

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, LBS. IN 100,000 GALLONS.	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, - - -	<u>380.00</u>	<u>26.600</u>

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	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, - - -	<u>380.0</u>	<u>26.600</u>

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,	-	-	-	<u>375.00</u>	<u>26.250</u>

The above constituents are probably combined as follows :

	PARTS IN 1,000,000			GRAINS IN ONE	
	PARTS, OR, LBS. IN			GALLON.	
	100,000 GALLONS.				
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,	-	-	-	<u>375.00</u>	<u>26.250</u>

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.

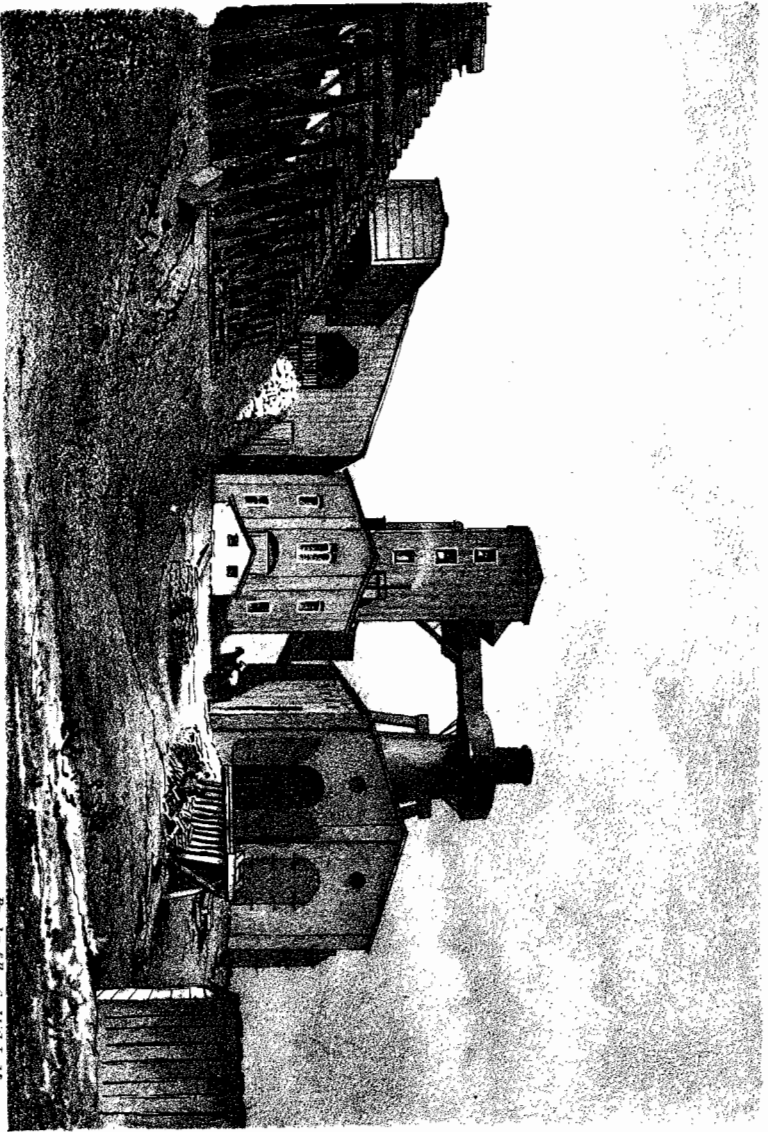
Though public attention has but recently been called to these springs by a notice in the papers giving the qualitative analyses which I made last summer, yet, they have already been largely attended by invalids from various parts of the country, and the acknowledged benefits which the afflicted have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

Brooks & Simpson Lumber Co's

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,	-	$\frac{1}{2}$ ft.
Black bituminous shale,	- -	2 ft.
Caking coal good quality,	3 ft. 6 in.	
Fire clay,	- - 0 ft. $\frac{1}{2}$ in.	
Caking coal,	- - 0 ft. 10 in.	
Fire clay,	- - 0 ft. 3 in.	
Caking coal,	- - 0 ft. 6 in.	
	—————	5 ft. $1\frac{1}{2}$ 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 and Gravel.
100	164.6				
			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	COAL 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.
	1006.		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.
800			82	White Limestone.
			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.)
1000			73	Dark gray Limestone and Flint.

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.
1100			5	Soapstone. (FIRE CLAY.)
			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.
			10	STRONG SALT WATER. Soapstone and Sandstone.
			15	Fine Sandstone.
1600			40	Blue Soapstone.
			15	Black Shale.
			5	Red Shale.
			16	Black Shale. OIL.
			5	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.

Ferruginous 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, con- taining fossil plants, - - - - -	4 ft.
Coal, - 4 ft. 6 in. } Clay parting, 0 ft. 9 in. } Coal, - 4 ft. 6 in. }	9 ft. 9 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. } Coal, 3 ft. }	6 ft. 4 in.
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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 millstone 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 Lesquerieux 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.		FR.	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
			<u>100.00</u>					<u>100.00</u>

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
			<u>100.00</u>					<u>100.00</u>

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
			<u>100.00</u>					<u>100.00</u>

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
	<hr/>
	100.00
	<hr/>
	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.
		6		Fire Clay.
105.		20		Covered space.
		37		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 character 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
	<hr/>		<hr/>
	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
	<hr/>	<hr/>
	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 alkalis."

*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 county, 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 north-eastern 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:

REPORT OF

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.
		20		Gray, argillaceous, silicious Shale.
91.6		68		Brown, schistose Sandstone and gray Shale.
		1	6	Black Shale.
4.		4		COAL I. (Main Newburg coal.)
		3	6	Fire Clay. <i>Top of Bore.</i>
		2		Shale.
		23	6	White and dark Sandstone.
124.		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
<hr/>	<hr/>
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
		<hr/>	<hr/>
		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
		<hr/>	<hr/>
		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
		<hr/>	<hr/>
		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.	
114.7		50		Covered space, containing Sandstone and Shale.
		4		Limestone.
		6		Sandstone.
		51		Silicious and argillaceous Shale.
4.4		3		Tough blue Clay.
		0	7	Black bituminous Shale.
		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:

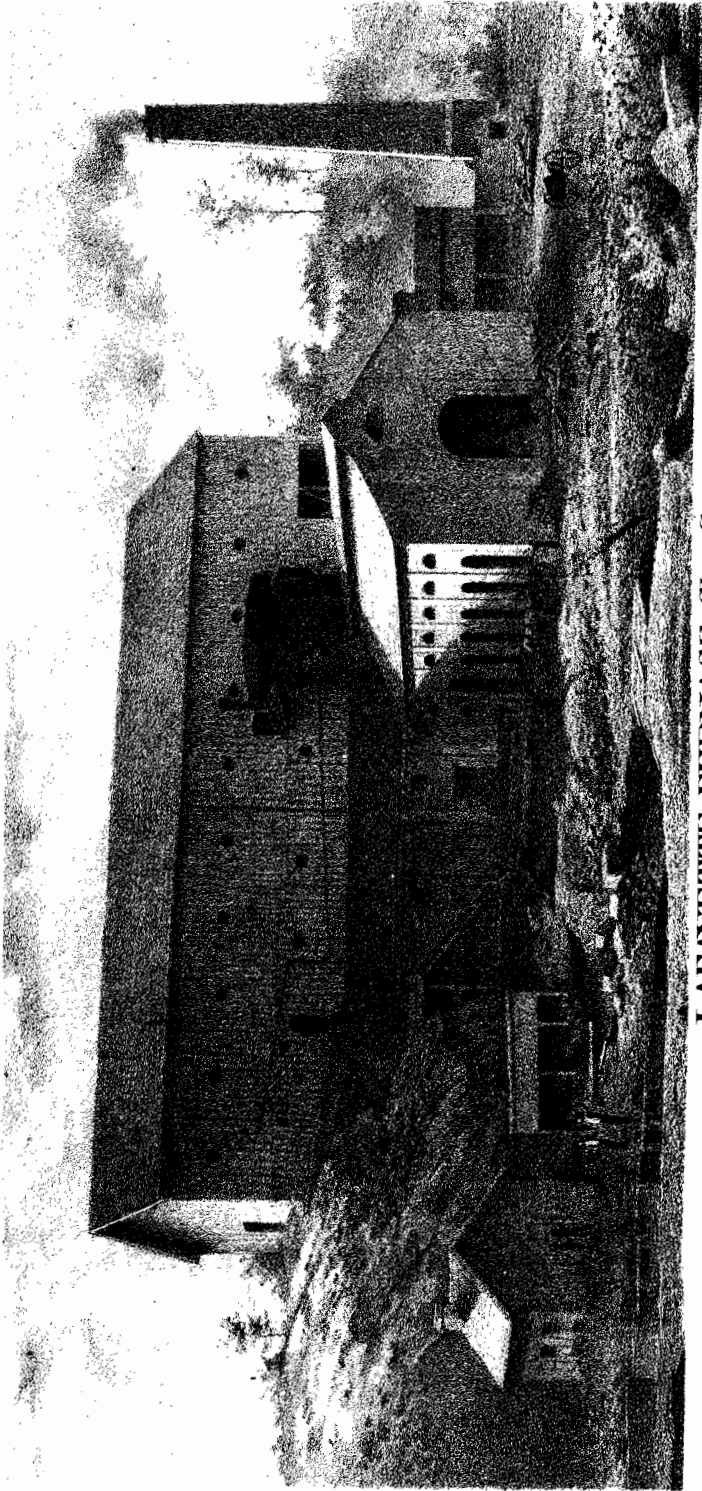
Soil and clay,	-	-	-	-	-	8 ft.
Schistose sandstone and shale,	-	-	-	-	-	50 ft.
Black, bituminous, fossiliferous limestone,	-	-	-	-	-	2 ft.
Arenaceous shale,	-	-	-	-	-	4 ft.
Black, bituminous, sheety shale,	-	-	-	-	-	2 ft.
COAL K, caking coal,	-	-	-	-	-	4 ft.
Fire clay,	-	-	-	-	-	? ft.

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, Supt.

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.:

Height 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.