," which I have placed in the Conglomerate as Limestone No. 1 of the Chester, does not give nearly enough thickness.

SECTION XXXIII.

From a comparison of the records of the wells and Prof. Worthen's sections, I have constructed the following ideal section, as it may be termed, to show what a fairly accurate record of drilling would disclose:

1. Soil and drift, about.....	40 feet.
2. Sandstone, at top more or less decomposed.....	30 "
3. Limestone.....	10 "
4. Coal (No. 7).....	2 "
5. Fire clay and shale.....	15 "
6. Limestone, with shale partings.....	22 "
7. Shale.....	0-3 "
8. Coal (No. 6).....	6 "
9. Fire clay and shale.....	6 "
10. Limestone.....	8 "
11. Shale.....	4 "
12. Coal (No. 5).....	4 "
13. Shale.....	8 "
14. Limestone, with shale partings.....	16 "
15. Shale.....	14 "
16. Coal (No. 3?).....	2-4 "
17. Shale.....	35 "
18. Coal (No. 2?).....	3 "
19. Sandstone and shale (Conglomerate).....	180 "
20. Limestone (No. 1 of Chester Group).....	20 "
21. Shale.....	15 "
22. Sandstone.....	40 "
23. Shale.....	17 "
24. Limestone (No. 2 of Chester Group).....	15 "

25. Shale.....	20 feet.
26. Sandstone.....	40 "
27. Shale.....	18 "
28. Limestone (No. 3 of Chester Group).....	30 "
29. Soft shale (Lyropora shale).....	65 "
30. Limestone (No. 4 of Chester Group).....	30 "
31. Sandstone.....	30 "
32. Shale and limestone.....	30 "
33. Shale.....	15 "
34. Sandstone (gas).....	7 "
35. Shale.....	20 "
36. Limestone.....	14 "
37. Shale.....	40 "
38. Sandstone and sandy shale (Aux Vases sandstone).....	120 "
Total thickness.....	1046 feet.

Nos. 2-19 are Coal Measures, No. 19 being the basal sandstone (Conglomerate). Nos. 20-38 represent the entire thickness of the Chester Group, which, in this section, is made 636 feet. Prof. Worthen's section, referred to before, gives 613 feet.

Between Coal No. 6 and Coal No. 5, Prof. Worthen gives 30 to 40 feet of shaly sandstone. This must have been a mistake in stratigraphical correlation, as none of the borings bear this out, and the miners in the county state that the interval between Nos. 6 and 5 is only from 15 to 20 feet. All the mines of the county, with one or two exceptions in the neighborhood of Percy, work No. 6, though No. 5, while not so thick, is universally considered a finer coal. Probably Prof. Worthen identified a lower seam as No. 5. In his description of Randolph county, he considers that but two seams appear developed in this county. The drill indicates the presence of three, and perhaps four, seams.

SECTION XXXIV.

Log of Isabella Thompson coal shaft, south of Eden, on the northwest quarter of section 8, township 5 south, range 5 west. Top of shaft 497 feet above sea level. Shaft put down July to September, 1888.

1. Soil and clay.....	3 feet.		
2. Yellow clay	17 "		
3. Blue clay	3 "		
4. Quicksand.	4 "		
5. Silt	2 "		
6. Gravel	4 "		
7. Silt	3 "	6 inches.	
8. Quicksand and gravel.....	6 "	6 "	
9. Silt, very pure and pale.....	8 "		
10. Silt, coarser, mouse-colored.....	3 "		
11. Hardpan or concrete.....	4 "		
12. Sand, fine, gray, close, firm.....	6 "		
13. Hardpan, sand and clay mixed	6 "	6 inches.	
14. Silt	2 "	6 "	
15. Boulder clay	6 "	3 "	
16. Fine gravel.....	4 "		
17. Boulder clay.....	1 foot	9 "	
18. Laminated clay.....	5 feet.		
19. Nodular limestone, bluish gray.....	6 "	10 "	
20. Clay shale.....	0 "	10 "	
21. Coal (No 7?).....	1 foot	7 "	
22. Light, argillaceous sandrock.....	1 "	8 "	
23. Fire clay.....	3 feet	2 "	
24. Blue clay shale.....	5 "	11 "	
25. Buff-colored limestone.....	2 "		
26. Blue-banded limestone.....	1 foot	11 "	
27. Clay shale.....	3 feet	6 "	
28. Clouded gray and buff limestone.....	3 "	6 "	
29. Fire clay parting.....	0 "	4 "	
30. Bluish gray slate.....	3 "	1 "	
31. Black limestone.....	2 "		
32. Buff and black spotted limestone.....	1 foot	1 "	
33. Gray and black lime bands.....	1 "		
34. Brownish gray limestone.....	3 feet	10 "	
35. Black slate.....	1 foot	8 "	
36. Coal No. 6.....	6 feet	6 "	
Total depth.....	140 feet	5 inches.	

The section condensed, is:

1. Soil and drift.....	90 feet.
2. Limestone and shale.....	7 " 8 inches.
3. Coal (No. 7?).....	1 foot 7 "
4. Fire clay and shale.....	10 feet 9 "
5. Limestone.....	22 " 3 "
6. Black slate.....	1 foot 8 "
7. Coal No. 6.....	6 feet 6 "
Total thickness.....	140 feet 5 inches.

The slate above Coal No. 6 is variable, ranging in thickness from 0 to 3 feet. The coal varies from 5 feet 10 inches to 6 feet 4 inches, being thickest where the black shale above it is thickest.

SECTION XXXV.

Boring at Coulterville, Ill. Record from Mr. J. Q. A. Nisbet, through the kindness of Mr. J. P. McClurken. Surface 545 feet above sea level.

1. Soil and drift.....	30 feet.
2. Slate.....	50 "
3. Clay shale.....	20 "
4. Black slate.....	40 "
5. Clay shale.....	15 "
6. Shale.....	45 "
7. Clay shale.....	20 "
8. Slate.....	75 "
9. Limestone.....	15 "
10. Coal (No. 6).....	7 "
11. Clay shale.....	30 "
12. Slate.....	25 "
13. Black slate.....	13 "
14. Coal.....	8 "
15. Slate.....	20 "
16. Limestone.....	7 "
17. Black slate.....	10 "
18. Limestone.....	5 "

19. White slate.....	20 feet.
20. Limestone	10 "
21. Clay shale.....	25 "
22. Limestone	20 "
23. Clay shale.....	15 "
24. Brown slate.....	20 "
25. White sandstone.....	55 "
26. Slate	40 "
27. Sandstone.....	215 "
28. Slate	10 "
29. Limestone	10 "
30. Slate.....	15 "
31. Limestone	20 "
32. Slate	40 "
33. Red rock.....	10 "
34. Limestone	40 "
35. Red rock.....	30 "
36. Limestone	20 "
37. Slate	25 "
38. Red slate.....	25 "
39. White sandstone, salt water.....	17 "
Total depth.....	1117 feet.

If the record is at all correct, No. 14 above is probably Coal No. 3. If so, it shows unusual thickness at this point. It can hardly be No. 5, as it is too far below No. 6. As best I can interpret the record, Nos. 2-28 are Lower Coal Measures, Nos. 24-28 being the Conglomerate, giving it a thickness of 340 feet; Nos. 29-39 are the Chester Group, No. 29 being the Chester Limestone No. 1, No. 31 the Limestone No. 2, No. 34 the Limestone No. 3, No. 36 the Limestone No. 4, and No. 39 the horizon of the gas sand at Sparta. This interpretation makes the Coal Measures and Conglomerate much thicker here than at Sparta, and the Chester Group much thinner, but the total distance between Coal No. 6 and the gas sand horizon only about 75 feet greater than at Sparta.

SECTION XXXVI.

Boring on Rurey farm, on northeast quarter of section 8, township 6 south, range 5 west. Record kindly furnished by Mr. C. E. Kingsbury. Surface about 450 feet above sea level.

1. Soil and drift.....	23 feet.
2. Slate and sand.....	4 "
3. Gray slate, with one foot of coal.....	37 "
4. Sandstone.....	6 "
5. Sandstone, dark.....	25 "
6. Sandstone and slate.....	30 "
7. Sandstone.....	159 "
8. Slate.....	16 "
9. Limestone.....	15 "
10. Slate.....	15 "
11. Limestone.....	70 "
12. Slate.....	30 "
13. Shale.....	16 "
14. Black shale.....	22 "
15. Limestone.....	112 "
16. Slate.....	62 "
17. Limestone.....	10 "
18. Slate.....	15 "
19. Limestone.....	73 "
20. Slate.....	7 "
21. Limestone.....	28 "
22. Slate.....	10 "
23. Slate and sandstone.....	16 "
24. Sandstone.....	6 "
25. Sandy shale.....	16 "
26. Slate.....	5 "
27. Sandstone.....	22 "
28. Limestone and shale.....	10 "
29. Shale.....	62 "
30. Sandstone.....	5 "
31. Shale.....	5 "
32. Sandstone.....	150 "
33. Limestone.....	207 "
Total depth.....	1289 feet.

Expressed geologically, the section reads:

Nos.		Feet.	Feet.
1.	Quarternary	—	23
2-5.	Lower Coal Measures (proper).....	—	72
6-8.	Conglomerate	—	205
9.	Chester Group—Limestone No. 1.....	15	
10.	“ —Shale	15	
11.	“ —Limestone No. 2.....	70	
12-14.	“ —Shale	68	
15.	“ —Limestone No. 3.....	112	
16-18.	“ —Lyropora shale.....	87	
19.	“ —Limestone No. 4.....	73	
20.	“ —Shale	7	
21-31.	“ —Limestone No. 5.....	185	
32.	“ —Aux Vases Sandstone.....	150	
33.	St. Louis Limestone.....	—	782 207
	Total thickness.....		1289

The horizon equivalent to the Sparta gas sand is somewhere in No. 29. The Chester Group is 782 feet thick, or about 150 feet more than is indicated by the borings at Sparta.

SECTION XXXVII.

Well bored at Stellville with diamond core drill. Record given me by Mr. C. E. Kingsbury, who has taken an active part in promoting and keeping records of drillings. Surface about 450 feet above sea level.

1.	Soil and quicksand.....	60 feet.	
2.	Sandstone	48 “	
3.	Limestone.....	0 “	5 inches.
4.	Sandstone	2 “	7 “
5.	Coal	0 “	5 “
6.	Clay shale.....	8 “	7 “
7.	Sandy shales and sandstone.....	5 “	6 “
8.	Sandstone, with dark streaks.....	2 “	
9.	Sandstone and sandy shale.....	7 “	
10.	Soft clay shale.....	9 “	2 “
11.	Striped sandy shale.....	1 foot	6 “
12.	White sandstone and striped sandy shale..	3 feet	6 “
13.	Limestone.....	0 “	4 “

14. Striped sandy shale.....	1 foot.
15. Dark clay shale.....	9 feet.
16. White sandstone.....	1 foot.
17. Dark sandy shale.....	4 feet.
18. Gray sandstone.....	1 foot 3 inches.
19. Limestone.....	0 feet 4 "
20. Sandstone and sandy shale.....	0 " 6 "
21. Dark shale.....	8 "
22. Sandstone.....	3 " 6 "
23. Hard rock.....	0 " 5 "
24. Striped sandstone.....	10 " 6 "
25. Hard rock.....	0 " 6 "
26. White and gray sandstone....	11 " 6 "
27. Limestone.....	0 " 1 "
28. Sandstone.....	3 "
29. Dark, coarse sandstone.....	0 " 3 "
30. White sandstone.....	34 " 2 "
31. Sandstone, with dark nodules.....	1 "
32. White sandstone.....	12 "
33. Dark, coarse sandstone.....	1 "
34. Conglomerate.....	0 " 2
35. Coarse sandstone.....	47 " 10,
Total depth.....	300 feet.

The greater part of this accurate section is Conglomerate, with a few overlying strata of the Lower Coal Measures proper. I am unable to draw this line in the record. Possibly No. 7 may be considered the top of the Conglomerate. Even an examination of the strata themselves is not always sufficient to decide, as the sandstones and shales of the two formations are very much alike. In fact, we may very much doubt the utility of attempting to separate the formations in the Illinois coal field, though in the Appalachian coal field the dividing line is easily drawn.

Perry County.

The line of the section passes diagonally through the southwestern corner of Perry county. No exposures were seen near the line of the section. A very careful and accurate boring made on the line of the Wabash, Chester & Western Railroad, in July, 1887, at Galum creek, about four miles northeast of the line, is here given, to give some idea of the character of the strata comprised in the lower Coal Measures along this portion of the line. The record has been previously published in Geol. Sur. Ill., VIII, 56.

SECTION XXXVIII.

Boring at Galum creek, on section 35, township 5 south, range 4 west. Surface about 440 feet above sea level.

1. Soil and clay.....	17 feet 6 inches.
2. Black shale.....	1 foot 10 "
3. Dark blue limestone.....	8 feet 8 "
4. Black shale.....	2 " 6 "
5. Coal No. 6.....	5 " 10 "
6. Fire clay.....	1 foot 6 "
7. Limestone.....	1 " 3 "
8. Soft white shale.....	2 feet 3 "
9. Light gray limestone.....	2 "
10. Sandy shales.....	7 " 10 "
11. Hard white limestone.....	6 " 7 "
12. Hard gray shale.....	2 "
13. Hard blue limestone.....	0 " 6 "
14. Coal No. 5.....	4 " 8 "
15. Fire clay.....	11 " 1 "
16. Limestone.....	0 " 9 "
17. Shale.....	2 "
18. Sandy shale and sandstone.....	52 " 6 "
19. Blue shale, with limestone nodules.....	5 " 3 "
20. Fossiliferous limestone.....	1 foot 4 "
21. Black shal.....	8 feet 3 "
22. Coal No. 4.....	3 " 1 "
23. Gray clay shale.....	1 foot 8 "
24. Coal.....	0 feet 2 "
25. Dark shale, with sulphur nodules.....	2 " 4 "
26. Gray shale with pyrites.....	0 " 9 "

27. Gray shale	0 feet 10 inches.
28. Black shale, with limestone nodules.	6 " 2 "
29. Limestone	0 " 1 inch.
30. Shale	13 " 10 inches.
31. Black shale.....	2 " 9 "
32. Coal No. 3.....	2 " 2 "
33. Gray shale	8 " 6 "
34. Limestone	0 " 9 "
35. Shale and sandstone	3 " 9 "
36. Shales, with bands of sandstone and lime- stone	15 " 7 "
37. Shale.....	9 " 8 "
38. Coal No. 2.....	1 foot 6 "
39. Green clay shale.....	0 feet 6 "
40. Limestone	0 " 11 "
41. Coal No. 2,.....	2 " 6 "
42. Fire clay.....	1 foot 7 "
43. Gray shale.....	0 feet 8 "
44. Sandy limestone.....	0 " 8 "
45. Gray shale	0 " 9 "
46. Dark shale.....	0 " 5 "
47. Soft coal and rock mixed	0 " 9 "
48. Brown and gray shales, with limestone nodules	7 " 6 "
49. Shale.....	12 " 9 "
50. Sandstone.....	4 " 6 "
51. Black shale, fossiliferous.....	1 " 11 "
52. Coal No. 1.....	3 " 5 "
53. Black shale.....	0 " 5 "
54. Dark sandy shales.....	8 " 7 "
55. Gray shale, with limestone nodules.....	1 foot 9 "
56. Shale.....	13 feet 5 "
57. Coal	1 foot 7 "
58. Dark shale, with limestone nodules.....	2 feet 2 "
59. Sandy gray shales.....	6 " 9 "
60. Shale, with streaks of coal.....	5 " 5 "
61. Shale	28 " 9 "
62. White sandstone, with streaks of coal.....	1 foot.
63. Coarse sandstone	14 feet 8 "
64. Pebbly conglomerate	1 foot.
Total thickness	344 feet.

No. 63 marks the top of the Conglomerate Division of the Lower Coal Measures.

Jackson County.

This is another very interesting county from a geological standpoint. The outcropping formations are given in the following table taken from the *Economical Geology of Illinois*, vol. 1, p. 505.

Lower Coal Measures, including conglomerate.....	500-600 feet.
Chester Group	800 "
St. Louis Group	250 "
Keokuk Group.....	150 "
Burlington Limestone	100 "
Hamilton Group	40-75 "
Corniferous limestone.....	20-30 "
Onondaga limestone.....	60 "
Oriskany Group (Clear Creek limestone).....	250 "
Lower Helderberg limestone.....	200 "

Along the line of the section the outcropping rocks are Lower Coal Measures exclusively. The Chester Group occupies a large area in the western and northwestern parts of the county, and the lower formations a rather small area in the southwestern part of the county.

SECTION XXXIX.

Outcrops along the line of the Mobile & Ohio Railroad between Bryden and Ava, on sections 28 and 29, township 7 south, range 3 west. Top of section about 550 feet above sea level.

1. Heavy-bedded sandstone.....	35 feet.
2. Shale with iron concretions.....	25 "
3. Interval not exposed, estimated at.....	10 "
4. Shale	3 "
5. Shaly sandstone	4 "
6. Sandstone.....	4 "
7. Shale	4 "
8. Sandstone thinly bedded	4 "
9. Sandstone ledge.....	2 "
10. Shale	4 "

11. Sandstone, heavy bedded with traces of plants.....	11 feet.	
12. Shale	4 "	
13. Sandstone, thinly bedded	3 "	
14. Sandstone.....	5 "	
15. Coal.....	.8 inches to	1 foot.
16. Shale with remains of plants.....	0 feet.	6 inches.
17. Sandstone.....	3 "	
Total thickness.....	122 feet	6 inches.

The section is near the top of the Conglomerate and may embrace a few strata belonging to the Lower Coal Measure proper. I was unable to determine the exact horizon.

SECTION XL.

Boring at Murphysboro, 1888. Record kindly furnished me by Mr. W. H. Hull. Surface about 430 feet above sea level.

1. Soil and drift.....	98 feet.
2. Black shale	27 "
3. Coal No. 2.....	6 "
4. Blue shale.....	20 "
5. Gray sandstone	48 "
6. Gray sandy shale.....	67 "
7. White sandstone.....	163 "
8. Blue shale.....	118 "
9. Limestone (?)	30 "
10. Light blue shale.....	20 "
11. Dark shale	25 "
12. Limestone	3 "
13. Dark blue shale	10 "
14. Gray limestone	18 "
15. Dark blue shale	13 "
16. Limestone.....	54 "
17. Bituminous shale.....	2 "
18. Light blue shale.....	20 "
19. Gray sandy shale.....	16 "
20. Dark blue shale.....	4 "
21. Dark sandy shale.....	23 "

22.	Gray limestone.....	5 feet.
23.	Dark limestone.....	10 "
24.	Dark blue shale.....	25 "
25.	Limestone.....	14 "
26.	Dark blue shale.....	11 "
27.	Dark sandy shale.....	13 "
28.	Gray sandstone.....	15 "
29.	Dark limestone.....	12 "
30.	Dark blue shale.....	44 "
31.	Dark limestone.....	4 "
32.	Gray limestone.....	30 "
33.	Dark limestone.....	22 "
34.	Blue shale.....	15 "
	Total depth.....	1005 feet.

No. 9 is certainly an error, it should be sandstone.
Expressed in geological terms the above section reads:

Nos.		Feet.
1.	Quaternary.....	98
2-6.	Lower Coal Measures.....	168
7-11.	Conglomerate.....	356
12-14.	Chester Group—Limestone No. 1.....	31
15.	—Shale.....	13
16.	—Limestone No. 2.....	54
17-21.	—Sandy shale.....	65
22-23.	—Limestone No. 3.....	15
24.	—Lyropora shale.....	25
25.	—Limestone No. 4.....	14
26-28.	—Sandstone and shale.....	39
29-34.	—Limestone No. 5.....	127
		<hr/> 383
	Total thickness.....	1005

SECTION XLI.

Boring made with diamond drill in 1892, near Murphysboro, on the northwest corner of the southwest quarter of section 34, township 8 south, range 2 west. Record furnished by Mr. J. D. Peters, the accomplished superintendent of the St. Louis Iron & Steel Co. Surface elevation about 445 feet above sea level.

1. Clay and sand	86 feet.		
2. Shale.....	30 "	6 inches.	
3. Dark blue shale, with concretions.....	33 "	5 "	
4. Coal No. 2.....	6 "	4'	
5. Dark blue shale.....	15 "		
6. Gray sandstone.....	20 "		
7. Blue sandy shale, with black partings.....	3 "		
8. Gray sandy shale, with black partings.....	13 "		
9. Dark sandy shale, with black partings.....	30 "		
10. Bituminous shale.....	9 "		
11. Gray sandy shales, with black partings.....	7 "		
12. Brown sandstone.....	69 "		
13. Dark shales, with sand partings.....	35 "		
14. Light sandstone.....	5 "		
15. Dark shale, with sand partings.....	21 "		
16. Light sandstone.....	46 "		
17. Dark shale, with sand partings.....	3 "		
18. Sandstone	6 "		
19. Light sandy shale.....	5 "		
20. Light sandstone	51 "		
21. Sandstone, with traces of coal.....	0 "	1 inch.	
22. Light sandstone.....	34 "	11 inches.	
23. Dark sandy shale.....	3 "		
24. Dark blue clay shale.....	67 "	6 "	
25. Sandstone, with shale partings.....	1 foot 6 "		
26. Dark blue clay shale.....	3 feet.		
27. Sandstone, with shale partings.....	45 "		
28. Sandstone	9 "		
29. Limestone.....	1 foot.		
30. Blue clay shale, with sand partings.....	5 feet.		
31. Limestone	33 "		
32. Dark blue clay shale.....	10 "		
33. Limestone	26 "		
34. Clay shale.....	9 "		
35. Light sandy shale.....	23 "	6 "	
36. Soft coal and shale mixed.....	1 foot 6 "		
37. Sandstone	0 feet 6 "		
38. Soft coal and shale mixed.....	1 foot 6 "		
39. Light sandy shale.....	15 feet.		
40. Sandstone, with streaks of coal.....	42 "		
41. Limestone.....	1 foot.		
42. Dark clay shale.....	5 feet.		
43. Limestone	2 "		

44. Dark clay shale.....	5 feet.
45. Limestone.....	1 foot.
46. Dark clay shale.....	3 feet.
47. Light limestone.....	11 "
48. Dark clay shale.....	5 "
49. Light sandy shale.....	2 "
50. Limestone... ..	5 "
51. Dark clay shale.....	14 "
Total depth.....	
881 feet.	

Expressed geologically, the section reads:

Nos.		Feet.
1.	Quaternary	86
2-12.	Lower Coal Measures.....	237
13-28.	Conglomerate	336
29-31.	Chester Group—Limestone No. 1.....	39
32.	—Shale.....	10
33.	—Limestone No. 2.....	26
34-40.	—Sandy shale.	93
41-45.	—Limestone No. 3.....	14
46-49.	—Lyropora shale.....	21
50-51.	—Limestone No. 4.....	19
		<u>222</u>
Total thickness.....		881

SECTION XLII.

Outcrop on hillside east of Makanda, Ill., on the west half of section 27, township 10 south, range 1 west. Top of section 725 feet above sea level.

1.	Soil and clay.....	10 feet.
2.	Conglomerate—Sandstone.....	150 "
3.	“ —Shale and thin ledges of sandstone..	36 "
4.	Concealed to level of railroad track.....	52 "
Total thickness.....		<u>248 feet.</u>

About a mile and a half southeast of Makanda and not far from the county line, near the top of the conglomerate hill, occurs a bit of picturesqueness, which locally had received the name "Giant City". It consists

of a series of chasms or clefts varying from a foot to twelve feet wide, and in depth from a few feet to thirty or more, intersecting each other at various levels and varying angles. Whether this unusual structure is due to erosive or other agencies, the limited examination I could give failed to disclose.

At Moore, two miles south of Makanda on the Illinois Central Railroad, the conglomerate sandstone is quarried; the vertical face of the quarry, all white sandstone of excellent quality, measured 87 feet. Some of the layers are slightly stained with iron.

Union County.

The line of the section passes not far from the middle of the county, cutting diagonally the townships in range 7 west. The conglomerate ridge crossing the northern part of the county gives it an almost mountainous aspect. Bald Knob, the highest elevation in southern Illinois, is about five miles west of the line. The formations outcropping are very much the same as in Jackson county, but do not run quite so high up in the series. The following formations were identified by the geological survey of the state.

Conglomerate sandstone.....	200 feet.
Chester Group.....	800 "
St. Louis Group.....	200-250 "
Kinderhook	80-100 "
Chemung (black slate).....	40- 60 "
Hamilton Group.....	60 "
Corniferous.....	25 "
Onondaga.....	60- 90 "
Oriskany (Clear creek).....	200-250 "
Lower Helderberg.....	250 "

No deep wells have come to my knowledge which would throw any additional light upon the above. A well 566 feet deep was sunk at the Southern Illinois Insane

Asylum, but no record was found. A few samples preserved showed the drill to have passed almost entirely through limestone, probably all of the St. Louis Group, stopping in the Warsaw division. If this interpretation is correct, though it is little more than guesswork, the St. Louis Group is thicker than indicated in the table of formation above.

The line of the section crosses successively the Conglomerate, the Chester and the St. Louis, the other formations being confined to the western side of the county.

SECTION XLIII.

Outcrop three and one-fourth miles south of Makanda, Ill., not far from the center of section 9, township 11 south, range 1 west. Top of section about 530 feet above sea level.

1. Thin bedded flaggy sandstone with fossil plants.....	7 feet.
2. Shale	5 "
3. Heavy bedded limestone, (Chester No. 1,) with characteristic fossils, exposed.....	18 "
Total thickness.....	30 feet.

This section shows the conformable superposition of the Conglomerate upon the Chester Group.

From the southwest quarter of section 16, township 11 south, range 1 west, for about two miles to Cobden, the railroad cuts through the sandstone, called No. 2, in the geology of Union county, by Prof. Worthen, lying immediately under the limestone No. 1. The thickness of the sandstone could not be measured as the exposures are not continuous. The sandstone which is mostly micaceous, lies in ledges from four to six inches thick.

SECTION XLIV.

Outcrops (not continuous) north and northeast of Anna, Ill., on sections 8 and 17, township 11 south, range 1 west. Top of section about 625 feet above sea level.

1. Limestone in ledges from one to twelve inches in thickness, with thin shale partings especially near the bottom; characteristic Chester fossils abundant	30	feet
2. Shale, somewhat marly, dark green, purple, and chocolate in color, with numerous finely preserved bryozoa, also brachiopods usually crushed and pentremites	20	"
3. Limestone heavily bedded.....	20	"
4. Sandstone and sandy shale, only partially exposed.....	—	
5. Interval not exposed.....	—	
6. Limestone.....	6	
7. Green shale, destitute of fossils.....	1	
8. Limestone with few fossils	8	
9. Sandy layers, only partially exposed.....	—	
10. Interval not exposed	—	
11. Limestone becoming leached.....	—	
12. Crystalline limestone.....	2	" 8 inches.
13. Oolitic limestone	0	" 5 "
14. Crystalline limestone	2	" 8 "
15. Crystalline limestone, with characteristic St. Louis Group brachiopods and pentremites.....	15	"
16. Oolitic limestone.....	5	"

Nos. 1-9 belong to the Chester Group, Nos. 11-16 to the St. Louis Group. As the outcrops were not continuous there was no way of determining the thickness of the basal sandstone of the Chester, immediately overlying the St. Louis.

Pulaski County.

The area of this county is occupied almost entirely by two formations, the St. Louis Group and the Tertiary. No records of deep wells or borings were discovered. The St. Louis consists of limestones presenting the usual characters. The Tertiary consists mainly of clay, micaceous sand derived from decomposed coal measure strata, and a ferruginous, pebbly, conglomerate.

SECTION XLV.

Outcrop in hillside east of Pulaski, Ill., near the center of section 15, township 15 south, range 1 west. Top of section about 455 feet above sea level.

1. Soil, loam and clay.....	59 feet.
2. Pebbly conglomerate.....	8 "
3. Clay shale, bluish and drab.....	30 "
4. Sand.....	1 foot.
5. Impure lignite.....	0 " 2-4 inches.
6. Drab clay.....	1 "
7. Sand, very fine and white.....	12 feet.
8. Concealed to level of railroad track, probably sand.....	4 "
Total thickness.....	115 feet 4 inches.

SECTION XLVI.

Outcrops in the vicinity of Caledonia, Ill., on section 23, township 15 south, range 1 east. Top of section about 400 feet above sea level.

1. Soil and clay (quaternary).....	25-30 feet.
2. Pebbly conglomerate.....	8-12 "
3. Clay shale.....	35 "
4. Sandy marl, greenish and brownish.....	18 "
5. Ferruginous sandstone.....	2-3 "
6. Bluish marl.....	3 "
7. Purplish marl or variegated clay.....	6 "
8. Impure lignite.....	2 "
Total thickness.....	109 feet.

The beds underlying No. 8 were covered by the high water of the Ohio river which was about 32 feet above low water mark on the day when the above section was measured. In both the preceding sections the different deposits succeeded each other in the same order. Whether this is true of all the tertiary deposits in this end of the State, or whether there is an indiscriminate commingling of the various kinds of material, my field-work was too limited to determine.

In sinking the piers of the Illinois Central bridge over the Ohio an *Exogyra costata* was found in excavating showing that the Cretaceous exists under the bed of the Ohio; but no outcrop of Cretaceous has ever been recorded in Illinois.

In the course of this work one thought has forced itself upon me again and again. If only the State could be induced to undertake a series of borings and keep careful and exact records of the strata penetrated, our knowledge of the geology of Illinois would gain a wonderful expansion. There can hardly be a doubt but that such an undertaking would be in the highest degree beneficial even from a utilitarian and economic standpoint, while from a scientific standpoint the results would be incalculably valuable.

ADDENDA.

In the prosecution of the work the following additional sections were collected, which have not been previously published.

SECTION XLVII.

Shaft of coal mine and boring of Centralia Mining and Manufacturing Co., at Centralia, Marion county. The record of the shaft is given in Geol. Sur. Ill. VI, 5; since publication a boring with a diamond core drill was made from the bottom of the shaft. For convenience of reference and comparison with the next section, the entire section is here given:

1. Hard pan.....	2 feet	6 inches.
2. Yellow clay.....	9 "	6 "
3. Clay shale.....	11 "	
4. Blue slate.....	47 "	
5. Shale.....	0 "	8 "
6. Limestone.....	1 foot	6 "
7. Coal.....	0 feet	8 "
8. Blue slate.....	24 "	6 "
9. Clay shale.....	2 "	

10. Limestone	5 feet	6 inches.
11. Hard sandstone.....	5 "	
12. Coal	0 "	2 "
13. Soft sandstone	6 "	
14. Coal	0 "	6 "
15. Sandstone.....	2 "	6 "
16. Coal	0 "	2 "
17. Clay shale.....	4 "	
18. Limestone	2 "	
19. Sandstone.....	12 "	2 "
20. Blue rock	1 foot	6 "
21. Fire clay.....	2 feet.	
22. Clay shale	15 "	6 "
23. Blue slate.....	29 "	
24. Limestone (Shoal Creek).....	11 "	
25. Shale	5 "	6 "
26. Coal	0 "	4 "
27. Clay shale	4 "	
28. Sandstone.....	10 "	
29. Slate	50 "	
30. Limestone	1 "	
31. Shale	2 "	
32. Clay shale	3 "	
33. Sandstone.....	24 "	
34. Blue slate.....	79 "	
35. Coal.....	1 "	2 "
36. Coal shale.....	3 "	
37. Conglomerate of limestone	8 "	
38. Light colored slate.....	10 "	
39. Sandstone.....	56 "	
40. Dark colored slate	43 "	
41. Black slate with carbonate of iron.....	0 "	6 "
42. Coal.....	0 "	1½ "
43. Clay shale with sulphite of iron.....	3 "	
44. Soft stratified rock, a mixture of limestone, kidney ore and fire clay.....	11 "	
45. Sandstone with sulphite of iron.....	1 foot.	
46. Deep black slate.....	1 "	
47. Fire clay.....	1 "	6 "
48. Gray limestone.....	2 feet.	
49. Variegated shale.....	8 "	
50. Coal.....	2 "	
51. Marble limestone.....	8 "	
52. Blue shale.....	2 "	

53. Gray limestone.....	4 feet	6 inches.
54. Black shale.....	2 "	6 "
55. Gray limestone.....	4 "	
56. Black shale.....	12 "	
57. Blue limestone.....	7 "	
58. Bituminous shale.....	2 "	6½ "
59. Coal (bottom of shaft 276 feet).....	7 "	
60. Sump, fire clay.....	10 "	
61. Sand, shale and lime mixed.....	3 "	
62. Lime shale.....	1 foot	2 "
63. Coal and slate.....	0 "	4 "
64. Clay shale.....	62 feet	6 "
65. Black slate.....	5 "	
66. Coal.....	2 "	2 "
67. Dark clay shale.....	2 "	10 "
68. Limestone.....	1 foot	4 "
69. Clay shale.....	11 feet	8 "
70. Gray slate.....	7 "	
71. Sandy shale.....	14 "	
72. Clay shale.....	3 "	3 "
73. Black slate.....	0 "	9 "
74. Coal.....	1 foot	3 "
75. Soft brown fire clay.....	3 feet	9 "
76. Conglomerate limestone and shale.....	1 foot.	
77. Sandy shale.....	9 feet.	
78. Dark clay shale.....	4 "	
79. Black slate.....	0 "	8 "
80. Coal.....	0 "	4 "
81. Gray shale.....	1 foot.	
82. Coal.....	0 feet	1 inch.
83. Sandy shale.....	5 "	11 inches.
84. Dark shale.....	2 "	
85. Black slate.....	1 foot	2 "
86. Coal.....	1 "	3 "
87. Gray shale.....	1 "	7 "
88. Sandy shale.....	4 feet.	
89. Gray shale with limestone partings.....	3 "	6 "
90. Coal.....	0 "	6 "
91. Gray sandstone.....	5 "	
92. Sandy shale.....	2 "	
93. Clay shale.....	3 "	6 "
94. Coal.....	0 "	6 "
95. Fire clay.....	3 "	
96. Clay shale.....	2 "	

97. Black slate.....	1 foot	3 inches.
98. Coal.....	1 "	3 "
99. Brown clay shale.....	4 feet	6 "
100. White fire clay.....	1 foot.	
101. Fire clay.....	3 feet	6 "
102. Limestone.....	1 foot	6 "
103. Clay shale.....	2 feet.	
104. Black slate.....	1 foot	7 "
105. Coal.....	6 feet	11 "
106. Dark shale.....	1 foot	6 "
107. Sandy shale.....	14 feet.	
108. Sandstone.....	16 "	
109. Gray shale.....	4 "	
110. Clay shale.....	25 "	6 "
111. Conglomerate of sand and boulders.....	6 "	6 "
112. Sandy shale.....	2 "	
113. Clay shale.....	12 "	8 "
114. Coal.....	0 "	4 "
115. Fire clay.....	0 "	2 "
116. Clay shale.....	3 "	7 "
117. Sandstone.....	18 "	3 "
Total depth.....	886 feet.	

SECTION XLVIII.

Log of Pittenger & Davis' coal shaft at Centralia, Ill.

1. Hard pan.....	3 feet.	
2. Red clay.....	10 "	
3. Red clay and gravel.....	2 "	
4. Blue clay.....	10 "	
5. Clay shale.....	5 "	
6. Coal.....	0 "	10 inches.
7. Fire clay.....	2 "	6 "
8. Blue shale.....	8 "	
9. Blue limestone.....	2 "	6 "
10. Blue shale.....	6 "	
11. Limestone.....	0 "	6 "
12. Fire clay.....	2 "	6 "
13. Sandy shale.....	6 "	
14. Blue shale.....	50 "	
15. Limestone.....	0 "	8 "
16. Coal.....	0 "	8 "

17.	Fire clay.....	5 feet.	
18.	Blue shale.....	50 "	
19.	Sandy shale.....	10 "	
20.	Sandstone.....	75 "	
21.	Blue shale.....	5 "	
22.	Limestone (Shoal creek).....	10 "	
23.	Black slate.....	3 "	
24.	Coal.....	0 "	6 inches.
25.	Fire clay.....	2 "	6 "
26.	Clay shale.....	6 "	
27.	Blue shale.....	53 "	
28.	Conglomerate limestone.....	1 "	6 "
29.	Black shale.....	3 feet.	
30.	Limestone.....	0 "	6 "
31.	Fire clay.....	2 "	6 "
32.	Fire clay and boulders.....	4 "	
33.	Sandy shale.....	4 "	
34.	Clay shale.....	6 "	
35.	Sandy shale.....	10 "	
36.	Blue shale.....	78 "	6 "
37.	Coal.....	1 foot	2 "
38.	Fire clay.....	1 "	8 "
39.	Conglomerate rock.....	2 feet.	
40.	Sandstone.....	2 "	
41.	Clay shale.....	1 foot	6 "
42.	Limestone.....	1 "	
43.	Blue shale.....	10 feet.	
44.	Sandstone.....	36 "	
45.	Blue shale.....	4 "	
46.	Sandy shale.....	2 "	
47.	Sandstone, with carbonate of iron.....	14 "	
48.	Sandy shale.....	5 "	
49.	Dark colored shale.....	37 "	
50.	Fire clay.....	1 "	6 "
51.	Conglomerate rock.....	1 "	6 "
52.	Clay shale.....	8 "	
53.	Black shale.....	0 "	6 "
54.	Red fire clay.....	6 "	
55.	Conglomerate rock.....	1 "	6 "
56.	Gray limestone.....	5 "	
57.	Shale.....	3 "	
58.	Variegated shale.....	1 "	6 "
59.	Fire clay.....	4 "	
60.	Dark colored shale.....	5 "	

61. Coal	3 feet	4 feet.
62. Fire clay	1 "	3 "
63. Limestone	5 "	
64. Shale	1 "	6 "
65. Gray limestone	2 "	6 "
66. Blue shale	3 "	
67. Gray limestone	1 "	8 "
68. Blue shale	0 "	8 "
69. Coal	0 "	2 "
70. Black rock	12 "	
71. Dark blue rock	3 "	
72. Black shale	1 "	8 "
73. Coal	6 "	4 "
74. Sandstone not penetrated	—	—
Total depth	637 feet	6 inch.

SECTION XLIX.

Boring at Highland, Madison county, Ill., for the Highland Prospecting Co. Data kindly furnished by Mr. George Roth.

1. Soil and drift	66 feet.	
2. Limestone	4 "	6 inches.
3. Black slate	3 "	
4. Fire clay	7 "	
5. Clay shale	16 "	6 "
6. Black shale	6 "	
7. Brown limestone	28 "	
8. Shale	55 "	
9. Sandstone	73 "	
10. Blue clay shale	10 "	
11. Fire clay	10 "	
12. Red rock	2 "	
13. Limestone	22 "	
14. Shale	5 "	
15. Sandstone	12 "	
16. Shale	12 "	6 "
17. Sandstone	6 "	
18. Shale	20 "	
19. Sandstone	39 "	
20. Shale	20 "	
21. Sandstone	40 "	

22.	Black shale	6	feet.
23.	Sandstone	6	"
24.	Black shale.....	35	"
25.	Coal	1 foot	10 inches.
26.	Fire clay.....	10	feet.
27.	Shell sandstone.....	5	"
28.	Coal	1 foot	2 "
29.	Fire clay.....	4 feet	6 "
30.	Black shale.....	55	"
31.	Sandstone	25	"
32.	Black shale	25	"
33.	Shale	75	"
34.	Limestone.....	4	"
35.	Shale	30	"
36.	Sandstone	29	"
37.	Shale	27	"
38.	Brown limestone.....	6	"
39.	Shale.....	4	"
40.	Limestone	8	"
41.	Red stone.....	2	"
42.	Shale	4	"
43.	Sandstone.....	8	"
44.	Shale	3	"
45.	Brown sandstone.....	20	"
46.	Red stone	12	"
47.	Shale	6	"
48.	Brown sandstone	19	"
49.	Green sandy shale.....	15	"
50.	Green sandstone	18	"
51.	White sandstone.....	92	" 6 "
52.	Limestone	75	"
	Total depth.....	1089	feet 0 inches.

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