SULLIVAN COUNTY.

EUGENE, IND., *Dec.* 20, 1870.

PROF. E. T. COX, STATE GEOLOGIST:

I herewith submit the following report on the geology of Sullivan county, Indiana:

In the absence of formal instructions, I have referred to the law authorizing the survey, and find that it is charged with the duty of "collecting and disseminating information in relation to geological and other scientific investigations for the promotion of agriculture, mining, the arts and manufactures." This may account for occasional notes on topics not strictly geological.

With thanks for your many courteous favors,

I am, etc.,

JOHN COLLETT.

GEOLOGY OF

SULLIVAN COUNTY, INDIANA.

Sullivan county is bounded on the north by Vigo county, east by Clay and Greene counties, south by Knox county, and west by the Illinois State line at the channel of the Wabash river, embracing an area of 443 square miles or 283,520 acres.

Of this area, about one-fifth was originally upland prairie, one-fifth the "bottoms" and terrace prairies of the Wabash and its affluents, and the remaining three-fifths upland timber. The surface is generally level or gently undulating. Descending from the table-land to the valleys, the bluffs have become covered with drift or soil derived from disintegration of underlying rocks.

The county is well watered by the Wabash river, Bosseron, Turtle, and Turmans creeks, and their many branches, which ramify into all parts. Numerous springs break out at the base of the bowlder clay, locally termed "hard pan," and at the outcrop of impervious strata accompanying the coal seams.

My examinations are embodied under the following heads:

I. PALEOZOIC GEOLOGY.
   (*a*) Coal and Coal Measure Strata.

II. RECENT GEOLOGY.
   (*a*) Glacial Drift.
   (*b*) Loess.
   (*c*) Alluvium or Modified Drift.

III. ECONOMICAL GEOLOGY.
   Statistics, Mining, Agriculture, etc.

PALEOZOIC GEOLOGY.

The *Coal Measures* are the only rock formations which occur in this county. The beds subject to investigation comprise a series of shales, compact and argillaceous sandstones, clays, and fossiliferous limestones, with four seams of coal. Deep boring has proven the existence of at least two other seams, without reaching the lower coals usually found in connection with the conglomerate.

These beds present the usual characteristics found in the coal measures of Europe and America, and, no doubt, their origin is due to the same causes. Without trenching upon the accepted theory for coal formation, we may remark that *all the animal life* represented by the fossils of the age of coal, found in this county, are of marine origin, so abundant that the individuals would amount to millions upon each acre. Part of these lived in the deep waters of the central ocean, for *Brachiopods*, the culminating family, were long supposed to be extinct until dredging by Mr. E. Forbes (Lyell El. Geol.) found their home at unexplored depths, and recently (August, 1869,) the British expedition is reported to have brought up a *Productus* from a depth of miles, near the coast of Cuba. These facts indicate the profound depths of that ancient sea adjoining or *in* whose bosom our coals were formed.

Sullivan, the county town, is situated near the center of the county. It is, by barometric measurement, ninety-two feet above low water in the Wabash at Merom. Here no coal is at present mined. Wells in the north and east part of town usually are dug to or through a thim seam of coal. Often, the crinoidal limestone, forming the roof, is found in place or in disturbed fragments.

During the petroleum excitement of 1864–66, a bore was made near the E. & C. R. R. depot to a depth of over five hundred feet. The record of this bore, if any was kept, is lost. I am indebted to Mr. Myer Beardslee for the following statement made from recollection. He is confident that

the spaces between coals and marked strata, as also the thickness of strata, may be relied upon:

SULLIVAN OIL WELL.

	FEET.
Soil,	5.0
Gray clay, with thin partings of white sand and pebbles,	8.0
Glacial "hard pan,"	2.0
Limestone,	.3
Black slate,	.8
COAL,	.2
Gray silicious fire clay,	8.0
Clay shale—iron nodules,	7.0
Brown sand rock,	20.0
Gray sand rock, sharp,	10.0
Clay shale,	10.0
Soapstone,	20.0
COAL and slate, N,	.9
Clay,	5.0
Sand Rock,	15.0
Soapstone,	20.0
Flint (?) iron ore,	1.6
Shaley Clay,	8.0
Soapstone,	40.0
COAL and slate, M,	1.6
Clay,	10.0
Soapstone,	50.0
Double limestone, flinty,	3.0
Soapstone,	20.0
COAL and slate, L,	4.0
Clay,	10.0
Soapstone,	30.0
Sand rock,	20.0
Shale,	10.0
Soapstone,	30.0
White sand rock,	8.0
Clay,	8.0

SULLIVAN OIL WELL.—Continued.

	Feet.
Soapstone,	35.0
Sand rock,	30.0
Clay,	10.0
Soapstone,	50.0
Hard rock,	10.0
Soapstone,	20.0
Slate,	1.6
Coal, K (?)	7.0
Total,	544.4

It is much to be regretted that an accurate record of this bore was not attainable, as no act of memory can be relied upon absolutely after the lapse of so much time. Mr. Beardslee's position as superintendent, and the care and anxiety by him manifested to make the section as accurate as possible, justifies our confidence. The few exposures near town bear testimony to the general correctness of the section.

East of Sullivan, a considerable stratum of limestone crops out on the Hamill farm. This stone furnishes good materials for foundations. In an early day, it was burned, yielding a fair article of dark colored lime. Below the limestone, fragments of coal were observed in the bed of the branch, but no section could be obtained. It was evidently seam N in the bore. More characteristic outcrops of this coal are found on Connor's land, northwest quarter, section 28, on R. Thornhill's land, northeast quarter, section 32, both township 8, range 9, and on Boon's and Kelly's, southeast quarter, section 5, township 7, range 9, with a thickness varying from one foot to twenty inches.

For local purposes, sand rock has been quarried at Hamill's quarry, section 26, at Thornhill's, section 32, both in township 8, and at Ferree's, section 4, township 7, range 9. A section at Ferree's quarry, following up Buck Creek against the dip, shows the following strata:

Hard, flaggy sandstone, with shelly layers interchanging,	20 ft. 0 in.
Compact flagstone,	0 ft. 10 in.
Ferruginous sandstone,	1 ft. 8 in.
Shaley soapstone,	1 ft. 4 in.
Good "pepper mix," S. S.,	2 ft. 0 in.
Soapstone, dark pyritiferous partings,	9 ft. 6 in.
Silicious flags,	0 ft. 10 in.
Soapstone,	0 ft. 10 in.
Irregular sandstone,	4 ft. 0 in.
(Continued on Boon's land.)	
Flaggy sandstone,	3 ft. 0 in.
Soapstone, iron nodules,	5 ft. 0 in.
Shelly limestone, with *Crinoid* stems and arms, *Cyathaxonia prolifera, Fusulina cylindrica Spirifer lineatus, Athyris subtilita,*	3 ft. 0 in.
Calcareous shale,	4 to 2 ft. 0 in.
Black slate,	1 to 0 ft. 0 in.
COAL, N,	1 ft. 2 in.
Fire clay to creek,	5 ft. 2 in.

The exposures at Thornhill's, section 32, township 8, range 9, indicate a similar section at and *below* his quarry.

The Ohio and Indiana Coal and Mining Company, in 1866, bored a test well on the Powers farm, southeast quarter, section 3, township 7, range 9. It was commenced a few feet below the place of coal M.

POWERS' BORE.

Shaft in drift,	9 ft. 6 in.
Double limestone,	3 ft. 1 in.
Soapstone, bituminous partings,	7 ft. 10 in.
Gray shale,	19 ft. 3 in.
Sandstone, (argillaceous ?)	33 ft. 8 in.
Soapstone,	5 ft. 6 in.
Dark clay shale,	3 ft. 0 in.
Soapstone,	18 ft. 6 in.

Coal, L, ...	4 ft. 4 in.
Fire clay, ...	0 ft. 0 in.
Total, ...	104 ft. 7 in.

I am indebted, for the above record, to Mr. Powers, who assisted in the work.

Going west from Sullivan, on the road to Gill's prairie, no outcrops were visible after passing the quarry on Morrison creek. Beyond New Lebanon, undulating knolls of the "Loess," here highly silicious, crown the bluff ridge. A valuable gravel bank of modified drift was observed near the center of the prairie.

Merom is situated upon the crest of a bluff, whose altitude of one hundred and seventy feet above low water in the Wabash river,* gives one of the most attractive views in the State.

By comparison, the following section of the bluff will be found to be very nearly a type of the coal measures of this county, from the top of the "massive sandstone," (or Anvil Rock) the highest rocky stratum, down to the bottom of Mr. Kearn's shaft and bore, or to within a short distance of coal L:

SECTION AT MEROM HILL.

Loess and drift, ...	30 ft. 0 in.
Soft sandstone, upper beds disintegrating, ...	20 to 25 ft. 0 in.
Massive sandstone, "Anvil Rock," with ferruginous seams and veins,	10 to 25 ft. 0 in.
Conglomerate pieces of shale, coal, pebbles and sandstone, bedded in calcareous materials, . .	2 to 8 ft. 0 in.
Productal Limestone, with Productus punctatus, P. longispinus, P. cora,	

*Note.—By calculation from Chas. Ellett's report, Vol. II, Smithsonian Contributions, low water in the Wabash at Merom is four hundred and one feet above the level of the ocean.

Spirifer cameratus, S. lineatus Terebratula, and *Crinoid* stems, . 2 to	4 ft.	0 in.
Dark clay shale, ...	2 ft.	0 in.
RASH COAL, ...	2 ft.	0 in.
Black slate, ...	1 ft.	2 in.
Fire clay, with pyritized pebbles, .	4 ft.	6 in.
Light drab clay shale, . . .	5 ft.	0 in.
Bituminous shale, small iron nodules,	7 ft.	6 in.
Crinoidal Limestone, Crinoid fragments very abundant, with *Spirifer cameratus, S. lineatus, S. Kentuckensis, Chonetes mesoloba, Terebratula bovidens, Pinnæ* Bryozoans (3 Sp.), *Serpulæ* very abundant, and a large Cephalopod (Indt.), . .	2 ft.	0 in.
Marl clay,*	1 ft.	6 in.
Drab clay marl,*	1 ft.	2 in.
Dark bit. and calc. shale, soft,* .	6 ft.	2 in.
Black sheety slate, ...	1 ft.	6 in.
COAL N, fat caking, . . .	1 ft.	6 in.
Good fire clay, ...	2 ft.	8 in.
Fire clay, pyritous, . . .	1 ft.	6 in.
Dark soapstone, iron stone pebbles, .	3 ft.	0 in.
Silicious flagstones, . . .	2 ft.	0 in.
Light blue argillaceous flagstones, .	2 ft.	0 in.
Light blue clay shale, with nodules containing *Dentalium obsoletum* and *Macrocheilus fusiformis*, .	5 ft.	0 in.

SECTION IN SHAFT.

Laminated sandstone, . . .	6 ft.	0 in.
Quarry sand rock, ...	10 ft.	0 in.
Hard silicious shale, large nodules,	6 ft.	0 in.
Gray silicious shale, . . .	4 ft.	0 in.
Soapstone, ...	5 ft.	0 in.

*These strata, in the north part of the county, *marly clay* or shell marl, change at Merom, Palestine, and the Busseron section west of Carlisle, to a *clay marl;* eastward they become *white* or *blue clays.*

COAL M:		
Choice caking coal,	2 ft. 0 in.	
Clay parting, .	— —	
Slaty coal, . .	0 ft. 10 in.	
Clay parting, .	0 ft. 0½ in.	
Rash coal, . .	1 ft. 2 in.	
		4 ft. 0½ in.

SECTION IN BORE.

Fire clay, ...	4 ft. 0 in.
Hard rock, (*double limestone,*) . .	2 ft. 0 in.
Clay shale, ...	0 ft. 4 in.
Hard rock, (*double limestone,*) . .	6 ft. 0 in.
Shale and soapstone, . . .	18 ft. 9 in.
Hard rock, ...	4 ft. 6 in.
Soapstone, ...	4 ft. 0 in.
Soft rock, ...	1 ft. 0 in.
Soapstone, ...	1 ft. 6 in.
Sand rock, ...	9 ft. 0 in.
Total to bottom of bore, .	230 ft. 3 in.

I am indebted to Mr. Thomas Kearns, who conducted the enterprise, for a statement of the strata passed, in sinking the shaft to Coal M, and in the bore to the bottom of the section.

The upper division of the four foot seam, M, is according to report, a good article of caking coal. The balance of the seam would burn, but did not prove desirable. The local market did not justify the expense of pumping and of the necessary machinery for hoisting; but with a larger demand it would probably pay to work M at this shaft. The bore, if continued a short distance farther, would undoubtedly have found coal L, which is a choice coal, rarely less than four and a half feet thick.

A considerable sum of money has been spent at this and other neighboring points, drifting after seam N, under the erroneons idea that the seam would become thicker under

the hill. To prevent a repetition of this experiment, and further waste of time and money, it may be well to remark that seam N, at no point observed in this vicinity, attains a greater depth than twenty inches, and that it will not average eighteen inches in thickness.

The neat and substantial edifice of the *Christian College* crowns the summit of Merom hill. The top of its spire, three hundred feet above the Wabash, offers a range of vision extending twenty-five miles north and south, nearly an equal distance east and west, and combines miles of river and prairie, bluff and forest in a tableaux of living beauty.

The stone work of the College edifice was quarried from massive ledges of the "Merom sandstone," north of town, and seems to weather far better than that stratum does generally.

Two miles northwest from Merom, coal N crops out at the water level of a small branch in northwest quarter, section 1, township 7, range 11. The overlying limestone is pretty compact, and a quantity has been quarried for foundations, etc. From a block obtained here, I secured a large Cephalopod, three inches long, one inch and a quarter at the largest diameter, and rapidly tapering to the other extremity. It is probably related to the fossil provisionally referred, by Meek & Worthen, in the second Illinois Report, p. 338, to the genus *Cyrtoceras.*

Going north from Merom, the road leads along the summit of the *Loess* ridge, often interrupted by creek valleys, which expose the yellow marl, or lower member of that deposit. Towards Graysville, it becomes highly silicious, probably from a mixture with disintegrated portions of the upper member of the "Merom sandstone."

This massive sandstone is here, at its northern terminus, well developed, especially on the lands of Mr. Ingersoll, Wm. Brewer, and Mrs. Ridgeway, sections 18 and 19, township 8, range 10. Deep, narrow gorges, with precipitous or overhanging sides, give a romantic boldness to the scenery, and afford good exposures for observation. It may be characterized as a very coarse grained sandstone, varying in color

from brown to yellowish red, with occasional strata of snowy whiteness irregularly laminated. False and diagonal bedding and coarseness of materials show that it was deposited by strong currents of water subject to frequent change of direction and to cross-currents. Portions are compact quarry rock, which, however, on exposure, generally tends to disintegrate. The coloring matter is derived from small partings and veins of iron which, being harder than their sandy matrix, fret the sides and overhanging arches of the gorges with an irregular tracery of network in relief.

Numerous fissures traverse this rock, which collect and conduct the surface water, more or less charged with iron in solution, to the impervious limestone at its base, whence, at every suitable exposure, springs burst forth—one of great volume, on the farm of Wm. Medsker, section 24, township 8, range 10, from a single opening, discharges enough water to serve the woolen mill a short distance below.

Several chalybeate springs are noteworthy features on the lands of Mrs. Ridgeway, W. Brewer, and Thomas Pogue. Their medical value is vouched for by those who have tested them. Another spring in north half, southeast quarter, section 24, township 8, range 10, which discharges bubbles of gas (probably *carburetted hydrogen*) with considerable power, was, at an early day, famous as a "deer lick." It is still frequented by domestic animals for saline waters.

Ochre, found on the farm of H. W. Ingersoll, north half, southeast quarter, section 18, township 8, range 10, has been tested by Mr. Ingersoll, Jos. Gray, and others, as a paint. It furnishes a good body and rich brown color, but has not been discovered in sufficient quantities to compete with the extensive paint banks of Martin county. Samples, exhibiting several colors, were secured for the State Cabinet. The ochre is found lodged in cavities under, and partings in the *limestone* at the base of the sand rock, and is a deposit from chalybeate waters. The *partings* above, represent two systems of straight, water-worn, vertical lines of division, crossing each other obliquely—one north, 81° east, the other south, 20° east—and, at good exposures, this stone presents

the appearance of a giant pavement laid with huge rhombic blocks.

All along Turmans creek and branches, north of Graysville, the Productal limestone (upper one of the Merom section) is rich in fossils, viz: *Productus puctatus*, large and abundant, *P. semireticulatus*, *P. longispinus*, Bryozoans, *Spirifer cameratus*, *Athyris subtilita*.

Coal N has been mined for local use on Thomas Pogue's land, section 13, and on the Ridgeway and Brewer tracts, section 18. It was generally found eighteen inches thick.

Further up, on Turmans creek, where the line dividing sections 8 and 9, township 8, range 10, crosses the creek, we meet seam M near the water's edge. Considerable coal has been mined by Nelson Barnes at his bank on the west half, section 9. The upper division of the seam proved to be a fat, caking coal, reported as excellent by blacksmiths. The lower part was not found so desirable. The bank was not in work, but, for local use alone would, it is believed, more than pay expenses.

With the assistance of Mr. Barnes, the following section was taken, commencing on the farm of Mr. Ladd, thence, by a ravine, northwest, to the Barnes mine. The strata were measured as correctly as the state of the atmosphere (thermometer at 98° in the shade) would allow:

BARNES–LADD SECTION.

(Southwest quarter, section 8, township 8, range 10.)

Soil, etc.,	20 ft.	0 in.
Anvil rock, ferruginous,	30 ft.	0 in.
Productal limestone, rich in fossils,	3 ft.	0 in.
Calcareous shale,	1 ft.	0 in.
Dark bit. shale,	5 ft.	0 in.
Coal, rash,	1 ft.	0 in.
Fire clay,	2 ft.	0 in.
Dark clay shale,	4 ft.	0 in.
Coarse, hard S. S.,	2 ft.	8 in.
Crinoidal limestone, shelly,		10 in.

Place of COAL N,			
Fire clay,			4 in.
Flaggy sandstone,		3 ft.	0 in.
Drab shale—large iron nodules,		10 ft.	0 in.
Gray shale, pyritous partings,		25 ft.	0 in.
Quarry sand rock,		15 ft.	0 in.
Hard silicious soapstone,		4 ft.	0 in.
Sil. soapstone—large iron nodules,		7 ft.	0 in.
Light col. soapstone—small, round iron nodules,		5 ft.	0 in.
COAL M:			
Choice B. S. coal,	2 ft. 0 in.		
Clay parting,	1 in.		
Black slate,	5 in.		
Clay,	1 in.		
Rash coal,	1 ft. 0 in.		
		3 ft.	7 in.
Dark slicken clay,			8 in.
Fire clay, light blue,		4 ft.	0 in.
Bed of Turmans creek,		0 ft.	0 in.

Coal M is here thrown up by a *horseback*, or rather, exposed by the termination of a ridge, which enlarges towards the north. The dip of strata southwest is about eleven feet to the mile, and to the south and east at the rate of *forty feet* to the mile.

Kidney iron ore, in considerable amount and good quality, was noticed a few yards east of Turmans creek bridge, in section 9, and also in a ravine in the northeast part of Ladd's farm, supposed to be southeast quarter, section 9, both township 8, range 10, but not in quantity to justify mining at present.

Three miles northeast of Barnes' bank, on the farm of A. Annis, another outcrop of coal N is seen, with the usual crinoidal limestone super-imposed. It is not workable.

At Eli Dix's, section 35, township 9, range 10, coal M is seen in the bed of the creek. Along the creek, a distance of half a mile, the following section was, with difficulty, secured:

SECTION AT DIX'S BANK.

Glacial and modified drift, . . 20 to	5 ft. 0 in.
Soapstone—good flat iron nodules, .	3 ft. 0 in.
Crinoidal limestone, ...	3 ft. 0 in.
Covered, ...	20 ft. 0 in.
Silicious and micaceous shale, .	10 ft. 0 in.
Quarry sandstone, ...	8 ft. 0 in.
Light col. soapstone, . . .	5 ft. 0 in.
"Black Clod"—softened pyrites with *Leda bellastriata, Cardinia fragilis, Nucula inflata, Cyathaxonia* abundant, ...	6 in.
Same, but softer, *Cardinia, Leda,* and *Astartella,*	1 ft. 0 in.
Rough, black, sheety, shale—fish fins,	1 ft. 3 in.
Cannel coal, slaty, ...	1 ft. 0 in.
Black, sheety shale, ...	1 ft. 3 in.
COAL, fat, caking, ...	1 ft. 0 in.
Fire clay, gray, ...	4 ft. 0 in.
Soapstone, ...	8 ft. 0 in.
Soapstone, with band of mammillary iron nodules, ...	2 ft. 0 in.
Turmans creek, ...	

This locality is interesting to the paleontologist on account of the number and good preservation of the fossils mentioned, especially *Leda* and *Nucula inflata.*

The crinoidal limestone connected with coal N frequently crops out along the Wabash bluffs, north of the mouth of Turmans creek, in thickness averaging about three feet. Large blocks of still greater thickness are exposed in the branch near the residence of Dr. VanVleck, section 2, township 8, range 11. In past years, a quantity of this stone was burned, furnishing a dark colored lime, which makes a cement of great strength, but requires more time to "set" than ordinary lime. Wm. Crowe, section 11, township 8, range 11, had just completed a kiln of some 500 bushels.

The walls of his new brick residence will test the quality of this lime.

At Badger's Mill, section 25, township 9, range 11, locally known as the "Narrows," the Wabash, in obedience to the law of gravitation, which constrains rivers flowing southward to hug their eastern shore, impinges against the rocky bluff. The walnut grove near the school-house, and the plateau reached by a steep ascent of one hundred feet, is a favorite pic-nic ground to boating parties from the towns and cities along the river.

Here, near its northern terminus, the Productal limestone, filled with *Productus punctatus, P. semireticulatus, P. cora (?), Spirifer cameratus, S. lineatus, Athyris subtilita,* and various lace-like Bryozoans, crowns the crest of the hill. Half way down the bluff is Coal N, with its shales capped by the Crinoidal limestone, containing the following fossils: Fish fragments, teeth or scales and fins of *Petrodus occidentalis, Pleurotomaria carbonaria, P. depressa, P. tabulata, Macrocheilus gracilis, M. fusiformis, Cardinia fragilis, Discina nitida, Chonetes mesaloba, Productus semireticulatus, Spirifer cameratus, Bellerophon carbonarius, B. Montfortianus, Crinoid* stems, etc., abundant; also, of plants, *Cordaites borassifolia.*

A shaft was sunk near the foot of the hill by Badger Bros., to whom I am indebted for a statement of the materials passed through. This, with the natural outcrops, gives the following stratigraphic exhibit at that locality:

SECTION AT THE NARROWS.

Soil, etc.,	20 to 10 ft. 0 in.
Productal limestone, fossils,	3 ft. 6 in.
Covered,	6 to 10 ft. 0 in.
Silicious shale and covered,	15 ft. 0 in.
Crinoidal limestone, fossils,	2 ft. 6 in.
Marl clay,	1 ft. 8 in.
Black sheety shale,	1 ft. 0 in.
COAL, N,	0 ft. 6 in.

Fire clay,	3 ft. 0 in.
Bit. clay, shale,	4 ft. 0 in.
Drab clay, shale,	5 ft. 0 in.
Quarry sandstone,	15 ft. 0 in.

SHAFT.

Compact banded sandstone,	4 ft. 0 in.
Drab shale, with iron nodules,	14 ft. 0 in.
Cream colored soapstone,	4 ft. 0 in.
COAL, M,	2 ft. 6 in.

BORE.

Fire clay,	3 ft. 6 in.
Hard stone at bottom,	0 ft. 0 in.

The seam M, in this shaft, was, as usual, a good, fat, blacksmith coal, but the thickness did not justify the expense of work; and, after a considerable amount of drifting to definitely settle the thickness, the shaft was abandoned. An interesting feature in this mine was the discovery of a *vertical* dyke or wall of intrusive clay, one foot wide, running a little east of north. This is the only fault, though here only a separation, that I have met with in the coals of Indiana; and can not well be explained without attributing the phenomenon to a crevice produced by earthquake action. A series of limestone veins, ten miles west of Vincennes, at the wagon bridge crossing the Embarras river in Illinois, is the only seeming parallel to this case.

On Parker creek, one mile northeast from the Narrows, the heavy quarry sandstone which so persistently accompanies coal M, is of easy access and good quality. The more micaceous deposit of the same, on "Wagon-defeat" creek, will be found capable of withstanding the heat of furnaces, and consequently will be valuable when rock having that quality is desired. On this last creek coal N is generally not in place, or presents a mere trace; but the deposits which accompany that seam, with some interchange, are present. Half a mile up the creek, from the point at which it leaves the river bluff, the strata contain the following fos-

sils: *Crinoid* stems and plates, *Bellerophon carbonarius, B. Montfortianus, B. sp.* (?), *Productus semireticulatus, Macrocheilus* (many species), *Chonetes mesoloba, Nautilus decoratus, Athyris subtilita, Lingula spatulata* (?), *Discina nitida*, with *Cordaites borassifolia, Neuropteris hirsuta*, and *N. rarinervis* in soapstone.

On the branches which flow into Prairie creek, near the north and northwestern boundary of the county, coal N is seen with an average thickness of eighteen inches, and with the usual band of fossils. Near Middletown, Vigo county, *Discina, Lingula, Macrocheilus*, and *Cardinia*, are abundant, to which are added *Euomphalus rugosus, Aviculopecten rectilateraria*, and *A. Coxanus*.

A shaft sunk by S. Fisk, Esq., near the latter town, from about the horizon of coal N, pierces the strata usually underlying that seam to a depth of 40⅔ feet. Work was stopped within a short space of coal M.

East, north, and northwest of Fairbanks, coal M is thrown up by a subterranean ridge, and the overlying strata have been eroded by glacial action. Outcrops are visible on the lands of J. Debaum, east of town; on those of John Griffin, James Newlan, and Mrs. B. Lea, along Clay branch a mile and a half northwest, and at De Camp's, Starkie's, Dilley's, and Welch's, on Welch creek. Nearly every exposure gives the following section and partings of the coal:

Good caking coal, . . .	1 to 2 ft. 1 in.	
White clay, ...	1 in.	
Slate and pyrites, ...	3 in. to 5 in.	
White clay, ...	2 in. to 1 in.	
Rash coal, ...	1 ft. 0 in.	
		3 ft. 9 in.
Dark stigmarial clay, ...		6 ft. 0 in.

The bank belonging to Welch heirs, northeast quarter, section 18, township 9, range 10, is of sufficient thickness (four feet) to justify further investigation, and the local demand would probably pay for opening a drift to the less exposed coal under the hill. Seam M. may be confidently looked

for within a circle of one or two miles around Fairbanks, with an average thickness of three feet, at a depth of from twenty to fifty feet below the surface.

Thin bands of iron nodules are frequently seen in Fairbanks township. Good kidney ore, in considerable quantity, was observed on De Camp's land, near southwest corner of section 8.

At the east side of De Camp's farm, during a thunder storm, the contents of a gulch, about three hundred cubic yards of earth, were violently thrown over the tree tops into the branch valley. It may be attributed to an explosion of inflammable gas. At many points in this region it is known that *carburetted hydrogen gas* bubbles up from the lower strata. A quantity of this collected in a cavity roofed with detrital clay was probably fired by a flash of lightning. The powerful explosion immediately succeeded.

At the risk of a seeming want of connection, we will pursue the outcrop of the higher seams while the strata are familiar to the reader.

Proceeding to the southern part of the county, the strata accompanying seam N, are seen a mile and a half southeast of Paxton, in southwest quarter, section 26, township 7, range 9, with fragments of coal and slate in the branch bed. The flaggy sandstones and grit-shales which lie between N, and the upper RASH coal, crop out on the bluff and banks of Busseron, west and northwest of Trexel's farm, section 34, township 7, range 9—here and at other parts of the southern half of the county becoming highly siliceous. At some exposures the sandy shales change into flagstones with layers varying, from mere laminæ, to bands of six, eight, and even ten or more inches, as at Trexel's, Ferree's, Nash's, and Hume's "Shaker Quarry."

Near low water of the creek, in northwest quarter, section 3, township 6, range 9, on Daly's farm, Mr. James Boon reports having seen a stratum of coal one foot or more thick. It was covered, but fragments were found in the talus of the hill confirming his statement.

In sinking wells at Carlisle, a seam of coal is reported to

have been dug through quite recently, at a level a short distance below that of the railroad depot. Reports of the material passed through in these wells indicate that this is coal N; which is confirmed by the outcrops above mentioned, and by the following section taken at Van Fossen's old mill, two miles northwest of town:

SECTION AT VAN FOSSEN'S MILL.

Drab silicious shale, . . .	5 to 8 ft. 0 in.
Shelly limestone, Crinoid stems, .	0 ft. 10 in.
Blue and drab *clay marl*, . . .	1 ft. 2 in.
Black bituminous *clay marl* with fossils,	1 ft. 4 in.
Black sheety shale, . . .	0 ft. 5 in.
Black shale, ...	1 ft. 4 in.
Dark bituminous clay shale, . .	1 ft. 2 in.
Black shale, ...	1 ft. 0 in.
COAL N—fat pyritous, . .	1 ft. 2 in.
Fire clay, ...	5 ft. 10 in.
Soapstone, with iron nodules at creek,	———

An outcrop similar to this and essentially a duplicate of that part of the Merom section reaching from N up to and including the "Merom sandstone," was seen on La Motte creek, a short distance south of Palestine, Illinois. Near this point, which is ten miles west of Carlisle, the "La Motte Petroleum and Mining Company" put down a bore. For the following record of strata in this well, I am indebted to the courtesy of the Hon. James C. Allen. This section is of deep interest in estimating the mineral wealth of all the south and southwestern part of the county, for by it, in conjunction with the bores at Sullivan and Currysville, the existance of *three* if not *four* workable coals underlying the whole intervening area is assured in the most positive manner.

SECTION AT LA MOTTE WELL, PALESTINE, ILLINOIS.

Soil and clay,	5 ft.	0 in.
Shale or soapstone,	15 ft.	0 in.
Sandstone, (quarry?)	10 ft.	0 in.
Clay slate,	6 ft.	0 in.
COAL M,	1 ft.	0 in.
Fire clay,	13 ft.	0 in.
Bastard limestone, (double L. S.)	3 ft.	0 in.
Fire clay,	5 ft.	0 in.
Limestone, (double L. S.),	2 ft.	6 in.
Stratified shale,	8 ft.	0 in.
COAL L,	3 ft.	6 in.
Fire clay,	4 ft.	0 in.
Sandstone,	43 ft.	0 in.
Shale,	5 ft.	0 in.
Hard sandstone,	4 ft.	0 in.
Soapstone and shale,	8 ft.	0 in.
COAL K,	4 ft.	6 in.
Fire clay,	5 ft.	0 in.
Shale, etc.,	4 ft.	0 in.
Dark shale,	15 ft.	0 in.
Gray sandstone,	4 ft.	0 in.
Dark shale,	39 ft.	0 in.
Gray sandstone,	17 ft.	0 in.
Black shale,	3 ft.	0 in.
ROTTEN COAL I,	3 ft.	0 in.
Fire clay,	5 ft.	0 in.
Sandstone,	22 ft.	0 in.
Reddish shale—"red keel,"	1 ft.	0 in.
Shale,	4 ft.	0 in.
Sandstone,	4 ft.	0 in.
Variegated shale, dark, green, yellow, and brown, with a one foot seam of bituminous tar having an offensive odor,	30 ft.	0 in.
Soft sandstone, becoming harder towards the bottom,	7 ft.	0 in.

This section presents some remarkable features, but the "quarry sandstone" above and the "double limestone below, identifies coal M, with reasonable certainty. It is a valuable contribution to the geology of Sullivan county.

On the northeast quarter, section 19, township 6, range 9, is a considerable stratum of blueish gray limestone several feet in depth, filled with *Crinoid* stems and arms, *Nautilus decoratus, Terebratula bovidens, Spirifer cameratus, Bellerophon carbonarius* abundant, *Hemipronites, Bryozoa* (2 Sp.,) *Corals* and *Orthis?* (Sp.?) Mr. G. G. Taylor, who owns the land, says the extent of the quarry is equal to any possible demand, and that sales in one year amounted to four hundred perches at one dollar a perch. It will undoubtably make good lime. There were no exposures to determine the exact position of this rock, but it may probably be referred to one of the upper limestones in the Merom section.

About Carlisle, the rocks are nearly horizontal, rising gently toward the north and east. Going in the latter direction, a rich alluvial plain, which widens toward the south line of the county, intervenes between town and the highlands of Maria creek. Coal is reported to have been found on Wilson's land, sections 17 and 18, township 6, range 9. Lewis Hume's stone quarry was extensively worked by the Shakers when founding their establishment in the year 1820. Some of the layers weather well and give satisfactory service. A block, mentioned by Dr. O'Haver, has been in constant use as a step-stone at his door for fifty years, and attests the quality of this stone. A stratum of limestone five to eight feet thick was observed in the bed of the branch below the quarry. On John Hume's land it is also seen, accompanied by two to four feet of good *white clay* and thin bands of ochre, but no section below could be obtained to settle their horizon definitely. From such evidence as could be obtained, it is equivalent to one of the upper limestones in the Merom section.

After a thorough trial at the "Pleasantville Pottery," Mr. Gilmore finds the Hume clay to be of excellent quality;

his workmen prefer it to the Brazil clay. The ware manufactured is strong and perfect in form. Samples were secured from different divisions of the clay, also, red, green and yellow ochres.

Coal has been found in digging wells in and near Pleasantville. The thickness *reported* varies from two feet on Dr. McDowell's farm, to five and six feet at the mills north and east of the village. Banks were formerly worked at O'Haver's in Greene county, and at Bedwell's, section 1, township 6, range 8, with a coal four and a half to six feet thick; they were unused and filled with water at the time of my visit. The scanty indications visible seemed to refer this coal to one of the *upper seams*. If further investigations shall find this to be the case, it will tend to confirm the fact set forth on page 16, Cox's Indiana Report, 1870, that thick coal seams appear as we approach the rim or margin of the western coal basin.

Further outcrops of coal N were seen in sections 8, 9, 19, 20, and 21, in township 7, range 9, and in section 32, township 8, range 9, varying in depth but little above or below two feet.

Coal N is rarely worked, except by "stripping" for local purposes. I have extended my observations in relation to this coal, not on account of its intrinsic value, but for the reason that it marks out an *important horizon* from which to estimate the depth at which the lower *well developed, and workable seams* may be found. Sections have been given only where the exposure or developments were greatest, omitting a large amount of *detail work*, which, taken piecemeal, establishes a remarkable uniformity and persistence in strata along the western, central, and southern parts of the county.

THE LOWER COAL SEAMS, to which we have referred as underlying the region already described, crop out or approach the surface in the northeastern division of the county.

The "Pioneer shaft," at Currysville, put down by a company of practical miners, in the midst of a prairie country,

without example or test bores, is a monument to the English energy of its projectors. Pioneer, in fact as well as name, this shaft became a mining center around which other shafts have been sunk or projected. It is conducted by the present proprietors, Smith and Beswick, two of the original company. The fixtures above and below the surface, are substantial, practical, and equal to any that I have ever seen.

To the kindness of Mr. E. Smith, of the company, I am indebted for the following statement of strata passed in the shaft:

PIONEER SHAFT AND BORE—SECTION.

Soil,	2 ft. 0 in.
Hard pan,	6 ft. 6 in.
Silicious shale, pyritous partings,	12 ft. 0 in.
Soapstone, "slickened,"	19 ft. 0 in.
COAL M,	0 ft. 8 in.
Dark bit. clay, slickened,	1 ft. 4 in.
Fire clay, plastic,	10 ft. 0 in.
Fire clay, sandy,	8 ft. 6 in.
Brown limestone, compact,	3 ft. 7 in.
Green clay,	2 ft. 3 in.
Blue limestone, Spir. lineatus,	3 ft. 6 in.
Blue clay shale, pyritous,	16 ft. 0 in.
Argillaceous shale, with plants,	15 ft. 0 in.
Silicious soapstone, with thin layers of small iron stone concretions, 2 to 3 feet apart, some parts compact argillaceous sandrock,	80 ft. 0 in.
Light colored soapstone, containing *Pecopteris arborescens, Neuropteris rarinervis, N. hirsuta, Annularia sphenophylloides, A. longifolia, Sphenophyllum Schlotheimii, Asterophyllites equisetiformis, Cordaites borassifolia, C. angustifolia, Lepidodendron* trunks, cones, or terminal spikes, *Sigillaria reniformis,* trunks	

and leaves of *Stigmaria ficoides*, *Paleoxylon* and *Calamites*,		1 ft. 6 in.
COAL L:		
Choice coal,	1 ft. 0 in.	
Smut trace,	— —	
Good coal,	1 ft. 6 in.	
Smut trace,	— —	
Laminated coal,	2 ft. 0 in.	
		4 ft. 6 in.
Fire clay,		5 ft. 0 in.
(Bottom of Shaft—Bore.)		
White sandstone,		8 ft. 0 in.
Soapstone, bands of iron ore,		34 ft. 6 in.
COAL K, Block:		
Coal,	4 ft. 1 in.	
Clay parting,	0 ft. 4 in.	
Coal,	0 ft. 9 in.	
		5 ft. 2 in.
Fire clay at bottom,		0 ft. 0 in.

The roof shales of L, in this mine, is a rich herbarium of the age of coal. For profusion of species and perfect preservation of plants, I have not seen its equal. A list mentioning those found in a hurried examination is given above; but words can not picture nature's beautiful fresco work of fern leaves, vining Annularias, and feathery Asterophyllites, relieved by sculptured trunks of Lepidodendra, Stigmaria, and Sigillaria. One of the latter, twenty feet long, with its flattened diameter of several inches, not perceptibly diminished at either extremity, tells of vigorous life in this past period of the earth's existence.

At Shelburn, one mile south of the "Pioneer," Buckley and Richards, two of the original pioneers, have commenced the "Shelburn shaft." After passing through shelly sand stones and gritty soapstones, containing pyritous partings, some bituminous streaks and plant remains, and small round iron balls, they found the COAL M at a depth of about forty-five feet, here ten inches thick. In the calcareous roof shales

were found *Productus longispinus*, *P. cora* (?), *Crinoid* stems and arms abundant (several species), *Athyris subtilita*, *Orthis carbonaria* (?), *Aviculopecten rectilateraria*, *Bellerophon carbonarius*, *B. percarinatus*, *Cyathaxonia prolifera*, *Nautilus decoratus*, *N. sp.* (?), *Macrocheilus*, *Pleurotomaria*, *Cardinia*, *Orthoceras Rushensis*, *Dentalium obsoletum*, and *Phillipsia scitula* (?). Below M, with about the usual space, or rather a little in excess, the *Double lime rock*, with an intercalation of clay, was passed.

I am indebted to Messrs. Richards & Bulkly, proprietors, for the following report of stratas passed in sinking their shaft at Shelburn:

SECTION AT SHELBURN SHAFT.

Soil,	3 ft. 0 in.
Yellow clay of hard pan,	8 ft. 0 in.
Shelly sandstone and clay shale with bit. partings,	27 ft. 0 in.
Hard quarry sandstone,	2 ft. 0 in.
Water vein, 16 bbs. per hour,	
Soapstone with plant remains,	11 ft. 0 in.
"Black clod" with *Productus longispinus*, *P. cora*, *Athyris*, *Cyathaxonia*, *Aviculopecten*, *Bellerophon carbonarius*, *B. per-carinatus*, *Nautilus* 1 Sp. *Macrocheilus*, *Loxonema*, *Pleurotomaria*, *Cardinia*, *Orthocerata*, *Dentalia*, *Phillipsia*, Crinoid stems and arms of many species very abundant,	0 ft. 7 in.
COAL M,	0 ft. 7 in.
Hard sil. fire clay,	2 ft. 0 in.
Soapstone, bit. partings,	28 ft. 0 in.
Fossilferous *limestone*,	2 ft. 0 in.
Argillaceous L. S. "marble"	10 ft. 0 in.
Dark argil. shales,	12 ft. 0 in.
Choice fire clay,	2 ft. 0 in.
Soapstone,	12 ft. 0 in.
Compact sil. soapstone,	35 ft. 0 in.

Blue soapstone, . . .	10 ft. 0 in.
Light soapstone with many species of *Pecopteris, Cordaites, Lepidodendron, Stigmaria, Sigillaria, Sphenophyllum,* and *Asterophyllites,* . .	6 ft. 0 in.
COAL L 3½ to 6 ft. av., . .	4 ft. 0 in.
Total depth, ...	176 ft. 0 in.

Coal M crops out in the hill side immediately east of Shelburn, and is found in wells at a depth of 20 to 25 feet in the northwestern part of the village. In one of the wells it attains a thickness of one and a half feet.

Near seam M, operations were interrupted for a time by the irruption of a large spring of water. This is now remedied by pumps, and the shaft, when last seen, was being forwarded with an energy that promised success.

A short distance south and east of Shelburn, in the year 1866, the "*Ohio and Indiana Coal Mining Company*" put down three test bores; for two of these, reference is made to page 195, "Sullivan County," where the record is given of the "Powers well." [The "Powers" and the "Thompson well," are both in section 3, township 8. range 9.] The third, or "Shelburn well," situated on southeast quarter, section 35, township 9, range 9, was commenced below the *Double* ("bastard") *limestone,* as that stratum was observed cropping out in the adjoining bluff to the south. Thanks are due to Mr. Powers for the following record of the

SHELBURN WELL.

Shaft in drift, ...	14 ft. 0 in.
Dark clay shale, ...	24 ft. 5 in.
Gray clay shale, ...	12 ft. 6 in.
Brown, ...	3 ft. 9 in.
Hard rock (iron stone,) . . .	1 ft. 8 in.
Soapstone, ...	3 ft. 9 in.
Hard rock—iron nodule, . .	0 ft. 10 in.
Sandstone or shale, . . .	4 ft. 5 in.

Soapstone,	6 ft.	6 in.
Coal L,	4 ft.	6 in.
Fire clay,	0 ft.	0 in.

The "Standard" Coal Company's shaft, one mile north of Currysville, is situated upon a farm bought of the Hon. J. M. Hanna. The members of this company are old citizens of the county, and, although not skilled in mining, have prosecuted this enterprise with remarkable dispatch. Work was commenced in March, 1870, and finished at the five foot seam of coal on the national thanksgiving day, November 25th, 1870.

I am indebted to the favor of M. Hemphill and B. Hanna for the following record of strata:

STANDARD SHAFT, (HANNA'S.

Soil and glacial drift,	25.0
Clay with iron balls,	5.0
Clay shale thin bit. partings,	10.0
Compact sandstone,	10.0
Banded soapstone—carb. remains,	5.0
Black calcareous "clod" with *Cyathaxonia, Chonetes mesoloba, Nautilus decoratus, Athyris, Productus longispinus,* Crinoid stems and arms, *Spirifer cameratus, Macrocheilus, Pleurotomaria, Bellerophon carbonarius, & montfortianus, Cardinia fragilis, Leda bellastriata, Nucula inflata, Orthoceras,* etc.,	0.9
Black slate with *Discina, Lingula,* etc.	.3
COAL M,	.9
Fire clay,	5.0
Hard limestone,	2.6
Clay,	5.0
Mottled limestone,	3.2
Green clay,	7.0
Red clay,	6.0
Green and red clay mixed,	9.0
"Slickened" clay,	8.0

Soft S. S. carbonaceous partings,			30.0
Compact, sileceous, white soapstone,			6.0
Sandy soapstone, plant remains with coal one to two inches thick,			25.0
Hard soapstone.			13.4
Fern bed, gray soapstone, containing *Lepidodendron elegans, Sphenophyllum Schlotheimii, Pecopteris arborescens, Alethopteris loschii, Asterophyllites longifolium, Cordaites augustifolia, Neuropteris hirsuta,*			1.8
Coal L.	Good coal,	1.1	
	Choice coal,	1.8	
	Fair coal,	2.1	
		—	4.10
Fire clay,			9.0

Measurments in foregoing section reported by Judge Hanna, January, 1871.

Specimens of coal from both seams were secured for analyses; also, of the white and green clays.

Three miles east of Currysville, is Banholzer's mine, in southeast quarter, section 30, township 9, range 8. It was not worked at the time of my visit. I obtained the following section from one of the employes who assisted in sinking the shaft. A careful examination of the debris thrown up from the excavation, and the outcrops in the surrounding ravines, fully sustains the section here given:

BANHOLZER'S SHAFT.

Soil and clay,		8 ft. 0 in.
Silicious shale and flaggy sandstone, with carbonaceous partings,		10 ft. 0 in.
Hard sandstone, nearly compact,		7 ft. 0 in.
Light drab soapstone,		10 ft. 0 in.
Coal M:		
Soft coal,	1 ft. 6 in.	
Clay parting,		
Soft coal,	0 ft. 8 in.	

Clay,	0 ft. 2 in.	
Coal,	1 ft. 0 in.	
Parting,		
Coal,	0 ft. 8 in.	
		4 ft. 0 in.
Fire clay, with *stigmaria*,		6 ft. 0 in.
Soapstone, with silicious layers,		3 ft. 0 in.
Brown lime rock, Crinoid stems, and *Spirifer lineatus*,		1 ft. 2 in.
Fine white clay, soft,		0 ft. 2 in.
Hard stone—*Mottled limestone*,		5 ft. 0 in.
Light drab soapstone, with small iron nodules,		29 ft. 0 in.
Blue clay shale,		5 ft. 0 in.
COAL L:		
Coal,	2 ft. 0 in.	
Slate,	0 ft. 2 in.	
Coal,	2 ft. 0 in.	
Slate,	0 ft. 2 in.	
Good coal,	0 ft. 8 in.	
Smut parting,	0 ft. 2 in.	
Coal,	1 ft. 6 in.	
		6 ft. 8 in.
Fire clay,		6 ft. 0 in.

I was assured by several colliers that, from the bottom of this shaft, a test bore had been made privately, which found coal K at a depth not exceeding twenty-four feet below. This tradition was afterward affirmed by Smith and Beswick's bore at the "Pioneer."

Comparing this section with those at the Pioneer, Shelburn, Standard and Merom shafts, and with the bores at the Narrows and LaMotte, Ills., it will be seen that a *double limestone*, with a parting or intercalation of clay, and accompanied by white or green clays, forms a horizon from which may be determined the two great seams of coal L and M. All limestones marked on the map or observed in township No. 9, and in the east half and northeast part of township

No. 8, both north of range No. 8, may be referred to this rock. The average thickness, both members included, is about five feet. Toward the eastern line of the county, this increased, at a few localities, to eight feet, and, at the same time, the position of the stratum is depressed, until it approaches to within a few feet of the roof of coal L.

The following section, running three-fourths of a mile along Busseron and a ravine, sections 24 and 25, township 9, range 8, illustrates the last-mentioned fact, and presents L with the new feature of a limestone roof:

SECTION AT MAHAN AND STINETT FARMS.

Soil Slope,	——	——
Yellow sandstone,	25 ft.	0 in.
Soapstone,	4 ft.	0 in.
Black slate,	?	
COAL M,	3 ft.	0 in.
Fire clay,	4 ft.	0 in.
Soapstone,	20 ft.	0 in.
Silico-calcareous band,	0 ft.	4 in.
Soapstone, with silicious flags,	40 ft.	0 in.
Limestone,	2 ft.	6 in.
Parting,	—	—
Limestone,	2 ft.	0 in.
Black sheety slate,	3 ft.	2 in.
Dark clay marl "clod,"	1 ft.	6 in.
COAL L, 2 to 11 feet, average,	6 ft.	6 in.
Fire clay,	4 ft.	0 in.
Drab soapstone,	3 ft.	0 in.
Hard sandstone,	0 to 8 ft.	0 in.
Compact pyritous soapstone,	6 ft.	0 in.

The "Alum cave," section 24, township 9, range 8, is frequented by animals to lick the saline efflorescence on the rocks. It is beneath the "hard sandstone," and its origin is due the more rapid decomposition of the underlying "pyritous soapstone" at the base of the above section.

Coal L at this locality varies from two feet, to a reported thickness of eleven feet. Near the line dividing sections 23 and 24, the greatest thickness observed was nine feet. The coal is here separated by parting into five divisions, and ranges in quality from inferior to fair coal. A few fragments of "block" were obtained, but generally it is a caking coal.

Coal L has been mined at

Vanhorn's, section 2, township 9, range 8, thickness, ... 5 ft. 0 in.
Clark's, section 11, township 9, range 8, thickness, ... 4 ft. 6 in
Crist and Graham's, section 13, township 9, range 8, thickness, . . 5 ft. 0 in.
——— ———, section 24, township 9, range 8, thickness, . . . 9 ft. 0 in.
A. Mahan's, section 25, township 9, range 8, thickness, . . . 6 ft. 6 in.
Shivers and Saxtons, section 13, township 8, range 8, thickness, . . 5 ft. 6 in.
Barnes', section 13, township 8, range 8, thickness, ... 5 ft. 6 in.

The small local demand does not constitute an important market for these coals. The banks consequently are not being worked.

The following section on Barnes' land, section 13, township 8, range 8, shows a slight change from the above; the strata becoming more silicious:

SECTION AT BARNES' BANK.

Soil, ... 5 ft. 0 in.
Drift, ... 15 ft. 0 in.
Clay, ... 1 ft. 0 in.
Soft, flaggy sandstone, . . 5 ft. 0 in.
Drab shale with carbonaceous partings, changing to flagstones, . . 18 ft. 0 in.

Soapstone,	2 ft. 0 in.
Limestone with *Spirifer cameratus, S. lineatus, Productus, Semi reticulatus, P. longispinus, Entolium? & Crinoid* stems,	4 ft. 0 in.
Calcareous shale, pyritous,	1 ft. 0 in.
Black sheety slate,	1 ft. 8 in.
COAL L,	5 ft. 6 in.
Fire clay,	5 ft. 0 in.

Throughout almost the whole of township nine, three-fourths of township eight, and the east half of township seven, north of range eight, coal M outcrops at so many localities that the accompanying map is referred to in place of a detailed list. Four sections, selected, one from the southern, two from the middle, and one from the northern part of this area, which fairly present the strata accompanying this seam will now be given. Duplicates taken at intermediate points could be added *ad libitum*. At a few localities, for the dark bituminous soapstone roof usually found covering M, a somewhat calcareous shale with fossils mentioned in "Standard" and "Shelburn" sections, is substituted, and rarely a black sheety slate, a few inches thick, containing scales and fins of *Petrodus occidentalis* is present.

SECTION AT PIGG'S BANK.

Southeast quarter, section 36, township 8, range 8:

Slope,	20 ft. 0 in.
Drift,	20 ft. 0 in.
Shelly sandstone,	10 ft. 0 in.
Compact *quarry* sandstone,	10 to 20 ft. 0 in.
Soapstone,	1 ft. 8 in.
Dark calcareous shale,	0 ft. 8 in.
COAL M:	
Good coal,	2 ft. 0 in.
Clay,	0 ft. 1 in.

Cubic coal, . .	0 ft. 6 in.	
Clay, . . .	0 ft. 1 in.	
Choice coal, . .	2 ft. 6 in.	
		5 ft. 2 in.
Fire clay, ...		5 ft. 0 in.

Specimens were obtained from the sides of the entry. No coal was being mined; and Mr. Pigg was absent, making preparation to resume work.

The following section was taken at the banks of D. Ring and John Everhart, sections 3 and 4, township 8, range 8:

D. RING AND J. EVERHART'S SECTION.

Slope, ...	—	— —
Quarry sandstone, . .	8 to 10 ft.	0 in.
Soapstone with iron nodules, .	1 to 2 ft.	0 in.
Dark calc. clay with *Athyris subtilita Cyathaxonia*, and *Crinoid* stems, . . .	0 to 0 ft.	8 in.
Black sheety shale, fish fins and scales, ...	1½ in. to	3 in.
COAL M:		
Good gas coal, . .	2 ft. 0 in.	
Clay, . . .	0 ft. 1 in.	
Cubic coal, . . .	0 ft. 6 in.	
Clay and *pyrites*, . .	0 ft. 4 in.	
Good coal, . .	2 ft. 0 in.	
Slaty coal, . . .	0 ft. 3 in.	
		5 ft. 2 in.
Fire clay sometimes compact and silicious, ...		5 ft. 0 in.
Soapstone, ...	5 to 3 ft.	0 in.
Brown limestone containing *Spirifer cameratus, Bellerophon carbonarius, Pleurotomaria, Cyathaxonia*, and *Crinoid* stems, ...		1 ft. 8 in.
Clay in branch, ...		0 ft. 0 in.

Coal mined from this seam by Henry Wilson, northeast quarter, section 15, is highly spoken of by blacksmiths, and presents a good appearance. For analysis of a specimen, I refer to the State Geologist's report.

DICK'S SHAFT—SECTION 30, TOWNSHIP 9, RANGE 8.

Soil and drift,			15 ft.	0 in.
Shelly sandstone,			2 ft.	0 in.
Quarry sandstone,			3 ft.	0 in.
Creamy col'd soapstone,			13 ft.	6 in.
COAL M:				
Pyrites band,	0 ft.	2 in.		
Choice coal,	2 ft.	1 in.		
Clay,	0 ft.	2 in.		
Good coal,	0 ft.	6 in.		
Clay,	0 ft.	1½ in.		
Fair coal—sulph. veins,	2 ft.	0 in.		
Clay,	0 ft.	2 in.		
Splinty coal,	1 ft.	0 in.		
			6 ft.	2 in.
Silicious clay, with *stigmaria*,			3 ft.	0 in.
Clay shale,			3 ft.	0 in.

This is a good steam and forge coal. Care should be used in separating the band and veins of sulphuret in mining, which may easily be done.

In this and several neighboring mines, it has been found necessary to leave the bottom division of the coal, one foot thick, undisturbed, on account of a strong flow of water, which otherwise springs up and floods the mine.

At the banks belonging to Burnham, Dr. Baldridge, Heck and others, in and near section five, township 9, range 8, the following strata are seen:

SECTION ON LICK FORK OF BUSSERON.

Soil,	7 ft. 0 in.
Drift,	8 to 10 ft. 0 in.

Shelly sandstone,		8 ft. 0 in.
Quarry sandstone,		15 ft. 0 in.
Soapstone, with pyritous partings, plant stems and *Calamites*,		10 ft. 0 in.
Coal M:		
Good coal,	2 ft. 4 in.	
Cubic coal,	0 ft. 6 in.	
Fair coal,	1 ft. 5 in.	
Choice coal,	1 ft. 8 in.	
		6 ft. 0 in.
Fire clay,		4 to 6 ft. 0 in.

Previous to the opening of the Terre Haute and Indianapolis railroad, the banks in section 5 were extensively worked. Coke was here baked to supply the founderies at Terre Haute, fragments of which, found after an exposure to the elements of a quarter of a century, were bright and lustrous as if fresh from the oven. It is believed that a fair trial will establish a high reputation for this as a *gas and coking coal.*

Seam M has, for a series of years, been worked for engine and forge use at a great many localities, of which a partial list is given below, viz:

	SEC.	TP.	R.
Duffield, or Burnham's bank,	5	9	8
Heck's bank,	5	9	8
Dr. Baldridge's bank,	5	9	8
Bennett's bank,	5	9	8
Mahan's bank,	18	9	8
Dick's shaft,	30	9	8
Banholzer's shaft,	30	9	8
McAnelly's (opened) slope,	29	9	8
H. K. Wilson's shaft,	33	9	8
Patton's bank,	33	9	8
A. Mahan's shaft,	25	9	8
D. Ring's bank,	4	8	8
Shepherd's bank,	3	8	8
——— bank,	11	8	8

Henry Wilson's bank, . .	15	8	8
D. Pigg's bank, . . .	36	8	8
Burke's bank, ...	12	8	8
Moss's bank, ...	1	8	8
——— bank, . . .	1 and 2	8	8

I visited the abandoned shaft half a mile southeast of Farmersburg, on Berlin's land, section 1, township 8, range 9. A careful examination satisfied me that the section given in "Geological survey of Indiana," 1860, was erroneous in locating a stratum of "hard, compact sandstone," twenty-three feet thick, in this shaft. The debris excavated had been reduced by the elements to a sandy clay, showing that this was an argillaceous sandstone. Outcrops of the "double limestone," lower down the branch, proved that the shaft was commenced below the place of that rock, and identified the coal formerly mined as seam L. This view is further sustained by the fact that the fossil plants which fill the roof shales of this mine are, as far as known, identical with those found above L at the "Pioneer." Prof. Leo Lesquereux (same Reps., p. 172,) recognized the following plants from those shales, viz.: *Sigillaria reniformis, Syringodendron pachyderma, Pecopteris arborescens, Sphenophyllum Schlotheimii*, and a *Neuropteris*.

I was informed that this mine was abandoned on account of the horsebacks which traverse it. It is probable that the managers made the mistake of working *parallel with*, instead of *driving across* these interruptions, as has been found best at other mines working coal L.

RECENT GEOLOGY.

The Glacial drift comes next in order of sequence. It rests immediately upon the rocks of the coal measures, and consists; first, of blue and gray clays, irregularly mixed with coarse and fine gravel; second, the same clays with coarse gravel and boulders of granite, gneiss, quartz rock, and porphyry, with a very small quantity of gold, copper, lead, and magnetic iron ore, and red garnets; third, and last, at

the base, blue and white plastic clay, from two to five feet thick. All these materials are foreign, and have been transported during the great ice flow from the stratified rocks, Azoic and Metamorphic regions at the northwest.

From this deposit the boulders and gravel found in "the terrace" and beds of creeks and branches have been washed by rain and flood.

The soil of the drift is tenacious and somewhat impervious to air and water, and without sufficient drainage cannot be relied upon for good crops.

The natural timber, characteristic of this soil, is beech, sugar maple, white, red, black and water oaks, black and shell-bark hickory, ironwood, dogwood, ash and gum. Native grasses were sedges; introduced, timothy, red top and clover.

No animal remains were found in this formation. It varies in thickness from little or nothing at the south, to fifty feet in the northern part of the county.

The Loess succeeds the drift in order of time, and is a deposit of comparatively recent date. It consists of obscurely stratified *marly clays* of a reddish brown color, at the base, but above becoming almost pure sand of a yellowish brown or gray-ash color. This bed has been determined by Sir Charles Lyell as equivalent to the "Loess of the Rhine," and is termed by Missouri geologists the "Bluff formation." It is sparingly exhibited in the northern part of the county, but is better developed northwest and southwest of Fairbanks, and southwest of Graysville, and at Merom, it attains a depth of over thirty feet. Thence it may be traced, in an almost continuous ridge, to Busseron near Carlisle, and forms a sand ridge along the Wabash bluff, which, although circuitous, was adopted by the early settlers as the army, stage and wagon road, between points in the upper and lower parts of the valley.

The average of several analyses (foreign and American,) shows this deposit to contain:

Sand and clay, . . .	per cent. 60 to 70
Carb. of lime and mag., .	per cent. 15 to 25
Oxide of iron, . . .	per cent. 2 to 5
Phosphates, potash, etc., .	per cent. 1 to 4

Prof. E. T. Cox identified the following Loess shells from "Fort Azatlan," near Merom, (all of which are found living in this State, except *H. occulta*, which is now confined to a southern latitude; he has never found it north of Arkansas), viz.: *Helix fraterna* Say, *H. concava* Say, *H. hirsuta* Say, *H. Monodon* Rackett, *H. labyrinthica* Say, *H. minuta* Say, *H. perspectiva* Say, *Helicina occulta* Say, *Cyclostoma lapidaria* Say, *Succinia elongata* (?), *Succinia* (?), *Pupa armifera* Say.

Prof. Swallow, 2d Missouri Rep., fol. 74, gives a list of fifty species found in that State, and says: "These *lacustrine fluviatile* and *land* species indicate a deposit formed in a fresh water lake, surrounded by land and fed by rivers; and refer back to a time when a large portion of this great valley was covered by a vast lake, into which flowed various rivers and small streams."

The surface configuration presents a succession of mounds and low ridges. These are often erroneously attributed to human agency.

The red marl clay at the base of the Loess forms a rich soil, and is characterized by a heavy growth of poplar, walnut, sugar tree, and oaks of large size; the upper and more sandy member is impervious to air and water, and bears a meager growth of oak, hickory, gum, iron wood, dog wood, and grape vines, with some trees of southern affinities—as sweet gum. The native grasses found on the Loess were sedges, blue grass and white clover.

The Terrace or *Modified drift* is a stratum of sand and gravel resting *against* or upon all the older deposits. It is sometimes elevated to a height of twenty to fifty feet above the present level of the streams. This material was evidently deposited *under* water, and its formation is due to circumstances antecedent to the present condition of affairs.

The Alluvial bottoms along the rivers and creeks, are due to causes now in action. They consist of a rich sandy clay or loam, formed mainly by the wash from the adjacent highlands and the sediment deposited by the streams during their annual overflow.

The bottom prairies were originally covered with a rank growth of sedges and blue grass; the timber consists of burr oak, hickory, elm, cotton wood, walnut, hackberry, birch, and willow. The large admixture of clay in this soil admits and invites the construction of a system of levees to give protection against summer floods.

ECONOMICAL GEOLOGY, ETC.

Sullivan county was organized in 1816. In 1850, it contained 1,675 dwellings, 1,678 families, 10,141 inhabitants, 1,251 farms, 31 productive establishments.

Advance sheets from the census of 1870, gives the present condition, viz.:

	Population.	Families.	Dwellings.	Voters.
Jackson Township	1,739	303	308	347
Cass Township	1,490	270	268	285
Curry Township	2,171	408	408	467
Fairbanks Township	1,234	238	238	288
Hamilton Township	2,366	444	443	476
Sullivan—town	1,397	274	270	322
Merom—town	426	91	90	94
Gill Township	1,709	323	322	381
Carlisle—town	499	98	96	120
Haddon Township	2,251	401	397	510
Turman Township	1,929	365	365	427
Jefferson Township	1,250	217	220	244
Total	18,459	3,329	3,425	3,961

During the Indian wars, Sullivan county was long the border line between the white and red men. Many localities of historic interest tell the story of peril incident to pioneer life, and attest the soldierly character of the early settlers. Fort Turman was situated at Turman's Prairie,

on the farm of J. Mann. Another stockade was built on the land now owned by William Crowe. (Section 11, township 8, range 11.) Trophies of the struggle are found at the scene of the destruction of Lieut. Fairbanks' command, on "Wagon-defeat" creek, which takes its title from this disaster; and the town and township take the name of the Lieutenant commanding. Busseron creek, in like manner, commemorates the name of Lieut. Busseron, an early pioneer.

The benificent laws of Indiana establish *free schools* in every neghborhood. Graded or high schools at Carlisle, Paxton, Sullivan, and "Ascension Academy," at Farmersburg, afford opportunity for academic instruction. And the Union Christian College" at Merom, by its sightly location, neat and commodious edifice, and efficient faculty, offers attractive facilities for the acquisition of a thorough collegiate education.

Transportation is furnished by the Wabash river along the western side of the county. The Evansville and Crawfordsville railroad passes from south to north through the center, and exports large amounts of coal, timber and agricultural productions. The new air line railway from Terre Haute to Chicago, by opening easy access to the markets of the great northwest, will give impetus to the mining, agricultural and horticultural interests of this region.

COAL.

COAL N occupies a narrow belt along the Wabash river and the southern part of the county. This seam is thin and can not be worked except by stripping. It is generally sulphurous, but becomes purer and thicker towards the southeast. The average thickness is two feet. Area, one-third of the county.

COAL M underlies the whole county, with an exception of twelve sections in the northeast corner of township 9, north of range 8, and of about two sections at section 13, township 9, range 8, where it has been eroded so as to expose coal L.

Along the Wabash, M has an average depth of three feet eight inches. Going eastward, it first gradually becomes thinner, as at Dix's and Alkire's, section 35, township 9, range 10, until it reaches a minimum of eight inches near the railroad, at Currysville; continuing eastward, the coal again gradually increases to a depth of twenty-two inches in northeast quarter, section 6, township 8, range 9; thence at all points northeast and southeast it becomes a *persistant thick* seam, ranging from four feet to nine feet thick, (on Pitt's farm, section 3, township 9, range 8,) with an average of five feet two inches for townships seven, eight and nine, north of range 9, and for the whole county, an average of three feet ten inches. East of the railroad this is a fat, caking coal, rich in gaseous matter, yielding good coke, and desirable for blacksmith's use. The sulphur present in this seam is banded or confined to a single division, consequently, can and should be separated from the coal at the mines. A practical test is said to have proved it superior to any western coal for gas, and but little less valuable than that of Pittsburg.

Coal L, with the exception of a few acres at the northeast corner, underlies the whole county. It is a thick seam, averaging five feet two inches, and so persistent that, contrary to all common maxims of prudence, miners shaft for it without a preliminary test bore. For fuel and engine use it is of choice quality. With less volatile matter than coal M, it is rich in carbon, burns with a small blaze, is free from soot and clinker, and leaves a gray ash. For analysis, I refer to the State Geologist's report.

Coal K has been pierced by test bores at Terre Haute, Palestine, Sullivan, Currysville, and outcrops along the eastern line in Greene county (Cox's Rep. 1869, fol. 104). These tests indicate a coal of great persistence. It probably underlies the entire county, with an average thickness of five feet. At outcrops in Greene and Clay, K is often splint or block coal. The residuum brought up from the test bores at Currysville and other points, it is believed, warrants the

hope that in some part of Sullivan county this seam will prove block coal.

Other seams still deeper in the earth are known to exist. They have not been explored, and will not be considered.

The total thickness of the seams practically tested in Sullivan county amounts to sixteen feet, and the area underlaid by these coals may be safely estimated at four hundred and thirty square miles, or two hundred and seventy-five thousand two hundred acres.

Over this area, after making allowance for horsebacks, refuse coal, waste in mining, and every other contingency, there exists fully ten feet of coal available for market. Every cubic foot of "seam" yields one bushel of coal, or four hundred and thirty-six thousand bushels per acre. This, at the usual royalty, one-half cent per bushel, gives two thousand one hundred and eighteen dollars for one acre, and, for the entire area, the bank value of the coal of Sullivan county amounts to five hundred and eighty-three millions two hundred and ninety-seven thousand dollars.

In recapitulation, the following general section of the known coals of Sullivan county, is given. The *averages* are made up from measurements heretofore given, in no case on a basis of less than five observations or tests. Spaces in even feet:

CONNECTED SECTION OF COALS IN SULLIVAN COUNTY.

Space.	Average.			Coals.	Average.		
Feet.	Feet.	In.		Feet.	Feet.	In.	
				0.-1.0		2	Rash Coal.
13.-40.	24	3					
	1	8		.4-1.10	1	8	Coal N.
31.-69.	48	5					
	3	10		.8-6.10	3	10	Coal M.
47.-149.	98						
	5	2		4.-9.0	5	2	Coal L.
34.-87.	67						
	5	0		3.6-7.0	5	0	Coal K.
	253	4			15	10	Total.

MINING.

Dick's Shaft.

Dick's shaft pierces coal M at a depth of thirty-three feet. Five miners were at work, sending up ten tons a day. Product is hauled by wagons three miles to the railroad at Curysville and Shelburn. Capacity, twenty tons a day.

Ohio and Indiana Mining Company.

This company own, in fee, one hundred acres adjoining the railroad track, also, valuable leases near. Have not commenced mining.

Shelburn Mining Company.

The company bought, in fee, thirty acres adjoining the railroad track, and have commenced their shaft—now (December, 1870,) eighty feet deep. Their fixtures will enable them to raise, with thirty miners and five workmen, one hundred tons a day. Since completed, see p. 214.

Standard Shaft.

This shaft was completed November 25th, 1870, with five feet of coal at the bottom. The fixtures are all first class, and designed with a capacity for raising two hundred tons a day, and the employment of sixty miners.

Pioneer Shaft.

This shaft is managed by two of the original "pioneers." The fixtures are substantial, in model order, and designed with a capacity for raising, with sixty miners and eight workmen, two hundred tons a day. They now employ thirty miners and seven workmen, and raise from thirty to sixty tons a day. An inspection of their pay-roll shows that steady workers earn from $85 to $105 a month. Shipments during October, 1870, amounted to thirteen hundred and twelve tons.

Acknowledgments are due to the proprietors of this mine for an interesting collection of fossil ferns, plants, etc., presented to the State Cabinet.

Recapitulation of Mining.

Excluding Sunday, and allowing sixty-three days for interruption, lost time, etc., it is believed that we may calculate the production of these shafts (completed or nearly so) on the basis of their full capacity for two hundred and fifty working days, viz.:

	Capacity per diem.	Annual Product.
	Tons.	Tons.
Dick's Shaft	20	5,000
Shelburn Shaft	100	25,000
Standard Shaft	200	50,000
Pioneer Shaft	200	50,000
Total	520	130,000

LIMESTONE.

The coal measure limestones are seen exposed in many parts of the county—generally argillaceous. At some points, this rock is pure, and suitable for foundations. At an early day, it was burned, making a dark-colored lime. All the lime now used in the county, with the exceptions heretofore mentioned, is imported.

ORES.

Nodules of ironstone were observed in all parts of the county—some of good quality, but not in sufficient quantity to justify the expense of mining and transportation. Small particles of gold, copper and lead ore have been occasionally reported in washes from the drift. It is hardly necessary to say that the latter are not native. Their origin is due to the imported rocks of the glacial drift.

CLAY.

A great variety of plastic and silicious clays are found connected with the coals and limestones. As a source of profit, they are second only to coal. This material is suited to the manufacture of potter's ware, tiling, fire brick, and

ornamental architraves and chimney-tops. It has been tested at Pleasantville Pottery with satisfactory results. Bricks have been made in every part of the county. Those from the Loess clays are superior, and will hereafter constitute a specific article of trade.

GRAVEL.

Beds of terrace gravel are found west of Graysville, on Turmans creek and in Gill's prairie. Adjoining the county line, supplies may be obtained at Middletown, Vigo county, and at the river bank nearly opposite to Merom. This is excellent material for road-making. When the *social and pecuniary* advantage of good roads is appreciated, this supply will prove a blessing to the Western townships.

SPRINGS.

At several localities, mineral springs burst out at the impervious strata near the base of the "Merom Rock" sandstone. They furnish soft water highly charged with iron in solution, and have all the medical properties which give character and value to chalybeate wells. A cluster of these, north of Graysville, in section 18, township 8, range 10, associated with sulphur and saline springs, and with bold, picturesque scenery, presents an attractive location for a watering place.

Other chalybeate and sulphur springs are marked on the map—one on the farm of Dr. McDowell, near Pleasantville, has considerable local reputation.

MILLS.

The county is well supplied with grist, saw, and woolen mills, all propelled by steam. Two extensive stave factories—one at Shelburn, the other at Currysville—employ twenty hands and assistants each, and turn out a large amount of choice staves. Capacity, twenty-two thousand staves per day for each establishment.

AGRICULTURE.

A productive soil is one of the great sources of a people's comfort and happiness. That of Sullivan county, formed by a generous admixture of material derived from all the older geological formations pulverized and prepared for use by natural agencies, combines elements of fertility which, with judicious management, will give ample returns.

The corn crop of 1870, in this county, may be fairly estimated at an average of sixty bushels per acre, with a proportionate yield of grass and clover. This crop annually repeated would pay the farmer for his labor, with large profits. But such crops are not often repeated. The yearly average will fall, probably, sixty per cent. below this standard.

The history of the past only serves as a lesson for the future. The summer of 1870, was neither too wet, nor too dry, and consequently afforded full opportunity for the elaboration of plant food by the soil.

This process can not take place when the surface is subject to the control of excessive moisture or of drouth.

Now this difficulty can be and is avoided, by farmers in other States and portions of this State. *Under-draining* will remedy both evils at once—carry away any excess of moisture, and at the same time, by its ameliorating effect on the soil, procure exemption from drouth.

This process, with a system of rotation in which clover is a proper constituent, would soon establish the crop of 1870 as an annual average.

Fair crops of wheat, oats and tobacco are also raised. The live stock, some of well improved breeds, attest the nutritious quality of the grass; and invite more attention to the cultivation of the tame grasses, and to grazing; one of the most profitable branches of agriculture.

FRUIT.

Sullivan county has long been noted for the excellence of its fruit. The peach and the pear, generally uncertain, are

here a reliable crop, and the quality good. Summer and autumn apples are of a fair quality and yield. But to the vine grower this county offers pre-eminent facilities. Situated upon the same degree of latitude in which the successful vineyards of Cincinnati and St. Louis are grown, it has a large area of soil covering the more elevated hills and plateaux identical with that which produces the famous wines of the Rhine; "and* (the loess) might be made a pomo-"logical paradise, under the management of those who know "how to improve the favorable conditions which the hand "of nature has so bountifully supplied." Native fruits consist of the grape, plum, and luscious persimmons—near Gills prairie, on the lands of S. R. Hamill and Parker Sheruman, a grove of twelve hundred pecan trees in full bearing was noticed—another grove of two hundred trees is reported at the mouth of Turman's creek.

ANTIQUITIES.

When first explored by the white race, this county was occupied by savage Indians, without fixed habitations, averse to labor, and delighting only in war and the chase. Their misty traditions did not reach back to a previous people or age.

But numerous earth works are found in this region, of such extent as to require, for their construction, time and the persistant labor of many people. Situated on the river bluffs, their location combines picturesque scenery, susceptibility for defense, and convenience to transportation, water, and productive lands. These are not requisites in the nomadic life of the red men, and identifies the Mound Builders as a partially civilized, agricultural people.

Over one hundred small mounds, from two to four feet high may be seen about one mile northwest of Middletown, Vigo county.

On the Hunt farm, sections 6 and 7, township 9, range 10, conical knolls of Loess have been artificially rounded,

*Prof. Worthen, III, Ill., fol. 121.

and used for sepulchral purposes. One of these contained at the summit, seventy feet above its base, a burial vault "three stories high;" on each floor from five to seven human skeletons were found.

On M. Drake's land, section 19, same township, are two large mounds, one two hundred feet in diameter, and eighteen feet high; the other twenty-eight feet high, covering an eliptic base one hundred and eighty feet wide, and three hundred and fifty feet long. The contents of the two mounds amount to nearly 30,000 cubic yards, and at present contract prices for earth work, their erection would cost five thousand dollars.

Another group, on Turman's farm, section 15, township 8, range 11, has been partially explored, exposing human and animal remains, pottery variously ornamented, flints, and stone implements. The "pit holes" accompanying these mounds and a rectangular excavation will reward future explorers.

The ancient works, near Merom, I have with the consent of the citizens of that town christened "Fort Azatlan," in honor of the kind memories with which the people of Montezuma reverted to their old home in "the valley of great lakes and rivers." On three sides, the fort is defended by the precipitous banks of the river and of ravines—in front by an earth (or adobe?) wall, and encloses an area of about three acres.

Explorations made by a cut traversing the largest mound from northeast to southwest discovered relics of stone and flint, shells of the *Unio*, *Helix*, and *Paludina*, and of the river turtle, bones of many other animals, and twelve human skeletons.

These last present anomalous forms of high interest to the anthropologist* and the section across the mound developed the following arrangement: At the base, ashes and mineralized bones of the mound-builders; near the surface, remains of the savage Indians; and, between these two,

*A full description has been prepared by Dr. H. F. Harper, of Merom.

intrusive graves of an intermediate race—fishermen who prepared vaults for their dead.

The degree of civilization attained by the latter may be inferred from the faith in immortality exhibited by the deposit of food for the departed; from the careful preparation of their sepulchres; and especially from the respectful burial of children—not the habit of the mound-builders.

In illustration of the last fact, a small stone vault near the brow of the hill was opened. It contained the bones of two babes who had been tenderly laid to rest, ornamented with a child's treasure of *shell beads*.

All the mounds which have come under my notice, are located so as to secure an outlook toward sun-rise, confirming the belief that the fires of the sun-worshippers have blazed upon every mound-capped eminence in the great valley of the continent.

FINIS.

In concluding this report, I take pleasure in returning my heartiest thanks to the people of Sullivan county, for their uniform kindness and co-operation.

Acknowledgments are due to the following gentlemen for hospitalities and special favors: Messrs. Thornhill, S. R. Hamill, I. Brown, M. Briggs, H. K. Wilson, M. Powers, Drs. Murphy, Hinkle, Kaufman, S. Coulson, and Aydelott & Buff, at Sullivan; Dr. O'Haver, at Carlisle; J. W. Spencer and J. Allsman, at Paxton; President Holmes, Thomas Kearns, Dr. Harper, Dr. H. F. Harper, and all the people at Merom; William Brewer, Joseph Gray, Esq., J. Mann, and N. Barnes, near Graysville; M. & N. Badger, at Fairbanks; Hon. J. M. Hanna and M. Hemphill, of the Standard shaft; J. D. Dick, of Dick's shaft; Smith & Beswick, of the "Pioneer," and Buckley & Richards, of the Shelburn shaft; S. Fisk, Esq., Middletown; Col. W. K. Edwards, Terre Haute; W. R. McKeen, Terre Haute.

To John Ingle, Jr., and to other officers of the E. & C.

R. R., the survey is indebted for every accommodation necessary or convenient.

Respectfully submitted,

JOHN COLLETT.

Eugene, Ind., December, 1870.