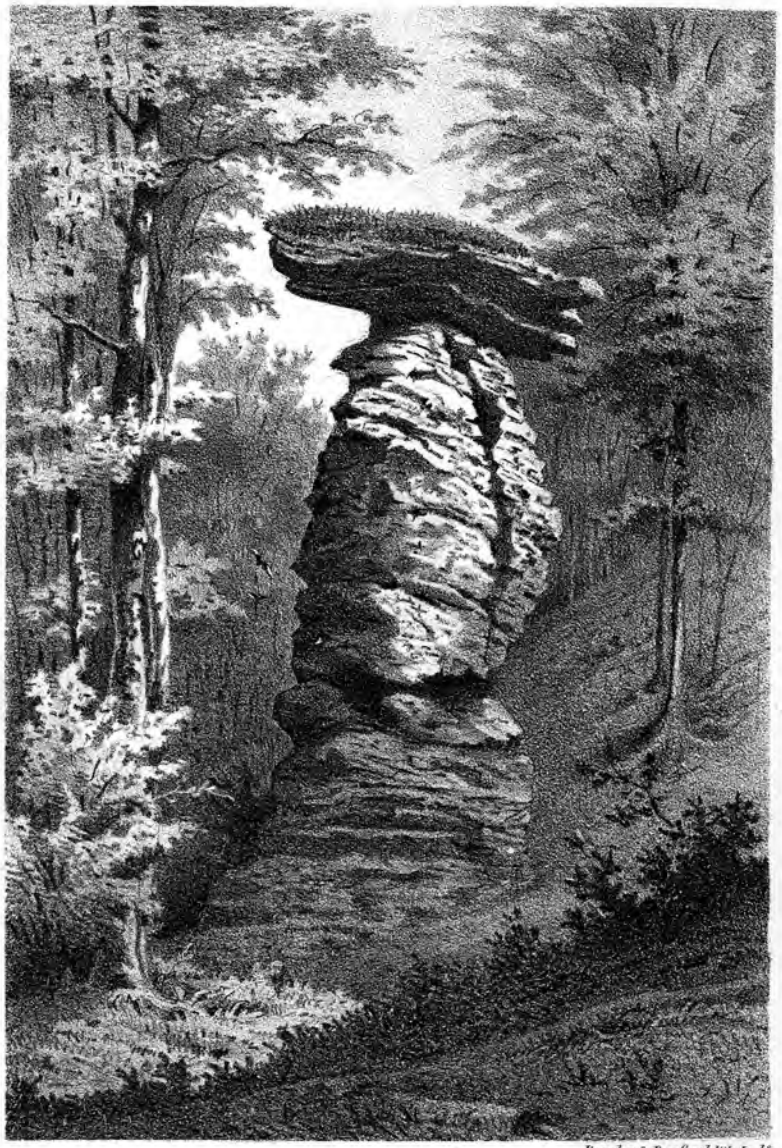


Braden & Burford lith Ind.ª

JUG ROCK.
Photographed by D. Allbright, Shoals, Ind.

SECOND REPORT

OF THE

GEOLOGICAL SURVEY

OF

INDIANA,

MADE DURING THE YEAR 1870,

BY

E. T. COX,

STATE GEOLOGIST,

ASSISTED BY

PROF. JOHN COLLETT AND DR. G. M. LEVETTE.

INDIANAPOLIS:
R. J. BRIGHT, STATE PRINTER.

1871.

OFFICE OF STATE GEOLOGIST,
INDIANAPOLIS, INDIANA,
December 1st, 1871.

To the Honorable President and Members of
the Indiana State Board of Agriculture:

SIRS:—I herewith submit to your honorable body, my Second Report of progress in the Geological Survey of the State, for the year 1870.

Very respectfully,

E. T. COX,
State Geologist.

INTRODUCTION.

Since my last Report, I have been principally engaged, with what assistance could be obtained, in determining the extent and importance of the coal seams adapted to household and manufacturing purposes, in the counties which lie to the south of the limits of last year's survey, namely: Sullivan, Knox, Daviess, Martin, Dubois, Pike, Gibson, Warrick, Spencer, Perry, Vanderburg and Posey. Only three of the above counties (Sullivan, Daviess and Martin) could be surveyed in detail, while Perry, Vanderburg and Posey had to be entirely omitted, and the others only alluded to in a brief manner from the notes of a reconnoissance which I made over a portion of the territory of each. This partial examination has, however, been sufficient to furnish a very good general knowledge of their Geology, and proves the continuance of the BLOCK or *iron smelting coal* from the northern limits of the Indiana coal basin to the Ohio river —a Geological discovery of incalculable advantage to the State, as the day can not be far distant when this coal, which is unequaled for smelting iron, will induce the building of blast furnaces along the entire eastern margin of the coal basin. Its great importance for manufacturing purposes has already been the inducement for locating a number of railroads that traverse the coal field in several directions, some of which are already under construction, with a fair prospect of being completed at an early day.

These roads all reach important coal basins, and one of the principal advantages to be derived from their construction

is the facility which they will afford for securing an abundant supply of good fossil fuel for the large commercial and manufacturing cities that lie beyond the coal basin.

The coal mines at Cannelton, on the Ohio river, in Perry county, are among the most valuable and extensively worked mines in the State, and I regret that I was compelled to defer their examination, as well as Judge Ingle's mines (Bodiam mines) at Evansville, in Vanderburg county, until another season.

My assistants are Prof. John Collett and Dr. G. M. Levette. Dr. Rufus Haymond was also engaged, but becoming sick soon after commencing field work in Dubois county, he was finally compelled to abandon the survey, which was a source of much regret, both on account of the loss felt in being deprived of the Doctor's valuable services and the anxiety expressed by the people of that county for an immediate report on its mineral resources, which, consequently, can now only be briefly alluded to in this report.

To Prof. John Collett, of Vermillion county was assigned the duty of making a detailed survey of Sullivan county, a labor which he has performed in a highly satisfactory manner, as the able and minute report of the Geology of that county, published in this volume, will bear testimony.

He has made known many interesting facts in the stratography of the coals, and collected a large number of organic remains, which serve to increase our knowledge of the vertical range of the fauna and flora of the coal measure.

Dr. G. M. Levette has been engaged in drawing maps and other office work, as well as assisting me in the laboratory with the chemical analyses of coals, iron, iron ores, mineral waters, etc. In this department, a very large amount of work has been accomplished.

Since my First Report there has been decided progress made in mining and manufacturing along the zone of block coal from Attica on the north to the Ohio river on the south, notwithstanding the blighting influence of a "strike" of the miners in Clay county, which continued for several months, and produced a complete stagnation in the coal and iron business.

The iron masters took advantage of the opportunity presented by this strike, and were otherwise induced by the prevailing low price of pig iron to go out of blast and put their furnaces in complete repair. The Knightsville furnaces have been, to some extent, remodeled and changed from open tops to closed tops.*

The Brazil furnace has, also, been changed from an open to a closed top, and is in complete repair, and ready to blow in at any time.

Several new furnaces were talked of in the early part of the spring, but the prevailing low prices of iron, caused in part by the reduction in the tariff on iron, so discouraged the iron men that but one new furnace has actually been built. This is the *Vigo blast furnace* at Terre Haute, built mostly by capital furnished by the citizens of that flouring manufacturing city. A lithographic plate, taken from a photograph that was furnished by the Vigo Iron Company, together with a description of this furnace, will be found in another place.

The Indiana North and South Railway, which runs the entire length of the belt of "iron smelting" coal, from Attica, in Fountain county, to Newburg, on the Ohio river, in Warrick county, has been put under contract, with the expectation that it will be completed inside of two years.†

This road will furnish a direct outlet for coal to the Chicago market.

The Indiana Mineral Railway is also projected to run through the southern portion of the block coal belt. Mr. Alexander, of Philadelphia, Pa., is, I believe, President of this road. Its southern terminus is to be near the mouth of Crooked Creek, in Spencer county, and it will connect with the Indiana North and South Railway, at Bloomfield,

*These furnaces have recently blown in, and the make of iron has been very greatly increased by the changes that were made.

†Dr. E. B. Thomas, President of this road, informs me that the grading was commenced simultaneously at Attica and Brazil, and that both divisions had nearly reached Rockville, in Parke county. Grading has also been commenced at Bloomfield, in Greene county, and will soon be completed to Worthington, on the Indianapolis and Vincennes Railroad.

in Greene county. This road passes through a valuable coal basin, and its completion will prove an immense benefit to the State at large, as well as the counties through which it will pass.

The enterprising gentlemen connected with this road, employed Colonel J. W. Foster, of Chicago, one of the oldest and most experienced geologists in the West, to make a survey and detailed examination of the coals along their respective routes. The results of Colonel Foster's investigations are embodied in two reports, containing maps, on which are located the principal coal out-crops.

In these reports are also given a number of analyses of coals, made by Prof. M. Delafontaine, of Chicago, late Professor of Chemistry in the University of Geneva, Switzerland.

It is highly flattering to me that this able report bears testimony to the accuracy of my previous geological work, and fully confirms all that I have said in regard to the value of the block coal for the manufacture of iron and steel, and sets forth the incalculable advantages possessed by Indiana for controlling the iron market of the new West, and for conducting the most gigantic metallurgical operations in the country.

The existence of two seams of block coal in Clay county below the only seam known at the time of commencing my survey, as shown in the vertical column of the coals given in the first report, 1869, has been fully proved by bores and shafts sunk to the coal.

At Carbon, on the Indianapolis and St. Louis Railroad, "the Carbon Coal Company" are working from the one shaft, coals I and G, and the existence of F has been proved by a bore which started from the bottom of the shaft. The following section made at this shaft, with the assistance of Mr. John Elder, indicates the relative position of these coals:

SECTION AT CARBON SHAFT.

Space.		Ft.	In.	
		12		Clay and drift.
		3		Soapstone.
27.		5		Sandstone.
		7		Gray Argo Shale.
4.6		4	6	Coal I. (Block.)
		3		Fire Clay.
		2		Soapstone.
		3		Gray Shale.
25.6		10	6	Sandstone.
		7		Dark gray Argo Shale.
3.		3		Coal G.
		2	6	Fire Clay.
		2		Sandstone.
26.		10	6	Sandstone and Shale.
		11		Bluish Shale.
4.		4		Coal F.
89.6	Total.			Fire Clay.

In this shaft we find a total of eleven feet and six inches of block coal.

The Clay Coal Company, recently opened a mine on this road about two miles and a half west of Carbon. I have not had an opportunity to visit this new mine, but have been informed that the seam worked is referable to the middle coal G of the above section.

Garlick & Collins work the upper and middle block coal seams on Otter creek, one mile and a half north of Brazil. The upper seam, I, is reached by tunnels, and the middle seam, G, by a shaft so situated that the coal from each is loaded into the cars from the same tip. Each seam will average four feet in thickness. The middle coal is, here, one of the purest and best coals for smelting iron that has come under my notice, as may be seen by the analysis, which is given in another part of this report.

Proper investigation will develop the existence of the lower block-coal seams at many places where they are at present unknown, and the lands on which these coals are so proved to exist, will be materially enhanced in value.

The lowest seams of all, A and B, are only to be found in certain localities along the extreme eastern margin of the basin in Clay county, but they have a much broader area in the counties to the south.

The St. L. V. T. H. & I. R. R., has extended its switches into the coal fields, both north and south of the main track.

South of Brazil, Ormsby & Co., have completed their shaft and are doing an extensive business. They are mining the coal seam (I.), whcih averages four feet in thickness, and the coal is of excellent quality.

Morrison, Woodruff & Co. have also sunk a shaft to coal I, about one mile southeast of Ormsby & Co., and are taking out a large quantity of coal. In this county, quite a number of new mines have been opened, and the quantity of coal shipped has been more than doubled since my last report.

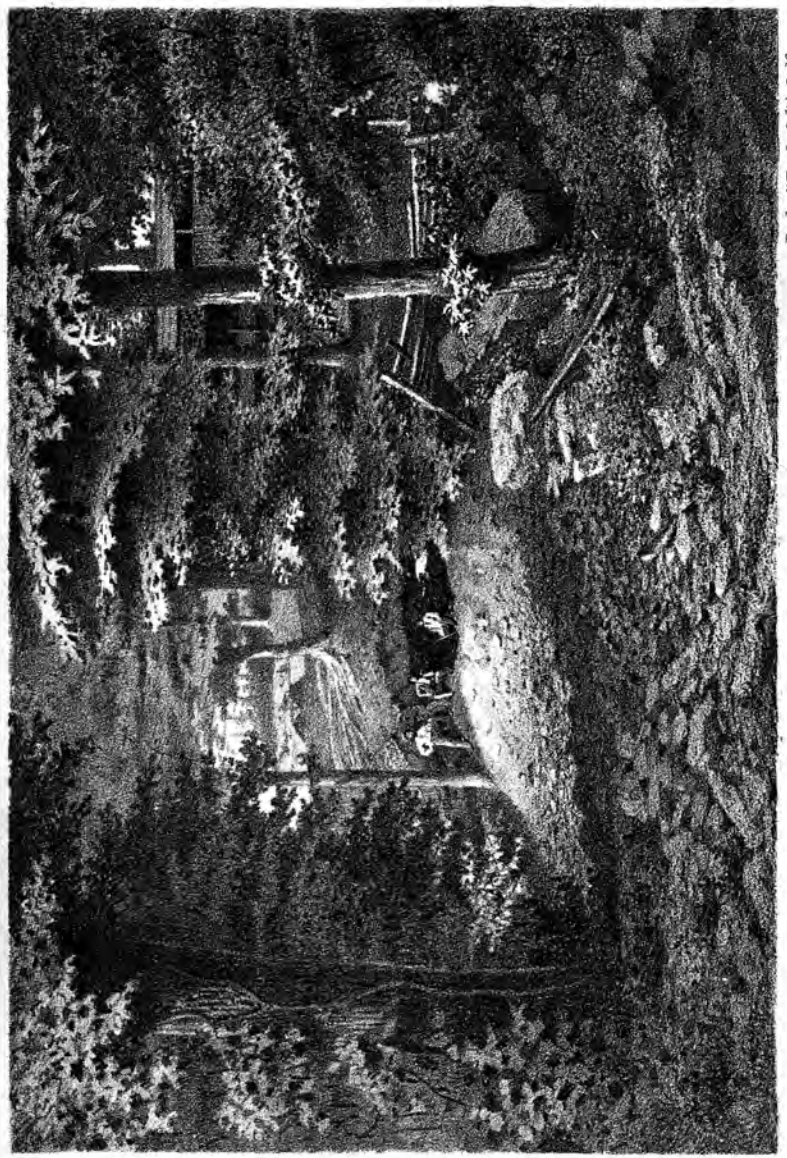
The following list shows the number of mines now opened in Clay county, on the Indianapolis and St. Louis Railroad:

Carbon Block Coal Company, at Carbon.
Miller & Sons, at Carbon.
Cabbage & Bro., at Carbon.
John C. Beasley, at Carbon.
David King, at Lena.
Webster & Garrigus, at Lodi.
Clay Coal Company, two miles west of Carbon.
D. Titcomb's, Fountain, in Vigo county.

Mines reached by the St. Louis, Vandalia, Terre Haute and Indianapolis Railroad:

Armstrong's mine, Knightsville.
Brazil Coal Company, Barnett mine, south of Harmony.
Brazil Coal Company, Weaver mine, North Branch.
Bartlett Coal Company, on the Y.
Butsch, Dickson & Co., Ashley Shaft, on the Y.

Clay Coal Company, North Branch.
Ernhart, Jane, on the Y.
Garlick & Collins, North Branch.
Great Western Coal Company, north of Brazil Furnace.
Guest's, Robert, mine, Knightsville.
Hutchinson & Jones, South Branch.
Indiana Coal and Iron Company, Knightsville.
Indiana Coal and Iron Company, North Branch.
Lafayette Coal and Iron Company, on the Y.
McClelland Coal Company, North Branch.
Morris Coal Company, Strains' old shaft, on the Y.
Morrison, Woodruff & Co., South Branch.
Niblock, Zimmerman & Co., North Branch.
Ormsby Coal Company, South Branch.
Samuel Strains' mine, South Branch.
Star Mines, (Planet Furnace,) north of Harmony.
Veach Coal Company, North Branch.
Watson Coal Company.
Wright's, Mansur, mine, at Fire Brick Factory, north of Brazil.
Great Western Coal Company, Newburg.
C. Ehrich & Co., Newburg.
Armstrong's mine, Newburg.
Fortner's mine, Newburg.
Bailey & Moore, Staunton.
Greencastle Coal Company, Staunton.
Somers & Somers, (two mines,) Staunton.
Williams & Co., Staunton.
E. A. Ferguson, Cloverland.
Bartlett Coal Company, (formerly Bigelow,) Seelyville.



Bratton & Burford, Lith. Ind.ª

VIEW of the MOUTH of the CAVE at Indian Springs, Martin Co. Ind.

REPORT.

In the report on Sullivan county, Prof. Collett has shown that coal N, which, in the western part of Clay and the eastern part of Vigo counties, is of good quality, and from four to five feet thick, is only found in Sullivan county, over a small area along the Wabash river, and in the southern part of the county. The quality is, here, generally poor, and the seam too thin to be mined with profit, except where so situated that it may be worked by stripping. A specimen from the seam on Mr. Chambers' land, section 8, township 7, range 8, proved, on analysis, to be a very fair coal.

ANALYSIS OF CHAMBERS' COAL.

Specific gravity, 1.206; one cubic foot weighs 75.37 lbs.

Coke, - -	50.50	Ash, light brown, -	-2.00
		Fixed Carbon, - -	48.50
Volatile matter,	49.50	Water, - - - -	4.50
		Gas, - - - -	45.00
	100.00		100.00

The coke has a metallic lusture, and is so much swollen that the original shape of the coal is quite lost.

On the other hand, coal M, which only appears as a thin seam in the former counties, underlies nearly the entire area of the latter county, and attains to the grand dimensions of a nine foot seam on Pitt's farm, section 3, township 9, range 8.

The subjoining analyses of specimens from this coal seam, taken at various localities, indicate that it is a good caking coal, suitable, in some places, for gas and coke.

B. & L. BURK'S COAL.

Specific gravity, 1.210; one cubic foot weighs 75.62 lbs.

Coke, - -	52.50	Ash, white, - - -	1.50
		Fixed carbon, - -	51.00
Volatile matter,	47.50	Water, - - - -	3.50
		Gas, - - - -	44.00
	100.00		100.00

The coke is puffed, brilliant and porous.

This is a good white ash coal, contains a large amount of gas and will make fair coke.

DICKS COAL, six feet two inches thick, section 30, township 9, range 8. Upper part of the seam.

Specific gravity, 1.258; one cubic foot weighs 78.62 lbs.

Coke, - -	52.00	Ash, white, - - -	1.50
		Fixed carbon, - -	50.50
Volatile matter,	48.00	Water, - - - -	4.50
		Gas, - - - -	43.50
	100.00		100.00

The coke is puffed, amorphous, glossy, and somewhat swollen.

DICKS COAL, middle part of the seam.

Specific gravity, 1.252; one cubic foot weighs 78.25 lbs.

Coke, - -	55.30	Ash, white, - - -	0.50
		Fixed carbon, - -	55.80
Volatile matter,	44.70	Water, - - - -	4.50
		Gas, - - - -	39.20
	100.00		100.00

The coke is slightly swollen, amorphous, compact and glossy.

DICKS COAL, lower part of seam.

Specific gravity, 1.278; one cubic foot weighs 79.05 lbs.

Coke, - -	54.50	Ash, red brown, - -	2.50
		Fixed carbon, - -	52,00
Volatile matter,	45.50	Water, - - - -	3.50
		Gas, - - - -	42.00
	100.00		100.00

The coke has a metallic lustre, is slightly puffed, amorphous and compact.

The middle part of this coal is very free from earthy matter, contains only .5 per cent. of ash, yields a compact, glossy coke, and a fine quantity of quite pure gas.

The upper and lower portions, though very pure coal, are not nearly so good as that taken from the middle part of seam.

PIGG'S COAL, section 36, township 8, range 8.

Specific gravity, 1,271; one cubic foot weighs 79.43 lbs.

Coke, - -	51.50	Ash, red brown, - -	2.50
		Fixed carbon, - -	49.00
Volatile matter,	48.50	Water, - - - -	6.00
		Gas, - - - -	42.50
	100.00		100.00

The coke is very much swollen, amorphous and lustreless.

This seam is five feet two inches thick; the quality of the coal, as shown by the analysis, is very good.

ST. JOHN'S, section 29, township 9, range 8.

Specific gravity, 1.287; one cubic foot weighs 80.43 lbs.

Coke - -	51.50	Ash, white, - - -	2.50
		Fixed carbon, - -	49.00
Volatile matter,	48.50	Water, - - - -	3.50
		Gas, - - -	45.00
	100.00		100.00

The coke is puffed and vitreous.

1. *Flour Mill and Woolen Factory.*
2. *Flour Mill and Woolen Factory.*
3. *Foundery and Machine Shop.*
4. *Planing Mill.*
5. *Foundery and Pump Factory.*
6. *Hotel.*
7. *Hotel.*
8. *Hotel.*
9. *Court House.*
10. *Presbyterian Church.*
11. *Cumb. Presbyterian Church.*
12. *Catholic Church.*
13. *Methodist Church.*
14. *Christian Church.*
15. *Baptist Church.*
16. *Flour Mill.*
17. *Saw Mill.*
18. *Masonic Hall.*
19. *Odd Fellow Hall.*
20. *Brewery.*
a. *School Houses.*

SECTION 22 — 23 — 24

Newberry Road.

Pro. Evansv. & Ind. R.R.

IND. S. & S. R.R.

Raymond's Slope.

H. Hyatt's Slope.

Coal Road.

B

Bedford Road.

Hyatts Bore.

W. Hyatts Bore.

Appaw Road.

Pro I. & M. R.R.

Toms Hill Road.

Peeks Bore.

27

26

25

Bretts Bore.

Coal R.R.

Old Slope.

Price's Drift.

Range Line.

WASHINGTON

OHIO & MISS. R.R.

to Cincinnati 172 Miles.

Wilson's Slope.

To St. Louis 168 Miles.

Ohio Bore.

D. & M. R.R.

DEPOT.

Louisville Road.

Ind. N. & S. R.R.

Marysville Road.

Coal Switch.

Peters burg Road.

Clark & Co's Slope.

Town Line.

Pro. Louisv. & Mall. R.R.

Thompsons Bore.

Spink, Cabel & Co.

Shaft.

Portersville Road.

35

36

Turners Bore.

Mooney's Slope.

Troy Road.

Mc Clelland's Bore.

To Evansville 15 Miles.

Sulphur Spring.

Township Line.

SURVEY
OF PART OF THE
COAL FIELDS
in T. 3 N., R. 7. W.
Daviess County
INDIANA.

Scale 3 inches to one Mile.

Underground Workings.

Drawn by S. D. Wright.

PROFILE and VERTICAL SECTION from A to B.
Constructed by **Prof. E. T. Coz.**

Graduation Bft.
Soil & Drift.
Covered.
Spink, Cabel & Co's Slope.
Soil & Drift.
Covered.
Soap Stone.
COAL Y.
Fire Clay.
Lime Stone.
Black Slate.
Sand Stone.
Clark & Co's Slope.
O. & M. R.R.
Wilsons Slope.
Soil & Drift.
Black Slate.
Sand Stone.
Soap Stone.
Black Slate.
Gray argla Shale.
COAL L.
Fire clay.
Shale.
Sand Stone (Letranders drift)
Soil & Drift.
Sand Stone.
Soap Stone.
Gray argla Shale.
COAL L.
Fire Clay.
Shale.
Sand Stone.
COAL I.
Fire Clay.
Siliceous Shale.
Calcareous Shale & L.S.
Black Sherly Shale.
COAL K.
Fire Clay.
Shale.
COAL J.
Fire Clay & Shale.
COAL I.
Fire Clay.
Argillaceous.
and Siliceous Shales.
Level of Low Water in White River.
COAL H.
Fire Clay.
Millstone Grit.
COAL B.
Fire Clay.
Shale.

Drawn by G. M. Levette.

Braden & Burford, Lith, Ind'a.

This coal is very similar to the above, but probably contains less sulphur.

HON. HENRY K. WILSON'S COAL, section 33, township 9, range 8.

Specific gravity, 1.228; one cubic foot weighs 76.75 lbs.

Coke, - -	52.40	Ash, white, - -	0.80
		Fixed carbon, - -	51.60
Volatile matter,	47.60	Water, - - -	2.35
		Gas, - - - -	45.25
	100.00		100.00

The coke is puffed, somewhat porous, and has a brilliant metallic lustre.

This is one of the best caking coals that has come under my notice in the State. In appearance it is of a glossy, jet black color, vitreous fracture, and will soil the hands little more than cannel coal. The ash is white, and does not amount to one per cent. The coke is of fair quality, and the gas is 6.1 per cent. greater than I found in a sample of the best gas coal from Pittsburg.

I understand that Mr. Wilson is making arrangements to build a railroad from this coal to Shelburn or Curryville, on the Evansville and Crawfordsville Railroad. There is but little doubt, when proper facilities are afforded for transportation, of its meeting with a ready market for manufacturing gas; such a character of coal being very much needed in the West, which is now almost entirely dependent on the Pittsburg district for coal suited to this important and growing branch of manufactures.

MR. H. WILSON'S COAL (Cass township), section 15, township 8, range 8.

Specific gravity, 1.249; one cubic foot weighs 78.06 lbs.

Coke, - -	54.00	Ash, bluish white, - -	2.00
		Fixed carbon, - -	52.00
Volatile matter,	46.00	Water, - - - -	3.00
		Gas, - - -	43.00
	100.00		100.00

The coke is puffed, glossy and amorphous. This coal is from the same seam as the above; is of very good quality, but contains considerable more ash, though not more than is commonly found in caking coal.

PIONEER SHAFT, Curryville, section 34, township 9, range 9, seam four feet thick; analysis of upper part.

Specific gravity, 1.282; one cubic foot weighs 80.12 lbs.

Coke, - -	52.50	Ash, rust color, - -	1.00
		Fixed carbon, - -	51.50
Volatile matter,	47.50	Water, - - -	4.00
		Gas, - - -	43.50
	100.00		100.00

The coke is much swollen, amorphous, and has a metallic lustre.

This is a good, strong coal, and is referred to L, of the vertical section. Has a bright black color; breaks into cubes more or less coated with thin scales of semi-transparent calc spar. A cubic foot of this coal will weigh as much as a cubic foot of Pittsburg coal, and gives a very fair coke and large quantity of gas.

STANDARD SHAFT, sunk by Judge J. M. Hanna, section 36, township 8, range 8; seam five feet thick; lower seam, L.

Specific gravity, 1.333; one cubic foot weighs 83.31 lbs.

Coke, - -	58.10	Ash, white, - -	2.90
		Fixed carbon, - -	55.20
Volatile matter,	41.90	Water, - - -	1.80
		Gas, - - - -	40.10
	100.00		100.00

The coke is dense, of a dull color, and but slightly changed.

This is the same coal worked at the Pioneer shaft, and the two analyses correspond very closely. The ash is white, but the quantity is rather greater than in the former, and

the quantity of coke is also somewhat greater. Altogether, this is a most valuable seam of caking coal, and is well adapted for household and steam purposes.

Another sample of coal taken from the upper seam, M, in the Standard shaft was subjected to analysis, and the following result obtained:

HANNA'S COAL.

Specific gravity 1.281; one cubic foot weighs 80.06 lbs.

Coke, - -	56.50	Ash, gray, - - -	2.50
		Fixed carbon, - -	54.00
Volatile matter,	43.50	Water, - - -	5.00
		Gas, - - -	38.50
	100.00		100.00

The coke is slightly swollen with the form of the coal unchanged, and has a metallic lustre. In quality it compares favorably with other samples taken from this seam.

Coal L, appears to be the lowest seam that is worked in Sullivan county, though coal K, has been reported in bores at several localities. At the Pioneer shaft, it was struck at the depth of forty-seven feet below the bottom of L, and is here reported to be over five feet thick. This seam may be found at the other shafts, and, if proved to be of good quality and workable thickness, will materially add to the value of the property.

From the Standard shaft, to the Shelburn shaft, there is a rise of about thirty feet, in the surface of the country, in a distance of two and a quarter miles. The rise of the strata in that direction is still greater. At the Standard shaft we find that it is 218 feet from the railroad track to the bottom of coal L; while at the Pioneer shaft, one mile and a half to the south, it is reached in 181.6 feet; at Shelburn, about two miles and a quarter, at 175 feet, and in the Powers bore, three miles and a half distant, in the same direction, at 104 feet. This indicates a rise in the strata between the two extreme points here given, of at least thirty

feet to the mile, along the Evansville and Crawfordsville Railroad, and brings us within four miles of Sullivan, where a bore was made to the depth of 544 feet for coal oil, in 1864–66. Though the above rise appears to be very regular to the south for three miles and a half, it does not follow, by any means, that it continues at that rate to Sullivan; in fact, it rather approaches the general line of strike, for the usual rise is to the eastward; yet, it must be confessed that the dip is very irregular throughout the county. A persistent rise, of thirty feet to the mile, between Shelburn and Sullivan, would run coal L out before reaching the latter point. On the other hand, it is equally perplexing to suppose, where the topographical features of the country appear to be directly opposed to such an inference, that an anti-clinal axis exists between the above points, sending coal L to a depth of 269 feet at Sullivan, a rate of dip equal to forty-one feet to the mile, even though we compute it directly from Powers' bore, where the coal is actually proved to be rising in the direction of the former place. From a general observation, I made Sullivan one hundred feet lower, topographically, than the town of Merom, which is nine miles west and situated on a high bluff overlooking the Wabash river, and could detect no material change in the geological horizon. One hundred and seventy-nine feet below the top of this bluff there is a coal three and a half feet thick, including its two clay partings. If we allow for a slight rise, which exists in the strata towards the Wabash river, from Sullivan, it will make this coal correspond very well to the place of the second coal in the bore at Sullivan, counting from the top downwards. The former seam is referred to M, and the latter to N, by Prof. Collett, whereas, by this study, they are referable to L. It must be borne in mind, that as a general rule, borings made during the oil excitement, are quite unreliable as a guide to the identification of coal seams, especially when they present anomalous features in the general order of the strata, and are given from memory. This correlation of the coals from Curryville to Sullivan and Merom, here

given, is perfectly natural, and requires no violation of the observed prevailing features in the stratography of the country.

A coal that is 104 feet beneath the surface at Powers' bore is not likely to be 269 feet at Sullivan. Below the seam marked L, in the bore at the latter place, it is my opinion that no workable seam can be found. The seven feet of coal reported at 544 feet, will prove to be a bituminous shale.

These suggestions regarding the equivalency of the coal seams along the Evansville and Crawfordsville Railroad in no way militate against the practical value of Prof. Collett's able report, but are thrown out for the purpose of stimulating research in a field where there is still much to be learned. Though no faults and grand disturbances have yet been found in the western coal basin, we have in Indiana quite as many geological difficulties to encounter from an unequal distribution of the seams over a portion, at least, of the basin, as are to be found in the eastern measures.

Sullivan county is rich in valuable coal beds, and the recent opening of the Evansville, Terre Haute & Chicago Railroad will furnish a good market. Josephus Collett, Jr., the energetic President of this road, is determined that it shall be one of the greatest coal roads in the country. Together with the connecting roads, it has a supply of nine hundred coal cars to start with. The three shafts in Sullivan are doing a fine business. Two mines have been opened in Vermillion county, which, together with the above and the block coal mines of Clay county, already furnish about one thousand tons per diem on this road alone. This rate of freightage will rapidly increase as the coals become known.

DAVIESS COUNTY.

Daviess county is bounded on the north by Greene, on the east by Martin, on the south by Pike and Dubois, and on the west by Knox county. In shape it is somewhat pentagonal and contains about 424 square miles, and is well supplied with water courses. The East Fork of White river flows along

its southern border and the West Fork along the western border. Sugar, Mud and Aikman creeks empty into the East Fork, and these, together with Veal's creek, a tributary of the West Fork, drain most of the county south of the Ohio & Mississippi Railroad. Prairie, Smithers, Pond and Purse creeks, tributaries of the West Fork, water the central and northern part of the county. The southern part of the county is, for the most part, high table land, rather broken by short hills from one hundred to two hundred and fifty feet in height as you approach the rivers. After passing the hills around Washington, the country north of the Ohio and Mississippi Railroad is low, rolling land, with numerous small prairies, except a small area in the eastern and northeastern part, where it is quite hilly.

Washington is the county seat and the principal town in the county, and has a population of about four thousand. It is the seat of many important manufactures, and does an extensive coal business. Indeed, Washington furnishes more business for the railroad than any other city between Cincinnati and St. Louis. No less than sixteen coal mines are in active operation in and around the city, and the shipment of coal is about seventy car loads per day, or twenty-one thousand bushels. Two seams are worked, but by far the greater portion is taken from the seam marked L in the column of coals given at page 34. The other seam is referable to X. This coal was not found, or at least not recognized, in Clay and Greene counties heretofore reported upon, and does not, therefore, appear in the column of coals given in the First Report. Indeed, at the time of arranging the general section of the coal strata, it did not appear to me, from the study of the coals in the counties then surveyed, that the small space seen everywhere between L and K would widen out to the southward in such a manner as to give room for another important seam of coal.

The evidence which served to establish the place of this coal in the column will be given in another place.

GEOLOGY.

Daviess county lies entirely within the coal measures, and, probably, includes within its area all the carboniferous strata from the highest to the lowest.

The annexed topographical map and section represents the position of the coal shafts and slopes around the town of Washington, and the extent of country worked over. The profile and vertical section taken in the direction of the line from A. to B. is made from a careful study of the measures seen at outcrops and in shafts; and from information derived from the records of numerous bores that have been put down, in search of coal, in the vicinity of Washington.

The elevations, and location of mines, outcrops and bores on this map, were determined by an instrumental survey, which was made under the direction of D. H. Kennedy, at my request, and paid for by the citizens of Washington. For the carrying out of this important work, I am indebted to Hon. W. S. Turner, Dr. Barton, Mr. W. Saltmarsh, Messrs. Spink & Cable, M. L. Brett, H. D. Kennedy, C. E., Charles Boyden, C. E., S. D. Wright, C. E., John Hyatt, and other citizens of Washington, whose names I have omitted to get. Its importance will be fully appreciated by all those who desire to acquire a knowledge of this highly favored mining district.

The section shows the order of the coals from B. to N. The zero line marks the horizon of low water in the West Fork of White River, at the crossing of the Ohio and Mississippi Railroad. The railroad elevation is indicated by the initial letters of the road (O. & M. R. R.) The position of the "Washington" or main coal seam L, with reference to the railroad level, does not hold good in this section for points along the road, but is correct for Spink, Cabel & Co.'s shaft, just west of the Petersburg road, and half a mile south of the city. At this mine the coal dips one degree to the southwest; at Mooney's slope, the dip is to the west; Wilson's slope, one degree nearly south;

Clark & Co.'s, one degree southeast. The mine at Sulphur Spring draws all the water from Spink & Co.'s, and from Mooney's slope. Though somewhat irregular, this clearly indicates that the general tendency of the dip is to carry this coal above the stratified rocks in the hills north of Washington, and it is only caught by the top of a very high hill in the northeast corner of section 25, near the Bedford road. The following diagrams will show the rise of the coal in two directions from the Sulphur Spring shaft:

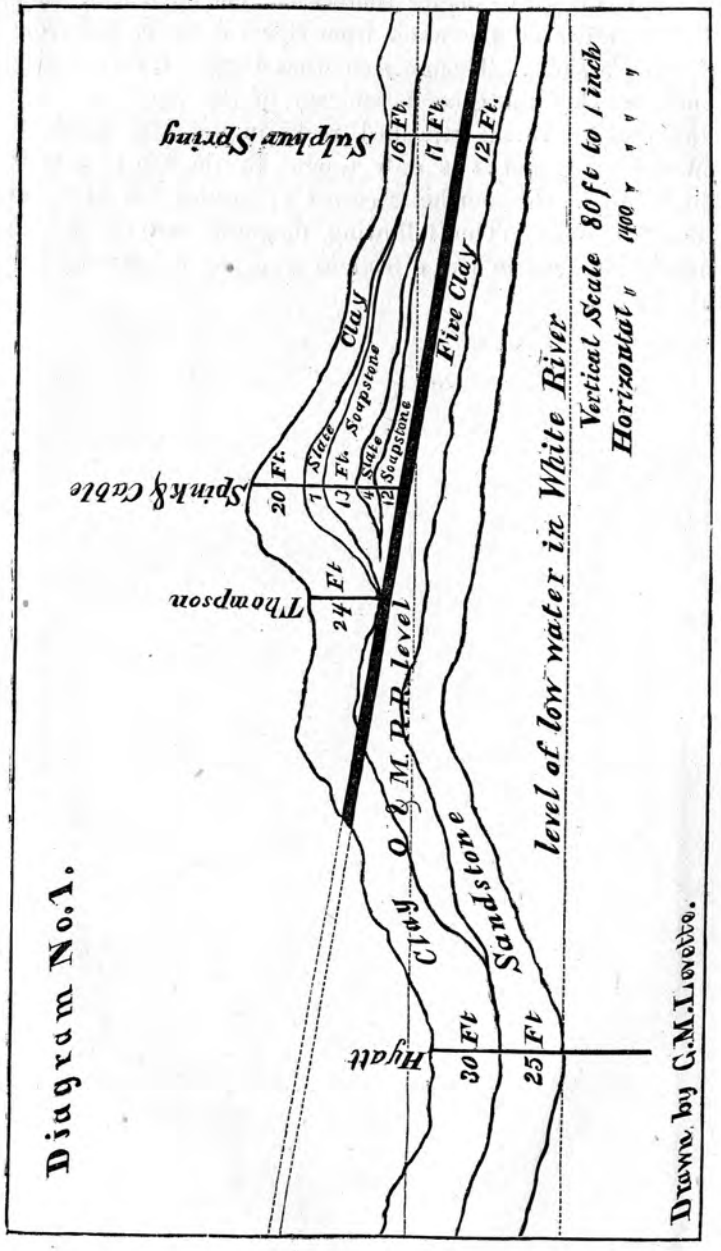


Diagram No.1.
Sulphur Spring
Spinks Cable
Thompson
Hyatt
16 Ft.
17 Ft.
12 Ft.
20 Ft.
24 Ft
30 Ft
25 Ft
7 Slate
13 Ft. Soapstone
4 Slate
12 Soapstone
Clay
Fire Clay
Clay
Sandstone
O & M. R.R. level
level of low water in White River
Vertical Scale 80 ft to 1 inch
Horizontal " 1400 " " "
Drawn by C.M.Lovette.

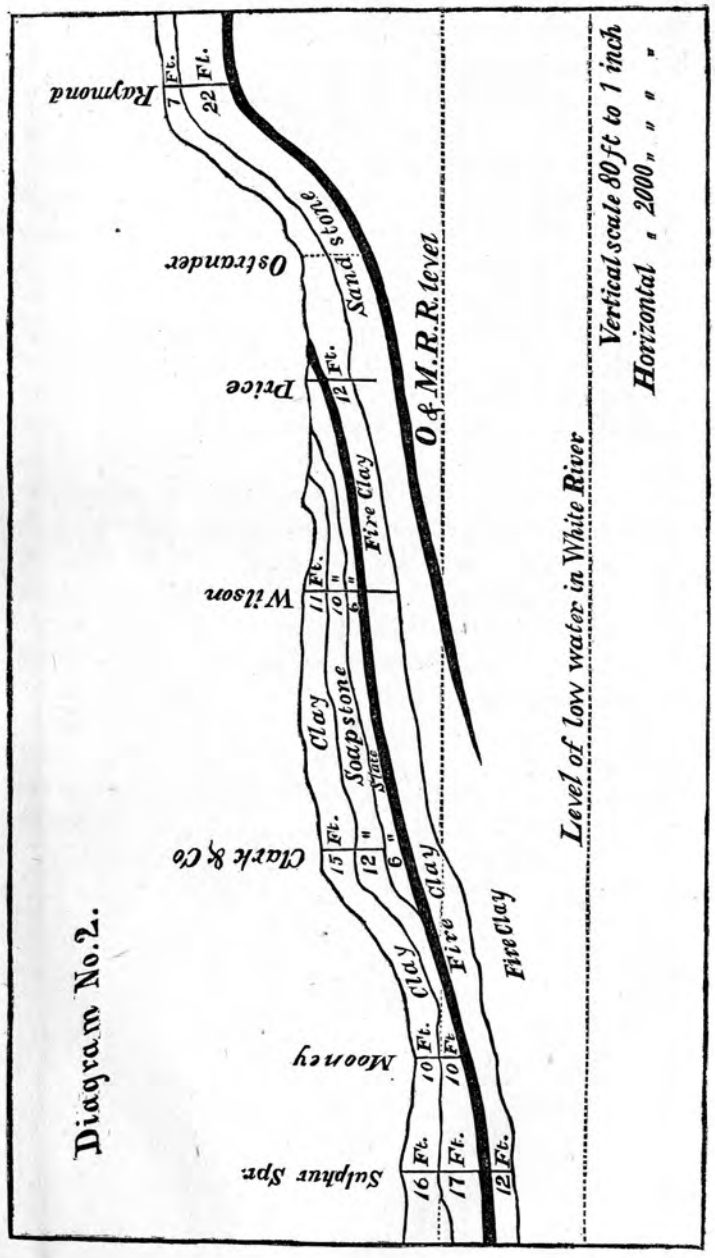


Diagram No.2.
Raymond
Ostrander
Price
Wilson
Clark & Co
Mooney
Sulphur Spr.
7 Ft.
22 Ft.
12 Ft.
11 Ft.
15 Ft.
16 Ft.
17 Ft.
10 Ft.
10 Ft.
12 Ft.
10 "
8 "
12 "
6 "
Sand stone
Fire Clay
Clay
Soapstone
Slate
Clay
Fire Clay
Fire Clay
O & M.R.R. level
Level of low water in White River
Vertical scale 80 ft to 1 inch
Horizontal " 2000 " " "

The lower dotted line represents the horizon of low water in the West Fork of White River, at the crossing of the Ohio and Mississippi Railroad; and the upper dotted line, the level of the Ohio and Mississippi Railroad, where it passes through the town of Washington.

Coal L, in the Sulphur Spring shaft, is seventeen feet below the level of the railroad, and is taken as the starting point in these sections. The section represented by Diagram No. 1, is one and one-twelfth miles long, and crosses the county in a northwest direction through, or near, Spink, Cable & Co.'s shaft, and Thompson's bore, to J. Hyatt's bore, which commences near the level of the railroad. At Spink, Cable & Co.'s, coal L is nearly on a level with the railroad; at Thompson's bore it is seventeen feet above, and continued at the same rate of rise, it is seen that J. Hyatt commenced his bore entirely below coal L. After passing through thirty feet of surface clay and drift material, this bore is reported to have penetrated twenty-five feet of sandstone, and twenty-four feet of soapstone and slate; beneath this, a coal was struck, but I was unable to learn its thickness. It is, however, a subordinate coal of moderate thickness. Higher up the same branch, which runs near the above bore, in a northeast direction, three other bores were made for coal. The first, in order, is Peck's. This bore commenced twelve feet above the railroad level, and furnished the following section:

SECTION OF PECK'S BORE.

Space.		Ft.	In.	
		10.		Clay.
		20.		Quick Sand.
68.				
		38.		Slate.
2.6		2	6	Coal K. ?.
		D.		Fire Clay.
85		81		Slate.
		4		Black Slate.
3		3		Coal I. ?.
				Fire Clay, ?
158.6	Total.			

W. Hyatt's bore commenced forty-seven feet above the railroad and passed through:

SECTION OF W. HYATT'S BORE.

Space.		Feet.	In.	
		20		Clay and soft rock.
		10		Reddish soft rock.
		2		Iron ore ?
		8		Hard pan.
88.		6		White sandstone.
		10		Blue sandstone.
		20		Light soapstone.
		1		Black slate.
		2		Hard rock.
		5		Hard black slate.
		4		Hard rock.
				Probable place of coal.
90		84		Slate.
		6		Brown slate.
1		1		Coal.
179.	Total.			

Hyatt's bore, about one and three-quarter miles northeast of the latter, commenced seventy-four feet above the railroad and seventeen feet below the horizon of Raymond's coal. It passed through:

Clay and soft rock, - - - - -	20 ft.
Hard sandstone, - - - - -	40 ft.
Soapstone, - - - - - -	40 ft.
Total, - - - - -	100 ft.

There is no report of coal being reached in this bore, and it is my opinion, that all the bores, above referred to, commenced below coal X.

Diagram No. 2, presents a section running northeast, from Sulphur Spring shaft, to Raymond's coal X. This section, also, shows that coal L, rises from the Sulphur Spring shaft, where it is seventeen feet below the level of the railroad, to the northeast, at the rate of about twenty-six feet to the mile. At Mooney's mine it is ten feet below the railroad level, at Clark's twenty-two feet above, at Wilson's thirty-four feet, and at Price's fifty-four feet above the railroad. This rise carries it out before reaching the hill at Raymond's mine, but it is caught by a much higher hill that lies between Raymond's and Ostrander's.

The conclusion to be drawn from the above diagrams and the study of the coal around Washington, is, that the strata rise with the hills to the north, and coal L was removed ages ago from the northern part of the county by denudation. The bores which have been cited above, as well as Brett's bore, are shown to have commenced on a horizon, even lower than coal X. At Mr. Brett's dwelling house, some thirty or forty feet above the commencement of his bore, a heavy sandstone was penetrated in digging his well, which I refer to the sandstone over Raymond's coal. Now, if these stones are synchronous, then coal X may be found just below it, but, as the bore which was made in search of this coal by Mr. Brett, was commenced at a lower horizon,

and on the side of a gently sloping hill, which proved to be largely composed of accumulated clay and other earthy material derived from disintegrating forces, it failed to find the coal, as may be seen by the following account of the material passed through, commencing thirty-eight feet above the railroad level:

SECTION OF BRETT'S BORE.

Space.		Feet.	In.	
100.		57		Surface Earth and Clay.
		33		Gray Slate.
		4		Dark gray Slate.
		1		Slate
		5.		Black Slate.

The five feet of black slate found in this bore, is probably the same seam passed through by W. Hyatt, three-quarters of a mile to the northwest. Specimens of the hard rock, reported as superimposed on the black slate in the latter bore, were sent to me for examination, and proved to be limestone. This leads me to believe that the five feet of black slate occupies the position of coal K.

This would, also, appear to be the place of the two and three quarter feet of coal in Peck's bore, as the spaces to the seam of coal eighty-four feet below, in the former, and eighty-one feet, in the latter, tend to confirm this correlation.

Fifty-five feet above coal L, and extending from the Portersville road to the Petersburg road, south of Washington,

is a seam of coal, two feet thick, which I refer to N. It shows itself by crops under all the high points, it is a very good quality of caking coal and about fifty thousand bushels have been mined from it.

The following column represents the number and position of the coals in Daviess county as nearly as they can be determined at this time:

CONNECTED SECTION OF COAL MEASURES IN DAVIESS COUNTY.

Space.		Feet.	In.	
26.		20		Surface Earth and Drift.
		6		Argo. Silicious Shale.
2.		2		COAL N.
55.		4		Fire Clay.
		8		Argo. Shales.
		1		Pyritiferous Shaley Limestone.
		14		Arenaceous Shale.
		31		Bluish Argo. Shale.
5.		5		COAL L. (Main Washington.)
41.		11		Dark and light colored Fire Clay.
		30		Arenaceous Shale and massive Sandstone.
3.10		3	10	COAL X.
23.		2		Fire Clay.
		10		Silicious Shale.
		6		Calc. Shale and Limestone.
		5		Black, sheety, bituminous Shale.
5.		3-5.		COAL K.
28.		3		Fire Clay.
		25		Shale.
1.		1		COAL J.
11.		1		Fire Clay.
		10		Shale.
3.6		3	6	COAL I. Good Block.

CONNECTED SECTION OF COAL MEASURES—*Continued.*

Space.		Feet.	In.	
60.		60		Argillaceous and Silicious Shale.
				Place of Coals F, G, and H.
25.		25		Silicious Shales.
1.		1.		Place of Coal B.
80.		65		Massive Sandstone. "MILLSTONE GRIT."
		15		Buff Shale.
2.6		2	6	COAL A.
13.		1		Fire Clay.
		12		Buff Shale.
.6			6	Coal.
368.4	Total.			Low water East Fork of White River.

From the limestone between coals N and L, I obtained a number of very fine fossil shells; *Brachiopods, Spirifer cameratus, Productus semireticulatus, P. wabashensis, P. elegans,* (*longispinus,*) *Athyrus subtiliti, Chonetes mesoloba, Cephalopods:* Fragment of large *Nautilus,* species undetermined, *Bellerophon carbonarious, B. percarinatus, B. Montfortianus,* and *Orthoceras Rushensis.* This stone had been thrown out in digging the air shaft to ventilate the Wilson mine, and having been decomposed by atmospheric influences, had left its less affected fossil contents in a very good state of preservation. On some of the *Productus elegans* I saw spines that were more than two inches in length, but too frail to be preserved.

The gray argillaceous shale, forming the roof of coal L, contains a variety of beautiful fossil plants, and remains of crustacea. Of the former, I could determine, *Sigillaria reniformis, Pecopteris arborescens, Sphenophyllum Schlotheimii, Neuropteris hirsuta, N. Loschii, Asterophyllites sublævis?* and *Alethopteris lonchitidis?*

Crustaceans. A small *Euproops Danæ?* (Limulus,) resembling the horse-shoe crab, not more than three quarters of an inch long. Great quantities of small crustaceans resembling *Cypris.*

The limestone over coal K is also highly fossilferous, containing large *Productus punctatus, P. cora, P. semireticulatus, P. elegans,* (longispinus,) *P. Rogersii, Spirifer cameratus, S. lineatus, Athyrus subtilita, Chonetes mesoloba, C. Smithii? Aviculopecten providences, Bellerophon, Sp.?* (a very large specimen subsequently lost or mislaid,) *B. carbonarious,* and *Orthis Rushensis.*

In the black, sheety, bituminous shales, usually forming the roof of coal K, in this county, there are spines, small bones and scales of fish. Below this horizon, no fossils were observed, probably from the fact that very little has been done, as yet, to develop the lower seams of coal.

At present, our knowledge, regarding the organic remains of the carboniferous epoch, is so imperfect, notwithstanding the labor that has been bestowed upon the subject, that no

reliance can be placed on palæontological evidence as a means of determining equivalent strata. Both the fauna and flora have a great vertical range, in the carboniferous rocks, and the majority of the species now known can be traced from the highest to the lowest members. The time usually spent at a locality, in collecting fossils, is, by no means sufficient to enable one to pronounce upon the non-occurrence of species that have been seen in abundance in another place, even though it should occupy a different horizon. Indeed, it is not an uncommon occurrence to find, at different localities, quite a change in the predominating fossils in strata of undoubted correlation. This may be accounted for from the fact, that in time past, as well as in the present, local causes, or conditions, existing at one place, favored the accumulation of certain kinds of organisms, while other kinds were repelled. The experienced collector, of recent shells, can readily tell, in what depth of water, character of the bottom, whether mud, sand or rock, where he must look for certain species; and, were the fauna and flora, of to-day, covered up by sediment and subsequently converted into stone, the future palæontologist would find in strata, that are synchronous, a marked difference in the fossil remains, and guided by this evidence, alone, would most likely fall into grave errors with regard to their relative age. There can be no well defined boundary of geological epochs based upon the progress of animal or vegetable life alone. Then, surely, we can not undertake, by such evidence, to establish the chronological order of the strata which it embraces.

Coal L, in Daviess county, is an excellent caking coal, being quite free from deleterious impurities. The seam ranges from three feet, ten inches, to five and a half feet, and will average five feet in the neighborhood of Washington. The color is dull-black, fracture irregular and cubical, contains but little calcite in the partings, and may be handled and stocked without much loss. It is used for making gas, both at Vincennes and St. Louis, and the quality

of the gas compares favorably with that made from the Youghiogheny coal.

Specimens taken from various mines south of Washington, were subjected to analyses and the following results obtained:

AIKMAN'S Coal, L, section 34, township 3, range 7, worked by Spink, Cable & Co.

Specific gravity, 1.270; one cubic foot weighs 79.37 lbs.

Coke, - -	59.50	Ash, nearly white, - -	3.00
		Fixed carbon, - -	56.50
Volatile matter,	40.50	Water, - - -	5.00
		Gas, - - -	35.50
	100.00		100.00

The coke is much puffed, brittle and glossy.

DUTCH BANK, Coal L. Section 34, township 3, range 7, worked by Spink, Cable & Co.

Specific gravity, 1.264; one cubic foot weighs 79 lbs.

Coke, - -	63.50	Ash, white, - - -	2.00
		Fixed carbon, - -	61.50
Volatile matter,	36.50	Water, - - -	2.00
		Gas, - - -	34.50
	100.00		100.00

SPINK, CABLE & Co.'s main slope, coal L, section 34, township 3, range 7.

Specific gravity, 1.294; one cubic foot weighs 80.87 lbs.

Coke, - -	64.50	Ash, fawn color, - -	4.50
		Fixed carbon, - -	60.00
Volatile matter,	35.50	Water, - - -	5.50
		Gas, - - -	30.00
	100.00		100.00

The coke is swollen, bright, porous and slightly laminated.

SULPHUR SPRING BANK, Coal L, section 34, township 3, range 7, worked by Spink, Cable & Co.

Specific gravity 1.280; one cubic foot weighs 80. lbs.

Coke,	64.30	Ash, brown,	6.00
		Fixed carbon,	58.30
Volatile matter,	35.70	Water,	4.50
		Gas,	31.20
	100.00		100.00

Coke much puffed, brittle and glossy.

THOMAS WILSON'S, Coal L, section 26, township 3, range 7.

Specific gravity 1.268; one cubic foot weighs 79.25 lbs.

Coke,	61.70	Ash, white,	2.50
		Fixed carbon,	59.20
Volatile,	38.30	Water,	3.40
		Gas,	34.90
	100.00		100.00

Coke slightly swollen, laminated and glossy.

Coal X, taken in the decending order, is the next workable seam in this county. The thickness varies from two to five feet. It outcrops in a great many places and has been opened and mined by Raymond, and H. Hyatt, on section 23, one mile northeast of Washington, and by Ostrander, on section 25, about half a mile south of the former openings.

It is a very pure coal, contains less ash and water, and, also, less fixed carbon, but more gas than coal L. The color is jet black, fracture cubical, shows more or less carbonaceous matter in the horizontal partings, and some scales of calcite in the vertical seams. A sample taken from Raymond's mine was analyzed and contained:

RAYMOND'S COAL, X, section 23, township 3, range 7.

Specific gravity 1.200, one cubic foot weighs 75 lbs.

Coke,	52.50	Ash, cream color,	1.75
		Fixed carbon,	50.75
Volatile matter,	47.50	Water,	1.00
		Gas,	46.50
	100.00		100.00

The coke is porous, puffed and lustreless.

Over this coal is usually found a heavy bedded or schistose, coarse grained, grayish brown sandstone, with, sometimes, a few inches of bituminous or argillaceous shale intervening between the two. At Raymond's and Hyatt's tunnels, or entries, the massive sandstone rests immediately upon the coal. At the former mine the seam is a little over three feet, and at the latter about two and a half feet thick. The altitude of these mines above the railroad is ninety-two feet. The coal is wagoned to the city, where it has a good reputation as a fuel.

At Ostrander's entry the seam is four feet thick and has an elevation of fifty-four feet above the railroad. This mine is extensively worked and the coal is hauled, over a tram road, to the Ohio and Mississippi Railroad.

Along the West Fork of White river, coal X can be traced, by outcrops, from Edwardsport, in Knox county, to a point some distance below the mouth of Veal's creek. An instructive section is here given of the strata at Edwardsport, from coals L to K, and presents the key to the chronological order of the coals around Washington:

SECTION AT EDWARDSPORT, KNOX COUNTY.

Space.		Feet.	In.	
26.		20		Surface, Soil and Clay.
		6		Gray Shale.
5.		5		COAL L. (Curry's Coal.)
		3		Fire Clay.
41.		38		Space containing silicious Shales and Sandstone.
1.10		1	10	COAL X.
		4		Fire Clay.
28.6		20		Shale, where exposed.
		2	6	Buff Fossiliferous Limestone.
		2		Black, Sheety Shale.
5.		5		COAL K.
		2		Fire Clay.
27.		25		Shales.
				Low water in White river.
134.4	Total.			

The buff fossiliferous limestone, in the above section, contains *Productus punctatus, P. semireticulatus, P. elegans, P. cora, Chonetes mesoloba, C. Smithii, Orthis Rushensis, Bellerophon carbonarius,* and an abundance of *Encrinite* stems, and in the black, sheety shale, below the limestone, are found teeth, scales and spines of fish.

At the town of Edwardsport, coal K is three and a half feet thick, lies twenty-five feet above the river bed, and is cut through by the grade of the Indianapolis and Vincennes Railroad. A quarter of a mile in a southerly direction,

where it is again cut through by the railroad, the thickness is scarcely two feet, but thickens up to five feet, where it shows in the river about one mile below the town on property belonging to Dr. Keith. Coal X is seen, at intervals, about twenty-five feet above. Previous to the time of my visit to this locality, it was the received opinion, of the citizens, that the coal on Dr. Keith's land was a lower seam than the one cut by the railroad, and in order to fully test the matter, Dr. K. put down a bore one and a quarter miles south of the town, near the railroad, which commenced just beneath coal X, passed through coal K and continued to a sufficient depth, through barren strata, to satisfy himself of the accuracy of my determinations. At this point a shaft was subsequently sunk to coal K, and it is now mined by Mr. Ostrander.

The levels obtained here show that the strata dip slightly to the south, and at Appraw's ford, carries coal X down to the level of the water. Formerly, in times of extreme low water, the citizens of Washington obtained most of their coal at this place, by mining it out of the bed of the stream. When I visited this locality, the river was up, and, I had no means of measuring the thickness of the seam, but, was informed by parties who had worked it, that it was about four feet thick; the superimposed rocks are schistose sandstone. About two miles below Appraw's ford, on the Knox county side of the river, is the Weaver mine—coal X. The seam at this place, is three feet ten inches thick, at high water mark, and has a sandstone roof. The quality of the coal at the Weaver mine is remarkably good, and mining operations have been abandoned, only, for the want of regular railroad transportation for the coal. The next opening to coal X, in going down the river, is one mile below Maysville, on section 6, township 2, range 7. Here, a slope was made to the coal, starting close to the bank of the old Wabash and Erie Canal; it has a sandstone roof and is, as nearly as I could determine owing to the interference of water, four feet thick.

When the canal was open for navigation, extensive mining operations were carried on at these mines, transportation was cheap and the coal found a ready market in the towns along the canal. The seam lies just below the bed of the canal, and the low ridge, above it, furnished the following section:

Space.		Feet.	In.	
				Covered slope.
		7		Soft, shaly Sandstone.
		6		Soft, gray Sandstone.
4		4		COAL X.
		0		Fire Clay.

The siliceous shale, in the upper part of this section, is seen for several hundred yards along the river bluff, going south.

Three quarters of a mile below the mouth of Veal's creek, coal K makes its appearance in the bed of the river, and coal X, reduced in thickness, is seen a few yards above. The following section exhibits the relative position of the two seams:

SECTION NEAR MOUTH OF VEAL'S CREEK.

Space.		Ft.	In.	
		4		Covered space.
24.		20		Shaly sandstone.
2		2.3		COAL X.
				Fire Clay.
		5		Siliceous shale
			6	Hard blue limestone.
15.6		2		Calc. shale, fossiliferous.
		5		Pyritiferous calcareous shale with fossils.
		1		Hard blue limestone.
		2		Black bituminous sheety shale.
2.		2		COAL K, exposed above low water.
51.6.	Total.			

The entire thickness of coal K could not be determined, as the coal extended beneath the water. The bituminous shale, forming the roof, contains a great number of round, ferruginous, calcareous concretions, a foot or more in diameter. Many of these balls have weathered out and are strewn over the bed of the river. This shale, also, contains numerous fins and scales of fish. The superimposed limestone and calcareous shale are highly fossiliferous, containing large *Productus punctatus, P. cora, P. elegans,* (longispinus,) *P. Semireticulatus, Aviculopecten providensis, Bellerophon carbonarius, Chonetes mesoloba, Orthis Rushensis,* and *Cyathaxonia prolifera.* The entire calcareous bed is remarkably rich in a great variety of shells; in some spots the surface was literally covered with large *Productus semireticulatus,* with their long spines entire and well preserved. I regret that a severe rain storm prevented me from making as complete a collection of its abundant fossil fanna as was desirable.

The sandstone overlying coal X, appears in the hills,

near Pond Creek Mills, on land owned by Hon. James D. Williams, in Knox county. At my request, he had Mr. Elbrig, of Brazil, who is an experienced hand at the business, put down a bore which reached coal X, four feet thick, within a few feet of the depth at which I stated that it would be found.

HON. JAMES D. WILLIAMS' BORE.

Space.		Feet.	In.	
		4		Surface.
		2		Sandstone.
		5		Shale.
32.4				
		21		Solid blue sandstone.
			4	Black slate.
4.		4		COAL X.
		4		Fire clay.
		5		Sandstone.
		4		Gray shale.
		5		Blue soapstone.
		7		Gray slate.
50				
		25		Black slate.
86.4				

This bore was stopped just before reaching coal K.

Believing that one seam of coal was sufficient for all the mining he might do, the boring was stopped without testing the depth to coal K and its thickness.

Between Washington and Montgomery the sandstone over X, makes its appearance in several places, and the coal, which is struck by a number of wells north and south of the road, between these points, may be referred to that seam. It is, also, possible that this coal seam may exist at Cross' on section 17, township 2, range 6, where I was not fully satisfied that all the coal, exposed at several openings, did not belong to the subordinate seam K, which is readily recognized by the superimposed black, sheety shale, and limestone.

As we approach the eastern border of the county, coal K passes from a caking to a semi-block, and, probably, block coal, but it also diminishes in thickness and is rarely found thick enough to justify working. In the neighborhood of Montgomery and Black Oak, on the Ohio & Mississippi Railroad, it ranges from one and a half to three feet in thickness. At Cross' the old openings were filled up and I was unable to make a measurement of the seam, but Mr. Cross assured me that it was four feet thick. From the examination of small fragments, found lying around the mouth of the abandoned mine, I am rather inclined to believe that this seam is, here, a good quality of block coal. For this reason, I was very anxious that an opening should be again made to the body of the coal, that I might be able to decide the question. Though this work was promised by the proprietor, other business occupied his time, and I was not able, on a second visit, which was made for the purpose, to obtain any further clue to its character, than that already derived from the small weathered fragments, above alluded to.

The limestone at Cross' is from five to ten feet thick, and may be followed, for several miles, down Akerman's creek, and contains a great many fossil shells, similar to those found below the mouth of Veals creek. The underlying bituminous shale, also, contains the same character of fish remains, seen at that locality. At Montgomery, the limestone and coal K crop out on the side of the road, the former is, here, about one foot, and the latter, about two feet thick. Coal K has, also, been found, near this town, by bores and sinking wells. On section 12, township 2, range 6, and on section 7, township 2, range 5, on Ricketts' land, coal K is reported to be three feet thick. In the south part of the county, it ranges from two and a half to three feet in depth of strata, and has been rudely opened at a great many places; particularly in the neighborhood of Alfordsville and Glendale. On section 20, township 2, range 5, at Mr. Shea's, a coal, reported to be four feet thick, was passed through in digging his well, which I refer to K. Southeast

of Shea's, on the hill, after crossing Sugar creek, and on the road to Alfordsville, I obtained the following section:

SECTION NEAR SHEA'S.

Space.		Feet.	In.	
		10		Soil and Clay.
32.		20		Silicious Shale, with alternating bands of Iron Ore.
		2		Gray, Silicious Limestone.
4.		4		Shale. Place of COAL K. ?
		3		Fire Clay.
			1	Flaggy Sandstone.
24.		20		Sandstone and Shale.
		?		COAL I?
		2		Fire Clay.
36.		14		Good Iron Ore mixed with Shale.
		20		Silicious Shale.
		0		Bed of Sugar Creek.
96.	Total.			

At Alfordsville, Mr. J. A. McCord is mining coal K by a drift running into the face of a low ridge. The section, visible, contains:

SECTION AT McCORD'S.

Space.		Feet.	In.	
38.		20		Covered space.
		15		Argo. Silicious Shale.
		3		Black, bituminous sheety Shale.
2.6		2	6	COAL K, (Block Coal.)
.6			6	Caking Coal.
		0		Fire Clay.
41.	Total.			

Though the limestone is seen in the road, near by, I did not find it in this section. The coal is quite sulphury, and is not suited for manufacturing purposes. The same seam is, also, found at the following localities, near the town of Alfordsville:

Ross, northwest quarter, section 34, township 2, range 5.
Camp, southwest quarter, section 34, township 2, range 5.
J. A. McCord, northeast quarter, sec. 34, town. 2, range 5.
O'Bryan, northwest quarter, section 26, town. 2, range 5.
J. A. McCord, northeast quarter, sec. 33, town. 2, range 5.
Allen, northeast quarter, section 4, township 1, range 5.
T. Scales, southwest quarter, sec. 9, township 1, range 5.

Near Ross' the limestone, which overlies the coal, is from four to five feet thick where it crops out in Sugar creek.

At Thomas Scales' mill, on Sugar creek, in southwest quarter, sec. 9, town. 1, range 5, I found the following section:

SECTION AT THOS. SCALES.

Space.		Feet.	In.	
		20		Covered space.
103.		70		Argo. shale, with bed of white clay and sandstone.
		3		Hard blue fossiliferous limestone.
		8		Arenaceous shale.
		2		Black bituminous shale.
2.		2		Semi-block COAL K.
		0		Bed of Sugar Creek.
105.	Total.			

Just below the mill, in the bed of the creek, is a layer of very hard bastard limestone, six inches thick. It is of a handsome blue color, and will take a fine polish.

The limestone, above the coal, contains: *Productus punctatus, P. cora, P. semireticulatus, Spirifer cameratus, S. lineatus, Pinna sp.* (?), and *Chonetes mesoloba.* Had time permitted, I have no doubt but the list of fossils might have been very greatly extended.

Near Glendale, coal K outcrops at a number of places, and is struck in digging wells. The following is a list of places where coal, probably referable to K, is found:

Burton, on Mud creek, east part section 10, township 1, range 6.

Arms, northeast quarter section 28, township 2, range 6.

Conner, southwest quarter section 27, township 2, range 6.

Fagan, southwest quarter section 34, township 2, range 6.

Gregory, southeast quarter section 29, township 2, range 6.

Gregory, Chris., southeast quarter section 5, township 2, range 6.

Lamb, northwest quarter section 27, township 2, range 6.

McGhee, northwest quarter section 34, township 2, range 6.

Ragsdale, southeast quarter section 28, township 2, range 6.

Rennselaer, southeast quar. section 27, township 2, range 6.

Smock, C., southwest quar. section 33, township 2, range 6.

At Glendale, Dr. Mitchell dug a well, which passed through:

Soil and drift,	8 feet.
Soft sandstone,	15 feet.
Hard blue limestone, containing flint,	0 feet.

Where the coal was exposed to view, at the above localities, it was not over two and a half feet thick, and is, generally, less. It is reported to be four and a quarter feet thick in Michael Fagan's well. Chris. Gregory's coal is fifteen inches thick, and is overlaid by black, bituminous, slaty shale, containing fish remains; superimposed on the black shale, is forty feet of argillaceous and silicious shale, which reaches to the top of the hill.

Analysis of CHRIS. GREGORY'S coal (K?), on section 29, township 2, range 6:

Specific gravity, 1.276; one cubic foot weighs 79.75 lbs.

Coke,	62.50	Ash, drab,	2.00
		Fixed Carbon,	60.50
Volatile matter,	37.50	Water,	7.00
		Gas,	30.50
	100.00		100.00

The coke is very porous and brilliant.

This is a very good coal; it contains a large amount of fixed carbon, and a small quantity of ash.

JOHN GREGORY'S coal (K?), on section 5, township 2, range 6, though I believe it to be the same seam as the above, is not so good, as may be seen by the following analysis:

Specific gravity, 1.275; one cubic foot weighs 79.68 lbs.

Coke,	51.50	Ash, lilac,	2.00
		Fixed carbon,	49.50
Volatile matter,	48.50	Water,	6.50
		Gas,	42.00
	100.00		100.00

The coke is puffed, porous, and brilliant.

McCord's coal, at Alfordsville, is of variable quality; the upper part of the seam is block coal, and the lower part caking coal. As stated above, it contains combined sulphur and irregular bands of iron pyrites. The following analysis was made from a sample of the block-coal part of the seam:

M'CORD'S COAL K.

Specific gravity, 1.245; one cubic foot weighs 77.81 lbs.

Coke	56.00	Ash, flesh,	2.00
		Fixed carbon,	54.00
Volatile matter,	44.00	Water,	4.00
		Gas,	40.00
	100.00		100.00

The coke is very compact, and unchanged in form.

A specimen of coal, thrown out in digging through a seam, said to be four feet thick, in Cornelius O'Brien's well, on section 25, township 2, range 5, gave, on analysis, the following result:

CORNELIUS O'BRIEN'S COAL K.

Specific gravity, 1.270; one cubic foot weighs 79.37 lbs.

Coke, - -	58.00	Ash, salmon, - - -	1.50
		Fixed carbon, - -	56.50
Volatile matter,	42.00	Water, - - - -	6.50
		Gas, - - - -	35.50
	100.00		100.00

The coke is slightly swollen, brilliant, and lamellar. This appears to be a very fair quality of semi-block coal.

The coal at Lamb's is said to be four feet thick, and was extensively worked by stripping, previous to the discovery of coal at Washington; the mine has, long since, been abandoned, and the old opening is so completely filled with clay, washed from the creek banks, that I was unable to determine its quality or measure its thickness. Following up the creek, a short distance, I found the fossiliferous limestone and chert, which is seen on Akerman creek at Cross'; this led me to refer the coal to K.

In the southern part of the county it is doubtful if any workable seam of coal exists between K and A, and, with the exception of the localities, already cited, I was unable to recognize any seam higher than A. The coal seam I is almost always a good quality of block coal. It is seen at outcrops and is struck in wells, and its presence, proved by trial bores, in a great many places in the neighborhood of Montgomery and Black Oak stations, in the east part of the county, on and near the Ohio & Mississippi railroad. The thickness of the seam varies from two and a half to four feet. At Montgomery there is an abandoned slope which reaches to this coal at a depth of forty feet. For some reason no mining has been carried on, here, for some years,

and the slope was full of water; the seam is said to be four feet thick, and the coal had a good reputation in the market. No good samples could be obtained from the old slack pile, and I was unable to infuse enthusiasm enough into the citizens to have the mine pumped out, that such an examination could be made, as would enable me to report on the value. The following section shows the position of the coals at this place:

SECTION AT MONTGOMERY.

Space.		Feet.	In.	
		8		Soil and Clay.
16.9		6		Brown Shale, with Ironstone.
		1	6	Dark, fossiliferous limestone.
		1	3	Black, bituminous, sheety Shale.
1.6		1	6	COAL K, (Caking.)
47.6		46.		Arenaceous Shale.
		1	6	Blue, argillaceous Shale.
4.		4		COAL I, (Block.)
6.	4	-6		Fire Clay.
75.9	Total.			

At Black Oak station, a shaft was being sunk to coal I, on the north side of the railroad, but it had not reached the seam at the time of my visit. On the south side of the railroad, along a small branch of Prairie creek, Mr. Alva Clark is mining coal I by a drift which had already been carried several hundred feet under the ridge. The seam ranges from three to four feet in thickness and is a good quality of block coal. The following analysis gives its composition in 100 parts:

ALVA CLARK'S BLOCK COAL I.

Specific gravity, 1.277; one cubic foot weighs 79.81 lbs.

Coke, - -	60.80	Ash, white, - - -		3.50
		Fixed carbon, - -		57.30
Volatile matter,	39.20	Water, - - - -		4.50
		Gas, - - - -		34.70
	100.00			100.00

The coke is brittle, swollen, brilliant and amorphous; the ash is white which indicates that it is free from iron pyrites, and the quantity of fixed carbon is very large. It will prove to be an excellent fuel for smelting iron. The roof is a bluish shale, passing upward into gray shale, of which there was six feet exposed to view; superimposed on the shale, is, ten feet of soil. Near by the above mine, Mr. Clark had dug down the low bluff, forming the west bank of the branch, and exposed the following section:

SECTION AT CLARK'S.

Space.		Feet.	In.	
10.		8		Gray and buff argo shales.
		2		Compact dark argo shale.
.10			10	Caking COAL J.
.4			4	Fire clay.
3.		2-3.		COAL I. (Block.)
1.		1		Fire clay.
.10			10	Caking COAL H.
6.		6		Hard fire clay, and not to the bottom.
22.	Total.			

In the above section, three seams have nearly united into one. The upper is probably a thin coal J, which is sometimes found between K and I; the middle seam is I, and the lower seam, probably H, which like J, is not a very reliable seam. At this place the coal is worked by stripping. South of Black Oak station, in the middle of the southwest

quarter, section 30, township 3, range 5, Col. James S. Morgan has driven an entry into the block coal seam I, and has three and a half feet of good solid coal. Openings have, also, been made on adjoining farms, and the coal has uniformly proved to be of good quality. Indeed, coal I has been proved, by the aid of bores, to extend over a very broad area in this part of the county, and as the Indiana Mineral Railway, running from Bloomfield, in Greene county, on the north, to the Ohio river, at the mouth of Crooked creek, in Spencer county on the south, will pass through this district, it will be of incalculable value to the land owners, and induce the building of blast furnaces, and other establishments for the manufacture of iron.

The following record of the bores, made for coal in township 3, ranges 5 and 6, were kindly furnished by Mr. Clapp, who directed the work; they will serve, in a great measure, to point out the number and thickness of the coal seams, including K, and some of the subordinate coals that lie above the millstone grit. The terms used in designating the material passed through, are those furnished by the superintendent of the drilling, and the distinction between the sandstone and limestone is not always reliable:

All sections, given in this report, are made on a scale, vertically, of forty feet to one inch.

Section of a bore on George T. Hays' farm, five miles east of Washington, Daviess county, Indiana.

BORE No. 1.

Space.		Feet.	In.	
		10		Clay.
		2		Sandstone.
		2		Shell rock and gravel.
		6		Blue Clay.
		4		Soft Sandstone.
		10		Hard Sandstone.
75.3		6		Hard Limestone.
		10		Sandstone.
		10		Hard Sandstone.
		15		Soapstone.
			3	Black Slate.
3.		3		COAL K ?
		11		Fire Clay.
		1		Lime Rock.
		2		Fire Clay.
		1		Hard Rock.
29.		6		Fire Clay.
		2		Hard Rock.
		6		Soap Stone.
4.		4		COAL I ?
		3	6	Fire Clay.
		2		Hard Rock.
		4		Fire Clay.
		1		Hard Rock.
		4		Fire Clay.
		1		Hard Rock.
		1		Hard Black Slate.
42.6		5		Soapstone.
		5		Fire Clay.
		1		Hard Rock.
		1		Chalk Slate.
		13		Black Slate.
		1		Hard Rock.
153.9	Total.			

In going along the wagon road from Washington to Montgomery, we find the limestone which lies above X quite persistent, and easily traced from Thomas Wilson's, where it was dug into, for some depth in sinking a shaft (and which, at the time, was thought to commence above L,) to the point in the road, where the limestone is seen which overlies coal K. In descending on the strata, along this road, no other limestone was observed. This leads me to doubt the existence of a limestone, six feet thick, in the upper part of this bore, and also the abundance of limestone reported in the lower part. The intervening spaces, and the thickness of the coal beds, are given, no doubt, with considerable accuracy. The upper coal in this bore is probably K, and the lower one I.

Section of a bore on Mr. Hitt's farm, four and a half miles northwest of Washington:

BORE NO. 2.

Space.		Ft.	In.	
		40		Surface.
60.				
		4		Slate rock.
		3		Pebble rock.
		5		Black Slate.
		8		Fire Clay and ashy Slate.
1.		1		Slate and COAL.
		13		Pale gray Slate.
		8		Dark gray Slate.
		24		Ashy gray Slate.
101.				
		56		Black Slate.
1.5		1	5	COAL.
13.		13		Gray Slate.
1.6		1	6	COAL.
		12		Gray Slate.
34.1		21	1	Black Slate.
		1		Fire Clay.
212.	Total.			

I am at a loss to point out the correlation of the thin coals found in this bore, but they evidently lie below the sandstone, superimposing coal X, in the hills north of Washington. Along the northern edge of these hills the sandstone makes its appearance at about the same level, above the streams, as the bore at Hitt's; and between these two places the county is devoid of prominent hills, and presents the appearance of having been subjected to the action of powerful denuding forces. Indeed, this level character of the country continues to the northern part of the county, and the coals which are found near Epsom, and elsewhere to the northward, are for the most part, subconglomerate.

Section of a bore on Alva Clark's land, at Clark's station on the Ohio & Mississippi railroad.

BORE NO. 3.

Space.		Feet.	In.	
		16		Surface.
38.				
		10		Fire Clay.
		12		Dark gray Slate.
1.2		1	2	COAL K?
42.		42		Slate Rock.
3.		3		COAL I.
7.1		7	1	Slate rock.
91.3				

In this section the coals are referable to K and I.

Section of a bore on Harris & Moot's land, west half, northwest quarter, section 29, township 3, range 5.

BORE NO. 4.

Space.		Feet.	Inches.	
118.3		72		Surface.
		4		Gray slate.
		4		Fire clay.
		22		Dark gray slate.
		3	3	Sand rock.
		13		Black slate.
4.3		4	3	COAL I.
5.		5		Fire clay.
127.6	Total.			

Coal I is found at 128 feet below the surface, in this bore, and is of good workable thickness.

Section of a bore on Harris & Moot's land, south of the Ohio & Mississippi Railroad.

BORE NO. 5.

Space.		Feet.	In.	
47.2		33	2	Surface.
		6		Sandstone.
		8		Dark gray Slate.
2.		2		COAL K?
		6		Fire Clay.
		4		White Sandstone.
25.		15		Dark gray Slate.
1.6		1	6	COAL J?
		3	6	Sandstone.
13.		9	6	Black Slate.
4.6		4	6	COAL I.
93.2	Total.			

In this section, coal I is reached at eighty-eight and one-third feet from the surface, and two other seams are passed, which are probably referable to J and K.

Section of a bore on J. C. Montgomery's land, one half mile north of Montgomery Station, on the Ohio and Mississippi Railroad:

BORE NO. 6.

Space.		Ft.	In.	
60.		30		Surface.
		25		Dark gray Slate.
		1		Sandstone.
		4		Black Slate.
1.		1		COAL K?
		4		Fire Clay.
20.		15		Dark gray Slate.
		1	4	Black Slate.
1.4		4		COAL J?
		5		Fire Clay.
23.		7		Ashy Slate.
		7		Dark gray Slate.
		4		Black Slate.
2.6		2	6	COAL I.
107.10	Total.			

Three seams are also passed in this bore that are, probably, referable to I, J and K.

Section of a bore on Harris & Moot's land, section 29, township 3, range 5.

BORE No. 7.

Space.		Feet.	In.	
64.		32		Surface.
		8		Hard Gray Rock.
		24		Dark Gray Slate.
.8			8	COAL K?
		1		Fire Clay.
9.		3		Sandstone.
		5		Gray Slate.
1.4		1	4	COAL J?
		2		Fire Clay.
16.		4		Sand Rock.
		10		Black Slate.
5.		5		COAL I.
96.	Total.			

This bore, also made on Harris & Moot's land, passed through three seams of coal. The lower one, I, at ninety-six feet from the surface. It is here reported to be five feet thick; the upper seams are thin.

Section of a bore on the land of C. H. Dant, southwest quarter section 19, township 3, range 5:

BORE NO. 8.

Space.		Feet.	In.	
		30		Surface.
71.		12		Fire clay.
		18		Black slate.
		10		Sand rock.
		1		Black slate.
2.9		2	9	COAL I.
		10		Slate rock.
		10		Dark gray slate.
46.		6		Black slate.
		5		Slate rock.
		4		Fire clay.
		6		Black slate.
		3		Fire clay.
		2		Black slate.
.3			3	COAL.
120.	Total.			

I am unable to correlate the coals in this bore, but the two and three-quarter feet seam evidently belongs to I.

Section of a bore on James Kennedy's land, section 19, township 3, range 5:

BORE NO. 9.

Space.		Feet.	In.	
50.		32		Surface.
		14		Dark gray Slate.
		4		Black Slate.
.2			2	COAL.
15.		5		Hard, gray Rock.
		10		Black Slate.
4.6		4	6	COAL I.
69.8	Total.			

In this bore, made a short distance north of the former, coal I has thickened up to four an l a half feet; K is not present, and the two inch coal, probably represents the place of J.

Section of a bore on A. J. Hart's place, section 29, township 3, range 6, north of Ohio and Mississippi Railroad:

BORE NO. 10.

Space.		Ft.	In.	
		12		Surface.
49.		27		Slate rock.
		10		Black Slate.
1.8		1	8	Slate and coal.
		5		Fire Clay.
		18		Pale gray Slate.
		35		Slate rock.
130.		19		Dark gray Slate.
		2		Black sand rock.
		1		Black Slate.
		1		Black sand rock.
		5		Fire clay.
		12		Pale gray Slate.
		1		Sand rock.
		15		Black Slate.
		4		Fire clay.
		4		Dark gray Slate.
		8		Ashy Slate.
180.8	Total.			

This bore evidently passed through the places usually occupied by the coals between K and the conglomerate coals, as indicated by the three beds of fire clay.

Section of a bore on the land of Ignatius Walker, east half, section 36, township 3, range 6.

BORE NO. 11.

Space.		Feet.	In.	
22.		22		Surface.
.10			10	Soft Coal.
18.7		8	7	Pale gray Slate.
		7		Dark gray Slate.
		3		Black Slate.
1.		1		COAL K?
		2		Fire Clay.
20.		4		Ashy Slate.
		4		Dark gray Slate.
		10		Blue Sandstone.
2.4		2	4	COAL I?
		3		Fire Clay.
22.		4		Ashy Slate.
		15		Dark gray Slate.
1.9		1	9	COAL G?
88.6	Total.			

The coal at sixty-two feet, in this bore, is probably the equivalent of I.

Section of a bore on the land of James Kennedy, on section 19, township, 3, range 5.

BORE NO. 12.

Space.		Feet.	In.	
54.		46		Surface.
		4		Gray Slate.
		4		Black Slate.
.4			4	Coal.
		4		Hard gray Rock.
8.		4		Black Slate.
.8			8	Coal.
		1		Fire Clay.
6.6		5	6	Black Slate.
4.2		4	2	COAL I.
73.8	Total.			

The coal, four feet two inches thick, at the bottom of this bore, is referable to I. The thin coal above is, probably, J, while K appears to be absent.

Section of a bore on Jessie Billings' place, sections 32 and 29, township 3, range 6, south of Ohio and Mississippi Railroad:

BORE NO. 13.

Space.		Ft.	In.	
		24.		Surface.
		51.		Slate Rock.
		6		Pale gray Slate.
		14		Dark gray Slate.
		2		Black Sand Rock.
		2		Slate.
		2		Fire Clay.
		16		Ashy slate.
		2		Blue Sand Rock.
		12		Black Slate.
		5		Fire Clay.
		10		Blue Slate.
		10		Black Slate.
		1		Gray Slate.
157.	Total.			

This bore is made about three-fourths of a mile southeast of Bore No. 10, and on the same section.

The sections, furnished by the above bores, are highly instructive, and go to show a marked want of persistency in the various coal seams, both as regards their thickness and continuance over the basin; a fact to which I called attention in my First Report, 1869, and at the same time pointed out the obstacles which are thus thrown in the way of determining the correlation of coal seams.

Coal A is a subconglomerate coal. It is the next workable seam, in the descending order, and makes its appearance by outcrops in the northeastern and southeastern part of the county. Near Epsom, on Mr. Critchlow's farm, is a caking coal, one and a half feet thick, and is, without hesitation, referred to A. Above it there is a calcareous, fossiliferous shale, containing *Productus semireticulatus, Orthis Rushensis, Chonetes mesoloba*, and fragments of undetermined species.

On Hon. W. S. Turner's land, in Clark's Prairie, southeast quarter, section 35, township 5, range 6, a coal was struck in digging a well, at the following depth:

Surface soil and clay, - - -	10 (?)	feet.
Ferruginous shale, - - -	6	feet.
Coal A, (good caking coal,) - -	1½	feet.
Fire clay, (good for fire brick,) - -	2	feet.

This coal is struck, in the wells, all around Clark's Prairie, which is three miles long and two and a half wide; and is also found in the same manner, at several places along the road, from thence to Clarksburg.

Around Clarksburg, coal A has been opened on the outcrop, at a number of places, and furnishes the coal required for neighborhood use, and is here, generally, a good quality of block coal.

Descending the hill to Howard's Mill, on a branch of First creek, the road passed over:

SECTION AT HOWARD'S MILL.

Space.		Feet.	In.	
		8?		Soil and Clay.
58.		20?		Drift, Clay and Gravel.
		25?		Heavy bedded Sandstone.
		5		Buff colored Sandstone in thin beds.
2.6		2	6	Coal A, lower 6 in. caking coal.
			3	Coal Rash.
		?		Fire Clay.
60.		60		Covered Slope to branch.
120.6	Total.			

The heavy sandstone in this section belongs to the Millstone Grit, and the lower carboniferous limestone makes its appearance two and a half miles to the east of Howard's Mill, in the western edge of Martin county.

I am of the opinion that there are two seams of subconglomerate coal in this part of the county. The upper seam averages eighteen inches in thickness, is a good block coal, and has a hard, silicious fire clay at the bottom. The lower seam averages about two and a half feet and is also good block coal, with the exception of the lower six inches, which is caking coal. The latter is the most persistent seam, and has been found at the following places:

Critchlows, - -	N. E. ¼, Sec. 14, T. 4, R. 6.
Hasting's, - - -	N. E. ¼, " 23, " 5, " 6.

Howard's B.,	S. E. ¼,	Sec. 15,	T. 5,	R. 5.
Ketchum's,	S. W. ¼,	" 13,	" 5,	" 6.
Kinneman's, E.,	N. E. ¼,	" 30,	" 5,	" 5.
Laughlin's,	S. E. ¼,	" 25,	" 5,	" 5.
McCallahan's,	N. W. ¼,	" 32,	" 5,	" 5.
Odell's,	N. W. ¼,	" 15,	" 5,	" 5.
Riggin's,	S. E. ¼,	" 8,	" 4,	" 5.
Shaffer's,	N. W. ¼,	" 20,	" 5,	" 5.
Sims',	S. W. ¼,	" 2,	" 4,	" 5.
Sims',	S. W. ¼,	" 35,	" 5,	" 6.
Smiley's	N. W. ¼,	" 15,	" 4,	" 5.
Spalding's,	S. ½,	" 34,	" 4,	" 5.
Suit's, J. N.,	S. E. ¼,	" 21,	" 4,	" 5.
Turner's, Hon. W. S.,	N. W. ¼,	" 13,	" 5,	" 5.
Turner's, Hon. W. S.,	S. W. ¼,	" 36,	" 5,	" 6.
Turner's, Hon. W. S.,	S. W. ¼,	" 10,	" 4,	" 5.
Ward's,	N. E. ¼,	" 8,	" 5,	" 5.
Ward's,	N. W. ¼,	" 17,	" 5,	" 5.

Mr. Clapp also furnished me with the record of a bore which he had made on the property of Mr. A. H. Doherty, northwest quarter, section 36, and which passed through strata as follows:

BORE NO. 14.

Space.		Ft.	In.	
		50		Surface.
99.6		9		Fire Clay.
		3		Hard Rock.
		8		Ashy Slate.
		12		Hard Sand Rock.
		17	6	Soft Sandstone.
99.6	Total.			

After passing a few miles north of the latitude of Washington, the whole county, as far as the southern boundary of Greene county, appears to have been subjected to powerful denuding forces, which swept away the upper part of the coal measures. Minor denuding forces were also, simultaneously, in operation along the valley of Veals creek, to the south of the Ohio & Mississippi Railroad, while the district around Washington was, in a great measure, exempt from these influences, and stood, like an island, in the midst of the destructive elements.

Coal A, probably covers the entire area of the county. In the northeastern part, at High Rock, on the property of Capt. Slicer and Mr. Sloan, it crops out in several places. It is two and a half feet thick, and composed of block and caking coals. The following section shows the strata at that point:

SECTION AT HIGH-ROCK.

SPACE.		FEET.	IN.	
		15		Covered Slope.
105.		65		Massive, coarse-grained sandstone—"MILLSTONE GRIT."
		25		Buff Silicious Shale.
2.6		2	6	COAL A, part "block."
12.		12		Bluish Argo, Silicious Shale.
.6			6	COAL.
		0		Low water in White river.
120.	TOTAL.			

About one hundred feet above the coal, under High Rock, is a fossiliferous chert rock, which has every appearance of being the representative of the cherty limestone usually found lying above coal K. The fossils seen in this chert were: *Productus punctatus, P. semireticulatus, P. cora, Spirifer cameratus, Chonetes mesoloba,* and *encrinite* stems. Large blocks of this chert are seen in the lane, near Capt. Slicer's house, at Scales', and on Mud creek. It is in connection with limestone superimposing coal K. Now, if the correlation here pointed out proves to be correct, it tends to show that there is a great diminution in the depth of the strata between coal K and the Millstone Grit.

QUATERNARY.

Drift: Except in a few places, where it has been removed by denudation, the drift is found resting upon the coal measure strata. It varies in depth from a few inches to twenty feet or more, and is composed of beds of yellowish clay and gravel, sand, and bluish clay and gravel—"hardpan." Boulders are rare, and seldom larger than a man's head. Associated with the granitoid pebbles, are rounded fragments of silurian limestone, containing fossil shells. On a low hill, mostly composed of drift material, in Col. Morgan's farm-yard, on section 31, township 3, range 5, fossils of the silurian age are found in considerable abundance, completely weathered out and in good preservation; they have been the subject of much wonderment to the uninitiated in the science of geology. In our search, we were only able to find *Orthis lynx, O. occidentalis,* and *Strophomaria alternata.*

Loess: Some of the sand ridges, along the West Fork of White River, may be of this age. The buff colored marl beds, belonging to this epoch, usually containing land and lacustrine fossils, were not found.

ECONOMICAL GEOLOGY.

Coal is the most important mineral found in Daviess county. It underlies its entire area, which comprises about 271,000 acres.

In parts of the county, as shown by the foregoing report, there are as many as six seams of coal that are of workable thickness; combined, they will give an average of *nineteen* feet of coal. As these seams are not all continuous, or of workable thickness throughout the county, it will be a reasonable estimate to take EIGHT feet as the available quantity, and estimated for 271,000 acres, will yield 3,497,661,500 tons, as the quantity of coal which is available for mining purposes in Daviess county.

Coal L, which is mined at Washington, is the best caking coal yet furnished to the market from the Western coal field. It makes excellent gas for illuminating purposes, and a fair quality of coke for foundries. It is used, both at Vincennes and St. Louis, in the gas manufactories. Between fifteen hundred and two thousand tons are mined daily from this seam alone.

The *Block Coal* in the eastern part of the county, is of excellent quality, and, like the same character of coal in Clay county, is eminently adapted for the manufacture of iron and steel.

The Indiana Mineral Railway, running in a northerly and southerly direction, will pass through the centre of this basin of block coal, and will provide additional opportunities for locating blast furnaces and other branches of iron manufactures.

Iron Ore: Bog iron ore is found at many places in the northern part of the county. South of Clarksburg, on Malica Cumming's place, there is a considerable bed, in a meadow, in which was growing a luxuriant crop of grass; it is reported to be four feet thick, and to cover six or seven acres. A spade was procured, and we dug a foot or more into the ore, which was dry and almost impenetrable. This locality is in Clark's Prairie, and the ore is said to be found in patches over a considerable area to the southwest.

At Z. N. Gaston's, it is said to cover four acres. There is no other way to determine the quantity of ore, in the deposit, than by measuring the area, and probing the beds in a number of places. When roasted, the ore will yield about fifty per cent. of metal.

Iron made from bog ores is apt to contain a little phosphorus, which makes the metal hard and suited for railheads, though worthless for steel and many other uses. Bog ore is not so highly esteemed by furnace men, when the water has been long drained from it.

There is, more or less, clay iron-stone interstratified with the shales throughout the county, but at no place was it seen of sufficient thickness to be of value. The greatest quantity observed is near the town of Alfordsville.

Ochre: Close to the town of Alfordsville, there are several beds of highly ferruginous, red clay, that will make a good, durable paint when properly ground and prepared.

Building Stone: The massive sandstone, overlying coal X, in the hills north of Washington, may be quarried in blocks of any required dimensions, and will make a durable building stone. Some portions of the bed are reddish brown, mottled with spots of a deeper red, while others are of a uniform chocolate shade. This stone is used in the foundations of houses at Washington, and if properly selected, would answer well for superstructures.

The limestone, at Cross' and elsewhere on Aikman's creek, may be had, of any desired length, in blocks four feet thick. The color is black, mottled with spots of gray, and occasionally contains small seams of white calc spar. It is very close grained, very hard, and will take a fine polish. For outside work it is not durable, but makes a handsome marble for mantels, table tops, etc.

This stone has been burnt into lime; the color is dark, but it makes a good, strong mortar for laying bricks or stone.

Clay: Good clay, for making brick, is found in all parts of the county.

Water, for drinking purposes, is usually found by digging wells to the depth of eighteen to thirty feet. Where coal is not encountered in these wells, the water is free from deleterious mineral and organic matter, and is quite wholesome to drink, though generally too hard to be used for laundry purposes, without resorting to what is commonly called "breaking." The best way to "break" hard water, is to mix a quantity of caustic lime with it. The free carbonic acid of the water unites with the lime, and precipitates the calcic and magnesian salts, which give hardness to the water.

AGRICULTURE.

There is, in this county, a great variety of soil, and marked attention is being paid to its improvement.

In the bottom land, along the rivers and creeks, the soil is a sandy loam; on the prairies and flat lands, in the northern part of the county, it is a light, ashen-colored soil, with, here and there, ridges of clayey brown soil, some portions of which are inclined to be wet, and are commonly termed "craw fish land." The wet lands are being rapidly improved by ditching. Thorough draining would make them among the best soils in the county. The hill land is a clay loam, with the exception of a strip of sandy soil two or three miles broad, extending along the West Fork of White River. The river "bottoms" yield large crops of corn, for which it is thought to be the best adapted, though all the cereals and grasses are grown upon it with profit. The hill land yields the largest crops of wheat, but is likewise good for corn, oats, and other small grain, as well as grasses, and is remarkably well adapted for clover. The prairie and flat lands in the north, are best adapted to the growth of grasses. The sandy soil of the ridges, in the west part, is rather thin for the cereals and grasses, but is well suited for the growth of peaches, apples, and other fruits, and is especially adapted for melons, of which large quantities are grown, and the crop is highly remunerative.

Timber: The following is a list of the forest trees, upland, low land, and undergrowth, observed in this county:

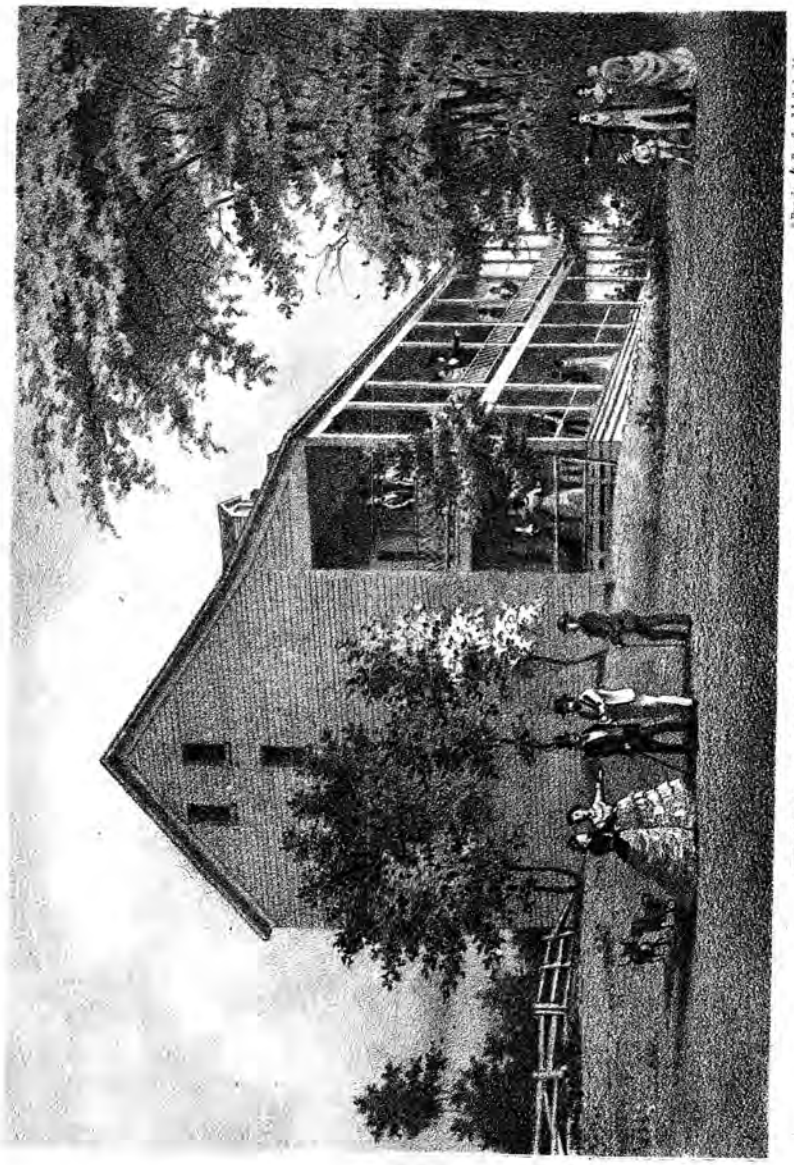
Ash, Black, *Fraxinus sambucifolia*—low land.
Ash, White, *Fraxinus americana*—low land.
Alder, Black, *Alnus glauca*—swampy ground.
Beech, Red, *Fagus ferruginea*—upland.
Beech, White, *Fagus sylvestris*—upland.
Birch, Black, *Betula lenta*—low land.
Buckeye, *Pavia lutea*—low land.
Cherry, Wild, *Cerasus virginiana*—low land.
Coffee Nut, *Gymnocladus canadensis*—low land.

Cottonwood, *Populus canadensis*—river banks.
Dogwood, *Cornus florida*—swamps.
Elder, Box, *Acer negundo*—low land.
Elm, White, *Ulmus americana*—low lands.
Elm, Red, *Ulmus rubra*—low land.
Gum, Black, *Nyssa sylvatica*—low land and upland.
Gum, Sweet, *Liquidamber styraciflua*—low land.
Hazel Nut, *Corylus americana*—swamps.
Hackberry, *Celtis crassifolia*—low land.
Hickory, Common, *Juglans tomentosa*—upland.
Hickory, Pignut—*Juglans porcina*—upland.
Hickory, Shellbark, *Juglans squamosa*—upland.
Ironwood, *Carpinus ostrya*—low land.
Locust, Black, *Robinia pseudo-acacia*—low land.
Locust, Honey, *Gleditsia triacanthos*—low land.
Linn (Basswood,) *Tilia americana*—low land.
Maple, Soft, *Acer rubrum*—low land.
Maple, Sugar, *Acer saccharinum*—low land.
Mulberry, *Morus rubra*—low land.
Oak, Black Jack, *Quercus ferruginea*—low land.
Oak, White, *Quercus alba*—low land.
Oak, Red, *Quercus rubra*—low land.
Oak, Black, *Quercus tinctoria*—low land.
Oak, Chestnut, *Quercus prinus-palustris*—upland.
Oak, Water, *Quercus aquatica*—swamps.
Pawpaw, *Annona triloba*—low land underbrush.
Persimmon, *Diospiros virginiana*—hills and low lands.
Poplar, *Lyriodendrum tulipifera*—hills.
Red Bud, *Cercis canadensis*—low land undergrowth.
Sassafras, *Laurus sassafras*—hills and low lands.
Spicewood, *Laurus benzoin*—upland underbrush.
Sycamore, *Acer pseudo-platanus*—river banks.
Willow, White, *Salix alba*—river banks.
Walnut, White, *Juglans cathartica*—low land.
Walnut, Black, *Juglans nigra*—low land.

In the northern part of the county, the growth is principally oak.

CONCLUSION.

To the citizens of Washington, and of the county generally, I am very greatly indebted for the aid rendered and facilities afforded in the successful accomplishment of the survey. Kind attentions were received on every hand, and no pains spared to make my sojourn among them pleasant. Especial thanks are due to Hon. W. S. Turner, Dr. G. G. Barton, Mr. Saltmarsh, Messrs. Spink, Cable & Co., Thomas Wilson, Hon. John Hyatt, Mr. Hyatt, Hon. Robert P. Haynes, D. H. Kennedy, C. E., S. D. Wright, C. E., Charles Boyden, C. E., Col. James S. Morgan, Capt. T. A. Slicer, Wm. Stone, Mr. O'Neal, Alva Clark, Mr. Taylor, Mr. Hopkins, Mr. Clapp, Mr. Crook, Mr. M. L. Brett, Dr. McMillan, S. Belding, Editor of the Democrat, George W. Colbert, Editor of the Gazette, and a number of others whose names I have not been able to procure.



VIEW of the HOTEL at INDIAN SPRINGS,
Martin Co. Ind., from the North.

MARTIN COUNTY.

Martin county is bounded on the north by Greene, on the east by Lawrence and Orange, on the south by Dubois, and on the west by Daviess county.

The East Fork of White River meanders in a southwesterly course through a large portion of the county, and, together with its tributaries, Boggs and Indian creeks on the north, and Beaver creek and Lost river on the south, furnish ample drainage and an abundance of clear, running water.

The surface is very much broken by hills from one hundred and fifty to three hundred feet, or more, in hight, which are mostly composed of the millstone grit and lower carboniferous limestones. The former is capped, in places, by the coal measure shales. The scenery is rugged and picturesque.

Lower Carboniferous: Limestones belonging to this geological epoch outcrop along most of the water courses and at the base of the high ridges. About one hundred and fifty feet of these rocks are visible, extending from the oolitic beds at the base to the upper archimedes and pentramital schistose layers. Between these two members there is, locally, an intercalated, fine-grained, reddish brown sandstone, often passing into a whitish sandstone. In the south and southwestern part of the county it appears as a fine-grained grit stone, and is extensively worked into grindstones and whetstones. They are known in the market as French Lick Stones, and are much esteemed.

At Dover Hill, the upper layers of limestone are rich in large and well preserved *Pentramites*, some of which, *P. cirvinus*, were presented to me by the county treasurer, Mr.

Moser. This limestone also contains **Archimedes Worthenii (?)*, *Rhynchonella subcuneata*, *Capulus acutirostris (?)*, *Zaphrentes spinifera*, and a number of undetermined shells and corals. The lower member does not appear to be very rich in organic remains, and the few observed were difficult to obtain on account of the compact character of the rock. The following genera and species were seen: *Pentramites ovatus*, *P. pyraformis*, *Spirifer incrassatus*, *S. lineatus*, *Productus tenuicostata*, *P. cora*, and *Athyris subtilita*.

Where this rock prevails, the county is characterized by "sink holes" and cavities formed where the limestone has been dissolved and removed by subterranean water charged with carbonic acid. Near Dover Hill, there is a small cave formed in the limestone, on land formerly owned by Hon. W. E. Niblack, the present Representative of this District in Congress. The extent of this cave is not very great, but I was glad to avail myself of the protection which it afforded during a severe rain storm which prevailed while making my examinations. This cave is remarkable for the fine specimens of *Pentramites* found in the debris at the mouth on the side of the hill, near the road leading to Indian Spring. A lithograph copied from a photographic view, which shows the mouth of this cave and surrounding scenery, is given at page 13. The building on the right almost hidden by the trees, is the bowling alley.

Millstone Grit: The principal member of this lower division of the coal measures, is a massive sandstone of a redish brown color, strongly charged with small white quartz pebbles near the bottom, is overlaid by arenaceous shales, belonging to the coal-measure series, and underlaid, in places, by a readily decomposing argillaceous shale, and coal. In all, it comprises about one hundred and fifty feet of strata. The massive, conglomerate sandstone forms a conspicuous bench in the high ridges, and its presence gives rise to wild and rugged scenery. The shales are readily

*The *Archimedes* are quite protean in form, and I can see no good reason for robbing Leseur of the specific name, though it should be deemed necessary to take it out of the genus *Fenestella*.

removed from beneath this stone, by the action of rains, in such a manner as to form large excavations, known as "rock-houses." These excavations continue until the gravity of the stone overcomes its cohesive force, and large blocks, forty to sixty feet in height, break from the parent bed and lie strewn over the valleys below.

One of the most interesting spots to visit, for obtaining a view of this character of scenery, is near the town of Shoals, on the road to the Indian Sulphur Springs. A high ridge of millstone grit, here, terminates within a few yards of the East Fork of White river, from the top of which, there is a projecting mass of conglomerate sandstone, called the "Pinnacle," which stands one hundred and seventy feet above the level of the stream. Cyclopean blocks, that have broken off, lie around the foot of the ridge, in every conceivable position. On the north side of this ridge, the conglomerate has been cut through by disintegrating forces, which left, at some distance from the main ledge, a tall mass of rock, which has received the name of "Jug Rock," from the fancied resemblance which it bears to a jug. It is forty-two feet high and supports, on its top, a flat projecting layer, which is called the "stopper." Just above the bulge of the jug are irregular lines of stratification, known as false bedding. The lower part is thickly set with quartz pebbles. The frontispiece to this volume presents a view of the "Jug Rock" which was copied from a photograph taken by D. Allbright. For this faithful representative of a highly interesting geological scene, I am indebted to B. F. Devol, and D. Allbright, of Shoals.

Coal Measures: The rocks of this epoch are not largely represented in this county; being confined to a limited area in the vicinity of Shoals. The following general section indicates the position of all the seams of coal that were seen in this county. It is compiled from strata exposed in Munson's Ridge and Sampson's Hill, on the Ohio and Mississippi Railroad, near Shoals, and includes a thin seam of coal, seen in the bed of White river, in the lower corboni-

ferous limestone, at the foot of Munson's Ridge, near the water tank one mile west of Shoals:

CONNECTED SECTION OF COAL MEASURES IN MARTIN COUNTY.

Space.		Feet.	In.	
		20		Soil and Drift
95.		50		Sandstone and Shaly Sandstone.
		25		Argillaceous Shale with good IRON ORE.
3.		2–3		COAL F? semi-block.
		2		Fire Clay, good Potter's Clay.
		10		Argillaceous and Arenaceous Shale.
62.		50		Thin and thick bedded Sandstone.
1.6		1	6	COAL D?
		4		Fire Clay. Arenaceous Shale.
44.		40		Sandstone.
1.		1		COAL B?

CONNECTED SECTION OF COAL MEASURES IN MARTIN COUNTY.—Continued.

Space.		Feet.	In.	
50.		50		Massive Sandstone, with pebbles,
4.1		3–4	1	COAL A.
		2		Fire Clay.
42.		10		Argo. Shale, with Iron Ore.
		30		Oolitic Limestone.
.6			6	COAL in the Limestone.
303.1	Total.			Low water of White river.

The lower coal in this section is not continuous over any great area, but a thin coal was seen in an analagous position, near Huron, in Lawrence county, where stone was being quarried for making lime. Though a true bituminous coal, it is entirely too thin to be of economical value, and is mentioned only for the purpose of calling attention to an interesting geological fact.

Coal A is a subconglomerate seam and is the most persistent and important coal in the county. Wherever observed, it is a good block-coal, or semi-block, and well adapted, as a fuel, in the raw state for the manufacture of iron. It is somewhat variable in thickness, ranging from two to four feet and over, having a laminated structure like the typical block coal, but contains less carbonaceous matter, resembling charcoal, between the laminæ, and is more difficult to separate into sheets, though it is mined in board-

like blocks. The color is jet black and the fracture irregular. Quite a number of analysis have been made of samples taken from this seam at various localities, which serve to show its general good qualities.

Analysis of BAKER'S COAL A, section 16, township 2, range 3, semi-block coal, *upper part of seam:*

Specific gravity, 1.238; one cubic foot weighs 77.37 lbs.

Coke, - -	52.75	Ash, white, - - -	1.50
		Fixed carbon, - -	51.25
Volatile matter,	47.25	Water, - - - -	2.50
		Gas, - - - -	44.75
	100.00		100.00

The coke is slightly swollen, lamellar, dense, and brilliant.

BAKER'S COAL A, *lower part of seam:*

Specific gravity, 1.239; one cubic foot weighs 77.43 lbs.

Coke, - -	49.50	Ash, white, - - -	.75
		Fixed carbon, - -	48.75
Volatile matter,	50.50	Water, - - -	3.00
		Gas, - - -	47.50
	100.00		100.00

The coke is much swollen, porous and lusterless. This coal is very free from earthy matter, the ash in the upper part is only one and a half per cent., and in the lower part, three quarters of one per cent. The hygrometric moisture which it contained, is also, quite small. It is an excellent blast furnace coal.

At Horn & Co.'s, the seam is only twenty-six inches thick and contains some bands of iron pyrites, otherwise the coal is good. The upper ten inches is block coal, four inches of the middle part contains irregular bands of iron pyrites, and the lower twelve inches is good caking coal. It has a dark argillaceous roof, overlaid by massive sandstone. The following analysis indicates its approximate constituents in 100 parts:

HORN & CO.'S COAL A, section 3, township 2, range 4.

Specific gravity, 1.246; one cubic foot weighs 77.89 lbs.

Coke, - -	45.00	Ash, light brown, - -	2.50
		Fixed carbon, - -	42.50
Volatile matter,	55.00	Water, - - -	3.00
		Gas, - - -	52.00
	100.00		100.00

The coke is puffed, swollen and vitreous. Horn & Co. are using this coal under the steam boilers at their mill, which is close to the opening, and it is regarded as an excellent fuel. There are two other openings, to this coal, near the mill, but they have not been worked for some time, and the mouth of the drifts are filled up.

Coal A outcrops on the side of a hill, on the east side of the road ascending Sampson's Hill, where it was formerly opened and worked, but a slide in the hill has covered up the old opening and rendered it impossible to obtain a good specimen for analysis. Some much weathered fragments, picked up near the mouth of the mine, seem to indicate that it is a very good semi-block coal, and have served for the subjoined analysis, which, consequently, does not fairly represent its quality:

TURNER'S COAL A, (Sampson's Hill,) section 32, township 3, range 3.

Specific gravity, 1.359; one cubic foot weighs 84.31 lbs.

Coke, - -	54.50	Ash, red, - - -	9.00
		Fixed carbon, - -	45.50
Volatile matter,	45.50	Water, - - -	4.00
		Gas, - - -	41.50
	100.00		100.00

The coke shows the laminæ of the coal, is without lustre, and not swollen.

This seam is reported to be three feet thick.

N. F. Crim's entry to the same coal, on section 7, township 2, range 3, had also caved in, so as to prevent our seeing the face of the coal, but fragments were found around

the mine, which indicated it to be the same quality as Baker's. In the decomposing shale, which forms the roof of Crim's coal, we found some large fragments of *Lepidodendron elegans, Sigillaria Menardii* (?), *Calamites Sp.* (?), *Cordaites borassifolia,* and some fragments of other plants too imperfect for determination; indeed, the shale was too much decomposed to admit of any specimens being preserved. Superimposing the shale, is a heavy bedded sandstone, referable to the millstone grit.

One and a half miles west of Shoals, on the Ohio and Mississippi Railroad, is a high ridge, lying nearly north and south, which contains two or more coals, without counting the thin seam in the lower carboniferous limestone, which are visible at low water in the bank of White River, which runs within a few feet of the ridge; so close, indeed, that a considerable cut had to be made into the solid bed of oolitic limestone to make room for the railroad track. The section furnished by this ridge, as nearly as could be determined, from the thick undergrowth of bushes and briers with which its eastern declivity was covered, is as follows:

SECTION, ONE AND A HALF MILES WEST OF SHOALS.

Space.		Feet.	In.	
		20		Soil and Drift.
55.		35		Thin and thick bedded Sandstone.
		?		COAL B ?
		?		Fire Clay.
70.6		65		Massive Conglomerate.
		2	6	Iron Ore.
		3		Black Slate with Coal Plants.
		2	6	COAL A.
3.4			10	Brash Coal.
		7		Fire Clay, good Potter's Clay.
		25		Arenaceous Shale.
67.		30		Oolitic Limestone.
		5		Argillaceous Shale.
.6			6	Coal.
196.4	Total.			Low water in White river.

Coal A is non-caking, and very free from earthy impurities, as shown by the following analysis:

COAL A, MUNSON'S RIDGE, (upper part).

Specific gravity, 1.270; one cubic foot weighs 79.37 lbs.

Coke, - -	51.50	Ash, brown, - -	1.50
		Fixed carbon, - -	50.00
Volatile matter,	48.50	Water, - - -	3.00
		Gas, - - - -	45.50
	100.00		100.00

The coke is slightly swollen, lamellar, and vitreous.

In the black shale, forming the roof of this coal, there are a great many poorly preserved coal plants, belonging to the genera: *Lepidodendron, Sigillaria, Calamites,* and *Pecopteris.*

Beneath the coal is a thick belt of fire clay, suitable for making common pottery. The iron ore, superimposed on this black shale, will be referred to in another place.

The base of the conglomerate is strongly charged with oxide of iron, arranged in irregular bands from a half inch to one inch in width, which stand out in bold relief from the weathered surface of the rock. In its lower part, there are casts of the stems of *Lepidodendron, Sigillaria,* and *Calamites.*

Another specimen, from seam A, was obtained from an opening near Willow Valley. The seam is said to be two feet thick, and the quality is very good. as indicated by the following analysis:

WILLOW VALLEY COAL A.

Specific gravity, 1.286; one cubic foot weighs 80.37 lbs.

Coke, - -	50.50	Ash, lead color, - -	2.50
		Fixed carbon, - -	48.00
Volatile matter,	49.50	Water, - - -	2.75
		Gas, - - -	46.75
	100.00		100.00

The coke is puffed, swollen, and lustreless.

Coal B (?) is not opened, and its position is only indicated by "coal dirt," a name usually applied to the decomposed, pulverulent, bituminous matter, which marks the outcrop of a coal seam.

On the west side of Munson's Ridge, another opening was made to coal A. The roof shale, iron ore deposit, and ferruginous, conglomerate sandstone, present the same appearance here as noted on the opposite side of the ridge. Heavy rains had mostly filled up the opening with washings from above, so that I was unable to measure the seam, but was assured by Mr. Devol, who had had the seam opened on purpose for my inspection, that it was four feet thick.

Philip Hutz has opened coal A on the southwest quarter of the southeast quarter of section 35, township 4, range 4, about two miles northwest of Dover Hill. The entry is made on the side of a small branch, where the crop was first observed, and the coal has been worked out to a distance of several hundred feet. The hill above the coal is quite low, and affords but little opportunity to make a section; however, the succession is virtually the same as observed in Munson's Ridge:

Covered space, - - - -	—— ——
Soft sandstone, (conglomerate,) -	—— ——
Bluish shale, soft and hard, -	0 feet 6 in.
Semi-block COAL A, (lower part inclined to cake,) - - -	3 feet 0 in.
Coal brash, - - - - -	0 feet 6 in.
Soft plastic fire clay, - - -	0 feet 6 in.
Shale, covered, - - - -	?
Lower carboniferous limestone, -	?

The coal contains two thin bands of iron pyrites; where free from this impurity, it is a good, white ash, semi-block coal. The following analysis gives the approximate constituents in 100 parts:

PHILIP HUTZ'S COAL A.

Specific gravity, 1.262; one cubic foot weighs 78.87 lbs.

Coke, - -	50.00	Ash, white, - -	2.50
		Fixed carbon, - -	47.50
Volatile matter,	50.00	Water, - - -	3.50
		Gas, - - - -	46.50
	100.00		100.00

The coke is swollen, porous and lustreless.

About one mile northwest of Philip Hutz', two openings have been made to this coal by Zachariah Sims. He found three feet two inches of good semi-block coal, entirely free from bands of iron pyrites. The excavation has been carried some fifty feet, or more, under the hill, which is composed of the same succession of rocks seen at the former locality. The specimens of this coal collected, at this mine, for analysis, by my assistant, Dr. G. M. Levette, were subsequently lost out of the buggy, returning to Shoals. A list of all the localities where coal A has been seen, in this county, will be given hereafter.

Coal B has not yet been found of workable thickness; its place is indicated by outcrops of impure coal in several of the sections herein given, and being an unimportant seam, special remarks, as to quality, are not deemed necessary.

Coal I?. Since coal I has, thus far, proved to be a more persistant seam than the coals which intervene between it and the subconglomerate coal A, I have been led to refer, with some doubt, the top coal in Sampson's Hill, one and a half miles southeast of Shoals, to that horizon. This is the only locality, seen in the county, where the strata are thick enough to contain a coal so high in the series. Taken from the level of the Ohio and Mississippi Railroad we find the following section, exhibiting three hundred and ten and one-third feet of strata:

SECTION AT SAMPSON'S HILL.

SPACE.		FEET.	IN.	
95.		70		Covered space, mostly Sandstone.
		25		Bluish Argo. Shale with good Iron Stone.
2.10		2	10	COAL I? { 6 in. compact. 2 ft. 4 in. semi-block.
		4		Fire Clay, good potters' clay.
99.		95		Arenaceous Shale and Flag Stones.
		?		COAL F?

SECTION AT SAMPSON'S HILL.—Continued.

Space.		Feet.	In.	
		?		Fire Clay.
71.		70		Sandstone, conglomerate.
		1		Bituminous Shale.
3.6		3		COAL A.
			6	Coal brash.
		3?		Fire Clay.
39.		30		Shale.
		6		Lower Carboniferous Limestone.
310.4	Total.			Level of O. & M. R. R.

Three analyses of this coal (I) are given:

Sampson Hill coal I, (upper part.)

Specific gravity, 1.588; one cubic foot weighs 99.25 lbs.

Coke, - -	69.50	Ash, gray, - -	41.00
		Fixed carbon, - -	28.50
Volatile matter,	30.50	Water, - - -	5.50
		Gas, - - - -	25.00
	100.00		100.00

The coke is unchanged, slaty, and has a metallic lustre.

Sampson Hill coal, I (middle part.)

Specific gravity, 1.232; one cubic foot weighs 77 lbs.

Coke, - -	54.00	Ash, white, - -	1.00
		Fixed carbon, - -	53.00
Volatile matter,	46.00	Water, - - -	2.00
		Gas, - - - -	44.00
	100.00		100.00

The coke is somewhat swollen, dense and vitreous.

Sampson Hill coal I, (lower part.)

Specific gravity, 1.252; one cubic foot weighs 78.12 lbs.

Coke, - -	48.50	Ash, red, - - -	1.50
		Fixed carbon, - -	47.00
Volatile matter,	51.50	Water, - - -	3.00
		Gas, - - -	48.50
	100.00		100.00

The coke is puffed, swollen and vitreous.

The upper six inches of this coal is simply a black, bituminous slate, that will burn so long as the bitumen lasts, and there will remain, unconsumed, a stony substance, diminished but little, if any, in size by the removal of the combustible matter. The middle and lower parts are semi-block and will make a fine fuel, in the raw state, for smelting iron. It is a very compact, laminated coal, with carbonaceous matter between the laminæ. An analysis was made of the carbenaceous matter from this coal, and the following result obtained:

Coke, - -	84.20	Ash, white, - - -	0.80
		Fixed carbon, - -	83.40
Volatile matter,	15.80	Water, - - -	2.50
		Gas, - - -	13.30
	100.00		100.00

In the relative proportion of approximate constituents, it closely approaches a semi-anthracite coal. The specific gravity was not taken, but it is undoubtedly much less than

that of bituminous coal, and probably even less than charcoal.

This coal covers an area of about four hundred and eighty acres, running through Sampson's Hill and some of the adjacent ridges.

The following are the localities where coal was seen in this county; commencing in the southern part and proceeding northward:

B. Miller,	-	-	Coal A,	2½ ft.,	Sec.	3, T.	1, R. 4
Asa White,	-	-	" A,	2 ft.,	"	32, "	1, " 4
Collins, *semi-block*,	-	-	" K?	2½ ft.,	"	31, "	2, " 4
Parsons, "	-		" K?	2½ ft.,	"	36, "	2, " 4
Unknown, "	-	-	" A,	2 ft.,	"	1, "	1, " 3
Braxton,	-	-	" A,	2 ft.,	"	2, "	2, " 3
Bell,	-	-	" A,	2 ft.,	"	26, "	2, " 3
Unknown,	-	-	" A,	? ft.,	"	21, "	2, " 3
Baker, *semi-block*,		-	" A,	4½ ft.,	"	16, "	2, " 3
Way, "	-		" A,	3 ft.,	"	17, "	2, " 3
J. French, *semi-block*,			" A,	3 ft.,	"	18, "	2, " 3
Stevens, "		-	" A,	3 ft.,	"	18, "	2, " 3
Abel,	-	- -	" A,	2 ft.,	"	14, "	2, " 5
N. F. Crim,	-	-	" A,	3 ft.,	"	7, "	2, " 4
B. F. Devol, *semi-block*,			" I?	2½ ft..	"	32, "	3, " 3
B. F. Devol,	-	-	" B,	? ft.,	"	32, "	3, " 3
B. F. Devol,	-	-	" A,	3 ft.,	"	32, "	3, " 3
B. F. Devol,	-	-	" A,	? ft.,	"	31, "	3, " 3
B. F. Devol,	-	-	" A,	3 ft.,	"	28, "	3, " 3
B. F. Devol,	-	-	" A,	? ft.,	"	26, "	3, " 4
B. F. Devol,	-	-	" A,	2½ ft.,	"	23, "	3, " 4
B. F. Devol,	-	-	" A,	3 ft,,	"	14, "	3, " 4
B. F. Devol,	-	-	" A,	? ft.,	"	18, "	3, " 3
B. F. Devol,	-	-	" A,	3 ft.,	"	17, "	2, " 3
B. F. Devol,	-	-	" A,	2 ft.,	"	16, "	2, " 3
B. F. Devol,	-	-	" A,	2 ft.,	"	9, "	2, " 3
B. F. Devol,	-	-	" A,	2 ft.,	"	2, "	2, " 3
Bruner,	-	-	" A,		"	25, "	3, " 3
Elliott,	-	-	" A,		"	25, "	3, " 3

Clark,	-	-	Coal A,		Sec.	17, T.	3, R. 3
Field,	-	-	" A,		"	3, "	3, " 3
Barker,	-	-	" A,		"	1, "	3, " 4
Unknown,	-	-	" A,		"	2, "	3, " 4
P. Hutz, *semi-block*,		-	" A,		"	35, "	4, " 4
Z. Sims, *semi-block*,		-	" A,		"	35, "	4, " 4
Sharon,	-	-	" A,		"	28, "	4, " 4
Porter,	-	-	" A,		"	18, "	4, " 3
Dunihue,	-	-	" A,		"	17, "	4, " 3
Laughlin,	-	-	" A,		"	19, "	5, " 4
Lewis,	-	-	" A,		"	16, "	5, " 3
Todd,	-	- -	" A,		"	8, "	5, " 3
Rollins,	-	-	" A,		"	5, "	5, " 3
Baker,	-	- -	" A,		"	5, "	5, " 3
Davis,	-	-	" A,		"	5, "	5, " 3

The average thickness of coal A may be set down at thirty inches. It is almost everywhere, throughout the county, an excellent semi-block coal, very hard and firm, stands handling, and will bear stocking.

Iron Ore: Near the junction of the millstone grit, with the lower carboniferous limestone, there is more or less iron ore throughout the county. Generally, it is a siliceous hydrated oxide, which lies in pockets, or local beds, often of great extent; but there are some localities where an earthy carbonate of iron is found in seams that vary from a few inches, to six feet in thickness; though, usually, where attaining the greatest thickness, it is mixed with more or less, silex. No effort has been made to properly open either the iron ore beds, or seams of coal in Martin county; consequently, I found it difficult to pronounce, with any degree of certainty, on the true commercial value of the minerals, seen under so great a disadvantage. To pick into a seam of ore or coal, through the superincumbent earth and rock, with a common geological hammer, seldom enables one to see the stratum, in so favorable a light, as where a clean, vertical face is shown, by a proper excavation.

On Mr. Stevens' land, section 1, township 3, range 3, near

the top of a hill, by the base of which runs the Ohio and Mississippi Railroad, there is a deposit of iron ore fully thirty feet thick, and half an acre in area, which contains a large per cent. of metal, but is also quite siliceous; it has a redish brown color, and contains bands of a gray steel color. The ore lies in regular stratified blocks, as though the conglomerate sandstone had been metamorphosed, or changed by displacement, into an ore of iron.

Chalybeate waters may have been chiefly instrumental in bringing about the conversion of the sandstone to ore, as springs of this water are quite common at the base of the millstone grit.

Specimens of this ore were taken for analysis, and after crushing equal portions from three varieties, and then reducing them to an impalpable powder, a weighed portion of the mixed ores gave:

No. 1.

Insoluble silicates,	27.00
Ferric oxide,	66.40
Alumina,	1.10
Phosphoric acid,	trace.
Sulphur,	trace.
Lime,	trace.

The yield of metal is equal to 44.48 per cent.

Similar deposits of siliceous ore are seen on sections 15 and 16, township 3, range 3.

Two varieties, which represent the larger portion of the ore bed, were taken for analysis, and gave the following:

No. 2, Limonite; color, reddish brown; containing small cavities filled with decomposed ore and clay; running through the mass are streaks of steel gray ore, with glistening specks of quartz:

No. 2.

Moisture, dried at 212° F.,	1.24
Ignited to bright red heat, lost,	6.56
Silica and silicic acid,	28.60

Ferric oxide,	54.45
Alumina,	7.20
Phosphoric acid,	trace.
Sulphur,	trace.
Lime, magnesia and loss,	1.95
	100.00

No. 3.

Color: Dark brown, mottled with pink.

Moisture, dried at 212° F.,	1.00
Ignited to bright red heat, lost,	8.00
Insoluble silicates,	36.80
Ferric oxide,	49.95
Alumina,	2.12

The Ferric oxide equals 34.96 per cent. of metal. The roasted ore will give about 38.41 per cent. of metal.

No. 4 contains too much silica to be worked with advantage in the blast furnace.

Nos. 1, 2, and 3, though containing a large amount of silica, are quite rich in iron and alumina, and, it is my opinion that they will work very well in the blast furnace, especially, when mixed with a small proportion of hematite ore. The metal will be hard and well adapted for rails.

Similar ores, to the above, are found on the following lands:

E. B. Elliott,	S. ½ Sec. 10, T. 3, R. 3
B. F. Devol,	N. ½ " 10, " 3, " 3
B. F. Devol,	N. ½ " 23, " 3, " 3
B. F. Devol,	" 22, " 3, " 3
R. Royles,	" 19, " 3, " 3
Shermans,	" 12, " 2, " 3
Unknown,	" 28, " 4, " 3
Dunihue,	" 14, " 4, " 4
Dunihue,	" 18, " 4, " 4
Eddington,	" 2, " 5, " 3

On sections 14 and 32, resting on the shale, forming the

roof of the coal in Munson's Ridge, is a bed of siliceous iron ore, two feet thick; its position is shown in the section given at page ——.

This ore is in thin lamina; color, reddish brown; stained with bituminous matter. Composition:

No. 5.

Moisture, dried at 212° F.,	4.00
Ignited to bright red heat, lost,	9.11
Insoluble silica and silicic acid,	32.35
Ferric oxide,	53.00
Lime, magnesia, and loss,	1.54
	100.00

The Ferric oxide equals 37.10 per cent. of metal.

If roasted, this ore will yield over 41 per cent. of iron; but contains too much silica to be worked alone.

There is a four inch layer of bituminous iron-stone, that is very rich in iron, as may be seen by the partial analysis here given:

No. 6.

Moisture, dried at 212° F.,	1.00
Ignited to bright red heat, lost,	28.00
Insoluble silicates,	7.00
Ferric oxide,	60.50
Sulphur,	trace.
Phosphorus,	trace.

The Ferric oxide is equal to 42.35 per cent. of iron.

If roasted, this ore will yield about 60 per cent. of metal. A portion of the 28.00 per cent. expelled, by ignition, is bitumen. In some respects, it resembles the celebrated black-band ore—*Mushetstone*—of Airdrie, Scotland.

In the blueish gray shales, overlying the top coal, in Sampson's Hill, there are a number of irregular bands of clay iron ore; a similar ore is seen in the shales which overlie the lower coal seam A, at many places where the coal has been opened, and where exposed, in washes, in the

hill sides; a considerable quantity was, also, seen in the road leading to Baker's, south of Sampson's Hill, and at Willow Valley, on the Ohio and Mississippi Railroad. The subjoined analysis shows it to be a good ore:

No. 7.

Moisture, dried at 212° F.,	1.15
Ignited to bright red heat, lost,	24.05
Insoluble silicates,	8.00
Ferric oxide, with some alumina,	60.00
Phosphoric acid, undetermined.	
Sulphur, undetermined.	
Lime, magnesia and loss,	6.80
	100.00

The Ferric oxide is equal to 42 per cent. of metal; and this ore, after roasting, will yield 56 per cent.

On sections 9 and 10, township 4, range 3, lying about thirty feet above the lower carboniferous limestone, there is a bed of iron stone, which is, where I saw it exposed, four feet thick;* samples from four parts of the bed, were taken for analysis, and the result is here given:

No. 8.

Lower stratum; greenish gray ore. About half a pound of the ore was crushed in an iron mortar, and the small quantity required for analysis was taken therefrom and reduced to an impalpable powder in an agate mortar, by which means a good average was secured:

Moisture, dried at 212° F.,	1.40
Ignited to bright red heat, lost,	22.80
Insoluble silicates,	13.00
Ferric oxide, (equal to 38.92 per cent. metal,)	55.60
Carbonate of lime and magnesia,	5.60
Sulphur,	.90
Phosphoric acid, undetermined.	
	99.30

*Since my visit to the county, Mr. B. F. Devol, of Shoals, and Mr. Cyrus Mendenhall, of Cincinnati, have had this bed of ore well opened, and inform me, that there is a total of six feet of iron bands.

No. 9: *Lower portion of the middle member.*

Moisture, dried at 212° F.,	3.00
Ignited to bright red, lost,	10.50
Insoluble silicates,	23.00
Ferric oxide, (equal to 41.75 per cent. of metal,	59.65
Alumina,	2.70
Phosphoric acid,	trace.
Lime, magnesia and loss,	1.15

No. 10: *Upper portion of middle part.*

Moisture, dried at 212° F.,	3.00
Ignited to bright red heat, lost,	8.00
Insoluble silicates,	37.75
Ferric oxide (equal 33.63 per cent. metal,)	48.05
Alumina,	1.15
Phosphoric acid,	trace.
Lime, magnesia and loss,	2.05
	100.00

No. 11: *Upper stratum, four inches thick at the crop.*

Moisture, dried at 212° F.,	.30
Ignited to bright red heat, lost,	28.50
Insoluble silicates,	8.50
Ferric oxide, (equal to 37.52 per cent metal,)	53.60
Phosphoric acid,	trace.
Sulphuric acid,	trace.
Lime, magnesia and loss,	9.10
	100.00

From the above analyses, the average yield of iron from the ores of this bed will be about 37.95 per cent.; and the average per cent. of silicates, about 20.56. Though the silica is pretty large, still, I am of the opinion that the ore may be worked in the blast furnace, alone; but, mixed with the hematite ores of Missouri, will undoubtedly yield a metal of excellent quality.

QUATERNARY.

The only representative of this period in Martin county, that I was able to recognize, is the *Drift* or *Glacial* epoch; though it is quite possible that the *Loess* may exist on the bluffs bordering the East Fork of White river.

Here, as in Daviess county, the drift consists of clays, small rounded granitic, basaltic, and occasionally, secondary limestone pebbles; boulders, more than six inches in diameter are rarely seen. The entire thickness will not exceed twenty-five feet. It is found on all the ridges, where not subsequently removed by denudation; nor did we find any marine relics. No grooving or scratching was seen on the boulders, or rocks beneath them.

Bones of the Mammoth and Mastoden have been found in this county, imbedded in marsh clay, resting on the drift. A large tooth, and I believe, some other bones of the *Mastodon Ohioticus*, Blum. (*M. gigantea*, Cuvier.,) were obtained some years ago, by Hon. W. E. Niblack, from near Hindostan, and presented by him, to the late Dr. D. D. Owen, and were transferred, in 1869, with the Owen Cabinet, to the State University, at Bloomington.

ECONOMICAL GEOLOGY.

Coal A may be said to occupy about one-half the area of Martin county, or about one hundred and eight thousand acres. Locally, it attains a thickness of four feet, and over, and the average may be put down at thirty inches. This will give, as the product of one seam, 434,954,666 tons of coal.

The coal seam I?, found in Sampson's Hill, is limited, in area, to the high ridges and table lands adjoining thereto; which will comprise about four hundred and eighty acres, and the average thickness may be taken at thirty inches, which will give, as the product of this seam, 1,936,000 tons of coal. The contents of the two seams, together, make 436,890,666 tons of available coal in this county. Most of

this coal will answer, in the raw state, for making iron, and is, likewise, admirably adapted for household use, for locomotives, and all other steam purposes. It is, for the most part, a non-caking coal, and burns to ash without leaving clinkers.

Iron Ore: As already stated, the seams and deposits of iron ore are large and numerous; though, for the most part, siliceous, there are some stratified ores comparatively free from silica; and I am of the opinion, that, when thorough search has been made, by digging into the shales lying between the millstone grit and lower carboniferous limestone, that the six foot seam, previously referred to as occurring on section 9, township 3, range 3, will be found, in many places, where it may prove to be of still better quality.

The average yield of iron, from the ores analized, is nearly 38 per cent.; which is sufficient to be remunerative; as they can be had convenient to coal suited for smelting them, and may be mined at little expense. At all events, should it not be deemed advisable to smelt these ores by themselves; rich hematite ores, that will make an admirable mixture, may readily be had from Missouri, over the Ohio and Mississippi Railroad. Indeed, Shoals would prove an admirable location for a blast furnace, even though all the ore had to come from Missouri. It is situated on the East Fork of White river; is now the county seat, and quite a flourishing manufacturing town; containing mills for cutting staves and headings, spoke, hub, and axe-handle factories, saw mills, planing mills, and potteries.

Mr. B. F. Devol, who, in connection with Mr. Town, is largely engaged in the lumber business, at this place, owns, or controls by leases, a large portion of the best coal and iron ore lands in the county. He holds, in fee simple, over twenty-six hundred acres, and has leases on about thirteen thousand six hundred acres, a part, or all of which, he is willing to dispose of to parties wishing to mine the coal and erect blast furnaces in the county.

Building Stone: Both lime and sandstone, of excellent

quality, may be had in this county. The conglomerate sandstone, where free from iron and pebbles, is a handsome and durable stone, and may be had in blocks of any required size. The oolite member of the lower carboniferous limestone epoch, may be had in large blocks; is handsome, durable and susceptable of being worked into ornamental forms.

Grit Stone: The sandstone, lying between the upper archimedes limestone, and the oolite limestone bed, is a fine grained, even textured, white stone; that is extensively worked into grind-stones and whetstones. They are sold in the market under the name of French Lick, or Hindostan stones. The principally worked quarries of this grit, are now, I believe, in the southeastern part of the county, near the French Lick Springs in Orange county. They are called Hindostan Stones because they were formerly shipped from that town, down the river, in flat bottom boats.

Lime: The oolitic limestone will make a good white lime, but, I believe, there are no kilns in the county; this branch of manufacture being left to the people of the adjoining county of Lawrence, where there are a number of kilns.

Potter's Clay: The four feet seam of clay, under the upper seam of coal, is not sufficiently refractory for fire brick; but is an excellent potter's clay. Since my visit to the county, Devol & Catterson have put up two potter's kilns at Shoals, and are making, from this clay, which is said to be well adapted to the manufacture, about ninety-two thousand gallons of common stoneware, per annum.

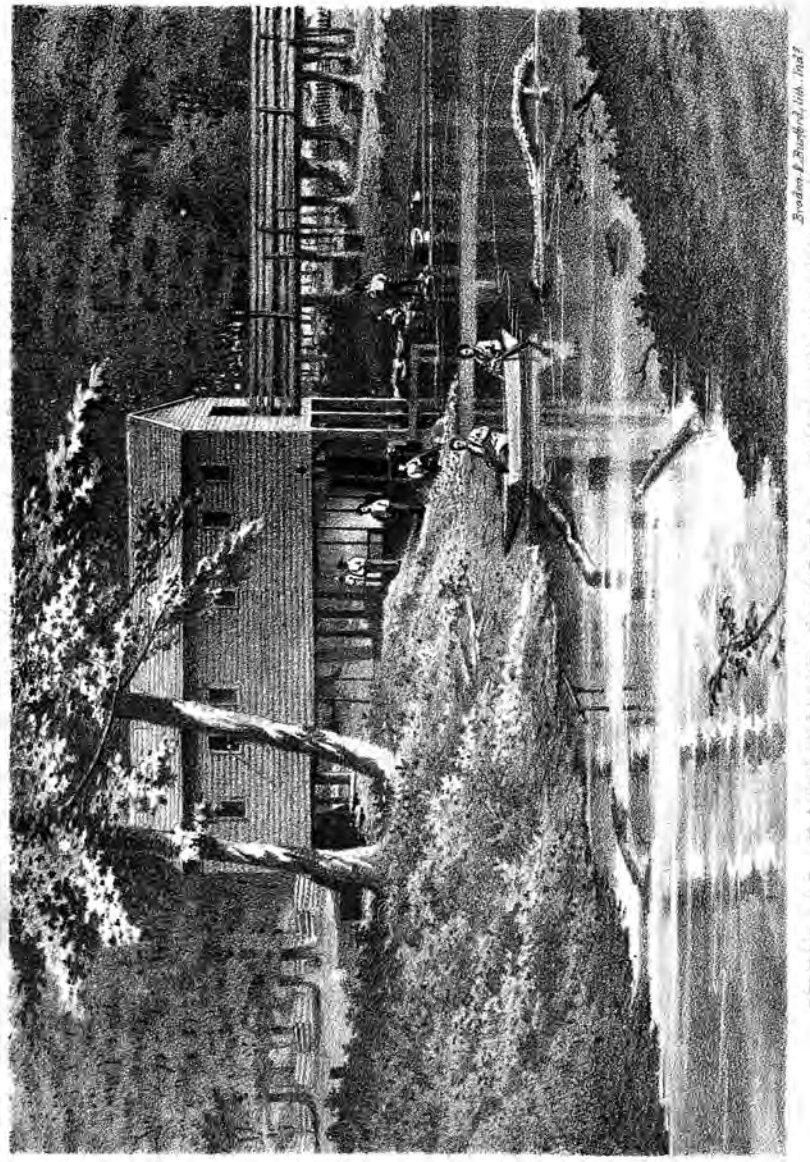
The seven feet bed of fire-clay, under the subconglomerate coal in Munson's Ridge, will probably also, prove to be a good clay for this business.

Mineral Paints: About one mile west of Dover Hill, on the head waters of Beech creek, in section 2, township 3, range 4, there is a heavy bed of variously tinted ferruginous shale and clay; the latter is derived from the decomposition of a band of iron ore, and its associate aluminous shale. It is underlaid by the subconglomerate coal A,

which is here too thin to work, though, a deserted drift, now filled up, shows that efforts have been made to that end. A slip of the strata, on the side of the hill, above the paint bed, has so covered it with rubbish, that I was unable to determine the extent of the ochreous shales; but they are reported to be fifteen feet thick. The colors, which they furnish, are: umber, and red, and yellow sienna. In the hill, above, is a heavy bed of conglomerate sandstone, some eighty feet thick; and ten or twelve feet below the seam of coal, is the lower carboniferous limestone, which outcrops in the branch. The scenery, around this spot, is picturesque and rugged.

Dr. Delameter, of Dover Hill, so I was informed, first opened and worked these paint beds, on a small scale, and subsequently, sold them to a company of gentlemen living in Cincinnati, Ohio. A few years ago, this company erected a mill for crushing and grinding this paint, on a large scale; quite a quantity was manufactured, and where introduced, gave good satisfaction, as a cheap, handsome and durable paint. I saw houses, in Dover Hill, painted, of a warm, chocolate color, with this paint, that, though the color had been on for a number of years, still looked fresh and bright. But for reasons, which I was unable to learn, the mill has been abandoned, and there are, now, stowed under sheds, several hundred barrels of well ground, mineral paint, which is rapidly going to waste, from the bursting of barrels; and the mill is going to destruction for the want of some one to look after it; surely, if mineral paint can be manufactured at a profit, anywhere, it ought to be here.

Mineral Waters: The Indian Springs, situated on section 17, township 4, range 3, and about nine miles north of Shoals (on the Ohio and Mississippi Railroad,) are owned by D. R. Dunihue. The character of the water is a saline sulphuret. A view of the Bath House and Springs is given at page 107, and a view of the Hotel at page 81, both lithographed from photographs, furnished by Mr. Dunihue. The water gushes up in several places, at the junction of the millstone grit, and lower carboniferous limestone, on



VIEW of the BATH HOUSE, CREEK &c. at INDIAN SPRINGS.
Martin Co. Ind. from the South.

the west bank of Sulphur creek, a branch of Indian creek, and is confined in wooden tubes, made of sections of the trunks of hollow sycamore trees. The main spring discharges from ten to twelve gallons per minute.

A qualitative chemical examination of this water, was made at the fountain head, which determined the presence of the following substance:

The water is perfectly clear, but leaves a whitish deposit on the curbing.

Temperature of the air 80° F.; of the water 56°*

Small bubbles of gas escape through the water.

Sulphuretted hydrogen.

Carbonic acid.

Sulphuric acid.

Hydrochloric acid.

Soda.

Lime.

Magnesia.

The sulphuretted hydrogen could be recognized by its strong odor at a considerable distance from the spring. Some two or three hundred yards down the creek, there is another spring, which proved to be chalybeate.

It contained small quantities of:

Protoxide of iron.

Sulphate of lime.

Sulphate of magnesia.

Carbonate of lime.

Carbonate of magnesia.

Chloride of sodium.

About a gallon of water was collected, from the main sulphur spring, for quantitative analysis at the laboratory. The result of this analysis is here given, both, in parts in one million, or pounds in one hundred thousand gallons, and in grains in an imperial gallon.

The elementary substances are given in one table, and the manner in which they are probably combined, in another;

*Mr. Dunihue informs me that there is no difference in the temperature of the water at any season of the year.

the quantity of water was not sufficient to enable me to determine the iodides and bromides, which are present in exceedingly small quantities.

Quantitative chemical analysis of mineral water from Indian Springs, owned by D. R. Dunihue:

The gaseous contents in one imperial gallon, are represented in cubic inches:

Carbonic acid,	11.500
Sulphydric acid,	4.000
Oxygen,	4.753
Nigrogen,	7.747
Total,	28.000

Mineral constituents given in parts in 1,000,000, or pounds in 100,000 gallons, in the first column, and in grains in one imperial gallon in the second.

Total solid matter, 198.18 grains.

	PARTS IN 1,000,000 OR, LBS. IN 100,000 GALS.	GRAINT IN ONE GALLON.
Silicic acid,	7.7157	.5401
Oxide of iron,	.0615	.0043
Lime,	392.2071	27.5245
Soda,	472.2286	33.0560
Potash,	35.4286	2.4800
Magnesia,	344.1328	24.0893
Alumina,	3.0243	.2117
Chlorine,	317.8885	22.2522
Carbonic acid,	536.4143	37.5490
Sulphuric acid,	695.8957	48.7127
Iodides and bromides,	trace.	trace.
Total,	2805.9971	196.4198

The above constituents are probably combined as follows:

	PARTS IN ONE MILLION, OR, LBS. IN 100,000 GALLONS.	GRAINS IN ONE GALLON.
Silicic acid,	7.7157	.5401
Oxide of iron,	.0615	.0043
Sulphate of iron,	346.9386	24.2857

Sulphate of soda,	202.8571	14.2000
Sulphate of potash,	41.2086	2.8846
Sulphate of magnesia,	521.1042	36.4773
Sulphate of alumina,	14.2271	.9959
Carbonate of lime,	567.6786	39.7375
Carbonate of soda,	61.9429	4.3360
Carbonate of potash,	41.2857	2.8900
Carbonate of magnesia,	324.9014	22.7431
Chloride of sodium,	675,1100	47.2577
Chloride of magnesium,	.9657	.0676
Iodides and bromides,	trace.	trace.
Total,	2805.9971	196.4198

From the above analysis, it will be seen, that the Indian Springs possess valuable medicinal properties. The hotel, see page 81, is situated on a gradually rising hill one hundred feet above the springs, in the midst of a grove of forest trees. The building is small and ill adapted to accommodate the many guests who visit the springs, annually, both in search of health, and as a pleasant retreat from the cares of business, during the heat of summer. At the time of my visit, the hotel was full, and many were deterred from going to the springs on account of the limited accommodations. A large and well arranged hotel, would soon make these springs among the most frequented in the country.

Trinity Springs: These springs are a quarter of a mile east of Harrisonville, on section 29, township 4, range 3, in the valley of Indian creek, and about two miles southeast of Indian Springs, and seven miles north of Shoals. These springs are owned by Mr. Benjamin Dunn, of Bloomington, Indiana. The hotel and other houses that had been erected at these springs, were burned seven or eight years ago, and have not since been rebuilt. Visitors to these springs stop with Mr. S. F. Lemar, at Harrisonville. He is Mr. Dunn's agent and provides bountifully for the few whom he has room to accommodate.

The name—Trinity Springs—originated from the occurrence of three bold running sulphur springs, all within a few feet of each other. There are, also, two springs of fresh water close by these sulphur springs, one is hard water, cool and pleasant to the taste, and the other is soft water, and is used without "breaking" for washing clothes, etc.

The temperature of the water of the Trinity Springs was 57° F., and that of the air 89°. Bubbles of gas escape through the water, and a whitish deposit is found on the inside of the curbing. The qualitative, chemical, examination of this water gave the following result:

Sulphuric acid.
Carbonic acid.
Sulphydric acid.
Hydrochloric acid.
Soda.
Potash.
Magnesia.
Lime.

This is also a saline, sulphuretted water, and contains precisely the same mineral constituents found in the Indian springs; therefore, it was not deemed necessary to carry the analysis any farther at this time. The source of the water is, also, the same, i. e. at the junction of the millstone grit, and lower carboniferous limestone.

The low ridge which rises above the springs, to the east, affords a fine site for a hotel, and with ample arrangements to accommodate the public, they would soon become attractive and remunerative as a place of resort.

Antiquities: In the northeastern edge of the town of Shoals, there is a mound about ten feet high, and twenty to twenty-five feet in diameter, built by the Mound-Builders. It has been dug into and some Indian bones taken out, but I could not learn of any relics having been found in it. A few stone arrow-heads, spear-heads, and stone axes have been picked up in different parts of the county. One mile southwest of Shoals, on Thomas Gormerly's place, there is, on a hill one hundred and fifty feet high, a large shell heap,

"Kitchen-middings," (*kjokkenmodding,*) as similar heaps are called in Denmark. In these "Kitchen-middings," are found mussel shells of species now common to our fresh water streams, such as belong to the genue: *Unio, Alasmodonta, Anodonta, Melania,* and *Paludina.* Associated with these shells, are ashes, charcoal, bones of quadrupeds, birds and fishes, bone needles, fish hooks, etc., etc., indicating that the heaps are formed of the refuse left by a race of people who fed upon the mollusca, fishes and other animals, and were probably, intermediate between the Mound-builders and savages in civilization. Shell heaps of this character are not uncommon in this State, and when time permits, they will be thoroughly examined and described in detail.

Agriculture: The broken character of the land makes this county less attractive to the agriculturist than the adjoining county of Daviess. The upland is mostly a clay soil, but, in general, produces most excellent crops of small grain and clover. On Munson's, and some other high ridges, I observed, among the undergrowth of dogwood and spice bushes, quite a number of paw paw trees. The high land is admirably adapted to growing peaches and apples; these crops are seldom injured by frosts.

The bottoms, along the East Fork of White river and its tributaries, are quite extensive; the soil is a sandy loam and yields large crops of corn, and fair crops of small grain.

Timber: No county in the State, can boast of a better growth of large and valuable trees for timber, such as black walnut, poplar, white, red, black, chesnut and burr oaks, hickory and maple. The varieties of trees are the same, in this county, as in Daviess county, and for a more detailed account, the reader is referred to the list given at page 78.

Conclusion: The mineral resources of this county are very great, though, as yet, scarcely anything has been done towards development. It is true, that, the coal seams are not so numerous, nor generally, so thick as in some of the other counties lying within the boundary of the coal measures; nevertheless, the quality is excellent, and like

other non-caking, or block-coals of Indiana, it may be used, in the raw state, for smelting and working iron. The iron ore beds are, also, shown to be numerous, and, for the most part, lie in close proximity to the coal; and even though it may not, at the present time, in the judgment of iron masters, be deemed prudent to work ores, containing so much silica, by themselves, every facility that could be desired, for mixing with them the rich hematite ores of Missouri, is secured by the Ohio and Mississippi Railroad which runs through the very heart of the minerals, and reaches St. Louis by almost an air line.

In this place I, also, desire to express my thanks to the citizens of Martin county, for their many acts of kindness, and my obligations for the aid received from the following gentlemen: Mr. B. F. Devol, Mr. Town, D. Allbright, Capt. McCarty, Hon. Mr. Dobbins, Mr. Hickman, E. Mason, R. McCormick, D. Lacey, Frank Baker, C. O. Bryant, and many others whose names I do not now recall.

FRENCH LICK AND WEST BADEN SPRINGS.

These Springs are situated in French Lick township, in Orange county, and are about one mile apart. They are owned and controlled by separate parties. The French Lick Springs are owned by Dr. W. A. Bowles, who has leased them for a term of years to Messrs. Ryan and Tucker. The West Baden Springs are owned and under the control of Mr. H. Wilkins and his son-in-law, Mr. W. F. Osborn. These Springs are within fifteen miles of Shoals, on the Ohio & Mississippi Railroad, and eighteen miles from Orleans, on the Louisville, New Albany & Chicago Railroad; from which points coaches are run daily to the springs. The water, at both French Lick and West Baden, issues from fractures in the lower carboniferous limestone, where it forms a junction with the millstone grit. This is the most common source of mineral water throughout the western country. Beginning with the French Lick, we have, in the hills above the Springs, forty to fifty feet of sandstone, beneath which

is seen four to eight feet of limestone, eroded and fissured at the outcrop, and containing large quantities of saline sulphuretted water, which breaks out in a multitude of places along the branch, and a number of them have been curbed with wood and stone, and each one is claimed to possess peculiar curative properties. A qualitative chemical examination, at the fountain head, revealed that they all contained the same elementary constituents, but in varying proportions. The principal constituents being:

Temperature of air, 93° F.; temperature of water, 56°.*

Numerous bubbles of sulphuretted hydrogen and carbonic acid gas, mixed with oxygen and nitrogen gas, were continually escaping from the water. I succeeded in collecting a small quantity which served for the analysis:

Free carbonic acid.
Free sulphydric acid.
Sulphuric acid.
Carbonic acid.
Hydrochloric acid.
Soda.
Potash.
Lime.
Magnesia.

Some bottles of water were collected from several of the Springs and sent to the laboratory for quantitative analysis, but I was unable, during the time allotted to chemical work in the laboratory, to make an analysis of more than one of the Springs, and selected, as the most important water, that taken from the Spring known as "Pluto's Well." The others will be analyzed during the progress of the survey.

Quantitative analysis of the water of French Lick Springs, taken from "Pluto's Well," given in parts in 1,000,000, or pounds in 100,000 gallons in the first column, and in grains in an imperial gallon in the second column.

*The standard thermometer used at the Indian and Trinity Springs was accidentally broken, and the temperature here given was taken by a common thermometer obtained at the Springs.

The gaseous contents in one imperial gallon are represented in cubic inches:

Carbonic acid,	7.337
Sulphydric acid,	6.717
Oxygen,	5.407
Nitrogen,	18.504
Total,	38.045

Total solid matter in one gallon, 381.85 grains.

	PARTS IN 1,000,000, OR POUNDS IN 100,000 GALLONS.	GRAINS IN ONE GALLON.
Silicic acid,	9.42	.6594
Oxide of iron,	1.90	.1330
Lime,	675.92	47.3144
Soda,	1140.20	79.8140
Potash,	41.72	2.9204
Magnesia,	723.26	50.6282
Alumina,	48.10	3.3670
Chlorine,	1185.96	83.0172
Carbonic acid,	690.55	48.3385
Sulphuric acid,	845.55	59.1885
Iodides and Bromides,	trace	trace
Total,	5362.58	375.3806

The above constituents are probably combined as follows:

	PARTS IN 1,000,000, OR POUNDS IN 100,000 GALLONS.	GRAINS IN ONE GALLON.
Silicic acid,	9.42	.6594
Oxide of iron,	1.90	.1330
Sulphate of lime,	223.03	15.6121
Sulphate of soda,	58.16	4.0712
Sulphate of potash,	17.31	1.2117
Sulphate of magnesia,	954.41	66.8087
Sulphate of alumina,	85.46	5.9822
Carbonate of lime,	574.00	40.1800
Carbonate of soda,	68.52	4.7964
Carbonate of potash,	47.48	3.3236
Carbonate of magnesia,	753.00	52.7100
Chloride of calcium,	470.04	32.9028
Chloride of sodium,	2027.04	141.8928
Chloride of magnesia,	72.81	5.0967
Iodides and Bromides,	trace	trace
Total,	5362.58	375.3806

This is a most excellent mineral water, and well deserves the celebrity which its hygienic virtues have gained for it. The hotel is pleasantly situated on elevated ground and contains a large number of well ventilated rooms, and is supplied with everything that is necessary to make guests comfortable. At the time of my visit, it was filled with a goodly number of invalids who expressed themselves as being benefited by the use of the water. I am under many obligations to Dr. Bowles and Messrs. Ryan & Tucker for kind attention while at the Springs.

West Baden Springs.—These Springs are about one mile north of "French Lick Springs," in the valley of French Lick Creek. Here, also, the sulphur water breaks up in a great many places, at the junction of the millstone grit and the lower carboniferous limestone. Curbs have been placed around a number, and each one is supposed to have its peculiar virtues.

I made, at the fountain head, a qualitative analysis of the three that were most used, and found in all the same elementary constituents:

Temperature of the air, 93° F.; temperature of water, 55°.*

A whitish, slimy deposit is formed on the gum, mostly sulphur, with some oxide of iron.

Free gases:

Sulphydric acid.
Carbonic acid.
Oxygen.
Nitrogen.

Sulphuric acid.

*Temperature taken with a common thermometer obtainen at the Springs.

Hydrochloric acid.
Carbonic acid.
Soda.
Potash.
Lime.
Magnesia.

A number of bottles were filled with water from the different Springs and sent to the laboratory for quantitative analyses, but I could spare only the time to analyze one and selected for the purpose the water from the Spring with a stone curbing, as it appeared to be the most frequented.

The gaseous contents in one imperial gallon are represented in cubic inches:

Carbonic acid,	6.198
Sulphydric acid,	5.931
Oxygen,	2.093
Nitrogen,	6.572
Total,	20.794

The mineral constituents are given in parts in one million, or pounds in one hundred thousand gallons, in the first column, and in grains in one imperial gallon in the second:

	PARTS IN 1,000,000, OR, POUNDS IN 100,000 GALS.	GRAINS IN ONE GALLON.
Silicic acid,	7.50	.5250
Oxide of iron,	1.50	.1050
Lime,	539.11	37.7377
Soda,	765.26	53.5682
Potash,	19.37	1.3559
Magnesia,	610.76	42.7532
Alumina.	43.50	3.0450
Chlorine,	779.26	54.5482
Carbonic acid,	675.21	47.2647
Sulphuric acid,	601.30	42.0910
Iodides and bromides,	trace.	trace.
Total,	4042.77	282.9939

The above constituents are, probably combined as follows:

	PARTS IN 1,000,000, OR, POUNDS IN 100,000 GALS.	GRAINS IN ONE GALLON.
Silicic acid,	7.50	.5250
Oxide of iron,	1.50	.1050
Sulphate of lime,	191.70	13.4190
Sulphate of soda,	53.28	3.7296
Sulphate of potash,	23.48	1.6436
Sulphate of magnesia,	619.83	43.3881
Sulphate of alumina,	77.28	5.4096
Carbonate of lime,	709.43	49.6601
Carbonate of soda.	19.08	1.3356
Carbonate of potash,	10.71	.7497
Carbonate of magnesia,	671.48	47.0036
Chloride of calcium,	124.78	8.7346
Chloride of sodium,	1337.18	93.6026
Chloride of magnesium,	195.54	13.6878
Iodides and bromides,	trace.	trace.
Total,	4042.77	282.9939

This water, judging from the analysis, possesses the same medicinal properties as that of the French Lick Springs, but it contains less free gases and a less quantity of solid constituents in a gallon; being a difference in degree rather than quality.

The lithographic view at page 112, presents a view of the springs and adjoining grounds. It was gratuitously furnished by the proprietor, Mr. H. Wilkins.*

It will be seen from this view, that the large and commodious hotel is situated on a hill some fifty feet above the valley of Lick creek, in the midst of a charming grove of native forest trees. The grounds around the hotel and springs are tastefully laid out and well kept. All the comforts that surround the most fashionable watering places are to be found at West Baden, and the gentlemanly proprietor does all in his power to please his visitors.

*I promised the proprietors of the French Lick Springs that if they would furnish a photographic view of their Springs, that it shonld be lithographed and published with the analysis; but it has not been received.

PUTNAM AND VIGO COUNTIES.

As yet no detailed survey has been made of these counties, but I deem it best to note at this time the result of some general observations made in the vicinity of Greencastle, in the former county, and Terre Haute, in the latter. Greencastle is a flourishing manufacturing city sixteen miles east of Brazil, in Clay county, and possesses fine railroad facilities, being on the line of the St. Louis, Vandalia, Terre Haute and Indianapolis Railroad, the Indianapolis and St. Louis Railroad, and the Louisville, New Albany and Chicago Railroad. Besides a number of minor manufactures there is at this place a first class mill for rolling iron plates and cutting nails: about two hundred and fifty kegs of nails of all sizes are made each week at this mill. The quality of the nails is said to be equal if not superior to any made in the country. They use the Clay county pig iron. This city is immediately on the drift, but the lower carboniferous limestone outcrops in the west and north side, and the millstone grit including a few inches of coal on the southwest side. The limestone is here extensively quarried for lime and building purposes; but by far the most important and extensive quarry in the county is at Greencastle Junction, one mile west of the city, at the crossing of the St. Louis, Vandalia, Terre Haute and Indianapolis Railroad, and the Louisville, New Albany and Chicago Railroad. This quarry is owned by Mr. Wm. Steck. The stone is fine grained and of a light, blueish gray color. The face of the quarry shows twenty-five feet of rock; the upper part is schistose and is used for making lime, the lower layers are from two to three feet thick and are quarried by blasting. The stone meets with a ready sale, and is handsome and durable, though somewhat hard to dress.

A quarry of the same stone has been recently opened on the east of Mr. Steck's, and another near Hamrick's Station.

It is from the latter quarry that the blast furnaces of Clay county obtain most of the limestone used as a flux.

Mr. Wm. Nelson has opened a quarry of this stone in the west edge of Greencastle. Here the exposure of rock is seventy-five feet, and the layers are from one to four feet thick. The texture of the rock is similar to that seen at the Junction.

South of the city, on the land of D. C. Donnohue, there is a light gray, fine grained sandstone, that is poorly exposed by a wash on the side of a hill; it is a remarkably handsome and durable stone, easy to work, and susceptible of high ornamentation. If this stone can be obtained in abundance, and of good dimensions, it will prove to be one of the most valuable building stones in the State. Ascending the hill, in the cut made by the road, I saw the following section:

Fine grained, buff colored sandstone,	15 ft.
Blue shale,	6? ft.
Light gray sandstone,	6? ft.
Covered space,	10 ft.
Oolitic limestone,	6 ft.

On Capt. Peck's land, in a ravine, a quarter of a mile east of the above, is the following exposure of rocks:

Drift,	10? ft.
Schistose, buff colored sandstone and shale,	8 ft.
Coal,	4 in.
Blue fire clay,	2 ft.
Buff colored sandstone,	4 ft.
Blue shale,	2 ft.
Thick bedded, whitish sandstone,	8–10 ft.

The sandstone which lies just above the oolitic limestone in this county, I am rather inclined to refer to the lower carboniferous epoch. At the junction of these rocks there is found, more or less, iron ore throughout the northwestern part of the county; a number of localities, where it makes its appearance, were visited. At Mr. Jacob Durham's,

section 9, township 15, range 5, in a ravine at the foot of a hill which contained the sandstone, I saw a number of large blocks of quite pure, hydrated, brown oxide of iron, each lump would weigh from twenty to thirty pounds. The only way to determine its extent is by digging into the face of the hill, on a level with the top of the limestone, which is exposed in places just below the ore. A similar, but quite siliceous, ore was seen in considerable abundance on Leatherman's branch of Little Walnut creek, at the school house, about six miles from the city, section 2, township 14, range 5. Here the massive sandstone forms quite a conspicuous cliff near the top of the hill, and is over twenty-five feet in thickness. It is coarse grained, readily crumbles to sand, and ranges in color from rust-red to snow white.

At the junction with the limestone, in the valley of Leatherman's creek, is the place of the iron ore.

This variegated sandstone has a broad outcrop and may be traced in a southerly and northerly direction, forming a belt between the outcrop of the millstone grit and the lower carboniferous limestone. On Mr. Dramer's place, near Hamrick's Station, this sandstone is remarkably white and readily crushes to sand. A car load of this white stone was sent to the glass works at Indianapolis and was found to answer well for making glass.

The following interesting section was obtained on Snake creek in section 33, township 14, range 5:

Drift and covered space, - - -	50 ft.
Ferruginous schistose sandstone, -	30 ft.
Blueish black shale and flag sandstone, -	10? ft.
Black bituminous sheety shale, - -	3 ft.
Dark shales with clay ironstone, - -	15 ft.
Thin bedded sandstone, - - -	8 ft.
Low water of Snake Creek, - - -	0 ft.

This section stops close to the limestone, which outcrops a short distance lower down the creek.

Thin seams of subconglomerate coal, from six to thirty

inches in thickness, may be found along the entire belt of millstone grit in the western part of the county; but, as yet, no mines have been regularly worked. The character of the coal is generally non-caking or block-coal.

Quite a number of ferruginous springs issue at the junction of the coarse grained ferruginous sandstone with the lower carboniferous limestone; they mostly contain protoxide of iron and leave a yellowish gelatinous sediment on the surface, around the mouth of the springs, that has often been mistaken, for coal oil. There are very fine chalybeate springs on this horizon, between Greencastle and the Junction. The water from two of these springs was analyzed, and the result is here given:

Quantitative chemical analysis of mineral water from two springs owned by Hon. F. E. McLean, and situated near Greencastle, Putnam county, Indiana, about one mile south of the Court house, on the St. Louis, Vandalia, Terre Haute and Indianapolis Railroad, close to the junction of the Louisville, New Albany and Chicago Railroad, and on the Greencastle gravel road. The water of these springs rises above the general level of the ground, in the box curbing, and each spring flows about two gallons of water per minute.

NORTH OR "DAGGY" SPRING.

Temperature 56° F. Neutral to test paper.

Solid constituents in one imperial gallon 26.6 grains, or, 380 pounds in 100,000 gallons.

Carbonic acid gas in a gallon 3.62 cubic inches.

	PARTS IN 1,000,000 PARTS, OR, IBS. IN 100,000 GALLOSN.	GRAINS IN ONE GALLON.
Silicic acid, - -	1.50	.105
Alumina, - - -	2.70	.189
Iron, - - -	4.00	.280
Lime, - - -	113.00	7.910
Magnesia, - -	50.40	3.528
Soda, - - -	8.30	.581
Potash, - -	1.00	.070

Carbonic acid,	182.90	12.803
Sulphuric acid,	7.30	.511
Chlorine,	7.30	.511
Sulphuretted hydrogen,	trace.	trace.
Loss, and undetermined,	1.60	.112
Total,	380.00	26.600

The above constituents are probably combined as follows:

	PARTS IN 1,000,000 PARTS, OR, LBS. IN 100,000 GALLONS.	GRAINS IN ONE GALLON.
Silicic acid,	1.5	.105
Alumina,	2.7	.189
Carbonate of the protoxide of iron,	7.0	.490
Carbonate of lime,	249.5	17.465
Carbonate of soda,	1.7	.119
Carbonate of potassa,	1.5	.105
Carbonate of magnesia,	80.6	5.642
Sulphate of soda,	2.3	.161
Sulphate of magnesia,	18.0	1.260
Chloride of sodium,	13.6	.952
Loss and undetermined,	1.6	.112
Total,	380.0	26.600

MIDDLE OR "DEW DROP" SPRING.

Temperature 52° F.

Solid constituents in one imperial gallon 26.25 grains, or 375 pounds in 100,000 gallons.

Carbonic acid gas in a gallon 3.58 cubic inches.

	PARTS IN 1,000,000 PARTS, OR, LBS. IN 100,000 GALLONS.	GRAINS IN ONE GALLON.
Silicic acid,	.08	.005
Alumina,	1.29	.090
Iron,	22.87	1.600
Lime,	114.15	7.990
Magnesia,	50.43	3.530
Soda,	7.03	.492

Potash,	.88	.061
Carbonic acid,	156.43	10.950
Sulphuric acid,	11.59	.811
Chlorine,	6.39	.447
Sulphureted hydrogen,	trace.	trace.
Loss,	3.86	.274
Total,	375.00	26.250

The above constituents are probably combined as follows:

	PARTS IN 1,000,000 PARTS, OR, LBS. IN 100,000 GALLONS.	GRAINS IN ONE GALLON.
Silicic acid,	.08	.005
Alumina,	1.29	.090
Carbonate of protoxide of iron,	40.82	2,857
Carbonate of lime,	203.82	14.267
Carbonate of soda,	1.22	.085
Carbonate of potash,	1.27	.089
Carbonate of magnesia,	91.50	6.405
Sulphate of soda,	1.70	.119
Sulphate of magnesia,	17.50	1.244
Chloride of sodium,	11.94	.835
Loss,	3.86	.274
Total,	375.00	26.250

In addition to the above, there is another spring on the grounds, called the SOUTH or "DIAMOND" SPRINGS: the water of which partakes of the character of the other two. It has a temperature of 51° F. at the fountain head; is alkaline to test paper after standing a short time, and contains 25.2 grains of solid constituents in an imperial gallon.

The water of these springs is of that class of mineral water known as, *Carbonated-alkaline-chalybeate.*

Each spring contains a notable quantity of iron and alkaline carbonates, in which respect they resemble some of the celebrated European chalybeate waters.

When fresh from the spring, the water sparkles with a surcharge of carbonic acid and is cool and pleasant to the taste.

The prominent medicinal properties are alterative, tonic, slightly aperient and diuretic. To correct acidity of the stomach, for most cases of dyspepsia, and for general debility, its use will be found beneficial.

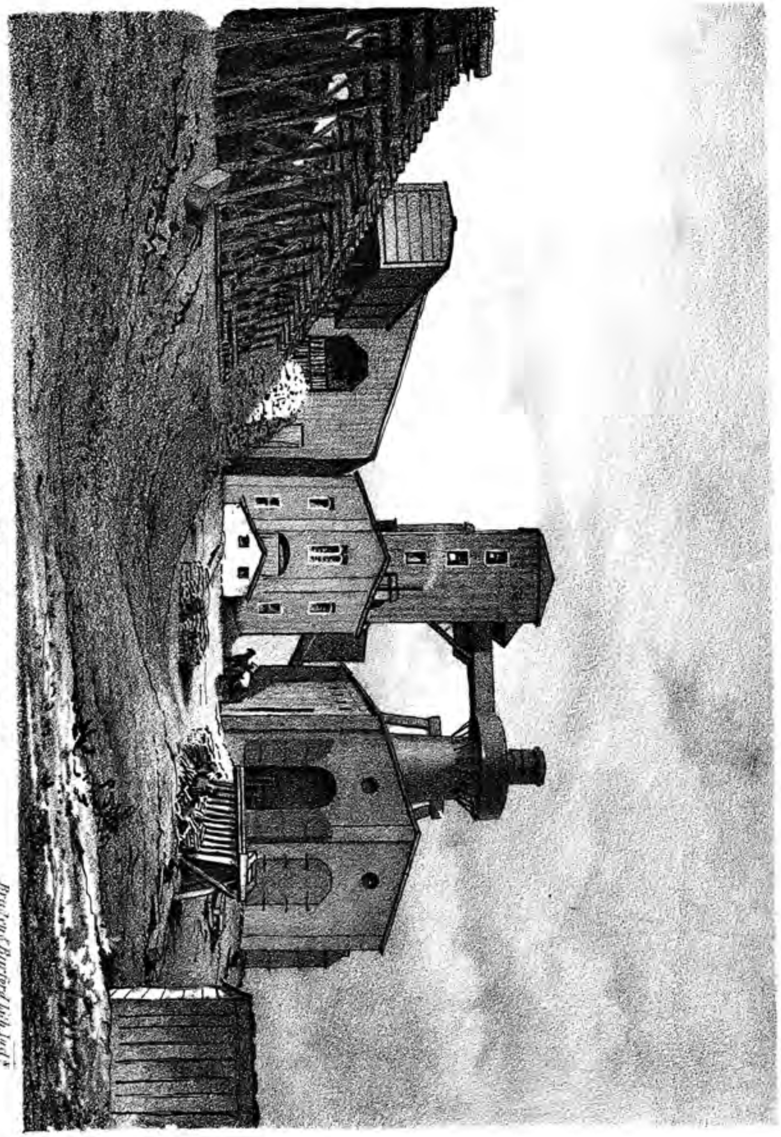
Though public attention has but recently been called to these springs by a notice in the papers giving the qualitative analyses which I made last summer, yet, they have already been largely attended by invalids from various parts of the country, and the acknowledged benefits which the afflicted have received from the use of the waters, has demonstrated, practically, their hygienic virtues.

These Springs are but a few yards apart and situated in a beautiful valley which lies in the midst of a fine agricultural district, with charming scenery on every hand.

As already stated, they are reached by three railroads, and are within one mile of the flourishing city of Greencastle, which contains the Asbury University, one of the most celebrated institutions of learning in the West. In fact, the location, as regards the general health of the country, good society and cheerful scenery, is all that could be desired, to make the Springs a place of resort for invalids and those who seek a healthful and cool retreat from the cares of business during the warm summer months.

VIGO COUNTY.

On the west side of the Wabash river, on section 9, township 12, range 9, on the St. Louis & Terre Haute Railroad, Messrs. Barrick & Co., have sunk a shaft to the same seam of coal which is mined at a number of shafts, a short distance to the east and one and a half miles from Terre Haute. This shaft goes by the name of "Sugar Creek Coal Mines." The shaft commenced eight feet above the level of



VIGO BLAST FURNACE.
Terre Haute, Ind.

the railroad track, which is here about fifty-seven feet above low water of the Wabash river, and penetrates to the depth of fifty-four feet. The following section, including some of the strata seen above the mouth of the shaft in the road cut, will indicate the position of the coal, which I take to be the equivalent of the Crooked Creek seam L mined at Seelyville, on the east side of the river, eight miles east of Terre Haute.

SECTION AT SUGAR CREEK COAL MINES.

Covered space to top of hill, - -	0 ft.
Arenaceous shale, - - - - -	0 ft.
Limestone, (poor in fossils,) stained on the outside with oxide of iron, - -	3 ft.
Arenaceous shale, - - - - -	8? ft.
Sandstone, - - - - -	10 ft.

Top of Shaft.

Dark blue argillaceous shale, - -		24 ft.
Shale and ironstone balls, - -		3 ft.
Bluish argillaceous shale, - -		24 ft.
Calcareous fossiliferous shale, -		½ ft.
Black bituminous shale, - -		2 ft.
Caking coal good quality,	3 ft. 6 in.	
Fire clay, - -	0 ft. ½ in.	
Caking coal, - -	0 ft. 10 in.	
Fire clay, - -	0 ft. 3 in.	
Caking coal, - -	0 ft. 6 in.	
		5 ft. 1½ in.

The coal in this shaft is about eleven feet above the horizon of low water of the Wabash river, and forty-six feet below the level of the railroad track. The shaft at the foot of the hill, one and a half miles west of Terre Haute, commencing just above high water mark, reaches the same seam at a depth of from twenty-five to thirty-five feet, showing a dip from the river to the west. At "St. Mary's in the

Woods," five miles northwest of Terre Haute, it is one hundred feet below the level of the railroad.

I have already called attention to the fact that the Wabash river runs on an anticlinal axis. At Terre Haute, on the east side of the river, coal L is cut out by the drift, and is reached at one hundred feet below the level of the railroad at Seelyville.

In my First Report, I endeavored to show that we had in Indiana, beneath the coal measures, the oil-bearing rocks in great force, and that, though up to that time but little oil had been obtained from the few wells then bored, yet I felt assured that oil might and would be found in paying quantities somewhere in the district. The prediction then made has been fully verified by a well bored last year, a quarter of a mile northeast of the Rose Well. This is the third well bored at Terre Haute, and the second one bored in search of oil. They all penetrate to the corniferous limestone, which immediately underlies the black slate (Genessee slate) of the Ohio survey. The first, or Rose Well, was sunk to the depth of seventeen hundred and ninety-three feet. It was bored for water, and strict attention was not paid to the character of the rocks after passing through the coals in the upper part of the section. At sixteen hundred and twenty-nine feet, a vein of oil was struck which yielded about two barrels per day. The oil was shut out and the bore continued to the depth mentioned above, having reached an abundant flow of good sulphur water. The second well was bored on the bank of the Wabash river, about one mile west of the first. This work was undertaken by a company expressly for oil. Experienced borers were employed and the record of the strata passed through may be relied on as accurate. A little oil was found, but not enough to justify pumping.

SECTION OF ARTESIAN WELL ON RIVER BANK, AT TERRE HAUTE.

Depth.	Space.		Feet.	In.	
			100		Sand aud Gravel.
	164.6				
100					
			64	6	Soap Stone.
	6.2		6	2	COAL I?
			2	3	Hard Sandstone.
	12.3		10		Soapstone.
	3.		3		COAL G?
			4	3	Soapstone.
			5	10	Gray Sandstone.
200				10	Blue Soapstone.
				6	Gray Sandstone.
	30.2		12	9	Blue Soapstone.
			6		Soft Black Shale.
	.9			9	COAF F?
			7	7	Soapstone.
					(Conglomerate?)
	45.		30	3	White Sandstone.

SECTION OF ARTESIAN WELL—Continued.

Depth.	Space.		Feet.	In.	
					SALT WATER.
			7	2	Blue Shale.
	2.3		2	3	COAL B?
			10		Black Shale.
			3		White Soap Stone.
	39.3		15		Black Shale.
300					
			8		White Soap Stone.
			3	3	Black Shale.
	3.		3		COAL A?
			17	8	Soap Stone.
			3		Sand Rock.
			20		Soap Stone.
			10		Sand Rock.
			22		Blue Shale.
			2		Limestone.
400					
			31		Blue Shale.
			5		Light Shale.
			60		Blue Shale.
	1606.		7		Sandstone.
500					

SECTION OF ARTESIAN WELL—Continued.

Depth.	Space.		Ft.	In.	
			24		Blue Shale.
			3		Sandstone.
			10		White Shale.
600			147		Blue Shale.
			11	7	Hard gritty Slate Rock.
			14	5	Hard gray Sandstone.
700			11		Hard Limestone.
			24		White Limestone.
			2		Gray Sandstone.
			14		Limestone.

SECTION OF ARTESIAN WELL—Continued.

Depth.	Space.		Feet.	In.	
			82		White Limestone.
800					
			3		Soapstone.
			35		Brown Limestone.
			5		Soapstone.
			9		Lime Rock.
			6		Soapstone.
			7		White Limestone.
900			2		Soapstone or Gypsum?
			21		White Limestone.
			5		Gray Limestone.
			5		Limestone and Soapstone.
			5		Gray Limestone.
			15		White Limestone.
			2		Fine blue Limestone.
					(Sulphur Water.)
			73		Dark gray Limestone and Flint.
1000					

SECTION OF ARTESIAN WELL—Continued.

Depth.	Space.		Feet.	In.	
			7		Light gray Limestone.
			7		Blue gray Limestone.
			26		Soapstone. (Fire Clay.)
			24		Gray Limestone.
			3		Gray Sandstone.
			5		Soapstone. (Fire Clay.)
1100					
			166		Quartz and Shale mixed.
1200					

SECTION OF ARTESIAN WELL—Continued.

Depth.	Space.		Feet.	In.	
			3		Quartz, Slate and Sandstone.
			21		Slate Rock.
1300					
			33		Soapstone.
			7		Slate Rock.
1400					
			235		Soapstone.
1500					

SECTION OF ARTESIAN WELL—Continued.

Depth.	Space.		Feet.	In.	
					Strong Salt Water.
			10		Soapstone and Sandstone.
			15		Fine Sandstone.
1600					
			40		Blue Soapstone.
			15		Black Shale.
			5		Red Shale.
			15		OIL. Black Shale. OIL.
			5		Lime Rock.
			5		Black Shale. OIL.
1700					

SECTION OF ARTESIAN WELL—Continued.

Depth.	Space.		Feet.	In.	
			149		Gray Lime Rock.
1800					Sulphur Water.
			23		Gray Sand Rock.
					Sulphur Water.
1900			73	4	Lime Rock.
					Sulphur Water.
	1912.4		1912	4	Total.

It will be perceived from the study of this section in connection with that made from the record of Bore No. 1, given in my First Report, 1869, that I have been induced to change the correlation of the coal seams through which they pass. The record of Bore No. 2, has been carefully made, and each layer of rock tested to determine its character,

consequently, the sandstones and limestones are correctly placed.

The upper coal is referred to I?, and the lower coal to the subconglomerate seam A?. In the first bore there are a number of limestones represented in the upper part of the bore where none occur, and the lower carboniferous limestone, over three hundred feet thick, is almost entirely represented by shales. A similar error was committed in the record of the bore at Lodi.

A third well was bored, by the same company, a quarter of a mile east of the first, which passed through the same succession of strata detailed above. The black slate was passed through at sixteen hundred feet; and twenty-five feet lower down, in limestone, which I refer to the corniferous, a vein of oil was found which yields twenty-five barrels per day. This limestone is so referred, from the fact that I find the corniferous immediately beneath the black slate at North Vernon, in Jennings county, and the rock is here quite oleiferous. Dr. T. Sterry Hunt, of Montreal, Canada, was highly pleased to find, in this district, confirmation of views, which he had previously published, regarding the oleiferous character of the corniferous and Niagara limestones.

He read a paper, on this subject, before the American Association for the Advancement of Science, at Indianapolis, August, 1871, which is here appended:

ON THE OIL WELLS OF TERRE HAUTE, IND.

BY DR. T. STERRY HUNT.

"In previous publications, I have endeavored to show, that the source of the petroleum in southwestern Ontario, and probably in some other localities, is to be sought in the oleiferous limestones of the Corniferous and Niagara formations, both of which abound in indigenous petroleum. I have, moreover, expressed the opinion, that the overlying sandstones of Pennsylvania are, also, truly oleiferous. In a paper read to this Association, last year, I showed that

the Niagara limestone, at Chicago, holds imprisoned in its pores an enormous quantity of oil, and remarked, that the reservoirs which supply the wells in other districts, are fissures along anticlinals, which fissures, though sometimes occurring in strata above the oil-bearing horizon, in Ontario frequently occur in the Corniferous limestone itself. Hence the view held by some that the source of the oil, in that region, is to be sought in the overlying strata, is negatived. In Ontario, there intervenes between the Corniferous and Niagara formations the great saliferous series known as the Onondaga or Salina formation. This, however, is wanting to the westward, where the first two formations come together, and, according to Prof. Cox, where exposed at North Vernon, Indiana, are both oleiferous.

A well lately sunk at Terre Haute, Indiana, in search of fresh water, has shown the existence of a productive source of oil in that region. It was carried nineteen hundred feet, and yields about two barrels of oil daily. A second well, a quarter of a mile east of north from the first, now gives a supply of twenty-five barrels of oil daily. After passing through one hundred and fifty feet of superficial sand and gravel, the boring was carried to a depth of sixteen hundred and twenty-five feet, where oil was struck. According to Prof. Cox, the strata passed through are as follows: Coal measures, seven hundred feet; Carboniferous limestones with underlying sandstones and shales, seven hundred feet; black pyroschists, regarded as the equivalent of the Genessee slates, fifty feet. Beneath, at a depth of twenty-five feet in the underlying Corniferous limestone, the oil-vein was met with. The oil in the first well was found at the same horizon. A third well about a mile to the westward, was carried to two thousand feet, but only traces of oil were found. This locality, on the Wabash river is, according to Prof. Cox, on the line of a gentle anticlinal or uplift, which is traced a long distance to the west of south. This relation of productive oil-wells, to such anticlinals, was pointed out by Prof. Andrews and by myself in 1861."

Vigo Blast Furnace: A lithograph of this furnace is here given. It was built at Terre Haute by the Vigo Iron Company, and went into blast in the fall of 1870. A. L. Crawford is President, and A. J. Crawford is Secretary and Treasurer of the company. Raw block coal, obtained from the company's mines on the branch road south of Brazil, in Clay county, is the fuel used. The ores are from Iron Mountain and Merrimac. I am informed, by a letter from the company, that the stack is fifty feet high, open topped, twelve feet across the boshes, six feet in diameter at the hearth, and six feet across at the tunnel head; has seven tuyeres with three inch nozzles; temperature of the blast, 750° F.; pressure, two and a half to three pounds; stoves for heating the blast are after the plan of Thomas Over. The pipes for carrying off the waste heat are thirty inches in diameter. The blowing cylinder is six feet in diameter, and four feet stroke. The make is twenty-four tons of mill-iron per day, and no effort is made to produce any other grade of iron. Forty-eight hundred pounds of coal are used per ton of metal made. This is a first class furnace, and has been very successfully managed. However, it is my opinion that, with a closed top, the consumption of coal, already small, would be materially reduced.

BRIEF ACCOUNT OF THE GEOLOGICAL FORMATIONS ALONG THE NEW ALBANY AND ST. LOUIS RAILWAY.

New Albany is situated on the Ohio river, just below the great Falls, and at the foot of the "Knobs." It has a population of about fifteen thousand, and is largely engaged in manufacturing; among the most prominent are the Ohio Falls Iron Works; New Albany Rail Mill; Steam Forge; Star Glass Company, and New Albany Glass Works. The Star Glass Company have extensive houses and machinery for making all sizes of fine finished plate glass and mirrors, and are, also, largely engaged in the manufacture of window glass and bottles.

The "Knobs" are, conical shaped hills composed of the soft shaley rocks which lie at the base of the lower carboniferous limestone formation; the lower portion being the "black slate," which here rests immediately upon the corniferous limestone. The hills at Edwardsville are about six hundred feet above low water in the Ohio river at New Albany.

At the base of the "Knobs," in the northwestern edge of the city, there is, above the valleys, sixty or seventy feet of greenish, marly shale, which contains one or more bands of impure, carbonate of iron, from four to six inches thick, which will yield from forty-five to fifty per cent. of metal. The earthy part is mostly carbonate of lime. A similar ore is used at the Nelson furnace, in Nelson county, Kentucky, and the quality of iron made from it is good. Superimposing the shales, is a heavy bedded sandstone, usually fine grained, even colored, and well adapted for building purposes, and hearthstones for blast furnaces. Above the sandstone are layers of encrinital limestone, that are extensively quarried, near Edwardsville, for building purposes. Surmounting the whole are the geodiferous beds, and sandstone and cherty lithostrotian beds, making, in all, about six hundred feet of strata, above the low water of the river, at New Albany.

The road will pass this ridge through a tunnel, which is now under construction.

In the bed of Indian creek, at the crossing of the road to Byrneville, the same layers of limestone are visible, that are seen at an elevation of about five hundred feet above the Ohio river, at William Benson's quarry, four and a half miles west of New Albany. Byrneville, fourteen miles from New Albany, is on the geodiferous limestone, and between there and Fairdale, in Harrison county, the cherty, ferruginous limestone is the prevailing rock. It is readily eroded and dissolved by running water, which has given rise to caves and "sinkholes." These sinkholes are quite numerous in this formation, and when the mud at the bottom is "puddled" by feeding hogs on it, they become

water-tight, and make large and convenient ponds for fish, and for watering stock.

Beneath this cherty member there is, locally, a light colored, fine grained, lithographic limestone, that is sometimes found sufficiently free from flint specks, to be used for lithographic purposes. At Milltown, on Blue river, in Crawford county, the cavernous limestone is one hundred and fifty feet thick.

The Wyandotte Cave,* which in its subterranean extent and the beauty of its crystal halls, is not inferior, and by many considered superior, to the celebrated Mammoth Cave of Kentucky, is formed in this limestone, and situated about eight miles south of Milltown. As the Air-Line Railway will cross Blue river at Milltown, I would suggest the propriety of building a branch to Leavenworth, on the Ohio river, to pass near the entrance of this cave. It would furnish a comfortable and speedy means of travel for many who are now deterred from visiting one of the most remarkable natural curiosities to be found in the world.

There are two small caves, in this limestone, at Springtown, on section 1, township 2 south, range 1 east, from which issue large streams of clear, cool water. On the tops of the ridges, near this place, are considerable deposits of siliceous iron ore, which may, in time, be made available for smelting purposes.

Heavy beds of white sandstone were seen on James L. Temple's land, section 16, township 2 south, range 1 east; it can be quarried in blocks ten feet thick; is soft when taken from the quarry, but hardens on being exposed to the atmosphere, and will make a very handsome building stone.

At Hartford, on Little Blue river, in Crawford county, is the first outcrop of coal seen on the line of this road. It is a thin seam, rather poor in quality, and belongs to the lower carboniferous limestone epoch. The following section exhibits the succession of the rocks associated with it,

* I propose, hereafter, to make a thorough survey, and complete report of all matters of interest connected with this cave.

in a space of two hundred and fifty feet from Little Blue river to the top of the ridge on the west side of town:

Surface soil and drift.
Schistose, yellowish sandstone.
Archimedes limestone, coated with oxide of iron.
Ferruyginous clay (mineral paint).
Red pentramital limestone.
Argillaceous shale, with bands of limestone.
Heavy bedded, white and mottled sandstone.

Argillaceous shale, - - - - -	2 ft. 6 in.
Coal, - - - - - - -	0 ft. 6 in.
Fire clay (very siliceous), - - -	1 ft. 0 in.

Cavernous limestone in bed of river.

This coal is of no economical value, and it is not until you reach Dubois county that the true coal measures are found in sufficient force to contain seams of coal, thick enough to be worked with profit.

Southwest of Hartford, on section 29, township 2, range 1, on the Otter Fork of Little Blue river, Mr. E. H. Golden has an artesian salt well, and is making an excellent article of salt. This well was bored for oil, and was sunk to a depth of eleven hundred and seventy feet. No record was kept of the strata passed through, but I learned from Mr. Golden that a small quantity of oil was found at two horizons, one hundred and thirty-one, and six hundred and eleven feet, respectively, but not in sufficient quantity to be a source of profit; it continued to diminish in quantity, and at this time scarcely any oil comes from the well. A good sulphur water was reached at two hundred and sixty-one feet, which is now stopped out, and the best brine is found at the depth of six hundred and eleven feet. The well discharges sixteen hundred gallons of brine in twelve hours. Eighty gallons of brine will make a bushel of salt. The bore stopped in the "black slate."

Sixteen kettles, each holding one hundred gallons, constitute the boiling capacity of the works, at this well, and the yield is twenty-five barrels of salt in thirty-six hours.

Wood is used for fuel under the kettles, and the cost of manufacturing, is about seventeen and a half cents per bushel.

One mile below Golden's, on section 33, Mr. Benham has two wells that yield the same quality of brine, and he is making twelve barrels of salt per day. These wells were also bored for oil, and were sunk to the depth of seven hundred and eight hundred feet respectively, and, as in Golden's well, two small veins of oil and one vein of sulphur water were found.

I have no doubt but that good brine can be found all along the valley of Otter creek, and, that salt making, in Crawford county, will become an important manufacturing interest, and furnish to the railroad a large amount of freight.

Notwithstanding it is my opinion that, we have in Indiana favorable indications of productive oil veins in the corniferous and Niagara limestones, I have no desire to encourage the reckless expenditure of money in its search when I say, that these wells should have been carried from thirty to sixty feet below the "black slate" to have reached the oil bearing rocks.

The conglomerate sandstone caps the hills in the vicinity of the salt wells.

On section 32, township 2, range 3, the subconglomerate coal A is opened by Mr. Hays, where the following section is exposed:

Brown, ferruginous, friable shale, -	20 ft. 0 in.
Black, bituminous, hard shale, -	10 ft. 0 in.
Black, cannel-like, bituminous shale,	3 ft. 0 in.
Coal A, semi-block, - - -	2 ft. 6 in.
Coal rash, - - - -	1 ft. 0 in.
Covered slope to valley below, - -	30 ft. 0 in.

The same seam was opened by Mr. Kesler on section 27, township 2, range 4, just in the edge of the village of St. Vincent. The roof of this mine had caved in and I was

unable to see the face of the coal. Mr. Kesler informed me that it was four feet thick; the character of the coal is the same as that seen at Hays' mine.

Coal A underlies quite a large district of country in this part of Dubois county, and is generally a good blast furnace coal.

About eight miles to the south, in the north edge of Spencer county, coal A is eminently suited to the manufacture of iron. At the Staab bank, in the latter county, it is from three, to three and a half feet thick. An analysis of this coal will be found in the table of analyses given at the end of this report.

Coal A is also found in the neighborhood of Jasper, the county seat of Dubois.

Between St. Vincent and Celestine are beds of good mineral paint—red oxide of iron and clay.

At Ferdinand, in the south part of the county, mineral paint is found in great abundance. A company, under the name of "Anderson Valley Paint Mining Company," have established a mill at Ferdinand for crushing oxide of iron and grinding and preparing the paints; which are highly esteemed for their beauty of color and durability, by those who have tried them. The following is a list of the colors manufactured by the company: Light and dark butternut, maroon and light red metallic fire-proof, brown and red Bismark, and light and dark slate, for cars, steamboats, bridges, roofing, etc., etc.

Light and dark yellow ochre, drab, Dubois stone, and raw and burnt sienna are recommended for house painting, wagons, plows, etc., etc.

When the excellence of this cheap paint is better known to the public, its manufacture will prove to be quite remunerative.

The fine stone church at Ferdinand is built of a heavy bedded sandstone which lies just above the paint beds. Its color is white, with streaks of grayish brown and redish brown, though somewhat odd, it is no doubt durable and the appearance is rather agreeable to the eye. In a space of

ten feet beneath this sandstone there are two bands of ferruginous stone, each about four inches thick, from which the paint is made. Intervening between the two, is a bed of ferruginous limestone, two and a half feet thick, and containing the usual carboniferous fossils; superimposing the upper band is a bed of soft white clay-shale, about one foot thick, that is used for making the stone color; beneath the lower band is a bed of fire clay, and, in places, I saw immediately under the limestone, about eight inches of good "Kidney" ore.

Near Pikeville, in Pike county, on Dr. De Tar's place, section 32, township 2, range 6, is a coal which I believe to be referable to K.

The following section was obtained:

Sandstone,	15 ft.
Gray shale,	10 ft.
Fossiliferous limestone,	1 ft.
Black bituminous sheety shale with fish scales and fins.	1 ft.
Cannel coal,	0 ft. 8 in.
Block coal K?	2 ft. 8 in.
Fire clay in bed of creek,	? ft.

The roof at this opening had fallen in and I had a poor opportunity to examine the seam, but, I believe it is a good quality of block coal, with a little cannel coal at the top of the seam. Coal seams, said to be two and a half to three feet thick, have been opened and worked for neighborhood use, at a number of places near Pikeville, but the mines had been lying idle for some time and the openings were more or less filled with mud, so that I was unable to measure the seams. Samples of the coal were seen at blacksmith shops and at the mouths of the mines which enabled me to determine that it was block and semi-block coal.

In the west part of the county, along the line of the road, there is a seam of good caking coal, that is probably referable to L. This coal seam is opened at a number of places

near Winslow. At Whitman & Wells' mine, one and a half miles southwest of Winslow, I saw the following section:

Covered slope,	10 ft.
Gray siliceous shale, with bands of flag-stone,	8 ft.
Bituminous shale,	1 ft.
Coal,	4 ft. 6 in.
Fire clay,	0 ft.

The upper six inches of this seam is a jet black, hard, ringing coal; the lower part is more friable, with some bands of pyrites, but altogether it is a good quality of caking coal. One and a half miles northeast of Winslow, on the land of Mr. Lewis Hecock, another opening was visited where the seam was five feet thick. At Dr. Posey's mine, in the vicinity of Petersburg, it attains the mammoth dimensions of a ten feet seam.

Four miles west of Winslow, on George W. Massey's land, section 4, township 2, range 8, this coal out-crops in the bank of Patoka river, where it was formerly mined and sent down the stream to markets on the Wabash river. It is here nine feet thick. The following section was obtained at this locality:

Argillaceous shale, with false bedding in places,		25 ft.
Tough, bluish, argillaceous shale, containing fossil plants,		4 ft.
Coal,	4 ft. 6 in.	
Clay parting,	0 ft. 9 in.	9 ft. 9 in.
Coal,	4 ft. 6 in.	
Fire clay,		0 ft. 0 in.
Bed of Patoka river.		

The same seam is seen at Martin's mine, west of south from Massey's, on the northwestern quarter of section 1, township 2, range 8; it is worked by stripping, in a valley, sixty feet below the top of the ridge:

Coal,	3 ft.	
Clay,	4 in.	6 ft. 4 in.
Coal,	3 ft.	

This is, also, a good quality of caking coal. The mine is

near the Gibson county line, and is the last workable seam of coal seen in the State, going west on the line of the road.

From the above hasty examination, it will be seen that the New Albany and St. Louis Air-Line Railway runs through a district of country that will furnish a great amount of mineral freight, consisting of coal, building stone, salt, iron ore, mineral paint, and potters' clay. A portion of the country is rich in agricultural resources, and excellent timber abounds along the entire route.

For favors and aid in making this trip along the route of the New Albany and St. Louis Air-Line Railway, I am greatly obliged to Mr. Washington Depaw, Augustus Bradley, President, and George Lyman, Secretary and Treasurer of the road, Mr. Cannon, and Dr. J. Sloan.

SPENCER AND WARRICK COUNTIES.

A visit was made to these counties, in advance of the detailed survey, in order to determine the character and extent of the Block-coal seams in the southern part of the Indiana coal-fields.

Spencer County: This county contains the most southerly land in the State,* and is well supplied with seams of good block coal. The measures are represented from the mill-stone grit at the base, to coal L, which is in the upper part of the Indiana column of coals, given in another part of this Report. The heavy bedded sandstone, called the "Lady Washington Rock," which forms a high bluff on the Ohio river at Rockport, has been referred by Prof. Leo Lesquereux to the horizon of the Mahoning sandstone of Pennsylvania.† I am satisfied that this is a mistake, and have no hesitation in pronouncing the "Lady Washington Rock" to be the equivalent of the massive sandstone which forms the cliff above Cannelton, in Perry county, and underlies the main seam of coal at that place. In my next report I hope

* The State maps generally show the most southerly land to be in Posey county; this is an error; as by reference to the United States Postal Route map, it will be seen that Spencer county extends decidedly farther south than Posey county.

† Indiana Geological Survey by Richard Owen, 1859-60, page 309.

to be able to furnish a section of the rocks which outcrop along the southern border of the State, along the Ohio river, and thus supply the data which has served to convince me that the "Lady Washington Rock" is referable to the millstone grit. It is a coarse-grained, brownish red sandstone, and contains no pebbles, such as are seen in this stratum at Cannelton, and near Shoals, in Martin county.

The sandstone near the top of the "Knobs," four miles north of Rockport, lies above coal L. The section obtained at the "Knob," coal is as follows:

SECTION AT THE "KNOB" COAL.

Space.		Ft.	In.	
50.		50		Covered space, Sandstone and siliceous Shale.
5.10		5	10	COAL L. (Knob Coal.)
		4		Fire Clay.
33.		25		Siliceous Shale.
		1		Limestone.
		3		Black, bituminous, sheety Shale.
1.8		1	8	COAL K.
30.		30?		Covered space.
2.6		2	6	COAL I.
35.		35?		Covered space.
		?		COAL G?
158.	Total.			

Coal L, which is here known as the "Knob" coal, covers but a small area near the top of a high ridge, and the seam has been nearly worked out in this township:

The quality of the coal is remarkably good. It is free from sulphur bands and, in physical structure, the lower two feet of the seam has some of the characteristics of a true block coal. The middle and upper parts resemble the main coal at Washington, in Daviess county, but contains less fixed carbon. The following analyses will show the approximate constituents of the coal taken from the different portions of the seam, where mined by Barr & Bro.:

Barr & Bro.'s coal L, (upper part.)

Specific gravity, 1.274; one cubic foot weighs 79.62 lbs.

Coke,	48.50	Ash, brown,	2.50
		Fixed carbon,	46.00
Volatile matter,	51.50	Water,	3.50
		Gas,	48.00
	100.00		100.00

The coke is puffed, swollen and vitreous.

Barr & Bro.'s coal L, (middle part.)

Specific gravity, 1.282; one cubic foot weighs 80.12 lbs.

Coke,	51.00	Ash, light brown,	2.50
		Fixed carbon,	48.50
Volatile matter,	49.00	Water,	4.00
		Gas,	45.00
	100.00		100.00

The coke is slightly puffed, with metallic lustre.

Barr & Bro.'s coal L, (lower part.)

Specific gravity, 1.278; one cubic foot weighs, 79.87 lbs.

Coke,	48.50	Ash, light red,	3.00
		Fixed carbon,	45.50
Volatile matter,	51.50	Water,	4.50
		Gas,	47.00
	100.00		100.00

The coke is swollen, puffed and vitreous.

This seam is found, also, in a high ridge about one mile northeast of Centerville, on section 9, township 6, range 6, and is mined by Peter McGarvey, on land owned by R. L. Crosby. It is here from four and a half to six feet thick, and contains some sulphur bands. The analysis is here given:

CROSBY'S COAL, L.

Specific gravity, 1.267; one cubic foot weighs 79.17 lbs.

Coke. - -	51.50	Ash, red, - - -	4.00
		Fixed carbon, - -	48.50
Volatile matter,	48.50	Water, - - -	3.50
		Gas, - - - -	45.00
	100.00		100.00

The coke is porous, puffed and lustreless.

For generating steam, coal L was highly esteemed by boatmen, and always brought a higher price than any other coal sold on the river.

Coal K lies thirty feet below L at Crosby's; is sixteen inches thick, and overlaid by black shale and limestone. Half a mile east of this place, on Goodman's land, it is reported to be two feet thick.

The following section was obtained on Mr. John Jims' land, opposite Lewisport, in Kentucky:

SECTION OPPOSITE LEWISPORT, KENTUCKY.

SPACE.		FEET.	IN.	
		15		Covered space to top of hill.
		20		Arenaceous Shale.
		6		Massive bluish gray Sandstone.
		5		Schistose Sandstone.
105.		6		Fire Clay.
		20		Covered space.
		3?		Bluish cherty Limestone.
		30		Schistose Sandstone.
2.6		2	6	COAL I. (Lewisport seam.)
		?		Fire Clay.
32.		32		Shale and schistose Sandstone.
1.6		1	6	COAL G.
3.		3		Space to high water of Ohio river.
144.	TOTAL.			

The coals in this section are block, but the seams are thin and mixed with bands of pyrites.

If I am correct in the correlation of the coal in this section, then the Lewisport seam, which is No. 9 of the Kentucky column, is the equivalent of I of the Indiana column.

On Crooked Creek, at Ira Breshears and J. M. Howard's saw mill, on section 9, township 6, range 4, coal I is opened and mined for neighborhood use. It is a true block coal, two and a half feet thick, but is full of sulphur bands, which render it useless as a fuel for smelting iron. The section

obtained at this mine shows the following succession of strata:

Covered slope to top of hill,	30 ft.
Fossiliferous limestone, with chert,	3–4 ft.
Shale,	?
COAL not opened, said to be thin,	?
Fire clay,	?
Heavy bedded sandstone,	6 ft.
COAL I, block coal,	2 ft. 6 in.
Fire clay,	?
Covered space,	30 ft.
COAL G,	1 ft. 6 in.
Bed of creek,	0 ft.

The following analysis will show the charaeter of the coal at these mines:

BRASHEAR & HOWARD'S coal I.

Specific gravity, 1.281; one cubic foot weighs 80.06 lbs.

Coke,	53.50	Ash, white,	1.00
		Fixed carbon,	52.50
Volatile matter,	46.50	Water,	3.50
		Gas,	43.00
	100.00		100.00

The coke is laminated, vitreous and not swollen.

In the middle and northern part of the county, coal seams I and K are both of workable thickness, and possess the characteristics of block or semi-block coal. In Clay township, coal I has been worked at a number of places, is between three and four feet thick, and mostly a hard, firm block coal, free from sulphur bands and suited for the blast furnace. The following is a list of owners on whose land this coal has been found. Though by no means complete, it will serve to show the extent of coal I over a large portion of the county, and where it is block or semi-block, it is marked with an asterisk:

*Brashears & Howard,	S. 9, T. 6, R. 4,	Coal I & K,	2 ft. 6 in.
John Jims,	" 30, " 6, " 4,	" I	2 ft. 6 in.
John Meeks,	" 2, " 6, " 5,	" I & K,	4? ft.
L. Stone, near Newtonville,		" I?	2 ft. 6 in.
Grandview, coal in well,		" I?	? ft.
Stockings,	S. 16, T. 5, " 5,	" I & K,	3 ft. 10 in
Wm. Scott,	" 21, " 5, " 5,	" I?	4? ft.
Fleggers,	" 29, " 5, " 5,	" I?	4? ft.
Mylers, in a well,	" 5, " 5, " 5,	" I?	4? ft.
James Egnew,	" 33, " 5, " 5,	" I?	4? ft.
John Bufkins,	" 28, " 5, " 5,	" I?	4? ft.
*W. S. Barker,	" 7, " 5, " 5,	" I	3 ft. 6 in.
John Townsend,	" 34, " 4, " 5,	" I	4 ft.

Coal I, mined by Stocking is three feet, ten inches thick, is a caking coal, and has the following composition:

STOCKING'S COAL I.

Specific gravity, 1.267, one cubic foot weighs 79.18 lbs.

Coke,	49.60	Ash, dark brown,	3.00
		Fixed carbon,	46.60
Volatile matter,	50.40	Water,	2.50
		Gas,	47.90
	100.00		100.00

The coke is swollen, porous and lusterless.

The crop of coal K is seen in the hill above this seam.

At W. S. Barker's, coal I is three feet, six inches thick, and is a good block coal, but the specimen analyzed appears to contain a large per cent. of ash.

W. S. BARKER'S COAL I.

Specific gravity, 1.317, one cubic foot weighs 82.31 lbs.

Coke,	50.00	Ash, brown,	6.50
		Fixed carbon,	43.50
Volatile matter,	50.00	Water,	2.50
		Gas,	47.50
	100.00		100.00

The coke is dense, laminated and has a metallic lustre.

Another specimen, obtained of Dr. Littlepage, and said to be from a mine south of Buffalo, was also analyzed:

COAL I, FROM NEAR BUFFALO.

Specific gravity, 1.294, one cubic foot will weigh 78.06 lbs.

Coke, - -	48.50	Ash, white, - -	1.00
		Fixed carbon, - -	47.50
Volatile matter,	51.50	Water, - - -	4.00
		Gas, - - - -	47.50
	100.00		100.00

The coke is porous, puffed and vitreous.

In the vicinity of Gentryville, a thin seam, probably K, has been opened at a number of places, and a well, dug in the village, passed through:

Brown and gray sandstone, -	27 ft. 0 in.
Coal, - - - - - -	0 ft. 6 in.

This coal is said to be thirty inches thick in other wells, but is thin where seen at the crop on the hill side.

In the neighborhood of Dale, in Carter township, coal I has been opened at many places.

At Wood's mine, on section 19, township 4, range 5, one and a half miles southwest of Dale, coal I is thirty three inches thick, and is a semi-block coal. The following is the analysis:

WOOD'S COAL I.

Specific gravity, 1.289, one cubic foot will weigh 80.56 lbs.

Coke, - -	51.50	Ash, dark brown, -	3.50
		Fixed carbon, - -	48.00
Volatile matter,	48.50	Water, - - -	3.00
		Gas, - - - -	45.50
	100.00		100.00

The coke is porous, puffed and lustreless.

In Harrison township, on the head waters of Crooked creek, and on the branches of Anderson creek, coal I ranges

from three and a half to four and a half feet in thickness, and is a remarkably fine quality of semi-block coal, eminently suited for the blast furnace.

At Mike Staab's, on section 8, township 4, range 4, this seam is three feet thick and overlaid by a dark arenaceous shale; the under clay has the appearance of being a good potter's clay. Prof. M. Delafontaine, of Chicago, made two analyses of coal from this seam, which are here given in connection with the analysis made in my laboratory.*

Analysis of two specimens of STAAB'S COAL, by Prof. M. Delafontaine:

	No. 1.	No. 2.
Water, dried at 212° F., - -	1.86	3.91
Volatile matter, - - -	37.11	30.84
Fixed carbon, - - - -	58.23	62.81
Ashes, - - - -	2.80	2.44
Color of ashes, - - -	gray.	faint yellow.

Analysis of STAAB'S COAL made in my laboratory:

Specific gravity, 1.243; one cubic foot will weigh 77.68 lbs.

Coke, - -	55.60	Ash, white, - -	1.60
		Fixed carbon, -	54.00
Volatile matter,	44.40	Water, - - -	1.80
		Gas, - - -	42.60
	100.00		100.00

The coke is puffed, swollen and vitreous.

Prof. Delafontaine, also, analyzed the ash of this coal and found that "One hundred parts of ash, contained two parts of oxide of iron, with alumina, silica and lime, but gave no traces of alkalies."

*The difference observed in the amount of fixed carbon in these analyses may, in part, be owing to a variation in the specimens, taken for analysis. My analyses are all made under similar conditions and are, therefore, comparable, one with another. For determining the coke and volatile matter, one gramme of coal is weighed out and ignited in a covered platinum crucible to a cherry red heat. The hygrometric moisture is ascertained by the loss of weight, after drying a decigramme of the crushed coal for half an hour, at a temperature of 212° F. It is then burned and the weight of the mineral residue gives the amount of ash which it contains.

I did not have an opportunity to visit the Priest seam, on Anderson creek, on section 14, township 4, range 6. This seam is four feet and four inches thick and is referred by Col. J. W. Foster, to coal A;* and, judging from the specimens I have seen, it is a semi-block coal and suited for smelting iron.

In this hasty sketch of the geology of Spencer county, I simply desire to point out, in advance of the detailed survey, the extent and character of the coals; enough, however, has been done to show that there is no lack of coal, suitable in its raw state for smelting and working iron. Two important railroads have been located to cross the coals of this county, and, surely, the value and great importance of this fossil fuel will ensure their completion.

The Indiana Mineral Railway, of which Mr. John Alexander is President, starts from a point on the Ohio river, in section 15, township 6, range 4, named Iron City, and passes northward by the way of Staab's, Jasper in Dubois county, Clark's station on the Ohio and Mississippi Railroad, in Daviess county, to Bloomfield in Greene connty, where it connects with the Indiana North and South Railway, of which Dr. E. B. Thomes, is president. The latter road runs through Brazil in Clay county, Rockville in Parke county, Attica in Fountain county and thence northward to Chicago.

The other road is the Cincinnati, Rockport and Southwestern Railway, of which Josiah Kirby, president, and E. H. Sabin, vice-president and general superintendent. This road starts from Rockport, on the Ohio river, and runs northward between Buffalo and Gentryville, through Dale, thence to Jasper, in Dubois county, and Mitchell, on the Ohio and Mississippi Railroad, in Lawrence county.

Spencer county is not only rich in minerals, but the soil is highly productive, and the lands are falling into the hands of a thrifty class of farmers, so that the marketable

*Report on the Iron Smelting Coals of Southern Indiana, adjacent to the Indiana Mineral Railway, 1871, by J. W. Foster, LL. D.

products of the county will supply these roads with an amount of freight that will prove remunerative.

For special favors, while in this county, I am under obligations to Mr. John Stephenson, Hon. H. Q. DeBruler, L. G. Smith, Jesse Laird, Hon. H. Kerchival, John Stocking, and Calvin Jones, editor of the Rockville Democrat.

Warrick County: With the exception of a narrow belt of hills flanking the broad bottoms of the Ohio river, the land in this county is well adapted for cultivation, being gently rolling and fertile. The coal measures extend over the entire county, and are capped with loess on the ridges along the Ohio river and Big Pidgeon creek. Though the coal seams in this county are equivalent to those of Spencer county, the coal, with the exception of that in the northeastern part of the county, is of the quality designated as caking coal. The following section is made from the outcrop of the strata at Newburg, as far down as the main seam, and below this, from the record of a bore which commenced in the under clay of that seam, and penetrated to the depth of two hundred and ninety-seven and a half feet:

SECTION AT NEWBURG.

Space.		Feet.	In.	
		15		Loess, Marl and Soil.
40.		10		Brown Sandstone. ("Anvil Rock" of Owen's Kentucky Report.)
		15		Arenaceous Shale.
?		?		COAL.
3.		2		Limestone.
		1?		Black Shale.
1.6		1	6	COAL K.
		2		Fire Clay.
91.6		20		Gray, argillaceous, silicious Shale.
		68		Brown, schistose Sandstone and gray Shale.
		1	6	Black Shale.
4.		4		COAL I. (Main Newburg coal.)
		3	6	Fire Clay. *Top of Bore.*
		2		Shale.
124.		23	6	White and dark Sandstone.
		58		Dark Shale.

SECTION AT NEWBURG—Continued.

Space.		Feet.	In.	
		37		Sandstone.
1.		1		COAL.
		1		Fire Clay.
		50		Light-colored Sandstone.
		17		Dark Shale.
		5		Gray Shale.
		5		Redish Shale.
		5		Hard redish Rock, no Grit.
172.6		87		Gray Shale.
		2	6	White Sandstone.
437.6	Total.			Brine.

The vein of brine struck at the bottom of this bore flows to the surface, but is too weak to be profitably used for manufacturing salt. Analysis might prove this water to be possessed of valuable medicinal properties.

It is highly probable that the sandstone, which appears at the bottom of this bore, is the millstone grit. The main coal I am disposed to refer to I of the Indiana column, hereafter given, which indicates that the main block coal seam of Brazil is the equivalent of No. 9 of Owen's Kentucky column of coals. It is, however, possible, that when Spencer and Warrick counties have been more critically surveyed, some change will have to be made in the correlation now given of the coal seams of these counties.

The four feet seam of coal has been reached by shafts, varying from eighty to one hundred feet deep, at four or five places along the bank of the Ohio river, just above the town. The coal is quite extensively mined at three of these shafts, and sold, principally, to steamboatmen, some being boated to markets down the river. The mines are known as the Love shaft, Locust Grove shaft, and Robert's shaft.

Four specimens, taken from different parts of the seam, were collected at the Locust Grove mine, for analysis, and the result is here given:

LOCUST GROVE COAL, SPECIMEN NO. 1.

Specific gravity, 1.300; one cubic foot weighs 81.25 lbs.

Coke,	61.50	Ash, dark brown,	14.00
		Fixed carbon,	47.50
Volatile matter,	38.50	Water,	4.00
		Gas,	34.50
	100.00		100.00

The coke is slaty, compact, and has a metallic lustre.

LOCUST GROVE COAL, SPECIMEN NO. 2.

Specific gravity, 1.279; one cubic foot weighs 79.93 lbs.

Coke,	52.50	Ash, white,	2.00
		Fixed carbon,	50.50
Volatile matter,	47.50	Water,	3.00
		Gas,	44.50
	100.00		100.00

The coke is swollen, puffed, and has a metallic lustre.

LOCUST GROVE COAL, SPECIMEN NO. 3.

Specific gravity, 1.313; one cubic foot weighs 82.06 lbs.

Coke,	53.00	Ash, brown,	7.00
		Fixed carbon,	46.00
Volatile matter,	47.00	Water,	2.00
		Gas,	45.00
	100.00		100.00

The coke is dense, laminated and lustreless.

LOCUST GROVE COAL, SPECIMEN NO. 4.

Specific gravity, 1.285; one cubic foot weighs 80.31 lbs.

Coke,	53.00	Ash, white,	2.50
		Fixed carbon,	50.50
Volatile matter,	47.00	Water,	2.50
		Gas,	44.50
	100.00		100.00

The coke is dense, laminate and lustreless.

No. 1 forms a thin layer on the top of the seam, and approaches cannel coal in appearance, but contains too much earthy matter to be a good fuel. No. 2 is from the upper part of the seam, No. 3 from the middle, and No. 4 from the lower part.

The average amount of fixed carbon is forty-nine per cent., and of ash three and a half per cent. It is a fatty, caking coal, contains some sulphur bands, breaks into small

cubes, and contains scales of white calcite between the numerous irregular seams which cut across the lines of stratification.

For steam and household uses, it meets with a ready sale.

The same seam has recently been opened by Mr. Spear, in section 15? township 7, range 8, where there is the same succession of strata seen in the Newburg mines; the seam is four feet four inches thick. About ninety feet below the four feet seam, there is a coal one foot three inches thick, lying in the bed of Little Pidgeon creek. This is, probably, the equivalent of the thin coal found in the bore at the mouth of the creek, which indicates a rise in the strata toward Rockport, a fact that furnishes additional evidence in favor of referring the "Lady Washington rock" to the millstone grit.

The coal, usually found under the limestone, is not seen in the hill at Spear's mine, and the space between the limestone and the four feet coal, and between the latter seam and the lower coal, is much less here than at Newburg. The following section indicates the position of the coal at Spear's mine:

SECTION AT SPEAR'S MINE.

Space.		Feet.	In.	
		50		Covered space, containing Sandstone and Shale.
		4		Limestone.
114.7		6		Sandstone.
		51		Silicious and argillaceous Shale.
		3		Tough blue Clay.
		0	7	Black bituminous Shale.
4.4		4	4	COAL I. (Caking Coal.)
		3		Fire Clay.
91.10		87		Arenaceous and argillaceous Shales.
			10	Ferruginous black Shale.
		1?		Black bituminous Shale.
1.3		1	3	COAL L.
212.	Total.			Low water of Little Pidgeon Creek.

At the time of my visit, Mr. Spear had just completed a railroad from his mine to the Ohio river, two miles in length, and was preparing to do a large business. The quality of the coal is the same as that at Newburg, but it appears to be somewhat firmer and will probably stand stocking better than the latter coal.

At Boonville, the county seat of this county, a thin coal is reached in many of the wells, at a depth of twenty to thirty feet, after passing through eight feet of soil and from twelve to twenty-two feet of sandstone. This is probably a thin seam which lies above coal K, as the limestone outcrops on all the hillsides in the vicinity.

At D. L. Hart's mine, a half mile northeast of Boonville, on section 13, township 5, range 8, is seen the following section:

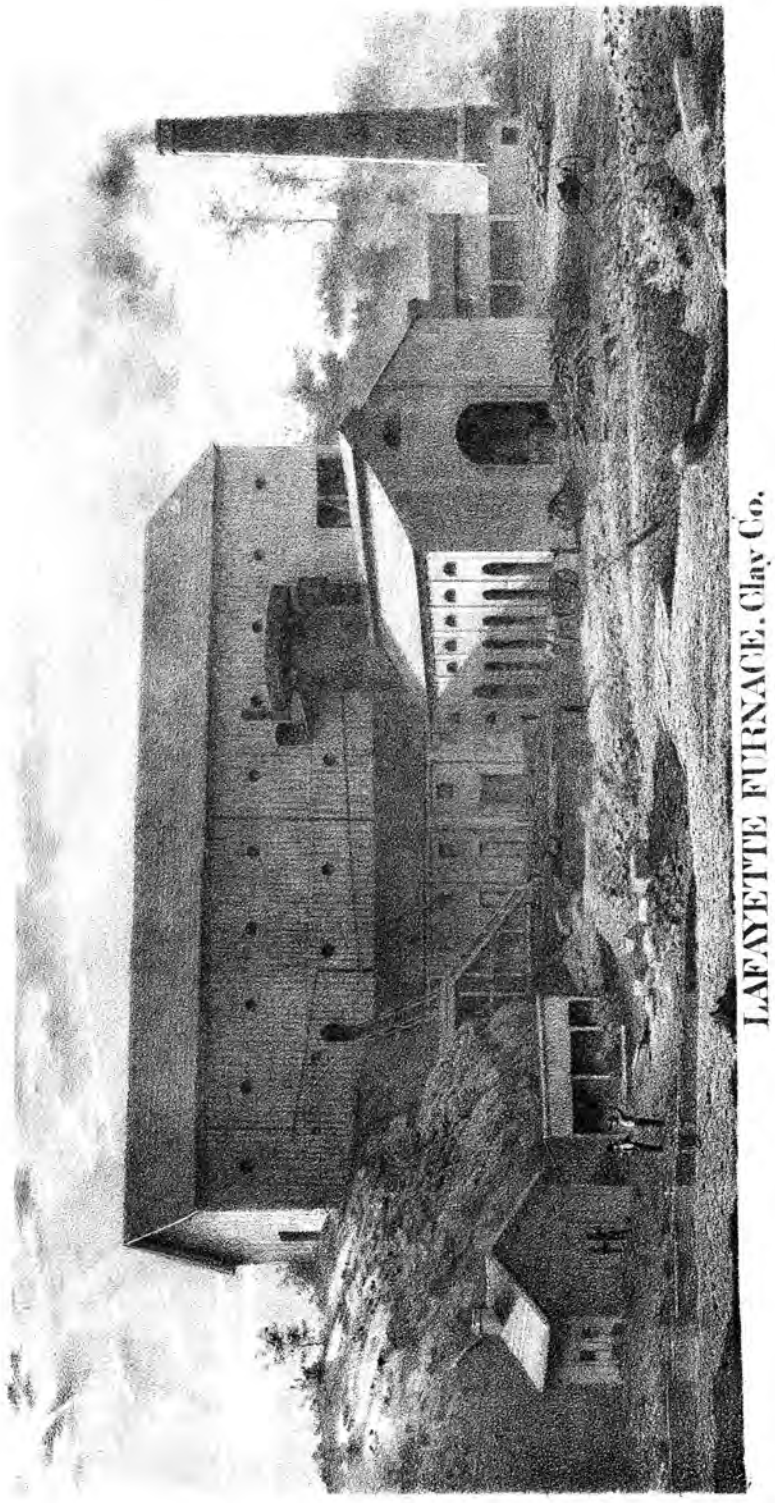
Soil and clay, - - - - - -	8 ft.
Schistose sandstone and shale, - -	50 ft.
Black, bituminous, fossiliferous limestone,	2 ft.
Arenaceous shale, - - - - -	4 ft.
Black, bituminous, sheety shale, - -	2 ft.
Coal K, caking coal, - - - -	4 ft.
Fire clay, - - - - - -	? ft.

Fragments of coal picked up on the surface indicate that it is block coal.

Seams of coal, of good, workable thickness, are reported at numerous places in Lane, Hart, Owen and Pidgeon townships, but they are only dug into occasionally during the winter months to take out a little coal for home use, and at the time of my visit, these pits were mostly filled by the caving in of the earth. Judging from what I saw, it is my opinion that coal I will be found in this part of the county sufficiently pure for smelting and working iron.

The citizens and land owners should see that the seams are well opened, so that the geologist, when hereafter making the detailed survey of the county, can have a good opportunity to view the coal at as many localities as possible.

I desire to express my obligations for kind attentions



LAFAYETTE FURNACE, Clay Co.
B.F. Master, Sup't

received while prosecuting the reconnoissance of this county to Hon. Benoni S. Fuller, C. F. Hopkins, Col. Bates, A. M. Phelps, and Dr. Barker.

Lafayette Blast Furnace, two miles north of Brazil, Clay county. The lithographic view which is here given of this furnace is taken from a photograph that was furnished by the proprietors, and as the furnace has already been described in the First Geological Report, I will only add here, for the convenience of those who may not have that report, a few remarks regarding its dimensions, etc.:

Hight of stack, - - - - -	45 ft.
Diameter of boshes, - - - -	10½ ft.
Diameter of hearth, - - - -	4 ft.
Diameter of tunnel head, - - -	5 ft.

The temperature of the blast is 600° F., and the yield of pig iron is eighteen tons per day.

On inspecting the view above referred to it will be perceived that the Lafayette Furnace has an admirable location. The stack has an outer casing of boiler iron and is supported by iron columns, is well built, and is a first class furnace in every respect.

Conclusion: I beg, in concluding this report, to testify, in general terms, my high appreciation of the many favors received from His Excellency, Gov. Conrad Baker, and all the other State officials, and to the officers and members of the State Board of Agriculture.

WESTERN COAL MEASURES AND INDIANA COAL.*

The study which I have given to the geology of the West, has led me to conclude that the carboniferous rocks embracing the coal beds, both of the Appalachian and Western coal fields, were formed in two great depressions that gave rise to large inland seas. These seas communicated with the ocean, on the south and west, which then extended far up the Mississippi valley, and covered most of the Southern States, as far north as the 35th parallel.

A high ridge, or plateau of Silurian rocks, capped in places with the Devonian, and lying in a northeasterly direction across the States of Tennessee and Kentucky, and along the western border of Ohio, and the eastern border of Indiana, separated these two seas from each other, and spreading out over the northern portion of the two latter States, extended into Pennsylvania, on the east, and Illinois and Iowa, on the west, formed an almost unbroken chain along their northern shores.

In these seas were formed the sub-carboniferous rocks, and, as the water became shallow from the accumulated sedementary material that went to build them up, a barrier was formed, which shut out the ocean and cut off the source of salt water supply. Facilitated, also, by the drainage from a large surface area, the water of these seas became less and less brackish, and the conditions necessary for the accumulation of the coal vegetation, were, in this way, brought about so gradually, that many marine forms of life continued to exist, and, by degrees, accommodate themselves to the new condition of things.

That marine forms of life are brought to adapt themselves to fresh water habitudes, under favorable conditions, has been shown by Dr. William Stimpson, who found, by deep dredging in Lake Michigan, a species of marine crustacea, in great abundance, and similar discoveries had previously been made of marine forms of life, by dredging in the large fresh water lakes of Europe.

From this, we may readily infer that the North American lakes communicated, at one time, with the ocean, and that their fauna and flora, were, to a certain extent, brought to accommodate themselves to the gradual change from salt to fresh water.

The position of the ocean relative to the land, and the great preponderance of water on the American continent during the carboniferous epoch, must have had a decided influence in modifying the temperature, and increasing the humidity of the atmosphere, thereby rendering it in every way adapted to the luxurient growth of the tropical plants, which furnished the carbon so providentially stored away in the fossil fuel; for we find that many of these coal-producing plants, whose dwarfed prototypes are now confined to the tropics, flourished then, as far north as the arctic zone.

There could have been no necessity for any increase of carbonic acid, or other material change, as many have supposed, in the composition of the atmosphere, beyond a slight increase in its humidity, and the probability is that, none existed.

The two great coal fields being separated from each other from the very beginning, as I have endeavored to show, by a barrier of rocks, which show no evidence of any subsequent submergence, and which long antedate the carboniferous era, renders it difficult to comprehend how an equivalency in the coal beds of the Appalachian field can be found in those of the West, as many of our eminent geologists have maintained.

It is true, that the fluctuations in level, which serve to build up the various strata, may have been, and in all probability were, synchronous over the two basins, but the special requirements for the production of coal beds could

*Read before the American Association for the Advancement of Science, at the Indianapolis meeting, August, 1871.

hardly have proved uniform over districts so widely separated.

Though once a firm believer in the equivalency of coal seams throughout the western coal measures, I have seen much, of late, to shake my faith in the possibility of determining an entire agreement in the coal beds, even in the limited area of the coal field in Indiana.

From a marked irregularity in the thickness of the carboniferous beds over a great extent of territory, we have good reason to believe that these inland seas, like all other great bodies of water, were of unequal depth, and, consequently, did not present, at all times, over their entire area, the conditions alike favorable for the formation of coal, and that, while the ocean was excluded from the Appalachian sea, where the material for coal beds was forming, the sea on the Western side was still filled with salt water, in which was accumulating the sedement that was subsequently changed to rock, and the conditions favorable to the production of coal, had not yet been reached.

Such a state of things will serve to account for the great discrepancy in the aggregate thickness of the strata in the two coal fields. The Appalachian being estimated at 2,500 or 3,000 feet, whereas in the Western coal field, the greatest depth will hardly exceed 1,000 feet, and in Indiana, not more than 700 feet, if so much, though we include in the latter estimate every stratum, from the Archimedes limestone upward.

From observations made in the western coal fields, during the past three years, over portions of southern Illinois, western Kentucky and Indiana, so many errors have been found in the sections of the coal strata given in the Third Kentucky Report, and which were pretty generally copied by other geologists, in more recent reports, that I have found it necessary to make an entirely new classification of the coals in the west. In speaking of the errors in Dr. D. D. Owen's section of the western coals, I do not want to be understood as referring to the errors of the sections published in his First and Second Reports on the Geology of

Kentucky, as some have supposed from reading the remarks on this subject made in my First Report on the Geology of Indiana, 1869, but to the subsequent general section to be found at page 18–24 in the Third Volume Kentucky Report, published in 1857, in which some of the most glaring errors of the previously published sections are omitted.

The Kentucky column was the first effort at a general classification of the western coals, and considering the difficulties encountered in accurately accomplishing so gigantic an undertaking at a time when a large portion of the country surveyed was almost in the condition of a wilderness and devoid of practical developments from mining operations, it is not at all strange that errors should be found by those who subsequently review the grounds, assisted in their researches by a knowledge of the labors of former explorers, and the still greater advantage derived from more recent developments. Hence, no undue merit is claimed for having been enabled to make more accurate observations than those able geologists who have gone before me, and with a due conviction that there are many facts yet to learn from the study of the measures before a correct general section of the western coal beds can be given, together with their equivalency over the field to which they belong, I have, in presenting a column of the Indiana coals, at this time, omitted the use of numbers and adopted, provisionally, letters in their place, while gaps are left in the order of succession to be filled by undiscovered seams of coal, or verified by future research.

The following diagram represents three columns of coal arranged on a common horizon for the purpose of comparison. No. 1, is copied from "A Geological Reconnoissance of Indiana, by Prof. Richard Owen, 1859–60," and represents the order of the coals in Indiana according to Prof. Leo. Lesquereux, with the exception of some unimportant changes in the lower portion, this column is the exact counterpart, as claimed by its author, of the Kentucky column above referred to. No. 2, presents a column of the Kentucky coals as corrected by myself, and No. 3 a corrected column of the Indiana coals:

NO. 3.

CONNECTED SECTION OF COAL MEASURES IN INDIANA, BY PROF. E. T. COX.

Ft.	In.		
45			
4	6		Coal N.
31	3		
	6		Coal M.
41			
8			Coal L.
40			
4			Coal X.
40			
5			Coal K.
17	7		
2			Coal J.
16			
4	4		Coal I. Main Block.
13			
1	6		Coal H.
17			
4			Coal G. 2d Block.
23	6		
4			Coal F. 3d Block.
265	3		"Millstone Grit."
2			Coal B.
20			
3			Coal A.
47			
			Shales and thin Coal.
659	5	Total.	

NO. 2.

GENERAL SECTION OF COAL MEASURES IN SOUTHERN ILLINOIS AND WESTERN KENTUCKY, BY PROF. E. T. COX.

Ft.	In.		
118			"Anvil Rock."
3			Shale and thin Coal.
36	8		
2			Coal No. 8.
46			
5			Coal No. 7.
41			
2	6		Coal No. 6.
65			
5			Coal No. 5.
86			
2	6		Coal No. 4.
90			
3			Coal No. 3.
24			
4			Coal No. 2.
140	6		
1	8		Coal No. 1.
130			
	3		"Millstone Grit." Thin Coal.
65			
	8		Coal.
165			
1036	9	Total.	

NO. 1.

CONNECTED SECTION OF COAL MEASURES IN INDIANA, BY PROF LEO LESQUEREUX.

Ft.	In.		
50			
	8		Coal No. 1B.
58			"Carthage Limestone."
2	8		Coal No. 17.
35	8		
	8		Coal No. 16.
82	9		
2	6		Coal No. 15.
115	4		
1			Coal No. 14.
78	6		
	4		Coal No. 13.
100	2		"Anvil Rock."
	3		Coal No. 12.
20	9		
5			Coal No. 11.
45	10		
3			Coal No. 10.
67			
5			Coal No. 9.
49			
2	6		Coal No. 8.
43			
2			Coal No. 7.
84			
3			Coal No. 6.
65			
4			Coal No. 5.
119			"Mahoning."
4			Coal No. 4.
34			
4			Coal No. 3.
103			
3			Coal No. 2.
62			
4			Coal No. 1C.
53			
5			Coal No. 1B.
32			
2			Coal No. 1A.
60			"Millstone Grit."
3			Subconglomerate Coal.
1415	7	Total.	Archimedes Limestone.

The column No. 3, is established upon the best evidence now before me, and though in some of its parts there may prove to be errors, still, as a guide in conducting researches for coal beds, it is confidently believed that it presents the best solution of the Indiana coal strata yet given to the public, and that in the main, it will be sustained by future investigations. In prosecuting the survey of Indiana my assistants are requested not to force local sections to agree with this column, but, rather give the order of the strata just as they are found and leave equivalencies, unless clearly proved, to a final summing up of all the evidence collected.

In the connected section of the western coal beds, given at page 18–24, Third Volume Kentucky Reports, the measurers are divided into upper and lower coal measures, and this arrangement, with some local modifications, has, until recently, been generally adopted by geologists.

Now, so far as my observations go, either in Kentucky, Illinois or Indiana, I can find neither lithological nor palæontological evidence which can be relied upon for cutting up the western coal measures into seperate epochs. The Anvil Rock sandstone, which was brought into requisition for this purpose, can hardly be depended upon as a horizon, beyond the small district in which it was first discovered, and the equivalency of the Mahoning sandstone of the Pennsylvania geologists, as designated by Owen and Lesquereux, has also proved totally unreliable as a basis for division, even though it should be found necessary to establish one. In the Third Volume Kentucky Report and in the Report of a Geological Reconnoissance of Indiana, 1859, the latter stone is at one place referred to the horizon of the Anvil Rock sandstone, and at another locality to that of the millstone grit. Indeed, so unfortunate has been the effort to transplant the Mahoning sandstone of Pennsylvania into our western coal measures, that I can recall no prominent locality where it is not distinctly referable to one or the other of the above sandstones. For the equivalency of sandstones in the western coal field I have as yet been unable to find any lithological or palæon-

tological evidence which can be relied upon as a guide to identity.

In the Indiana Report, by Prof. Richard Owen, published in 1859–60, Prof. Lesquereux refers, from palæontological evidence, the sandstone above the "Knob" coal in Spencer county, to the Mahoning sandstone, and appears undecided whether the position of the "Martha Washington" sandstone, which forms the bluff at Rockport and presents a vertical face of thirty to fifty feet on the side fronting the river, should be referred to the Mahoning or the sandstone above coal No. 2, of his general section given at page 299–305, (column No. 1, of diagram.) At these localities, from my own examinations, I found the Rockport sandstone to be the millstone grit, and the "Knob" coal to be coal L of my general section of the coals in Clay county, (column No. 3, of diagram.) Consequently, the sandstone which overlies it in the hill, if referred at all to an equivalency in the Kentucky section, will be, at least, about the place of the Anvil Rock sandstone.

At Washington, in Daviess county, Prof. Lesquereux found a paucity of palæontological evidence, nevertheless, it was believed to be sufficient to warrant him in referring the main coal of that place to No. 1, B, of his section. In his account of the measures in Daviess county, no mention is made of the heavy bed of sandstone two miles northeast of Washington, which is overlaid by the "Washington" coal, which he refers to No. 1, B, this sandstone is quite a marked feature in the geology of this part of Daviess county and is underlaid by two workable beds of coal—the upper three feet thick and the lower three to six feet thick, the space between the two varying from twenty to forty feet. The lower coal has usually a limestone over it and being the second coal, in the descending order, below the "Washington" coal, is represented as K on my section.

A coal fourteen miles north of Washington, overlaid by limestone, is, from its position, referred by him to coal No. 1, C. I suppose the coal in the bed of the river below Edwardsport, in Knox county, is the seam here referred to,

if so, it is the second seam below the "Washington" coal. Now, the "Washington" coal is at least as high up in the measures as coal L of my section. The first coal below it in Daviess county was not recognized in Clay county, and at the time of making my section it was thought that no coal would be found intervening between L and K, consequently I am now compelled to make an interpolation of a letter and designate this coal, provisionally, as X; the coal with the limestone above it as K and the five foot coal bed near the top of the hill at Edwardsport, which is the equivalent of the "Washington" coal, as L. Passing on northward into Clay county, coal I, of my section, refers to No. 1 A, and K to No. 1 C, of Prof. Lesquereux's section.

Now, it is clearly demonstrated in this county that there are two workable block-coal beds in a space of fifty to sixty feet below the seam reported by Prof. Lesquereux as No. 1 A, or the lowest workable seam.

At Garlick & Collins' mine, on Otter Creek, in Clay county, coal K is seen on the side of the hill in the road cut. Coal I is worked by a drift, and coal G is worked by a shaft sunk at the foot of the hill on the bank of the creek. Both coals I and G, are here loaded into the cars from the same coal tip.

In my First Report, 1869, I pointed out the existence of a second workable seam of block coal below the seam then generally worked. Its position in the column was determined from imperfect outcrops, and, for a time, an error was committed in confounding it with a still lower seam, F.

Previous to my survey of Clay county no geologist or other person who had examined the ground, ever dreamt of finding another workable bed of coal below what was called the Brazil seam (I.) They universally believed that the strata at Brazil indicated the latter seam to be the lowest workable coal in the coal measures proper, and, consequently, that no lower seam of any economical value could be found below it. Since the publication of my First Report, the second seam has been reached by shafts and worked at a

number of localities in the county, and the existence of the third seam is fully proved by bores.

At Highland, two miles west of Brazil, coal L, of my column, is the principal seam worked, and, probably, the only seam in the basin, at that locality, which is of suitable thickness to be mined with profit. Notwithstanding the high position which it undoubtedly occupies in the measures, we find that it is referred by Prof. Lesquereux to No. 4 of his column. The same seam at Williams' is referred to No. 3, and the sandstone which is seen above the coal at Highland, he refers, without doubt, to the Mahoning sandstone. In fact, the misplacing of coal seams, and the confounding of sandstones at all levels with the Mahoning sandstone of Pennsylvania and the Anvil Rock sandstone of Kentucky, I might continue to trace throughout the entire coal field of Kentucky, Indiana and Illinois.

In the Kentucky Reports and the Report of a Geological Reconnoissance of Indiana, made in 1859, as well as in the reports of other geologists who have written on the Western coal measures, the distinguished authors have satisfied themselves that the Western coal beds and sandstones are synchronous with the Appalachian strata, and that the Mahoning sandstone, which is there a conspicuous horizon, must, as a matter of necessity, have a similar place in the Western field, and to divide the coal measures here, as there, into upper and lower measures, and that the coal beds should conform thereto.

Having pointed out a few of the errors committed in the stratography of the Indiana coals, at localities where their position can be proved beyond a doubt, I will now proceed to show some of the errors that exist in the Kentucky column, from observations made at the same localities that furnished the data upon which it was constructed, and which column served as a basis for the arrangement of the coal beds and sandstones of all other districts in the West.

The column of the coal measures of Kentucky given at pages 18–24, Third Volume Geology of Kentucky, presents

us with 1350 feet of strata above the Millstone Grit, or Caseyville conglomerate.

From the sandstone under coal No. 18, down to the Anvil Rock sandstone, there is a repetition of the strata, including the latter rock, probably as far down as No. 7. This part of the column was constructed from bores that started on the Carthage limestone, which, in Union county, Ky., is, I now believe, the equivalent of the limestone over coal No. 11. Though the details of strata passed through in these bores can hardly be relied upon, and in no two instances do they fully agree as to the character of the rocks, still the place of the coals, and, probably, their full thickness, is given with considerable accuracy, as the parties who made the bores were in search of that mineral. Therefore, in the arrangement of this part of the column, it was erroneously assumed that the bottom of the lowest bore in Union county, starting from the horizon of the Carthage limestone, stopped just before reaching coal No. 11. From No. 17 down to No. 13, by reference to column No. 3 of the diagram, you will observe the close agreement in the spaces between the coals above and those below No. 11. In the former they are 35, 102, 115 and 77 feet, respectively, while in the latter they are 46, 67, 86 and 127 feet—the aggregate distance from No. 17 to No. 13 being 329 feet, and from No. 11 to No. 6, 326 feet. In giving the space from No. 8 to No. 6 I have omitted No. 7, which, at best, is but a streak of coal, and has no existence in Union county where the principal data for the section was obtained. We are thus carried down to about the place of the little coal at Mulford's, now Shotwell's mines, or No. 6 of the Kentucky column, and from No. 5, passing down, there is but one thin coal seam in the space intervening between it and Bell's coal or No. 1, B.

The Curlew sandstone, that is referred to a horizon just below the Mahoning sandstone of Pennsylvania, is the equivalent of the Anvil Rock sandstone; No. 4 coal is No. 11; and No. 3 is the equivalent of No. 1 B, or Bell's coal, which lies just above the Millstone Grit, or Caseyville conglomerate. In Union county, Ky., there is a thin coal in the conglomerate below Bell's coal, but there appears to be no workable seam.

The total thickness of the strata in the Kentucky column, exclusive of the Millstone Grit, is 1350 feet; now, strip it of the above errors of repeated strata, and we have, as the depth of the carboniferous rocks in Union county, Ky., only 612 feet, including the Millstone Grit.

The above errors are, in a great measure, to be attributed to too great a reliance on palæontological evidence and to an apparent desire to make the measures conform to the Pennsylvania sections of the Appalachian coal field. Though there are some striking analogies, so far as relates to the character and peculiar arrangement of their accompanying rocks, which were first pointed out by myself in a lecture on the Western coals in 1857, between the Pittsburg seam of Pennsylvania and the mammoth seam of the Western measures, (No. 11 of Owen, and which may prove to be K of my column,) yet, from the undoubted disconnection of the two fields while the coals were being formed, it is difficult to conceive how any reliable equivalency can be established.

More especially are we led to doubt the equivalency if we take into account the great preponderance of coal measure strata in the Pennsylvania district, which goes to show that, the conditions necessary for the production of coal, extended over a much greater period of time in the Appalachian than in the western field.

Though I have assumed that the greatest depth of coal strata in the western measures will not exceed 1,000 feet, in Indiana it will not be found greater than 650 feet, including the millstone grit. In a few localities in this State there are, one or more, very thin seams of coal below the Archimedes limestone, but no coal of any economical value has yet been found lower than the base of the Millstone Grit.

There are, in Indiana, two well defined zones of coal, the eastern and the western zone, and though an equivalency, in some of the seams, is clearly traced from one to the other, yet the quality of the coal is quite distinct in each. The eastern zone extends from the Ohio river, in Perry county,

on the south, to Warren county on the north, being about 150 miles in length with an average width of three miles.

The outline of the eastern boundary has a northwesterly and southeasterly trend, but is very irregular and marked by numerous tongue shaped projections which have been, here and there, cut across by denuding forces, leaving patches or outliers of carboniferous rocks, with their seams of coal resting on the subcarboniferous limestone far beyond the true boundary of the coal measures.

The area of the eastern zone is about 450 square miles or 288,000 acres, and the included coals belong to the bituminous variety characterized as *non-caking* or *free-burning*. The *cherry-coal* or *soft-coal* of England is a non-caking coal, but the non-caking coals of Indiana differ somewhat in physical structure from the English coal and a similar class of coals found in the Mahoning valley, Ohio, and the Shenango valley, Pennsylvania, the two latter being the only other localities in the United States where non-caking coal is found in any quantity. The Indiana coal from this zone has received the local name of BLOCK-COAL, a name given to it by the miners on account of the facility with which it can be mined in blocks as large as it is possible to handle. The beds are crossed, nearly at right angles, by joint seams that greatly facilitates the operation of mining which is usually carried on without resort to blasting. Blocks are taken out smooth the full depth of the seam and leave a zigzag notched outline, on the face of the mine, resembling a Virginia worm fence.

Block coal has a laminated structure and is composed of alternate thin layers of vitreous dull black coal and fibrous mineral charcoal. In the direction of the bedding lines, it splits readily into thin sheets like a slate but breaks with difficulty in the opposite direction. When struck with a hammer it emits a sound like that given by wood. Chemically it does not appear to differ from the caking coals, but in burning behaves quite differently. Unlike the latter it does not swell, shoot out jets of gas nor form a cake by running together, neither does it leave an ash mixed with

clinkers, but retains its shape like hickory wood, until entirely consumed to a small quantity of white ash which contains no trace of clinker. I have not yet had time to make an ultimate analysis of the block coal, but I believe that when so examined its superior heating properties, which have been determined in practice, by actual work done, though mainly due to its physical structure, will be found in part owing to its containing less oxygen and relatively more hydrogen than is commonly found in bituminous coals. The block coal in the great majority of the mines that have been opened, is remarkably free from sulphur and phosphorus.

A specimen taken from Garlick & Collins' new shaft, coal G of my section, of Clay county, and which has a specific gravity of 1.232, gave in 100 parts: Water 2.10, gas 37.35, fixed carbon 57.95, ash, white, 2.60, and contained sulphur 0.07, phosphorus 0.22.

At the White River Valley Rolling Mills, in this city, I was informed by the Superintendent, Mr. Sims, an experienced iron master from Pittsburg, Pennsylvania, that it not only required a less quantity of block coal, than of any of the coals in use around Pittsburgh, to make a ton of wrought iron, but that, they were likewise enabled to bring off the heats in a much shorter space of time, and the resulting iron is of a superior quality. Three important advantages that can not be overlooked by iron masters. And it must be conceded that the good behaviour of a coal in the puddling furnace is one of the very best tests, of purity and effective heating properties, to which it can be subjected, for here its good qualities are brought into requisition and the bad ones are soon made manifest in the poor quality of the iron produced.

Though the blast furnaces of Clay county can not be looked upon as filling all the requisites of an iron furnace best adapted to the use of block coal, still they are enabled to make a ton of No. 1, foundry iron that will in quality compare favorably with charcoal iron, by the use of less than two tons of coal. And I feel fully satisfied that by

materially increasing the width of these furnaces across the boshes and raising the temperature of the blast to 1200°–1500° F., that the make will be greatly increased and the consumption of coal very much reduced. By increasing the cubic contents of the furnaces and raising the temperature of the blast, they have been enabled, in the Cleveland district, England, to lessen the quantity of coke fully one fifth, per ton of iron made.

In the block coal zone, of the Indiana coal fields, there are as many as eight seams of non-caking coal, four of which are of good workable thickness over a portion of the field: these are I, G, F, and A, which together have a maximum thickness of fifteen feet, and by including the other four seams we have six feet more, making a total of twenty-one feet of block coal. If we take one half of this as a moderate average over the 288,000 acres, comprised within the eastern zone, it will give us 5,269,017,600 tons of coal, adapted to the smelting of iron, which will produce, at the rate of two dollars and twenty-five cents per ton, the average price of this coal at Brazil, the sum of 11,855,-289,600 dollars.

Ample allowance is here made for loss of coal incurred in mining, and the estimated value is believed to be within bounds. The superior excellence of the block coal for smelting and working iron and steel, in all the varied departments of their manufacture has been fully established by practical tests. Pig iron made with this coal is, in every respect, equal to charcoal iron made from the same ores. It is a soft gray iron of a highly crystaline structure, contains a large per centage of combined carbon, with but a mere trace of sulphur and phosporus—properties which render it admirably adapted to the manufacture of Bessemer steel. For steam and household purposes, it likewise has an unrivaled reputation. It burns under boilers with a full and uniform flame that spreads evenly over the exposed surface, thus securing a more uniform expansion of the boiler plates and greater freedom from leaks that are so common when caking coals are used. No clinkers are formed and,

owing to its freedom from sulphur, it has but little detrimental effect upon the boilers, grates or fire boxes.

I am informed by the owner, Mr. Stunkard, that a boiler in a saw mill at Brazil, under which block coal is burnt, has been in use for sixteen years without requiring any repairs, and is now in good condition.

Mr. Charles R. Peddle, late General Superintendent of the St. Louis, Vandalia, Terre Haute and Indianapolis Railroad, informed me, by letter, that their company has been using the block coal from Clay county for the past two years, on locomotives, with excellent results. He says, "the coal is free burning, does not cake in the fire box, makes no clinkers, burns completely to ash, and requires very little more attention in firing than wood. Its freedom from sulphur renders it comparatively harmless to the iron of the furnace and flues, and the only difference between it and wood is that the heat is concentrated upon the lower sheets of the fire box, instead of being more generally diffused as in wood, and greater care must be taken in keeping the legs of the fire boxes clear of scale and mud. We are running our western division of passenger engines from Terre Haute to St. Louis, 165 miles, with one tender of coal, averaging three tons (of 2,000 lbs. each) per trip."

"On the eastern division (Terre Haute to Indianapolis) it is used on freight engines only, and the average number of miles run to one ton of coal, in the year 1870, was $26\frac{28}{100}$, and the cost per one hundred miles was nine dollars and a half, which includes cost of hauling and cost of wood for kindling fires. This statement, of course, does not show as favorable results as would be obtained if the coal was used on both passenger and freight engines, as the latter requires as much as fifty per cent. more fuel, per mile run, than the former."

This coal has recently been introduced on many other roads, on all of which it has given perfect satisfaction.

The block coal does not require as much draft as caking coal, consequently, an engine may be run with it that is constructed for burning wood. But to obtain the best results on engines designed for burning block coal, they

should be so constructed as to secure the proper draft, as all in excess of this will cause a waste of fuel. This rule holds good, also, with regard to burning the block coal in grates or heating stoves: *i. e.*, the draft should not be as strong as is required for burning the caking coals. Block coal burns in grates with a bright, cheerful blaze like hickory wood, making a very hot fire, and for comfort and economy, when properly burnt, surpasses any other bituminous coal with which I am acquainted.

It is used at the Indianapolis Glass Works, and Mr. Fought, one of the Company, informed me that the glass pots, which cost from $100, to $125, each, and last from six to eight weeks, when fired with Pittsburg coal, will last, at least, two weeks longer when block coal is used.

The western zone of coals in Indiana, comprises, by far, the greatest area of measures, being somewhat over 6,000 square miles, and contains three or more very thick beds of coal, besides a number that are too thin for working. Its eastern boundary, which is formed by the zone of block coal, is irregular in outline, and with my present knowledge of the geology of the country, it can not be well defined. It is evident, however, that the block coal beds, as we go west, are changed in character, and pass into caking coal. The lower members thin out and are no longer of workable thickness, even before reaching the Wabash river. Of this we have abundant proof by the three deep bores made at Terre Haute.

These bores commence about forty feet above low water of the Wabash river, and after passing a few feet of alluvium deposit were in strata of gravel, sand and hard pan, peculiar to the drift epoch, for a depth of about 150 feet, and though they penetrated the Silurian rocks, the records show that but five seams were passed, only the top one being of workable thickness, while the lowest is but 293¾ feet below the surface.

Two and a-half miles east of Terre Haute, coal N, which is worked by a shaft at Seelyville, crops out, thus indicating a rise of the strata to the west, and as a still further means of accounting for the absence of the upper part of the coal

measures in the bores, it is possible that the great bed of drift which is found on the east bank of the river at Terre Haute, filled up a ravine, or valley, from which some of the upper coal beds were removed by abrading forces.

On the west bank of the Wabash river, coal L is mined in a number of places, from shafts thirty to fifty feet deep.

From the foregoing data, therefore, I am enabled to correct the error into which I fell, in my First Report, 1869, of making the top coal in the Terre Haute bore, coal L, and now place it, at least, as low down as coal I.

Though, from the records that were kept of these bores, it is difficult to point out the base of the coal measures, or that of the Millstone Grit, with accuracy; it is, nevertheless, my opinion, that the latter epoch commenced at about the depth of 500 feet.

This thinning out of the coal seams as we go west, toward the center of the basin, is a remarkable feature first pointed out by myself in 1867. A few miles west of the Indiana line, in Clark county, Illinois, bores have been made, in searching for petroleum, to the depth of 800 feet, without passing a single workable seam of coal, and the two or three thin seams reported in some of these bores are in the upper part of the measures.

Judged by the dip of the coal, on both sides of the river, the Wabash runs on a slight anticlinal axis, and I believe this to be the case from Attica, in Fountain county, to its mouth, in Posey county, and that along its course it cuts through the same strata of rocks from the bluff at Merom to its confluence with the Ohio river.

Near the eastern boundary of the zone of caking coals in Indiana, we find coals K and L, and sometimes N, of good workable thickness, averaging from four to eight feet, and, at one locality in Pike county, there is a bed not yet studied, but thought to be coal K, that attains to the thickness of ten feet, or more. Taken altogether, the maximum thickness of these beds may be estimated at twenty feet, and will yield an average, over the greater part of the district, of ten feet of coal. At some localities, the caking coal is of

inferior quality, and largely contaminated with pyrites, which is so generally disseminated through the seam that it is impracticable, in mining, to separate it from the coal. In many of the counties, however, within this zone, the caking coals will compare very favorably with the caking coals of the Pittsburg district.

Coal K, at Washington, in Daviess county, is a bright, rich looking coal, quite free from sulphur; is extensively mined; and meets with a ready market at St. Louis, and all the towns along the Ohio and Mississippi Railroad. I am informed that this coal is used by the gas companies at St. Louis and Vincennes, and, that both as to yield and illuminating quality of the gas produced, it holds an average rank with the gas coals that have been tried at these places.

The specific gravity of this coal is 1.294, a cubic foot weighs 80.87 lbs., by analysis it yields, fixed carbon, 60.00, ash, 4.50, volatile matter, 35.50. The coke is bright, porous, and slightly laminated.

The per centage of coke in the caking coals of Indiana, ranges from 52.00 to 64.50, and the ash from 0.50 to 7.00 per cent.

In Perry, Spencer, Warrick, Vanderburg, Gibson, Pike, Daviess, Sullivan, Greene, Clay, Vigo, Parke, Vermillion, and Fountain counties, there are seams of rich looking and pure caking coal, which have, for the most part, been but recently developed by the survey, and I feel assured in saying, that they will prove to be good gas coals when subjected to a practical test on a large scale.

The chemical analysis of a coal is not always a safe guide for determining its value for gas purposes.

From her geographical position, and more especially on account of the extent and value of her coal beds, and the peculiar adaptation of this coal to the metallurgy of iron and steel, which now forms one of the leading industries of the world, we can safely predict for Indiana a bright future as a manufacturing State. The commerce of the new far-west, which is increasing with a rapidity unprecedented in the growth of empires, will just as naturally look to Indiana

for its supply of iron and steel, with which to keep up the system of railroads traversing the great plains to the Pacific ocean, as the old west formerly looked to Pennsylvania. In Indiana, we find the last great belt of timber suited for manufacturing purposes, and, after crossing her borders, from thence to the Pacific ocean, no coal has yet been found that can successfully be used in the manufacture of iron.

ANALYSES OF COALS—DAVIESS COUNTY.

County.	Name of Mine or Owner.	Specific Gravity.	Weight of one cubic foot.	Fixed Carbon.	Ashes.	Coke.	Gas.	Water.	Total Volatile Matter.	Color of Ash.
Daviess	Allen, Joseph .....coal K	1.293	80.81	56.00	6.50	62.50	30.50	7.00	37.50	Brown.
Daviess	Aikman's coal L	1.270	79.37	56.50	3.00	59.50	35.50	5.00	40.50	Nearly white
Daviess	Berry's, Walter, coal.....	1.288	80.50	59.00	5.50	64.50	28.50	7.00	35.50	Red brown.
Daviess	Cox's coal L	1.259	78.68	57.50	3.50	61.00	35.00	4.00	39.00	White.
Daviess	Clark's coal 1	1.277	79.81	57.30	3.50	60.80	34.70	4.50	39.20	White.
Daviess	Dutch Bank L	1.264	79.00	61.50	2.00	63.50	34.50	2.00	36.50	White.
Daviess	Gregory's coal.....K ?	1.276	79.75	60.50	2.00	62.50	30.50	7.00	37.50	Drab.
Daviess	Gregory's, John, coal .....K ?	1.275	79.68	49.50	2.00	51.50	42 00	6.50	48.50	Lilac.
Daviess	McCord's coal.....K	1.245	77.81	54.00	2.00	56.00	40.00	4.00	44.00	Flesh.
Daviess	O'Brian's, Cornelius.....K	1.270	79.37	56.50	1.50	58.00	35.50	6.50	42.00	Salmon.
Daviess	Odell's coal ....A	1.262	78.87	53.00	2.00	55.00	36.50	8.50	45.00	White.
Daviess	Raymond's coal X	1.200	75.00	50.75	1.75	52.50	46.50	1.00	47.50	Cream.
Daviess	Spink, Cable & Co.'s main shaft L..	1.294	80.87	60.00	4.50	64.50	30.00	5.50	35.50	Fawn.
Daviess	Sulphur Spring bank, ...L	1.280	80.00	58.30	6.00	64.30	31.20	4.50	35.70	Brown.
Daviess	Spicer's Mill L	1.268	79.25	48.50	1.00	49.50	44.00	6.50	50.50	Blue.
Daviess	Stone's coal.....	1.264	79.00	54.30	2.00	56.30	35.20	8.50	43.70	Red brown.
Daviess	Shaffer's, John, coal ....A	1.308	81.75	58.00	3.50	61.50	30.50	8.00	38.50	Brown.
Daviess	Turner's coal ....A	1.278	79.75	55.50	1.50	57.00	35.50	7.50	43.00	White.
Daviess	Ward's coal .....A	1.261	78.81	55.00	2.50	57.50	36.00	6.50	42.50	White.
Daviess	Wilson's, Thomas, coal L	1.268	79.25	59.20	2.50	61.70	34.90	3.40	38.30	White.

ANALYSES OF COALS—MARTIN, VIGO, AND FOUNTAIN COUNTIES.

County.	Name of Mine, or Owner.	Specific Gravity.	Weight of one cubic foot.	Fixed Carbon.	Ashes.	Coke.	Gas.	Water.	Total Volatile Matter.	Color of Ash.
Martin	Baker's coal, (upper part). .....A	1.238	77.37	51.25	1.50	52.75	44.75	2.50	47.25	White.
Martin	Baker's coal, (lower part) .....A	1.239	77.43	48.75	0.75	49.50	47.50	3.00	50.50	White.
Martin	Horn & Co.....A	1.246	77.87	42.50	2.50	45.00	52.00	3.00	55.00	Light brown.
Martin	Hutz, Philip .....A	1.262	78.87	47.50	2.50	50.00	46.50	3.50	50.00	White.
Martin	Munson's Ridge, (upper part).....A	1.270	79.37	50.00	1.50	51.50	45.50	3.00	48.50	Brown.
Martin	Sampson's Hill, (upper part) I	1.588	99.25	28.50	41.00	69.50	25.00	5.50	30.50	Gray.
Martin	Sampson's Hill, (middle)..... I	1.232	77.00	53.00	1.00	54.00	44.00	2.00	46.00	White.
Martin	Sampson's Hill, (bottom)..... I	1.252	78.12	47.00	1.50	48.50	48.50	3.00	51.50	Red.
Martin	Sampson's Hill, (carbon. markings)	.....	.....	83.40	6.80	84.20	13.30	2.50	15.80	
Martin	Turner's Bank, (Sampson's Hill) A	1.359	84.31	45.50	9.00	54.50	41.50	4.00	45.50	Red.
Martin	Willow Valley.....A	1.286	80.37	48.00	2.50	50.50	46.75	2.75	49.50	Lead color.
Vigo	Foote's coal, (Honey creek).....	1.217	76.06	50.10	1.80	51.90	44.40	3.70	48.10	Light brown.
Vigo	Titcomb's coal, (Grant).....L ?	1.257	78.56	46.50	2.50	49.00	48.00	3.00	51.00	White.
Vigo	Titcomb's coal, roof of.....	1.496	93.50	39.00	32.00	71.00	25.00	4.00	29.00	Fawn color.
Fountain	W. B. Coats, coal N, (top).....	1.249	78.06	51.80	2.60	54.40	42.60	3.00	45.60	Dark brown.
Fountain	W. B. Coats, coal N, (bottom).....	1.301	81.31	49.00	7.20	56.20	40.20	3 60	43.80	Blue gray.
Fountain	Hatfield's Mill, (Cannel coal).....	1.195	74.68	47.50	1.00	48.50	47.00	4.50	51.50	Red.
Brookfield, Ohio	Mahoning Valley.....	1.270	79.37	53.70	2.50	56.20	39.80	4.00	43.80	White.
Spencer Co., Ind.	Priest Coal.....	1.282	80.12	51.90	1.50	53.40	43.10	3.50	46.60	Cream.
Lake Co	Peat from Crown Point.....	.....	.....	21.50	23.00	42.50	51.25	6.25	57.50	Buff.

ANALYSES OF COALS IN SULLIVAN AND CLAY COUNTIES.

County.	Name of Mine or Owner.	Specific Gravity.	Weight of one cubic Foot.	Fixed Carbon.	Ashes.	Coke.	Gas.	Water.	Total Volatile Matter.	Color of Ash.
Sullivan	Chamber's coal .....N	1.206	75.37	48.50	2.00	50.50	45.00	4.50	49.50	Light brown.
Sullivan	Burks, B. & L., ...M	1.210	75.62	51.00	1.50	52.50	44.00	3.50	47.50	White.
Sullivan	Dick's coal (upper part) .....M	1.258	78.62	50.50	1.50	52.00	43.50	4.50	48.00	White.
Sullivan	Dick's coal (middle part) .....M	1.252	78.25	55.80	0.50	55.30	39.20	4.50	44.70	White.
Sullivan	Dick's coal (lower part) .....M	1.278	79.05	52.00	2.50	54.50	42.00	3.50	45.50	Red brown.
Sullivan	Hanna, J. M., (Standard Shaft,) .M	1.281	80.06	54.00	2.50	56.50	40.50	3.00	43.50	Gray.
Sullivan	Pigg's coal .....M	1.271	79.43	49.00	2.50	51.50	42.50	6.00	48.50	Red brown.
Sullivan	St. John's coal .....M	1.287	80.43	49.00	2.50	51.50	45.00	3.50	48.50	White.
Sullivan	Wilson, Henry K., ...M	1.228	76.75	51.60	0.80	52.40	45.25	2.35	47.60	White.
Sullivan	Wilson, H., (Cass Tp.) .....M	1.249	78.06	52.00	2.00	54.00	43.00	3.00	46.00	Blue white.
Sullivan	Curryville Shaft, (upper part,) ...L	1.282	80.12	51.50	1.00	52.50	43.50	4.00	47.50	Rust color.
Sullivan	Shelburn, Richards & Buckley, top L	1.278	79.05	51.50	2.50	54.00	43.00	3.00	46.00	Light red.
Sullivan	" " " mid. L	1.284	80.25	50.25	2.00	52.25	44.75	3.00	47.75	Cream.
Sullivan	" " " bot. L	1.296	81.00	53.75	2.75	56.50	39.75	3.75	43.50	Light red.
Sullivan	Standard Coal Co., ...L	1.333	83.31	55.20	2.90	58.10	40.10	1.80	41.90	White.
Clay	Carbon Block Coal Co.....G	1.296	81.00	55.25	1.50	56.75	39.85	3.40	43.25	White.
Clay	Garlick & Collins (Otter Cr. Shaft) G	1.244	77.75	57.90	3.50	61.40	35.85	2.75	38.60	White.
Clay	Garlick & Collins (lower seam) ....G	1.232	77.00	57.95	2.60	60.55	37.35	2.10	39.45	White.
Clay	Niblock, Zimmerman & Co.....I	1.231	76.93	55.63	0.75	56.38	40.62	3.00	43.62	White.
Clay	Morris Coal Co., Brazil I	1.244	77.75	52.00	1.00	53.00	43.50	3.50	47.00	White.

ANALYSES OF COALS—SPENCER, WARRICK AND PARKE COUNTIES.

County.	Name of Mine or Owner.	Specific Gravity.	Weight of one cubic foot.	Fixed Carbon.	Ashes.	Coke.	Gas.	Water.	Total Volatile Matter.	Color of Ash.
Spencer	Barker's, W. L., Mine I	1.317	82.31	43.50	6.50	50.00	47.50	2.50	50.00	Brown.
Spencer	Brashear & Howard.....I	1.281	80.06	52.50	1.00	53.50	43.00	3.50	46.50	White.
Spencer	Barr & Bro. (upper part).....L	1.274	79.62	46.00	2.50	48.50	48.00	3.50	51.50	Brown.
Spencer	Barr & Bro. (middle part).....L	1.282	80.12	48.50	2.50	51.00	45.00	4.00	49.00	Brown.
Spencer	Barr & Bro. (bottom part).....L	1.278	79.87	48.50	3.00	48.50	47.00	4.50	51.50	Light red.
Spencer	Crosley, R. L.....L	1.267	79.17	47.50	4.00	51.50	45.00	3.50	48.50	Red.
Spencer	Lewisport Vein.....I	1.294	78.06	47.50	1.00	48.50	47.50	4.00	51.50	White.
Spencer	Rockport Vein.....	1.275	79.68	49.50	4.00	53.50	40.00	6.50	46.50	White.
Spencer	Smith, L. G.....I	1.232	77.00	45.50	1.50	47.00	47.00	6.00	53.00	White.
Spencer	Staab's Coal.....I	1.237	77.31	47.20	3.50	50.70	44.30	5.00	49.30	Gray.
Spencer	Staab's Coal* I	1.243	77.68	54.00	1.60	55.60	42.60	1.80	44.40	White.
Spencer	Stocking's Coal.....	1.267	79.18	46.60	3.00	49.60	47.90	2.50	50.40	Brown.
Spencer	Wood's Coal.....I	1.289	80.56	48.00	3.50	51.50	45.50	3.00	48 50	Brown.
Warrick	Locust Grove, No. 1.....I	1.300	81.25	47.50	14.00	61.50	34.50	4.00	38.50	Dark brown.
Warrick	Locust Grove, No. 2.....I	1.279	79.93	50.50	2.00	52.50	44 50	3.00	47.50	White.
Warrick	Locust Grove, No. 3 I	1.313	82.06	46.00	7.00	53.00	45.00	2.00	47.00	Brown.
Warrick	Locust Grove, No. 4.....I	1,282	80.31	50.50	2.50	53.00	44.50	2.50	47.00	White.
Parke	Judge Maxwell, near Rockville.....	.....	.....	48.75	2.50	51.25	45.50	3.25	48.70	Whi e.
Parke	Cannel ? Coal, near Rockville.....	.....	.....	34.50	26.00	60.50	32.00	7.50	39.50	Dark brown.

*Specimen sent by Col. J. W. Foster.

ANALYSES OF COALS—ILLINOIS, WEST VIRGINIA, COLORADO TERRITORY.

Locality.	Name of Mine or Owner.	Specific Gravity	Weight of one cubic foot.	Fixed Carbon.	Ashes.	Coke.	Gas.	Water.	Total Volatile Matter.	Color of Ash.
Danville, Illinois	Moss Bank, specimen No. 1*	1.357	84.81	46.78	8.64	55.42	40 58	4.00	44.58	Brown.
Danville, Illinois	Moss Bank, specimen No. 2*	1.298	81.12	45.93	5.73	51.66	44.94	3.40	48.34	Light red.
Kanawha County, West Virginia	Kanawha Coal Co., Coalburg	1.257	78.56	56.00	1.50	57.50	40.50	2.00	42.50	White.
Kanawha County, West Virginia	Campbell Creek Coal	1.290	80.62	57.00	2.50	59.50	38.00	2.50	40.50	Dark red.
Boone County, West Virginia	Peytona (cannel coal)	1.322	82.62	59.50	3.50	63.00	34.50	2.50	37.00	White.
Colorado Territory	Carbon City†	1.291	80.68	41.25	9.25	50.50	46.00	3.50	49.50	Lead color.
Colorado Territory	Canon City†	1.279	79.23	56.80	4.50	61.30	34.20	4.50	38.70	Ochre yellow.
Colorado Territory	Fair Play*	1.254	78.37	55.58	2.00	57.58	37.92	4.50	42.42	Fawn.
Colorado Territory	Godfrey's, 75 miles east of Denver†	1.383	86.43	48.95	6.40	55.35	42 40	2.25	44.65	Sap green.
Colorado Territory	Hodgson's, 33 m's north of Denver†	1.269	79.31	53.95	3.80	57.75	33 85	8.40	42.25	Dirty yellow.
Colorado Territory	Murphy's, 15 miles west of Denver†	1.332	83.25	52.55	1.25	53.80	39.45	6.75	46.20	Sap green.
Colorado Territory	Rock Spr'g, 312 m's w. of Cheyenne*	1.254	78.37	53.90	0.50	54.40	38.10	7.50	45.60	White.
Colorado Territory	Van Dyke's, Hulleville*	1.257	78.56	50.50	1.75	52.25	40.95	6.80	47.75	Cream.
Colorado Territory	Briggs Coal, 32 m's n.w. of Denver†	1.252	78.25	53.80	1.00	54.80	35.65	9.55	45.20	Pale yellow.

*Caking coal. †Brown coal.

ANALYSES OF IRON ORES.

County.	Owner and Number of Specimen.	Moisture dried at 212° F.	Loss from Ignition.	Silica.	Ferric Oxide.	Metallic Iron.	Alumina.	Lime.	Magnesia.	Sulphur.	Phosphorus.
Martin	B. F. Devol, No. 1			27.00	66.40	44.48	1.10	trace.		trace.	trace.
Martin	do No. 2	1.24	6.56	28.60	54.45	38.10	7.20	1.95		trace.	trace.
Martin	do No. 3	1.00	8.00	36.80	49.95	34.96	2.12				
Martin	do No. 5	4.00	9.11	32.35	53.00	37.10		1.54			
Martin	do No. 6	1.00	28.00	7.00	60.50	42.35				trace.	trace.
Martin	do No. 7	1.15	24.05	8.00	60.00	42.00		6.80			
Martin	do No. 8	1.40	22.80	13.00	55.60	38.92		5.60		.90	
Martin	do No. 9	3.60	10.50	23.00	59.65	41.75	2.70	1.15			trace.
Martin	do No. 10	3.00	8.00	37.75	48.05	33.63	1.15	2.05			trace.
Martin	do No. 11	.30	28.50	8.50	53.60	37.52		9.10		trace.	trace.

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 erroneous 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 Currysville 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.

MANUAL

OF THE

BOTANY OF JEFFERSON CO.,

BY

A. H. YOUNG,

OF HANOVER COLLEGE, IND.

PREPARED FOR THE

SECOND REPORT OF THE

GEOLOGICAL SURVEY OF INDIANA.

INDIANAPOLIS:
1871.

The following catalogue of plants, collected in Jefferson county, Indiana, was kindly furnished by A. H. Young, of Madison.

The list is very complete, and is a valuable contribution to our knowledge of the botany of the southern part of the State. The common names and medical properties, when known, are given in connection with the scientific nomenclature, so that a great many of the plants will be readily recognized by the less scientific students of botany.

E. T. COX,
State Geologist.

INTRODUCTION.

HANOVER, IND., November, 1871.

PROF. COX:—The list of flowers furnished in this report, is, we think, but partial, and a thorough canvass of the hills and valleys, flat lands, marshes and pools, would largely increase it; placing it at least 200 to 300 species in advance of its present standing. This estimate, though somewhat large, is not beyond what we think reasonable; for our researches thus far have been confined to rather a small area, say one-sixth to one-fifth of the county. The supposition that there is in the county a large number of plants not mentioned in the Catalogue, is founded on the fact, that each new locality we have visited has disclosed several species differing from those found in other places not far distant, and also many plants unknown to us, that had not arrived at the analyzable period. The supposition is further strengthened by the great diversity of surface to be found in this county. From the river bluffs of the Ohio, creviced in all directions by ravines and gulleys, there rolls back a comparatively unbroken stretch of flat land—this again is gradually changed, and the country becomes diversified by brooks, and creeks, along whose banks flowers flourish in great abundance.

The Cyperaceæ (*Sedges,*) Gramineæ (*Grasses,*) Filices (*Ferns,*) and Lichens, are all well represented in this county; and an interesting field of labor is opened to the Botanist

in these departments. Especially in the rich moist woods do the ferns attain a luxuriant growth; some species, we think, being three to four feet in hight. Of the grasses we have examined a few, but not carefully enough to notice them in the report. Want of time and of the requisite instruments for investigating the properties of most of the above named classes, has deterred us from entering on their study. It is to be hoped that some one better able to prosecute this work, will at no distant day undertake the labor of presenting to the public a full list of the Flora of Jefferson county.

I am,

Your obedient servant,

A. H. YOUNG.

ABBREVIATIONS.

The *month* named in the description, indicates the time of flowering.

The *letters* immediately following the specific name of each plant, indicates the person who first described it.

The abbreviation *adv.* for adventive, denotes that the plant is exotic.

Eu. Europe, *Afr.* Africa, *Mex.* Mexico, *S. Am.* South America.

CATALOGUE

OF THE

FLORA

OF

JEFFERSON COUNTY, INDIANA.

ORDER 1. **RANUNCULACEÆ.** (CROWFOOT FAMILY.)

1. CLEMATIS, L. VIRGIN'S-BOWER.

1. **C. Viorna,** L. (LEATHER-FLOWER.) A vine, may be known by its thick sepals, which are reflexed at points, and of a purplish color. Plentiful. May, June, July.

2. **C. Virginiana,** L. (COMMON VIRGIN'S BOWER.) August. Medical properties of Viorna and Virginiana. These plants are of use in cancerous ulcers and severe headaches.

2. ANEMONE, L. (WIND-FLOWER.)

1. **A. Virginiana,** L. (VIRGINIAN ANEMONE.) Rather common on rocky cliffs. June to August.

3. HEPATICA, Dill. (LIVER-LEAF. HEPATICA. LIVERWORT.)

1. **H. acutiloba,** DC. (SHARP-LOBED HEPAVICA.) Varies in color from white to pink and purple. Seeks moist places, and flowers for about four weeks. March. Medical properties: Is a mild demulcent tonic and astringent.

4. THALICTRUM, Tourn. (Meadow-Rue.)

1. **T. anemonoides,** Michx. Found about the roots of trees. March. Very common.
2. **T. dioicum,** L. (Early Meadow-Rue.) Fertile and sterile flowers on different plants; sterile most abundant. March, April, May.
3. **T. purpurascens,** L. (Purple M.) Rather a pretty plant, and somewhat common. April, May, June.

5. RANUNCULUS, L. Crowfoot. Buttercups.

1. **R. alismæfolius,** Geyer. (Water-Plantain Spearwort.) Rather common in wet places. June, July, August.
2. **R. Flammula,** L. (Smaller Spearwort.) Rather rare. July.
3. Var. **reptans,** (Creeping S.) August.
4. **R. abortivus,** L. (Small-flowered C.) Abundant; wet places. April, May.
5. **R. recurvatus,** Poir. (Hooked C.) Damp soils. April.
6. **R. fasicularis,** Muhl. (Early C.) Rather rare. April.
7. **R. repens,** L. (Creeping C.) Not plentiful. April, May.

Med. prop, of the Buttercups: *repens* is used for inflaming and vesicating the skin. Its action, however, is uncertain.

6. AQUILEGIA, Tourn. (Columbine.)

1. **A. canadensis,** L. (Wild Columbine.) Very common on rocks April to June.

7. DELPHINIUM, Tourn. (Larkspur.)

1. **D. tricorne,** Michx. (Dwarf L.) Quite common on the river bluffs. April, May.
2. **D. azureum,** Michx. (Azure L.) June.

8. HYDRASTIS, L. (Orange Root or Yellow Puccoon.)

1. **H. Canadensis,** L. Flower but one, which is raised on a flower stem, and of a greenish color. Not common. March. Med. Prop.: Used as a dye, producing a permanent yellow. It is also used as a tonic and aperient.

9. ACTÆA, L. (Baneberry.)

1. **A. spicata,** L. var. rubra, Michx. (Red Baneberry.) Red berries. April and May.
2. **A. alba,** Bigel. (White Baneberry.) White berries. April. Med. prop.: Actæa alba is mentioned as a violent purgative.

10. CIMICIFUGA, L. (Bugbane.)

1. **C. racemosa,** Ell. (Black Snakeroot.) July. Med. Prop.: Exercises considerable influence over the nervous system, probably of a sedative character. Dangerous in large doses.

Order 2. MAGNOLIACEÆ. (Magnolia Family.)

1. LIRIODENDRON, L. (Tulip Tree.)

1. **L. Tulipifera,** L. (Poplar.) Common forest tree, and makes very good lumber—from 2 to 6 feet in diameter. Med. Prop.: Used as a stimulant tonic, and for chronic rheumatism and dyspepsia. May and June.

2. MAGNOLIA, (Magnolia.)

1. **M. acuminata,** L. (Cucumber-tree.) This tree is said to be found in this county.

Order 3. ANONACEÆ. (Custard-apple Family.)

1. ASIMINA, Adans. (North American Papaw.)

1. **A. triloba,** Dunal. (Common Papaw.) An abundant shrub: flower, dark purple. March, April, and May.

Order 4. MENISPERMACEÆ. (Moonseed Family.)

1. MENISPERMUM, L. (Moonseed.)

1. **M. Canadense,** L. (Canadian Moonseed.) Plentiful; vining along fences, and over other plants. May to July.

Order 5. BERBERIDACEÆ. (Barberry Family.)

1. CAULOPHYLLUM, Michx. (Blue Cohosh.)

1. **C. thalictroides,** Michx. (Blue C., or Pappoose Root.) Rare. April, May.

2. JEFFERSONIA, Barton. (Twin Leaf.)

1. **J. diphylla,** Pers. Often found growing side by side with *blood root*, and for which the flower is sometimes taken. Roots very numerous, and take a deep hold for a small plant. April. Med. Prop.: The root is said to act as an emetic, in large doses, and as a tonic, and expectorant, in small doses.

3. PODOPHYLLUM, L. (MAY APPLE. MANDRAKE)

1. **P. peltatum,** L. Very plentiful. April, May. Med. Prop.: It is an active and certain cathartic.

ORDER 6. **PAPAVERACEÆ.** (POPPY FAMILY.)

1. STYLOPHORUM, Nutt. (CELANDINE.)

1. **S. diphyllum,** Nutt. Very abundant, sometimes bedecking whole hillsides with its yellow hue. March, April, May, and June.

2. SANGUINARIA, Dill. (BLOOD-ROOT.)

1. **S. Canadensis,** L. Very pretty, and quite abundant. Found often in patches; season, about a month. March. Med. Prop.: Is an acrid emetic, with stimulant narcotic powers. Is, also, an expectorant. The plant occupies a high place in medicine.

ORDER 7. **FUMARIACEÆ.** (FURMITORY FAMILY.)

1. DICENTRA, Bork. (DUTCHMAN'S BREECHES.)

1. **D. Cucullaria,** DC. (DUTCHMAN'S BREECHES.) Plentiful, and grows frequently in large patches. Of a white color. March, April, and May.

2. **D. Canadensis,** DC. (SQUIRREL CORN.) In abundance, this species is not far behind *calcullaria.* Flower frequently tinged with purple.

REMARKS.—The other species *eximia* is probably found here, but we have not yet been able to satisfy ourself as to its identity.

2. CORYDALIS, Vent. (CORYDALIS.)

1. **C. flavula,** Raf. Not plentiful. April.
2. **C. aurea,** Wild. (GOLDEN C.) Plentiful—seems to flourish best in stony places. Bright yellow. April, May.

ORDER 8. **CRUCIFERÆ.** (MUSTARD FAMILY.)

1. NASTURTIUM, R. Br. (WATER-CRESS.)

1. **N. armoracia,** Fries. (HORSE-RADISH.) Escaped from cultivation. Comparatively rare. Med. Prop. Is a valuable stimulant, as promoting appetite and invigorating digestion.

2. DENTARIA, L. (TOOTH-WORT. PEPPER-ROOT.)

1. **D. diphylla,** L. Rare, only two specimens having been found. April and May.

2. **D. laciniata,** Muhl. This plant varies much in the form of its leaf; being found in all grades from a fine linear, very accute leaf, to an oblong, almost oval. Very abundant. March to May.

3. CARDAMINE, L. (BITTER-CRESS.)

1. **C. rhomboidea,** DC. (SPRING-CRESS.) Common in damp ground and along creeks. April, May.
2. **C. rhomboidea,** Var. purpurea. Torr. Rare. Of a purple color.
3. **C. hirsuta,** L. (SMALL BITTER CRESS.) April to July.
4. **C. hirsuta,** Var. Sylvatica. Dry ground. White color. March and April.

4. ARABIS, L. (ROCK CRESS.)

1. **A. petræa,** Lam. May.
2. **A. patens,** Sulliv. May.
3. **A. lævigata,** DC. Common on rock. Flowers white. March.
4. **A. hesperidoides,** May and June.

5. BARBAREA, R. Br. (WINTER CRESS.)

1. **B. vulgaris,** (COMMON WINTER CRESS. YELLOW ROCKET.) April and May. Wet places. Rare.

6. SISYMBRIUM, L. (HEDGE MUSTARD.)

1. **S. officinale,** Scop. (HEDGE MUSTARD.) Gardens and meadows, common. May and June. Med. Prop. The juice mixed with sugar is useful in chronic coughs, hoarseness, and ulcerations of mouth.

7. BRASSICA, Tourn.

1. **B.** (or SINAPIS) ALBA. (WHITE MUSTARD.) Cultivated and adventive from Europe. Not common.
2. **B.** (OR SINAPIS) NIGRA. (BLACK MUSTARD.) Very common. Adventive from Europe. Med. Prop. The uses of these plants are almost too familiar to need my remarks. Suffice it to say, that mustard is used as a laxative, emetic, stimulant and rubefacient, according to doses used.

8. ALYSSUM, Tourn. (ALLYSSUM.)

1. **A.** MARITIMUM, L. (SWEET ALYSSUM.) Escaped from cultivation. June.

9. CAMELINA, Crantz. (FALSE FLAX.)

1. **C.** SATIVA. A weed in flax fields. Adv. from Europe. June.

10. CAPSELLA, Vent.

1. **C.** BURSA-PASTORIS. (SHEPHERD'S PURSE.) Grows everywhere, and seems to flourish best where it is most likely to be trodden down. Adv. from Europe. March to December, if weather is warm.

11. LEPIDIUM, L. (PEPPERWORT. PEPPERGRASS.)

1. **L. Virginicum,** L. (WILD PEPPERGRASS.) May to September, a common weed.

ORDER 9. **CAPPARIDACEÆ.** (CAPPARIDS.)

1. POLANISIA, Raf.

1. **P. graveolens,** Raf. Plentiful. June.

ORDER. 10. **VIOLACEÆ.** (VIOLET FAMILY.)

1. SOLAE, Ging., DC. (GREEN VIOLET.)

1. **S. concolor,** Ging. Found mostly about rocks. Rather common. April, May and June.

2. VIOLA, L. (VIOLET. HEART'S-EASE.)

1. **V. rotundifolia,** Michx. (ROUND-LEAVED VIOLET.) Found on hill-sides, and is rare. March and April.
2. **V. lanceolata,** L. (LANCE-LEAVED VIOLET.) Wet meadows. Very common. April and May.
3. **V. cucullata,** Ait. (COMMON BLUE VIOLET.) Found growing everywhere. March to May.
4. **V. cucullata,** Var. palmata. (HAND-LEAF VIOLET.) Rather scarce. April and May.
5. **cucullata,** Var. abba. Y. & N. (WHITE VIOLET.) Some specimens are smooth, and some very hairy. Lower petal streaked with purple lines, side petals bearded. Both dry and wet soils. The leaves as in cucullata. April.
6. **V. sagittata,** Ait. (ARROW-LEAVED VIOLET.) Rather plentiful; moist meadows. May.
7. **V. striata,** Ait. (PALE VIOLET.) Abundant. April and May.
8. **V. Canadensis,** L. (CANADA VIOLET.) Color of the flowers vary, even on the same plant. Common. April to July.
9. **V. pubescens,** Ait. (DOWNEY YELLOW VIOLET.) Common, It varies from pubescent to almost smooth.

ORDER 11. **HYPERICACEÆ.** (ST. JOHN'S-WORT FAMILY.)

1. HYPERICUM. ST. JOHN'S-WORT.

1. **H. prolificum,** L. (SHRUBBY ST. JOHN'S-WORT. July to September.
2. **H. perforatum,** L. (COMMON ST. JOHN'S-WORT.) Nat. from Europe. June. Med. prop.: Leaves and seeds act as an astringent.
3. **H. corymbosum,** Muhl. Plentiful. June, July.
4. **H. mutilum,** L. July.

ORDER 12. **CARYOPHYLLACEÆ.** (PINK FAMILY.)

1. SAPONARIA, L. (SOAP-WORT.)

1. **S.** OFFICINALIS, L. (COMMON SOAP-WORT. BOUNCING BET.) Sparingly escaped from cultivation. The principal Saponin obtained from plant is said to be poisonous.

2. VACCARIA, Medik. (COW-HERB.)

1. V. VULGARIS, Horst. Escaped from cultivation. Adv. from Eu. July to October.

3. SILENE, L. (CATCHFLY. CAMPION.)

1. **S. stellata,** Ait. (STARRY CAMPION.) Rather scarce. June and July.
2. **S. nivea,** DC. Rare. August.
3. **S. Pennsylvanica,** Michx. (WILD PINK.) Rare. July.
4. **S. Virginica,** L. (FIRE PINK. CATCHFLY.) Plentiful in certain localities. May. Med. prop.; A decoction of the root is said to act as an anthelmintic.
5. **S.** NOCTIFLORA, L. (NIGHT-FLOWERING C.) Rather rare. Nat. from Eu.

4. LYCHIS, Tourn. (LYCHNIS COCKLE.)

1. L. GITHAGO, Lam. (CORN COCKLE.) Found in wheat and old fields. Although a very pretty weed, it is a great nuisance to the farmer, and should be destroyed immediately; otherwise it will be very troublesome. Adv. from Eu. May, June.

5. STELLARIA, L. (CHICKWEED. STARWORT.)

1. **S.** MEDIA, Smith. Grows best on moist soils. Flowers from March till frost comes in the fall. Nat. from En.
2. **S. pubera,** Michx. (GREAT CHICKWEED.) Scarce. Found generally in small bunches or clumps. White. March and April.
3. **S. longifolia,** Muhl. (LONG-AEAVED STICHWORT.) Common along creeks. April to June.

6. CERASTIUM, L. (MOUSE-EAR CHICKWEED.)

1. **C.** VULGATUM, L. (MOUSE-EAR CHICKWEED.) Common along road-sides and waste places. April. Nat. from Eu.
2. **C.** VISCOSUM, L. (LARGER M.) Aug. Nat. from Eu.
3. **C. nutans,** Raf. April and May.

7. ANYCHIA, Michx. (FORKED CHICKWEED.)

1. **A. dichotoma.** Very common. May.

8. MOLLUGO, L. (Indian Chickweed.)

1. **N. verticillata,** L. (Carpet-weed.) Common in gardens, sometimes almost furnishing a carpet of its leaves for large spaces. July.

Order 13. PORTULACACEÆ. (Purslane Family.)

1. PORTULACA, Tourn. (Purslane.)

1. P. oleracea, L. (Common Purslane.) A troublesome weed in gardens. Seeming impossible to exterminate it. Hogs are very fond of it. Med. Prop.: Purslane is considered a cooling diuretic, and is recommended in scurvy, and affections of the urinary passages. Nat. from Eu. July and August.

2. CLAYTONIA, L. (Spring-Beauty.)

1. **C. Virginica,** L. Has very narrow linear leaves, and is much more abundant than the next species. March and April.
2. **C. Caroliniana,** Michx. Leaves two or three times broader than Virginica. Comparatively rare. March and April.

Order 14. MALVACEÆ. (Mallow Family.)

1. MALVA, L. (Mallow.)

1. M. rotundifolia, L. (Common Mallow.) Common. Nat. from Eu.

2. SIDA, L. (Sida.)

1. **S.** spinosa, L. A common weed along roadsides, and in gardens. Nat. from Trop. Amer. or Afr. July and August.

3. ABUTILON, Tourn. (Indian Mallow.)

1. **A.** Avicennæ, Gærtn. (Velvet Leaf.) Waste places. July. Adv. from India.

Order 15. TILIACEÆ. (Linden Family.)

1. TILIA, L. (Linden. Basswood.)

1. **T. Americana,** L. (Basswood.) See Wood's Botany for description of the tree. The timber is very valuable; the wood soft and white. June and July.
2. **T. heterophylla,** Vent. (White Basswood.) River bluffs. Not common. A very pretty tree. May and June.

Order 16. LINACEÆ. (Flax Family.)

1. LINUM, L. (Flax.)

1. L. usitatissimum, L (Common Flax.) Found occassionally in old fields, or along roadsides. July. Europe. Med. Prop.: Valuable as a demulcent and mollient, in inflammatory affections of the mucous membrane of the lungs, intestines, and urinary passages.

Order 17. GERANIACEÆ. (Geranium Family.)

1. GERANIUM, L. (Cranesbill.)

1. **G. maculatum,** L. (Wild Cranesbill.) Plentiful. April and May. Med. Prop.: This plant is one of the best astringents; and is particularly useful to infants, and persons of very delicate stomach. Is used in cases of diarrhœa, chronic dysentery, and cholera infantum.

2. IMPATIENS, L. (Balsam. Jewel-weed.)

1. **I. pallida,** Nutt. (Pale Touch-me-not.) Moist places. Common. July and August.
2. **I. fulva,** Nutt. (Spotted Touch-me-not.) Wet places. Common. July.

3. OXALIS, L. (Wood-sorrel.)

1. **O. Violacea,** L. (Violet W.) Abundant. Grows in patches. April and May.
2. **O. stricta,** L. (Yellow W.) Common in woods, and along old fences. May to September.

Order 18. RUTACEÆ. (Rue Family.)

1. ZANTHOXYLUM, Colden. (Prickly Ash.)

1. **Z. Americanum,** Mill. (Northern Prickly Ash.) Not rare. Med. Prop.: It is used as a stimulant in medicine.

2. PTELEA, L. (Shrubby Trefoil. Hop Tree.)

1. **P. trifoliata,** L. Gray states the odor of the flowers is disagreeable, while we have found it just the opposite, viz, pleasant.

3. AILANTUS. (Chinese Tree-of-Heaven.)

1. A. glandulosus, Desf. Med. Prop.: The powdered bark of this tree, is a powerful anthelmintic, and has been used very successfully in expelling the tape worm from the human body. May. Adv. from China.

ORDER 19. **ANACARDIACEÆ.** (CASHEW FAMILY.)

1. RHUS, L. (SUMACH.)

1. **R. glabra,** L. (SMOOTH S.) Rather common. Med. prop. The berries are astringent and refrigerant, and are considered almost as a specific in sore mouth, attending mercurial salivation. June and July.

2. **R. copallina,** L. (DWARF S.) July and August.

3. **R. Toxicodendron,** L. (POISON IVY. POISON OAK.) Common. Found vining on trees and along fences. April and May. This plant not only poisons by immediate contact, but it also gives off a volatile principle, which, on some persons, acts very readily, even when they come within the vicinity of the plant. It produces, by its action, erysipelatoid affection.

4. **R. aromatica,** Ait. (FRAGRANT S.) Rare. Found in only one locality, and that is a high bluff of the river. The plant is considered not poisonous, but the leaves and juice, to our knowledge, produced sores on the mouth of one who chewed them.

ORDER 20. **VITACEÆ.** (VINE FAMILY.)

1. VITIS, Tourn. (GRAPE.)

1. **V. labrusca,** L. (NORTHER FOX-GRAPE.) Common; and the vine is often of considerable thickness. May and June.

2. **V. æstivalis,** Michx. (SUMMER GRAPE.) Scarcer than LABRUSCA. Thickets. May.

3. **V. indivisa.** (WILD.) Rare. June.

2. AMPELOPIS, Michx. (VIRGINIAN CREEPER.)

1. **A. quinquefolia,** Michx. Called AMERICAN IVY and WOODBINE. Very common; found attached to fences and trees. June and July.

ORDER 21. **CELESTRACÆ.** (STAFF-TREE FAMILY.)

1. CELASTRUS, L. (STAFF-TREE. SHRUBBERY BITTER SWEET.)

1. **C. scandens,** L. (WAX-WORK. CLIMBING BITTER SWEET.) Not plentiful. A climbing shrub. May and June. Med. prop. Possesses emetic, diaphoretic, and narcotic properties.

2. EUONYMUS, Tourn. (SPINDLE-TREE.)

1. **E. atropurpureus,** Jacq. (BURNING BUSH. WAAHOO.) Rather common. May be known by the bright red color of its fruit, which reaches maturity in the autumn. The properties of this plant are not well known.

2. **E. Americanus,** Var. Obovatus. Torr. and Gray. Rare.

ORDER 22. **SAPINDACEÆ.** (SOAPBERRY FAMILY.)

1. STAPHYLAE, L. (BLADDER-NUT.)

1. **S. trifolia,** L. (AMERICAN BLADDER-NUT.) Found in the neighborhood of small streams. Flower greenish white. Common. April and May.

2. ÆSCULUS, L. (HORSE-CHESTNUT. BUCKEYE.)

1. **Æ. glabra,** Willd. (FETID OR OHIO BUCKEYE.) Plentiful in the woods; wood of no use except for firewood. April to June.

2. **Æ. flava,** Ait. (SWEET BUCKEYE.) Rather rare. April and May.

3. **Æ. flava.** Var. PURPURASCENS. Rare. May.

3. ACER, Tourn. (MAPLE.)

1. **A. sacharinum,** Wank. (SUGAR OR ROCK M.) One of our most common trees, forty to eighty feet high. The flowers are of a greeish color. From this tree the maple molasses and sugar are obtained. March, April.

2 **A. dasycarpum,** Ehrhast. (WHITE OR SILVER MAPLE.) Scarce. Found along river banks. April.

3. **A. rumbrum,** D. (RED OR SWAMP MAPLE.) One of the first flowering trees in spring. Very abundant on wet lands back from the river. Wood quite soft. Tree forty to sixty feet high, and, when covered with blossoms, is a very pretty sight. March.

4. NEGUNDŌ, Moench. (BOX ELDER.)

1. **N. aceroides;** Moench. (ASH-LEAVED MAPLE.) A rather rare tree, and is cultivated for ornament. Found along the Ohio river bank. Thirty to fifty feet high.

5. CARDIOSPERMUM, L. (HEART SEED.)

1. **C. Hallacabum,** L. See "Woods' Botany" for description of plant. August.

ORDER 23. **LEGUMINOSÆ.** (PULSE FAMILY.)

1. TRIFOLIUM, L. (CLOVER TREFOIL.)

1. T. PRATENSE, L. (RED CLOVER.) This and repens are the common clover of our fields and meadows. May. Adv. from Eu.

2. **T. repens,** L. (WHITE C.) Fine for bees. April.

2. MELILOTUS, Tourn. (MELILOT. SWEET CLOVER.)

1. **M.** ALBA, Lam. (WHITE M.) Rare. Adv. from Eu. August.

3. ROBINIA, L. (Locust-tree.)

1. **R. Pseudacacia,** L. (Common Locust.) Tree common, and is valuable timber. April and May. Medl prop.: Tonic, in small doses, purgative, and emetic in large doses.

4. ASTRALGUS, L. (Milk Vetch.)

1. **A. Canadensis,** L. Rare. A very pretty plant. May, June.

5. DESMODIUM, DC. (Tick-Trefoil.)

1. **D. nudiflorum,** DC. August.
2. **D. acuminatum,** DC. July.
3. **D. pauciflorum,** DC. August.
4. **D. rotundiflorum,** DC. August.
5. **D. viridiflorum,** Beck. August.
6. **D. Dillenii,** Darlingt. July.
7. **D. paniculatum,** DC. August.
8. **D. ciliare,** DC. August.

6. PHASEOLUS, L. (Kidney Bean.)

1. **P. perennis,** Walt. (Wild Bean.) August.
2. **P. helvolus,** L. August.

7. BAPTISIA, Vent. (False Indigo.)

1. **B. australis,** R. Brown. (Blue False Indigo.) Found along river banks. June.
2. **B. leucantha,** Torr. & Gray. Rare; fields. White. June.

8. CERCIS, L. (Red-bud. Judas-tree.)

1. **C. Canadensis,** L. (Red-bud.) Very abundant, and when in blossom is very pretty. March and April.

9. CASSIA, L. (Senna.)

1. **C. Marilandica,** L. (Wild Senna.) Common along small creeks. Leaflets oblique at base. August and July.
2. **C. Chamæcrista,** L. (Partridge Pea.) Rare. August.

Remark.—Have probably a variety of obtusifolia, or else an entirely new species. Having found but one specimen, and that somewhat defective, we could not determine certainly its identity.

10. GYMNOCLAUDUS, Lam. (Kentucky Coffee-tree.)

1. **G. Canadensis,** Lam. Rather rare. Flowers quite fragrant. May.

11. GLEDISCHIA. (Honey Locust.)

1. **G. triacanthos,** L. (Honey Locust or Three-thorned Acacia.) Common. Bloom quite fragrant.

Order 24. ROSACEÆ. (Rose Family.)

1. PRUNUS, Tourn. (Plum and Cherry.)

1. **P. Americana,** Marshall. (Wild Yellow or Red Plum.) Quite common. The fruit seldom reaches maturity. Thickets; and is somewhat cultivated. March and April.
2. **P. serotina,** Ehrhart. (Wild Black Cherry.) Common along old fences and edges of woods. Wood hard. Tree often quite large. April and May.

2. SPIREA, L. (Meadow Sweet.)

1. **S. opulifolia,** L. (Nine-Bark.) Rather rare May.
2. **S. salicifolia,** L. (Common Meadow Sweet.) May.
3. **S. tomentosa,** L. (Hardhack, Steeple Bush.) Common about old meadows and thickets. June and July. Med. prop. Used as a tonic and as an astringent. And may be used in diarrhœa and cholera infantum.
4. **S. Aruncus,** L. (Goat's Beard.) Has its flowers in a compound panicle, making a bunch of flowers about the size of the head. Rare. May and June.

3. GEUM, L. (Avens.)

1. **G. album,** Gmelin. Common. June.
2. **G. Virginianum,** L. June and July.
3. **G. strictum,** Ait. July.
4. **G. vernum,** Torr. and Gray.

4. POTENTILLA, L. (Cinque-foil. Five-finger.)

1. **P. Norvegica,** L. Rare. June.
2. **P. Canadensis,** L. (Common Cinque-foil.) Common fields. April and May.

5. FRAGARIA, Tourn. (Strawberry.)

1. **F. Virginiana,** Var. Illinœnsis. Rather common. April.
2. **F. vesca,** (English Strawberry.)

6. RUBRS, Tourn. (Bramble.)

1. **R. strigosus,** Michx. (Wild Red Raspberry.) May.
2. **R. accidentalis,** L. (Black Raspberry.) Common. Rocky places. April and May.

3. **R. villosus**, Ait. (COMMON OR HIGH BLACKBURRY.) Very common. May. Med. prop. The roots of the blackberry and bewberry are tonic and strongly astringent.
4. **R. villosus.** (VAR. HUMIFUSUS.) About woods. Trailing. May.
5. **R. Canadensis,** L. (LOW BLACKBERRY. DEWBERRY.) Common. Fields and meadows. April and May.
6. **R. hispidus,** L. (RUNNING SWAMP BLACKBURRY.) Common in wet or moist fields. June.

7. ROSA, Tourn. (ROSE.)

1. **R. setigera,** Michx. (CLINGING OR PRAIRIE ROSE.) Rather rare. June.
2. **R. Carolina,** L. (SWAMP ROSE.) June and July.
3. **R. lucida,** Ehrhart. (DWARF WILD ROSE.) May and June.
4. **R. lucida,** (VAR. NITIDA.) Wild. May and June.
5. R. RUBIGINOSA, L. (SWEET BRIER.) Quite common. Nat. from Eu. May and June.
6. R. MICRANTHA, Smith. (SMALL FLOWERED ROSE.) Nat. from Eu. May and June.

8. CRATGAUS, L. (HAWTHORN. WHITE THORN.)

1. **C. coccina,** L. SCARLET-FRUITED THORN.) Rather Common. April and May.
2. **C. tomentosa,** L. (BLACK OR PEAR THORN.) Our most common haw. Woods and thickets. April and May.
3. **C. tomentosa,** (Var. PUNCTATA.) Common. April and May.
4. **C. Crus-galli,** L. (COCKSPUR THORN.) Rare. April and May.

9. PYRUS, L. (APPLE.)

1. **P. coronoria,** L. (AMERICAN CRAB-APPLE.) Rare. April.
2. **P. arbutifolia,** L. (CHOKE BERRY.) Quite common in wet grounds. This shrub may be found with blossoms when not any more than six inches high. It reaches a hight of from eight to ten feet; diameter, one-half to three-fourths of an inch.

10. AMELANCHIER, Medic. (JUNE-BERRY.)

1. **A. Canadensis.** (TORR. and GRAY.) Rare, and is being killed by frosts. April.
2. **A. Canadensis.** (Var. BOTRYPIUM.)

ORDER 25. SAXIFRAGACEÆ. (SAXIFRAGACEÆ FAMILY.)

1. RIBES, L. (CURRANT. GOOSEBERRY.)

1. **R. cynosbati,** L. Seems to thrive best among the rocks and cliffs. Common. Flowers greenish. April.

2. **R. rotundifolium,** Michx. March and April.
3. **R. prostratum,** L, Her. (FETID CURRANT.) Rare. April.

2. HYDRANGEA, Gronov. (HYDRANGEA.)

1. **H. arborescens,** L. (WILD HYDRANGEA.) Common on rocky cliffs. June.

3. ASTILBE, Don. (FALSE GOATSBEARD.)

1. **A. decandra,** Don. Rather common. Woods. July and August.

4. SULLIVANTIA, Torr. & Gray. (SULLIVANTIA.)

1. **S. Ohionis** Torr. & Gray. Found growing on the rocky cliffs in spots where the earth has fallen. Delicate pinkish white flowers, and beautiful round shining leaves. June.

5. HEUCHERA, D. (ALUM-ROOT.)

1. **H. Americana,** L. (COMMON ALUM-ROOT.) Rather common. Med. prop.: Is a powerful astringent.

6. MITELLA, Tourn. (MITRE-WORT. BISHOPS-CAP.)

1. **M. diphylla,** L. Very delicate flowers. Found in rocky places. Common. March and April.

ORDER 26. CRASSULACEÆ. (ORPINE FAMILY.)

1. PENTHORUM, Gronov. (DITCH STONE-CROP.)

1. **P. sedoides,** L. Not common. July.

2. SEDUM, Tourn. (STONE-CROP. ORPINE.)

1. **S. ternatum,** Michx. Common on rocks. April and May.

ORDER 27. HAMAMELACEÆ. (WITCH HAZEL FAMILY.)

1. HAMAMELIS, L. [WITCH HAZEL.]

1. **H. Virginica,** L. Blooms in the autumn, and the flowers remain till spring, so that it would lead one finding it in spring to think that it was a spring flower. Med. prop.: A decoction of the bark is useful in hemorrhage of the lungs and stomach.

2. LIQUIDAMBAR, L. (SWEET GUM TREE.)

1. **L. Styraciflua,** L. [SWEET GUM. BILSTED.] Plentiful. The timber is not of any use except as fuel. April. Med. prop.: A syrup made from bark may be used in summer diarrhœa and dysentery.

ORDER 28. **HALORAGEÆ.** (WATER MILFOIL FAMILY.)

1. PROSERPINACA, L. (MERMAID-WEED.)

1. **P. palustris**, L. Common. Wet pools. June.

ORDER 29. **ONAGRACEÆ.** (EVENING PRIMROSE FAMILY.)

1. CIRCÆA, Tourn. [ENCHANTERS' NIGHT-SHADE.]

1. **C. Lutetiana,** L. Rich moist woods. June.
2. **C. alpina,** L. This species is doubtful. June.

2. ŒNOTHERA. (EVENING PRIMROSE.)

1. **Œ. biennis,** L. (COMMON EVENING PRIMROSE.) July and August.
2. **Œ. biennis,** Var. (PARVIFLORA.) Aug.
3. **Œ. fruiticosa,** L. (SUNDROPS.) Rather rare. June.

3. LUDWIGIA, L. (FALSE LOOSE-STRIFE.)

1. **L. alternifolia,** L. (SEED BOX.) Plentiful. July.
2. **L. hirtella,** Raf. August and September.
3. **L. virgata,** Ph. August.

ORDER 30. **MELASTOMCAEÆ.** (MELASTOMA FAMILY.)

1. RHEXIA, L. (DEER GRASS. MEADOW BEAUTY.)

1. **R. Virginica,** L. Plentiful in wet or moist meadows. July and August.

ORDER 31. **LYTHRACAEÆ.** (LOOSESTRIFE.)

1. CUPHEA, Jacq. (CUPHEA.)

1. **C. viscosissima,** Jacq. (CLAMMY CUPHEA.) Rare. July and August.

2. AMMANIA, Houston. (AMMANIA.)

1. **A. latifolia,** L. This species somewhat doubtful.

ORDER 32. **PASSIFLORCEAÆ.** (PASSION FLOWER FAMILY.)

1. PASSIFLORA, L. (PASSION FLOWER.)

1. **P. lutea,** L. Rare. A very remarkable flower. June, July and August.

ORDER 33. **CUCURBITACEÆ.** (GOURD FAMILY.)

1. MELOTHRIA, L. (MELOTHRIA.)

1. **M. pendula,** L. August and September.

2. SICYOS. (ONE-SEEDED STAR CUCUMBER.)

1. **S. angulatus.** L. Rather common. September.

ORDER 34. **UMBELLIFERÆ.** (PARSLEY FAMILY.)

1. SANICULA, Tourn. (SANICLE OR BLACK SNAKEROOT.)

1. **S. Canadensis,** L. May.
2. **S. Marilandica,** L. July. Med. prop.: Useful in intermittent fever. Known as BLACK SNAKEROOT.

2. DAUCUS, Tourn. (CARROT.)

1. **D. Carota,** L. (COMMON CARROT.) Sparingly escaped into the fields. Adv. from Eu. June.

3. PASTINACA, Tourn. (PARSNIP.)

1. **P. sativa,** L. (COMMON PARSNIP.) May and June.

4. ARCHEMORA, DC. (COWBANE.)

1. **A. rigida,** DC. This plant is a deadly poison. June, July and August.

5. THASPIUM, Nutt. (MEADOW PARSNIP.)

1. **T. barbinode,** Nutt. May.
2. **T. aureum,** Nutt. Moist places. May.
3. **T. trifoliatum.** Rare. April.

6. CICUTA, L. (WATER HEMLOCK.)

1. **C. Maculata,** L. (SPOTTED COWBANE.) Poisonous. Wet places. July.

7. CRYPTOTÆNIA, DC. (HONEWORT.)

1. **C. Canadensis,** DC. June.

8. CHÆROPHYLLUM, L. (CHERVIL.)

1. **C. procumbens,** Lam. Plentiful. Moist places. April.

9. OSMORRHIZA, Raf. (SWEET CICELY.)

1. **O. longistylis,** DC. (SMOOTH SWEET CICELY.) Common. May.

2. **O. brevistylis,** DC. (Hairy Sweet Cicely.) April.

10. ERIGENIA, Nutt. (Harbinger of Spring)

1. **E. bulbosa,** Nutt. Commonly called *Pepper and Salt.* Found abundantly on the river bluffs. March and April.

Order 35. ARALIACEÆ. (Ginseng Family.)

1. ARALIA, Tourn. (Ginseng or Wild Sarsaparilla.)

1. **A. spinosa,** L. (Angelica-tree, Hercules' Club.) Rather common; woods and thickets. July and August. Med. prop. An infusion acts as an emetic and cathartic.
2. **A. quinquefolia,** (Ginseng.) June.

Order 36. CORNACEÆ. (Dogwood Family.)

1. CORNUS, Tourn. (Cornel. Dogwood.)

1. **C. florida,** L. (Dwarf Cornel. Bunch-berry.) Most abundant on the river bluffs, but frequently met with on the flats back from the river. March, April and May.
2. **C. sericea,** L. (Silky Cornel. Kinnikinnick.) Rare. June. Med. prop. Both the florida and sericea may be used as tonics and astringents.
3. **C. asperifolia,** Michx. (Rough-leaved Dogwood.)
4. **C. paniculata,** L'Her. (Panicled Cornel.) Rather rare. May.
5. **C. alternifolia,** L. (Alternate-leaved Cornel.) Rare. May.

2. NYSSA, L. (Tupelo. Pepperidge. Sour Gum-tree.)

1. **N. multiflora.** Common; woods. The timber is not valuable. Thirty to fifty feet high.

Order 37. CAPRIFOLIACEÆ. (Honeysuckle Family.)

1. SYMPHORICARPUS, Dill. (Snowberry.)

1. **S. occidentalis,** R. Brown. (Wolfberry.) August.
2. **S. racemosus,** Michx. (Snowberry.) May.

2. LONICERA, L. (Honeysuckle. Woodbine.)

1. **L. sempervirens,** Ait. (Trumpet. Honeysuckle.) A few specimens of this plant have been found. May.

3. TRIOSTEUM, L. (Fever-wort. Horse-gentian.)

1. **T. perfoliatum,** L. Common. Med. prop. The bark of the roots acts as an emetic and cathartic. April and May.

4. SAMBUCUS, Tourn. (Elder.)

1. **S. Canadensis,** L. (Common Elder.) Common. May and June. Med. Prop.: The flowers, in the form of a poultice are gently excitant and sudorific, and the berries act as an aperient.

5. VIBURNUM, L. (Arrow-wood. Laurestinus.)

1. **V. lentago,** L. (Sweet Viburnum. Sheep Berry.) April and May.
2. **V. prunifolium,** L. (Black Haw.) Rather rare. April and May.
3. **V. prunifolium** Var. **ferrugineum.** Leaves ovate to oval and rusty beneath, shining above. May.
4. **V. dentatum,** L. (Arrow-wood.) Rather common. Moist thickets. May and June.
5. **V. molle,** Michx. June.
6. **V. acerifolium,** L. (Maple-leaved A. Dockmackie.)

Order 38. RUBIACEÆ (Madder Family.)

1. GALIUM, L. (Bedstraw. Cleavers.)

1. **G. Aparine,** L. (Cleavers. Goose-grass.) Quite common. White. April.
2. **G. asprellum,** Michx. (Rough Bedstraw.) July.
3. **G. concinnum,** Torr. and Gray. May.
4. **G. trifidum,** L. (Small Bedstraw.) June.
5. **G. trifidnm** Var. **tinctorium.** May.
6. **G. trifidum.** (Var. Latifolium.) June.
7. **G. triflorum,** Michx. (Sweet-scented Bedstraw.) June.
8. **G. circæzans,** Michx. (Wild Liquorice.) May and June.
9. **G. uniflorum,** Michx. May.

2. SPERMACOCE, L. (Button Weed.)

1. **S. glabea,** Michx. May and June.

3. CEPHALANTHUS, L. (Button Bush.)

1. **C. occidentalis,** L. Rather common. June and July. Med. Prop.: Used as a tonic and laxative.

4. MITCHELLA, L. (PARTRIDGE BERRY.)

1. **M. repens.** Common. Woods, about the roots of trees. May and June.

5. HOUSTONIA, L. (HOUSTONIA.)

1. **H. purpurea,** L. Common. Moist meadows. April and May.
2. **H. cærulea,** L. (BLUETS. DWARF PINK. INNOCENCE.) Plentiful. Wet grounds. April and May.

ORDER 39. **VALERIANACEÆ.** (VALERIAN FAMILY.)

1. VALERIANA, Tourn. (VALERIAN.)

1. **V. pauciflora,** Michx. Common. Moist woods. Root leaves *heart-shaped.* May.
2. **V. sylvatica,** Richards. Damp woods. May.

2. FEDIA. (CORN SALAD. LAMB-LETTUCE.)

1. **F. olitoria,** Vahl. Abundant. Escaped from cultivatiou. Adv. from Eu. April and May.

ORDER 40. **DIPSACEÆ.** (TEASEL FAMILY.)

1. DIPSACUS, Tourn. (TEASEL.)

1. **D. sylvestris,** Mill. (WILD TEASEL.) Very common. June and July. Nat. from Eu.

ORDER 41. **COMPOSITÆ.** (COMPOSITE FAMILY.)

1. VERNONIA, Schreb. (IRON WEED.)

1. **Noveboracensis,** Wild. Very common, and a great nuisance in pastures, as it is very hard to exterminate. Summer months.

2. ELEPHANTOPUS, L. (ELEPHANT'S FOOT.)

1. **E. Carolinianus,** Wild. Common—Creek and river banks. August and September.

3. EUPATORIUM, Tourn. (THOROUGHWORT BONESET.)

1. **E. purpurium,** L. (JOE-RYE WEED. TRUMPET WEED.) Rather common. August.
2. **E. fistulosum,** Barratt. (TRUMPET WEED.) See Wood's Botany for description. August.

3. **E. perfoliatum,** L. (THOROUGHWORT BONESET.) Common; fields and woods. July and August to October.
4. **E. serotinum,** Michx. August and September.
5. **E. ageratoides,** (WHITE SNAKE-ROOT.) August and September.

4. ASTER, L. (STARWORT ASTER.)

1. **A. undulatus,** (VAR. ASPERULUS.) See Wood's Botany for description. October.
2. **A. Shortii,** Bott. September.
3. **A. cordifolius,** L. September.
4. **A. ericoides,** L. September.
5. **A. tenuifolius,** L. November.

5. ERIGERON, L. (FLEABANE.)

1. **E. Canadense,** L. (HORSE-WEED. BUTTERWEED.) Common. August and September.
2. **E. bellidifolium,** Muhl. (ROBIN'S PLANTAIN.)
3. **E. Philadelphicum,** L. (COMMON FLEABANE.) Medical Prop.: either bellidifolium or Philadelphicum, will make a pleasant diuretic.
4. **E. annum,** Pers. (DAISY FLEABANE. SWEET SCABIOUS.) This is a very troublesome weed in meadows. Very common. May to August.
5. **E. strigosum,** Muhl. (DAISY FLEABANE.) Plentiful. June to August.

6. DIPLOPAPPUS, Cass. (DOUBLE-BRISTLED ASTER.)

1. **D. umbellatus,** Torr. & Gray. August.

7. BOLTONIA, L'Her. (BOTTONIA.)

1. **R. glastifolia.** August.

8. SOLIDAGO, L. (GOLDEN-ROD.)

1. **S. petiolaris,** Ait. September and October.
2. **S. cæsia,** L. September.
3. **S. puberula,** Nutt. August and September.
4. **S. arguta,** Ait. June.
5. **S. altissima,** L. August and September.
6. **S. ulmifolia,** Muhl. August and September.
7. **S. pilosa,** Walt. September.
8. **S. nemoralis,** Ait. September.
9. **S. Canadensis,** L. August.
10. **S. gigantea,** Ait. August and September.
11. **S. lanceolata,** L. August.

9. INULA, L. (ELECAMPANE.)

1. **I. Helenium,** L. (COMMON ELECAMPANE.) June and July. Eu. Med. prop.: Tonic and gently stimulant.

10. PLUCHEA, Cass. (MARSH FLEABANE.)

1. **P. fœtida,** DC. Rather common. August.

11. POLYMNIA, L. (LEAF-CUP.)

1. **P. Uvedalia,** L. August.

12. PARTHENIUM, L. (PARTHENIUM.)

1. **P. integrifolium,** L. June.

13. AMBROSIA, Tourn. (RAGWEED.)

1. **A. artemisiæfolia,** Michx. A great nuisance in fields and gardens. August.
2. **A. trifida,** L. (GREAT RAGWEED.) Quite common. August.
3. **A. psilostachya,** DC. River banks. June.

14. XANTHIUM, Tourn. (COCKLEBUR.)

1. **X. strumarium,** L. (COMMON COCKLEBUR.) Common, roadsides and fields. August and September.
2. **X. spinosum,** L. Nat. Trop. Amer.

15. ECLIPTA, L. (ECLIPTA.)

1. **E. procumbens** or **alba,** Michx. August.

16. HELIOPSIS, Pers. (OX-EYE.)

1. **H. lævis,** Pers. July and August.
2. **H. lævis,** Var. scabra. Rather common. June to October.

17. RUDBECKIA, L. (CONE-FLOWER.)

1. **R. laciniata,** L. August and September.
2. **R. speciosa,** Wenderoth. August.
3. **R. hirta,** L. Getting quite common in our meadows. June and July.

18. HELIANTHUS, L. (SUN FLOWER.)

1. **H. annuus,** L. (COMMON SUNFLOWER.) This is sparingly escaped from cultivation.
2. **H. microcephalus,** Torr. and Gray. August

19. COREOPSIS, L. (TICKSEED.)

1. **C. tripteris,** L. (FALL COREOPSIS.) August.
2. **C. arguta,** Ph. August.

20. BIDENS, L. (BURR-MARIGOLD.)

1. **B. frondosa,** L. (COMMON BEGGAR TICKS.) August.
2. **B. connata,** Muhl. (SWAMP BEGGAR TICKS.) September.
3. **B. bipinnata,** L. (SPANISH NEEDLES.) Common. July and August.

21. DYSODIA, Cav. (FETID MARIGOLD.)

1. **D. crysanthemoides,** Lag. August.

22. HELENIUM, L. (SNEESEWEED.)

1. **H. autumnale,** L. August.
2. **H. Brachypoda.** August.

23. MARUTA, Cass. (MAY-WEED.)

1. **cotula,** DC. (COMMON MAY-WEED.) Common along roadsides. May to July.

24. ACHILLEA, L. (YARROW.)

1. **A. millefolium,** L. (COMMON YARROW MILFOIL.) Waste places. May and June. Med. prop.: A mild aromatic tonic and astringent.

25. LEUCANTHEMUM, Tourn. (OX-EYE.)

1. **L.** VULGARE, Lam. (OX-EYE OR WHITE DAISY. WHITE WEED.) June. Nat. from Eu.

26. TANACETUM, L. (TANSY.)

1. **T.** VULGARE, L. (COMMON TANSY.) Escaped to the woods, probably from cultivation. Adv. from Eu.

27. GNAPHALIUM, L. (CUDWEED.)

1. **G. uliginosum,** L. (LOW CUDWEED.) Rather common. Scales about flower, yellowish to brown. May.

28. ANTENNARIA, Gærtn. (EVERLASTING.)

1. **A. plantaginifolia,** Hook. (PLANTAIN-LEAVED EVERLASTING.) Common, edges of woods. April and May.

29. ERECHTHITES, Raf. (Fireweed.)

1. **E. hieracifolia,** Raf. (Fireweed.) August and September.

30. CACALIA, L. (Indian Plantain.)

1. **C. reniformis,** Muhl. (Great Indian Plantain.) June and July.
2. **C. artiplicifolia,** L. (Pale Indian P.) August.

31. SENECIO, L. (Groundsel.)

1. **S. aureus,** L. (Golden Ragwort. Squaw Weed.) One of the earliest flowers, and very plentiful. Color, yellow. March and April.
2. **S. aureus.** (Var. Obvatus.) April.

32. CIRSIUM, Tourn. (Common Plumed Thistle.)

1. **C. altissimum,** Scop. (Common Thistle.) Very abundant. Nat. from Eu.
2. **C. lanceolatum,** Spreng. Woods. Rather rare. August.

33. ONOPORDON, Vaill. (Cotton or Scotch Thistle.)

1. **O.** acanthium, L. Rather an attractive plant. Rare. June and July. Adv. from Eu.

34. LAPPA, Tourn. (Burdock.)

1. **L.** officinalis, Allioni. Common. Grows everywhere. A great trouble to farmers, as the burs get into the wool of their sheep. Remedy: *Dig up and burn the plant.* Summer. Nat. from Eu.

35. HIERACIUM, Tourn. (Hawkweed.)

1. **H. Canadense,** Michx. (Canada Hawkweed.) August and September.
2. **H. Gronovii,** L. (Hairy H.) August.

36. NABALUS, Cass. (Rattlesnake Root.)

1. **N. altissimus,** Hook. September.
2. **N. asper,** Torr. and Gr. August.

37. TARAXACUM, Haller. (Dandelion.)

1. **T. Dens-leonis,** Desf. (Common Dandelion.) Grows everywhere. April to the end of the flowering season. Med. Prop.: Slightly tonic, diuretic and aperient. It is somewhat used as a substitute for coffee.

38. LACTUCA, Tourn. (Lettuce.)

1. **L. Canadensis,** L. (Wild Lettuce.) Common. June.
2. **L. Canadensis,** Var. Integrifolia. Torr. and Gray. June.
3. **L. Canadensis,** Var. Sanguinea. Torr. and Gray. June.

This last species is rare.

39. MULGEDIUM, Cass. (False or Blue Lettuce.)

1. **M. leucophæum,** DC. August.

40. SONCHUS, L. (Sow-Thistle.)

1. **S.** oleraceus, L. (Common Sow Thistle.) Common in old meadows and along fences. May. Nat. from Eu.
2. **S.** asper, Vill. (Sping-Leaved S.) Rather rare. June.

Order 42. LOBELIACEÆ. (Lobelia Family.)

1. LOBELIA, L. (Lobelia.)

1. **L. cardinalis,** L. (Cardinal Flower.) Rather plentiful. Moist places, especially woods. August and September.
2. **L. syphilitica,** L. (Great Lobelia.) Wet places. Common. August and September.
3. **L. puberula,** Michx. July and August.
4. **L. leptostachys,** A. DC. Rare. June.
5. **L. inflata,** L. (Indian Doctor.) Common. July to September. Med. Prop.: Is a powerful emetic, and it also has narcotic powers. Its effect on the system is much the same as tobacco.
6. **L. spicata,** Lam. September.

Order 43. CAMPANULACEÆ. (Campanula Family.)

1. CAMPANULA, Tourn. (Bell Flower.)

1. **C. Americana,** Tourn. (Fall Bell Flower.) Plentiful. June and July.

2. SPECULARIA, Heister. (Venus Looking-Glass.)

1. **S. perfoliata,** A. DC. Rather common. Dry grounds. May.

Order 44. ERICACEÆ. (Heath Family.)

1. GAYLUSSACIA, H. B. K. (Huckleberry.)

1. **G. resinosa.** Torr. and Gray. (Black Huckleberry.) Quite plentiful in the woods. April and May.

2. MONOTROPA, L. (Indian Pipe. Pine Sap.)

1. **M. uniflora**. L. (Indian Pipe. Corpse-Plant.) Plant white throughout. Very delicate and pretty; resembles wax. Not abundant. July to September.

Order 45. **AQUIFOLIACEÆ.** (Holly Family.)

1. ILEX, L. (Ilex and Prinos, L.) (Holly.)

1. **I. mollis,** Gray. Rather rare. June.
2. **I. verticillata,** Gray. (Black Alder. Winterberry.)

Order 46. **EBENACEÆ.** (Ebony Family.)

1. DIOSPYRUS, L. (Date-Plum; Persimmon.)

1. **D. Virginiana,** L. (Common Persimmon.) Plentiful. Moist places and flat fields, and woods. April.

Order 47. **PLANTAGINACEÆ.** (Plantain Family.)

1. PLANTAGO, L. (Plantain. Rib Grass.)

1. **P. Major,** L. (Common Plantain.) Very plentiful. July. Nat. from Eu.
2. **P. lanceolata,** L. (Rib Grass. Ripple Grass. English Plantain.) Meadows. Somewhat common. August, and September.

Order 48. **PRIMULACEÆ.** (Primrose Family.)

1. DODECATHEON, L. (American Cowslip.)

1. **D. Meadia,** L. Rocky woods. Quite plentiful. April and May.

2. LYSIMACHIA, Tourn. (Goose-strife.)

1. **L. quadrifolia,** L. May and June.
2. **L. ciliata,** L. June and July.
3. **L. lanceolata,** Walt. Common. Wet meadows. June.
4. **L. lanceolata,** Var. Hybrida.
5. **L. longifolia,** Pursh. July.

3. ANAGALLIS, Tourn. (Pimpernel.)

1. **A. arvensis,** L. (Common Pimpernel.) Rare. August.

4. CENTUNCULUS, L. (Chaffweed.)

1. **C. minimus,** L. Common. May.

5. SAMOLUS, L. (Water Pimpernel. Brookweed.)

1. **S. Valerandi,** L. Rather common. Wet places. May to July.

Order 49. **BIGNONIACEÆ.** (Bignonia Family.)

1. TECOMA, Juss. (Trumpet Flower.)

1. **F. radicans,** Juss. (Trempet Creeper.)

Order 50. **OROBANCHACEÆ.** (Broom Rape Family.)

1. EPIPHEGUS. Nutt. (Beech Drops.) (Cancer-root.)

1. **E. Virginiana,** Bart. Very common in the woods. September and October.

2. CONOPHOLIS, Wallroth. (Squaw-root.)

1. **C. Americana,** Wallroth. Rather plentiful in the woods. Looks very much like a cone. It is a parasite. April and May.

3. APHYLLON, Mitchell. (Naked Brown-rape.)

1. **A. uniflorum.** (One-flowered Cancer-root.) Is reported as being found in the woods. It is rare.

Order 51. **SCROPHULARIACEÆ.** (Figwort Family.)

1. VEBRASCUM, L. (Mullein.)

1. **V. thapsus,** L. (Common Mullein.) Very plentiful and quite troublesome. June and July.
2. **V. blattaria,** L. (Moth M.) Not scarce. June.

2. LINARIA, Tourn. (Toad Flax.)

1. **L. vulgaris,** Mill. (Toad Flax. Butter and Eggs Ramsted.) Common. May to July and September. Med. Prop.: Diuretic and cathartic.

3. SCROPHULARIA, Tourn. (Figwort.)

1. **S. nodosa,** L. July and August.

4. COLLINSIA, Nutt. (Collinsia.)

1. **C. verna,** Nutt. Damp woods and thickets. Plentiful. April and May.

5. CHELONE, Tourn. (Turtle-head. Snake-Head.)

1. **C. glabra,** L. Rare. September and October.

6. PENTSTEMON, Mitchell. (Beard-tongue. Pentslemon.)

1. **P. pubescens,** Solander. Common. Rocky bluffs. May to July.
2. **P. digitalis,** Nutt. The presence of this species is somewhat doubtful. June.

7. MIMULUS, L. (Monkey-flower.)

1. **M. ringens,** L. Common. Wet places. June and July.
2. **M. alatus,** Ait. July.

8. CONOBEA, Aublet.

1. **C. multifida,** Benth. August.

9. GRATIOLA, L. (Hedge Hyssop.)

1. **G. virginiana,** L. Leaves toothed toward apex and entire at base. Tube of flower striped with purple lines. May.
2. **G. sphærocarpa,** Ell. Found growing in water. May.
3. **G. viscosa,** Schweinitz. Rather plentiful. All the specimens we have found have the peduncle a little longer than the leaves.

10. ILYSANTHES, Raf.

1. **I. gratioloides,** Benth. (False Pimpernel.) July to September. Wet places.

11. VERONICA, L. (Speedwell.)

1. **V. virginica,** L. (Culver's Root. Culver's Physic.) Rather rare. August. Med. Prop.: Emetic and cathartic.
2. **V. Americana,** Schweinitz. (American Brooklime.) August.
3. **V. officinalis,** L. (Common Speedwell.) Grassy woods and meadows. Common. May.
4. **V. serpyllifolia,** L. (Thyme-leaved Speedwell.) April and May.
5. **V. peregrina,** L. (Neckweed. Purslane Speedwell.) Common. April and May.
6. **V.** arvensis, L. (Corn Speedwell.) Common. April and May. Nat. from Eu.

12. SEYMERIA, Pursh. (Seymeria.)

1. **S. macrophylla,** Nutt. (Mullein. Foxglove.) August.

13. GERARDIA, L. (Gerardia.)

1. **G. auriculata,** Michx. August.
2. **G. flava,** L. (Downy False Foxglove.) August.

14. PEDICULARIS, Tourn. (Lousewort.)

1. **P. Canadensis,** L. (Common Lousewort.) Somewhat rare. April and May.

Order 52. ACANTHACEÆ. (Acanthus Family.)

1. DIANTHERA, Gronov. (Water Willow.)

1. **D. Americana,** L. River bank. June.

2. RUELLIA, L.

1. **R. ciliosa,** Pursh. June.
2. **R. strepens,** L. May.

Order 53. VERBENACEÆ. (Vervain Family.)

1. VERBENA, L. (Vervain.)

1. **V. hastata,** L. (Blue Varvain.) Common. June and July.
2. **V. urticifolia,** L. (Nettled-leaved or White V.) Common in waste places and roadsides. June to August. Med. Prop.: Antidote in poisoning with Phus. Foxicodendron.
3. **V. stricta,** L. (Hoary V.) July.
4. **V. bracteosa,** Michx. Quite common, waste places generally June to September.

2. PHRYMA, L. (Lopseed.)

1. **P. Leptostachya,** L. Somewhat common—woods. June to August.

Order 54. LABIATÆ. (Mint Family.)

1. TEUCRIUM, L. (Germander.)

1. **T. Canadense,** L. (American Germander.) June.

2. HYPTIS, L.

1. **H. Radiata,** Willd. July.

3. ISANTHUS, Mnx. (False Pennyroyal.)

1. **I. cæruleus,** Michx. Dry woods, and plentiful. August to October.

4. MENTHA, L. (Mint.)

1. **M.** viridis, L. (Spearmint.) Common. Wet places. Leaves sessile. July to September. Adv. from Eu.
2. **M.** pipirita, L. (Peppermint.) Wet places. Common. Leaves petiolate. July to September. Adv. from Eu.
3. **M.** sativa, L. (Whorled Mint.) August. Adv. from Eu.
4. **M.** arvensis, L. (Corn Mint.) Aug. Adv. from Eu.

5. LYCOPUS, L. (Water Horehound.)

1. **L. Virginicus,** L. (Bugle-weed.) August.
2. **L. Europæus,** L. August.
3. **L. Europæus,** Var. integrifolius. August.
4. **L. Europæus,** Var. sinuatus. August.

6. PYCNANTHEMUM, Michx. (Mountain Mint. Basil.)

1. **P. lanceolatum,** Pursh. Rare. Flower aggregated into a head, resembling the *Compositæ*. June to July.

7. CALAMINTHA, Mœnch. (Caliminth.)

1. **C. glabella,** Var. Nuttallii. Gray. August and September.
2. **C. Clinopodium,** Benth. (Basil.) August.

8. MELISSA, L. (Balm.)

1. **M. officinalis,** L. (Common Balm.) Rare. June and July.

9. HEDEOMA, Pers. (Mock Penneroyal.)

1. **H. Pulegioides,** Pers. (American Penneroyal.)

10. COLLINSONIA, L. (Horse Mint.)

1. **C. Canadensis,** L. (Rich Weed. Stone Root.) August to September.

11. SALVIA, L. (Sage.)

1. **S. lyrata,** L. (Lyre-leaved Sage.) Not plentiful. May.

12. MONARDA, L. (Horse Mint.)

1. **M. fistulosa,** L. (Wild Bergamot.) Quite common. Rocky woods. May and June.

2. **M. Bradburiana,** Beck. Calix, hairy within and without Bracts, ciliate, and strongly cuspidate. Upper lip of corolla, densely bearded; also, the outer surface of corolla. The lateral lobes of the lower lip of the corolla, each marked with a *dark purple* stop at the juncture with the middle lobe, and also, lighter spots in other places.

Remark.—This might probably be called, a variety of *Bradburiana*. Rare. June.

13. BLEPHILIA, Raf. (Blephilia.)

1. **B. hirsuta,** Benth. See both Wood and Gray, for description of this species. The only flowers of the specimen, we have found, were pure white, with the exception of a few purple spots. Rare. June.

14. LOPHANTHUS, Benth. (Giant Hysop.)

1. **L. nepetoides,** Benth. August.
2. **L. scrophulariæfolius,** Benth. August.

15. NEPETA, L. (Cat-mint.)

1. **N.** cataria, L. (Catnip.) Common. Dry grounds. June and July. Med. prop.: Tonic and stimulant.
2. **N.** glechoma, Benth. (Ground Ivy. Gill.) Abundant. Woods and lately cleared fields. Spreads rapidly. Med. prop.: Gently stimulant and tonic; not much used. March to May. Eu.

16. SYNANDRA, Nutt. (Synandra.)

1. **S. grandiflora,** Nutt. Stamens beset with red hairs, and corolla streaked with pinkish lines. Very pretty. May.

17. PHYSOSTEGIA, Benth. (False Dragon Head.)

1. **P. Virginiana,** Benth. August.

18. BRUNELLA, Tourn. (Self-heal.)

1. **B. vulgaris,** L. (Common Self-heal, or Heal-all. Blue Curls.)

19. SCUTELLARIA, L. (Scull-cap.)

1. **S. versicolor.** Nutt. Rare. June.
2. **S. nervosa,** Pursh. Scarce. May and Jnne.
3. **S. lateriflora** L. (Mad-dog S.) July and August.

20. MARRUBIUM, L. (Horehound.)

1. **M.** vulgare, L. (Common Horehound.) Common. Dry hillsides. Nat. from Eu. May and June.

21. GALEOPSIS, L. (Hemp Nettle.)

1. **G.** Tetrahit, L. (Common Hemp Nettle.) June. Nat. from Eu.

22. LEONURUS, L. (Motherwort.)

1. **L.** cardiaca. Commencing to escape to woods, streets, and roadsides. Nat. from Eu. June.

23. STACHYS, L. (Hedge Nettle.)

1. **S. palustris,** Var. Aspera. June.
3. **S. palustris,** Var. Cordota. Plentiful. June.

24. LAMIUM, L. (Dead Nettle.)

1. **L.** amplexicaule, L. Common in fields near a river. March to June. Nat. from Eu.

Order 55. BORRAGINACEÆ. (Borage Family.)

1. LYCOPSIS, L. (Bugloss.)

1. **L.** arvensis, L. (Small Bugloss.) August. Eu.

2. SYMPHYTUM, Tourn. (Comfrey.)

1. **S.** officinale, L. (Common Comfrey.) Plentiful. Dry woods. April and May. Adv. from Europe.

3. LITHOSPERMUM, Tourn. (Groomwell. Puccoon.)

1. **L. latifolium,** Michx. May.

4. MERTENSIA, Roth. (Smooth Lungwort.)

1. **M. Virginica,** DC. (Virginian Cowslip, or Lungwort.) Woods. On hillsides facing the south. Flowers, various shades of color, from pink to blue. March.

5. MYOSOTIS, L. (Scorpion-grass. Forget-me-not.)

1. **M. palustris,** Withering. (True Forget-me-not.) August.
2. **M. verna,** Nutt. Rare. May.

6. CYNOGLOSSUM, Tourn. (Hound's Tongue.)

1. **C.** officinale, L. (Common Hound's Tongue.) Common on poor and rocky soils. April.
2. **C. Virginicum,** L. (Wild Comfrey.) Doubtful.)
3. **C. Morrisoni,** DC. (Beggar Lice.) Abundant. Woods. June to August.

Order 56. HYDROPHYLLACEÆ. (Waterleaf Family.)

1. HYDROPHYLLUM, L. (Waterleaf.)

1. **H. macrophyllum,** Nutt. Plentiful. Woods. April to June.
2. **H. Canadense,** L. Rather rare. Moist woods. June.
3. **H. appendiculatum,** Michx. Not plentiful. April.

2. PHACELIA. Juss.

1. **P. bipinnatifida,** Michx. Abundant. Moist hillsides April.

Order 57. POLEMONIACEÆ. (Polemonium Family.)

1. POLEMONIUM, Tourn. (Greek Valerian.)

1. **P. reptans,** L. Varies much in color, even on the same plant. Blue and white prevail. March to May.

2. PHLOX, L. (Phloy.)

1. **P. paniculata,** L. June.
2. **P. paniculata,** Var. Acuminata. Rich woods. June.
3. **P. maculata,** L. (Wild Sweet William.) June.
4. **P. glaberrima,** L. Common. Flat woods and meadows. June to July.
5. **P. pilosa,** L. June.
6. **P. procumbens,** Lehm. June and July.
7. **P. divaricata,** L. River hills. Petals vary from deeply lobed to simply toothed. March and April.
8. **P. divaricata,** Var. Laphamii. April and May.

Order 58. CONVOLVULACÆE. (Convolvulus Family.)

1. IPOMOEA, L. (Morning Glory.)

1. **I.** purpurea, Lam. (Common Morning Glory.) Found somewhat escaped, but more frequently cultivated. Adv. from trop. Amer. June.
2. **I. Nil,** Roth. (Smaller M.) Fields, especially along the river. Very common. August.
3. **I. lacunosa,** L. August.
4. **I. lacunosa.** Var. Alpha. We have a plant or vine growing spontaneously in our gardens, that is probably a variety of lacunosa. This we call Alpha. August.

5. **I. pandurata,** Meyer. (WILD POTATO-VINE. MAN OF THE EARTH.) Rather common. Woods and river banks. June and July.

2. CALYSTEGIA, R. Br. (BRACTED BINDWEED.)

1. **C. sepium,** R. Br. (HEDGE BINDWEED.)

3. CUSCUTA, Tourn. (DODDER.)

1. **C. Gronovii,** Wild. August.
2. **C, compacta,** Juss. August and September.
3. **C. glomerata,** Choisq. August.

ORDER 59. **SOLANACEÆ.** (NIGHTSHADE FAMILY.)

1. SOLANUM, Tourn. (NIGHTSHADE.)

1. **S.** DULCAMARA, L. (BITTERSWEET.) Rare. May and June. Med. Prop.: Possesses feeble narcotic properties, with the power of increasing the secretions. Nat. from Eu.
2. **S.** NIGRUM, L. (COMMON NIGHTSHADE.) Common. Fields an copses. Said to be poisonous. June to November. Nat. from Eu.
3. **S. Carolinense,** L. (HORSE-NETTLE.) Common. Fields. May to July.

2. PHYSALIS, L. (GROUND CHERRY.)

1. **P. pubescens,** L. Not common. June.
2. **P. Philadelphica,** Lam. June.
3. **P. viscosa,** L. Summer months.
4. **P. Pennsylvanica,** L. June.

3. LYCIUM. Duval. (MATRIMONY VINE.)

1. **L.** VULGARE, Duval. Just commencing to escape from cultivation. May. Adv. from Eu.

4. DATURA, L. (JAMESTOWN WEED. THORN APPLE.)

1. **D.** STRAMONIUM, L. (JIMSON WEED OR THORN APPLE.) Plentiful. June to October. Adv. from Asia.
2. **D.** TATULA, L. (PURPLE T.) June to August. Adv. from trop. Amer. Med. Prop.: STRAMONIUM and TATULA are powerful narcotics, and in large doses a violent poison. In the hands of a skillful physician, these herbs may be used beneficially in many diseases.

ORDER 60. **GENTIANACEÆ.** (GENTIAN FAMILY.)

1. SABBATIA, Adans. (AMERICAN CENTAURY.)

1. **S. angularis,** Pursh. August.

2. GENTIANA, L. (GENTIAN.)

1. **G. Andrewsii,** Griseb. (CLOSED GENTIAN.) Plentiful. Wet, flat ground. September and October. Used in making bitters.

3. OBOLARIA, L. (OBOLARIA.)

1. **O. Virginica,** L. Rare. Only one specimen has been found, and in this the petals seemed to be convolute in their arrangement. April 17th.

ORDER 61. **APOCYNACEÆ.** (DOGBANE FAMILY.)

1. APOCYNUM, Tourn. (DOGBANE. INDIAN HEMP.)

1. **A. androsæmifolium,** L. (SPREADING DOGBANE.) June. Rather scarce. Med. Prop.: Root acts as an emetic.
2. **A. cannabinum,** L. (INDIAN HEMP.) Plentiful. River bank and fields. June to September.

ORDER 62. **ASCLEPIADACEÆ.** (MILKWEED FAMILY.)

1. ASCLEPIAS, L. (MILKWEED. SILKWEED.)

1. **A. Cornuti,** Decaisne. (COMMON MILKWEED OR SILKWEED.) Common. Grows everywhere. June and July.
2. **A. phytolaccoides,** Pursh. (POKE MILKWEED.) June.
3. **A. purpurascens,** L. (PURPLE M.) Rare. June.
4. **A. quadrifolia,** Jacq. (FOUR-LEAVED M.) Plentiful. April and May.
5. **A. incarnata,** L. (SWAMP MILKWEED.) August.
6. **A. incarnata.** Var. pulchra. August.
7. **A. perennis,** Walt.
8. **A. variegata.** Var. nivea. June.

2. ENSLENIA, Nutt. (ENSLENIA.)

1. **E. albida,** Nutt. Rather rare. August.

ORDER 63. **OLEACEÆ.** (OLIVE FAMILY.)

1. FRAXINUS, Tourn. (ASH.)

1. **F. Americana,** L. (WHITE ASH.) Not plentiful. Flowers purple, and each subtended by a bract. The young branches much angled. March.
2. **F. quadrangulata,** Michx. (BLUE ASH.) March.

ORDER 64. **ARISTOLOCHIACEÆ.** (BIRTHWORT FAMILY.)

1. ASARUM, Tourn. (WILD GINGER.)

1. **A. Canadense,** L. Root has somewhat the taste of ginger, and quite aromatic. March to May.

ORDER 65. **PHYTOLACCACEÆ.** (POKEWOOD FAMILY.)

1. PHYTOLACCA, Tourn. (POKEWOOD.)

1. **P. decandra,** L. (COMMON POKE OR SCOKE. GARGET. PIGEON-BERRY.) Common. June.

ORDER 66. **CHENOPODACEÆ.** (GOOSEFOOT FAMILY.)

1. CHENOPODIUM, L. (GOOSEFOOT. PIGWEED.)

1. **C.** ALBUM, L. (LAMB'S QUARTERS. PIGWEED.) Common; gardens. Nat. from Eu.
2. **C. ambrosioides,** L. (MEXICAN TEA.) August. Nat. from trop. Amer.

2. CYCLOLOMA, Moquin. (WINGED PIGWEED)

1. **C. platyphyllum,** Moquin. August.

ORDER 67. **AMARANTACEÆ.** (AMARANTH FAMILY.)

1. AMARANTHUS, Tourn. (AMARANTH.)

1. **A.** SPINOSUS, L. (THORNY AMARANTH) Livid purple, stem and mucronate leaves. August. Nat. from trop. Amer.
2. **A.** LIVIDUS, L. August.

2. MONTELIA, Moquin. (WATER HEMP.)

1. **M. tamariscina.** August.

3. IRESINE, P. Browne. (IRESINE.)

1. **I. celosioides,** L. August.

ORDER 68. **POLYGONACEÆ.** (BUCKWHEAT FAMILY.)

1. POLYGONUM. (KNOTWEED.)

1. **P. Careyi,** Olney. August.
2. **P. Pennsylvanicum,** L. August.
3. **P. incarnatum,** Ell. May. Glands raised on hairs.
4. **P.** PERSICARIA, L. (LADY'S THUMB.) June. Nat. from Eu.
5. **P. Hydropiper,** L. (COMMON SMART WEED, or WATER-PEPPER.
6. **P. acre,** H. B. K. (WATER SMART-WEED.) June and July.
7. **P. Hydropiperoides,** Michx. (MILD WATER-PEPPER.)
8. **P. Hydropiperoides,** Var. Setaceæ. (WOOD.) Leaves and stem above more or less hispid. Wet. June.

9. **P. amphibium** L. (WATER PERSICARIA.) July.
10. **P. Virginianum,** L. Scarce. August.
11. **P. aviculare,** L. (KNOT-GRASS. GOOSE-GRASS. DOOR-WEED) Common around houses. June to August.
12. **P. aviculare,** Var. Erectum. June and August.
13. **P. ramosissimum,** Michx. May.
14. **P. sagittatum,** L. (HALBERD-LEAVED. TEAR THUMB, or SCRATCH-WEED.) Angust.
15. **P.** CONVOLVULUS, L. (BLACK BINDWEED.) June and August. Eu.
16. **P. dumetorum,** L. (CLIMBING FALSE BUCKWHEAT.) May and June.

2. FAGOPYRUM, Tourn. (BUCKWHEAT.)

1. **F.** ESCULENTUM, Mœnch. (BUCKWHEAT.) Remaining in cultivated fields. August. Adv. from Eu.

3. RUMEX, L. (DOCK-SORREL.)

1. **R. orbiculatus,** G. (GREAT WATER DOCK.) Plentiful. May and Juue
2. **R. altissimus,** Wood. (PEACH-LEAVED D.) August.
3. **R.** OBTUSIFOLIUS, L. (BITTER DOCK.) Nat. from Eu. August.
4. **R. Acetosella,** L. (FIELD, or SHEEP SORREL.) Waste places and meadows. May and June.

ORDER 69. **LAURACEÆ,** Nees. (LAUREL FAMILY.)

1. SASSAFRAS, Nees. (SASSAFRAS.)

1. **S. officinale,** Nees. Plentiful. April and May.

2. LINDERA, Nees. (WILD ALLSPICE. FEVER-BUSH.)

1. **L. Benzoin,** Meisner. (SPICE-BUSH. BENJAMIN BUSH.) Plentiful on river bluffs. Found growing in patches. Flowers fragant, and appear before the leaves. Wood has a spicy taste.

ORDER 70. **LORANTHACEÆ.** (MISTLETOE FAMILY.)

1. PHORADENDRON, Nutt. (FALSE MISTLETOE.)

1. **P. flavescens,** Nutt. (AMERICAN MISTLETOE.) Found as a parasite on Elm, (ULMUS AMERICANA,) Walnut, common Locust. January, February, and March. Med. Prop.: This plant is little used in medicine. Several deaths are recorded from eating the berries.

ORDER 71. **SAURURACEÆ.** (LIZARD'S-TAIL FAMILY.)

1. SAURURUS.

1. **S. cernuus,** L. (LIZARD-TAIL.) July and August.

ORDER 72. **EUPHORBIACEÆ.** (SPURGE FAMILY.)

1. EUPHORBIA, L. (SPURGE.

1. **E. maculata,** L. Common. August to November.
2. **E. humistrata,** Englem. August.
3. **E. hypericifolia,** L. Common. Gardens and fields. Summer and autumn.
4. **E. marginata,** Pursh. Common. The juice is very acrid and pungent, and if taken in large doses, may produce death. August to October.
5. **corollata,** L. Rare. August.

2. RICINUS. (CASTOR OIL PLANT.)

1. **R.** COMMUNIS, L. Commencing to escape into roads and streets. Adv. from E. India.

ORDER 73. **URTICACEÆ.** (NETTLE FAMILY.)

1. ULMUS, L. (ELM.)

1. **U. fulva,** Michx. (SLIPPERY OR RED ELM.) Plentiful. Flowers pinkish and somewhat fragrant. Thirty to fifty feet high. March. The use of the bark is familiar to every one.
2. **U. Americana,** L. (AMERICAN OR WHITE ELM.) A common tree in the woods. Bloom precedes the leaves, and lasts but a few days. A few very odd specimens are to be seen in this county. Their peculiarity consists in a monstrous enlargement of the limbs and branches at various distances from each other. March.

2. MACLURA, N. (OSAGE ORANGE.)

1. **M. aurantiaca.** There seem to be a few spontaneous specimens of this shrub. May.

3. CELTIS, Tourn. (NETTLE-TREE. HACKBERRY.)

1. **C. occidentalis,** L. (SUGAR-BERRY. HACKBERRY.) Plentiful. Bloom greenish. March.
2. **C. Mississippiensis,** Bosc. Very rare. We have seen but one specimen. April.

4. MORUS, Tourn. (MULBERRY.)

1. **M. rubra,** L. (RED MULBERRY.) A common tree in the woods. April and May.
2. **M.** ALBA. (WHITE MULBERRY.) Found growing in the fields. Rather scarce. Adv. from Eu.

5. URTICACEÆ, Tourn. (NETTLE.)

1. **U. gracilis,** Ait. June.

6. LAPORTEA, Gaudichaud. (WOOD NETTLE.)

1. **L. Canadensis,** Gaudichaud. Plentiful. July to September.

7. CANNABIS, Tourn. (HEMP.)

1. **C.** SATIVA, L. (HEMP.) July and August. Adv. from Eu.

ORDER 74. **PLATANACEÆ.** (PLANE-TREE FAMILY.)

1. PLATANUS, L. (PLANE-TREE. BUTTONWOOD.)

1. **P. occidentalis,** L. (AMERICAN PLANE OR SYCAMORE.) Common. April.

ORDER 75. **JUGLANDACEÆ.** (WALNUT FAMILY.)

1. JUGLANS, L. (WALNUT.)

1. **J. cinerea,** L. (BUTTERNUT.) April. Med. Prop.: Butternut is a mild cathartic, resembling rhubarb in its action.
2. **J. nigra,** L. (BLACK WALNUT.) Plentiful; forms our most valuable timber. April and May.

2. CARYA, Nutt. (HICKORY.)

1. **C. oliveæformis,** Nutt. (PECAN-NUT.) There are but two specimens of this tree found in this county; of these one was planted, and the other is probably native. May.
2. **C. alba.** (SHELL-BARK OR SHAG-BARK HICKORY.) Common. April.
3. **C. micro-carpa,** Nutt. (SMALL-FRUITED HICKORY.) Rare. May.
4. **C. sulcata,** Nutt. (WESTERN SHELL-BARK HICKORY.) April.
5. **C. tomentosa,** Nutt. (MOCKER-NUT. WHITE-HEART HICKORY.)
6. **C. porcina,** Nutt. (PIG-NUT OR BROOM H.) April.

ORDER 76. **CUPULIFERÆ.** (OAK FAMILY.)

1. QUERCUS, L. (OAK.)

1. **Q. alba,** L. (WHITE OAK.) April. Med. Prop.: Astringent and tonic.
2. **Q. bicolor,** Willd. (SWAMP WHITE OAK.) Common. Moist woods. April.
3. **Q. prinus.** Var. acuminata. Michx. (YELLOW CHESTNUT OAK.) Scarce.
4. **Q. coccinea,** Wang. (SCARLET OAK.) April.
5. **Q. rubra,** L. (RED OAK.) Common. April.

2. CASTANEA, Tourn. (CHESTNUT.)

1. **C. vesca.** Var. Americana, L. (CHESTNUT.) Not plentiful. June.

3. FAGUS, Tourn. (BEECH.)

1. **F. ferruginea,** Ait. (AMERICAN BEECH.) Forms a large proportion of our forests. March.

4. CORYLUS, Tourn. (HAZEL-NUT. FILBERT.)

1. **C. Americana,** Walt. (WILD HAZEL-NUT.) Common. Flat woods. March.

5. OSTRYA, Micheli. (HOP-HORNBEAM. IRON WOOD.)

1. **O. Virginica,** Willd. (AMERICAN HOP-HORNBEAM. LEVER WOOD.) Wood very hard. Bark shaggy. March.

6. CARPINUS, L. (HORNBEAM. IRON WOOD.)

1. **C. Americana,** Michx. (BLUE, or WATER BEECH.) Bark smooth. Found mostly, near running water. March.

ORDER 77. **SALICACEÆ.** (WILLOW FAMILY.)

1. SALIX, Tourn. (WILLOW OSIER.)

1. **S. humilis,** Marshall. (PRAIRIE WILLOW.) April.
2. **S. discolor,** Muhl. (GLAUCUS W.) March.
3. **S.** VIMINALIS, L. (BASKET OSIER.) April. Adv. from Eu.
4. **S. nigra,** Marsh. (BLACK W.) Common. April.
5. **S.** ALBA, L. (WHITE W.) March. Adv. from Eu.
6. **S.** ALBA, Var. CAERULEA. April. River banks. Adv. from Eu.
7. **S. longifolia,** Muhl. (LONG-LEAVED W.) June.

2. POPULUS, Tourn. (POPLAR ASPEN.)

1. **P. monilifera,** Ait. (COTTON-WOOD. NECKLACE POPLAR.)

River banks. Also, probably found along creeks. Height, 75 to 100 feet; diameter, 1 to 3 feet.

ORDER 78. **ARACEÆ.** (ARUM FAMILY.)

1. ARISÆMA, Martius. (INDIAN TURNIP.)

1. **A. triphyllum,** Torr. INDIAN TURNIP. DRAGON. ARUM.) Common. Some specimens attain a height of three feet. April and May.

2. ACORUS, L. (SWEET-FLAG. CALAMUS.)

1. **A. Calamus,** L. Rare.

ORDER 79. **TYPHACEÆ.** (CAT-TAIL FAMILY.)

1. TYPHA, Tourn. (CAT-TAIL FLAG.)

1. **T. latifolia,** L. (COMMON CAT-TAIL, or REED MACE.) June and July.

ORDER 80. **ALISMACEÆ.** (WATER PLANTAIN FAMILY.)

1. ALISMA, L. (WATER PLANTAIN.)

1. **A. plantago,** Var. Americanum. Plentiful. August.

2. SAGITTARIA, L. (ARROW HEAD.)

1. **S. variabilis,** Engelm. Scarce. August.

ORDER 81. **ORCHIDACEÆ,** L. (ORCHIS FAMILY.)

1. ORCHIS, L. (ORCHIS.

1. **O. spectabilis,** L. (SHOWY ORCHIS.) Rare. Slightly fragrant. April and May.

2. CORALLORHIZA, Haller. (CORAL-ROOT.)

1. **C. odontorhiza,** Nutt. Rare. April.

3. APLECTRUM, Nutt. (PUTTY-ROOT. ADAM AND EVE.)

1. **A. hyemale,** Nutt. Rare. May.

ORDER 82. **AMARYLLIDACEÆ.** (AMARYLLIS FAMILY.)

1. HYPOXYS, L. (STAR-GRASS.)

1. **H. erecta,** L. Rare. May.

ORDER 38. **IRIDACEÆ.** (IRIS FAMILY.)

1. SISYRINCHIUM, L. (BLUE-EYED GRASS.)

1. **S. Bermudiana,** L. June.
2. **S. Bermudiana,** Var. Anceps. Plentiful. May.

ORDER 84. **DIOSCOREACEÆ.** (YAM FAMILY.)

1. DIOSCOREA, Plumier. (YAM.)

1. **D. villosa,** L. (WILD YAM-ROOT.) Leaves, some opposite, 4's, 's, or 6's. Abundant. May and June.

ORDER 85. **SMILACEÆ.** (SMILAX FAMILY.)

1. SMILAX, Tourn. (GREENBRIER. CATBRIER.)

1. **S. rotundifolia,** L. (COMMON GREENBRIER.) Common. April and May.
2. **S. glauca,** Walt. June.
3. **S. hispida,** Muhl. Damp woods. May.
4. **S. herbaceæ,** L. (CARRION FLOWER.) A scarce vine in the woods. June.
5. **S. herbaceæ.** Var. pulverulenta. May.

ORDER 86. **LILIACEÆ.** (LILY FAMILY.)

1. TRILLIUM, L. (THREE-LEAVED NIGHTSHADE.)

1. **T. sessile,** L. Common. There is a plant resembling this in color that has the leaves in 5's, sopals 4, petals 4, stamens 8, and pistils 4. Whether this variation is constant or not, we have not been able to observe. March and April.
2. **T. recurvatum,** Beck. Plentiful. April and May.
3. **T. erectum,** L. (PURPLE T. OR BIRTHWORT.) Scarce. April.
4. **T. erectum.** Var. album, Pursh. Common. March and April.
5. **T. erectum.** Var. declinatum. Rare. May.
6. **T. cernuum.** Var. atrorubens. This is a new species or rather variety; and having corresponded with Prof. Wood in regard to it, I take the liberty to report his letter:

WEST FARMS, N. Y., Sept. 25th, 1871.

MR. YOUNG—*Dear Sir:* Your plant is a new variety of T. cernuum, Linn. I would by no means call it a new species, for it forms a strong connecting link between two other species, (viz.: T. erectum and T. cernuum,) and makes it highly probable that the two should be united into one, and this with them. We describe it as follows:

T. cernuum, L. B. atrorubens. Leaves orbicular-rhombic, sessile, with a small abrupt point; peduncle declinate half the length of the leaves

petals ovate, lanceolate, acuminate, twice broader than the sepals, brownish purple. Plant large, leaves 5 to 6′ diam. Flowers 3′ broad.

Differs from T. erectum in its cernuus peduncle, acuminate petals. Otherwise very similar to that species.

Respectfully yours, A. WOOD.

7. **T.** REMARK—We also found another Trillium, the identity of which we have not been able to make out.

DESCRIPTION.—Leaves sessile, rhombic ovate, abruptly acuminate, and tapering at base. Peduncle thick, nearly as long as the flower and deflexed beneath the leaves. Petals ovate, lanceolate, longer than sepals, and more than twice as broad, *dark purple.* Sepals lanceolate, bordered slightly with purple. Styles separate, stigmas strongly reflexed and as long as stamens. Plant, one to two feet.

2. UVULARIA, L. (BELLWORT.)

1. **U. grandiflora,** Smith. Rather scarce. April.
2. **U. perfoliata,** L. Not rare. April.
3. **U. sessilifolia,** L. Rare. April and May.

3. SMILACINA, Desf. (FALSE SOLOMON'S SEAL.)

1. **S. racemosa,** Desf. (FALSE SPIKENARD.) Common. Rocky woods. April.
2. **S. stellata,** Desf. Rare. April.

4. POLYGONATUM, Tourn. (SOLOMON'S SEAL.)

1. **P. biflorum,** Ell. (SMALLER SOLOMON'S SEAL.) April.
2. **P. giganteum,** Dietrich. (GREAT S.) Common. April.

5. ASPARAGUS, L. (ASPARAGUS.)

1. **A.** OFFICINALLIS. (GARDEN ASPARAGUS.) Escaped from cultivation. Adv. from Eu.

6. LILIUM, L. (LILY.)

1. **L. superbum,** L. (TURK'S-CAP LILY.) Not plentiful. July.

7. ERYTHRONIUM, L. (DOG'S-TOOTH VIOLET.)

1. **E. Americanum,** Smith. (YELLOW ADDER'S TONGUE.) March. Common in the woods.
2. **E. albidum,** Nutt. (WHITE DOG'S-TOOTH VIOLET.) Rare. Woods. March.

8. ORNITHOGALUM Tourn. (STAR OF BETHLEHEM.)

1. **O. umbellatum,** L. This plant is commencing to escape, and grow spontaneously in the streets, and we think that in a few years, it will be growing abundantly in the fields. April.

9. SCILLA, L. (SQUILL.)

1. **S. Fraseri.** (EASTERN QUAMISH. WILD HYACINTH.) Abundant. April and May.

10. ALLIUM, L. (ONION GARLIC.)

1. **A. cernuum,** Roth. (WILD ONION.) Rare. July.

ORDER 87. **COMMELYNACEÆ.** (SPIDERWORT FAMILY.)

1. COMMELYNA, Dill. (DAY-FLOWER.)

1. **C. communis,** L. See Wood's Botany. August.
2. **C. erecta,** L. August.

2. TRADESCANTIA, L. (SPIDERWORT.)

1. **T. Virginica,** L. (COMMON SPIDERWORT.) Not plentiful. May.
2. **T. pilosa,** Lehm. May and June.

TOTAL.

Number of Families	87
Number of Genera	315
Number of Indigenous Species	537
Number of Adventive, or Introduced Species	72
Total Number of Species	609

INDEX TO LIST OF PLANTS.

INDEX.

ERRATA.

Page 6, 12th line, for "coal measure" read "coal measures."
Page 79, 26th line, for "Juglans" read "Carya."
Page 79, 27th line, for "Juglans" read "Carya."
Page 79, 28th line, for "Juglans" read "Carya."
Page 109, 3d line, for "Lemar" read "Leonard."
Page 148, 6th line, for "Crosby" read "Crosley."
Page 148, 17th line, for "Crosby" read "Crosley."
Page 148, 20th line, for "Crosby" read "Crosley."
Page 161, 2d line, for "Coal L" read "Coal."
Page 184, 4th line, for "Burk's" read "Burke's."
Page 192, 18th line, after "to be" insert "nearly."
Page 195, 16th line, after "Cylindrica" insert a comma.
Page 196, 19th line, for "Anvil Rock" read "Merom Rock."
Page 196, 27th line, for "Anvil Rock" read "Merom Rock."
Page 197, 1st line, after "lineatus" insert a comma.
Page 197, 13th line, after "Pinna" insert a comma.
Page 201, 7th line, before "Athyris" insert "and."
Page 201, 28th line, for "Anvil Rock" read "Merom Rock."
Page 204, 20th line, for "mesaloba" read "mesoloba."
Page 214, 24th line, for "1" read "2 Sp."
Page 217, 9th line, for "augustifolia" read "angustifolia."
Page 221, 3d line, omit the comma after "Productus."
Page 226, 4th line, before "Azoic" insert "and."
Page 257, 14th line, for "Sheruman" read "Sherman."